Geotechnical and Constructability Lessons from the WALK Bridge Program

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Connecticut Department of Transportation
District 5 - Construction

TIME-2 Projects

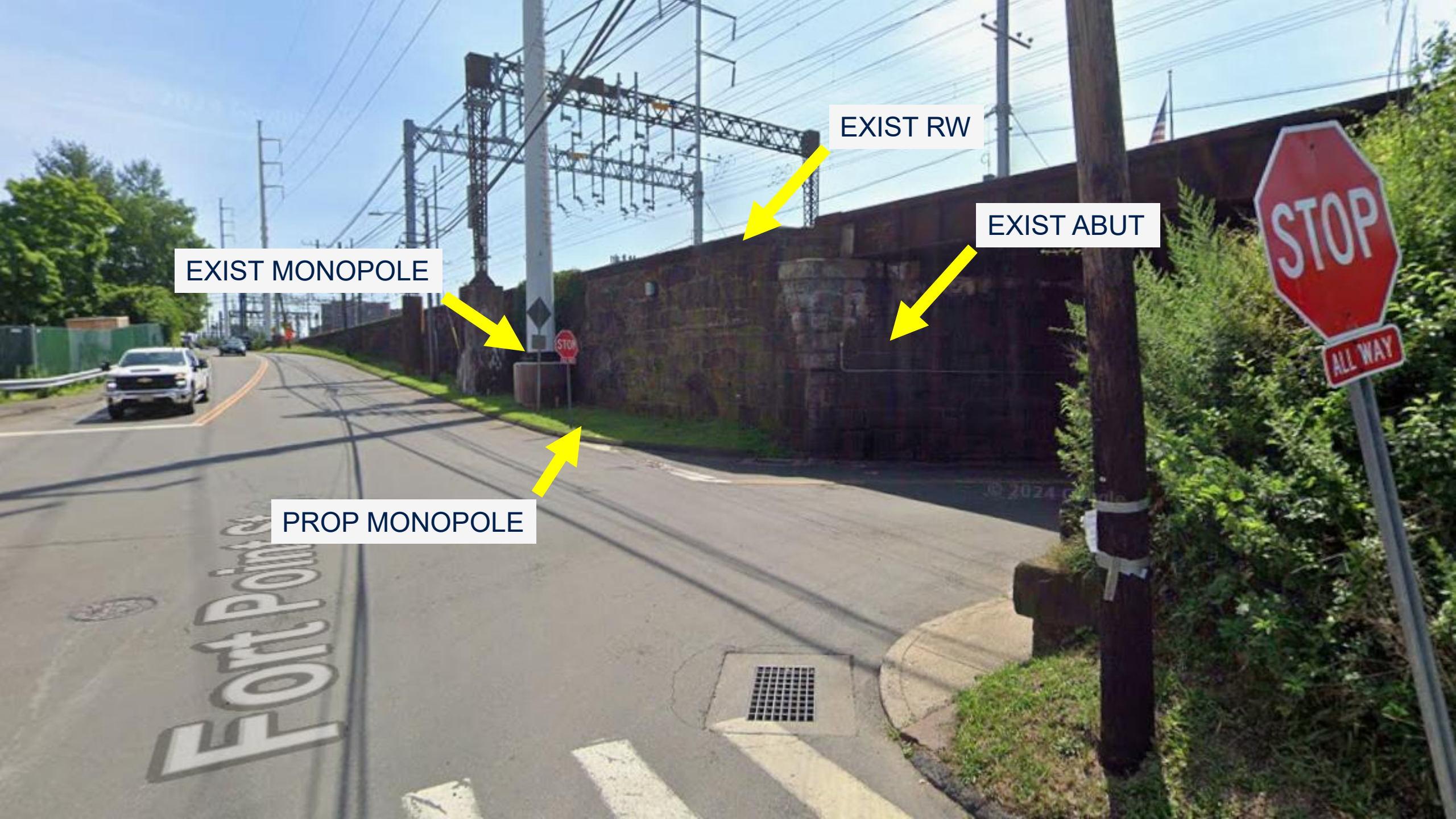
Track
Improvement
Mobility
Enhancement

5 YEARS
Construction Duration

LATE 2023
Construction Start

TIME FOR CT


S Smith St
4
5
S Smith St
Fort Point St
Fort Point St
Moore Pl
Yard
Point St


EXIST RW
EXIST ABUT
EXIST MONOPOLE
PROP MONOPOLE
STOP
ALL WAY
Fort Point


EXIST MONOPOLE
PROP MONOPOLE
PENNA
GROVE


PENNA

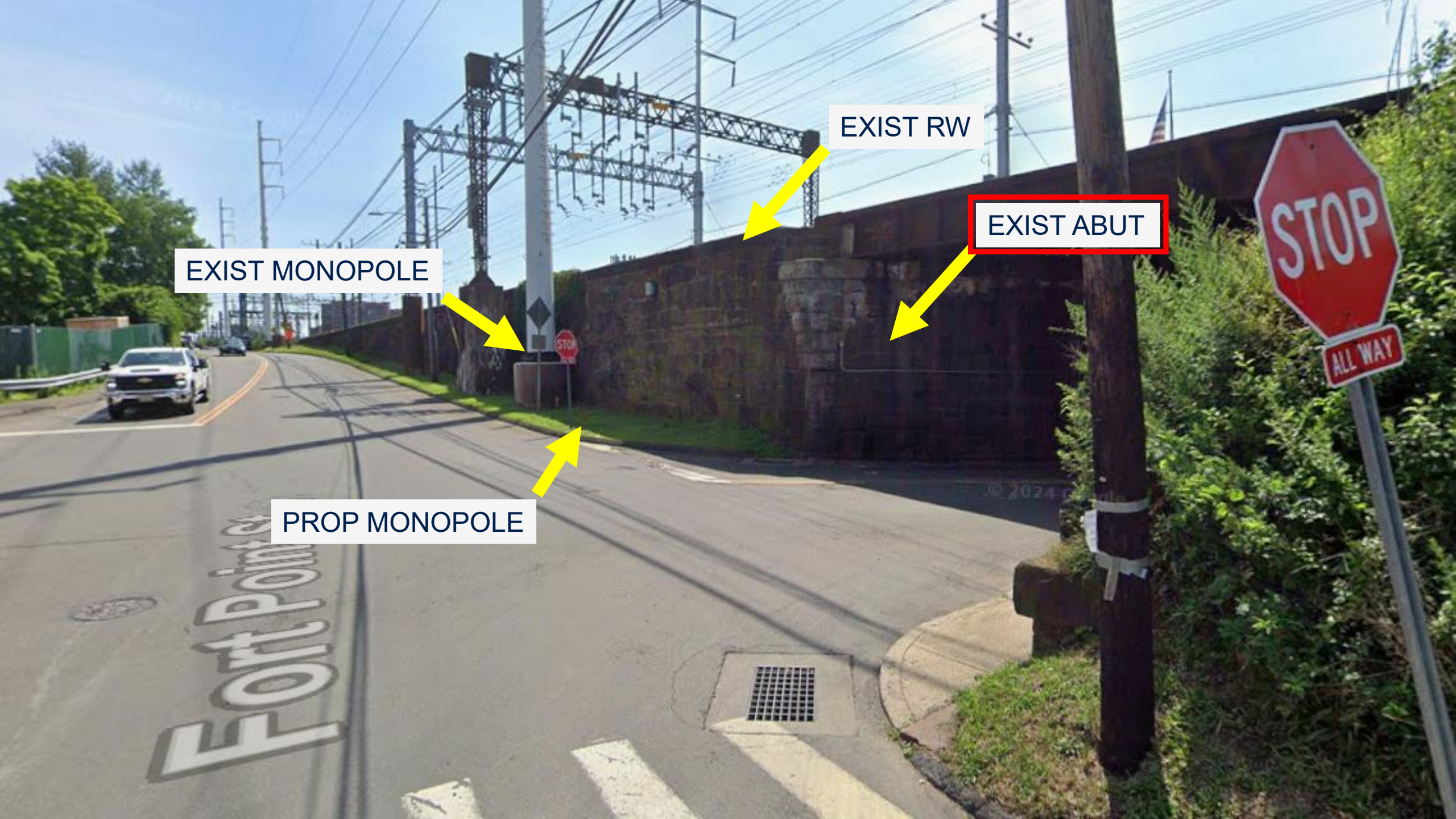

PENNA


PENNA

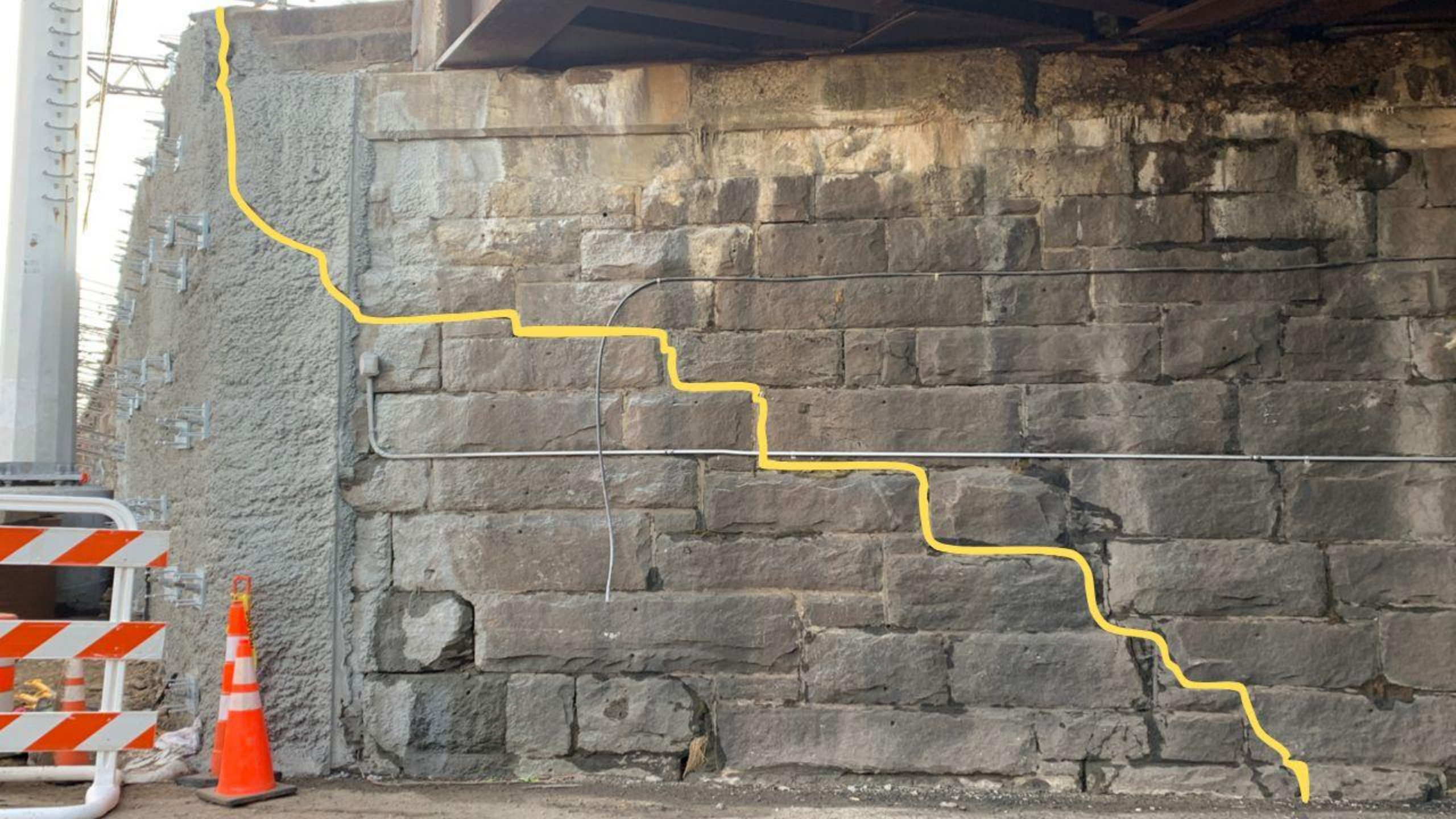

PENNA

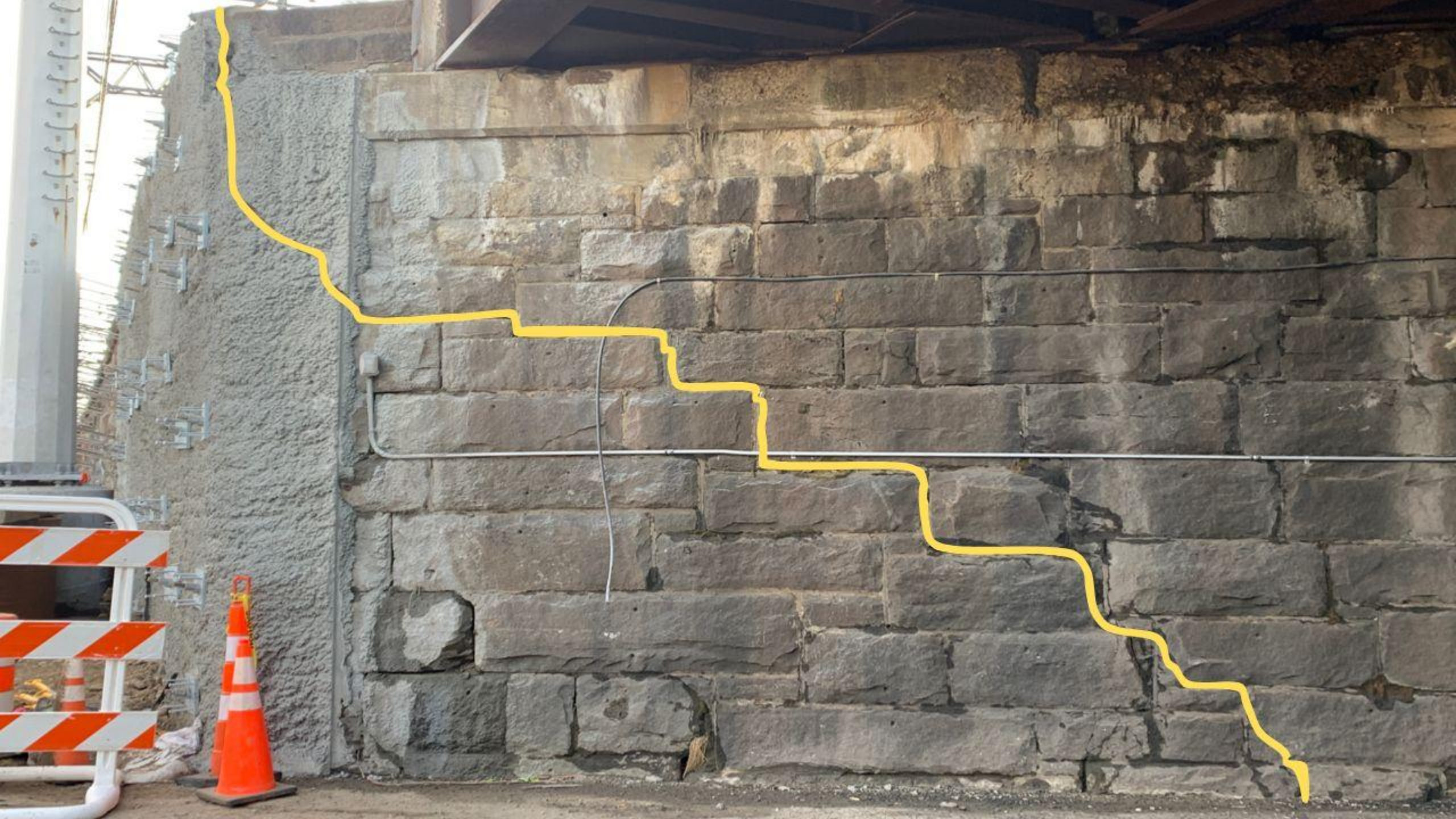

PENNA


