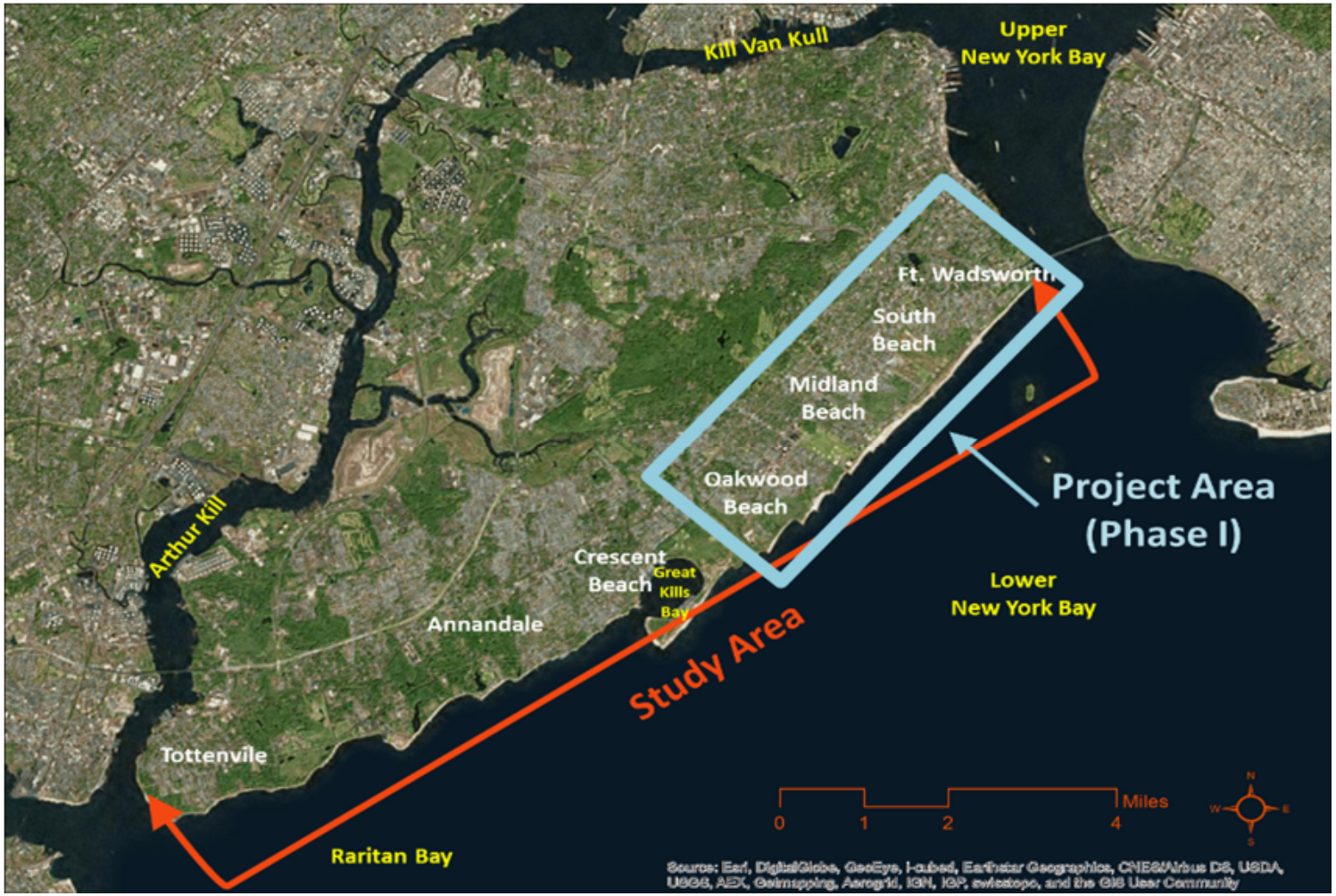
FIGURES

Vicinity Map
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: June, 2012	FIG NO: 1

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 1



Study Area Storm Damage Reduction Feasibility Study Staten Island, New York		
URS CLIFTON, NEW JERSEY		
DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: September, 2014	FIG NO: 2

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 2

Project Area
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: September, 2014	FIG NO: 3

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 3

MATCH LINE THIS SHEET

REACH A-1
TOTAL LENGTH = 2,815'
(LEVEE & STOP LOG STRUCTURE)

REACH A-2
TOTAL LENGTH = 615'
(LEVEE)

REACH A-3
TOTAL LENGTH = 1,826'
(VERTICAL FLOOD WALL)

OAKWOOD BEACH WASTE WATER TREATMENT PLANT

EXISTING TIDE GATE TO BE RE-CONSTRUCTED (SEE SHEET C-510)

MILL ROAD

CHESTERTON AVENUE

HEAVY BRUSH & WOODED AREA

ASPHALT PARKING AREA

WETLANDS AREA

STA 10+25.00

STA 13+40.00

STA 15+00.00

STA 40+00

STA 41+00

STA 47+14.81

STA 65+20.54

10+00 15+00 20+00 25+00 30+00 35+00 40+00 45+00 50+00 55+00 60+00 65+00

B-2 B-3 B-4 B-5 P5 P7 P8 A

SS02-4 SS02-5 SS02-6 SS02-7

LEGEND:

REACH A-4
TOTAL LENGTH = 22,705'
(BURIED SEAWALL)

OAKWOOD BEACH

KISSAM AVE.

FOXBEACH AVE.

TARLTON STREET

EBBITTS ST

CEDAR GROVE AVENUE

O'REILLY WAY

DRAINAGE OUTFALL PENETRATION - TYPE 2

LOWER NEW YORK BAY

70+00 75+00 80+00 85+00 90+00 95+00 100+00 105+00 110+00 115+00 120+00 125+00 130+00

B-29 B-28 B-27 B-26 B-25 B-24 B-23 B-34 B-35 B-36 B-37 B-38

SS02-8 SS02-9

MATCH LINE THIS SHEET

MATCH LINE SHEET 2

LEGEND:

SS02–5 ⌖	APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 2002 BY USACE NY DISTRICT
B–5, P5 ⌖	APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 1949 AND 1966, AND PROVIDED BY NYCDEP
150+00	ALIGNMENT OF PROTECTION STRUCTURES (LINE OF PROTECTION)
DTP	COMBINED TRUCK & PEDESTRIAN ACCESS RAMP
MVA	MAINTENANCE VEHICLE ACCESS RAMP

0 250 500 1000
SCALE (FEET)

SITE PLAN – SHEET 1
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 01–PLAN	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO. 4	

K:\CADD\11020302(SOUTH SHORE STATEN ISLAND)\01-PLAN.DWG(SHEET-1)

MATCH LINE SHEET 1

MATCH LINE SHEET 3

NEW DORP LANE

MILLER FIELD

GATEWAY NATIONAL RECREATION AREA MILLER FIELD

GRAVEL BEACH ACCESS ROADWAY

ASPHALT ROADWAY

MIDLAND AVE

FATHER CAPODANNO BLVD

NAUGHTON AVE

135+00 140+00 145+00 150+00 155+00 160+00 165+00 170+00 175+00 180+00 185+00 190+00 195+00 200+00 205+00

SS02–10

SS02–11

SS02–12

SS02–13

SS02–14

DRAINAGE OUTFALL PENETRATION - TYPE 2

DRAINAGE OUTFALL PENETRATION - TYPE 2

DRAINAGE OUTFALL PENETRATION - TYPE 2

REACH A-4
TOTAL LENGTH = 22,705'
(BURIED SEAWALL)

REACH A-4
TOTAL LENGTH = 22,705'
(BURIED SEAWALL)

REACH A-4
TOTAL LENGTH = 22,705'
(BURIED SEAWALL)

LOWER NEW YORK BAY

LEGEND:

- SS02–5 ⊕ APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 2002 BY USACE NY DISTRICT
- B–5, P5 ⊕ APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 1949 AND 1966, AND PROVIDED BY NYCDEP
- 150+00 ALIGNMENT OF PROTECTION STRUCTURES (LINE OF PROTECTION)
- DTP COMBINED TRUCK & PEDESTRIAN ACCESS RAMP
- MVA MAINTENANCE VEHICLE ACCESS RAMP

0 250 500 1000

SCALE (FEET)

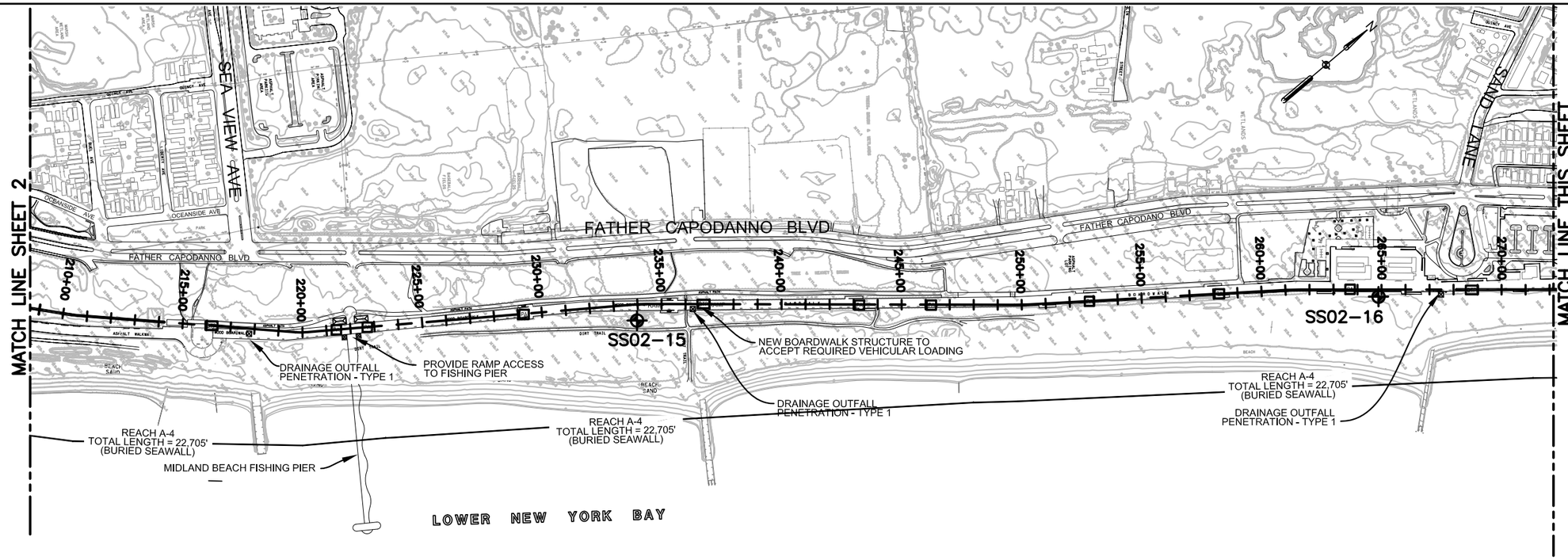
SITE PLAN – SHEET 2
SOUTH SHORE STATEN ISLAND
NEW YORK

