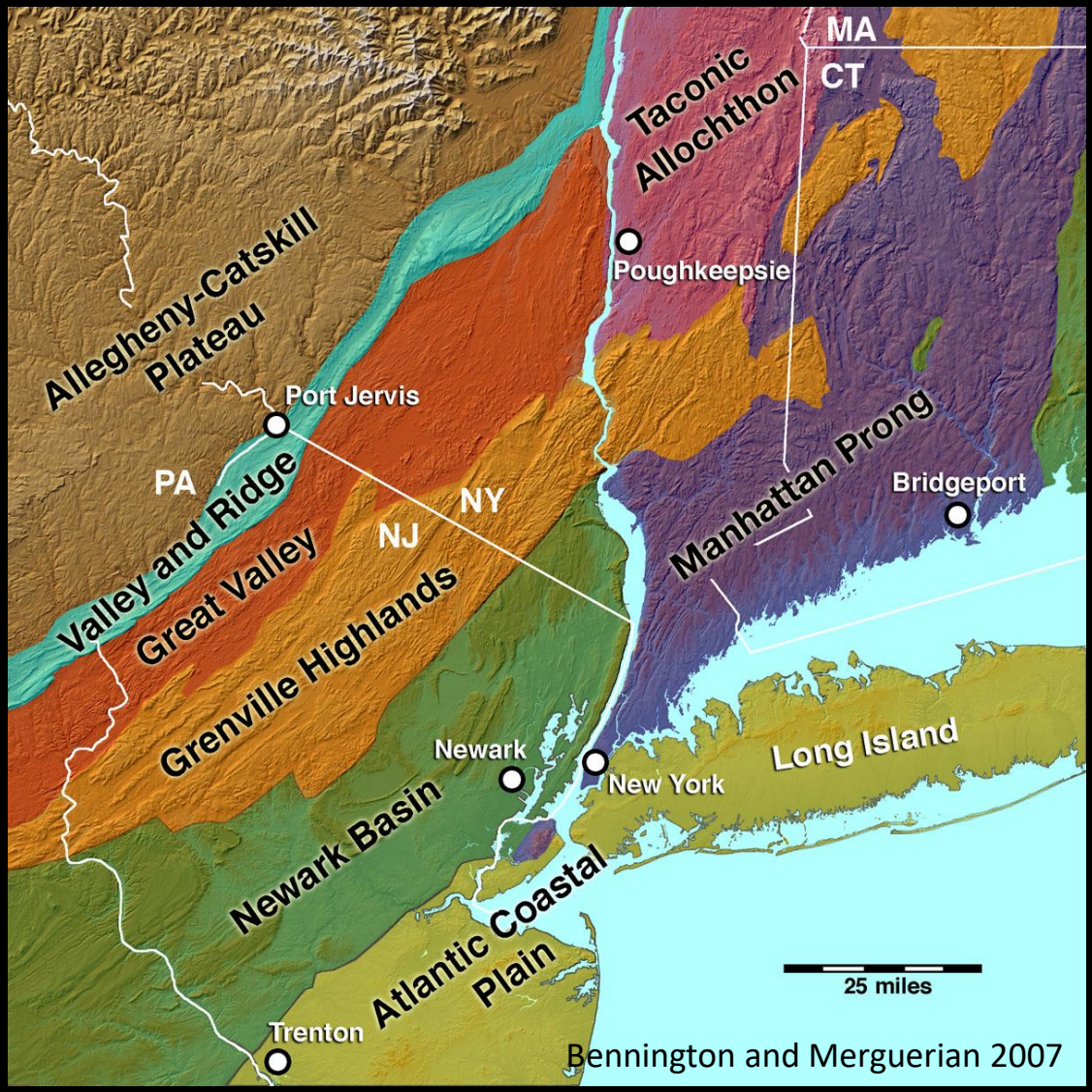
Geological Solutions for Providing a Scientific Basis for Differing Site Condition Claims (DSC)