18” SAG


EXIST RW
EXIST ABUT
EXIST MONOPOLE
PROP MONOPOLE
STOP
ALL WAY
Fort Point


PROP MONOPOLE






PROP MONOPOLE

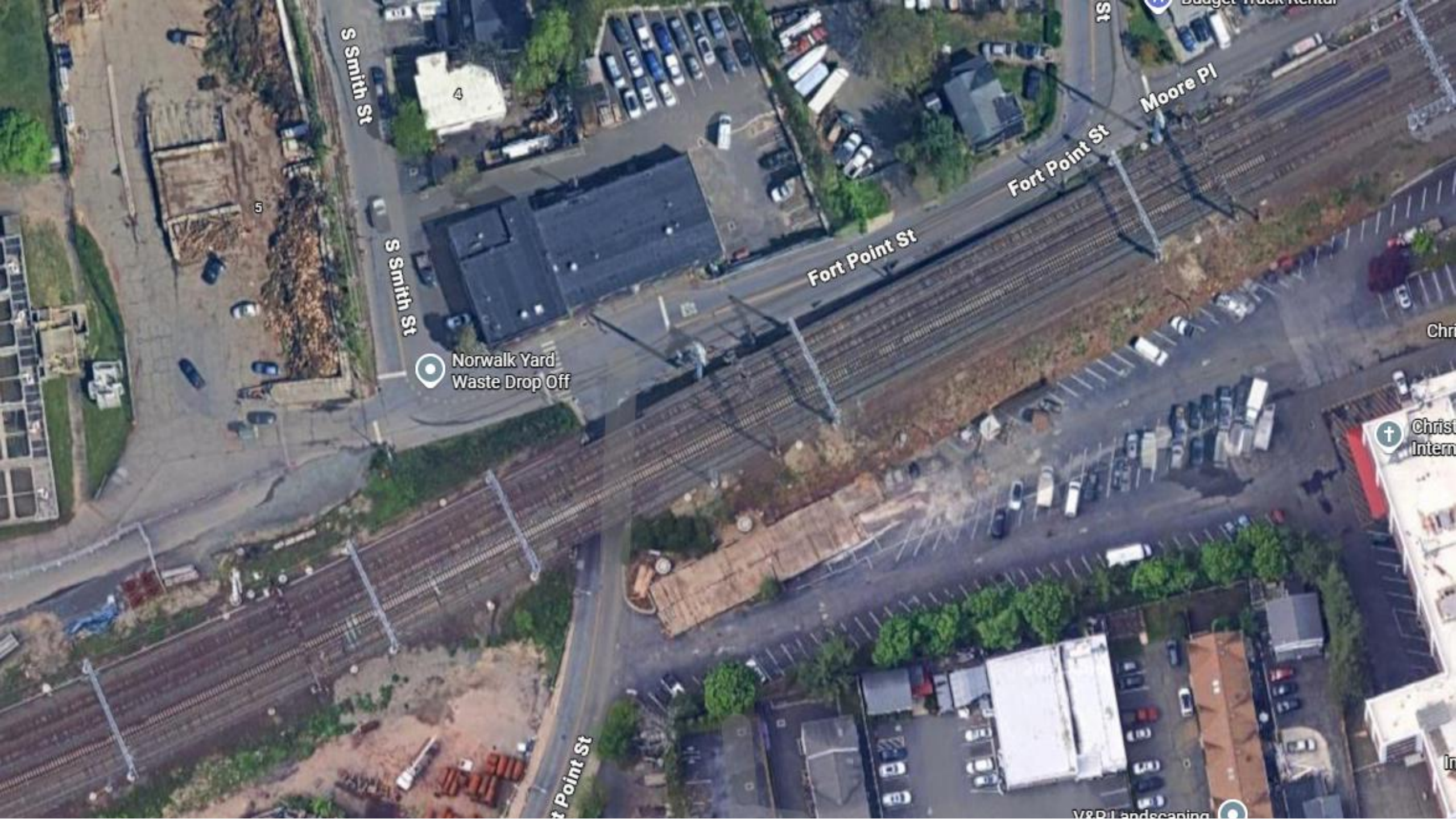

PROP MONOPOLE
OUT OF SERVICE
OUT OF SERVICE
IN SERVICE
IN SERVICE
S Smith St
S Smith St
Fort Point St
Fort Point St
Moore Pl
Norwalk Yard
Waste Drop Off
4
5

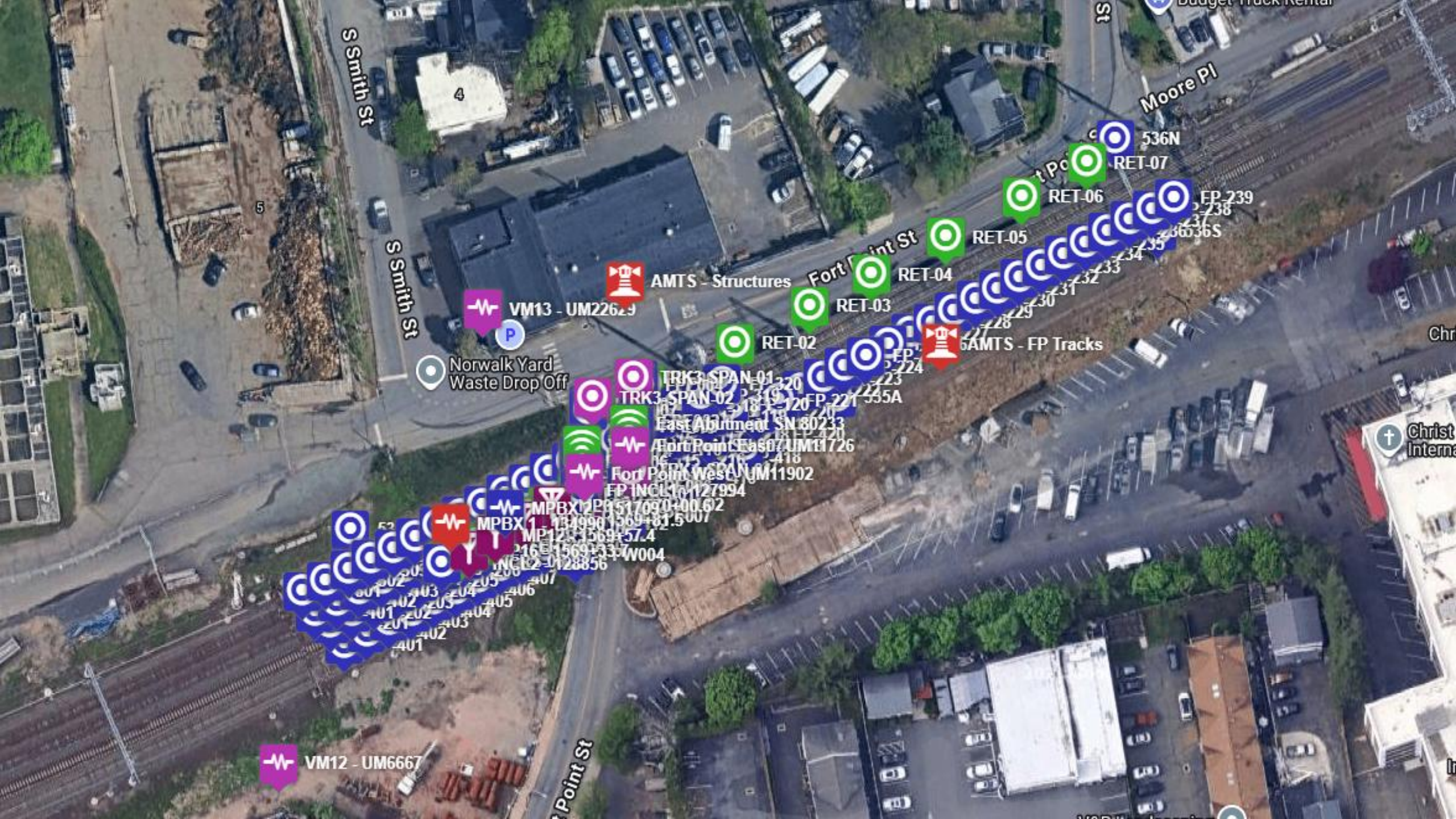
Automated Movement & Vibration Monitoring

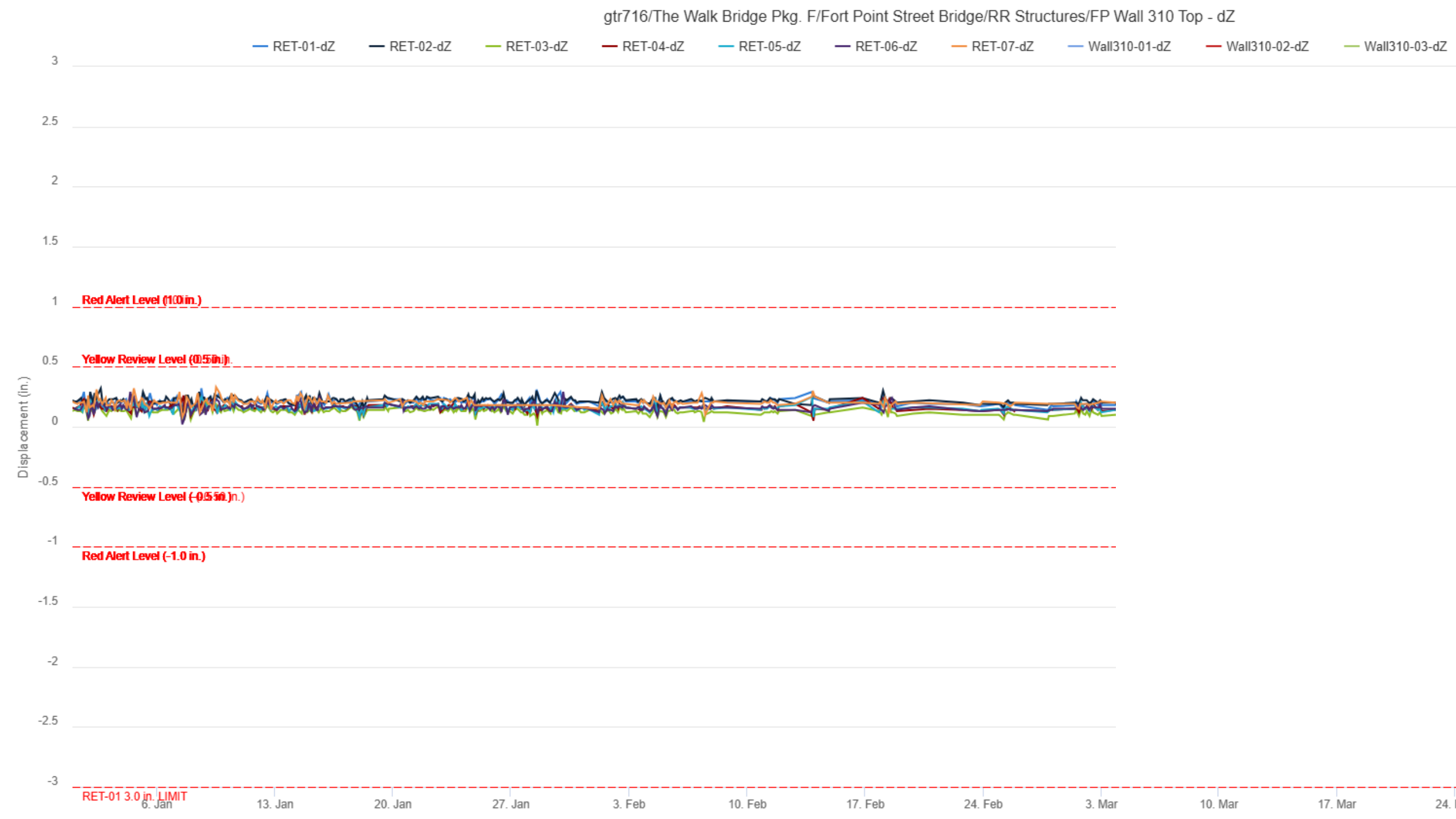
Includes:

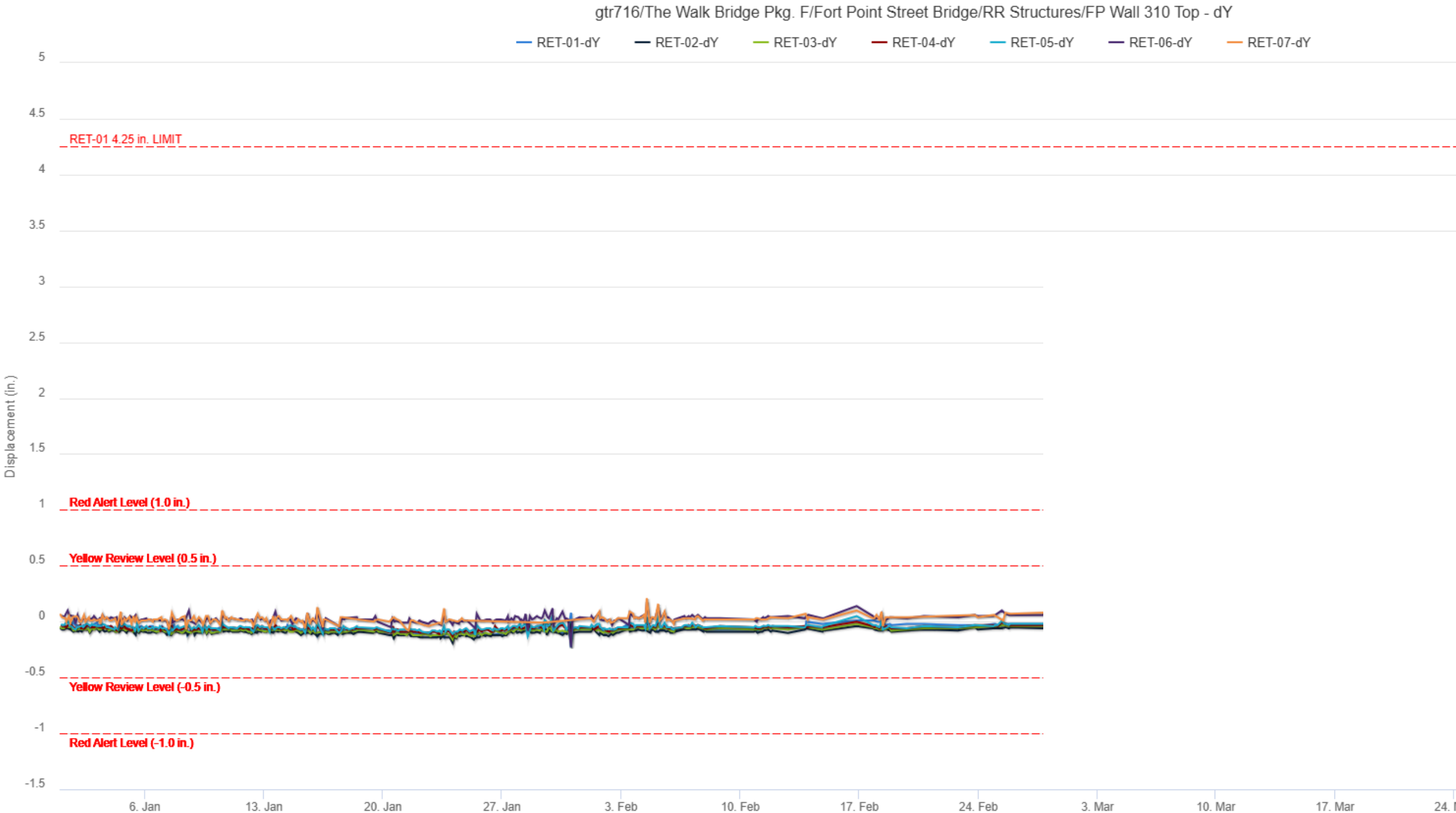
- **Monitoring for life of project**
- **Web interface**
- **Email alerts**

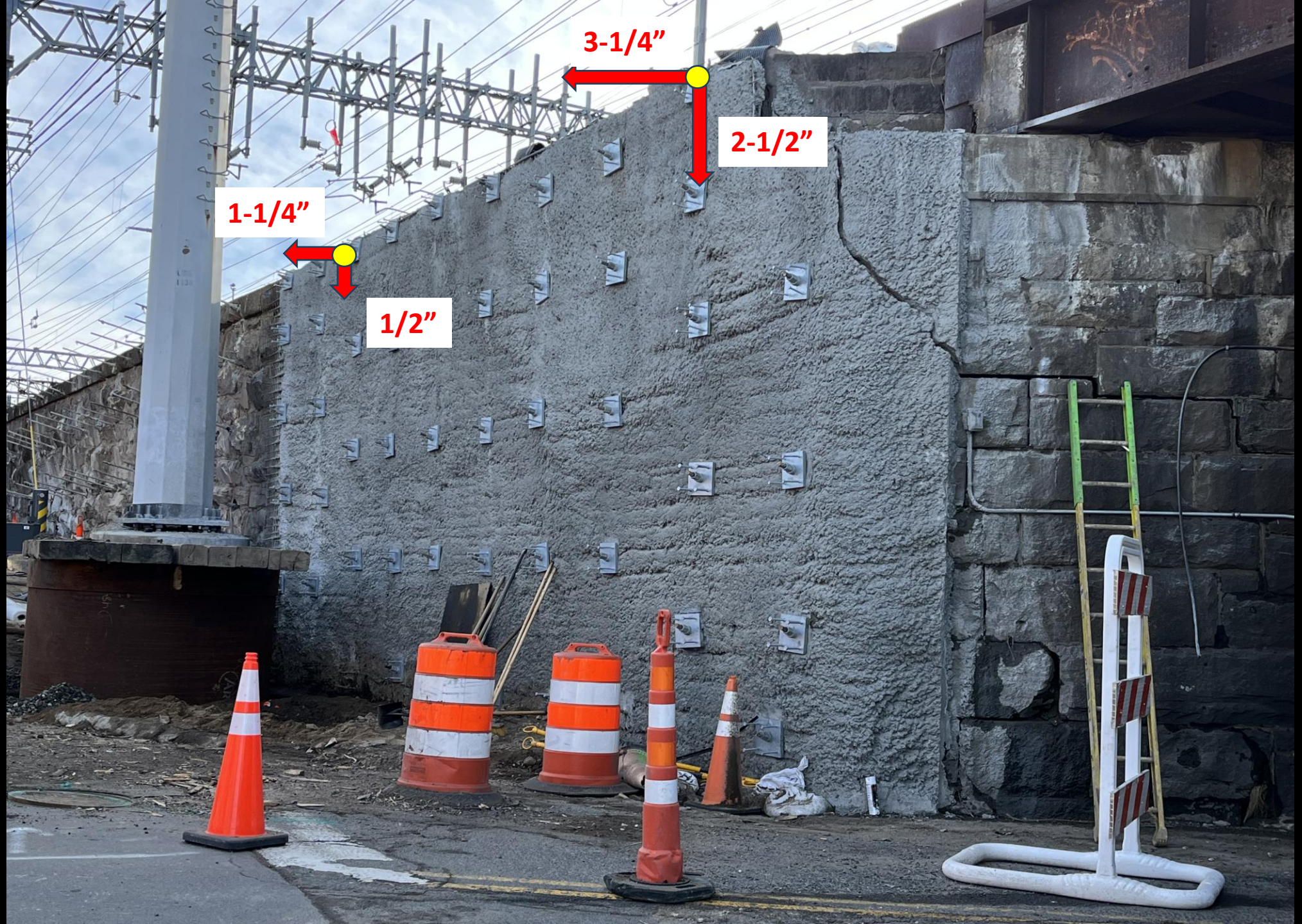
Optical Prism


S Smith St
S Smith St
Fort Point St
Fort Point St
Moore Pl
Norwalk Yard
Waste Drop Off
4
5


