New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

I-25 La Bajada - (MP 264 to MP 267.5) Slope Mitigation and Roadway Improvements

2024 Southwest Geotechnical Conference

May 22, 2024

WILSON & COMPANY

discipline | intensity | collaboration | shared ownership | solutions

Presentation Team - Outline

- I-25 La Bajada - Milepost 264 to Milepost 267.5
  - Project Team/Details
    - Derek Meier, PE – , Senior Project Manager, Wilson & Company, Inc.
  - Geotechnical History
    - Melissa Bates, PE – Geotechnical Engineer, NMDOT Geotechnical Section
  - Geotechnical Analysis/Slope Mitigation/Construction
    - Michael Pegnam, PE – Senior Geotechnical Engineer, WSP USA, Inc.

Project Team

Owner =

Designer =

Contractor =

NMDOT
I-25 La Bajada Slope Mitigation

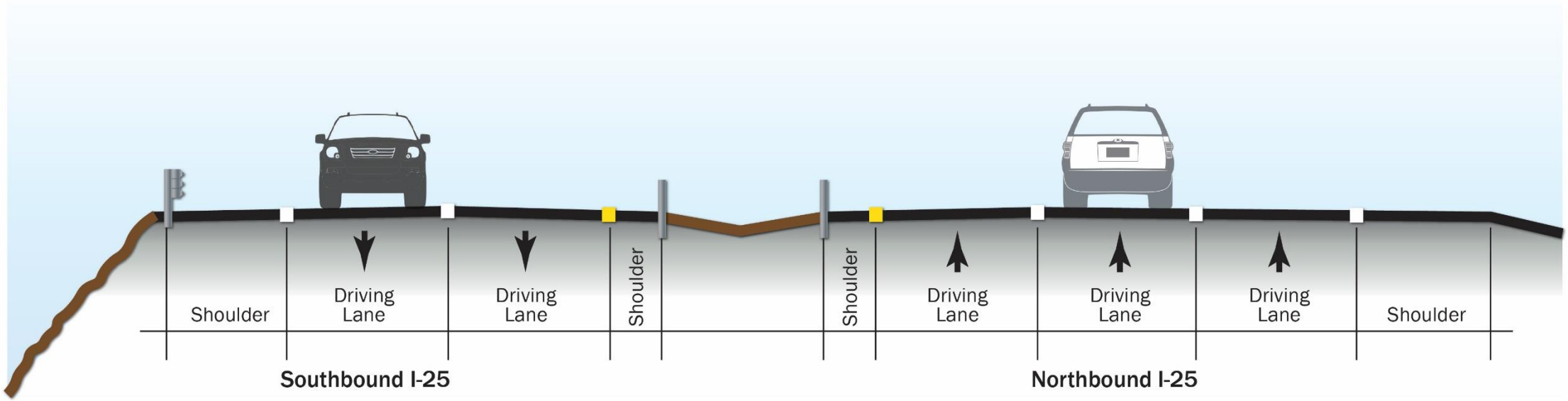
Project Limits

Project Details

- I-25 La Bajada – Milepost 264 to Milepost 267.5
  - Geotechnical analysis – slope mitigation measures
  - Roadway reconstruction –
    - Fill in the depressed median and build a concrete wall barrier to divide NB/SB lanes
    - Accommodate for a future 3rd driving lane in the SB direction
  - Drainage improvements –
    - Larger concrete rundowns
    - Replace and/or extend existing pipes
    - Install parallel storm drain system to capture seepage flows
  - Safety improvements –
    - Extended the entrance/exit ramps at Cochiti (Exit 264)
  - Intelligent Transportation System (ITS) was installed

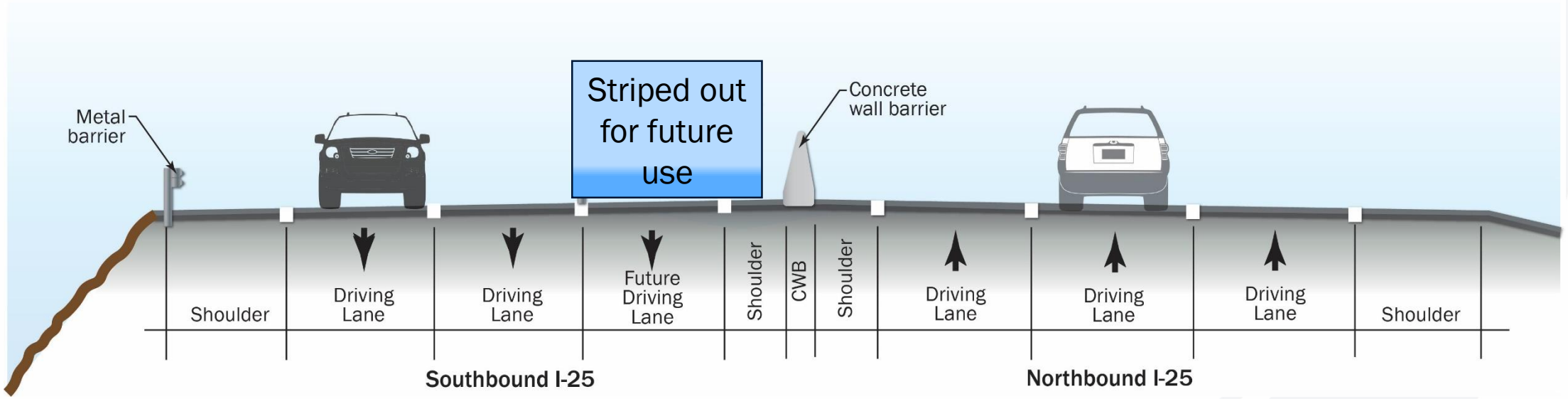
Existing Roadway Section

- Three northbound lanes, two southbound lanes
- Depressed median
- Cable barrier separates traffic



Design Roadway Section

- Addition of future third southbound lane
- Concrete wall barrier (CWB) will replace cable barrier
- New metal barrier



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Project Details

- I-25 La Bajada – Milepost 264 to Milepost 267.5
  - Design (CN 5101340) was awarded in September 2019 and completed in January 2022
  - Construction (CN 5101341) was bid/let in February 2022
  - Mountain States Constructors, Inc. was awarded project for a cost of $39.9M
  - Construction (CN 5101341) NTP was issued in March 2022

NMDOT I-25 La Bajada Slope Mitigation

Construction Update

- I-25 La Bajada – Milepost 264 to Milepost 267.5
  - MSCI started site work in July 2022
  - Geo-Solutions, Inc (GSI) mobilized and installed test columns in Oct. 2022
  - Full-scale In-Situ Soil Mixing (SM) began in November 2022
  - SM of the southbound lanes was completed in January 2023
  - SM of the northbound lanes was completed in November 2023
  - The parallel storm drain system was installed in February 2024
  - The northbound driving lanes paving completed in March 2024
  - Overall project completion anticipated for May 31st, 2024

Geotechnical History

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Geotechnical

- Undulations and pavement cracking
- Sealing and patching
- Starting in the shoulder and moving into the traffic lanes

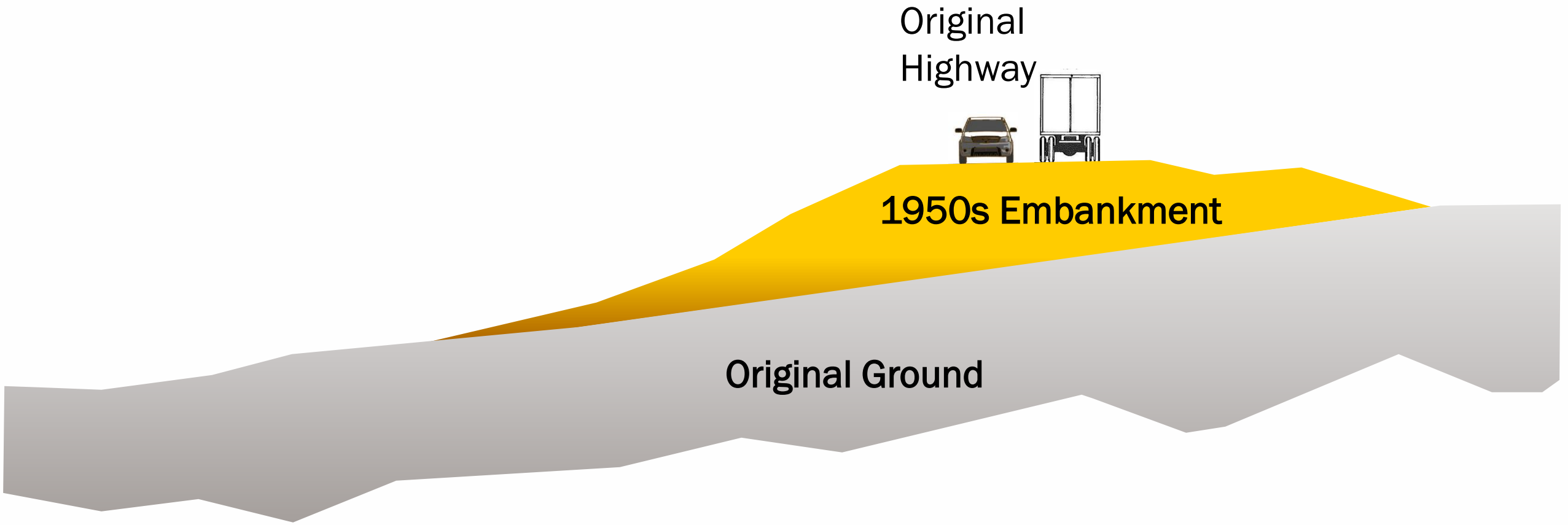
Geotechnical

- Vertical displacement and voids
- Deeper than just a pavement problem

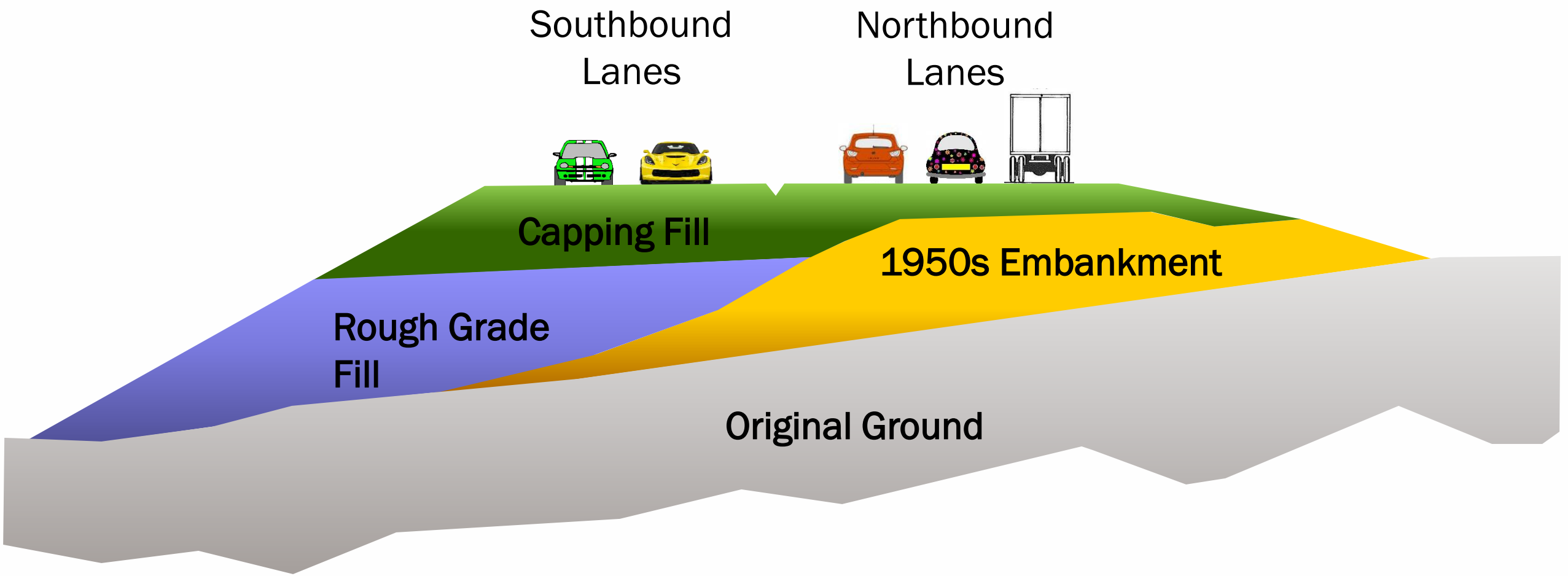
Geotechnical

- Erosion downslope
- Cracks = water entry points

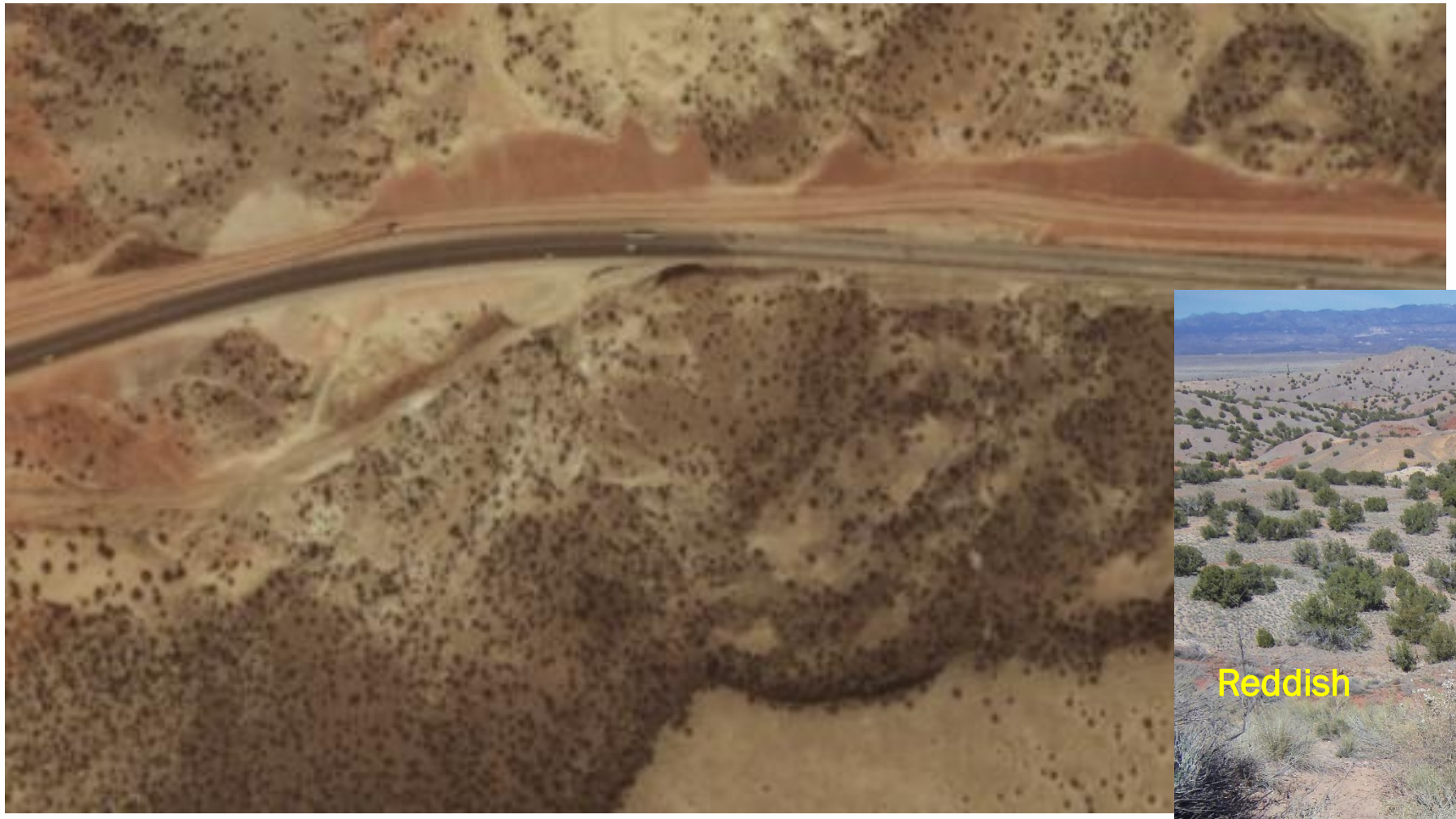
Geotechnical – Original 1950's Era Highway