Charles Merguerian
Mickey Merguerian*
Dukelabs
Stone Ridge, NY

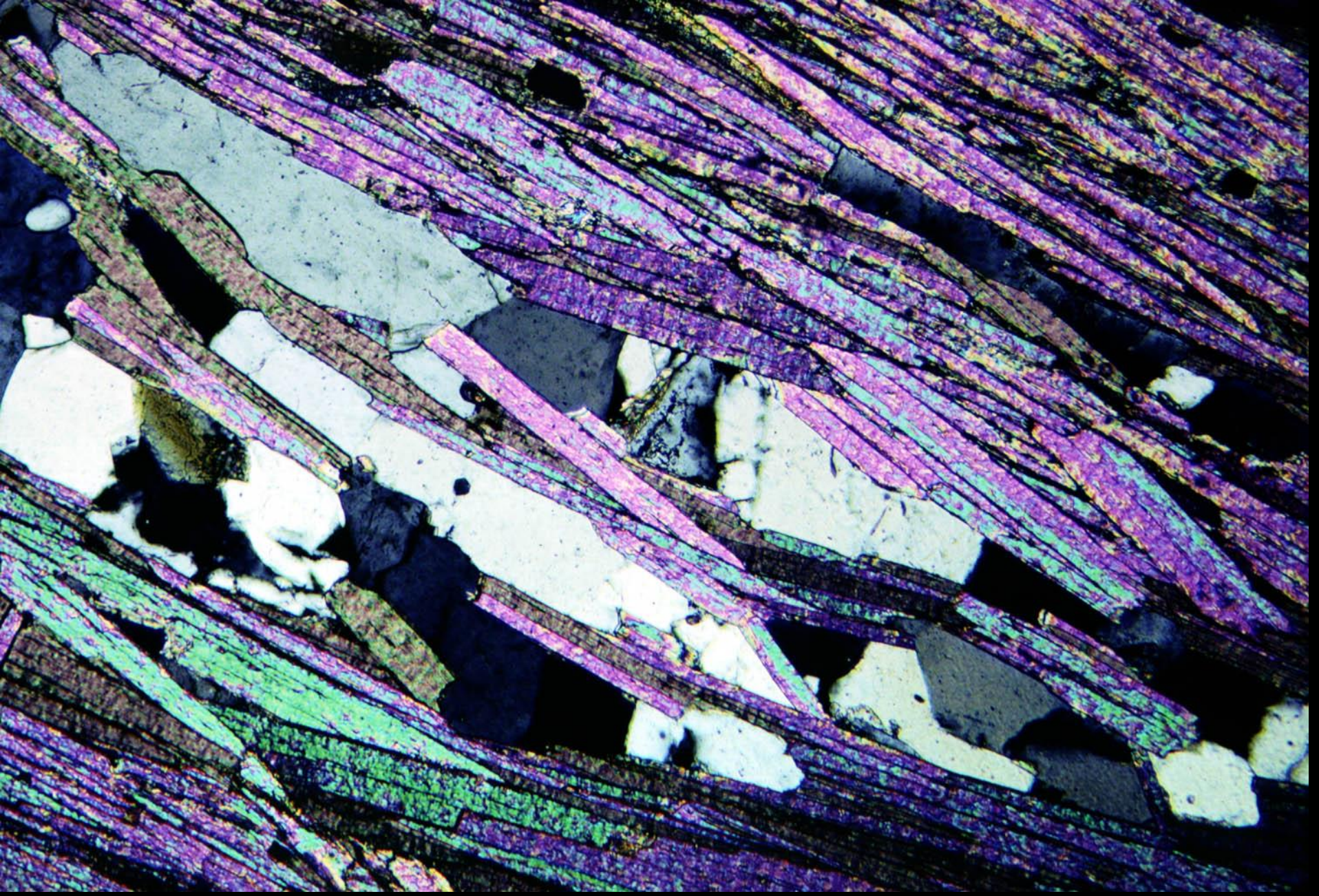
DUKE

Stonybrook 29th
Metro NY Conference
09 April 2022

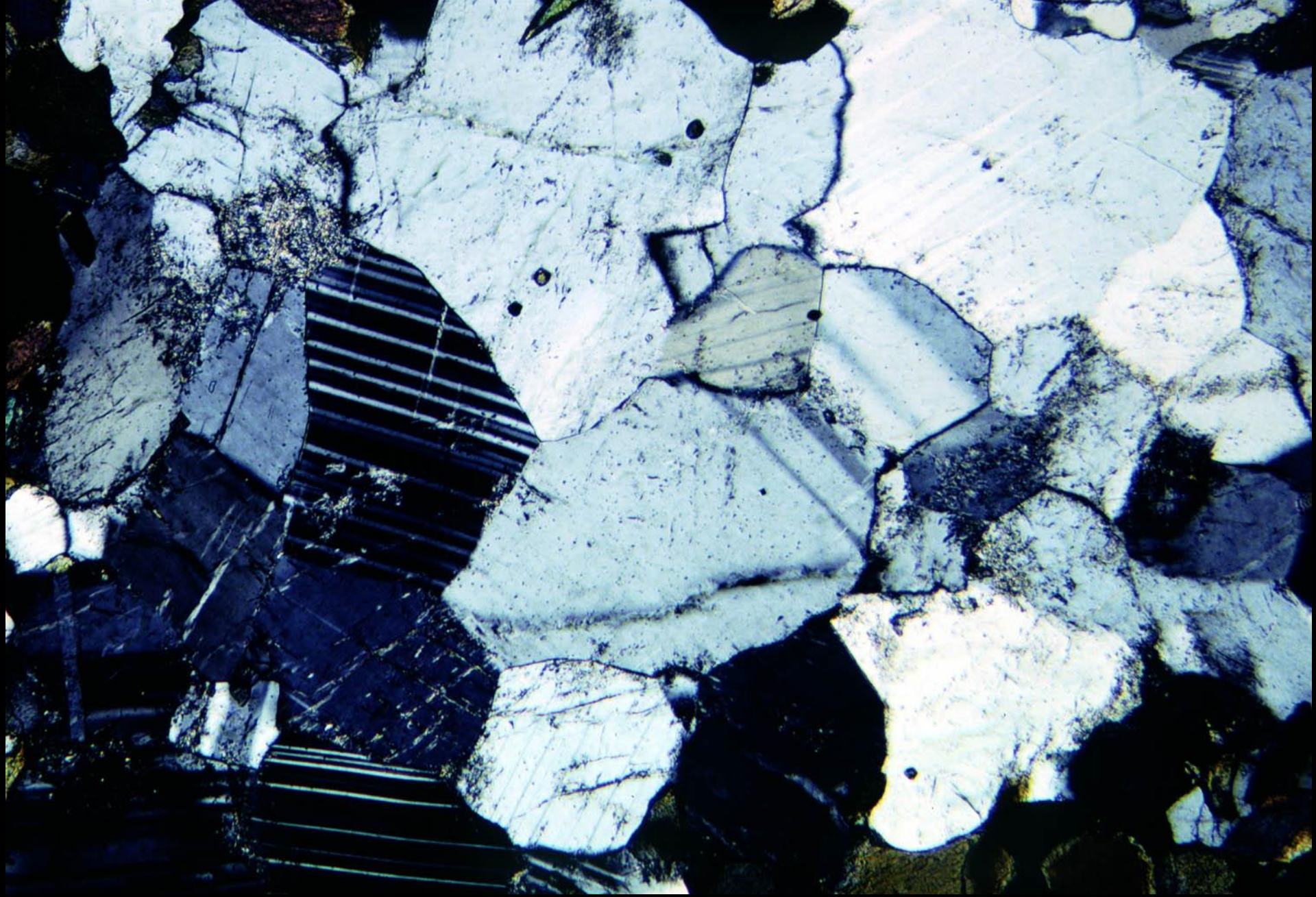



TBM Tunnel

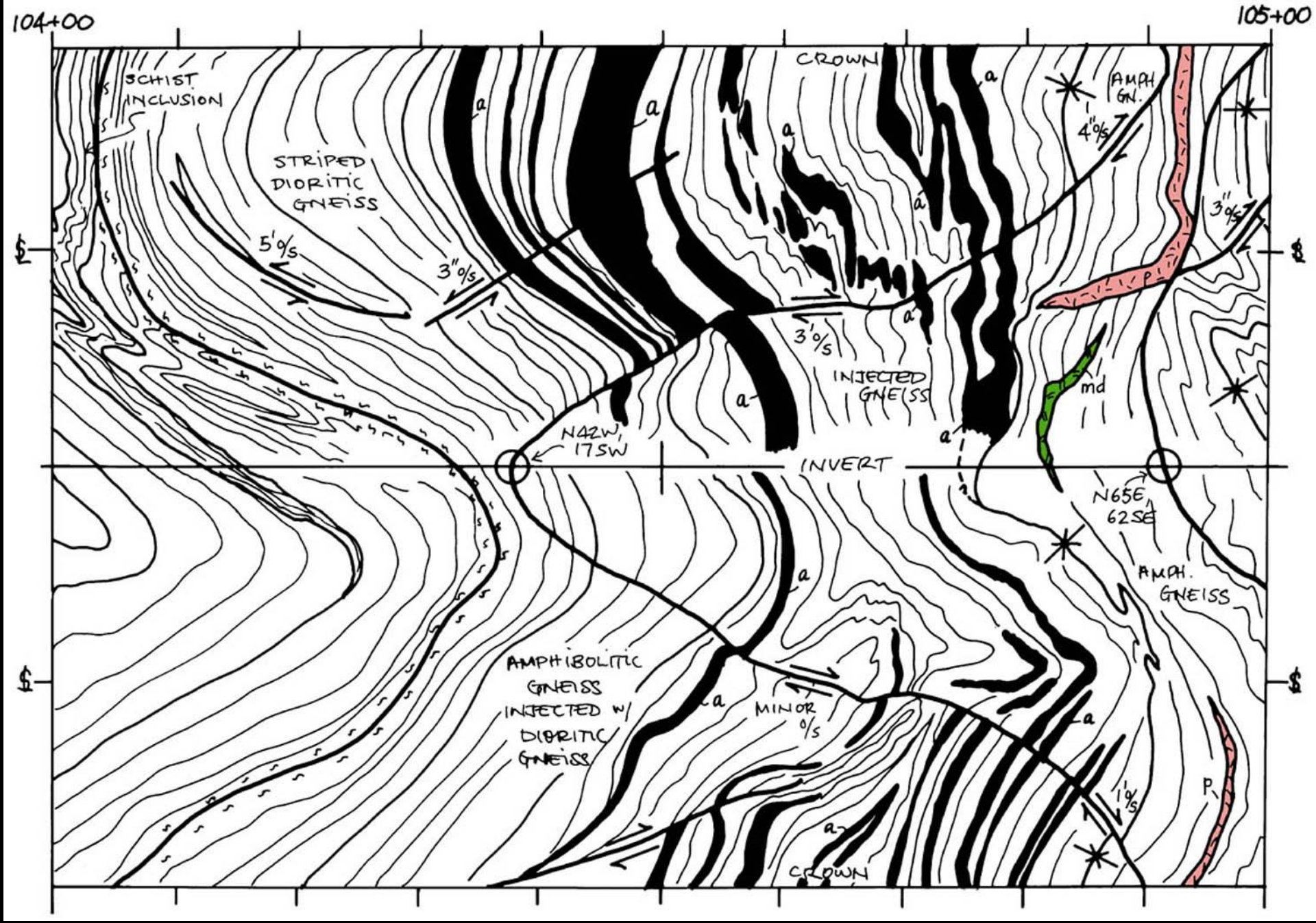
Foliated Textures Anticipated in Well-Layered Hartland Formation



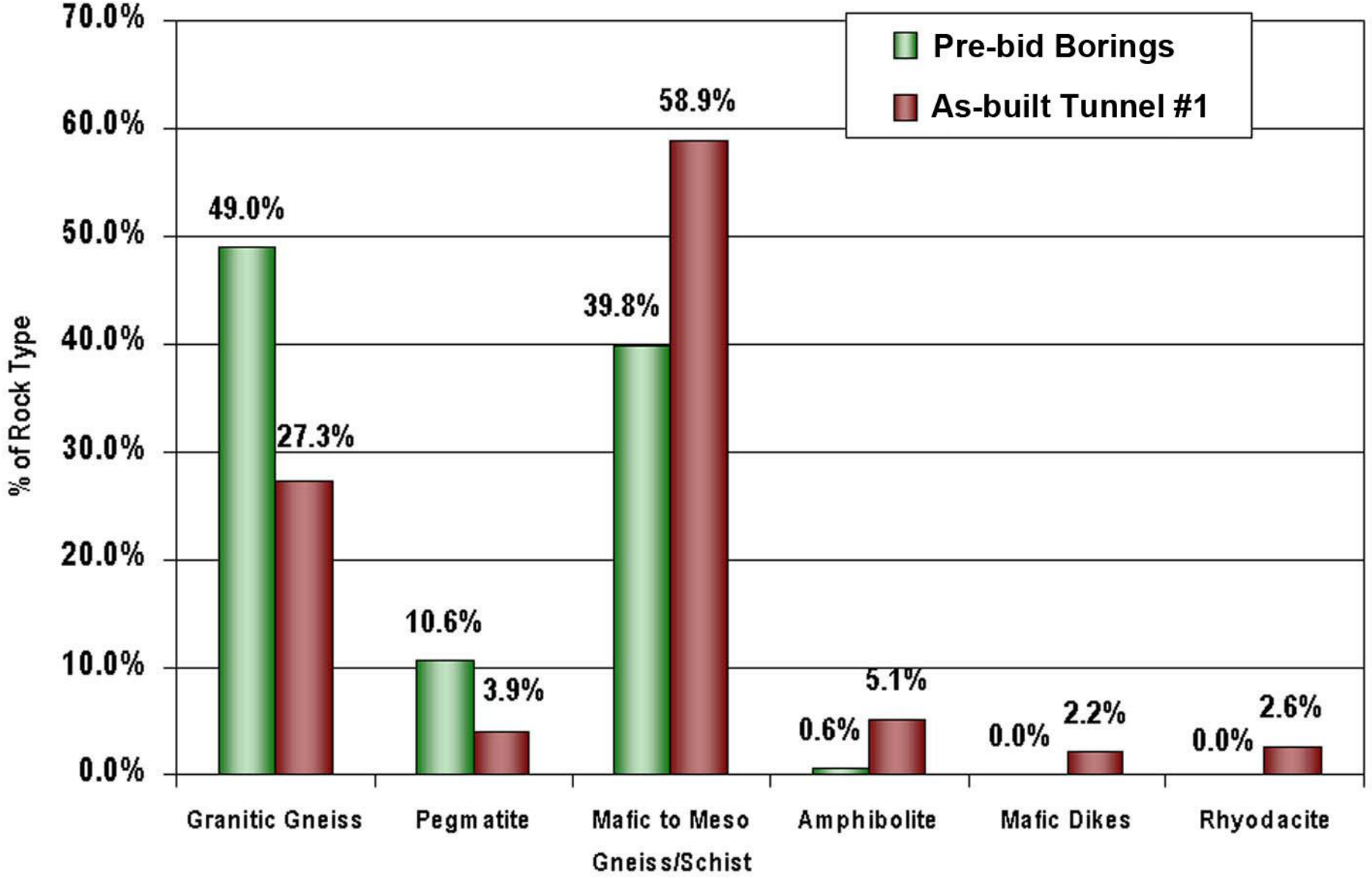
Foliated Textures Anticipated



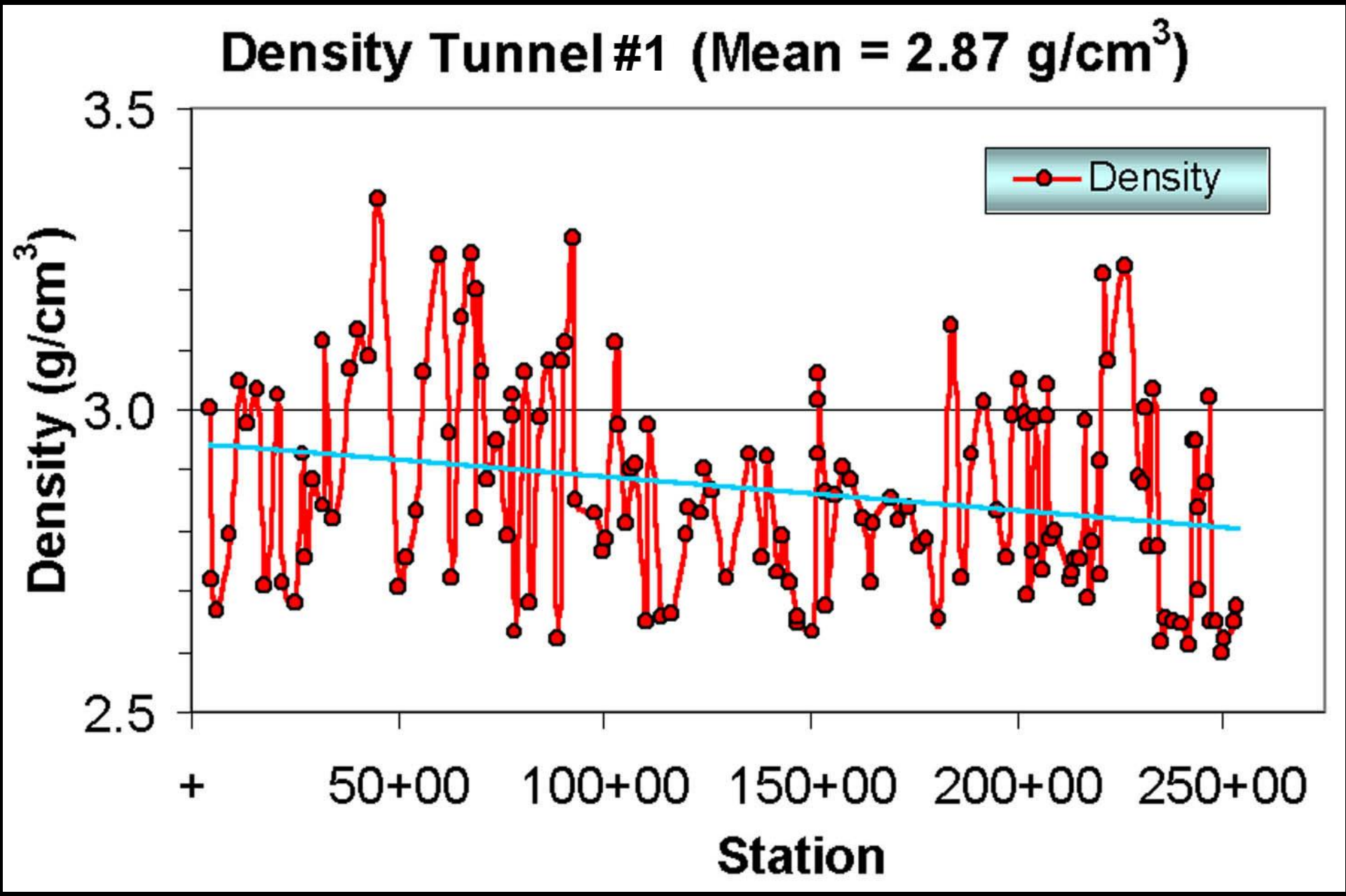
Tough, Granoblastic Textures Encountered