S Smith St
Moore Pl
Fort Point St
536N
RET-07
RET-06
RET-05
RET-04
RET-03
RET-02
FP 239
AMTS - Structures
AMTS - FP Tracks
VM13 - UM22629
Norwalk Yard
Waste Drop Off
TRK3-SPAN-01
TRK3-SPAN-02
East Abutment SN 80233
Fort Point East UM11726
Fort Point West UM11902
MPBX1 - UM11990
VM12 - UM6667


gtr716/The Walk Bridge Pkg. F/Fort Point Street Bridge/RR Structures/FP Wall 310 Top - dZ
RET-01-dZ
RET-02-dZ
RET-03-dZ
RET-04-dZ
RET-05-dZ
RET-06-dZ
RET-07-dZ
Wall310-01-dZ
Wall310-02-dZ
Wall310-03-dZ
Displacement (in.)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Red Alert Level (1.0 in.)
Yellow Review Level (0.5 in.)
Yellow Review Level (-0.5 in.)
Red Alert Level (-1.0 in.)
RET-01 3.0 in. LIMIT
6. Jan
13. Jan
20. Jan
27. Jan
3. Feb
10. Feb
17. Feb
24. Feb
3. Mar
10. Mar
17. Mar


gtr716/The Walk Bridge Pkg. F/Fort Point Street Bridge/RR Structures/FP Wall 310 Top - dY
RET-01-dY
RET-02-dY
RET-03-dY
RET-04-dY
RET-05-dY
RET-06-dY
RET-07-dY
Displacement (in.)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
RET-01 4.25 in. LIMIT
Red Alert Level (1.0 in.)
Yellow Review Level (0.5 in.)
Yellow Review Level (-0.5 in.)
Red Alert Level (-1.0 in.)
6. Jan
13. Jan
20. Jan
27. Jan
3. Feb
10. Feb
17. Feb
24. Feb
3. Mar
10. Mar
17. Mar


3-1/4”
2-1/2”
1-1/4”
1/2”

Ground Penetrating Radar (GPR)

- Detects subsurface **anomalies** via high-frequency radio wave pulse emission and detection
- Limited to 5-15 FT depths in typical soils
- Performed at street level only

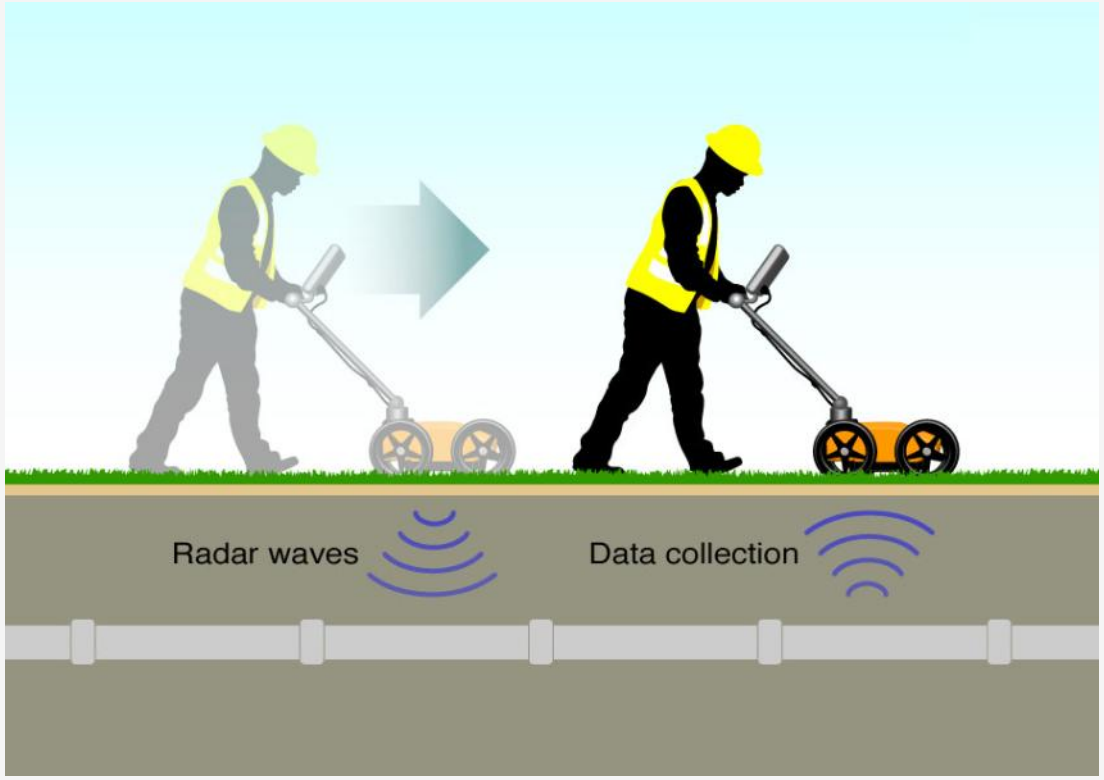
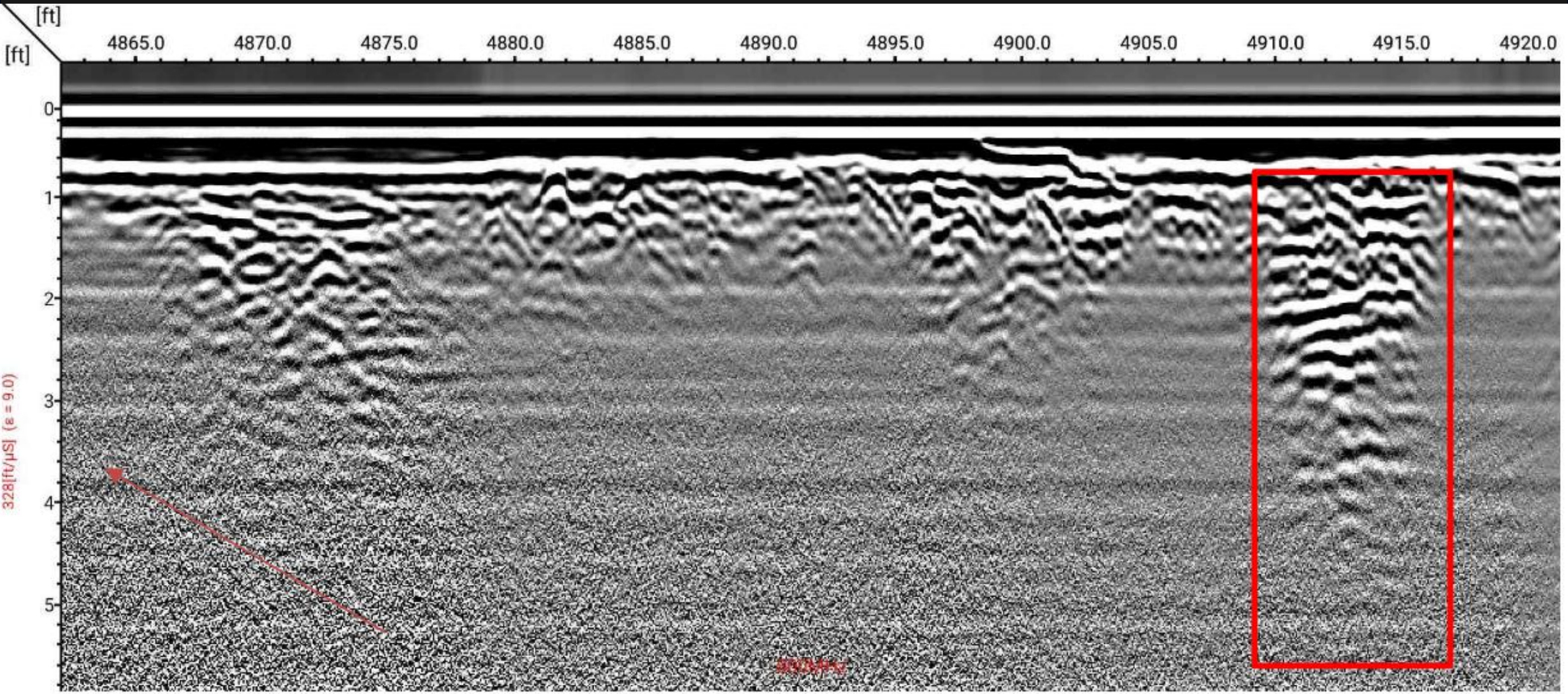
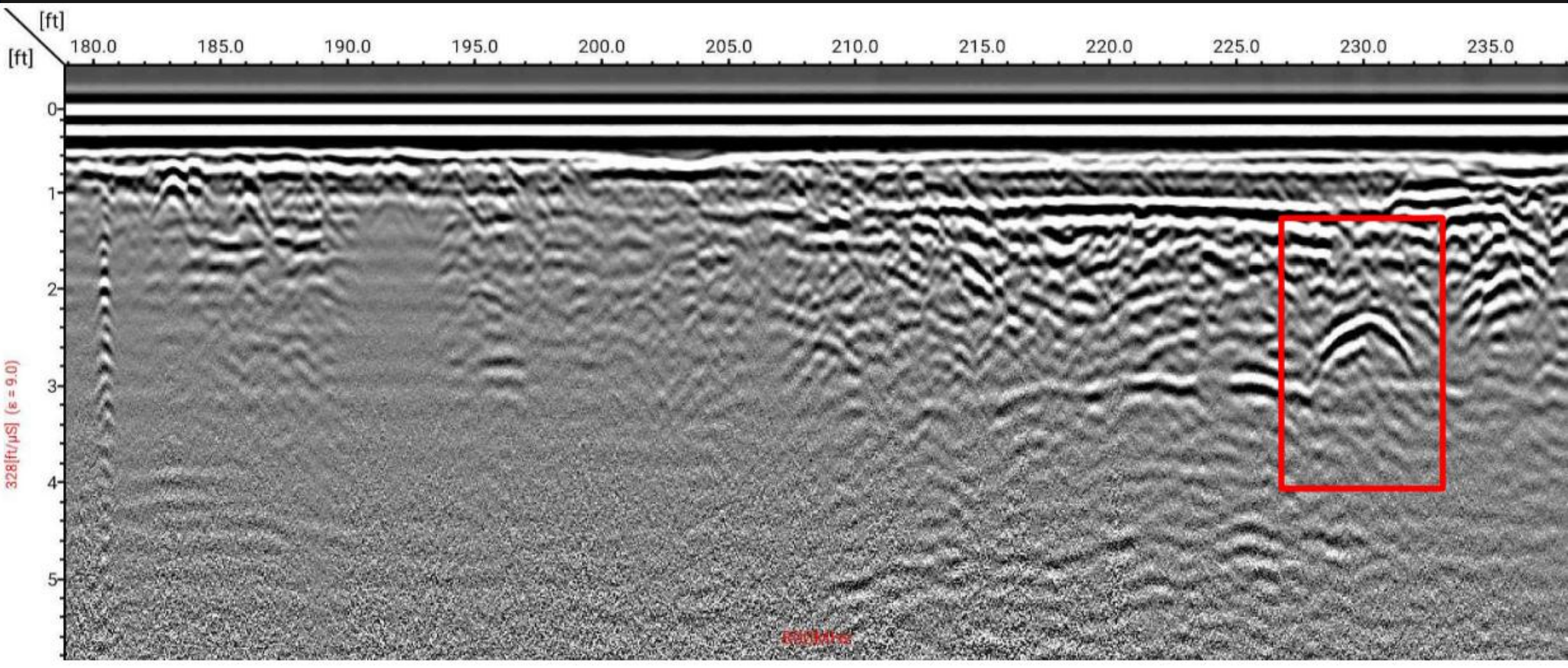


Photo Credit: certerra-subsurface.com


[ft]
[ft]
4865.0
4870.0
4875.0
4880.0
4885.0
4890.0
4895.0
4900.0
4905.0
4910.0
4915.0
4920.0
0
1
2
3
4
5
328[ft/µS] (ε = 9.0)


[ft]
[ft]
180.0
185.0
190.0
195.0
200.0
205.0
210.0
215.0
220.0
225.0
230.0
235.0
0
1
2
3
4
5
328[ft/µS] (ε = 9.0)


PROP MONOPOLE
OUT OF SERVICE
OUT OF SERVICE
IN SERVICE
IN SERVICE
In Service Track Showing Northward Movement & Settlement
S Smith St
Fort Point St
Moore Pl
Norwalk Yard
Waste Drop Off

Seismic Source Testing

- Multichannel Analysis of Surface Waves (“MASW”)
- Provides a detailed section showing surface wave velocities
- Surface wave velocities are used to infer soils’ relative stiffness/density