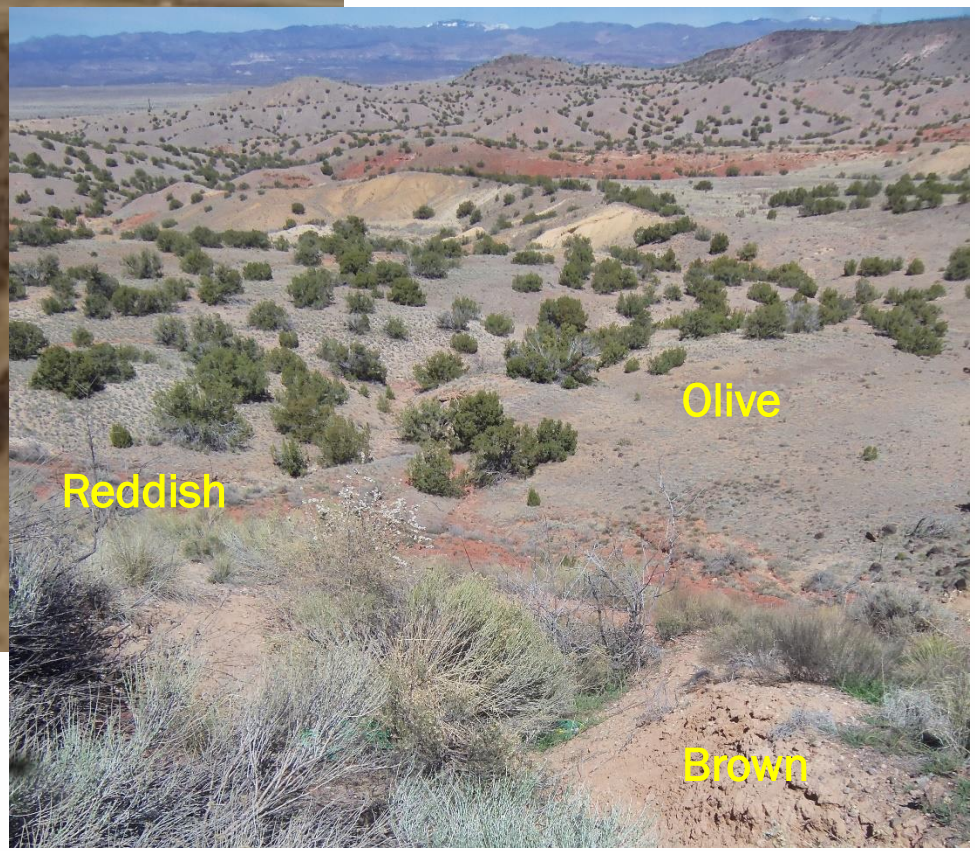


Geotechnical – Widening in the 1980's



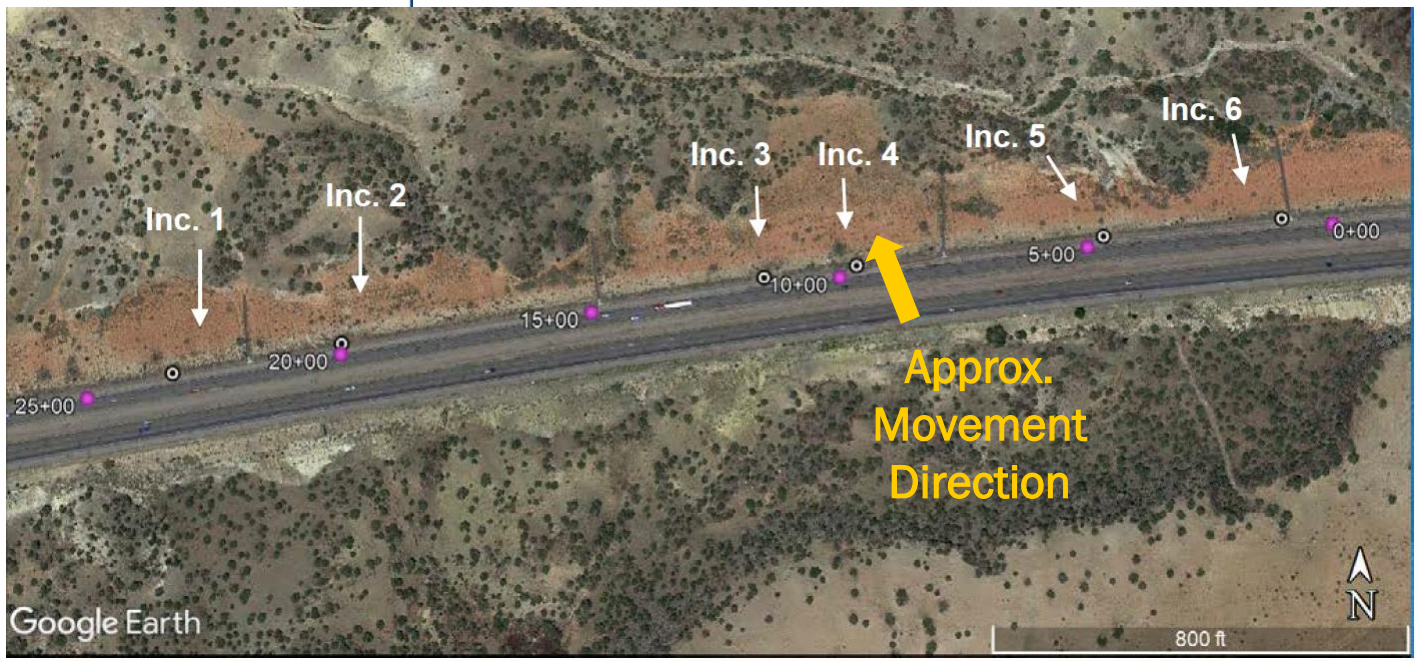
Geotechnical – Widening Construction



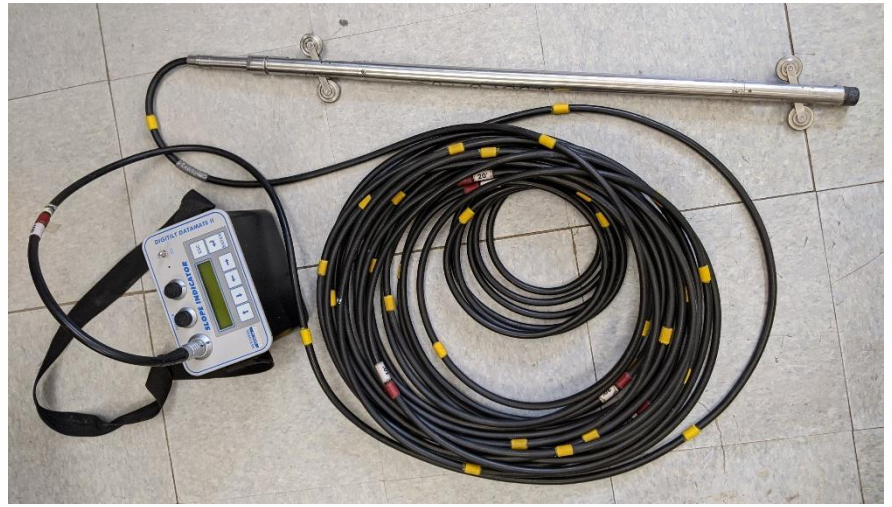


NMDOT I-25 La Bajada Slope Mitigation

Geotechnical – Inclinometers



- Six inclinometers (extending 37 to 62 ft. below ground) installed behind the southbound (downslope side) guardrail
- Probe fed down a slotted pipe
- Data collected monthly
- Inclinometer #4 shows the most downslope movement

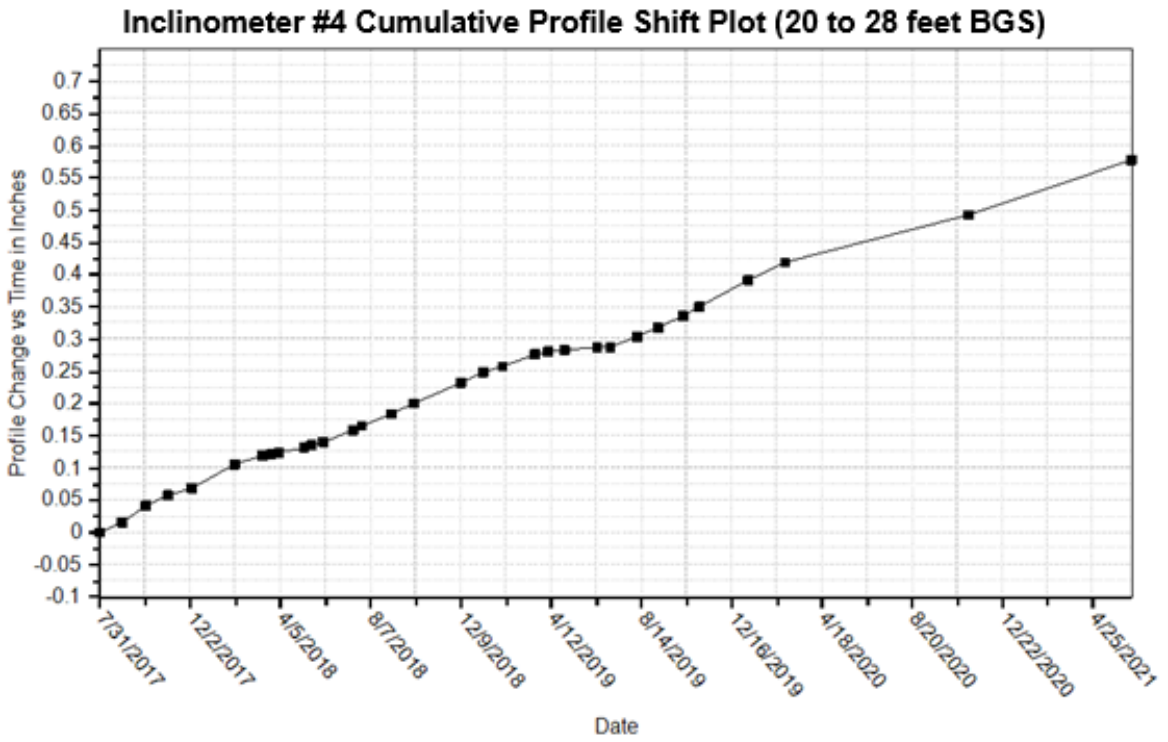


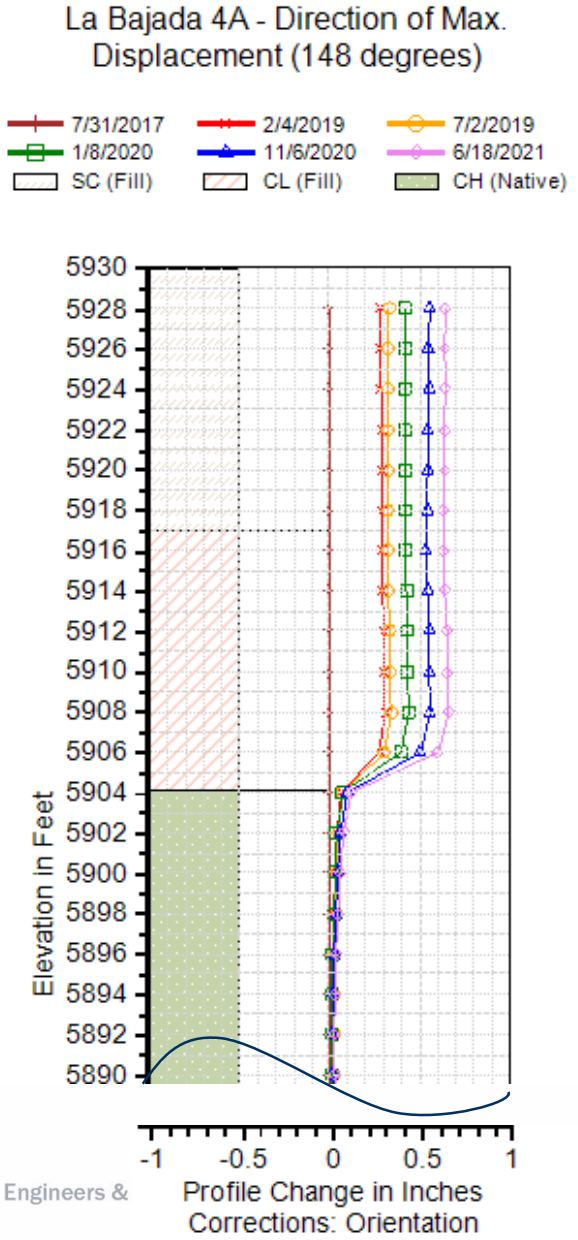
NMDOT I-25 La Bajada Slope Mitigation

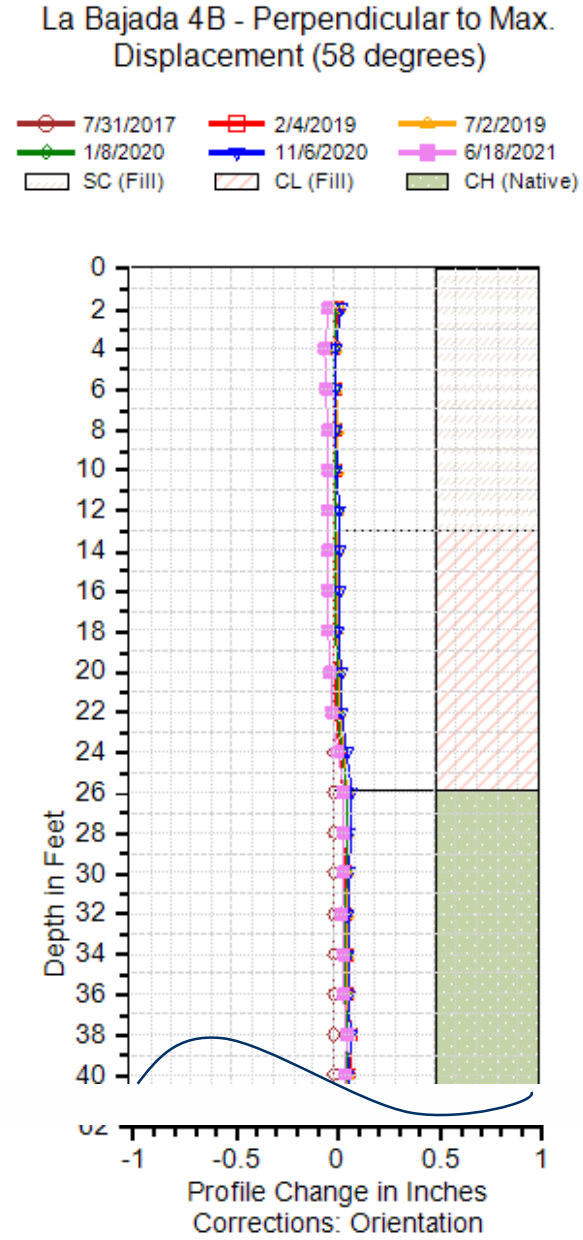
Geotechnical – Inclinometer Data – Creep Movement