1" = 10' Mapping Program 1997-1999



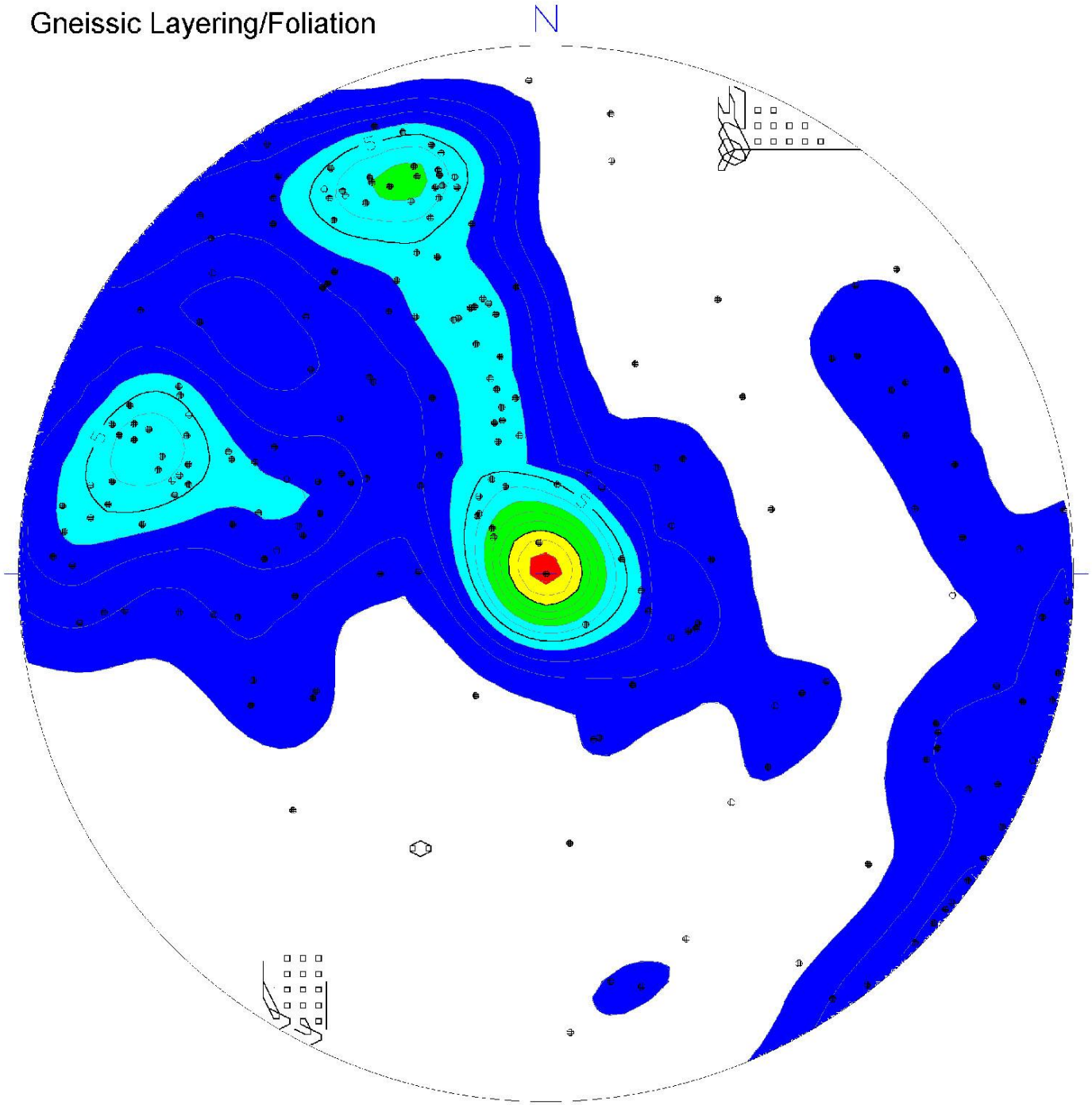
Incorrect Pre-Bid Lithotype Anticipation from Tunnel-Horizon Borings

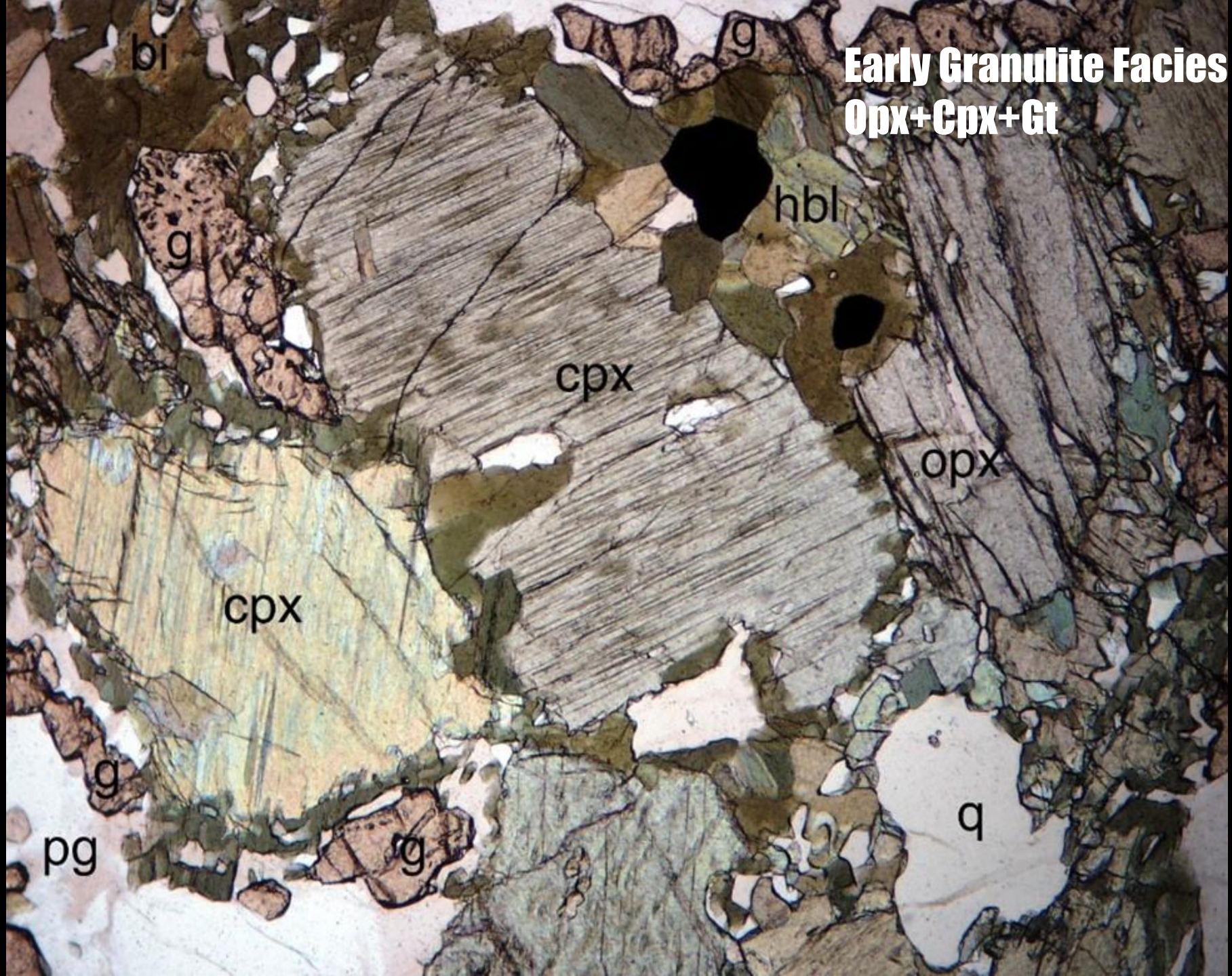


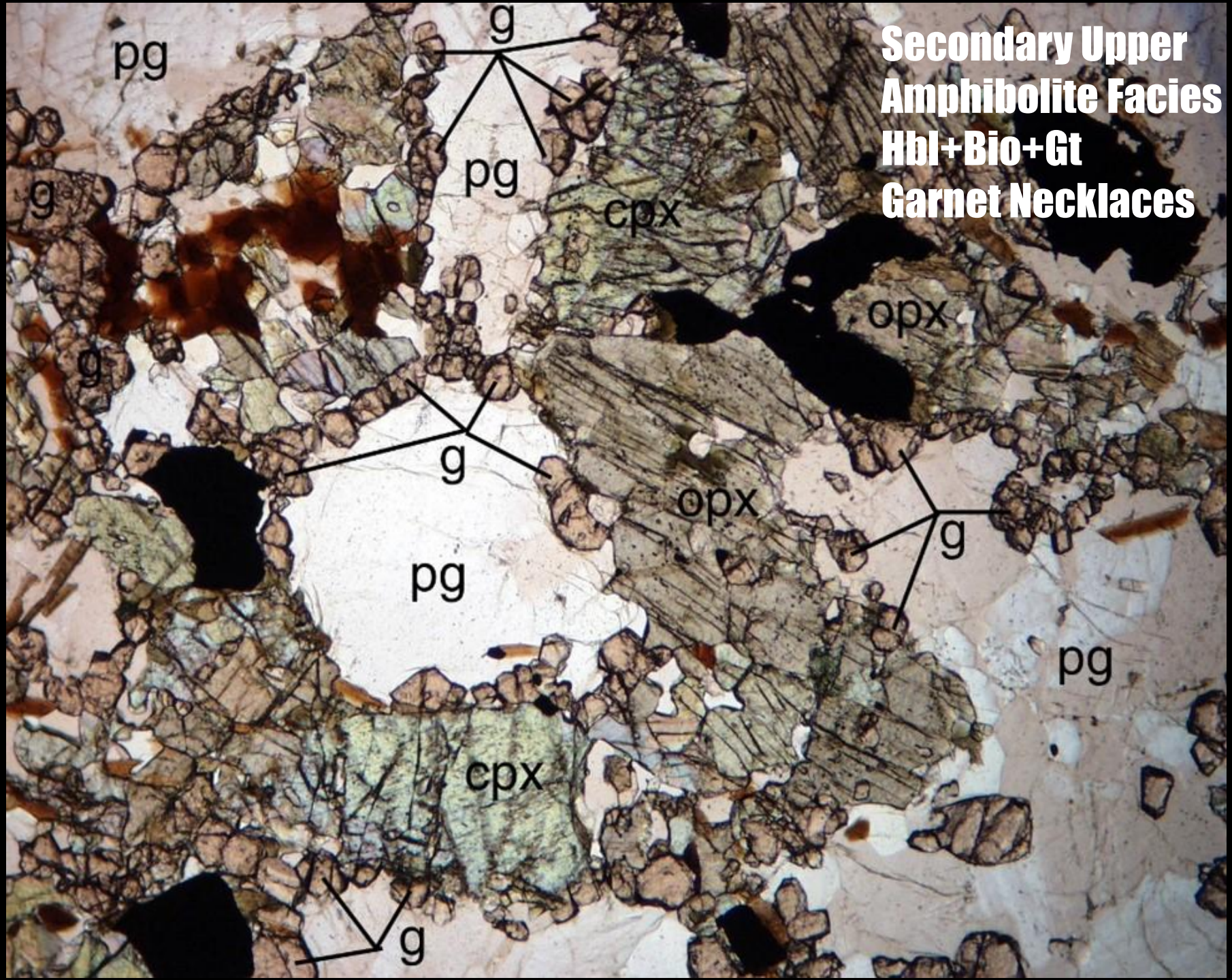
Density Analysis >> Anticipation (~2.5-2.6)