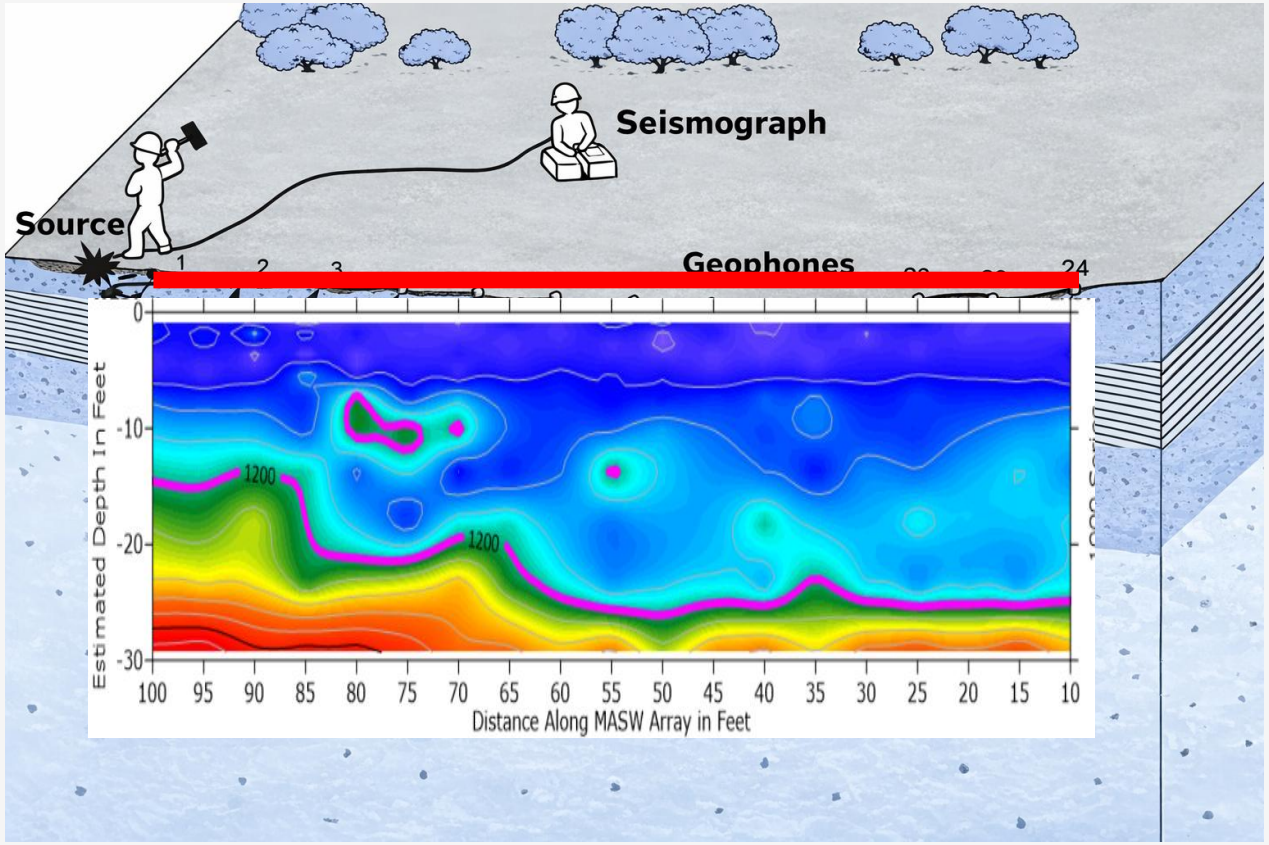
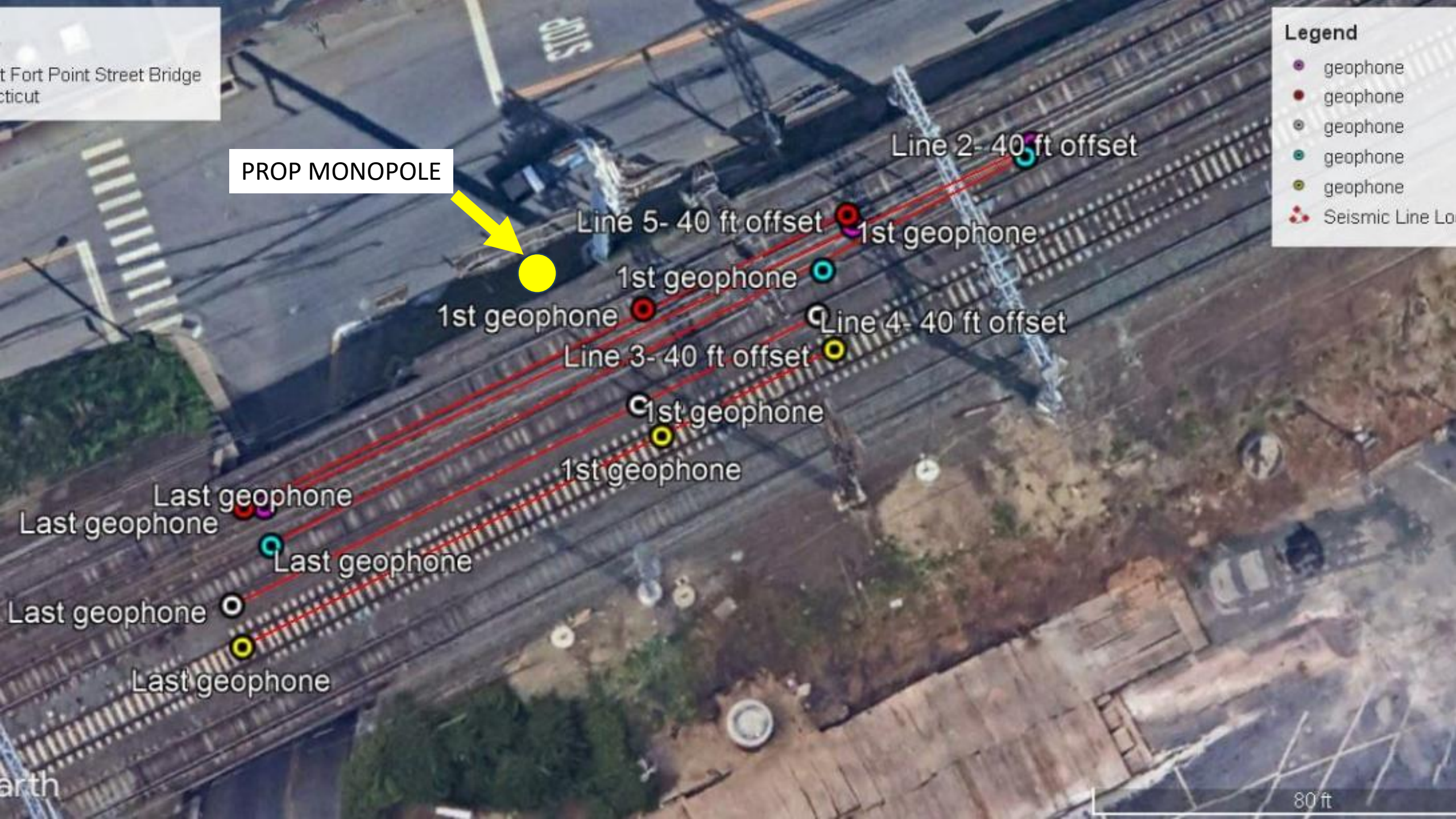
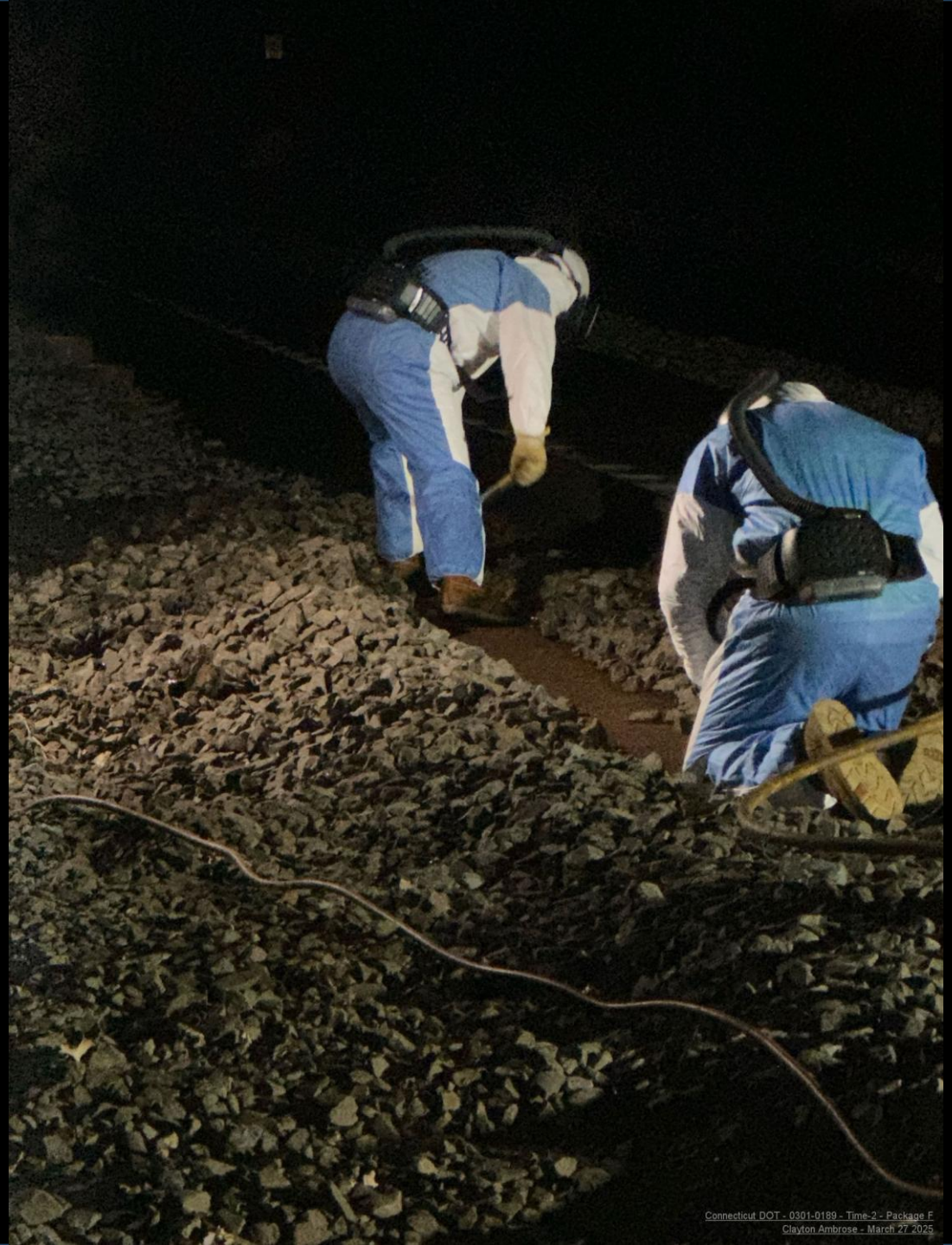
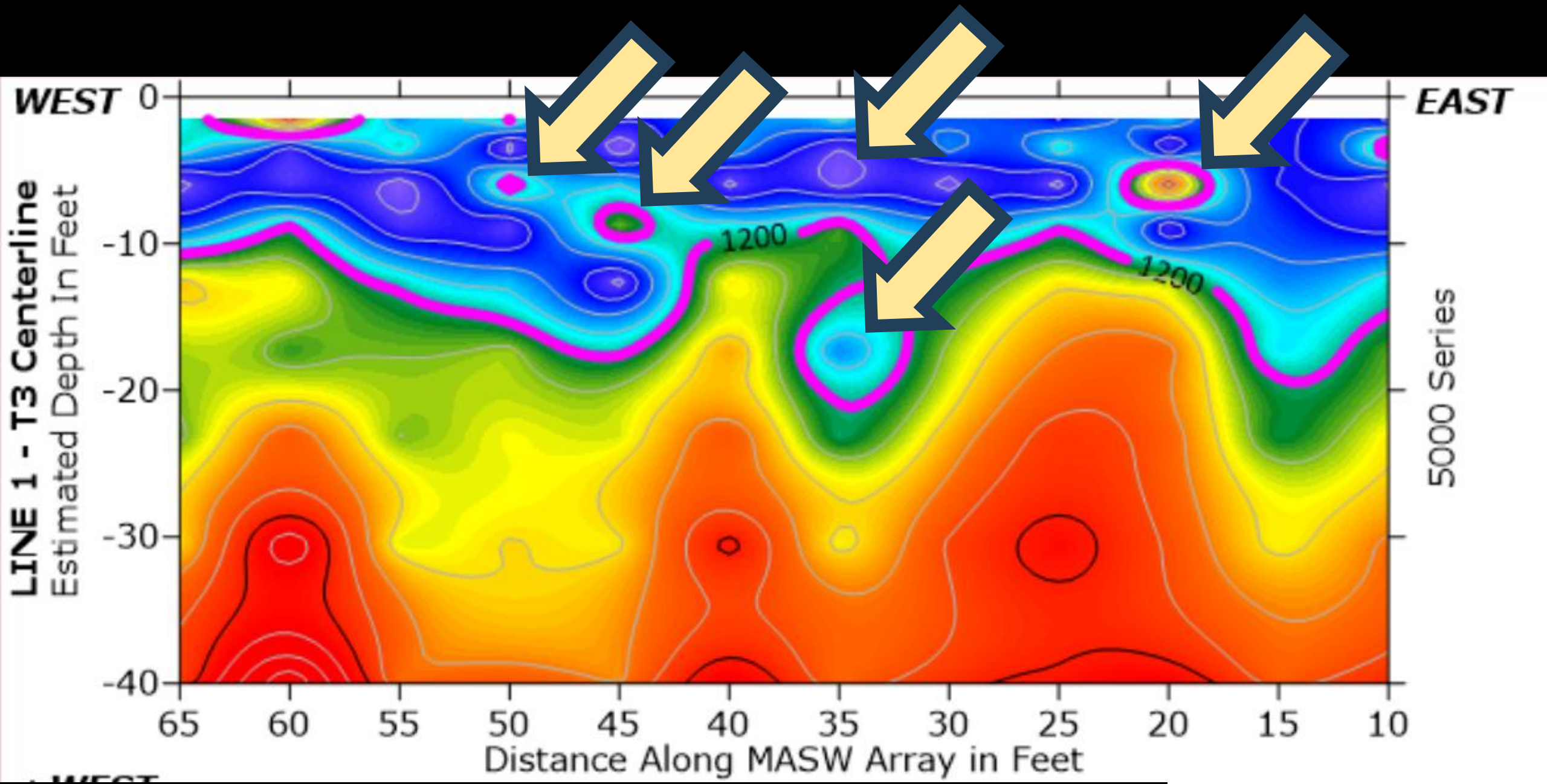


Photo Credit: geophysical.biz


t Fort Point Street Bridge
cticut
PROP MONOPOLE
Line 2- 40 ft offset
Line 5- 40 ft offset
1st geophone
1st geophone
1st geophone
Line 4- 40 ft offset
Line 3- 40 ft offset
1st geophone
1st geophone
Last geophone
Last geophone
Last geophone
Last geophone
Last geophone
arth
Legend
geophone
geophone
geophone
geophone
geophone
Seismic Line Lo
80 ft


Connecticut DOT - 0301-0189 - Time-2 - Package F
Clayton Ambrose - March 27, 2025

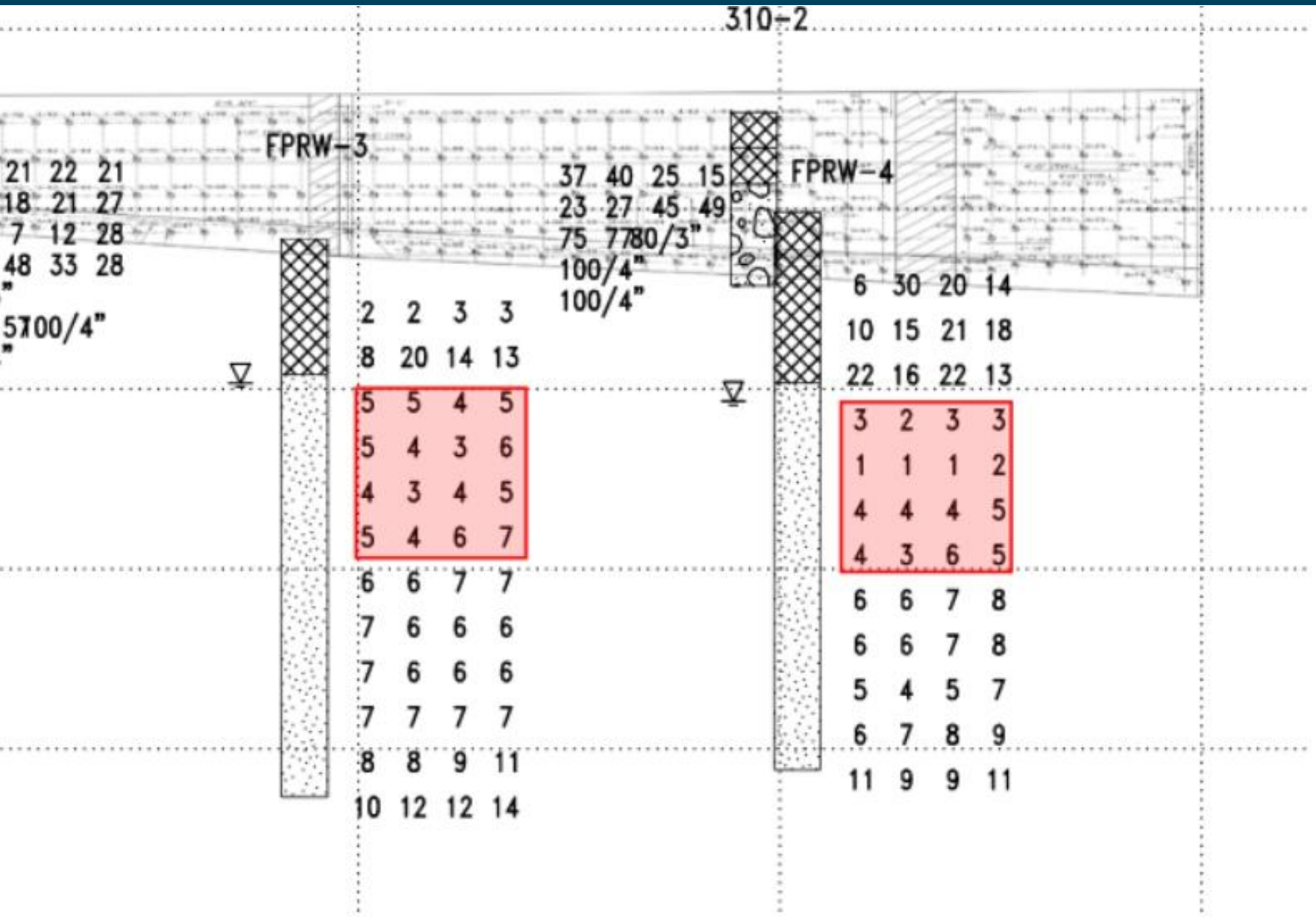

Connecticut DOT - 0301-0189 - Time-2 - Package F
Clayton Ambrose - March 27, 2025