Data for Inclinometer #4

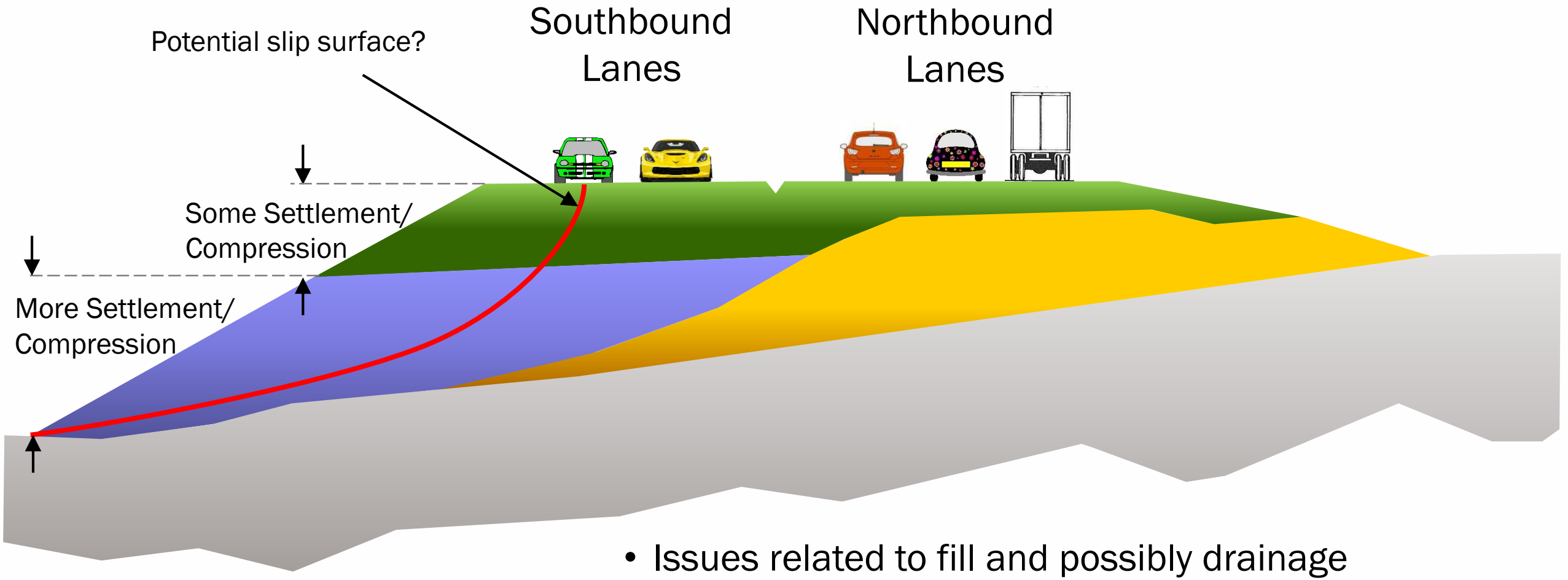
- Approx. 5/8 inch cumulative over 4 years
- Starts around the interface between native and fill
- Possible seasonal trends (monsoon season and winter)







Geotechnical – Causes of Surficial Pavement Distress



- Issues related to fill and possibly drainage
- Both horizontal and vertical movement components

Geotechnical Analysis/Mitigation Design

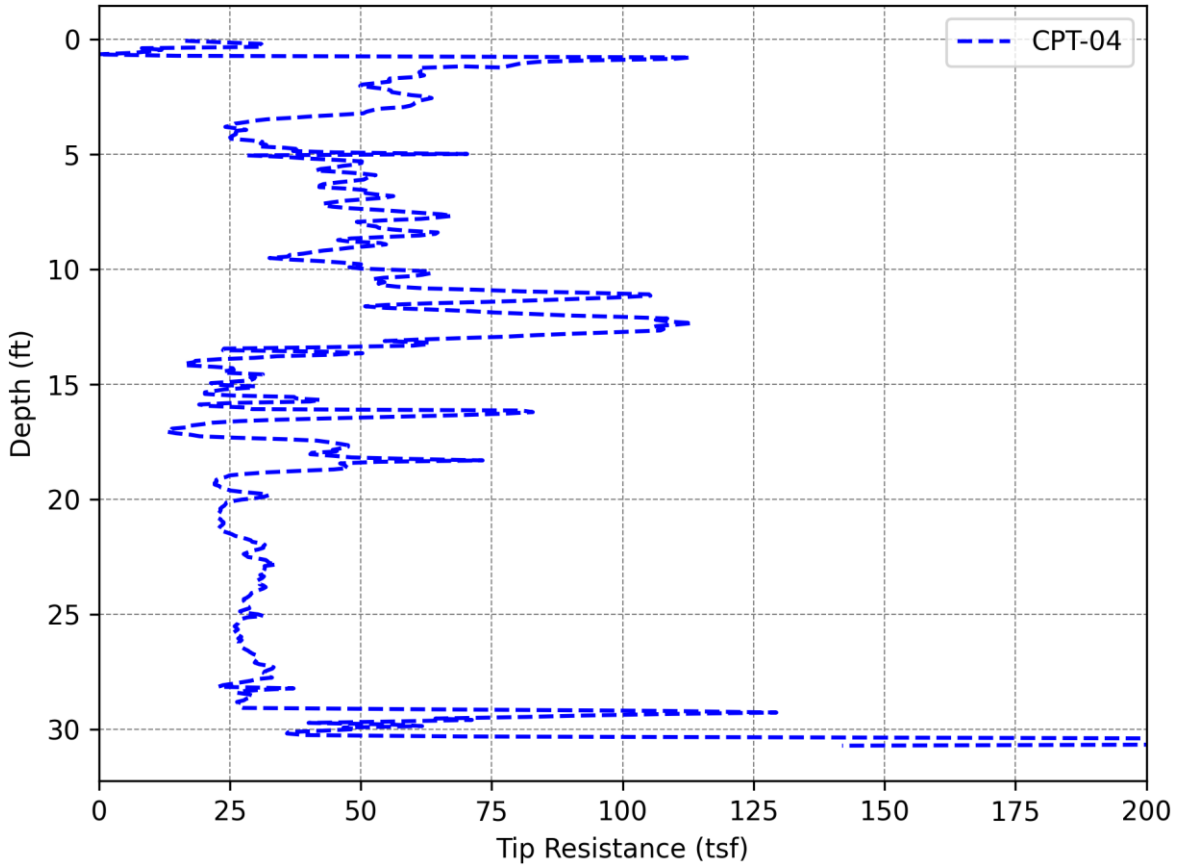
Geotechnical – Field Investigation

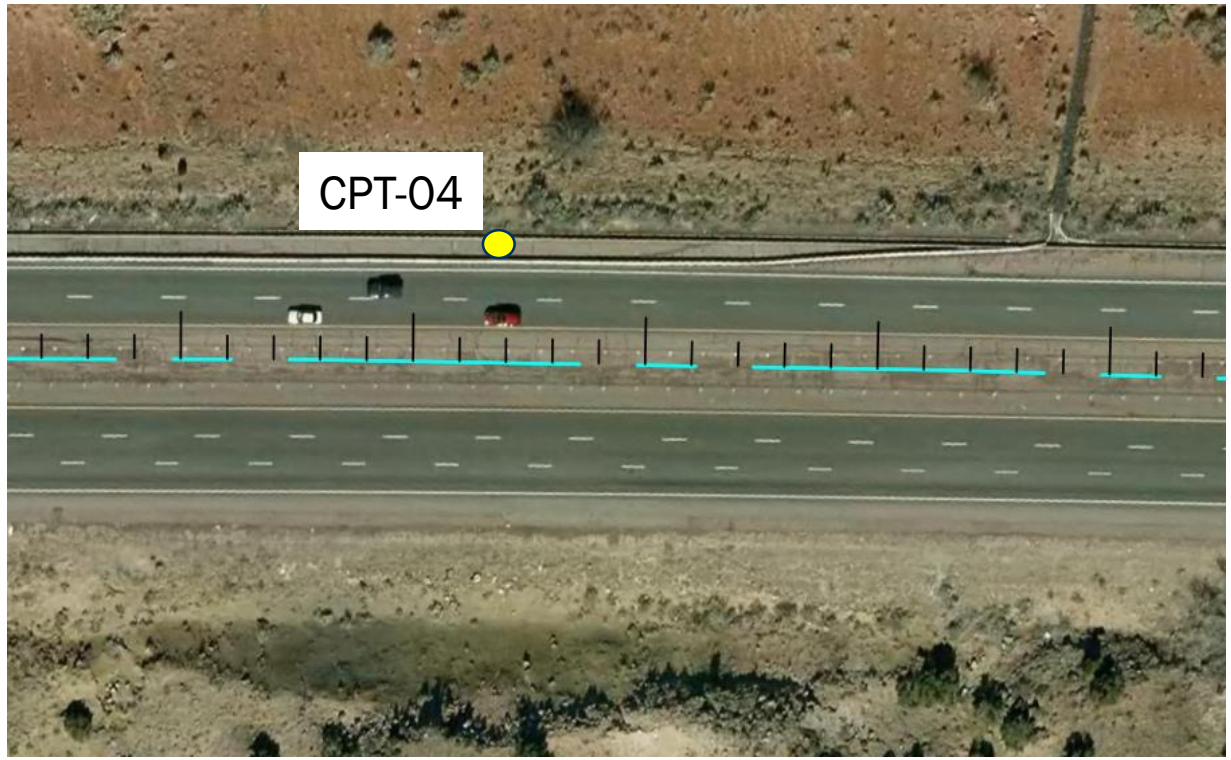
Geotechnical Investigation Timeline

- 1996/1998 – 12 boreholes drilled by NMDOT
- 2013 – 7 cone penetration tests
- 2017 – 6 inclinometer boreholes installed along southbound lanes
- 2020 – 16 hollow-stem auger/HQ3 core boreholes
- 2020 – 4 MASW profiles along edge of southbound and northbound lanes

Geotechnical – Field Investigation

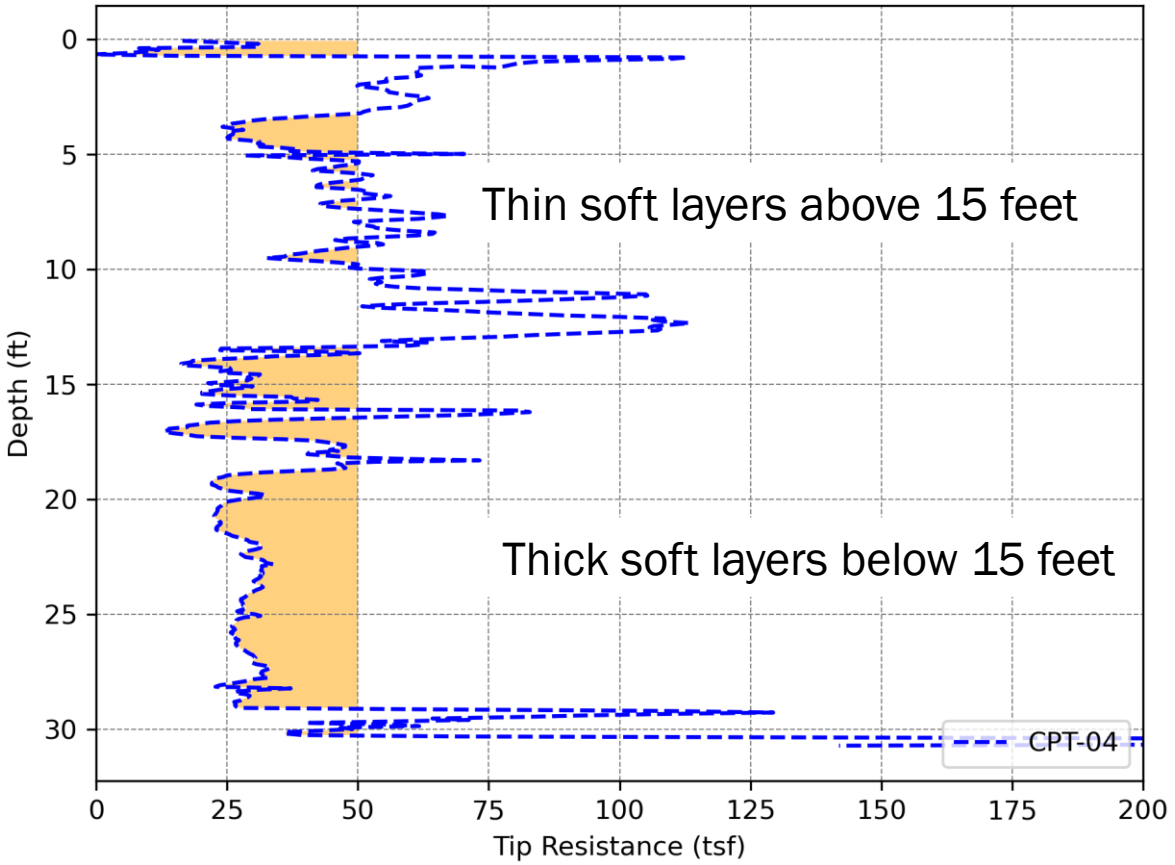
> 50 tsf is preferred = 250 tsf constrained modulus – typical of compacted embankment