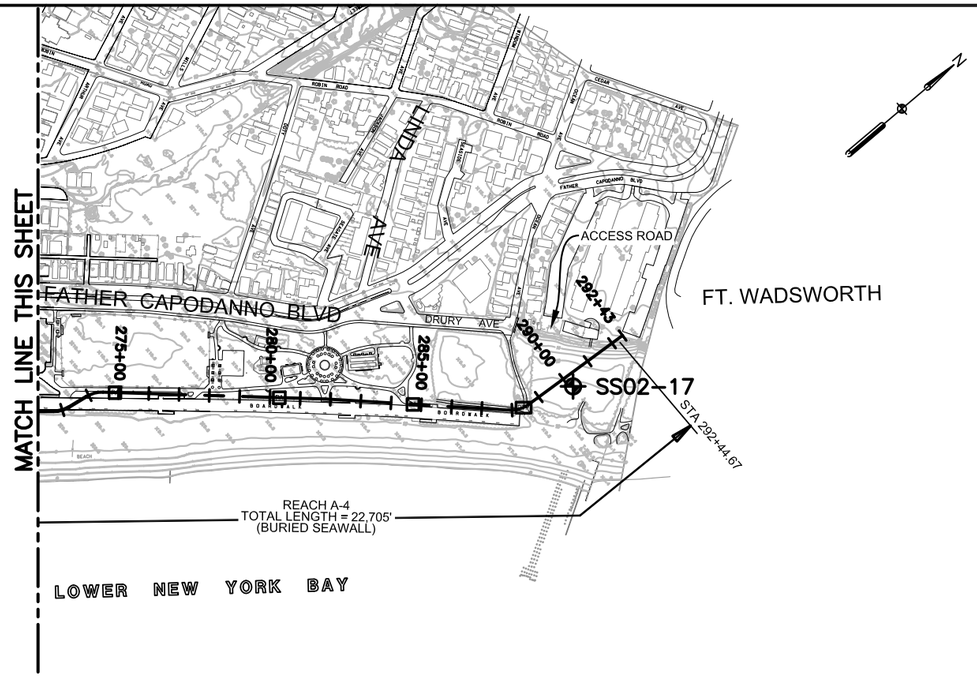
URS

CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 01–PLAN	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	5

K:\CADD\11020302(SOUTH SHORE STATEN ISLAND)\01-PLAN.DWG(SHEET-2)





LEGEND:

- SS02–5 — APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 2002 BY USACE NY DISTRICT
- B–5, P5 — APPROXIMATE BORING LOCATION AND NUMBER– PERFORMED IN 1949 AND 1966, AND PROVIDED BY NYCDEP
- 150+00 — ALIGNMENT OF PROTECTION STRUCTURES (LINE OF PROTECTION)
- DTP — COMBINED TRUCK & PEDESTRIAN ACCESS RAMP
- MVA — MAINTENANCE VEHICLE ACCESS RAMP

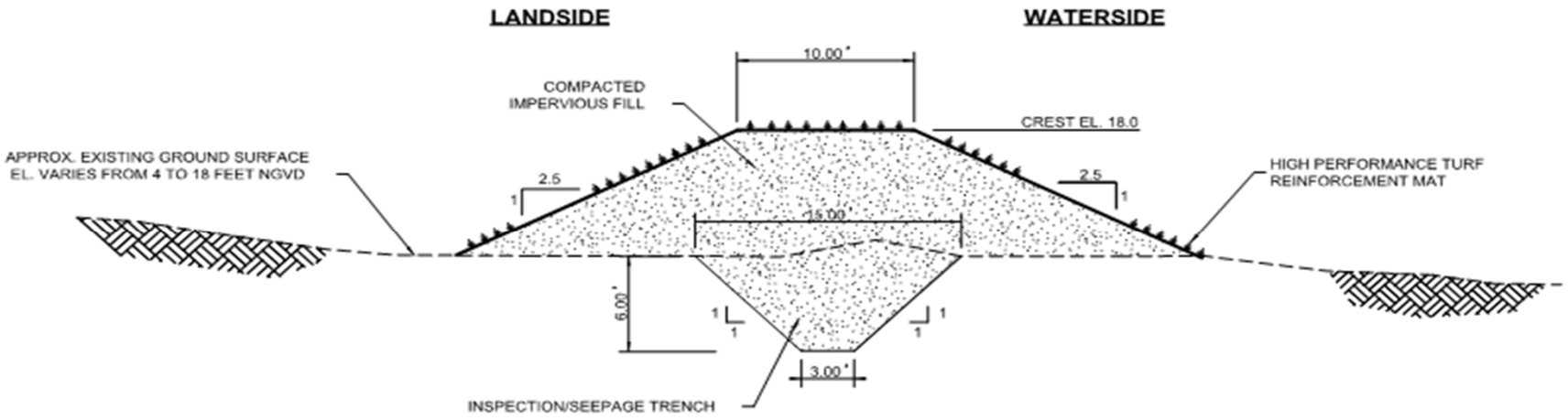
0 250 500 1000
SCALE (FEET)

SITE PLAN – SHEET 3
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO.	01–PLAN	PROJ. NO.	11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	6		

K:\CADD\11020302(SOUTH SHORE STATEN ISLAND)\01-PLAN.DWG(SHEET-3)



C2 / C-501 LEVEE SECTION (15.6 FT SWL)

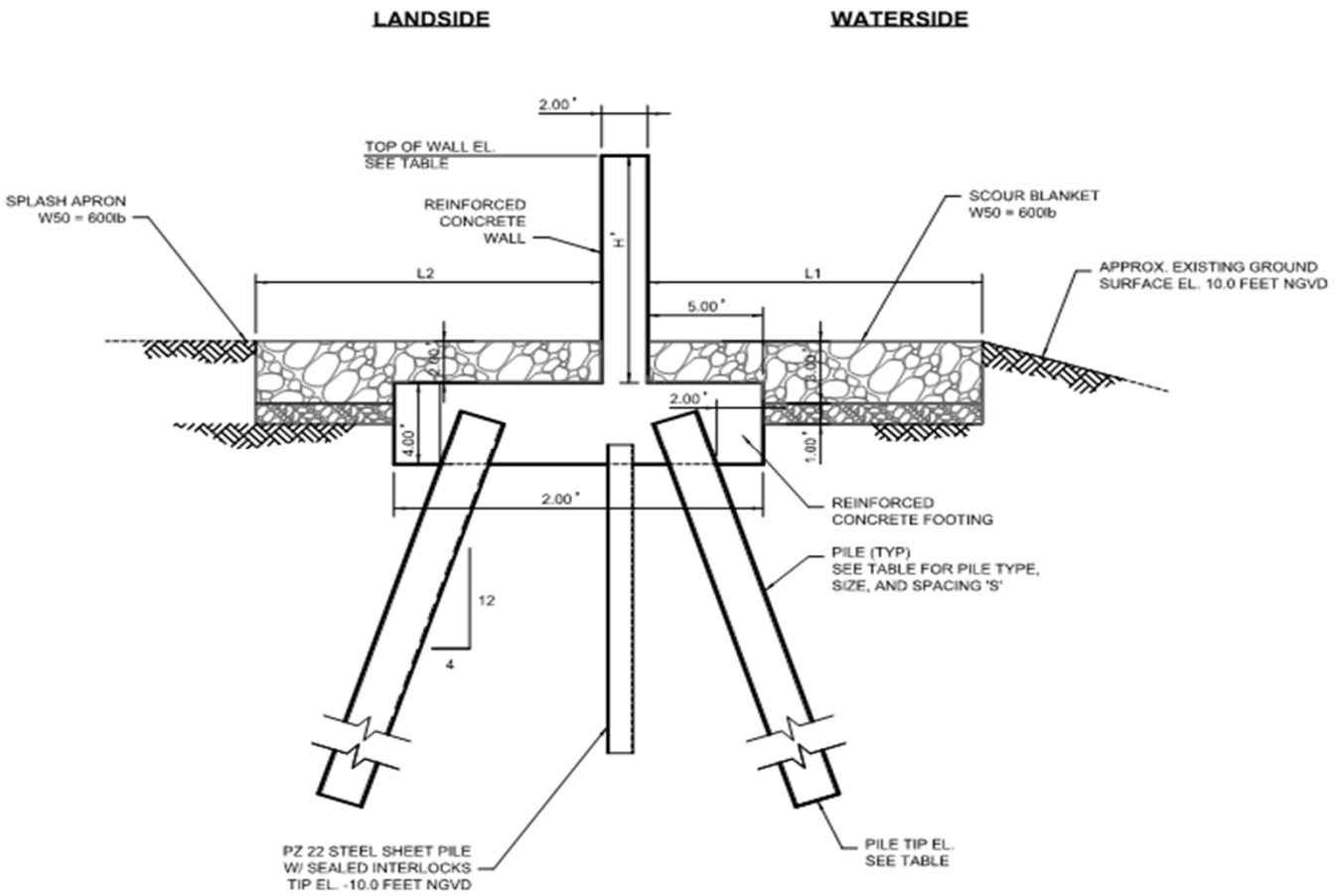
SCALE: 3/16"=1'-0"

Levee (Reach A-2)
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: September, 2014	FIG NO: 7

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 7



B2 / C-503 FLOOD WALL SECTION

SCALE: 1/4"=1'-0"

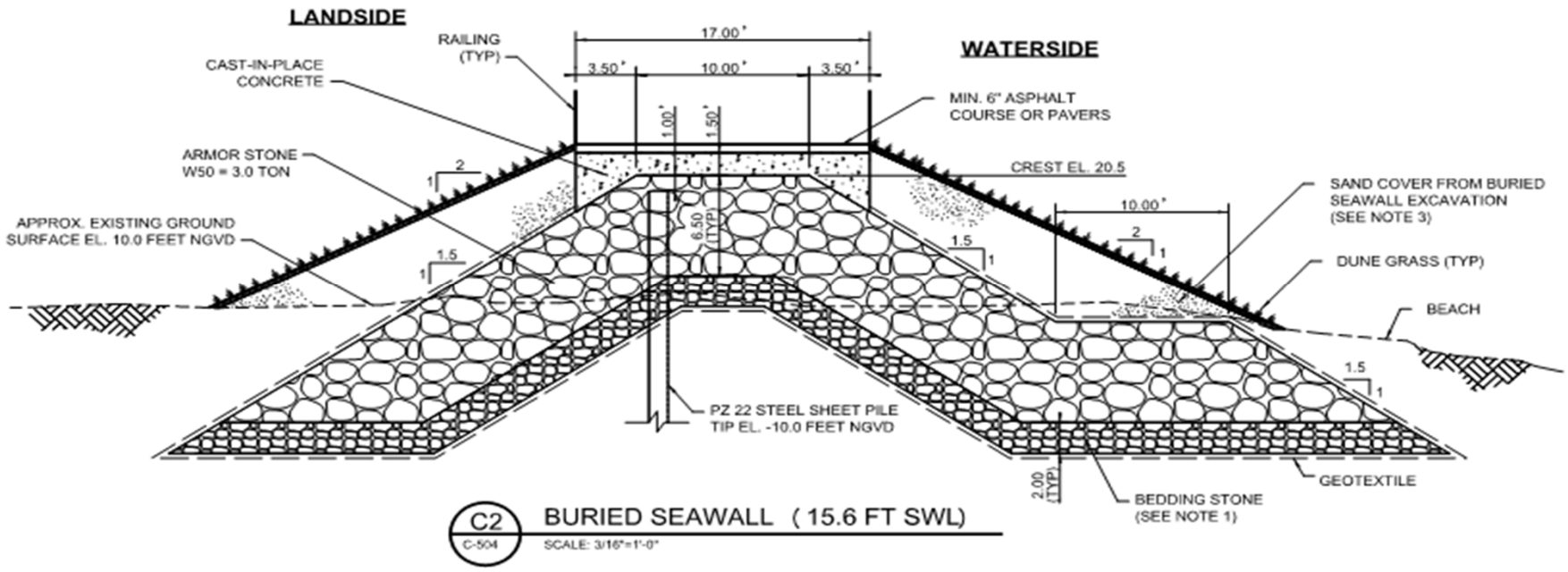
ELEVATIONS (FT, NGVD)			PILE DATA		DIMENSIONS					
SWL (FT)	TOP OF WALL	PILE TIP	TYPE	SIZE	H (FT)	B (FT)	T (FT)	L1 (FT)	L2 (FT)	S (FT)
13.3	16.0	-75.0	H-PILE	HP14 X 89	8.0	12.0	1.5	15.0	10.0	12.0
14.3	18.0	-75.0	H-PILE	HP14 X 89	10.0	15.0	1.5	15.0	12.0	12.0
15.6	20.5	-90.0	H-PILE	HP14 X 89	12.5	16.0	2.0	15.0	15.0	12.0
16.6	22.5	-90.0	H-PILE	HP14 X 90	14.5	18.0	2.5	15.0	16.0	10.0