Cool Colors = Less Dense

Warm Colors = More Dense

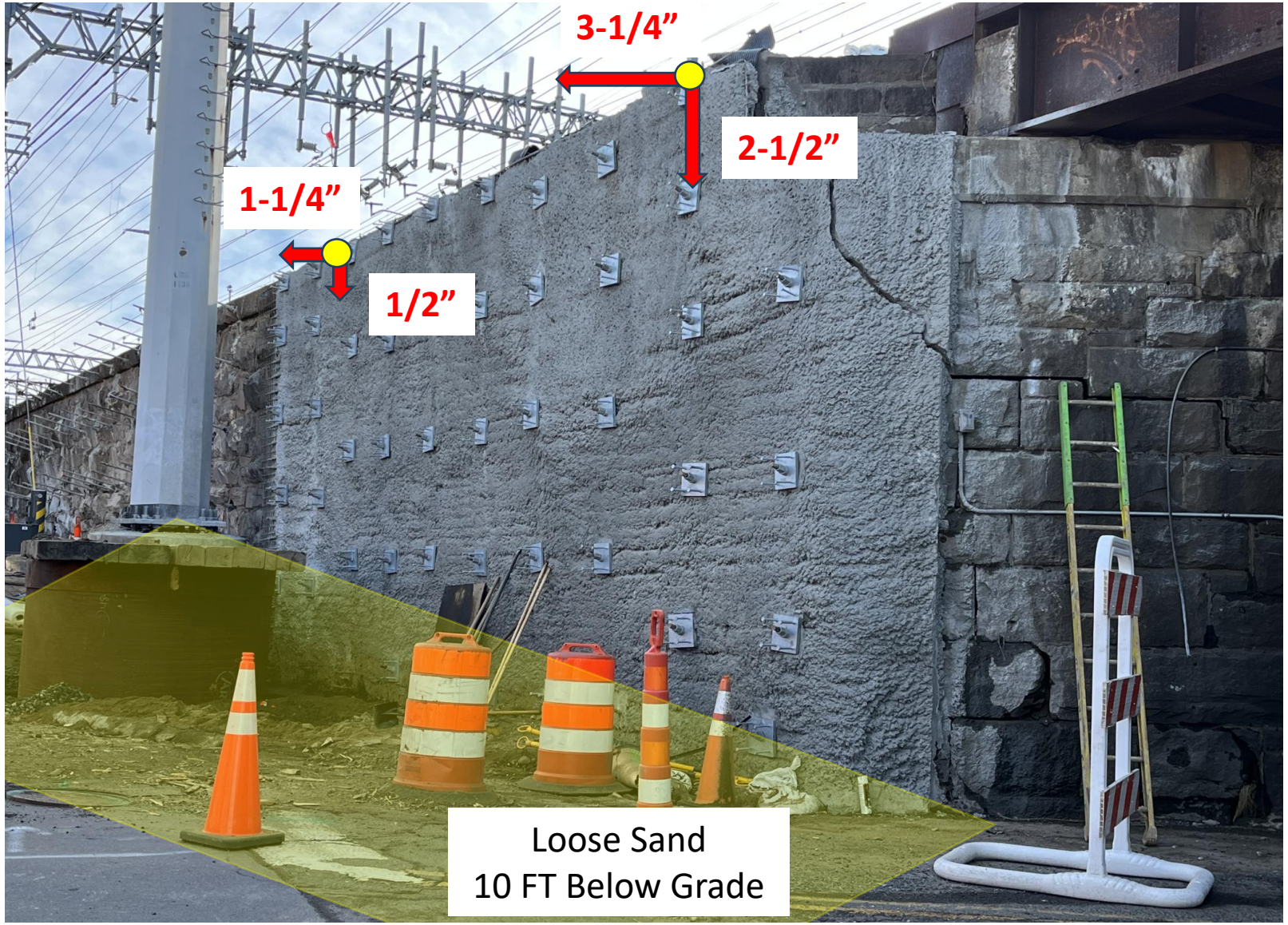
Cause & Effects



Vibratory Installation of Monopole Casing

Consolidation & Migration of Existing Loose Sand Layer

Cause & Effects



Consolidation & Migration of Existing Loose Sand Layer

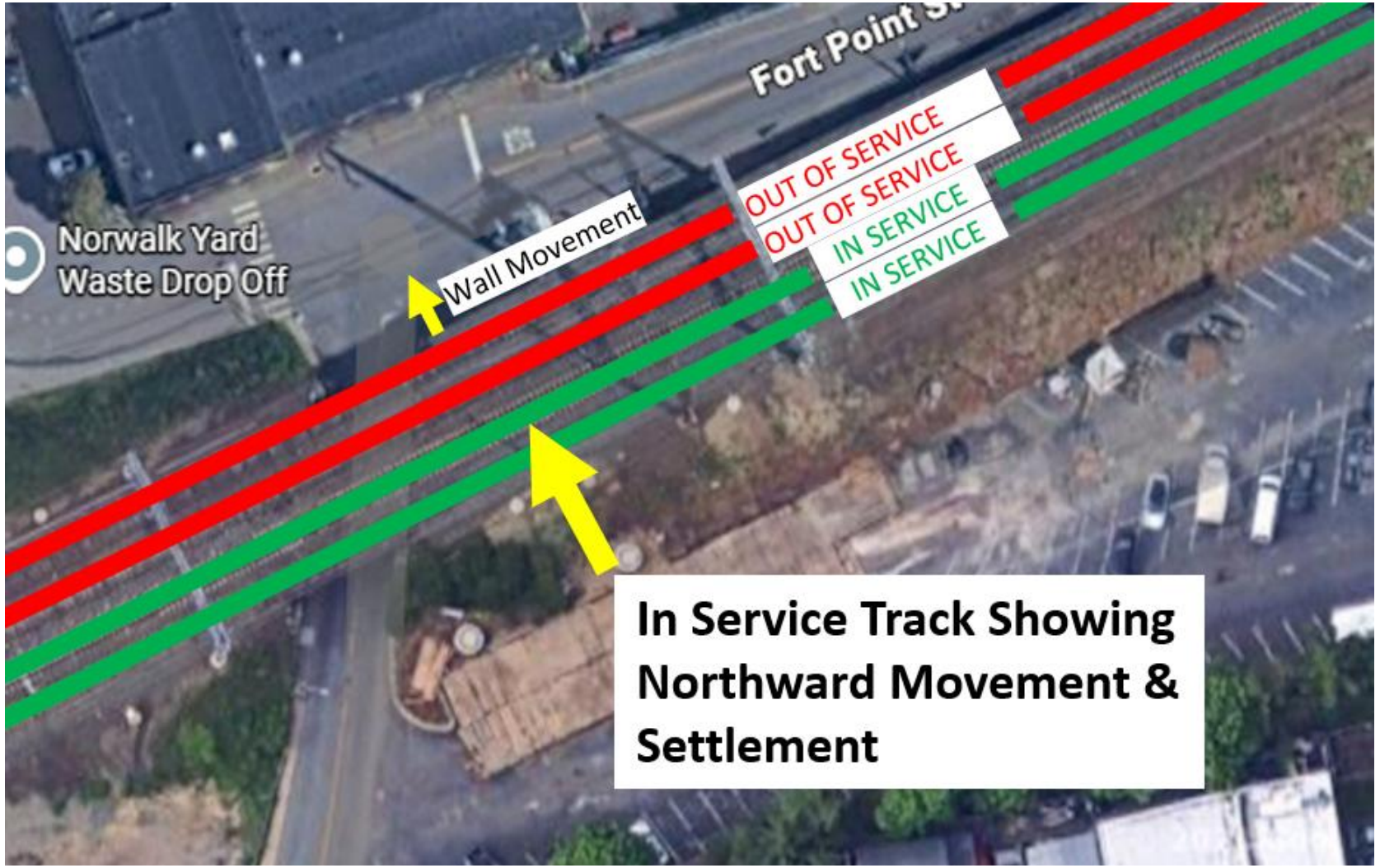
↓

Displacement of Retaining Wall

↓

Embankment Migration & Localized Shear Failures

Cause & Effects



Embankment Migration & Localized Shear Failures

Track Creep

Solution: Permeation Grouting

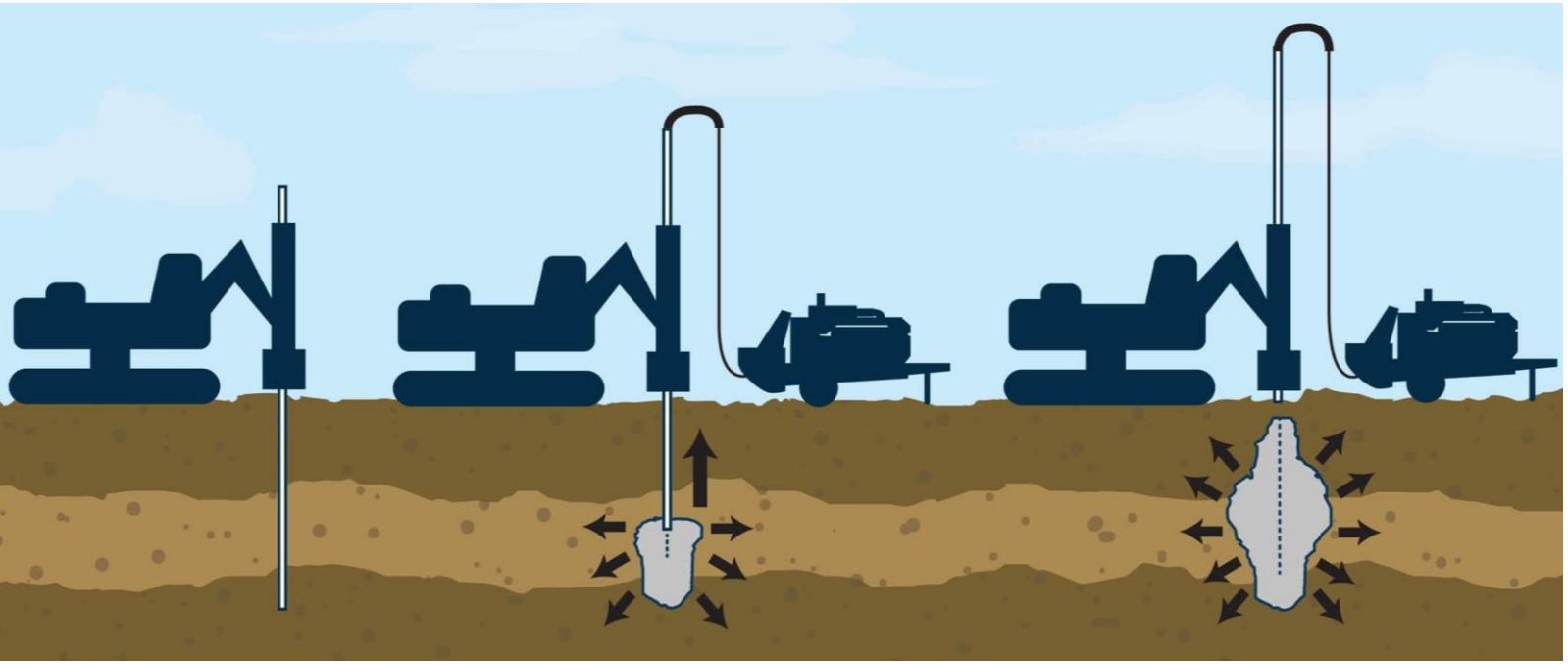
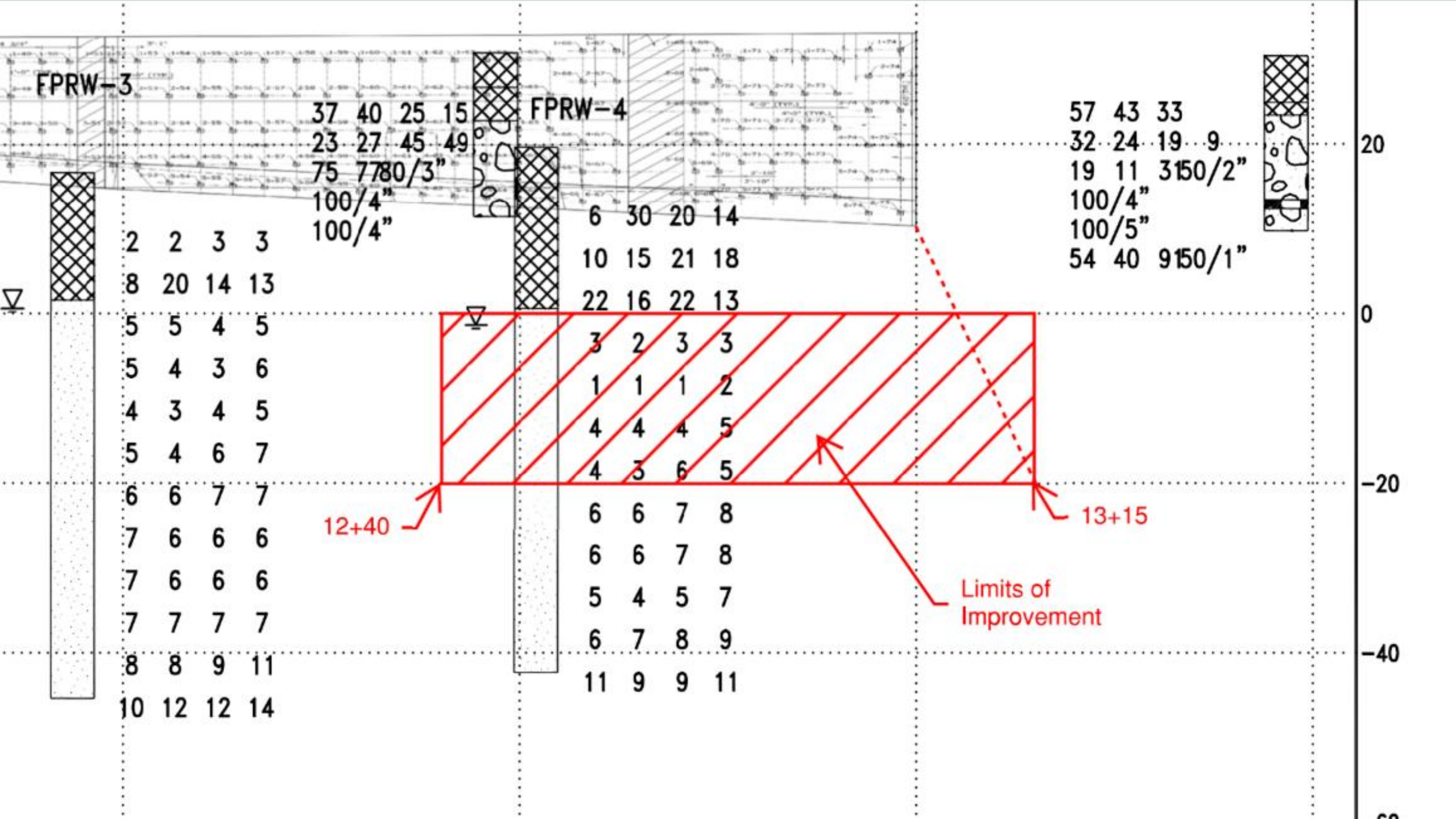
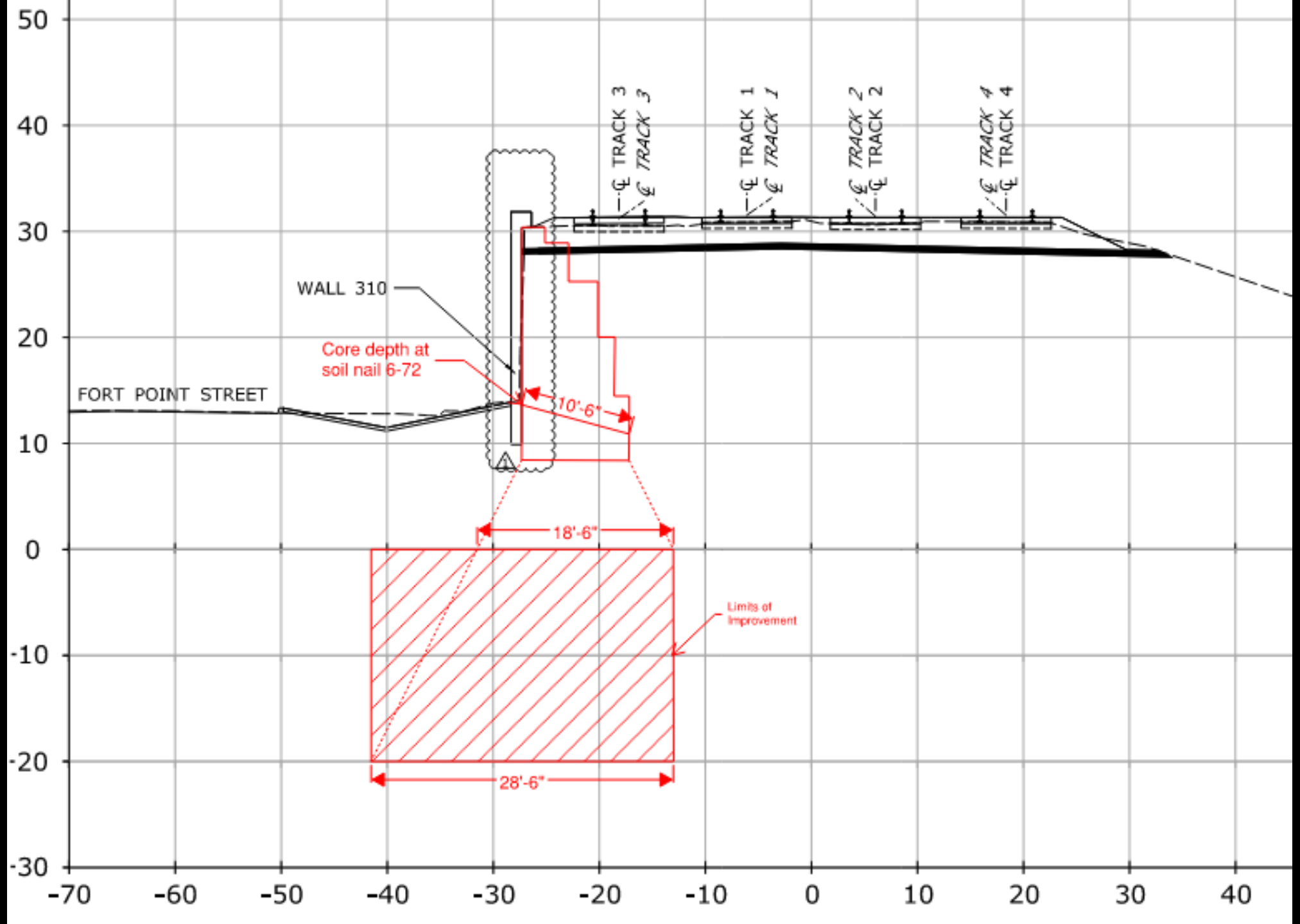
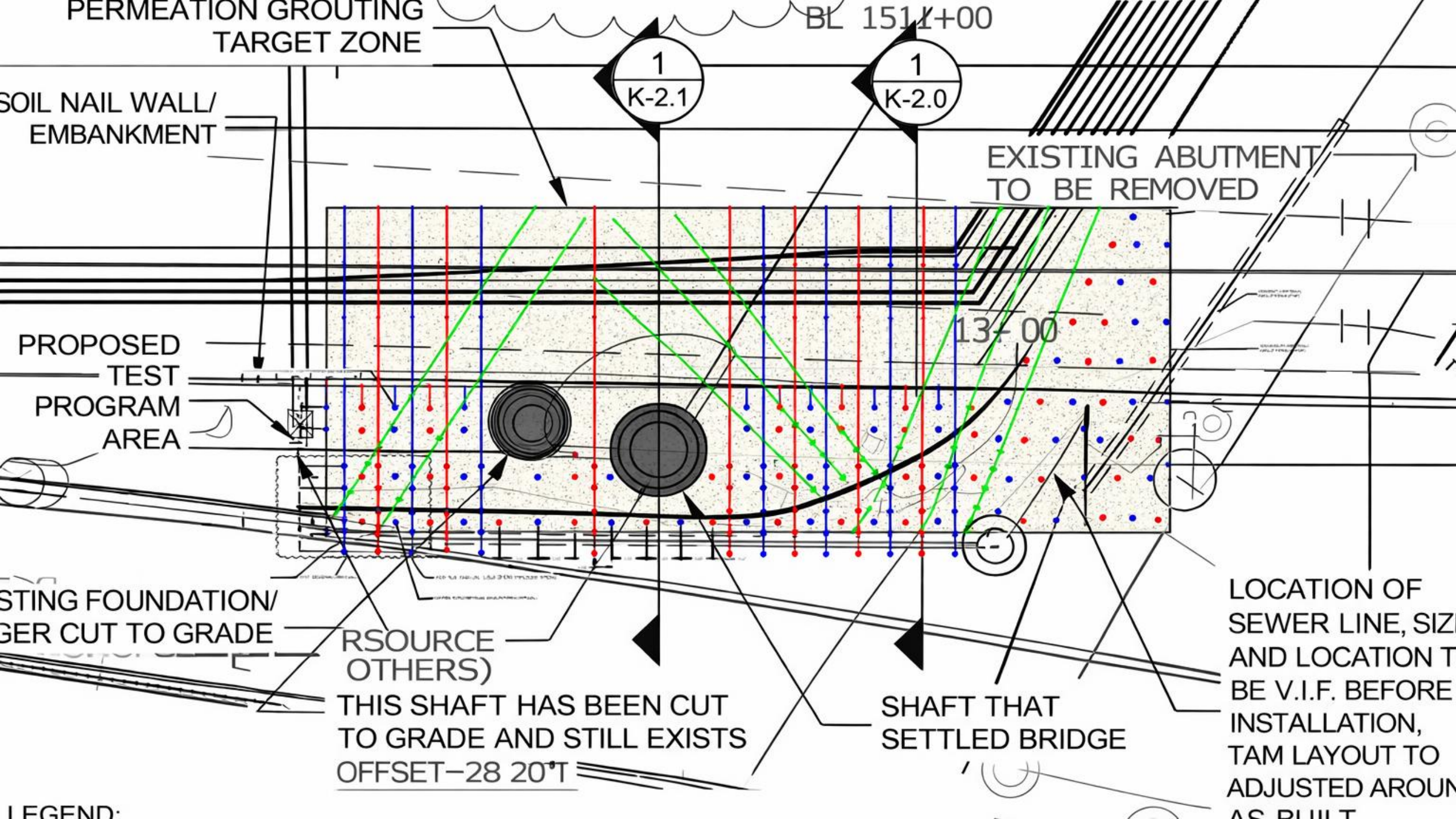