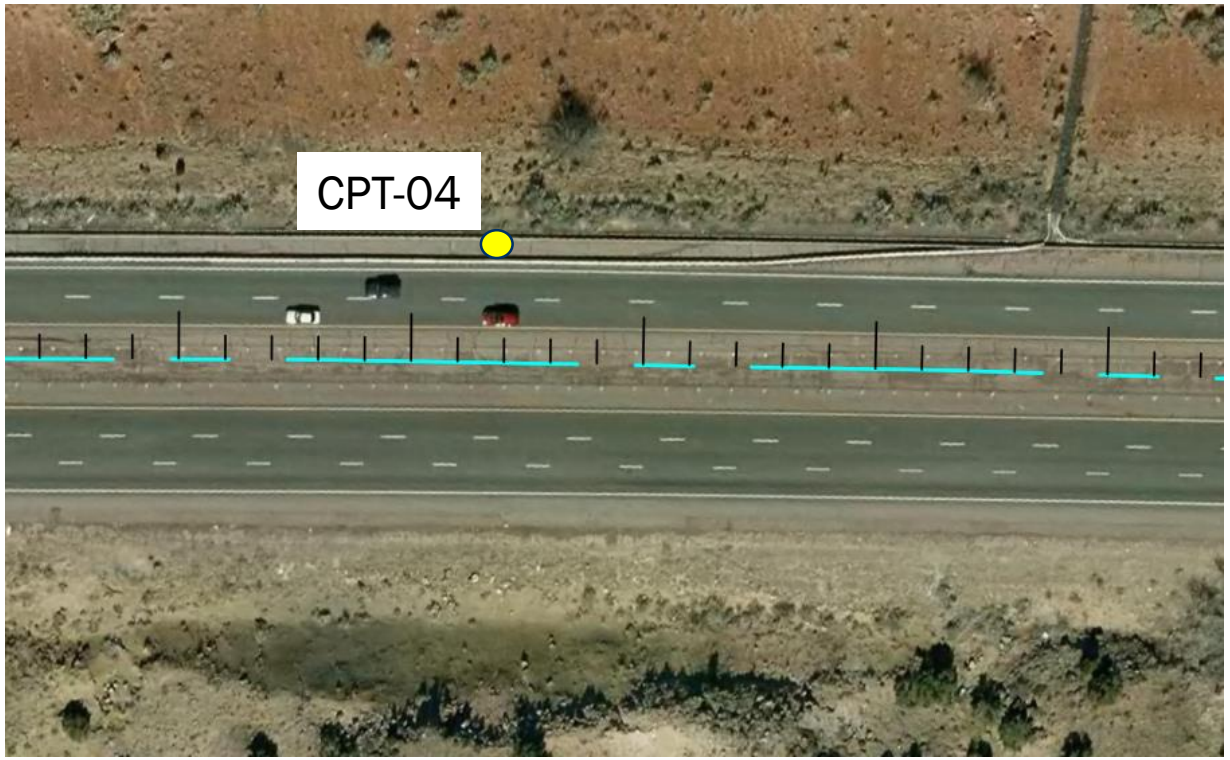




Geotechnical – Field Investigation

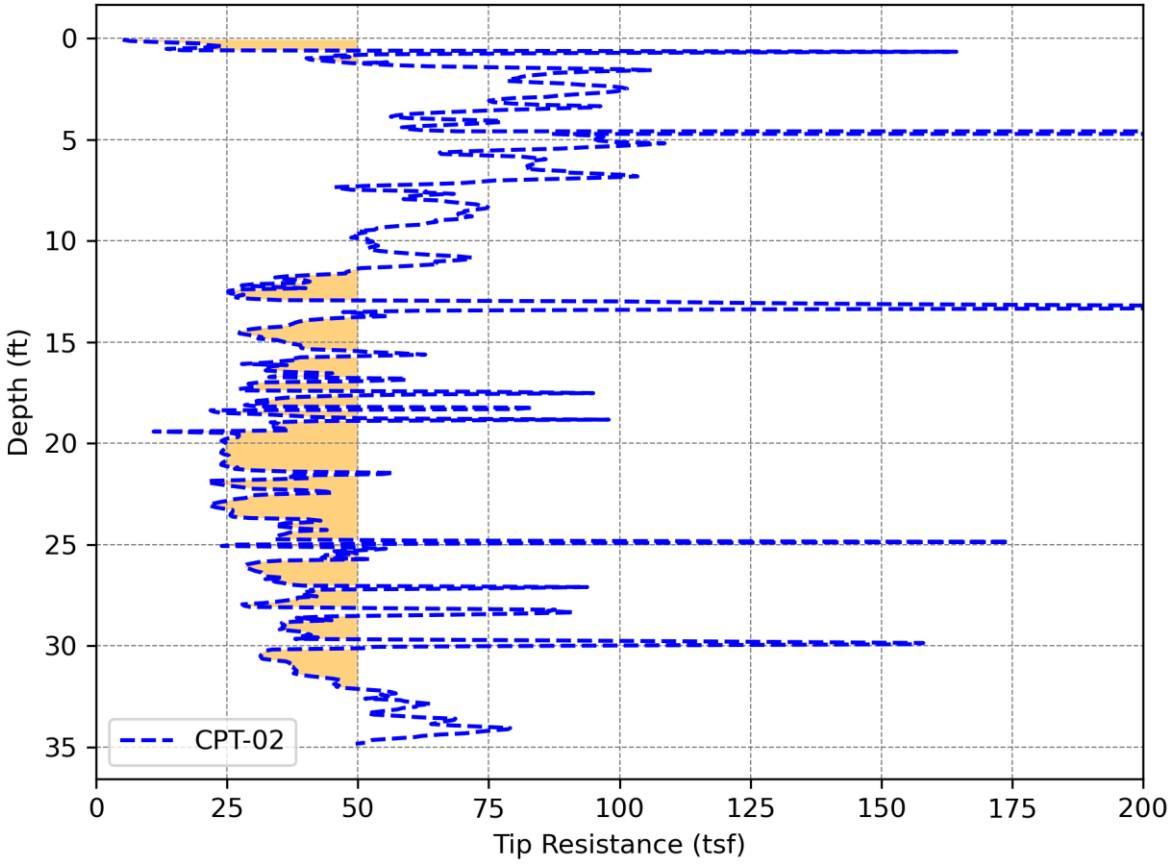
> 50 tsf is preferred



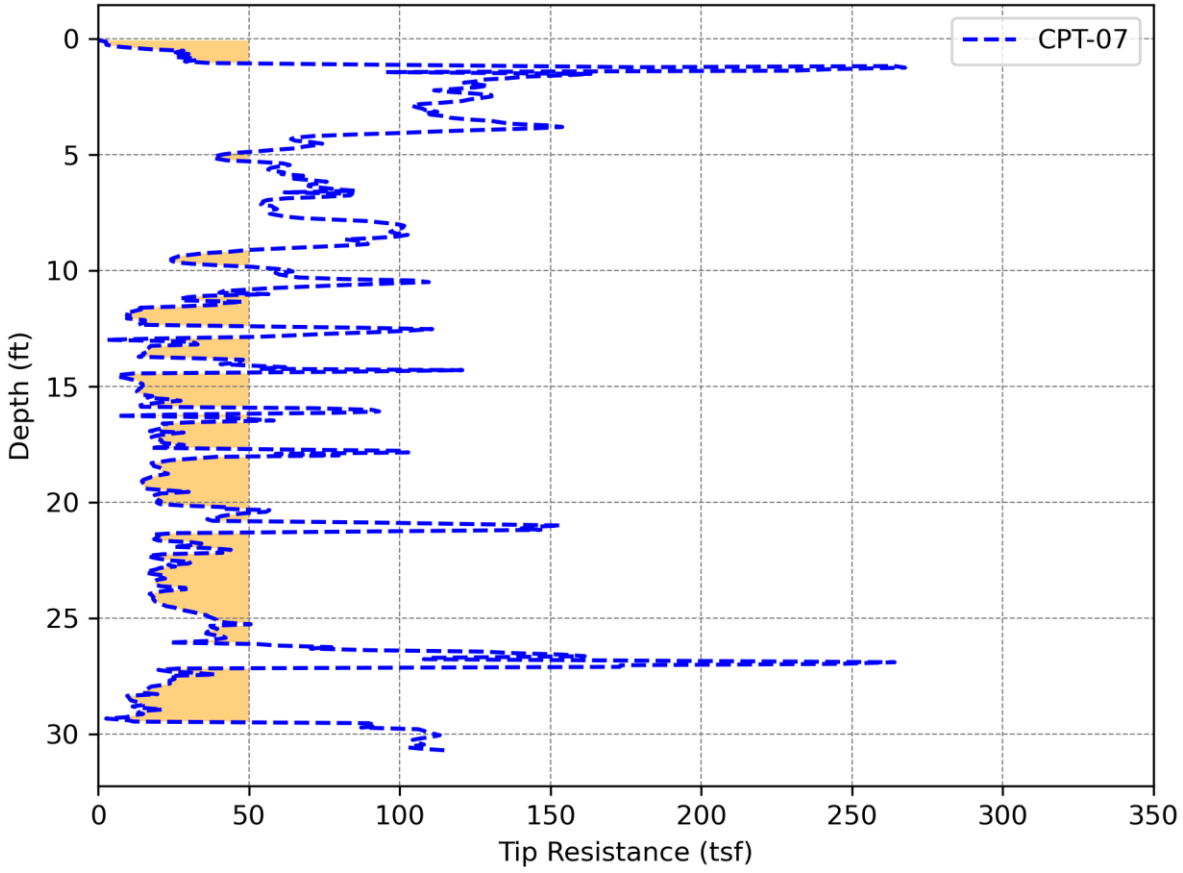


Geotechnical – Field Investigation

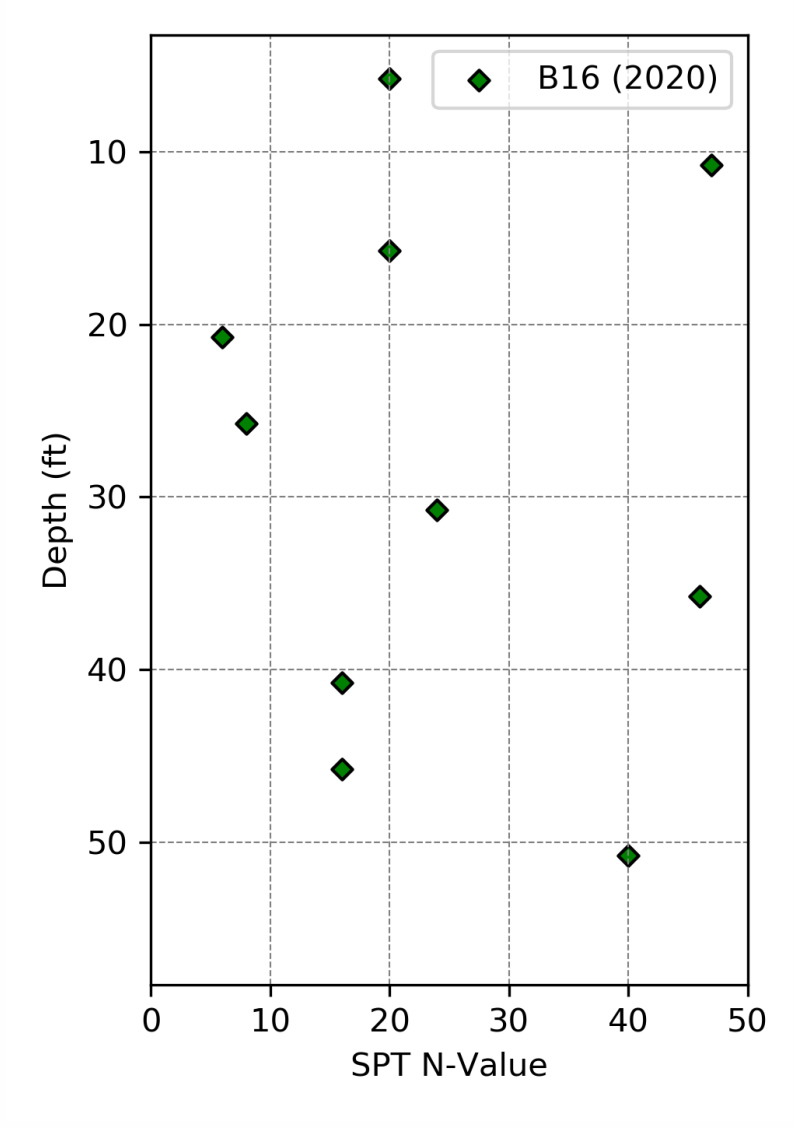
CPT-02



CPT-07

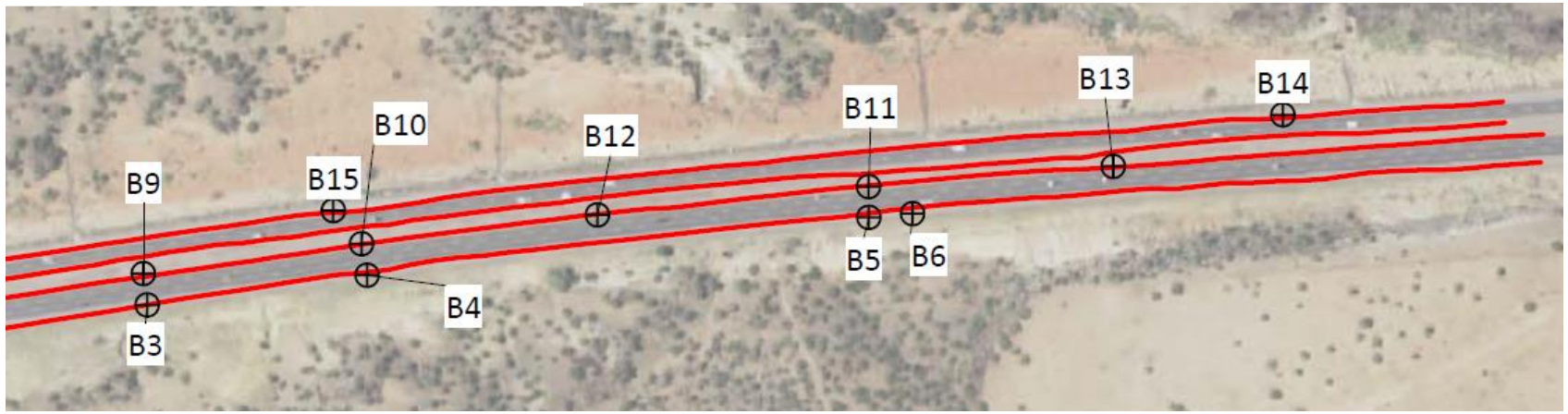


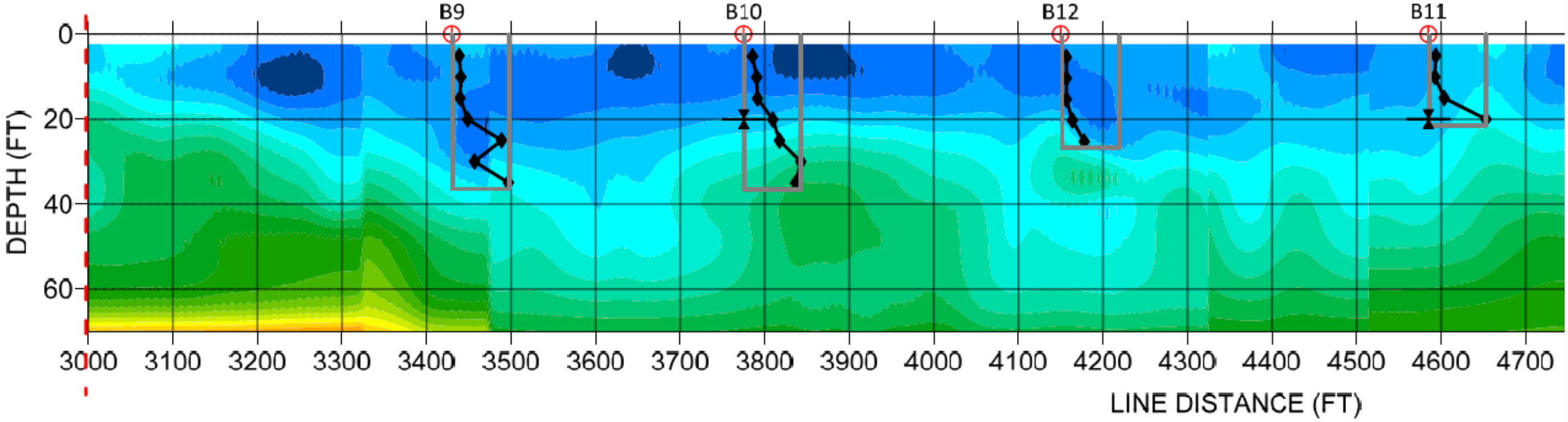
Geotechnical – Field Investigation



Geotechnical – Field Investigation

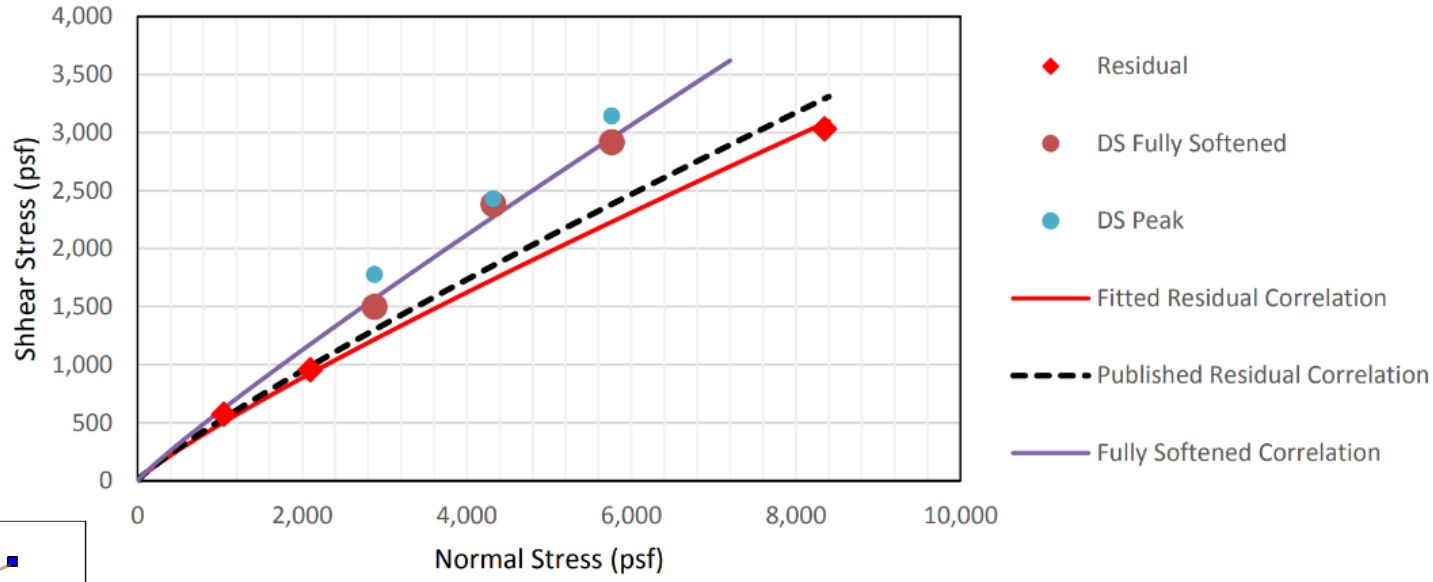