Floodwall (Reach A-3)
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: September, 2014	FIG NO: 8

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 8



C2 / C-504 BURIED SEAWALL (15.6 FT SWL)

SCALE: 3/16"=1'-0"

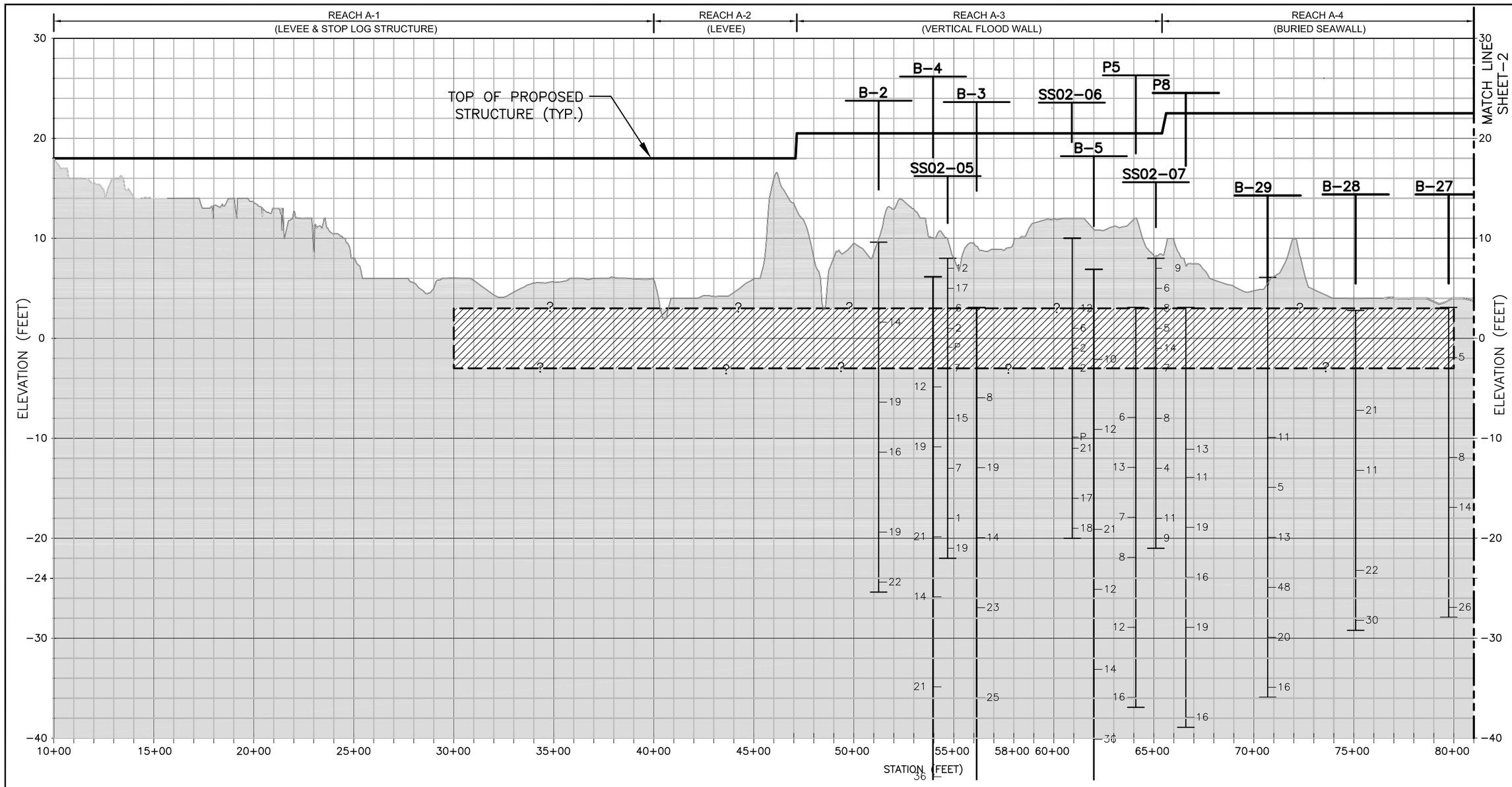
Buried Seawall (Reach A-4)
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS

CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: NTS	PROJ: 11020302
	DATE: September, 2014	FIG NO: 9

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 9



LEGEND

SS02-05 — GEOTECHNICAL BORING CONDUCTED BY MATRIX ENVIRONMENTAL SERVICES OF FLORHAM PARK, NJ.

-19 — N-VALUE, DEFINED AS NUMBER OF BLOWS OF A 140-LB HAMMER FREE FALLING FOR 30 INCHES REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES AFTER INITIAL 6 INCH PENETRATION

-P — PUSHED SHELBY TUBE

-?- — APPROXIMATE STRATA BOUNDARY

GENERALIZED SOIL DESCRIPTIONS:

- COARSE TO FINE SAND WITH SILT AND GRAVEL
- INORGANIC CLAY/INORGANIC SILTY CLAY
- ORGANIC CLAYEY SILT
- INORGANIC SILT/INORGANIC CLAYEY SILT

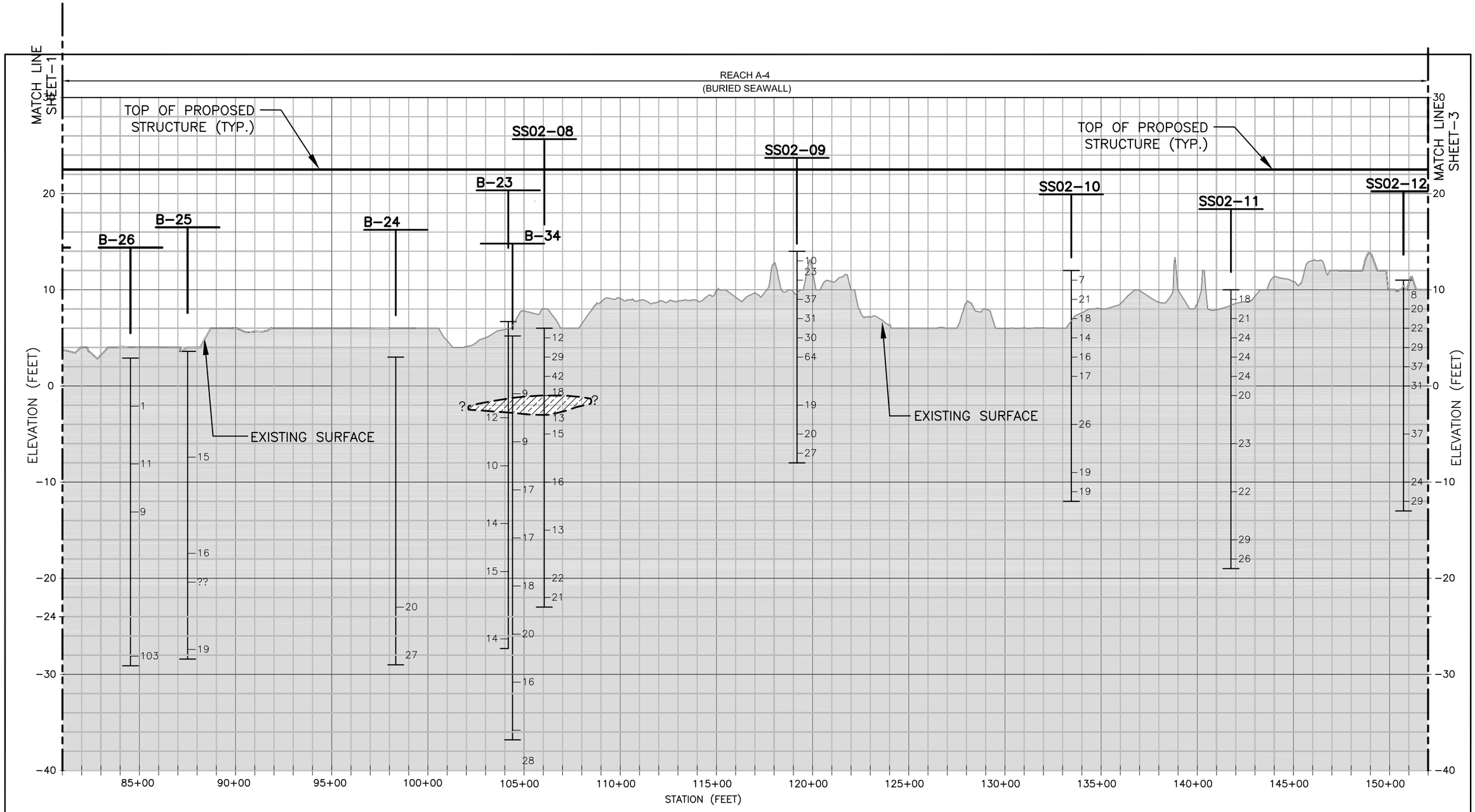
0 250 500 1000
HORIZONTAL SCALE (FEET)

0 5 10 20
VERTICAL SCALE (FEET)

CROSS-SECTION - SHEET 1
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 02-SECTIONS	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	10



LEGEND

SS02–05 — GEOTECHNICAL BORING CONDUCTED BY MATRIX ENVIRONMENTAL SERVICES OF FLORHAM PARK, NJ.

–19 — N–VALUE, DEFINED AS NUMBER OF BLOWS OF A 140–LB HAMMER FREE FALLING FOR 30 INCHES REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES AFTER INITIAL 6 INCH PENETRATION

–P — PUSHED SHELBY TUBE

– –?– – APPROXIMATE STRATA BOUNDARY

GENERALIZED SOIL DESCRIPTIONS:

- COARSE TO FINE SAND WITH SILT AND GRAVEL
- INORGANIC CLAY/INORGANIC SILTY CLAY
- ORGANIC CLAYEY SILT
- INORGANIC SILT/INORGANIC CLAYEY SILT

0 250 500 1000
HORIZONTAL SCALE (FEET)

0 5 10 20
VERTICAL SCALE (FEET)

CROSS–SECTION – SHEET 2
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 02–SECTIONS	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	11

REACH A-4
(BURIED SEAWALL)

MATCH LINE SHEET-2

MATCH LINE SHEET-4

TOP OF PROPOSED STRUCTURE (TYP.)