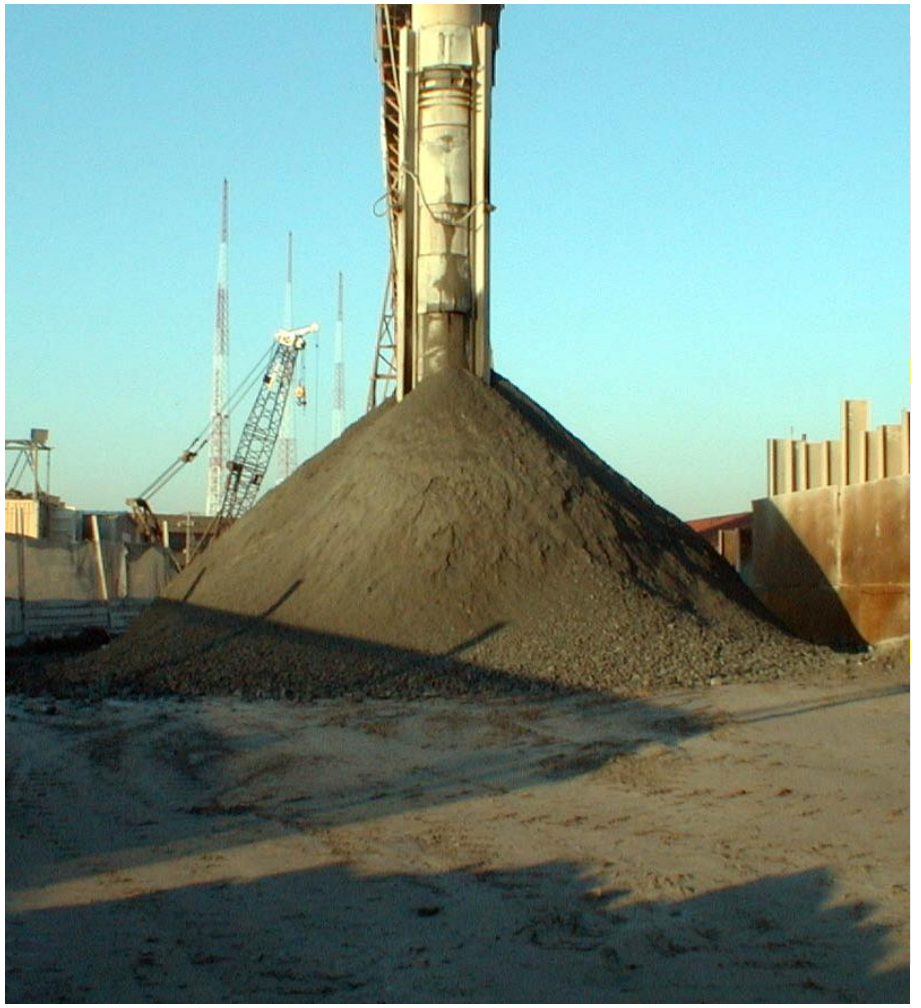
Pre-bid Data = NE-trending Steep SE Dip of Foliation
Very Favorable Tunnel Drive Orientation!!

Instead:
11% ~ 0°
27% <30°
38% Gentle Dips
Very Unfavorable TBM Tunnel Drive Orientation!!




Early Granulite Facies
Opx+Cpx+Gt
bi
g
g
hbl
cpx
opx
cpx
g
pg
g
q


Secondary Upper Amphibolite Facies
Hbl+Bio+Gt Garnet Necklaces
pg
g
pg
g
cpx
opx
g
g
opx
g
pg
pg
cpx
g



~11% of Tunnel up to 50% Garnet in 32 Zones (Ore Deposit!!)

Abrasive, Tough Granoblastic Rock Mass = Low Penetration Rate of <6'/hour vs. 9'/hour Anticipated and Excessive Fines

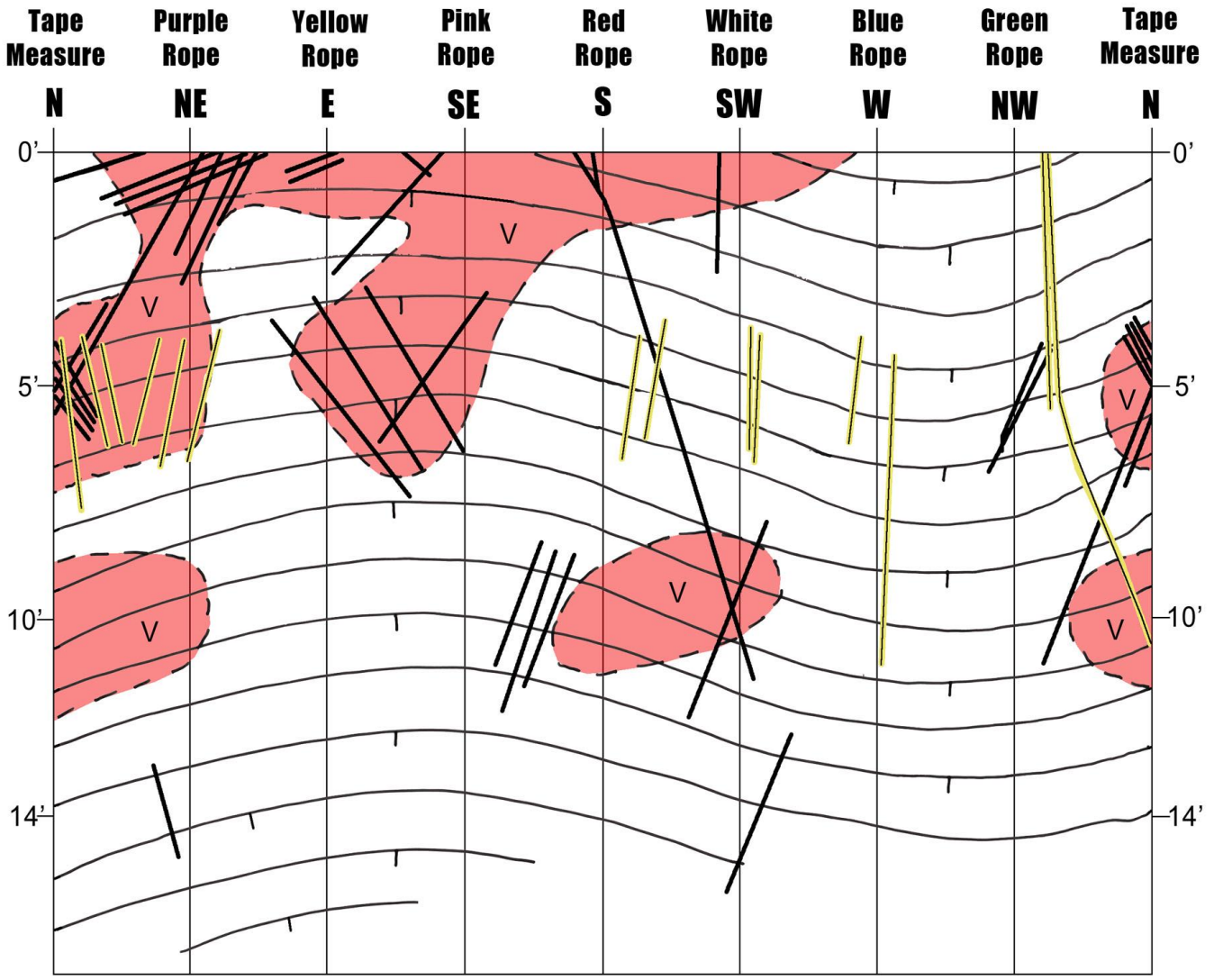
Subaqueous Bridge Shafts


Passaic Fm Sandstone
Water, Blocks and Aquatic Life = Hydrologic Connectivity with River

Video Mapping System

2-D Map From Videos

CIRCUMFERENTIAL MAP - SHAFT 23 ROCK SOCKET PASSAIC RIVER BRIDGE



EXPLANATION

Bedding Planes

Fractures

Fractures with Calcite

V Voids Outlined by Intersecting Fractures

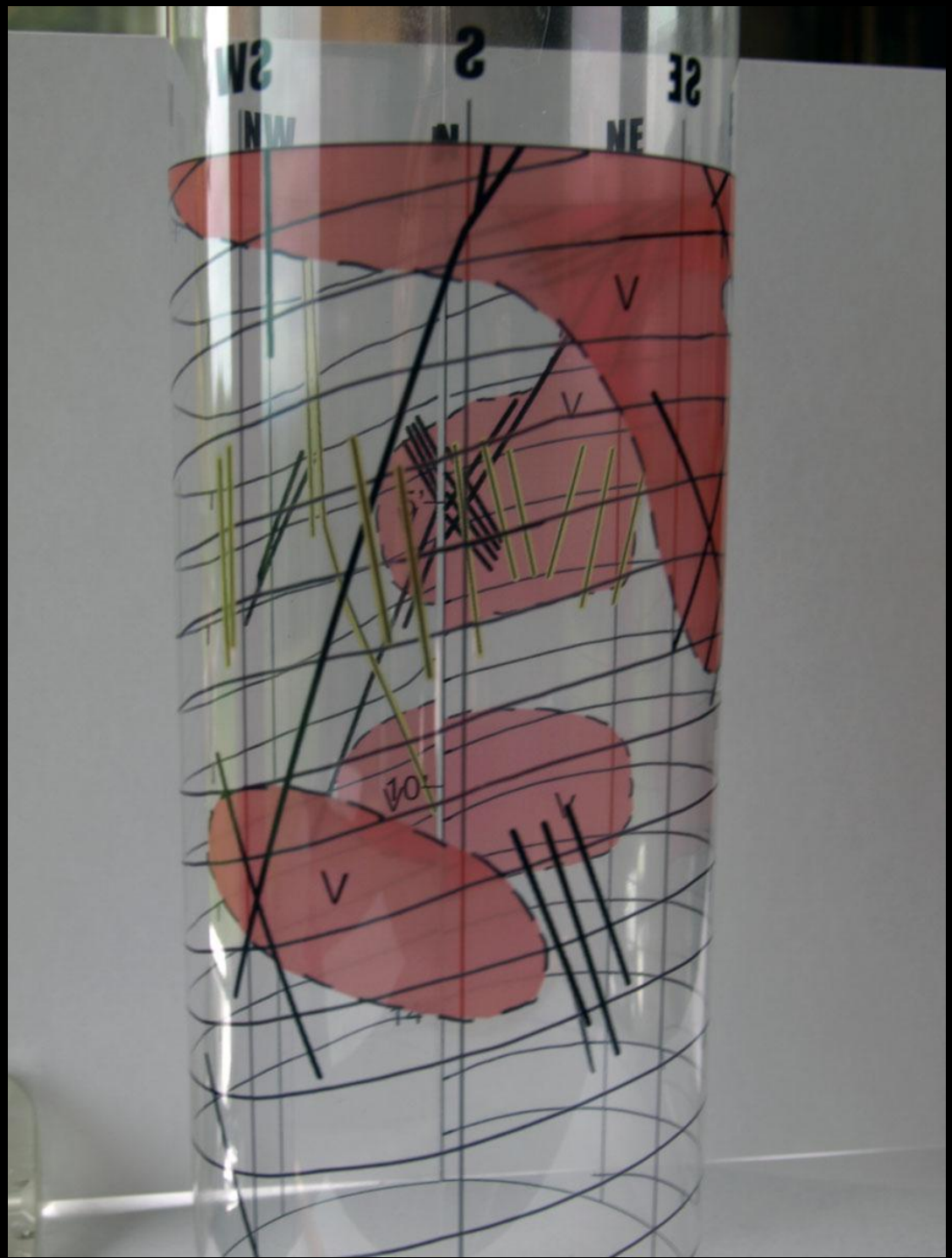
Geology Mapped By C. Merguerian
From 22 July 2013 Video Calibrated
with Tape Measure and Oriented Rope