Geophysics - MASW

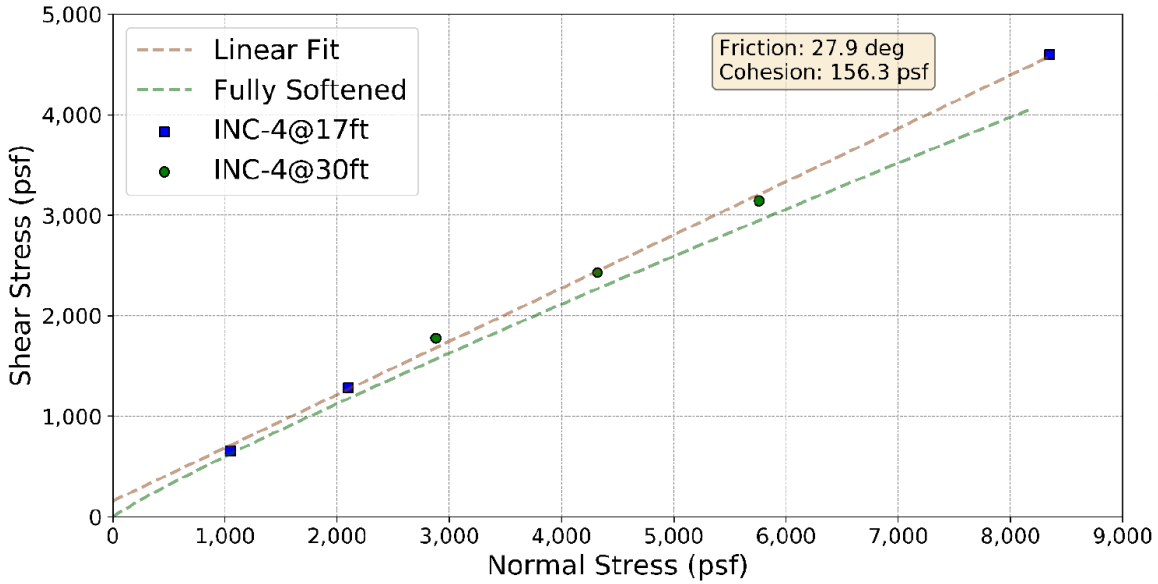




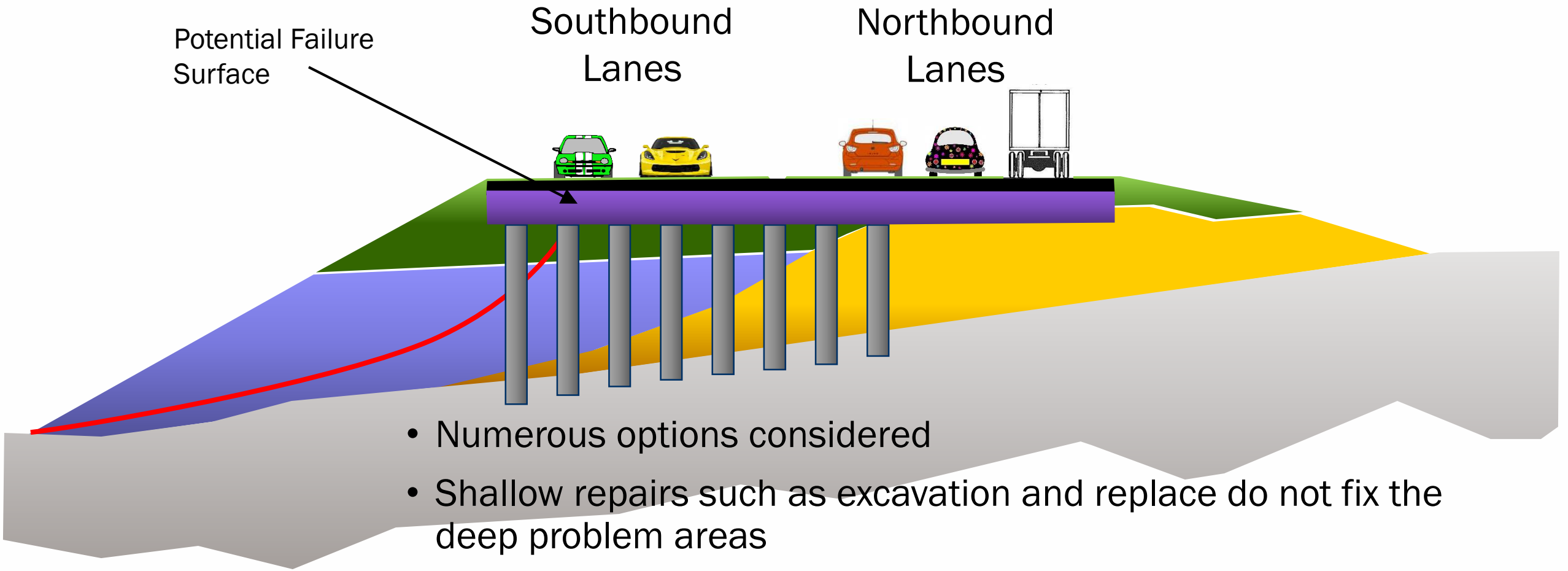
Geotechnical – Field Investigation

Shear strength Tests – Torsional Ring Shear and Direct Shear





Geotechnical – Designed Mitigation: Soil Mix Columns



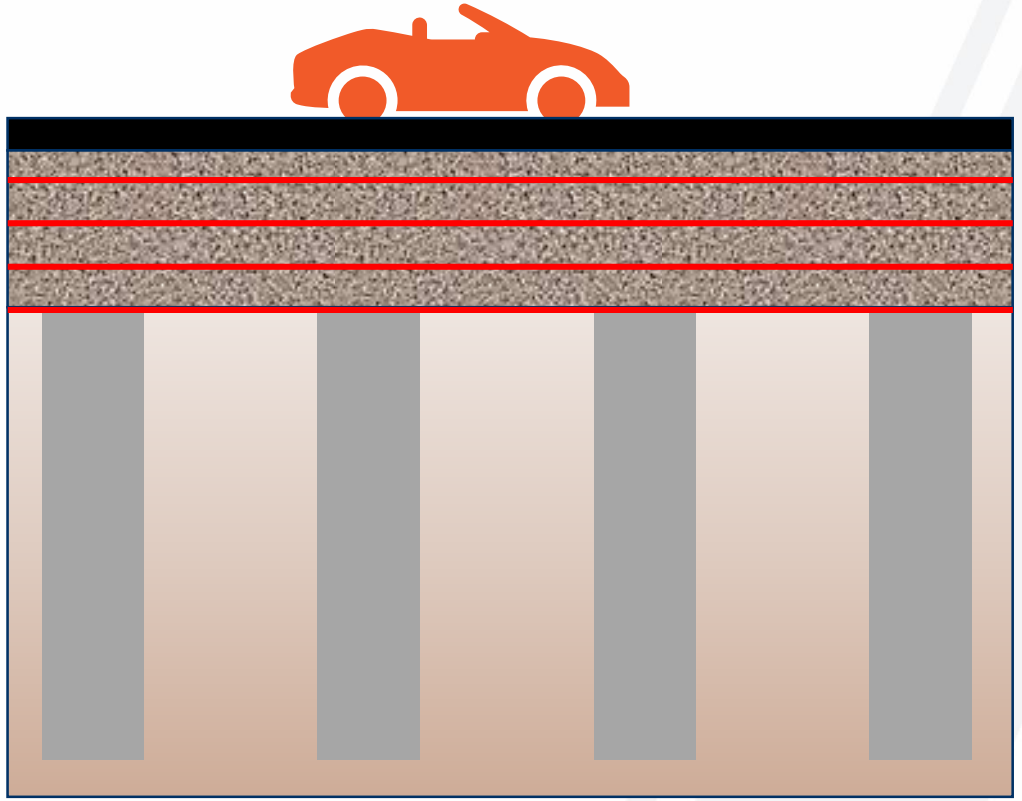
- Numerous options considered
- Shallow repairs such as excavation and replace do not fix the deep problem areas
- Repair must address both potential instability and settlement of fill