SS02-13

SS02-14

EXISTING SURFACE

EXISTING SURFACE

ELEVATION (FEET)

ELEVATION (FEET)

30
20
10
0
-10
-20
-24
-30
-40

SS02-13: 20, 16, 13, 9, 7, 10, P, 1, 5, 10, 13

SS02-14: 7, 11, 11, 6, 6, 5, 4, P, P, 6, 10

?

?

155+00 160+00 165+00 170+00 175+00 180+00 185+00 190+00 195+00 200+00 205+00 210+00 215+00 220+00

STATION (FEET)

LEGEND

SS02-05 — GEOTECHNICAL BORING CONDUCTED BY MATRIX ENVIRONMENTAL SERVICES OF FLORHAM PARK, NJ.

-19 — N-VALUE, DEFINED AS NUMBER OF BLOWS OF A 140-LB HAMMER FREE FALLING FOR 30 INCHES REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES AFTER INITIAL 6 INCH PENETRATION

-P — PUSHED SHELBY TUBE

—?— APPROXIMATE STRATA BOUNDARY

GENERALIZED SOIL DESCRIPTIONS:

- COARSE TO FINE SAND WITH SILT AND GRAVEL
- INORGANIC CLAY/INORGANIC SILTY CLAY
- ORGANIC CLAYEY SILT
- INORGANIC SILT/INORGANIC CLAYEY SILT

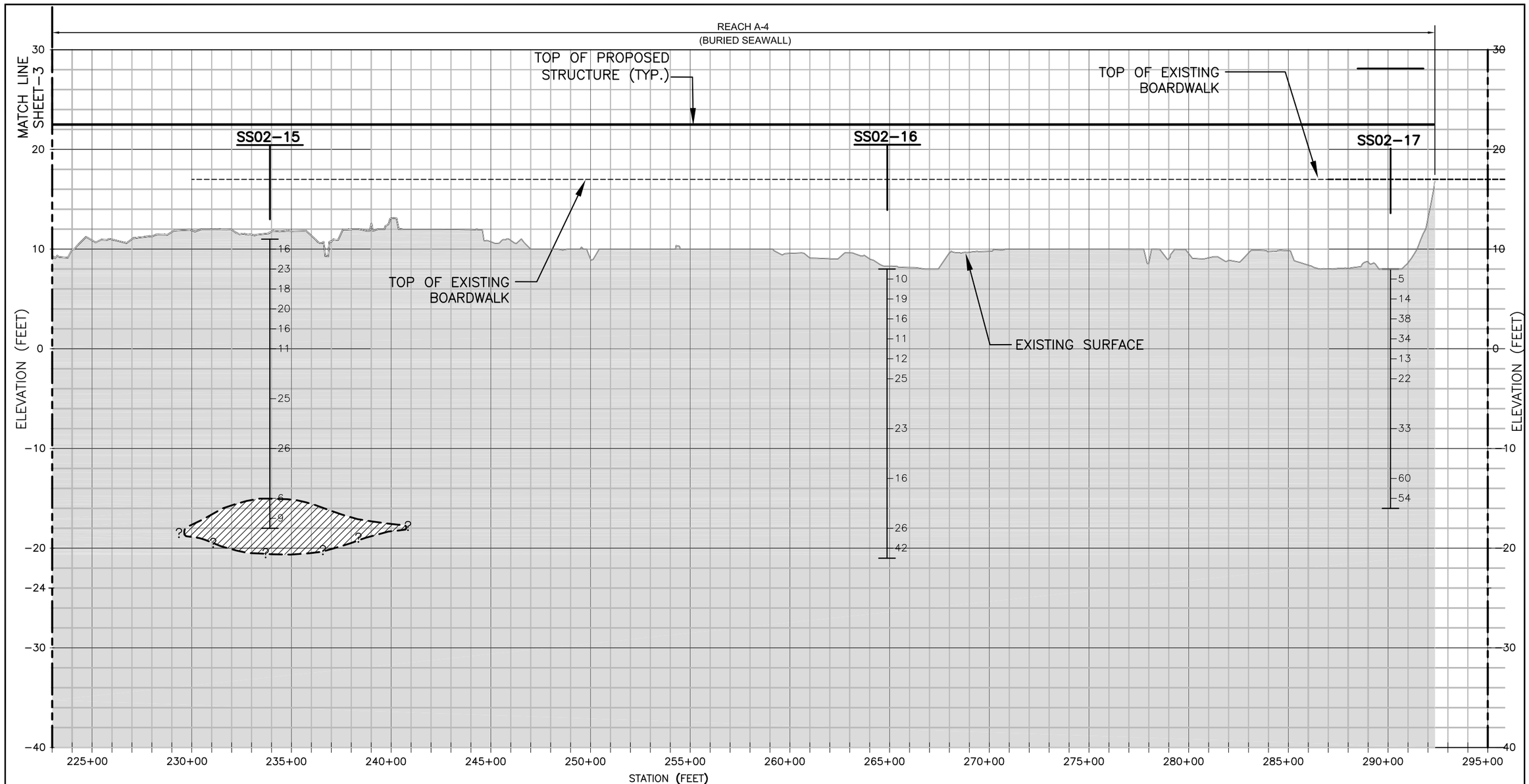
0 250 500 1000
HORIZONTAL SCALE (FEET)

0 5 10 20
VERTICAL SCALE (FEET)

CROSS-SECTION - SHEET 3
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 02-SECTIONS	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	12



LEGEND

SS02-05 — GEOTECHNICAL BORING CONDUCTED BY MATRIX ENVIRONMENTAL SERVICES OF FLORHAM PARK, NJ.

-19 — N-VALUE, DEFINED AS NUMBER OF BLOWS OF A 140-LB HAMMER FREE FALLING FOR 30 INCHES REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES AFTER INITIAL 6 INCH PENETRATION

-P — PUSHED SHELBY TUBE

-?- — APPROXIMATE STRATA BOUNDARY

GENERALIZED SOIL DESCRIPTIONS:

- COARSE TO FINE SAND WITH SILT AND GRAVEL
- INORGANIC CLAY/INORGANIC SILTY CLAY
- ORGANIC CLAYEY SILT
- INORGANIC SILT/INORGANIC CLAYEY SILT

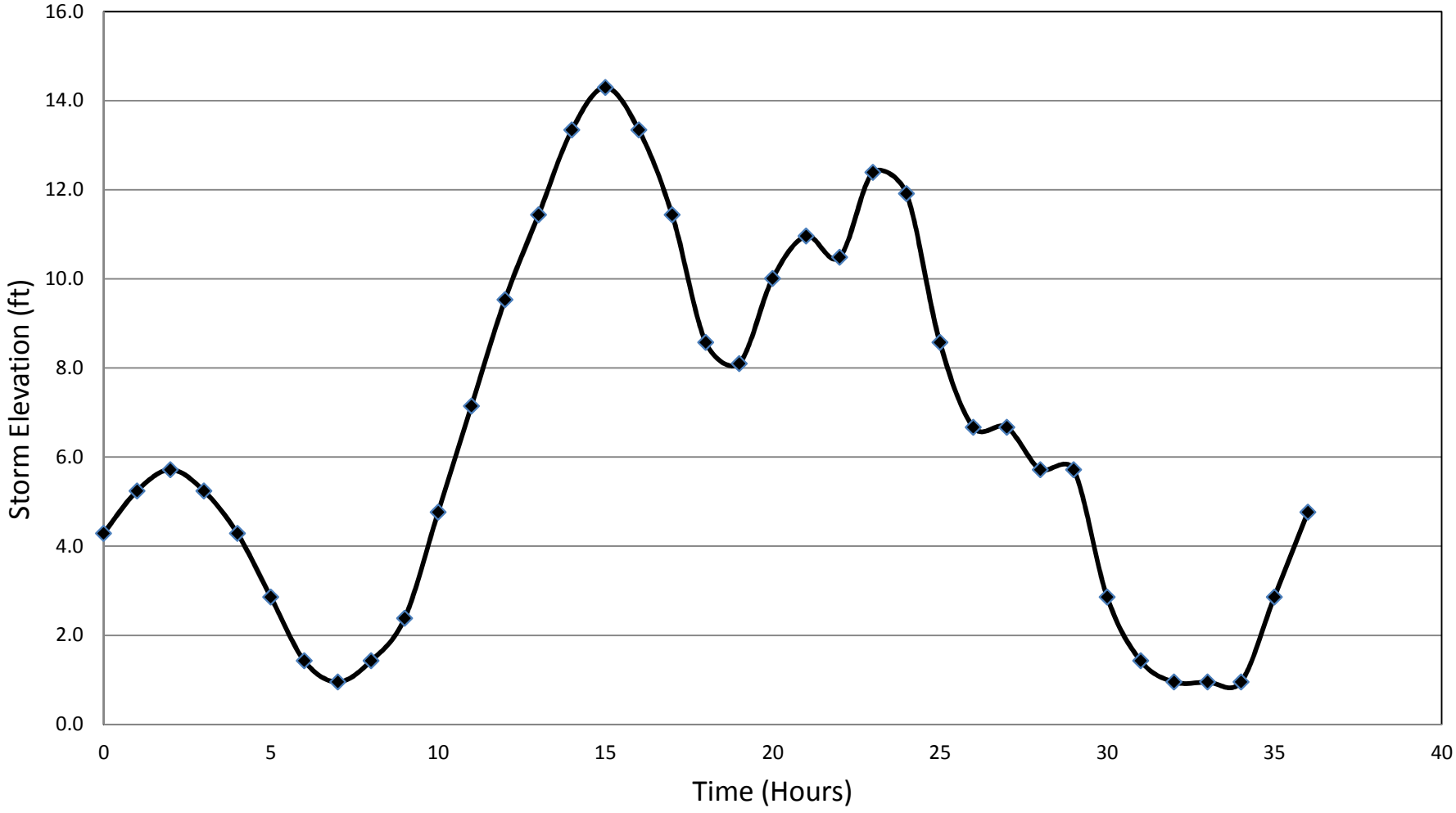
0 250 500 1000
HORIZONTAL SCALE (FEET)

0 5 10 20
VERTICAL SCALE (FEET)