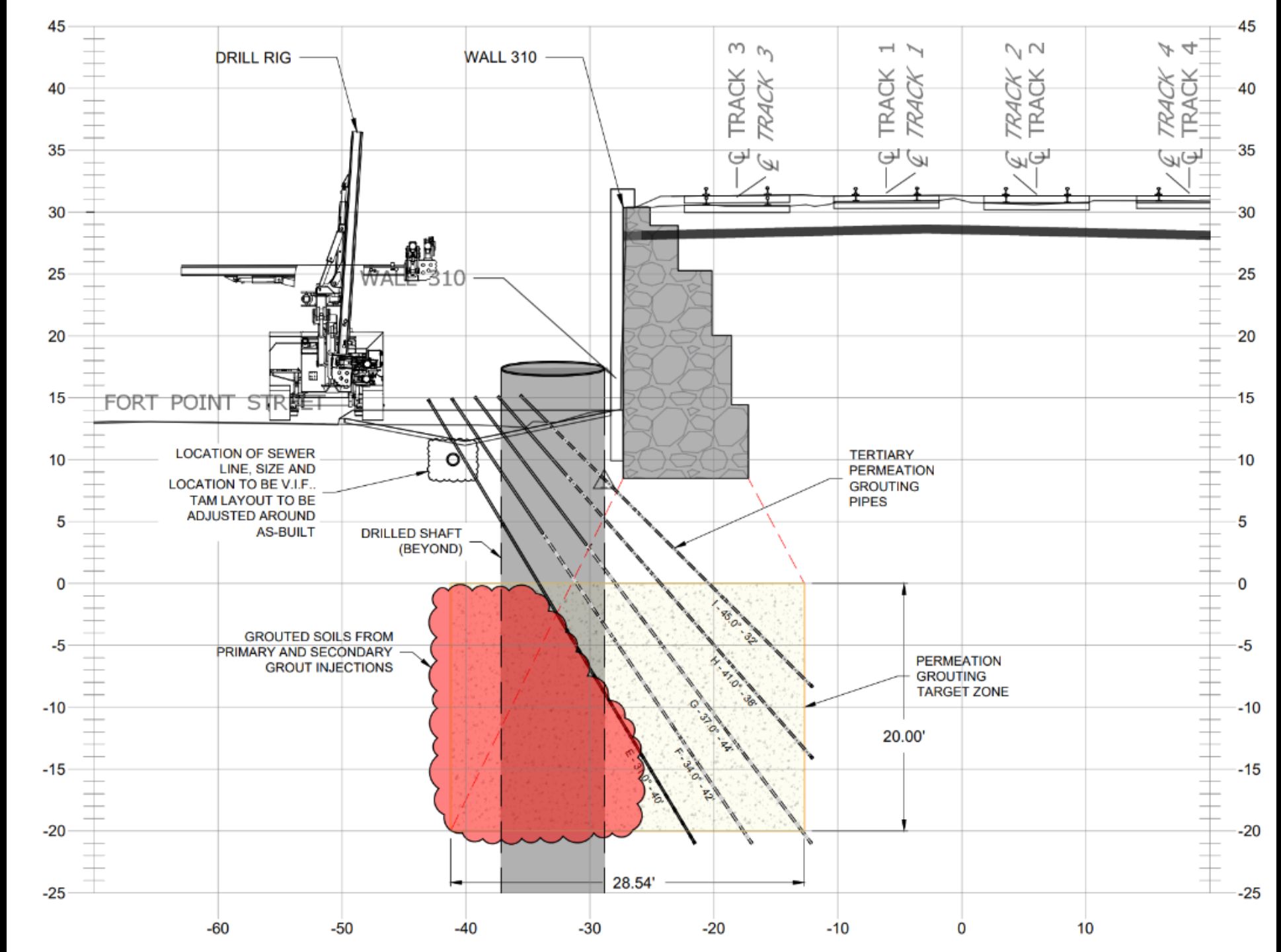
Photo Credit: geostabilization.com

- Stiffens soils by filling voids with low viscosity grout
- Transforms granular soils into sandstone-like mass
- Cost: $6M (Extra Work)
- Duration 4-6 Months

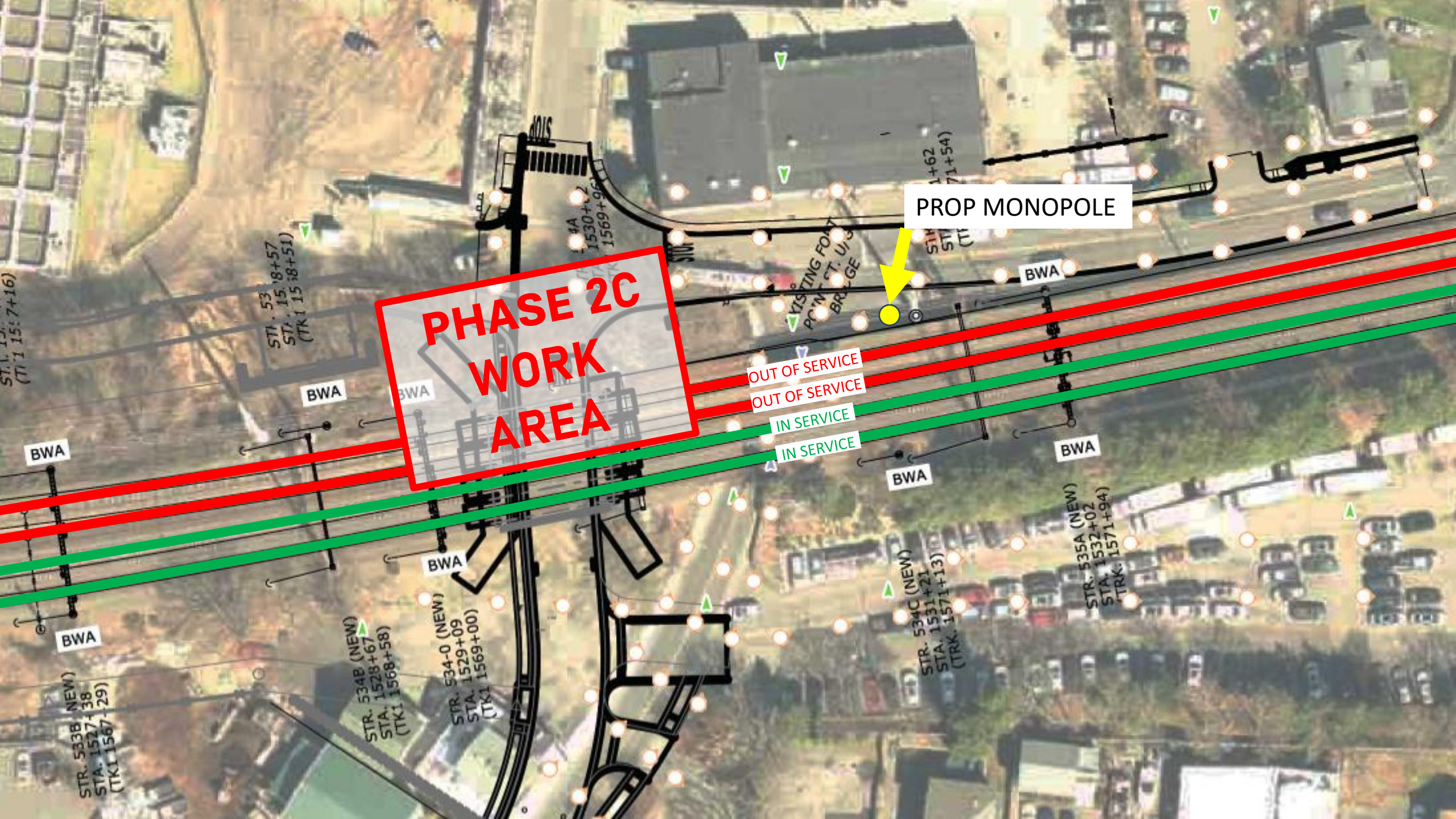

FPRW-3
FPRW-4
37 40 25 15
23 27 45 49
75 7780/3"
100/4"
100/4"
2 2 3 3
8 20 14 13
5 5 4 5
5 4 3 6
4 3 4 5
5 4 6 7
6 6 7 7
7 6 6 6
7 6 6 6
7 7 7 7
8 8 9 11
10 12 12 14
6 30 20 14
10 15 21 18
22 16 22 13
3 2 3 3
1 1 1 2
4 4 4 5
4 3 6 5
6 6 7 8
6 6 7 8
5 4 5 7
6 7 8 9
11 9 9 11
57 43 33
32 24 19 9
19 11 3150/2"
100/4"
100/5"
54 40 9150/1"
12+40
13+15
Limits of Improvement
20
0
-20
-40


TRACK 3
TRACK 3
TRACK 1
TRACK 1
TRACK 2
TRACK 2
TRACK 4
TRACK 4
WALL 310
Core depth at
soil nail 6-72
FORT POINT STREET
10'-6"
18'-6"
28'-6"
Limits of
Improvement
50
40
30
20
10
0
-10
-20
-30
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40


PERMEATION GROUTING
TARGET ZONE
BL 151+00
1
K-2.1
1
K-2.0
SOIL NAIL WALL/
EMBANKMENT
EXISTING ABUTMENT
TO BE REMOVED
13+00
PROPOSED
TEST
PROGRAM
AREA
STING FOUNDATION/
GER CUT TO GRADE
RSOURCE
OTHERS)
THIS SHAFT HAS BEEN CUT
TO GRADE AND STILL EXISTS
OFFSET=28 20'T
SHAFT THAT
SETTLED BRIDGE
LOCATION OF
SEWER LINE, SIZ
AND LOCATION T
BE V.I.F. BEFORE
INSTALLATION,
TAM LAYOUT TO
ADJUSTED AROUN
AS-BUILT
LEGEND:


DRILL RIG
WALL 310
TRACK 3
TRACK 3
TRACK 1
TRACK 1
TRACK 2
TRACK 2
TRACK 4
TRACK 4
WALL 310
FORT POINT STREET
LOCATION OF SEWER LINE, SIZE AND LOCATION TO BE V.I.F.. TAM LAYOUT TO BE ADJUSTED AROUND AS-BUILT
DRILLED SHAFT (BEYOND)
TERTIARY PERMEATION GROUTING PIPES
GROUTED SOILS FROM PRIMARY AND SECONDARY GROUT INJECTIONS
I - 45.0° - 32'
H - 41.0° - 36'
G - 37.0° - 44'
F - 34.0° - 42'
E - 30.0° - 40'
PERMEATION GROUTING TARGET ZONE
20.00'
28.54'
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-60
-50
-40
-30
-20
-10
0
10


Feb 11, 2026 at 5:29:58 PM
46° NE
Walk Bridge Program
Norwalk CT 06855
N
E
S
W


PROP MONOPOLE
PHASE 2C WORK AREA
OUT OF SERVICE
OUT OF SERVICE
IN SERVICE
IN SERVICE
BWA
BWA
BWA
BWA
BWA
BWA
STR. 534B (NEW) STA. 1528+67 (TK1 1568+58)
STR. 534-0 (NEW) STA. 1529+09 (TK1 1569+00)
STR. 534C (NEW) STA. 1531+21 (TRK. 1571+13)
STR. 535A (NEW) STA. 1532+02 (TRK. 1571+94)


~ 130 FT
PROP MONOPOLE


WATER
CTDOT

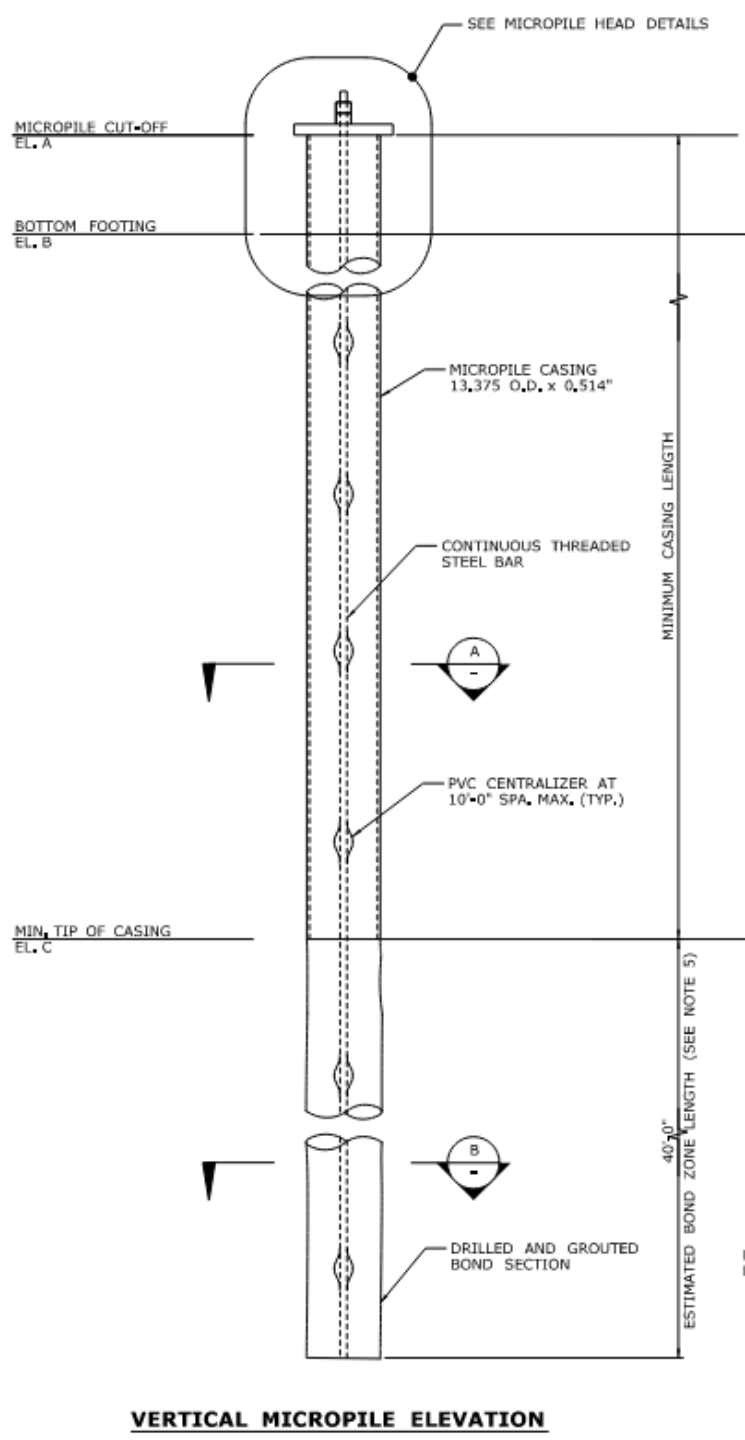

WATER


WATER

Permanent Micropile Installation

Issues Encountered

- Fines migration and material blowback during drilling
- Persistent accumulation of material at bottom of casing
- Ground loss & surface subsidence
- Excessive grout overruns
  - Up to 330% of theoretical volume irrespective of drilling method
- Irretrievable casing at many pile locations
- Measurable displacement of adjacent structures