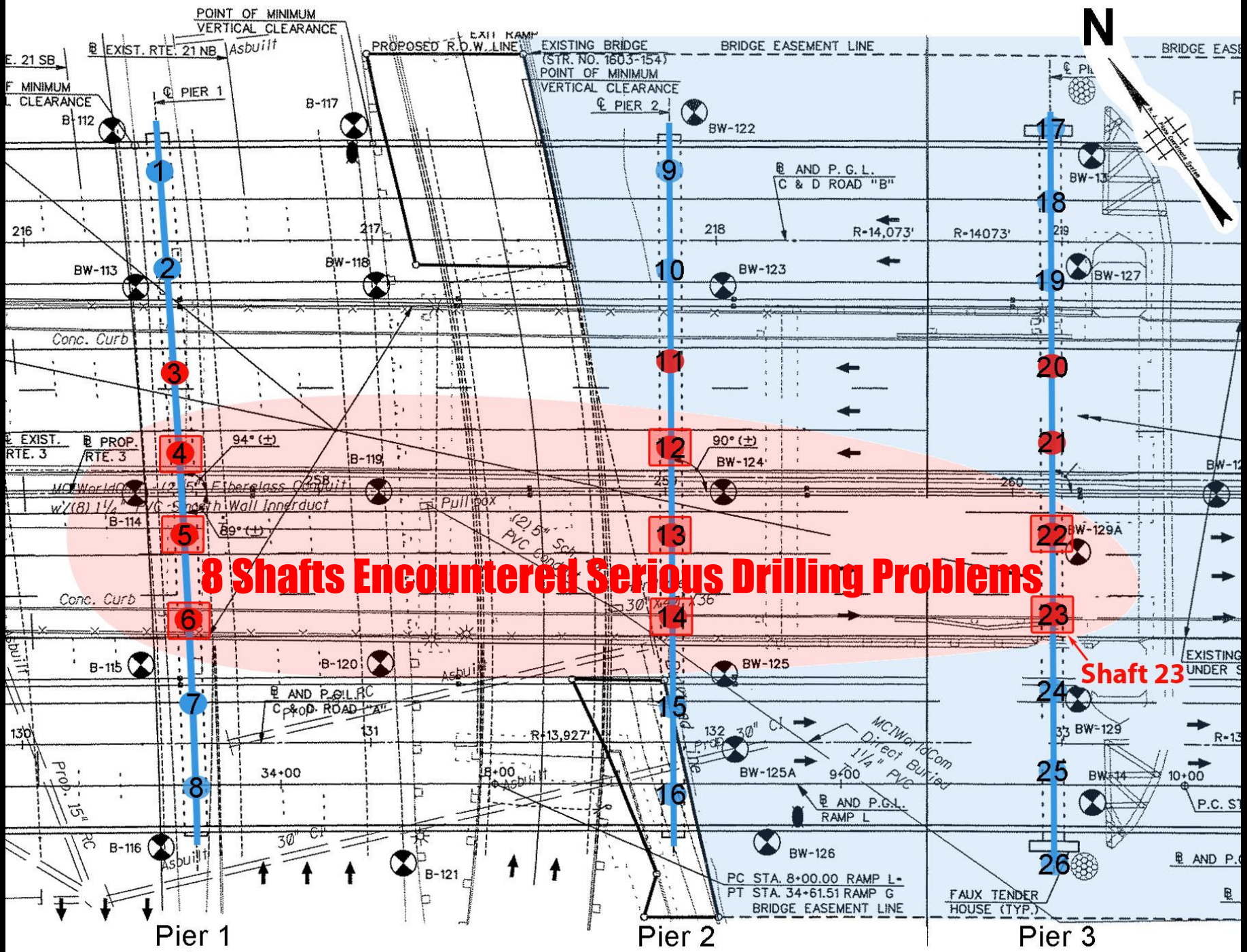
Shaft 23 – Curled 3-D Map on Acetate Detected Three Intersecting Fault Systems

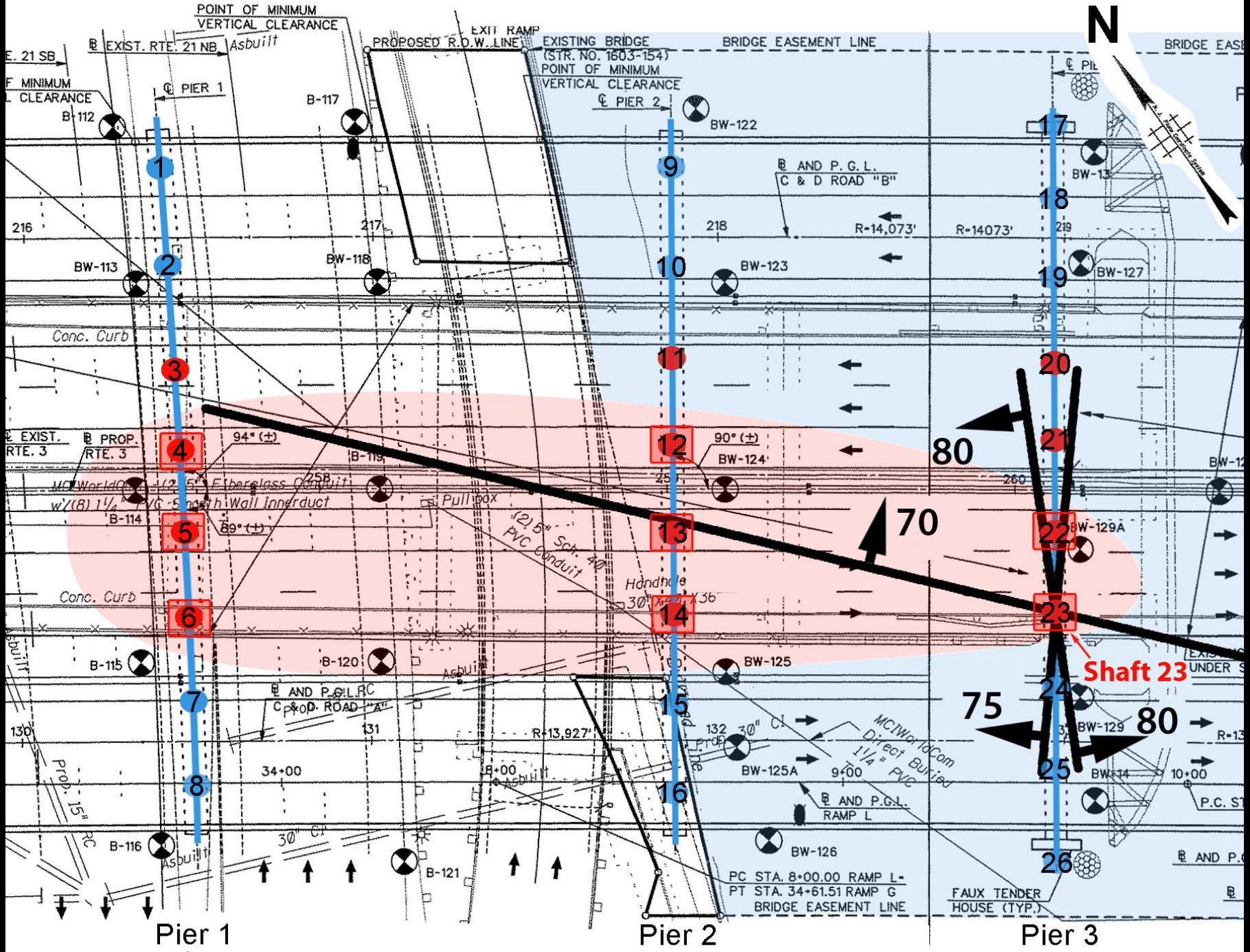
1) N35 ° E, 75 ° NW

2) N25 ° E, 80 ° SE - 80 ° NW Conjugate Set

3) N40 ° W, 70 ° NE




8 Shafts Encountered Serious Drilling Problems
Shaft 23
N
Pier 1
Pier 2
Pier 3
POINT OF MINIMUM VERTICAL CLEARANCE
℄ EXIST. RTE. 21 NB Asbuilt
PROPOSED R.O.W. LINE
EXISTING BRIDGE (STR. NO. 1603-154)
BRIDGE EASEMENT LINE
℄ PIER 1
℄ PIER 2
B-112
B-117
BW-122
BW-113
BW-118
BW-123
BW-127
Conc. Curb
℄ EXIST. RTE. 3
℄ PROP. RTE. 3
94° (±)
90° (±)
B-119
BW-124
B-114
89° (±)
Pull Box
B-115
B-120
BW-125
℄ AND P.G.L. C & D ROAD "A"
℄ AND P.G.L. C & D ROAD "B"
R-14,073'
R-13,927'
BW-125A
9+00
BW-126
℄ AND P.G.L. RAMP L
PC STA. 8+00.00 RAMP L
PT STA. 34+61.51 RAMP G
BRIDGE EASEMENT LINE
B-116
B-121
34+00
8+00
30" CI
Prop. 15" RC
MCIWorldCom Direct Buried 1 1/4" PVC
FAUX TENDER HOUSE (TYP.)
BW-129A
BW-129
BW-14
10+00
P.C. ST
EXISTING UNDER S
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