CROSS-SECTION - SHEET 4
SOUTH SHORE STATEN ISLAND
NEW YORK

URS
CLIFTON, NEW JERSEY

DR. BY	ET	SCALE	AS SHOWN	DWG. NO. 02-SECTIONS	PROJ. NO. 11020302
CK'D. BY	NV	DATE	AUGUST, 2012	FIG. NO.	13



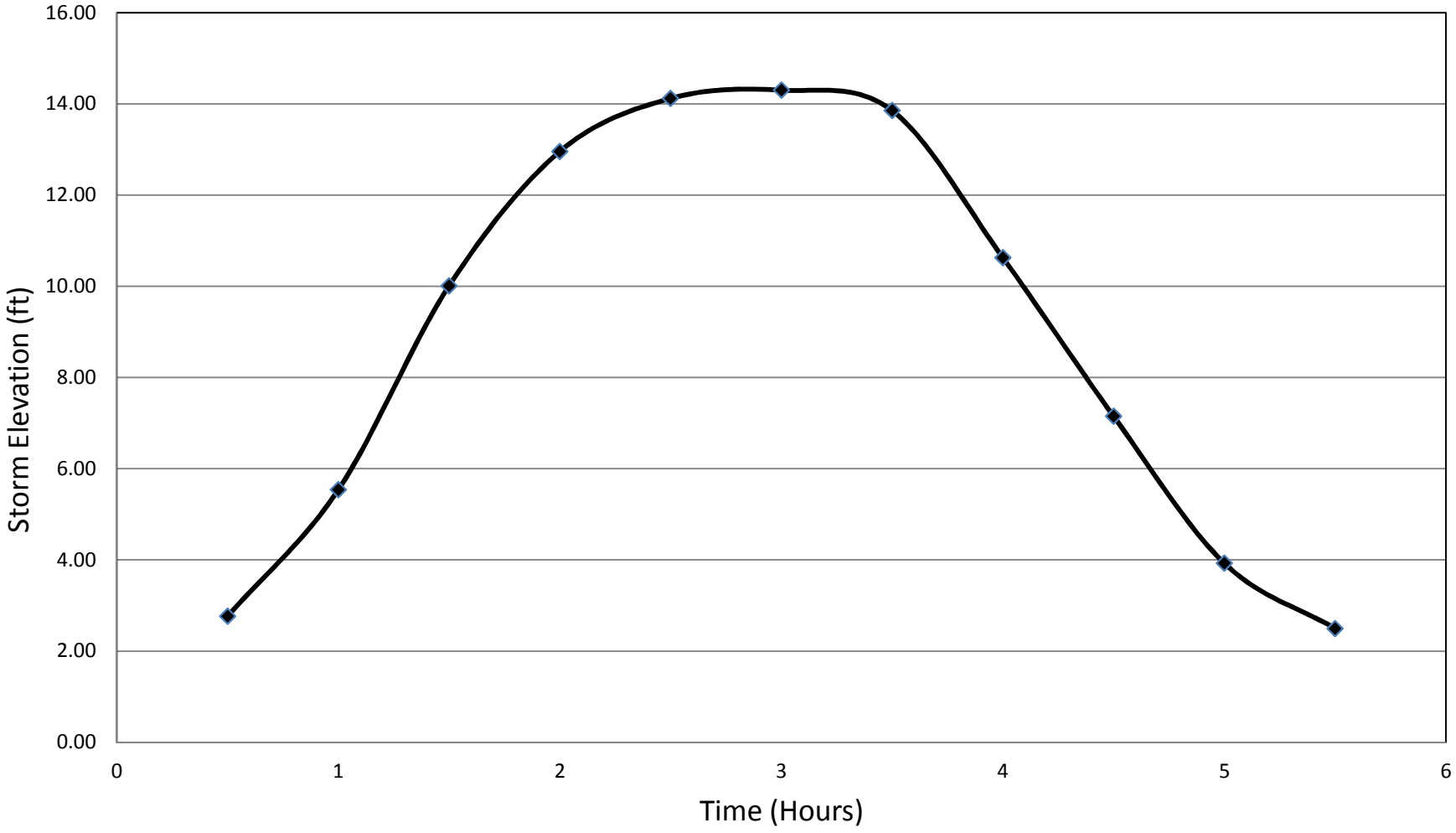
Source:
November 1950 nor'easter in NYC, peak water elevation
modified to match the design storm elevation

Storm (Nor'Easter) Hydrograph
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: VN	SCALE: As Shown	PROJ: 11020302
	DATE: July, 2011	FIG NO: 14

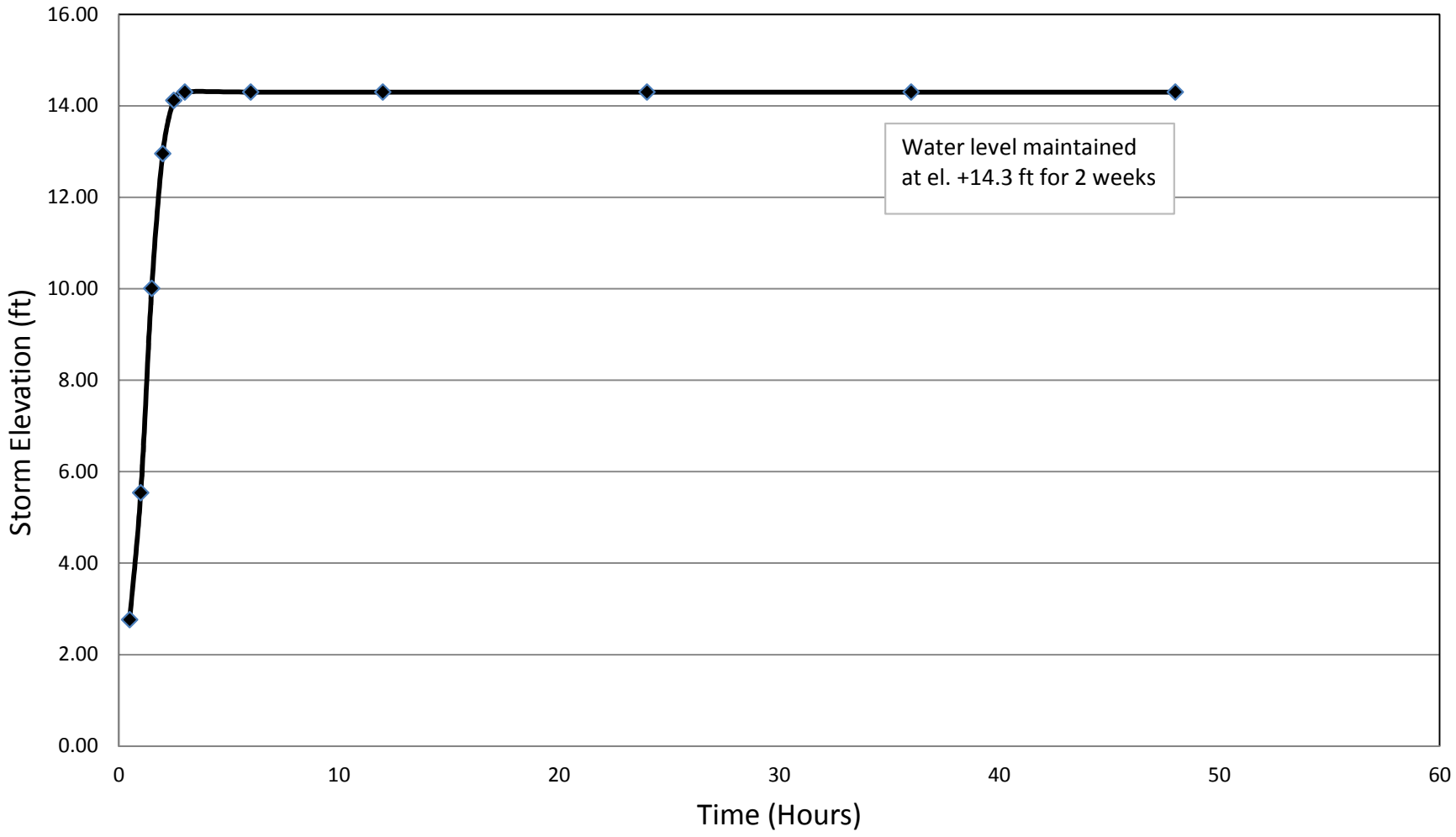
I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 14-16 Figure15



Source:
Huricane hydrograph from another location, peak water elevation modified to match the design storm elevation

Hurricane Hydrograph Storm Damage Reduction Feasibility Study Staten Island, New York		
URS CLIFTON, NEW JERSEY		
DR. BY: VN	SCALE: NTS	PROJ: 11020302
	DATE: July, 2011	FIG NO: 15

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 14-16 Figure16



NOTE:
Maximum still water level hypothetically maintained
for about 2 weeks

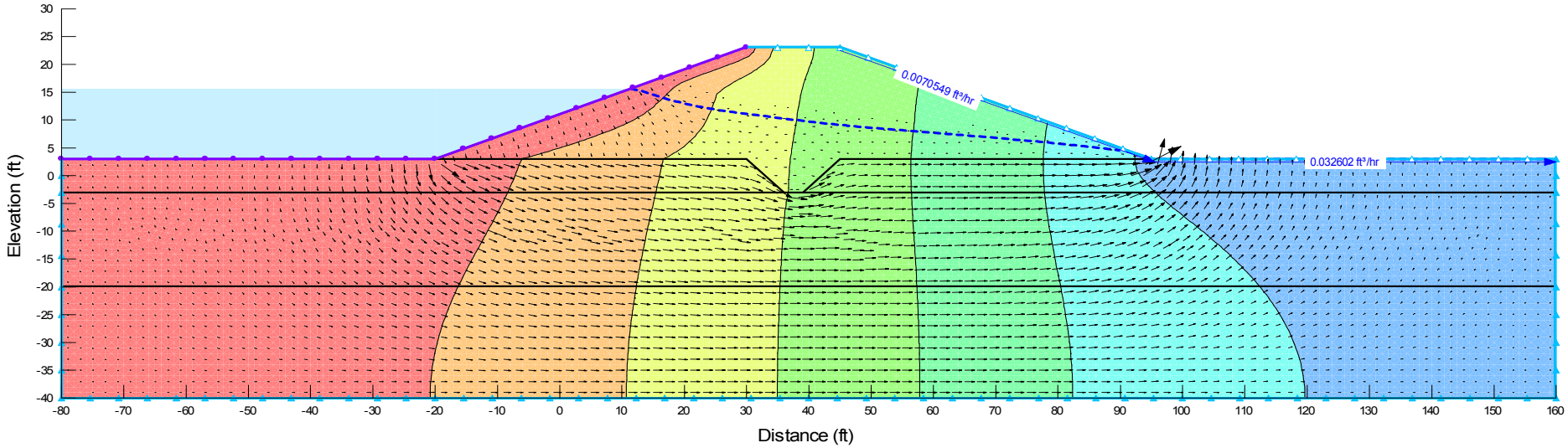
Hypothetical Hurricane Hydrograph
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: VN	SCALE: NTS	PROJ: 11020302
	DATE: JAN., 2012	FIG NO: 16

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 14-16 Figure17

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Compacted Impervious Fill Model: Saturated / Unsaturated K-Function: k=1x10-5cm/s Vol. WC. Function: Silty Sand
Name: Loose Sand (k=1x10-4cm/s) Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Common Fill Model: Saturated / Unsaturated K-Function: k=1x10-4cm/s Vol. WC. Function: Silty Sand