Geotechnical – Deep Soil Mixing Method to Create Columns

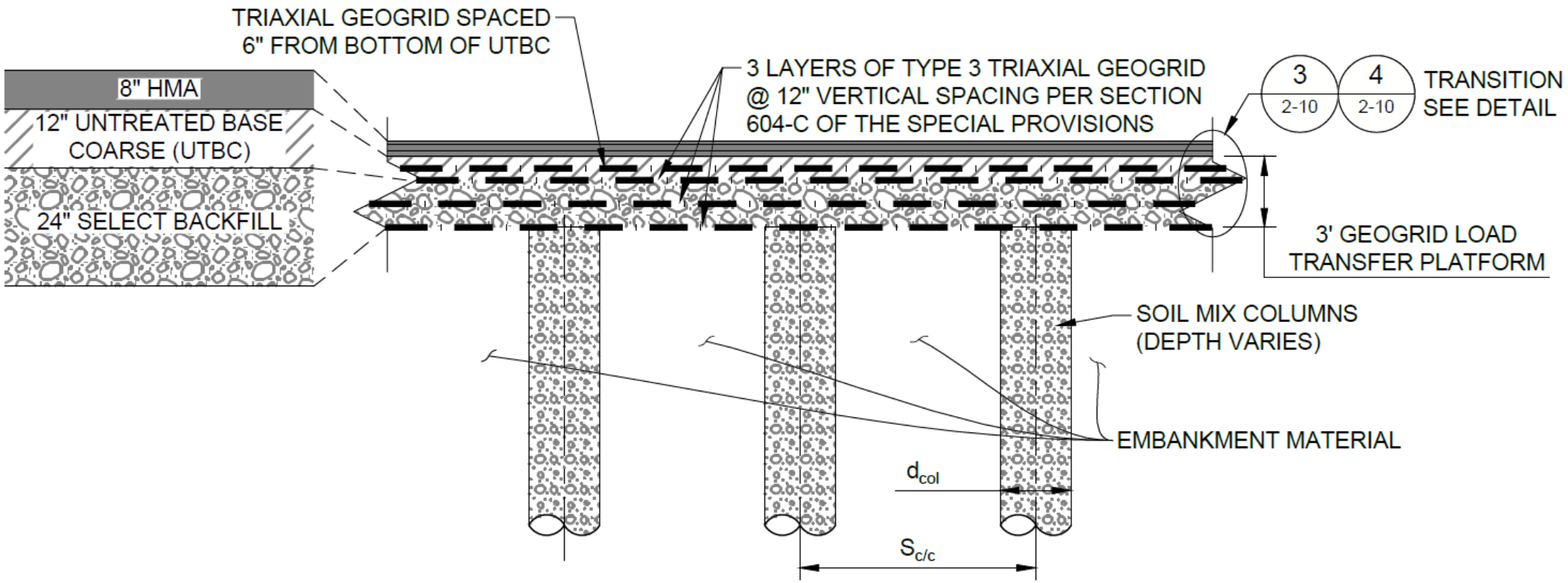
- Paddles mix soil in place
- Water/cement slurry injected during mixing
- Result is “soilcrete” columns
- Columns are much stiffer and stronger than surrounding soil
- Prevent settlement of the roadway embankment
- Stabilize potential sliding failure surfaces

Geotechnical – Geosynthetic Reinforced Soil Platform

- Platform to support roadway and transfer load into the columns
- Layers of strong, high-density polypropylene (PP) geogrids
- Layers of compacted road base (aggregate) material



Geotechnical – Geosynthetic Reinforced Soil Platform



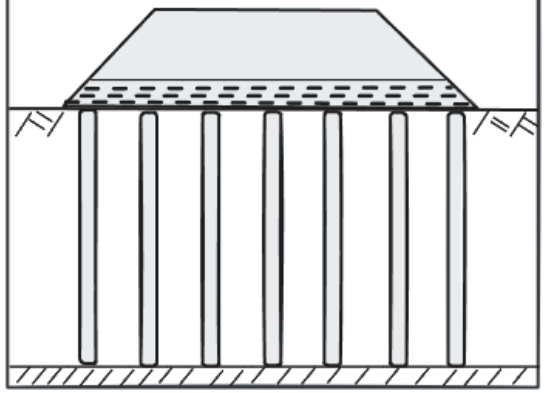
NOT TO SCALE 2 (2-10) GEOGRID LOAD TRANSFER PLATFORM PROFILE

Geotechnical – Soil Mix Column Design

Design Methods

1

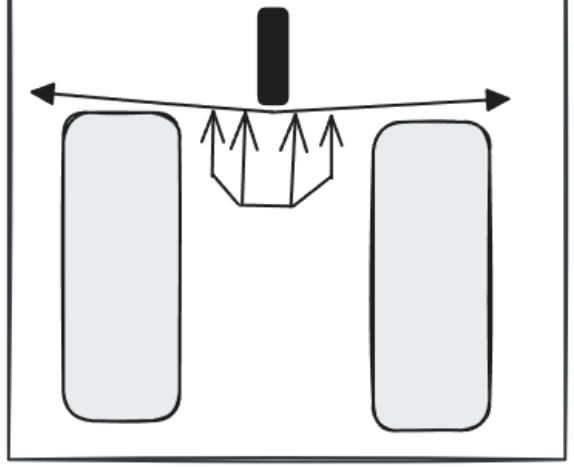
Column-Supported Embankment



Filz et al. GeoGrid Bridge (2012)

2

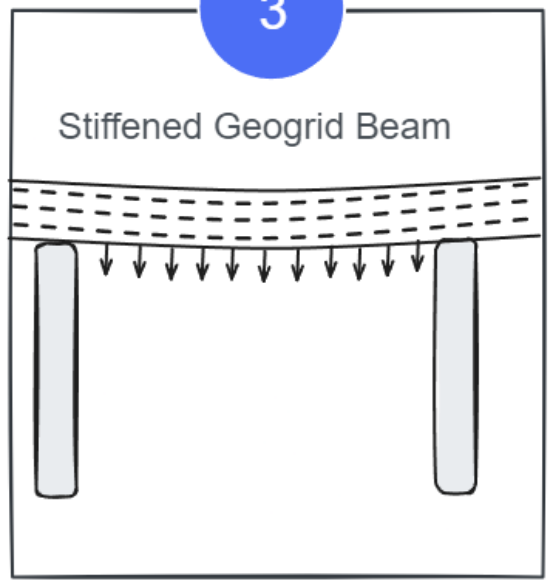
Tensioned Membrane



Giroud et al. Method (1990)

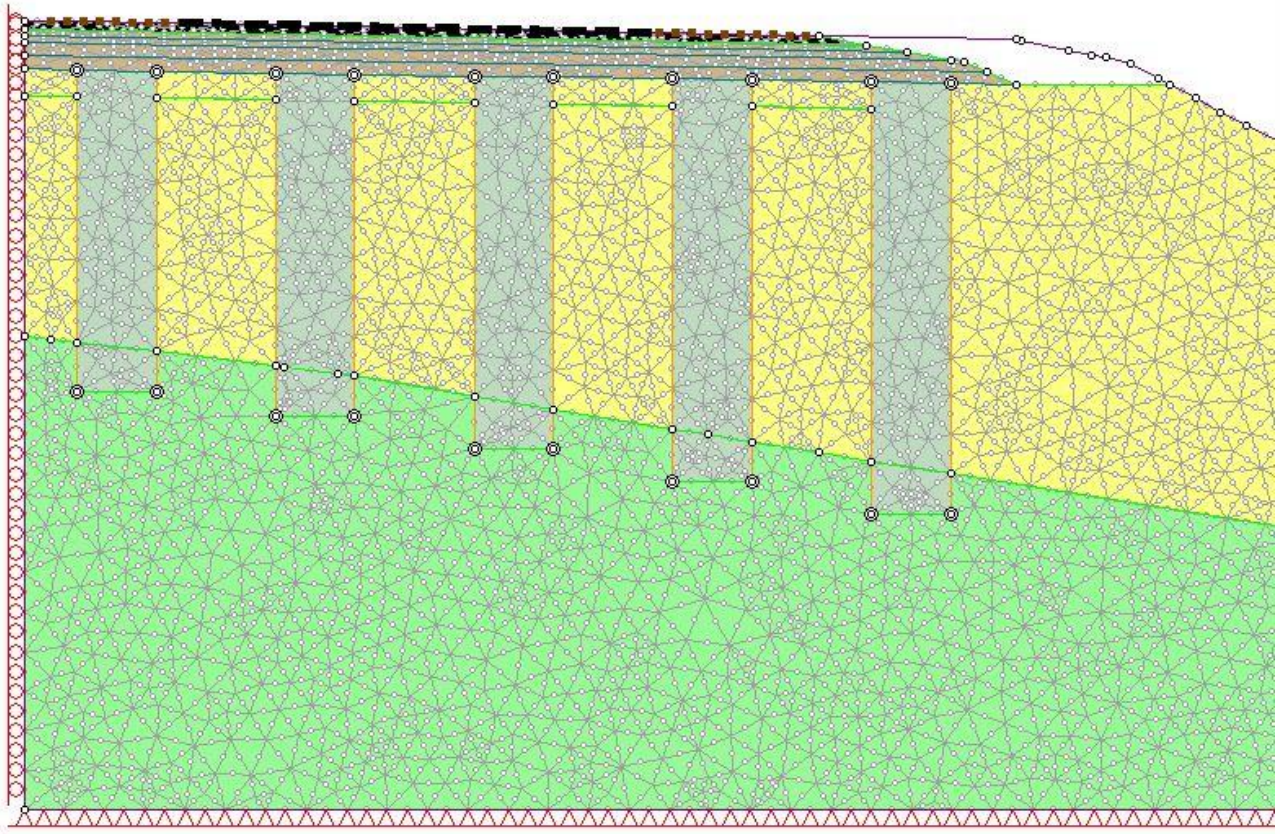
3

Stiffened Geogrid Beam



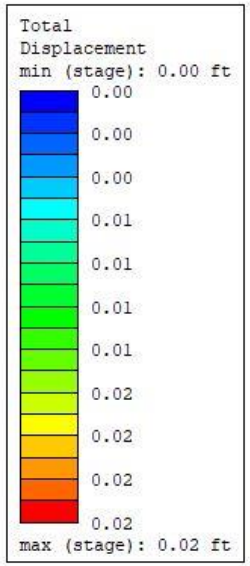
Collin (2003)

Geotechnical – Soil Mix Column Design

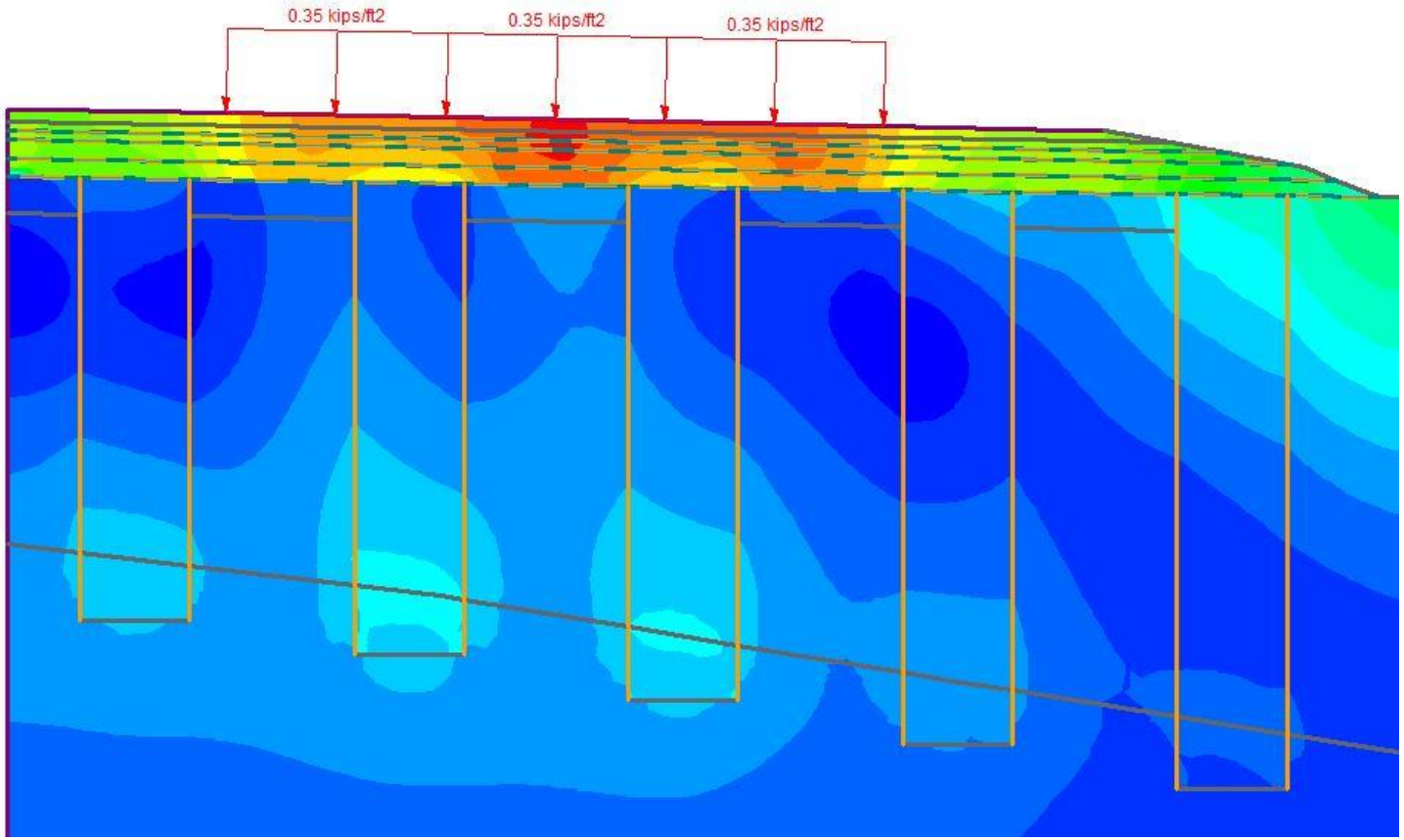


- Finite Element Modeling using Rocscience RS2
- Geogrid modeled as Geotextile Structural Interface Element
- Soil Mix columns modeled as a slip joint between soil and grout
- Softening of elements between columns to determine beam action
- Also checked differential settlement using Geogrid Bridge Spreadsheet