VERTICAL MICROPILE ELEVATION

Permanent Micropile Installation

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- Ground loss & surface subsidence
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- **Irretrievable casing at many pile locations**
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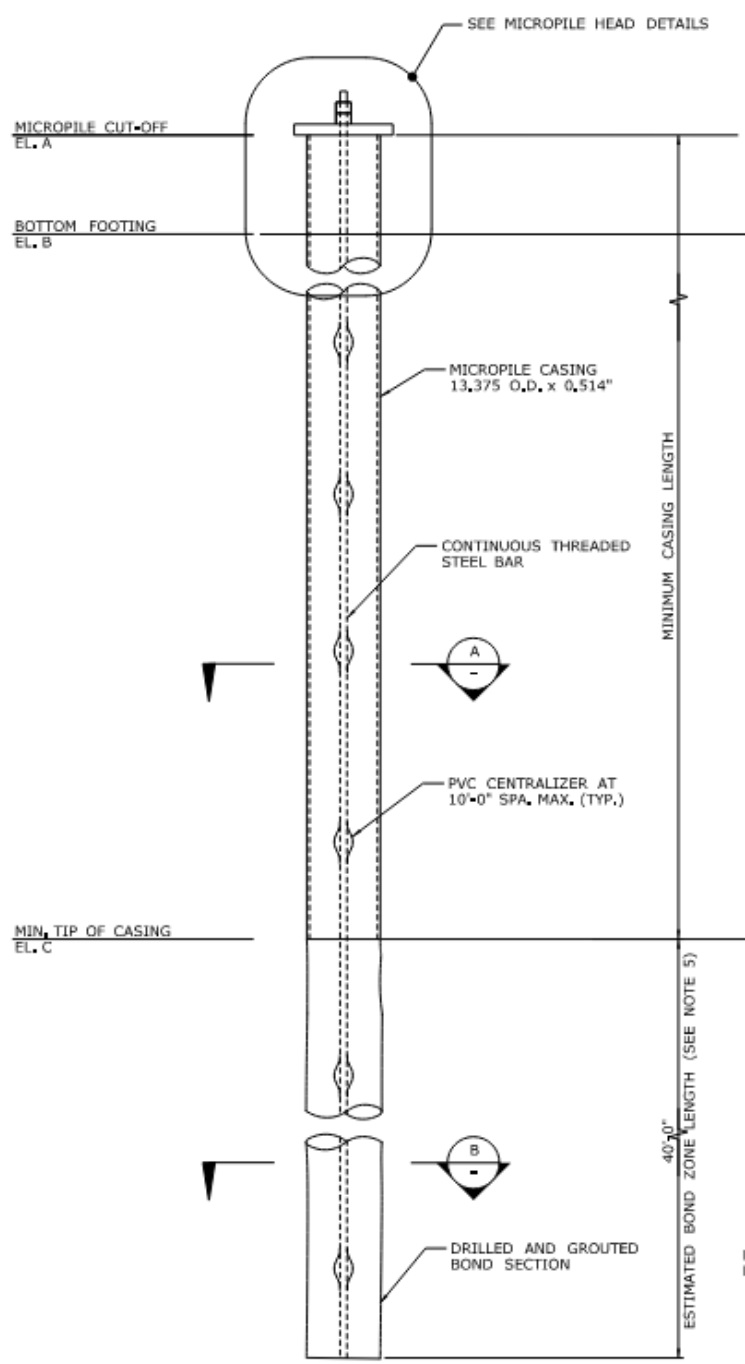

VERTICAL MICROPILE ELEVATION

Permanent Micropile Installation

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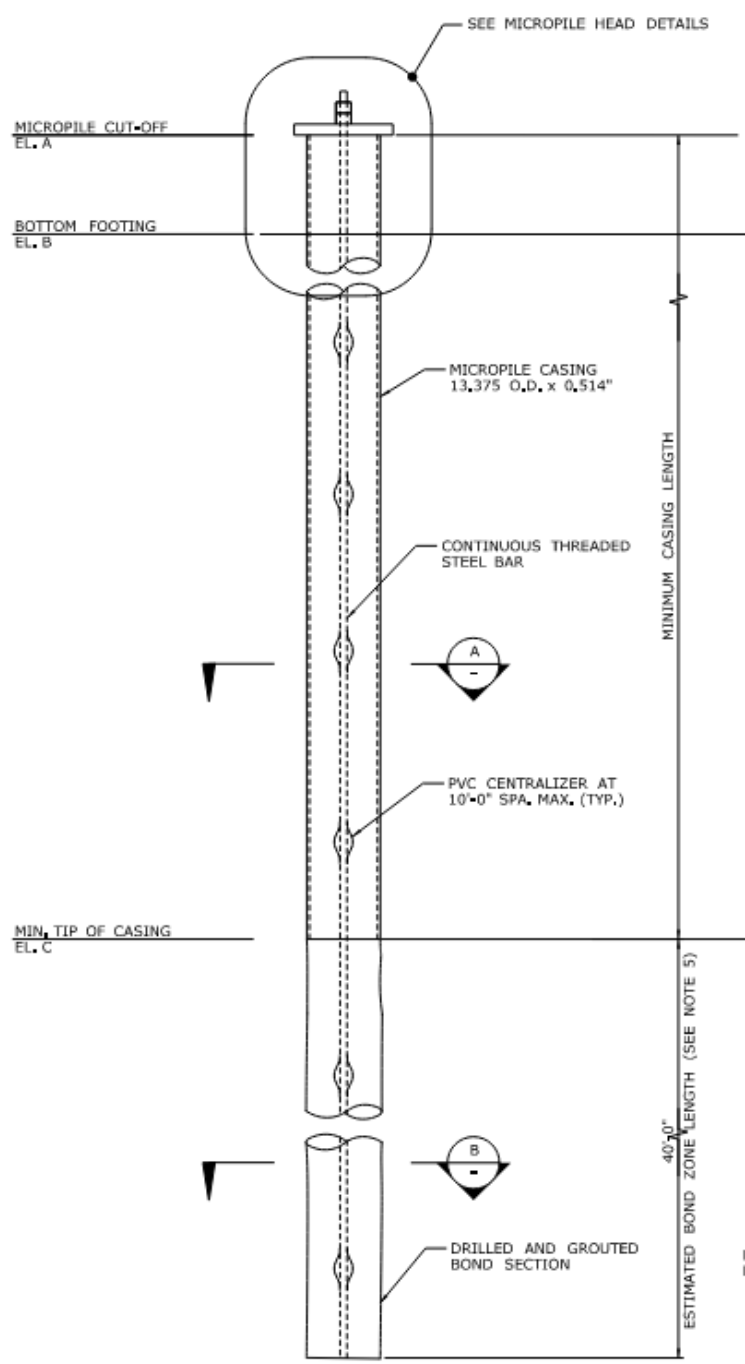
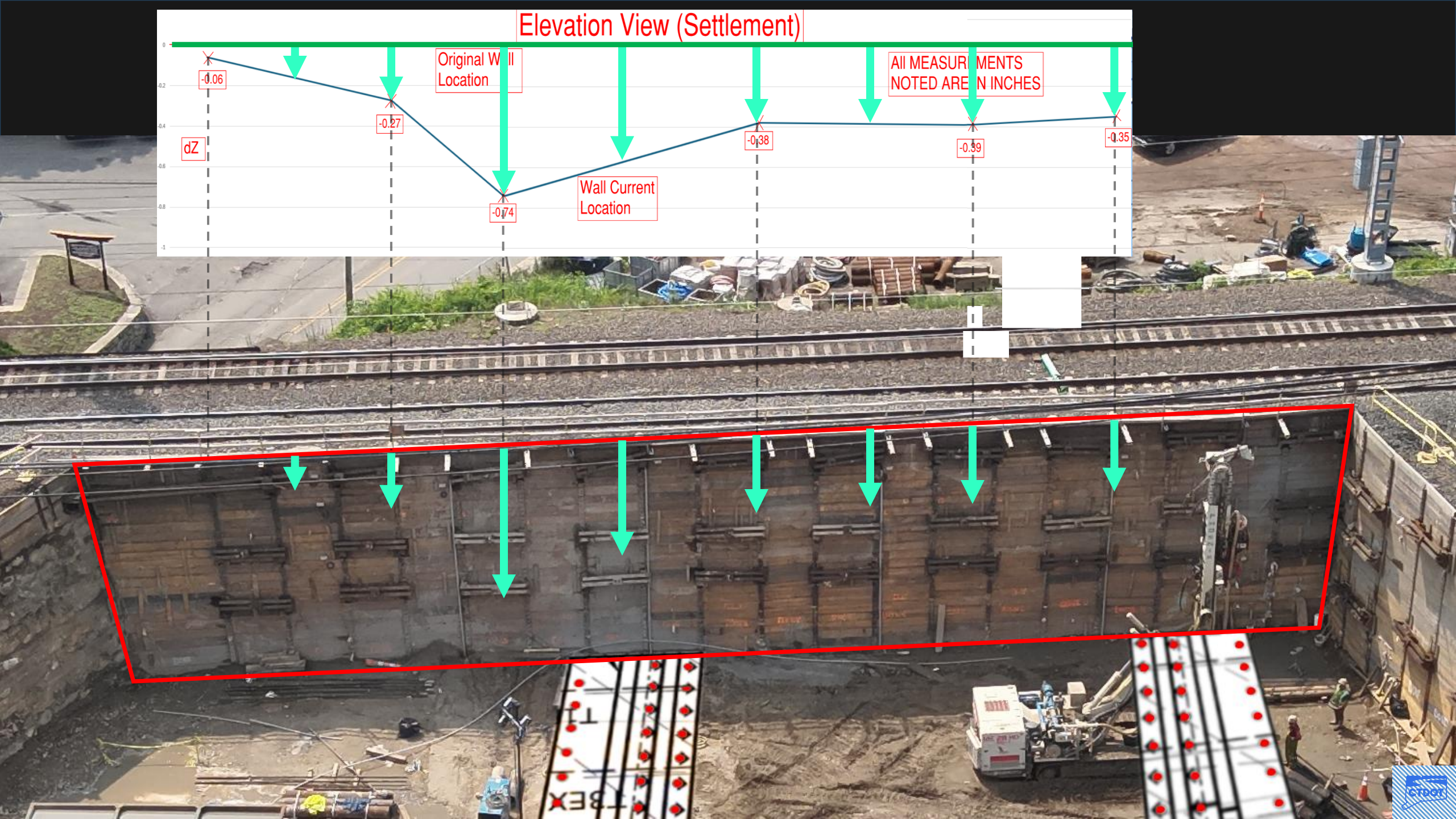
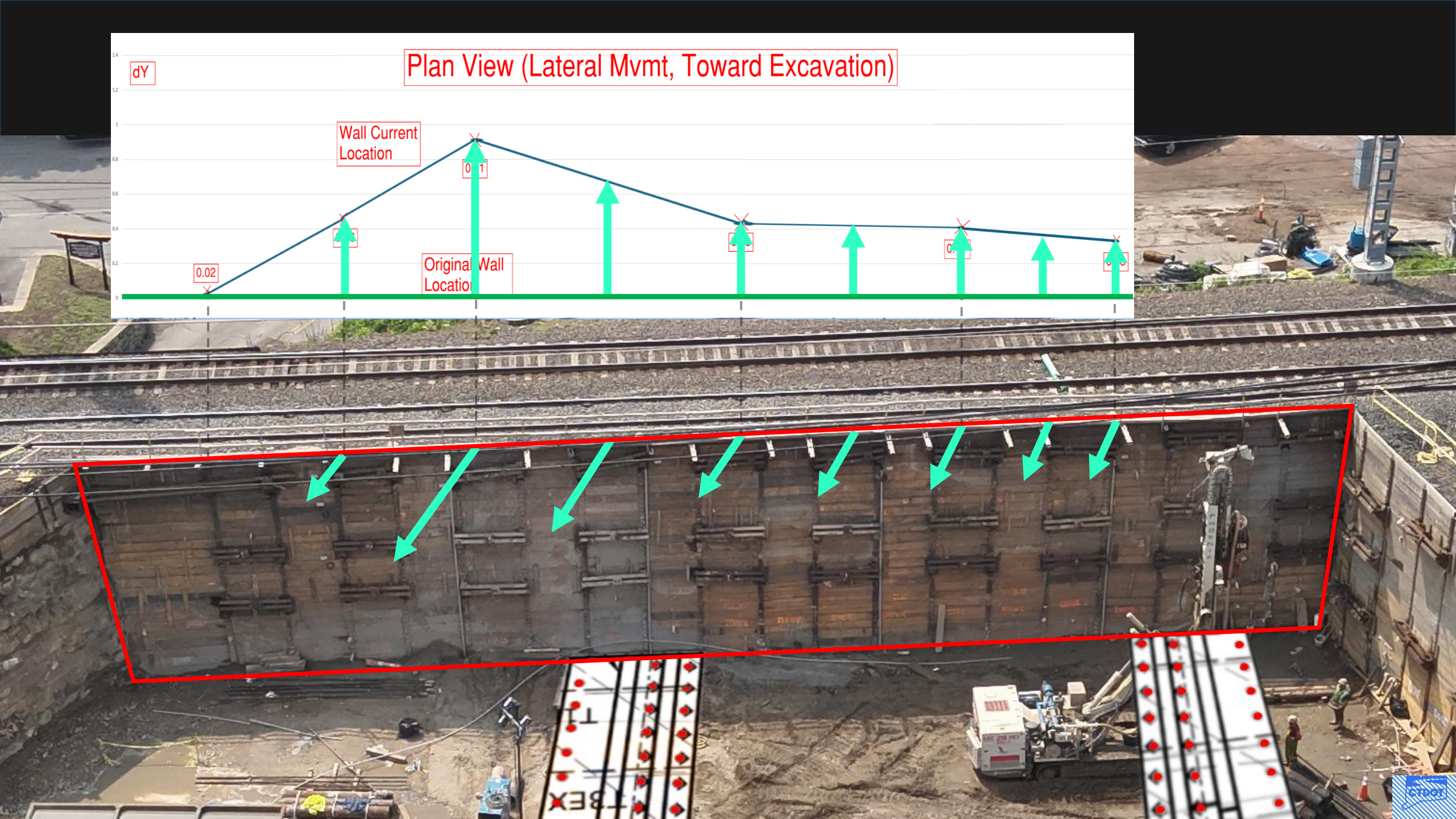
- Irretrievable casing at many pile locations
- **Measurable displacement of adjacent structures**