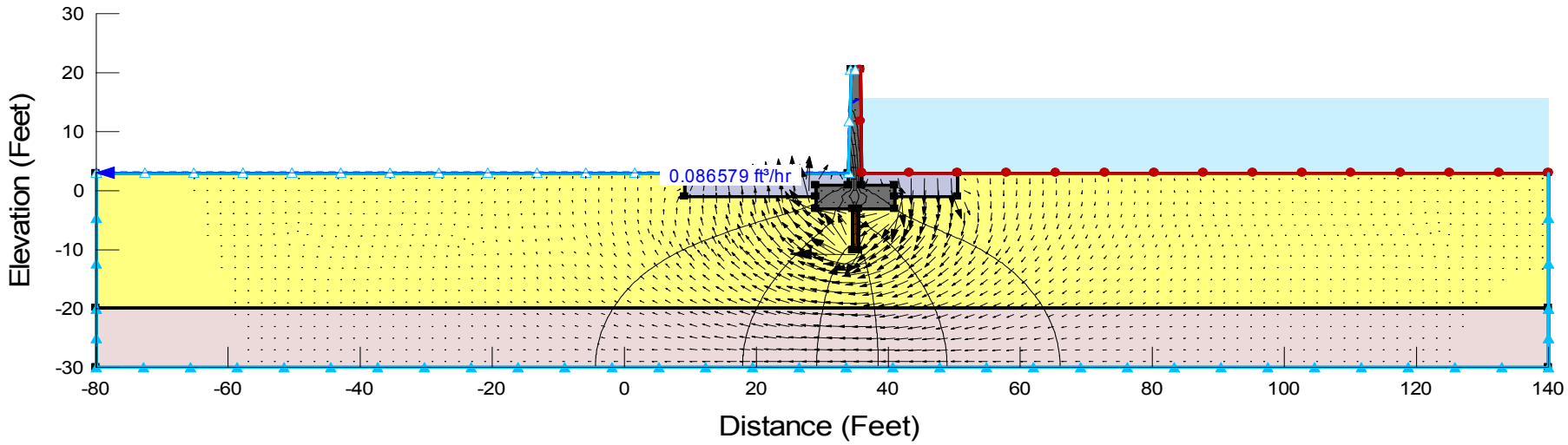
File: C2-Levee_ExGradeEl+3'.gsz Analysis: Steady Seepage
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Levee (Reach A-2)
Seepage Analysis Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 17

Name: Loose Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Med Dense Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Porous Materials Model: Saturated / Unsaturated K-Function: k=1x10-2cm/s Vol. WC. Function: Silty Sand
Name: Concrete Model: Saturated / Unsaturated K-Function: k=1x10-6cm/s Vol. WC. Function: Silty Sand
Name: sheet pile Model: Saturated / Unsaturated K-Function: k=1x10-6cm/s Vol. WC. Function: Silty Sand



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\B2_Floodwall_SWL15-6ft_ExGradeEl-3'.gsz

Floodwall (Reach A-3)
Seepage Analysis Results
Staten Island, New York

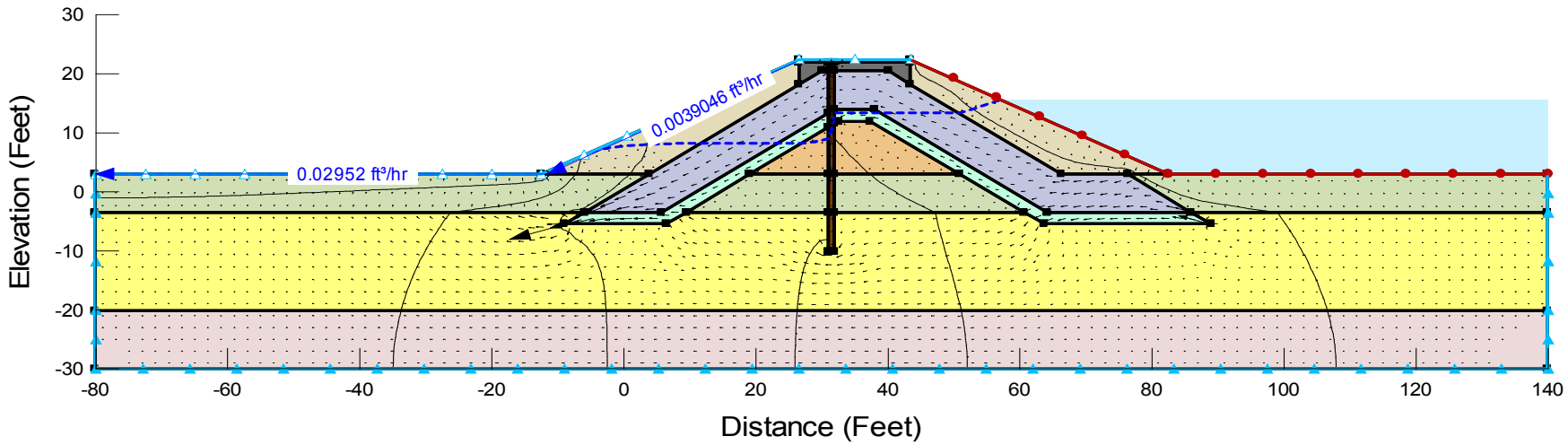
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 18

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 18

Steady-State Seepage

Name: Loose Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Med Dense Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Armor Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol. WC. Function: Silty Sand
Name: Bedding Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol. WC. Function: Silty Sand
Name: Embankment Model: Saturated / Unsaturated K-Function: Embankment Vol. WC. Function: Silty Sand
Name: Organic Silt Model: Saturated Only K-Sat: 0.00118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: RCC Model: Saturated / Unsaturated K-Function: k=1x10-6cm/s Vol. WC. Function: Silty Sand
Name: sheet pile Model: Saturated / Unsaturated K-Function: k=1x10-6cm/s Vol. WC. Function: Silty Sand
Name: Fill Model: Saturated / Unsaturated K-Function: Embankment Vol. WC. Function: Silty Sand



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

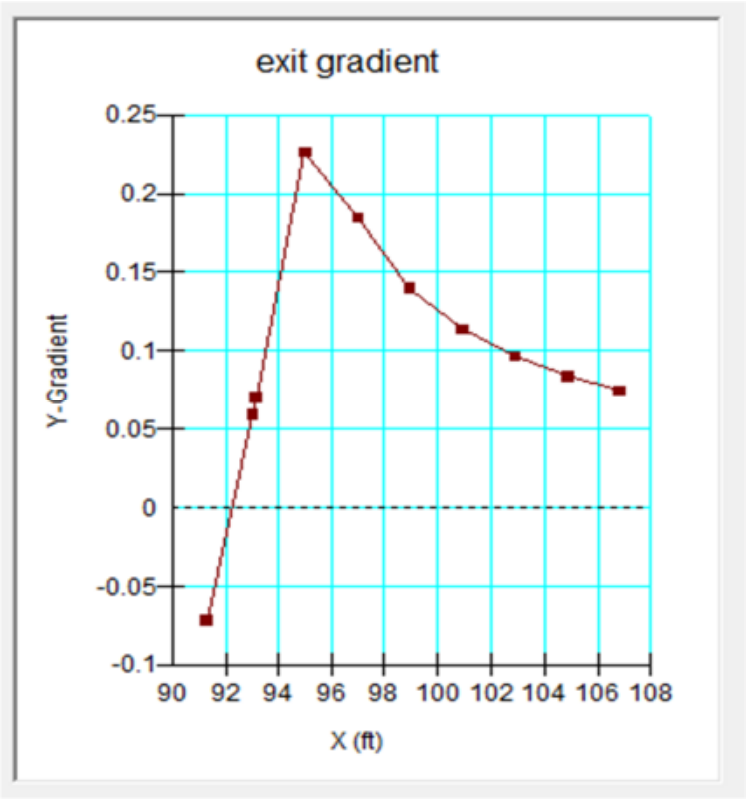
Buried Seawall (Reach A-4)
Seepage Analysis Results
Staten Island, New York

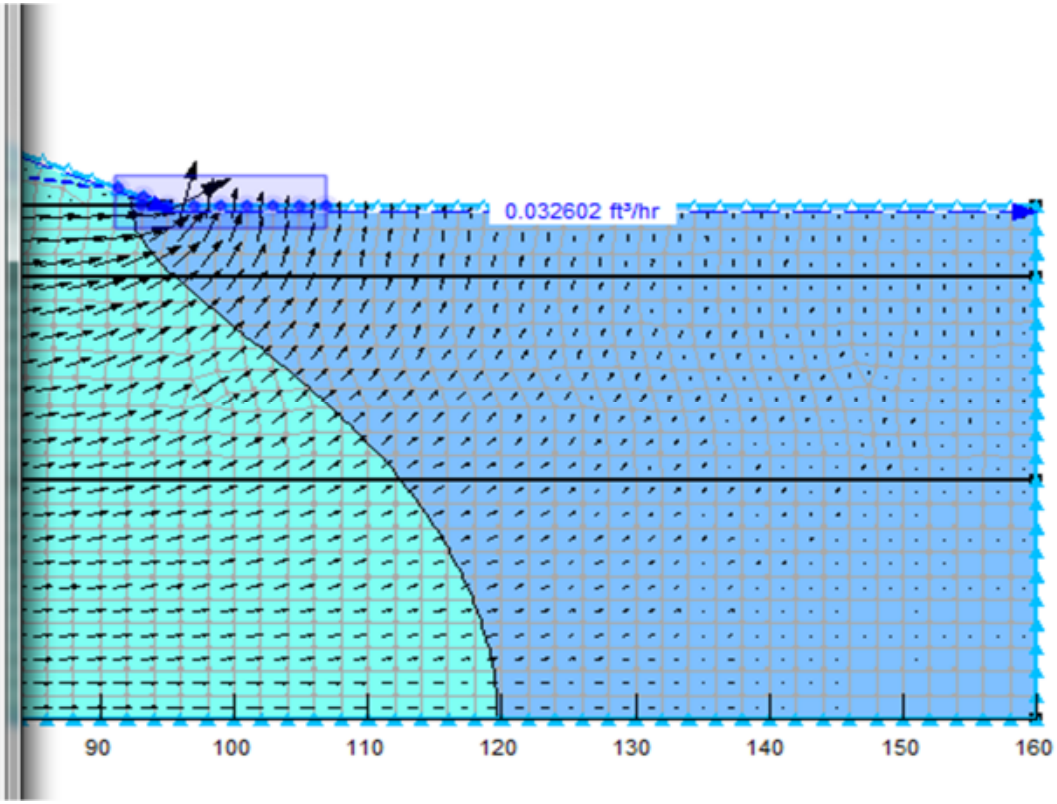
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 19