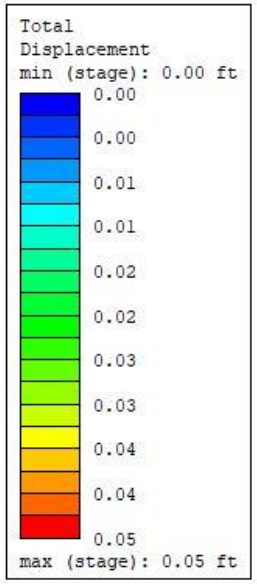
Geotechnical – Soil Mix Column Design



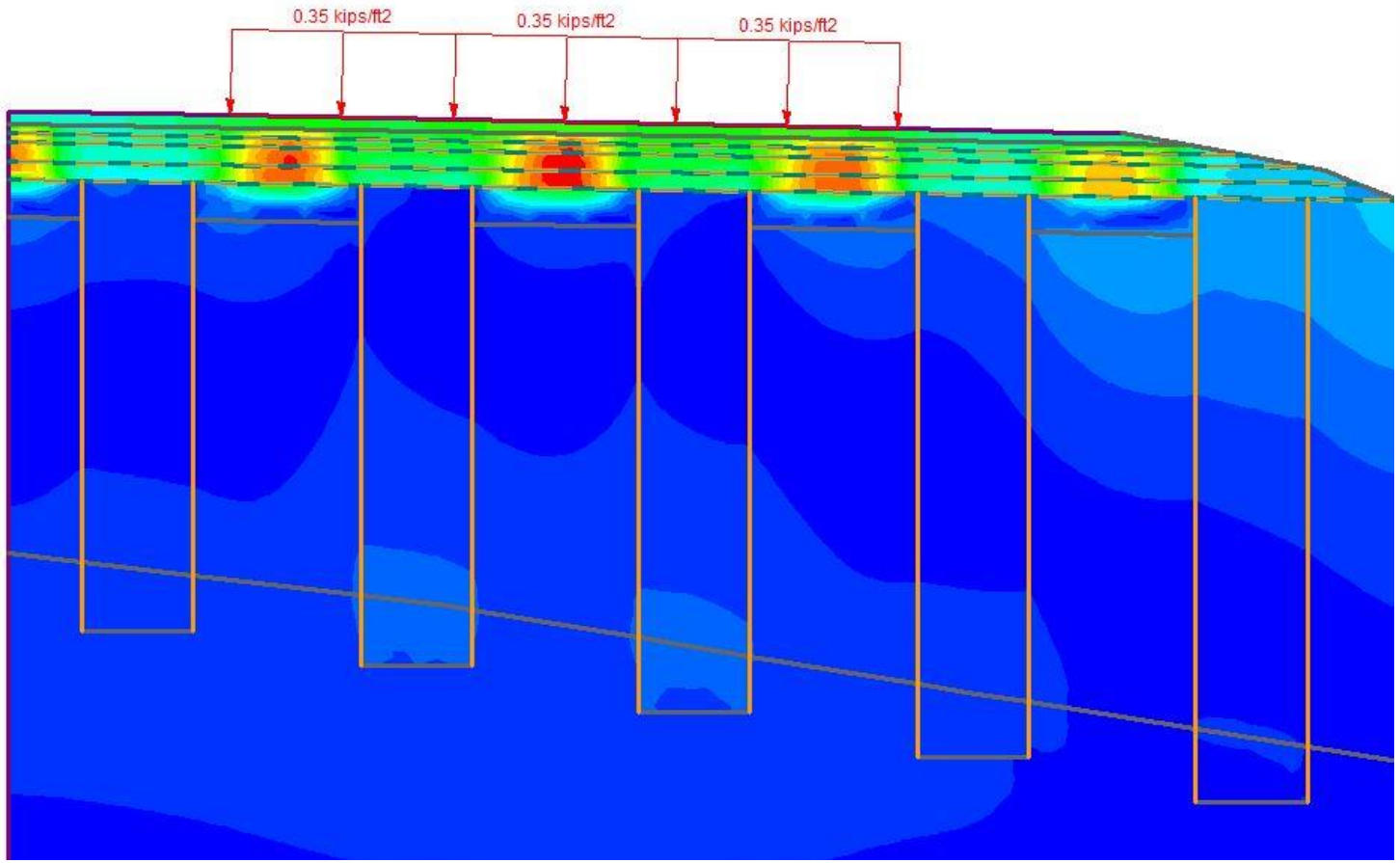
- Displacements contained within LTP under traffic loads



Geotechnical – Soil Mix Column Design



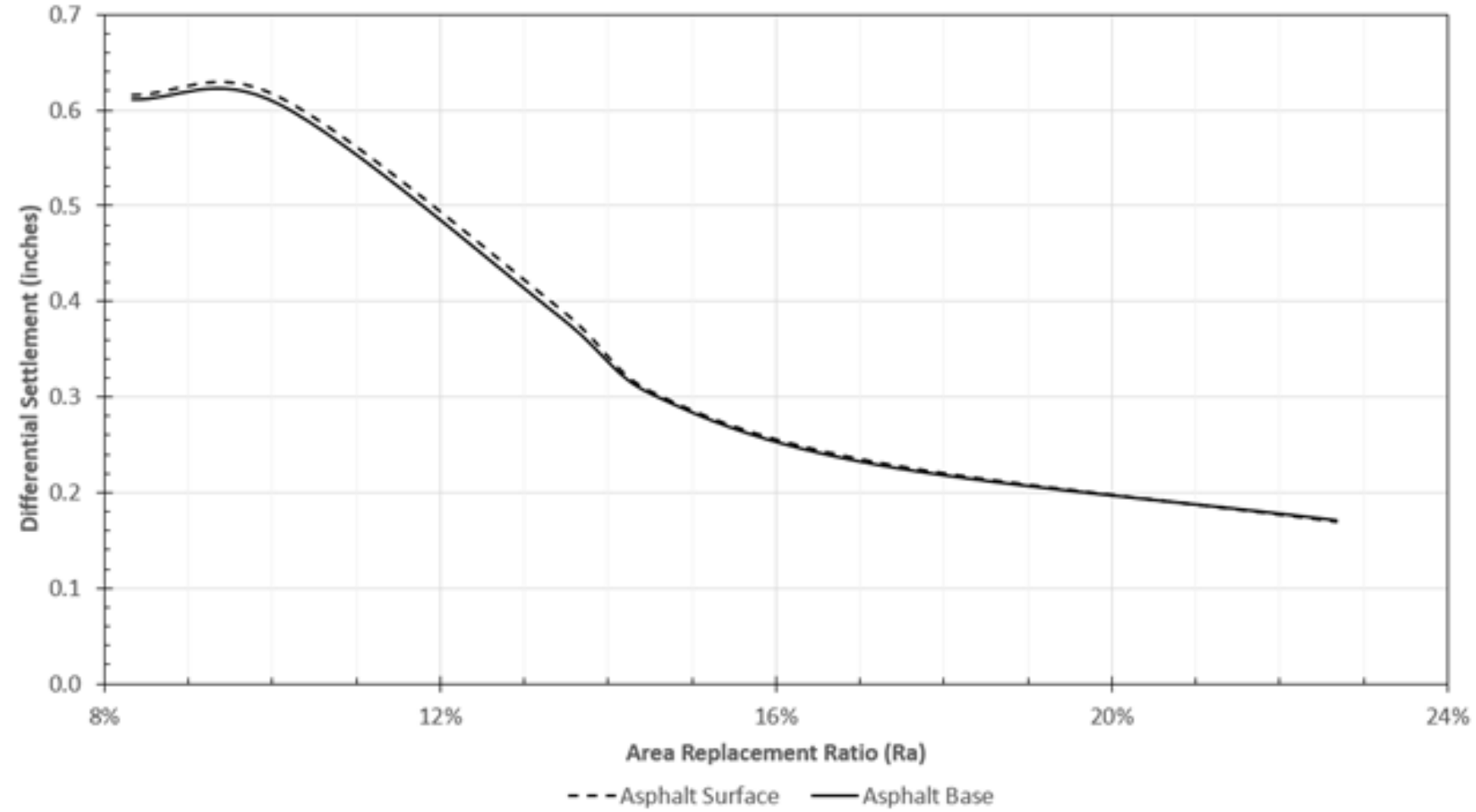
- Beam action of LTP maintained with minimal settlement over “softened” zones



Geotechnical – Soil Mix Column Design

Final area replacement ratio of 15%

- limits differential settlement to ~1/4-inch
- Achieves average modulus value of compacted embankment



Construction

Construction

- I-25 La Bajada – Milepost 264 to Milepost 267.5
  - Construction (CN 5101341) NTP was issued in March 2022
  - Mountain State Constructors, Inc. (MSCI) started site work in July 2022
  - Geo-Solutions, Inc (GSI) mobilized and installed test columns in Oct. 2022.

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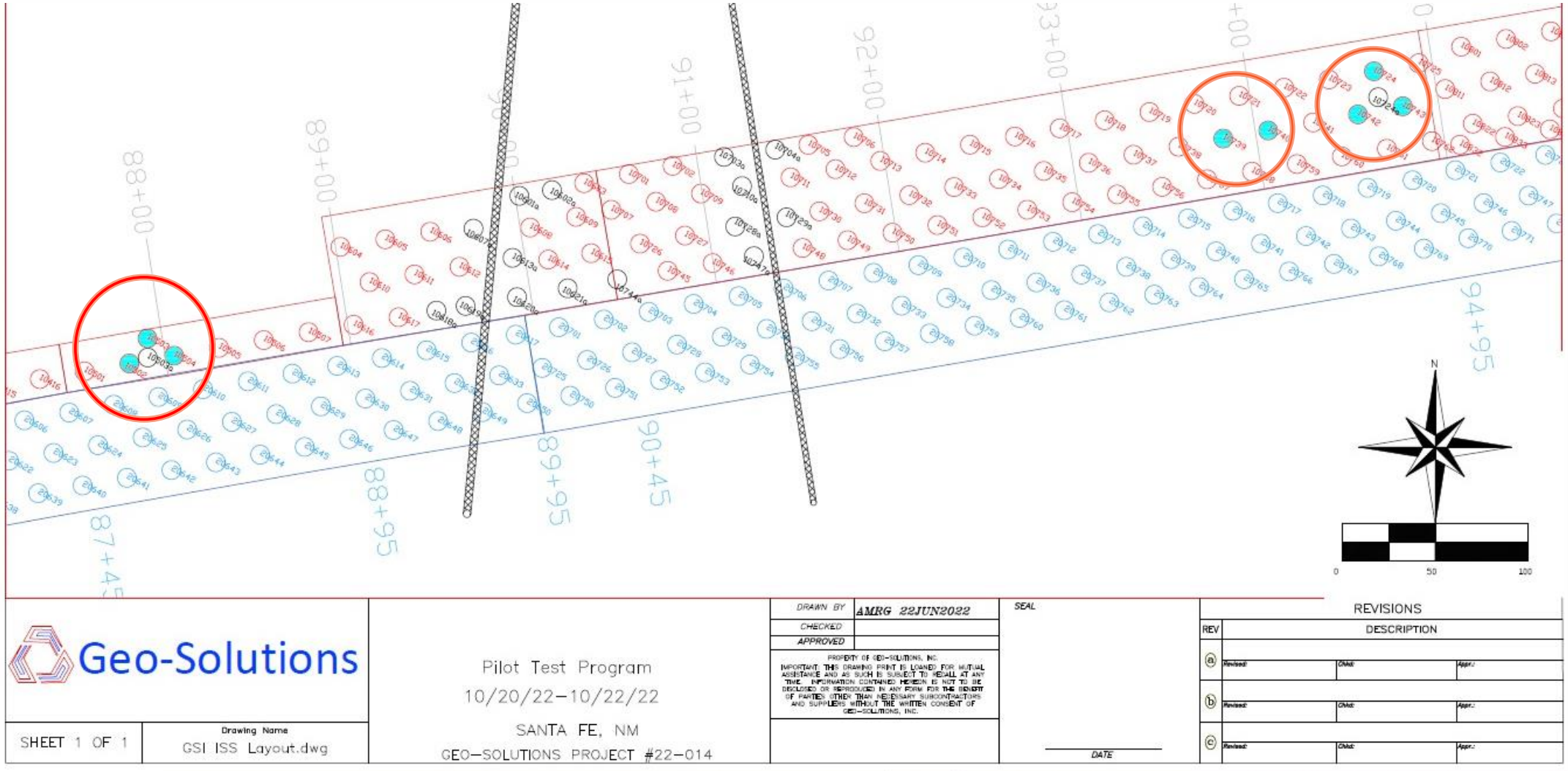
Construction - Test Program



Construction - Test Program

- 8 different grout mixes were tested during test program
- Grout mix for full scale production chosen to achieve the design strength with a factor of safety

Construction - Test Program

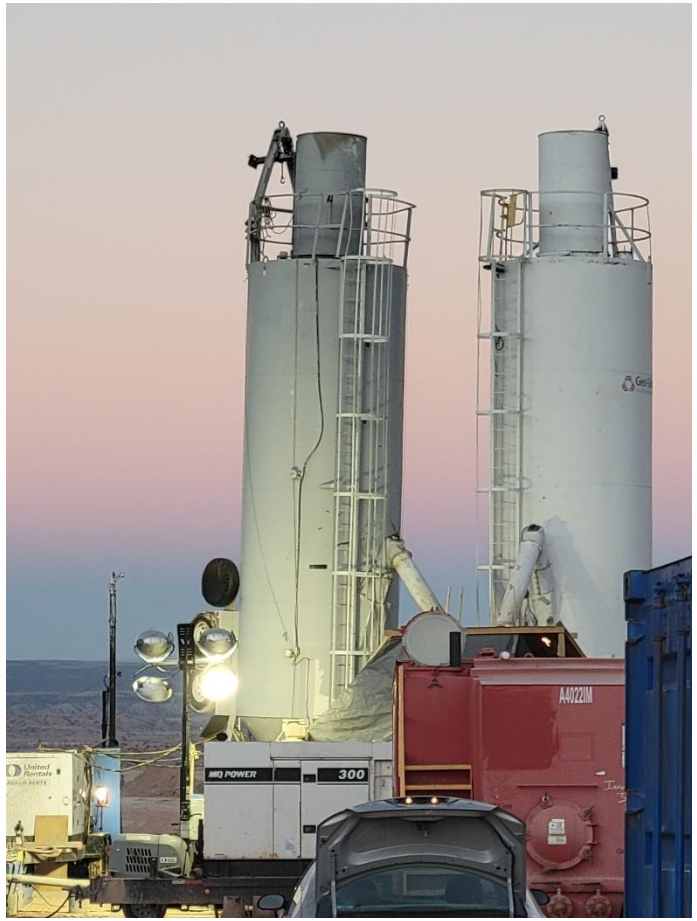
- Wet grab samples collected, and cores completed

Figure 2 – Sampling Tool

Construction - Test Program

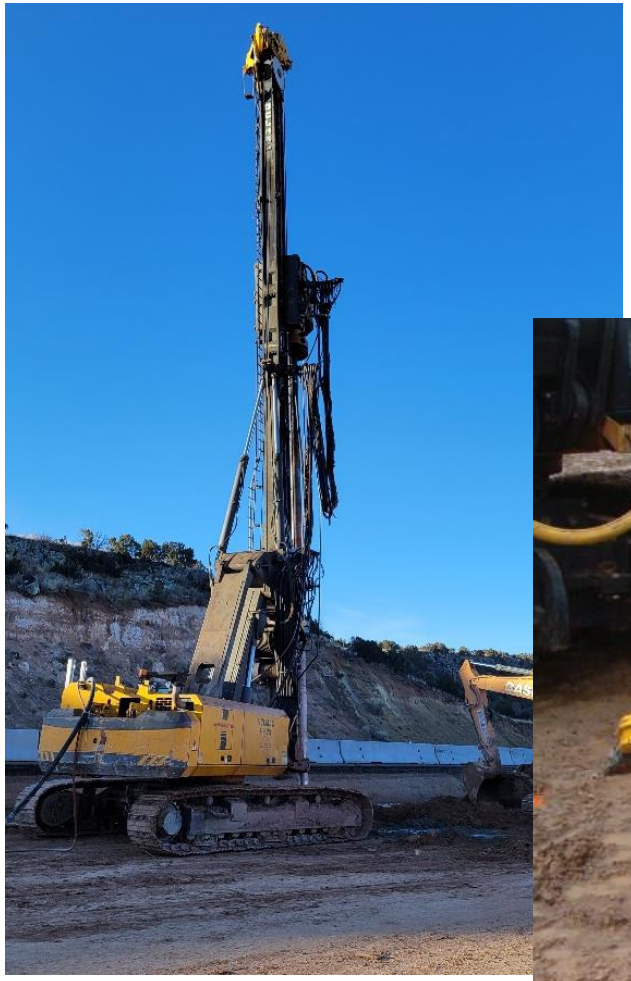
- Wet grab samples collected, and cores completed

Construction - Grout production



- Portland cement delivered to site in pneumatic tankers
- Water provided by MSCI and stored in frac tanks
- Metered out by weight then pumped to SM rigs.