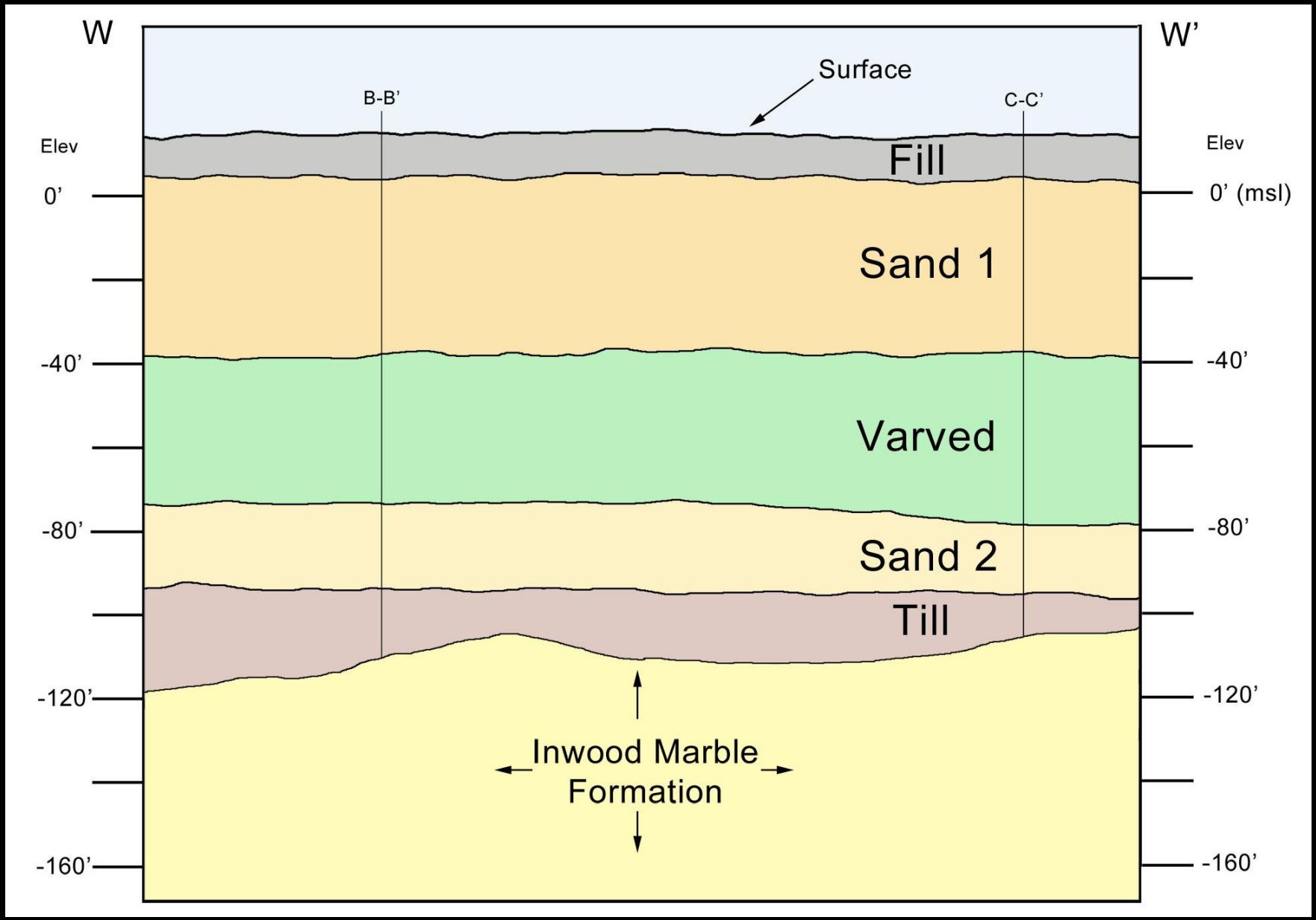

N
Shaft 23
Pier 1
Pier 2
Pier 3
80
70
75
80
EXIT RAMP
PROPOSED R.O.W. LINE
EXISTING BRIDGE
(STR. NO. 1603-154)
POINT OF MINIMUM
VERTICAL CLEARANCE
BRIDGE EASEMENT LINE
℄ PIER 1
℄ PIER 2
℄ AND P. G. L.
C & D ROAD "B"
℄ AND P.G.L.
RAMP L
℄ AND P.G.L.RC
C & D ROAD "A"
℄ EXIST. RTE. 21 NB
Asbuilt
℄ EXIST. RTE. 3
℄ PROP. RTE. 3
R-14,073'
R-14073'
R-13,927'
Conc. Curb
Pull Box
Handhole
30"X36"
(2) 5" Sch. 40 PVC Conduit
MCIWorldCom Direct Buried 1 1/4" PVC
94° (±)
90° (±)
89° (±)
B-112
B-113
B-114
B-115
B-116
B-117
B-118
B-119
B-120
B-121
BW-122
BW-123
BW-124
BW-125
BW-125A
BW-126
BW-127
BW-129
BW-129A
BW-13
BW-14
34+00
9+00
8+00
10+00
PC STA. 8+00.00 RAMP L-
PT STA. 34+61.51 RAMP G
BRIDGE EASEMENT LINE
FAUX TENDER
HOUSE (TYP.)
Prop. 15" RC
30" CI
P.C. ST
UNDER S

Terrestrial Caissons

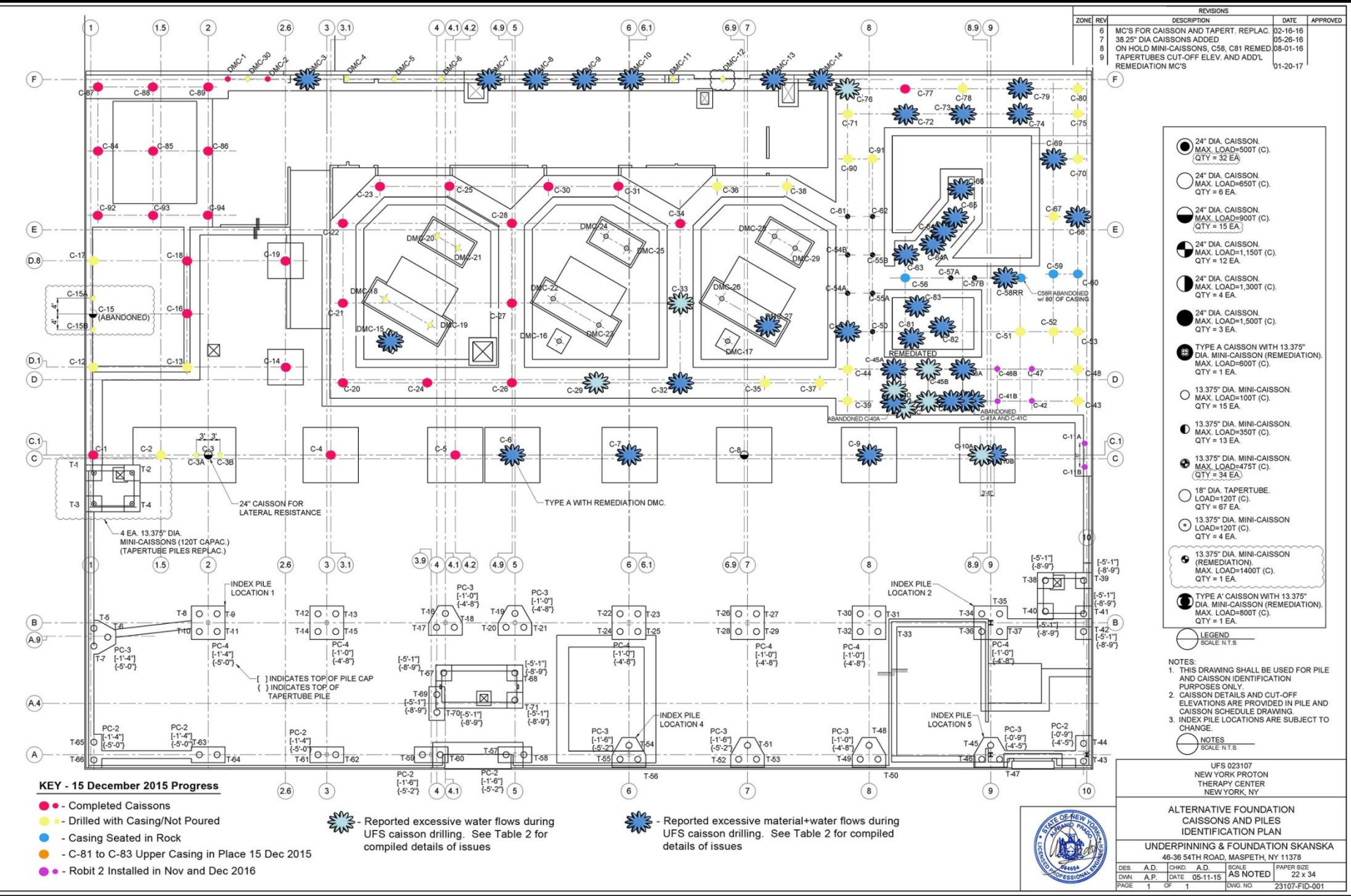
As-Built Contractor Experience -

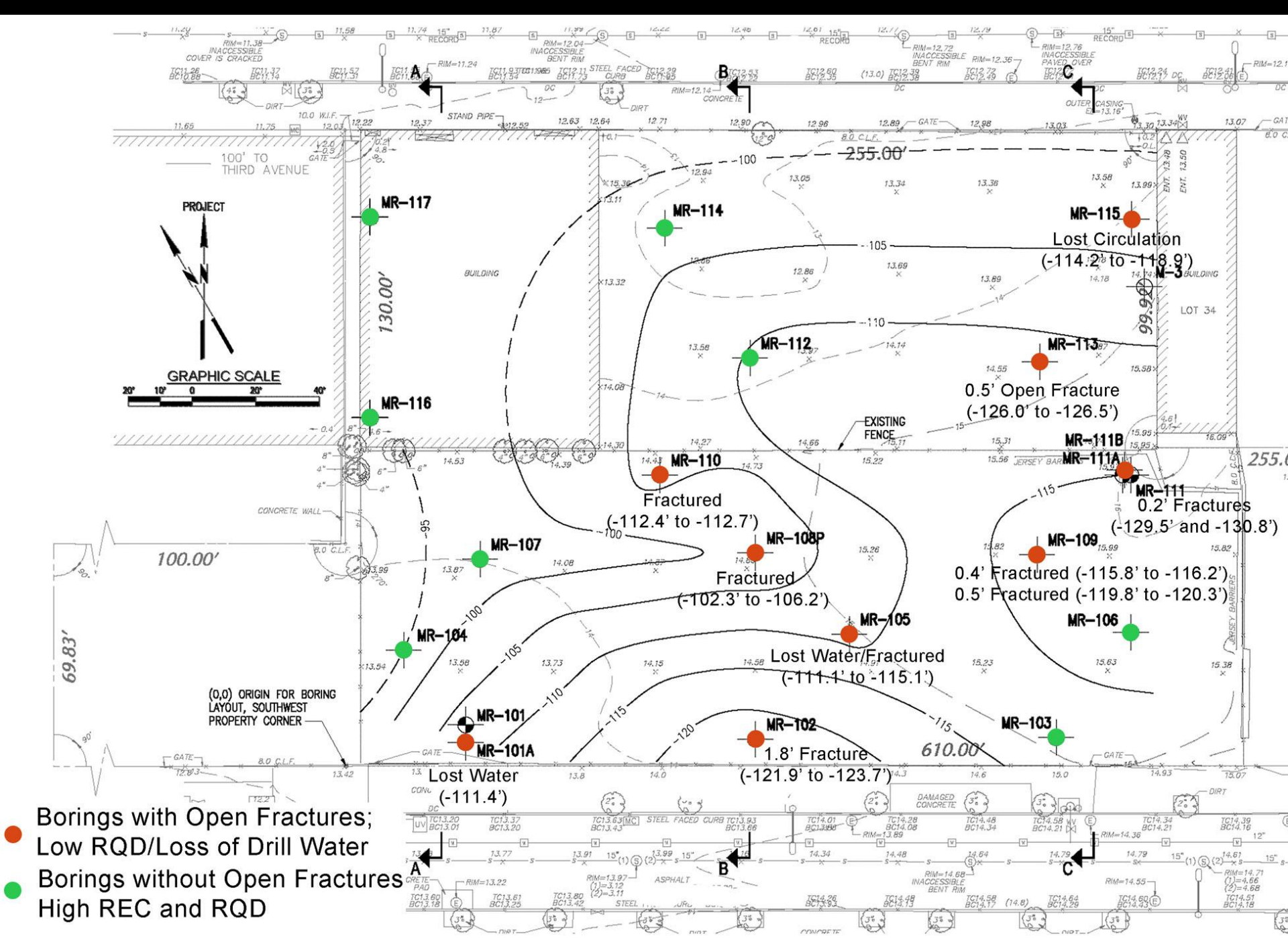
- "heavy water, sand, and rock”
- “excessive water from casing”
- “thick (heavy) sediment inflows up to 25 feet”
- “seams and rock ledges”
- “large rocks and dirty discharge”
- “socket making water”
- “communication between open drill sites”
- “flooding of the jobsite”
- “spoils on the ground”
- “equipment damage including broken shoes, rig tilting, hammer clogging and unanticipated hammer firing"