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 19

Exit Hydraulic Gradient





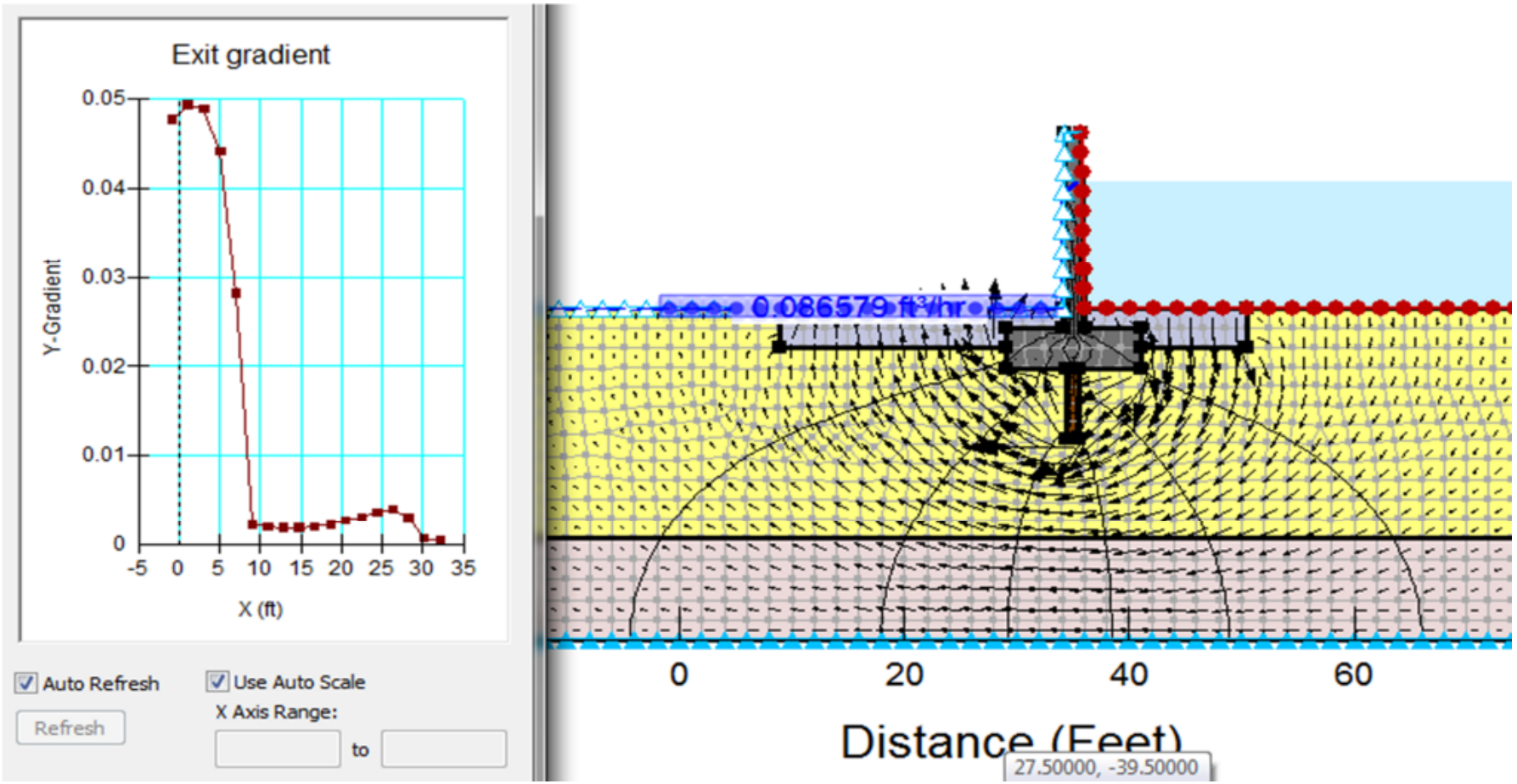
Levee (Reach A-2)
Exit Hydraulic Gradient
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 20

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 20

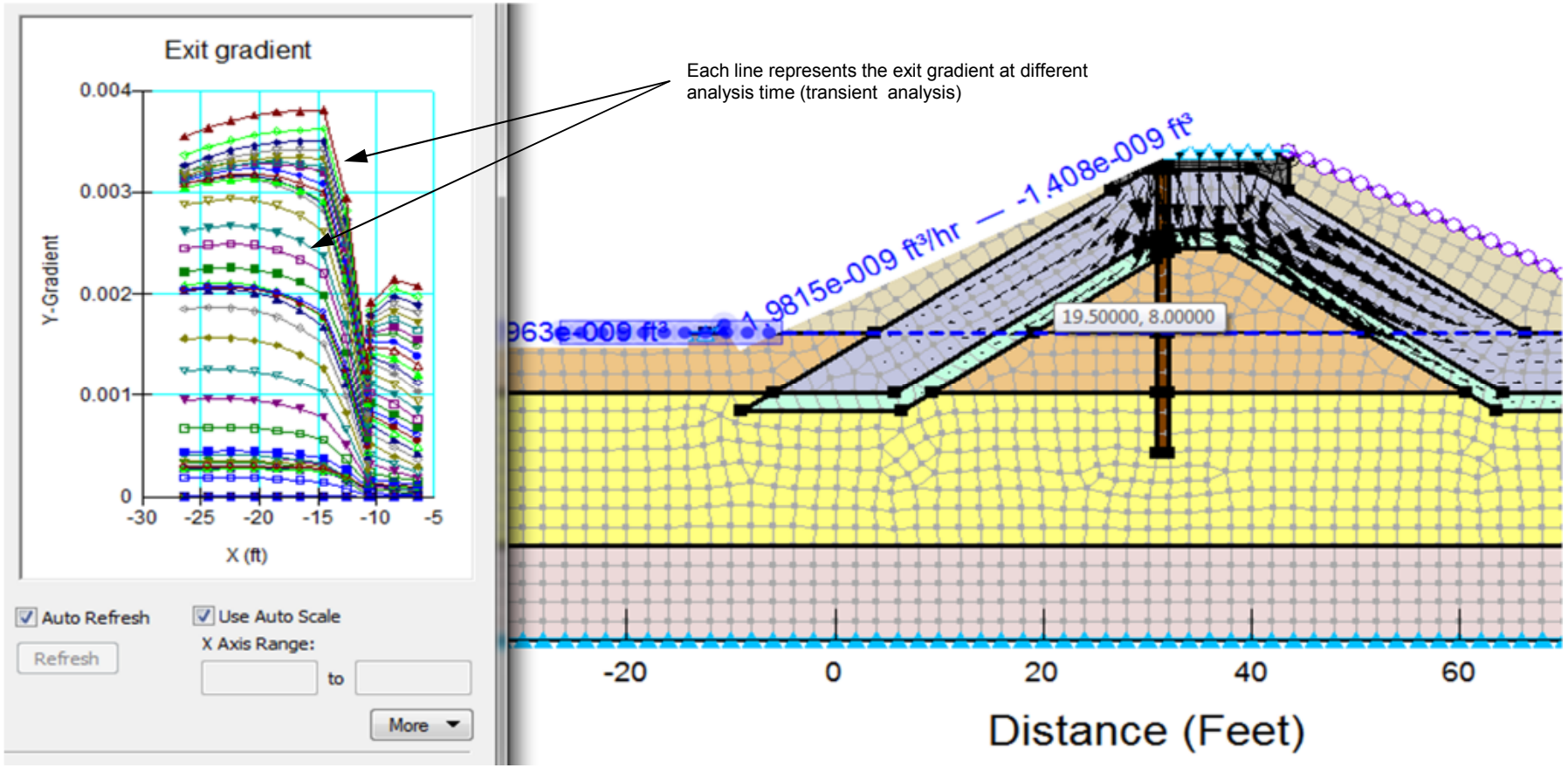
Exit Hydraulic Gradient



Floodwall (Reach A-3) **Exit Hydraulic Gradient** **Staten Island, New York**		
URS CLIFTON, NEW JERSEY		
DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 21

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 21

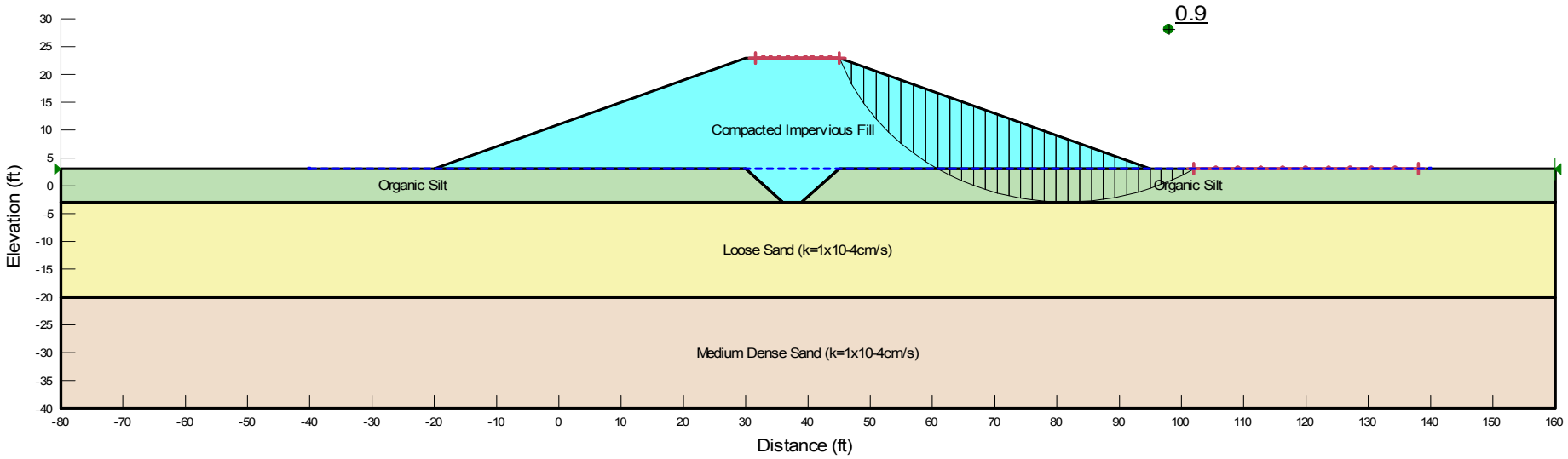
Exit Hydraulic Gradient



Buried Seawall (Reach A-4) **Exit Hydraulic Gradient** **Staten Island, New York**		
URS CLIFTON, NEW JERSEY		
DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 22

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 22

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Compacted Impervious Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: Loose Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Organic Silt Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion: 200 psf Phi: 0 ° Piezometric Line: 1



File: C2-Levee_ExGradeEl+3'.gsz Analysis: End of Construction (with Organics)
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Note:

1. The above results are for End of Construction analysis **with** Organic soil layer
2. Analysis on the Upstream Stability yielded same Factor of Safety (FOS).

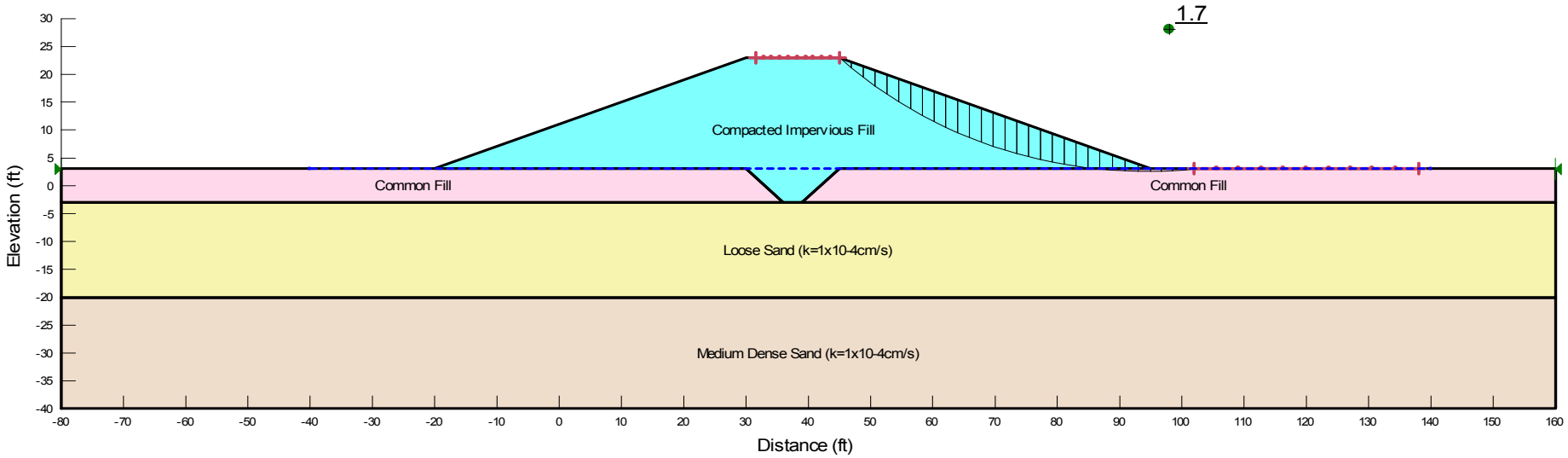
Levee (Reach A-2)
Slope Stability Case I Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 23

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 23

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Compacted Impervious Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: Loose Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Common Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1



File: C2-Levee_ExGradeEl+3'.gsz Analysis: End of Construction (Downstream Slope)
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Note:

1. The above results are for End of Construction analysis **without** the Organic soil layer
2. Analysis on the Upstream Stability yielded same Factor of Safety (FOS).