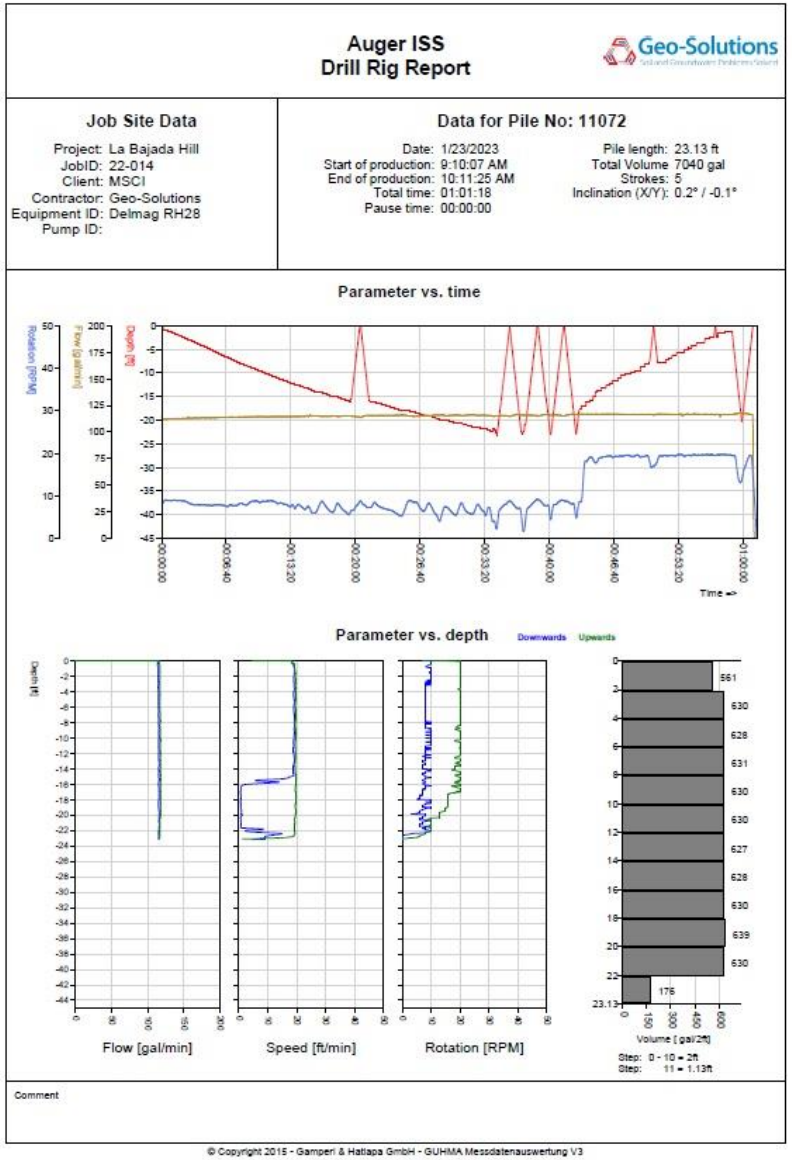
Construction - Soil Mixing Rigs



- Delmag rig can reach a maximum depth of 42 feet below ground surface

Construction - Soil Mixing Process

- Auger is advanced through layers of material
- Swell removed to make room for stabilized material
- After depth has been reached, column is stroked several times to ensure homogenization.
- On-board monitoring equipment ensures all depth intervals receive adequate grout



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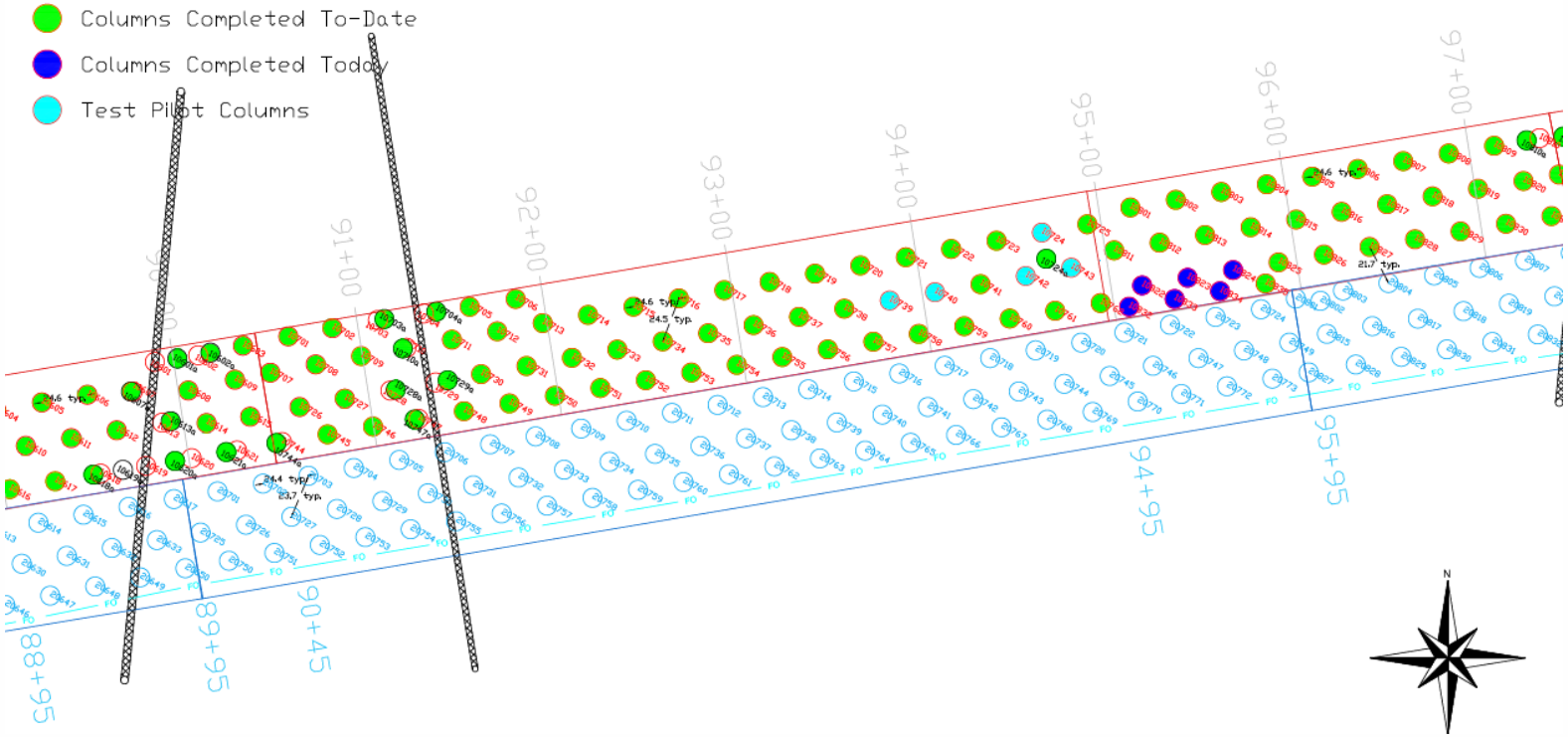
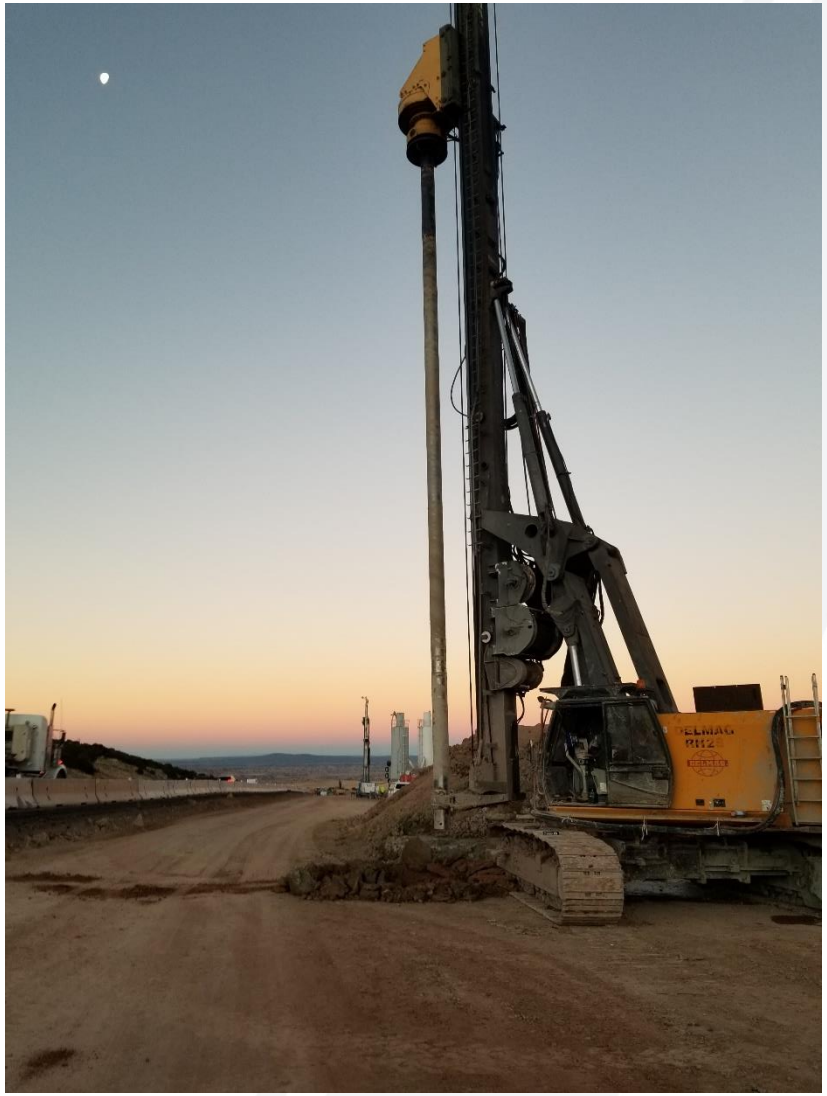
Construction - Soil Mixing Completion

- 547 Columns Completed in Phase I (SB Lanes)
- 414 Columns Completed in Phase 2 (NB Lanes)

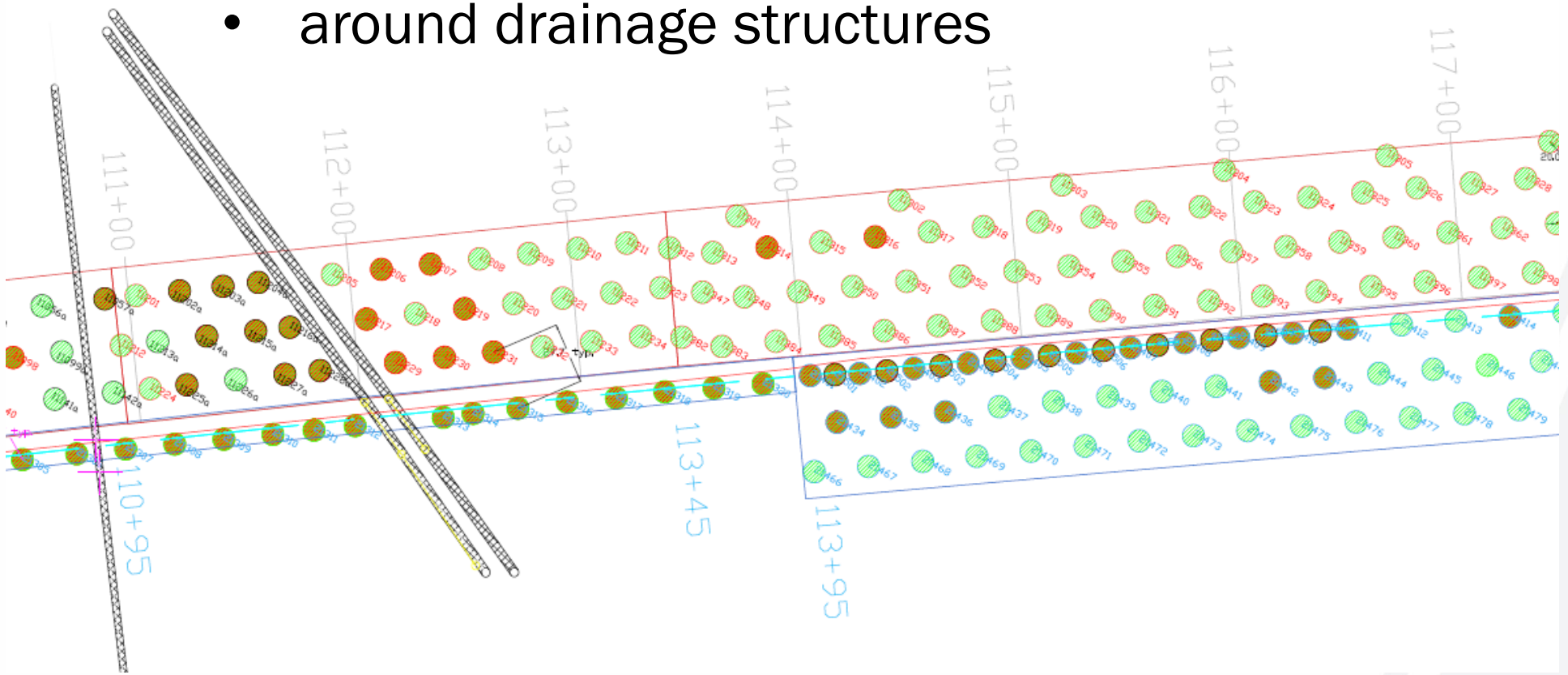




Construction - Boulder Obstructions

Obstructions encountered during soil mixing

- Within median
- around drainage structures



Construction - Boulder Obstructions

- Buried rock excavation debris from previous widening
- Shallow refusal of SM columns
- Solution: additional columns to minimize voids spanned by LTP

Construction – Load Transfer Platform

- Tensar TriAx TXSW geogrid reinforcement
- Overlaps of 4 feet and 2 feet in the directions of roll length, roll width

Construction - Paving Operations

Project substantial completion date: May 31, 2024

Long-term settlement monitoring at two locations: SAAV and TEPC

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Thank you!

New Mexico DEPARTMENT OF TRANSPORTATION
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wsp