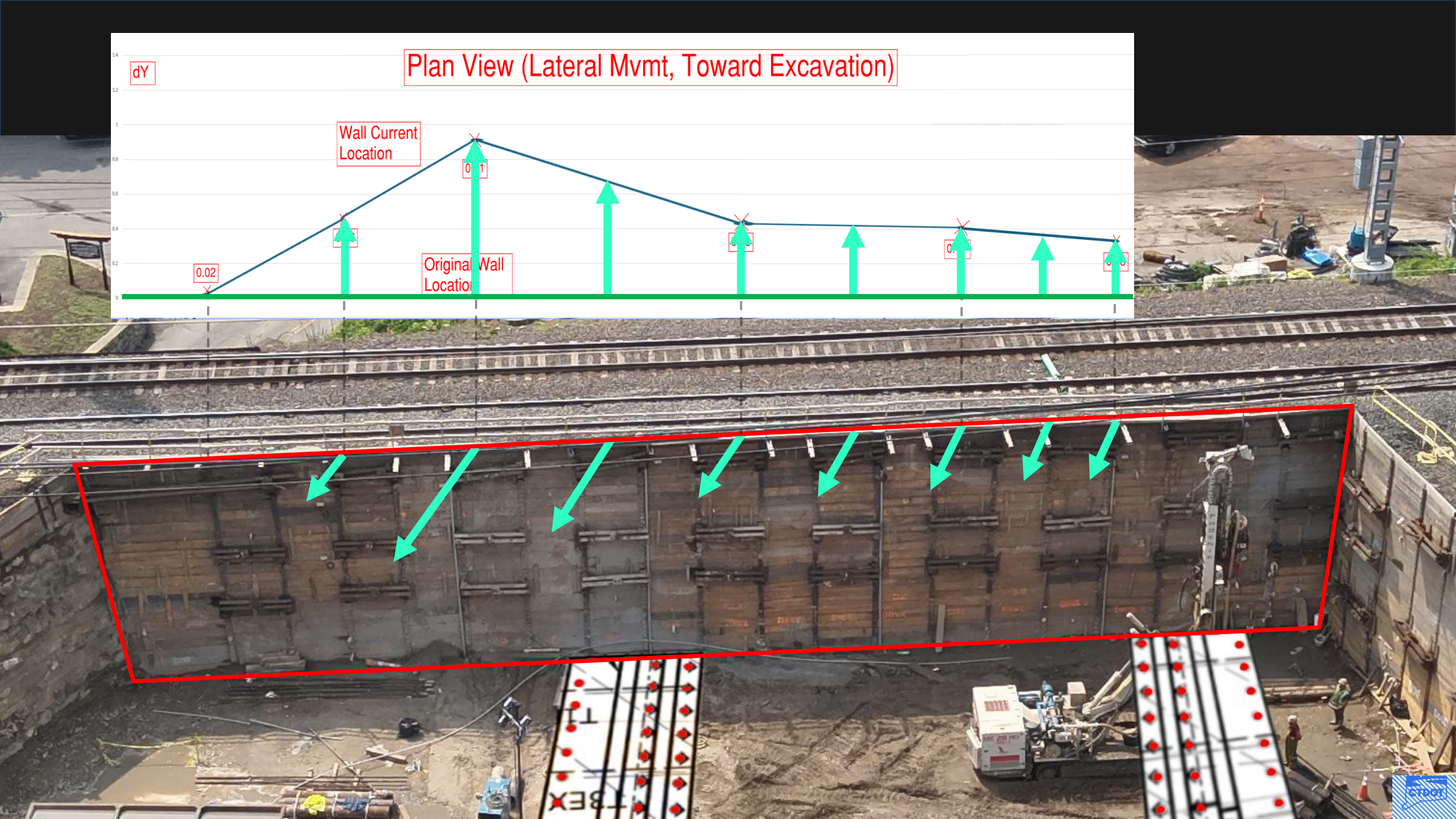


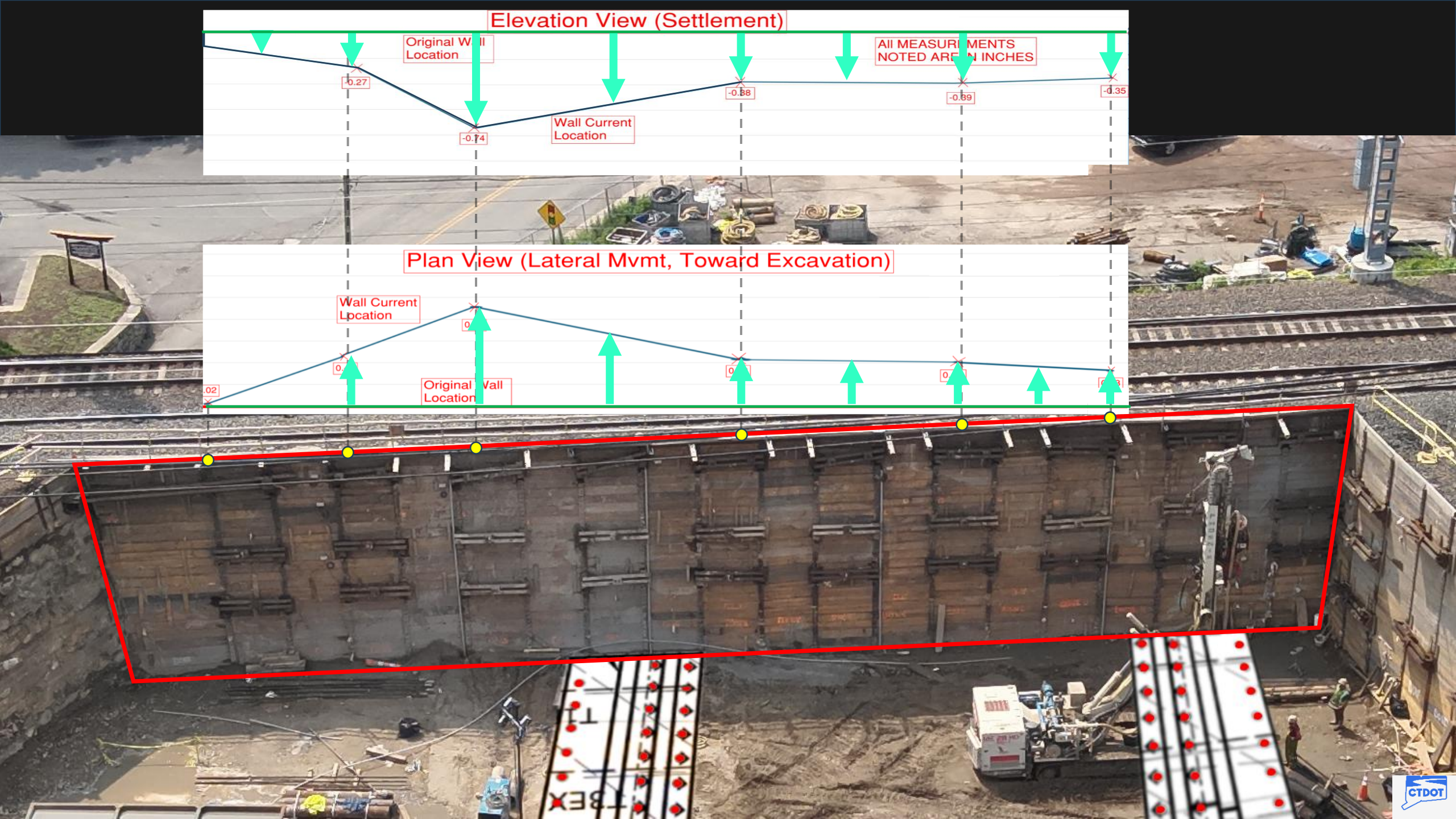
VERTICAL MICROPILE ELEVATION


WATER

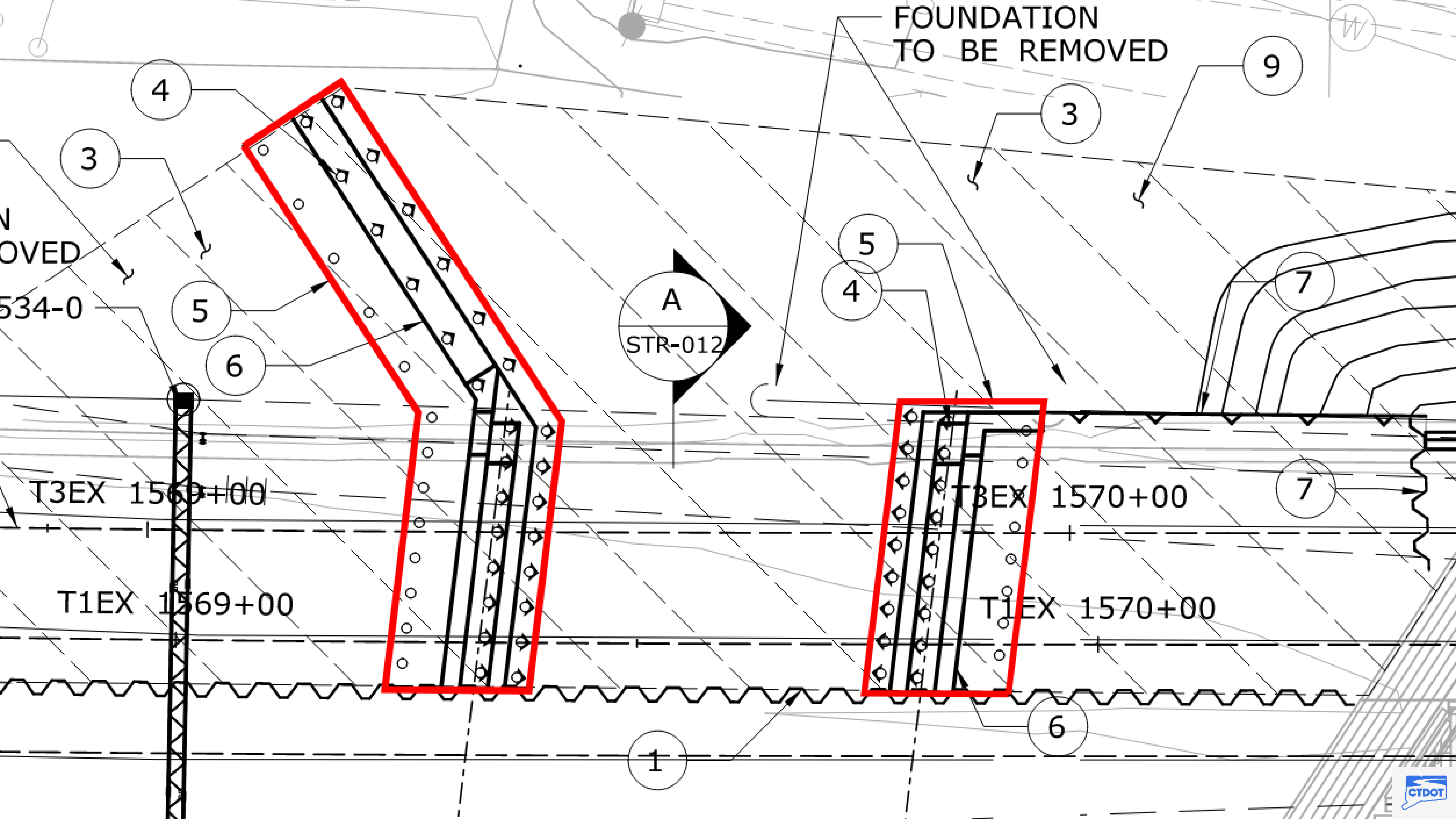

Elevation View (Settlement)
Original Wall Location
Wall Current Location
All MEASUREMENTS NOTED ARE IN INCHES
dZ
-0.06
-0.27
-0.74
-0.38
-0.39
-0.35


Plan View (Lateral Mvmt, Toward Excavation)
dY
Wall Current Location
Original Wall Location
0.02

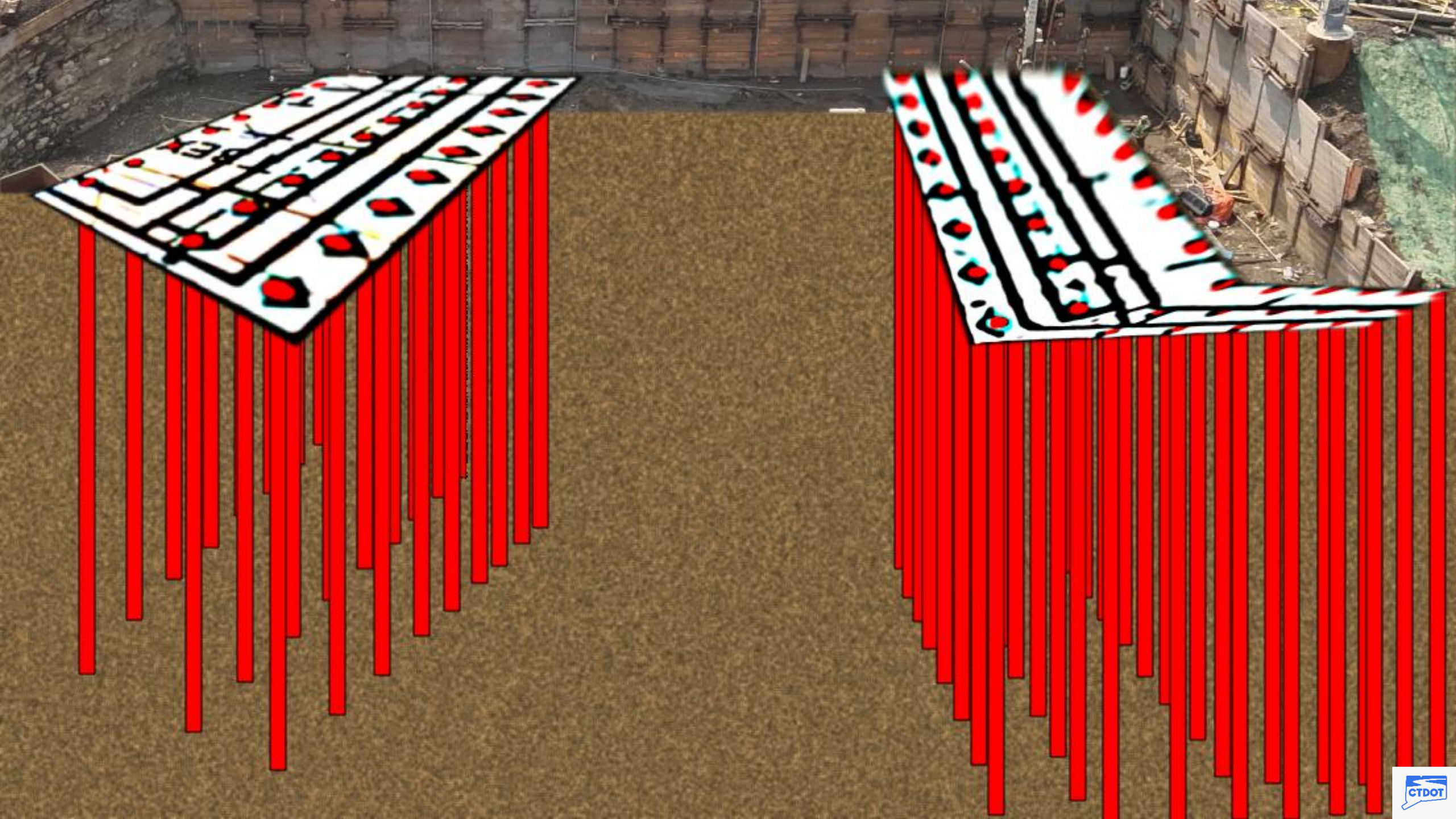

Plan View (Lateral Mvmt, Toward Excavation)
dY
Wall Current Location
Original Wall Location
0.02


Elevation View (Settlement)
Original Wall Location
All MEASUREMENTS NOTED ARE IN INCHES
-0.27
-0.74
-0.38
-0.89
-0.35
Wall Current Location
Plan View (Lateral Mvmt, Toward Excavation)
Wall Current Location
Original Wall Location
.02


WATER


FOUNDATION
TO BE REMOVED
9
3
4
3
N
OVED
534-0
5
6
A
STR-012
5
4
7
7
T3EX 1569+00
T1EX 1569+00
T3EX 1570+00
T1EX 1570+00
1
6
CTDOT


WATER



Future Phases – Planned Mitigations

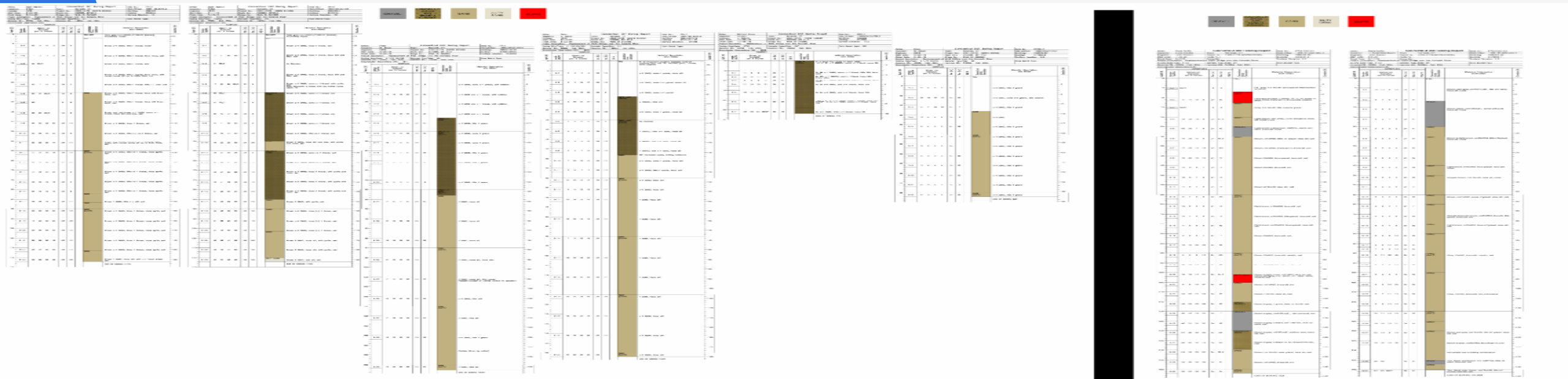
- Potential Modifications to Micropile Design
  - Cost-Schedule-Risk evaluation underway
  - Alternative designs based on Phase 2C constructability finding
- Enhancing next phase SOE to better tolerate the observed differential settlement and ground loss

	Alternate 1 – Per Contract	Alternate 2	Alternate 3
Pile Type	13.375" OD x 0.514" Micropile, Bonded in Soil	10.75" OD x 0.5" Micropile, Bonded in **Soil**	10.75" OD x 0.5" Micropile, Bonded in **Rock**
Benefit	Per design and original contract; successful for Stage 1 in 85% of cases, contingencies prepared for rest	Reduced pile size overall; reduced torque requirement, lower risk of lock-up during retraction	Reduced pile size overall; drilled to rock, no need to retract
Inner Casing Size / Length	None	7" OD x 0.5", 20' Long	7" OD x 0.5", 20' Long
Cut-Off Elev.	7.55'	7.55'	7.55'
Tip of Casing Elev (West/East)	-53'	-53'	-155'
Outer Casing Length	60.55'	60.55'	162.55'
Inner Casing Length	-	20'	20'
Est. Bond Length	40'	49'	10'
Contingency 1	Outer casing locks up in soil, cannot be retracted		
Potential Solution	As in Stage 1: Advance 9.625" x 0.545" inner casing below outer casing to bond in soil	Advance 7" inner casing to bond in rock	N/A, casing advanced to rock, no retraction
Outer Casing Length	Up to 100.55'	Up to 109.55'	162.55'
Inner Casing Length	Up to 100.55'	162.55'	20'
Est. Bond Length	56'	10'	10'
Contingency 2	Inner casing locks up when drilling Contingency 1, can't be retracted		
Potential Solution	As in Stage 1: Advance micropile to 8" Dia. bond in rock; Casing already near top of rock	N/A, casing already advanced to rock, no retraction	N/A, casing already advanced to rock, no retraction
Outer Casing Length	Up to 100.55'	Up to 109.55'	162.55'
Inner Casing Length	Up to 162.55'	162.55'	20'
Est. Bond Length	10'	10'	10'

Differing Site Condition Review

What We Verified

- Results consistent with baseline: no material change in stratigraphy (within expected variability)



Differing Site Condition Review

Why It Was Not Reasonably Encounterable

- Contract documents suggested conditions were within expected means/methods

Questions?