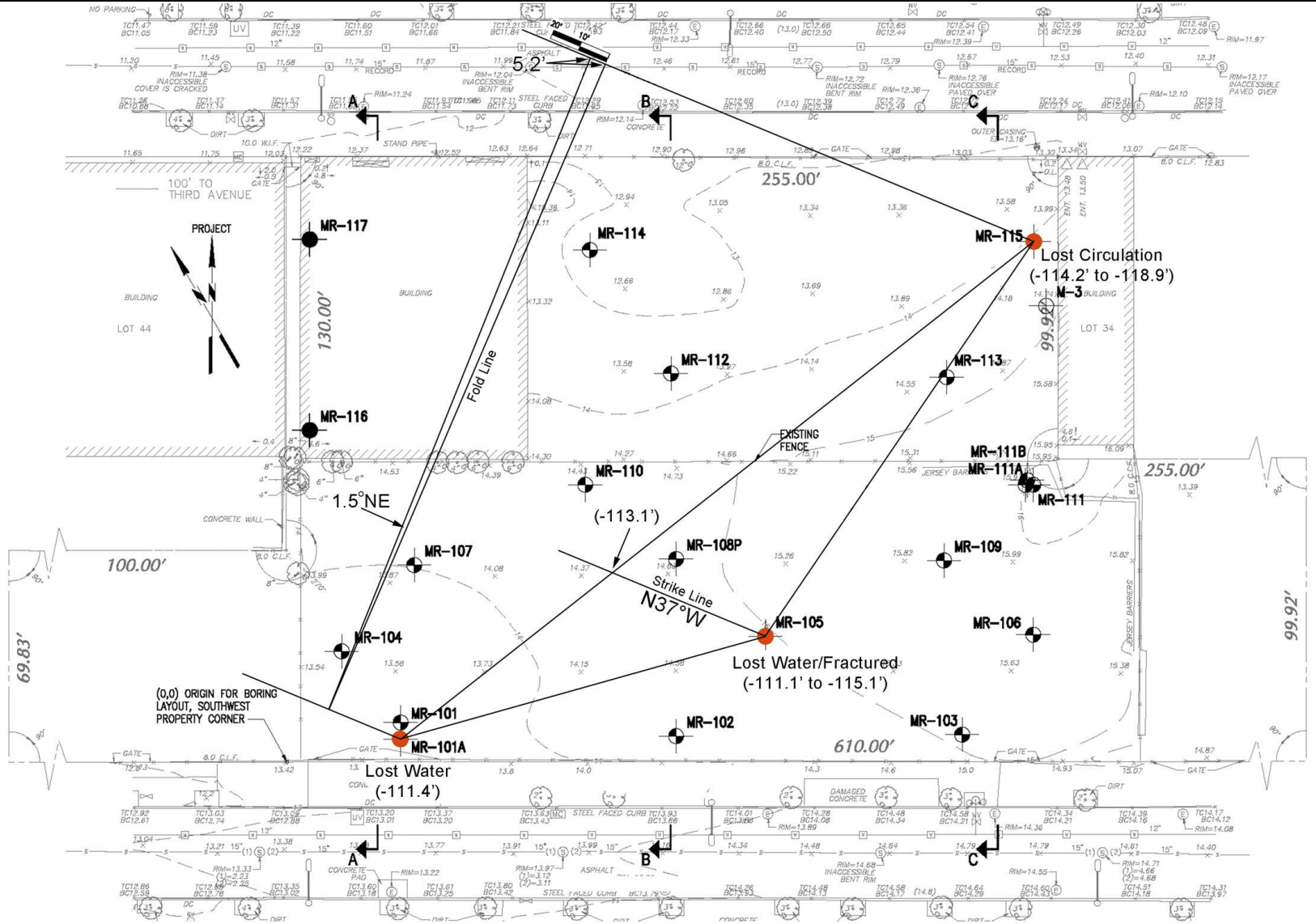
Expectation: Roughly 100' of unconsolidated overburden covering competent marble bedrock – the softest and easiest to drill rock type in NYC!



44 (29.7%) of 148 Caisson Drilling Issues – Same Means/Methods



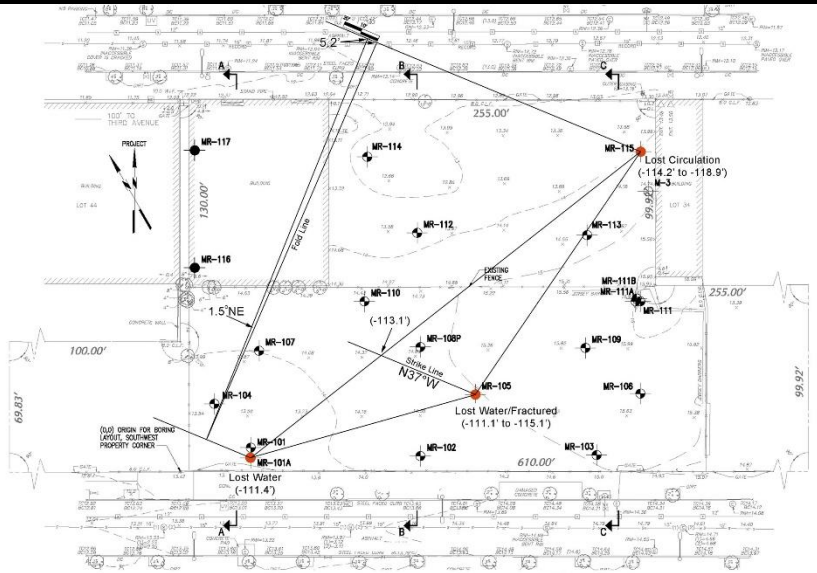

MR-117
MR-114
MR-115
Lost Circulation
(-114.2' to -118.9')
M-3
MR-112
MR-113
0.5' Open Fracture
(-126.0' to -126.5')
MR-116
MR-110
Fractured
(-112.4' to -112.7')
MR-111B
MR-111A
MR-111
0.2' Fractures
(-129.5' and -130.8')
MR-107
MR-108P
Fractured
(-102.3' to -106.2')
MR-109
0.4' Fractured (-115.8' to -116.2')
0.5' Fractured (-119.8' to -120.3')
MR-104
MR-105
Lost Water/Fractured
(-111.4' to -115.1')
MR-106
MR-101
MR-101A
Lost Water
(-111.4')
MR-102
1.8' Fracture
(-121.9' to -123.7')
MR-103
PROJECT
GRAPHIC SCALE
100' TO THIRD AVENUE
BUILDING
LOT 34
EXISTING FENCE
CONCRETE WALL
JERSEY BARRIERS
STEEL FACED CURB
DAMAGED CONCRETE
STAND PIPE
(0,0) ORIGIN FOR BORING LAYOUT, SOUTHWEST PROPERTY CORNER
255.00'
130.00'
100.00'
69.83'
610.00'
99.90'
Borings with Open Fractures; Low RQD/Loss of Drill Water
Borings without Open Fractures High REC and RQD



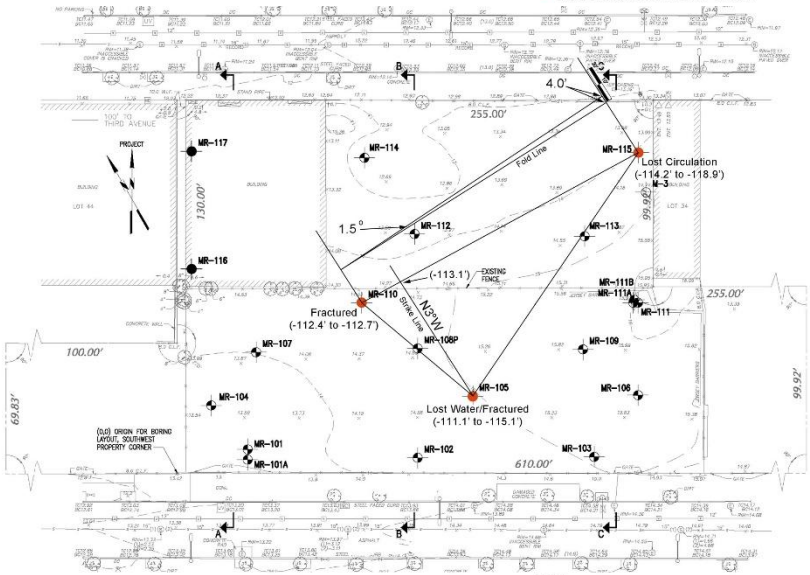
Upper Fracture
Three-Point Problem #1
MR-101A/MR-105/MR-115
Solution = N37°W, 1.5°NE

LEGEND:

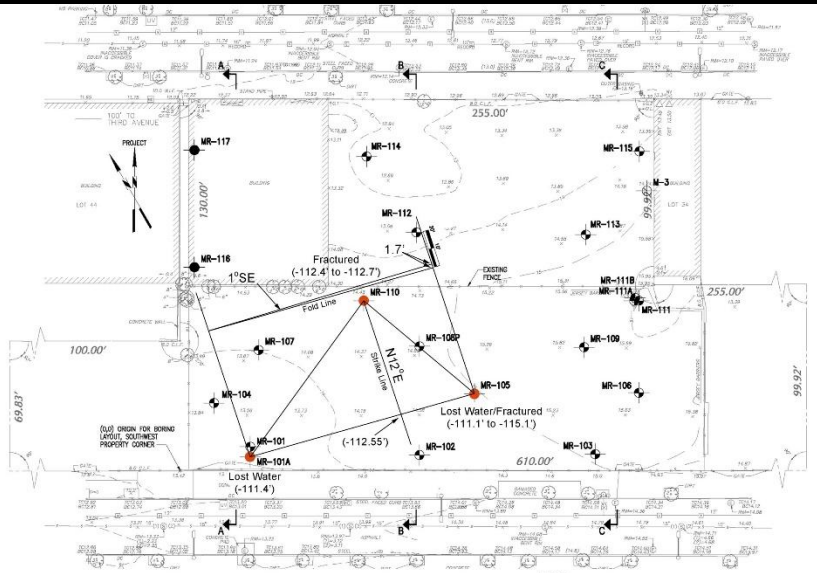
- M-3 – PREVIOUS BORING MADE IN JUNE 2007
- MR-101 – BORING MADE IN JUNE 2013
  P – PIEZOMETER
- MR-117 – PROPOSED ADDITIONAL BORING
- ● Borings with Open Fractures; Low RQD/Loss of Drill Water



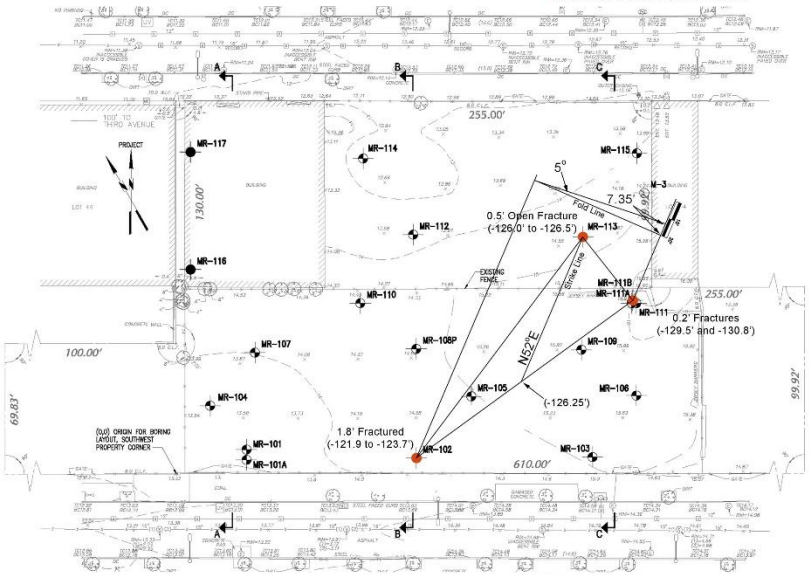
Upper Fracture
Three-Point Problem #1
MR-101A/MR-105/MR-115
Solution = N37°W, 1.5°NE



Upper Fracture
Three-Point Problem #3
MR-105/MR-110/MR-115
Solution = N3°W, 1.5°NE



Upper Fracture
Three-Point Problem #2
MR-101A/MR-105/MR-110
Solution = N12°E, 1°SE

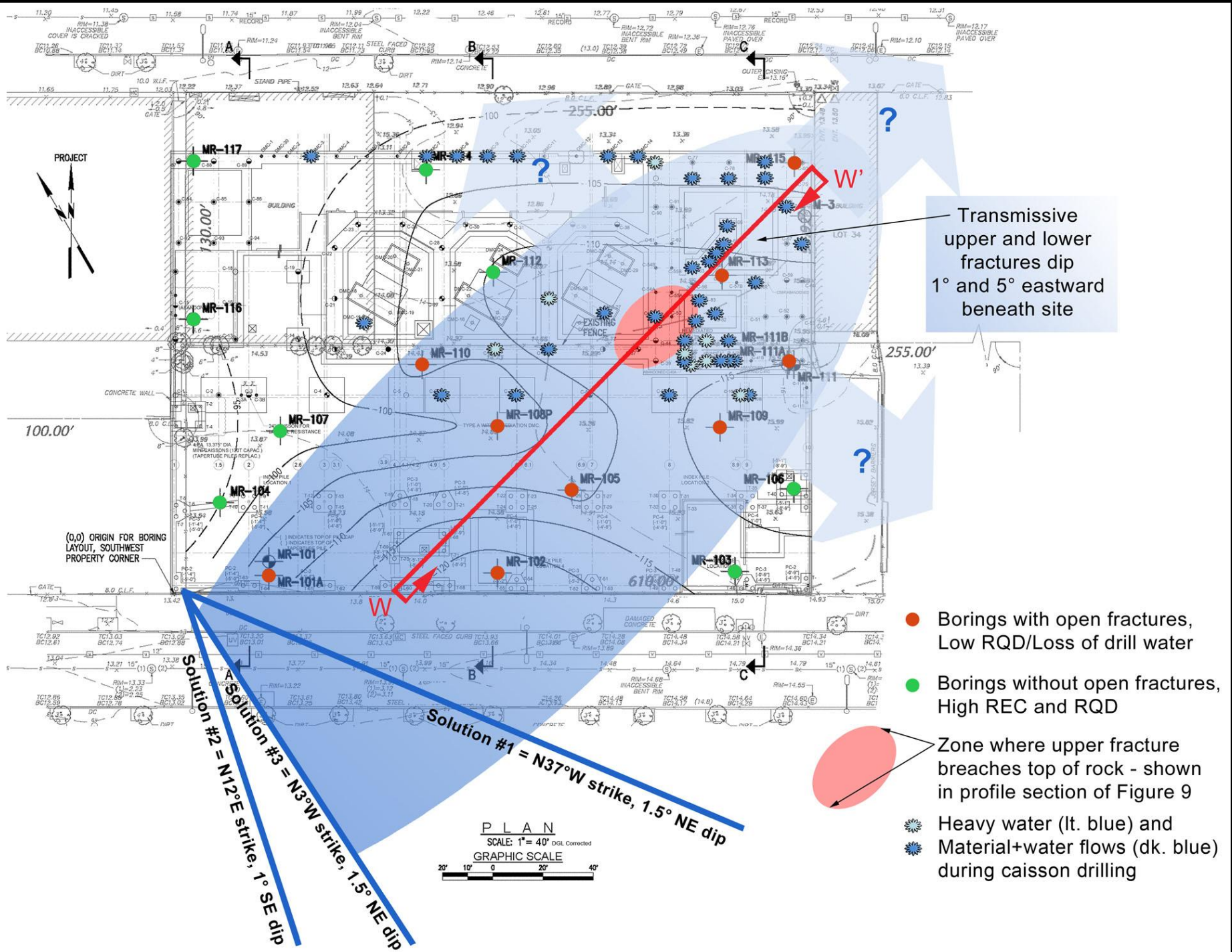


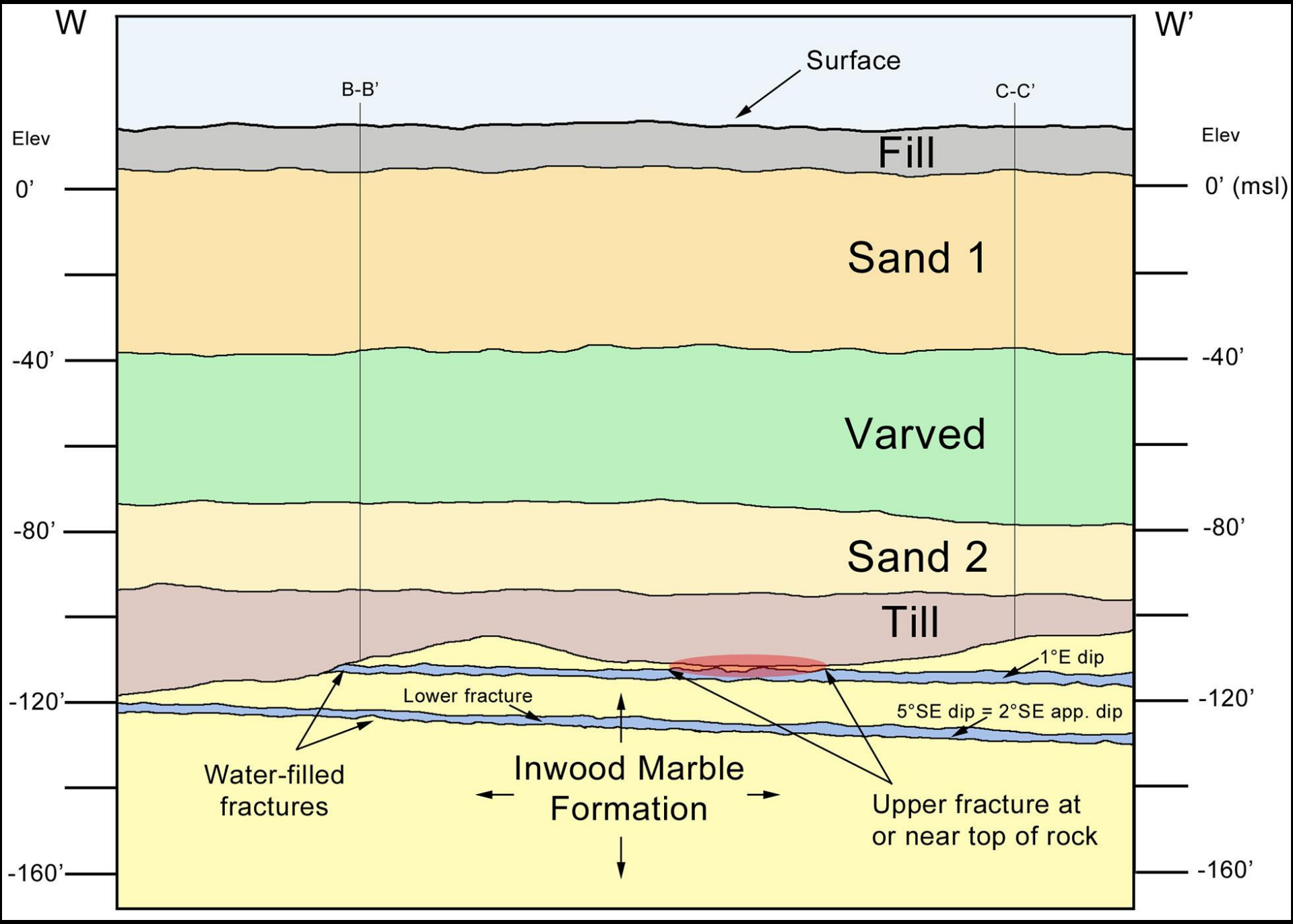
Lower Fracture
Three-Point Problem #4
MR-102/MR-111B/MR-113
Solution = N52°E, 5°SE

GRAPHIC SCALE

LEGEND:
M-3 – PREVIOUS BORING MADE IN JUNE 2007
MR-101 – BORING MADE IN JUNE 2013
P – PIEZOMETER
MR-117 – PROPOSED ADDITIONAL BORING

Borings with Open Fractures; Low RQD/Loss of Drill Water


PROJECT
N
MR-117
MR-114
MR-115
MR-112
MR-113
MR-116
MR-110
MR-111B
MR-111A
MR-111
MR-107
MR-108P
MR-109
MR-104
MR-105
MR-106
MR-101
MR-101A
MR-102
MR-103
W
W'
255.00'
130.00'
100.00'
610.00'
(0,0) ORIGIN FOR BORING LAYOUT, SOUTHWEST PROPERTY CORNER
Transmissive upper and lower fractures dip 1° and 5° eastward beneath site
Solution #1 = N37°W strike, 1.5° NE dip
Solution #2 = N12°E strike, 1° SE dip
Solution #3 = N3°W strike, 1.5° NE dip
PLAN
SCALE: 1"= 40' DGL Corrected
GRAPHIC SCALE
20' 10' 0 20' 40'
Borings with open fractures, Low RQD/Loss of drill water
Borings without open fractures, High REC and RQD
Zone where upper fracture breaches top of rock - shown in profile section of Figure 9
Heavy water (lt. blue) and Material+water flows (dk. blue) during caisson drilling


W
W'
Surface
B-B'
C-C'
Elev
Elev
Fill
0'
0' (msl)
Sand 1
-40'
-40'
Varved
-80'
-80'
Sand 2
Till
1°E dip
-120'
-120'
Lower fracture
5°SE dip = 2°SE app. dip
Water-filled
fractures
Inwood Marble
Formation
Upper fracture at
or near top of rock
-160'
-160'

100’ of Water Saturated Overburden + Unanticipated Fractured Bedrock That Breaches Top of Rock = Water, Water, Everywhere = Valid Differing Site Condition Claim