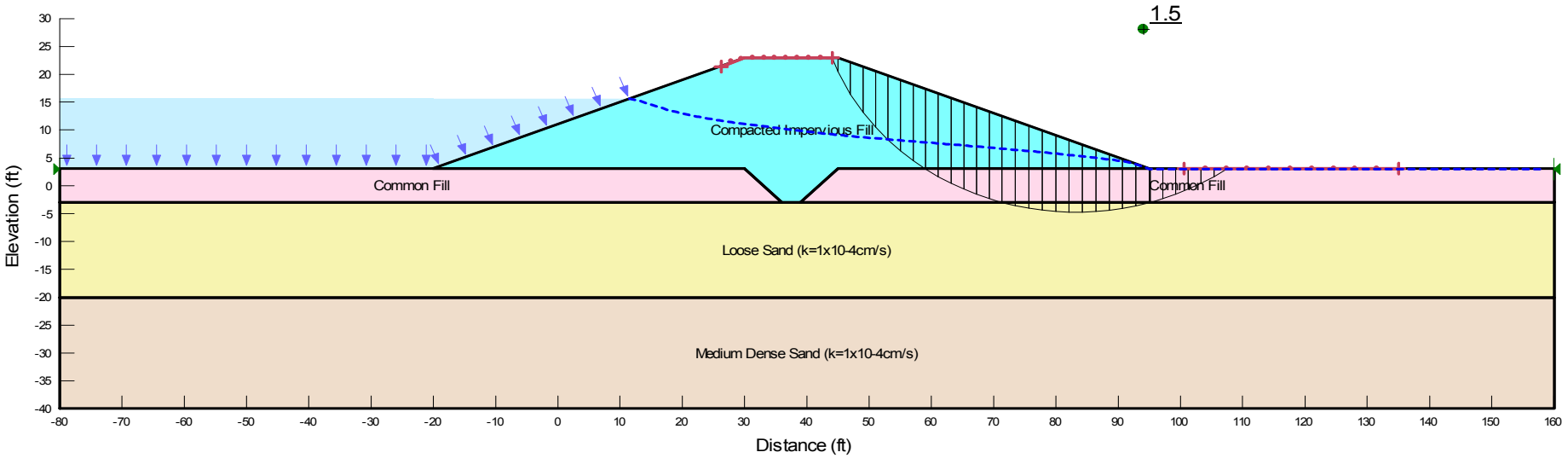
Levee (Reach A-2)
Slope Stability Case I Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 24

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 24

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Compacted Impervious Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °
Name: Loose Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 °
Name: Common Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °



File: C2-Levee_ExGradeEl+3'.gsz Analysis: Long Term
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Note:

1. The above results are for Steady Seepage analysis **without** the Organic soil layer

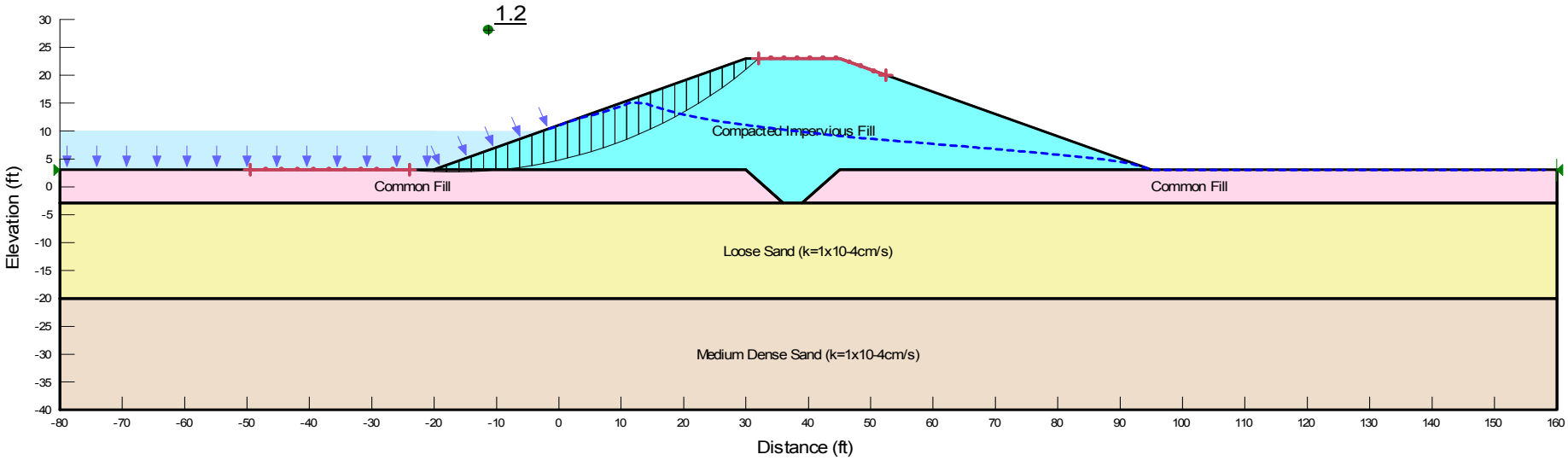
Levee (Reach A-2)
Slope Stability Case 2 Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 25

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 25

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Compacted Impervious Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °
Name: Loose Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 °
Name: Common Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °



File: C2-Levee_ExGradeEl+3'.gsz Analysis: Slope Stability
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Note:

1. The above results are for Rapid Drawdown Analysis **without** the Organic soil layer

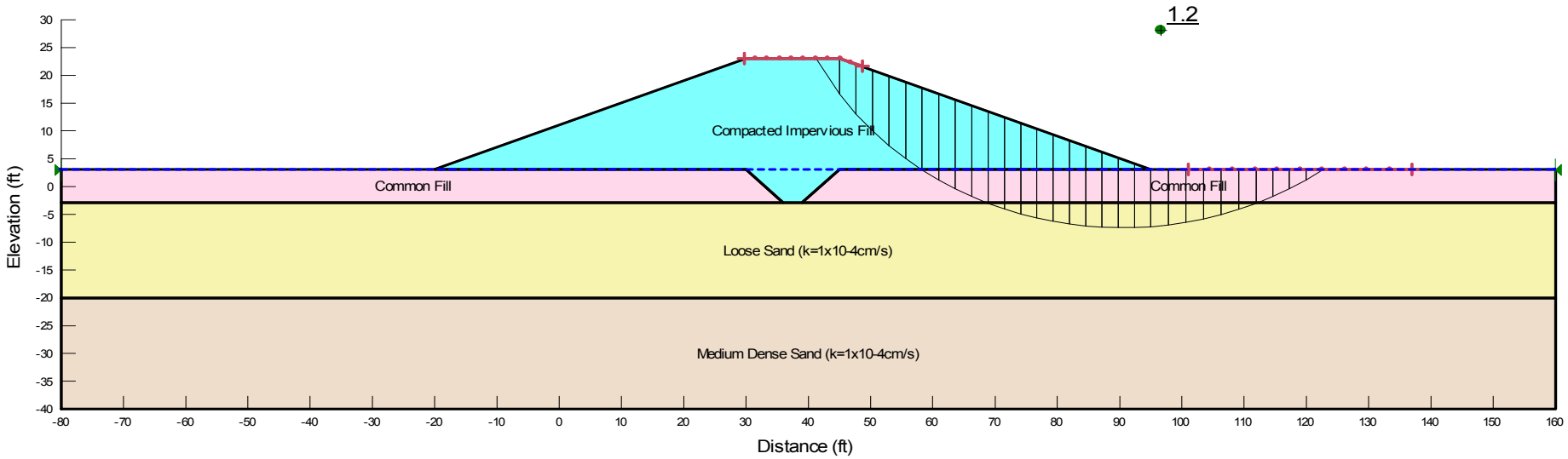
Levee (Reach A-2)
Slope Stability Case 3 Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 26

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 26

Name: Medium Dense Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Compacted Impervious Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: Loose Sand (k=1x10-4cm/s) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Common Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1



File: C2-Levee_ExGradeEl+3'.gsz Analysis: Seismic Case 2
Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\

Note:

1. The above results are for Seismic Stability Analysis **without** the Organic soil layer

Levee (Reach A-2)
Slope Stability Case 4 Results
Staten Island, New York

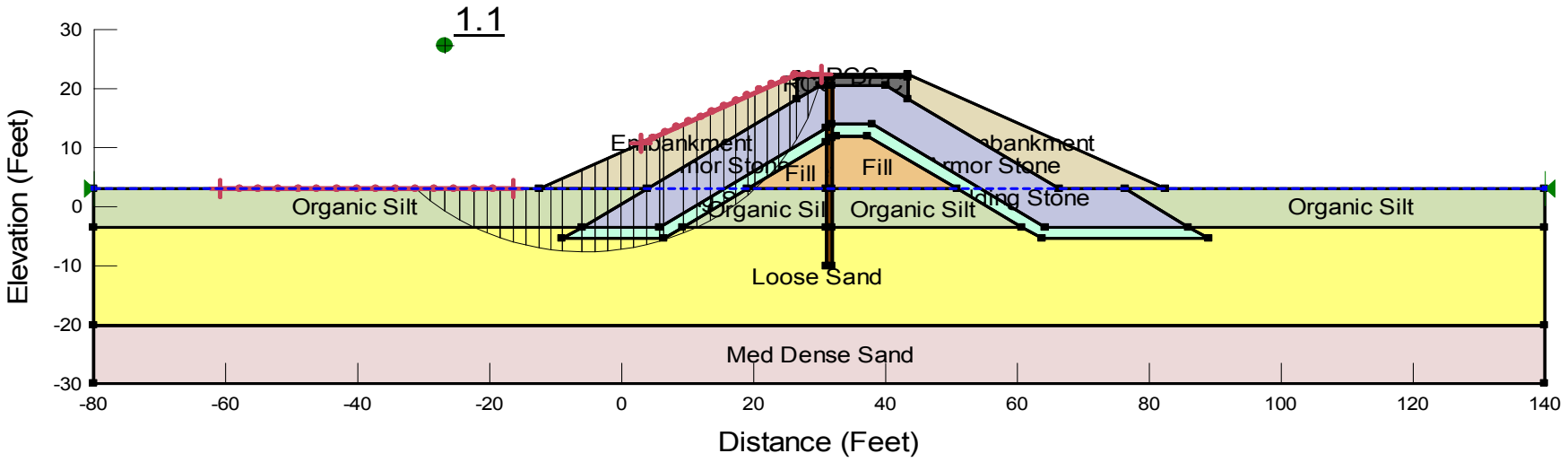
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 27

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 27

Stability: End of Construction (Downstream Slope)

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 ° Piezometric Line: 1
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 ° Piezometric Line: 1
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: Organic Silt Unit Weight: 100 pcf Cohesion: 200 psf Phi: 0 ° Piezometric Line: 1
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 1
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 ° Piezometric Line: 1
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for End of Construction analysis **with** Organic soil layer
2. Analysis on the Upstream Stability yielded same Factor of Safety (FOS).

Buried Seawall (Reach A-4)
Slope Stability Case I Results
Staten Island, New York

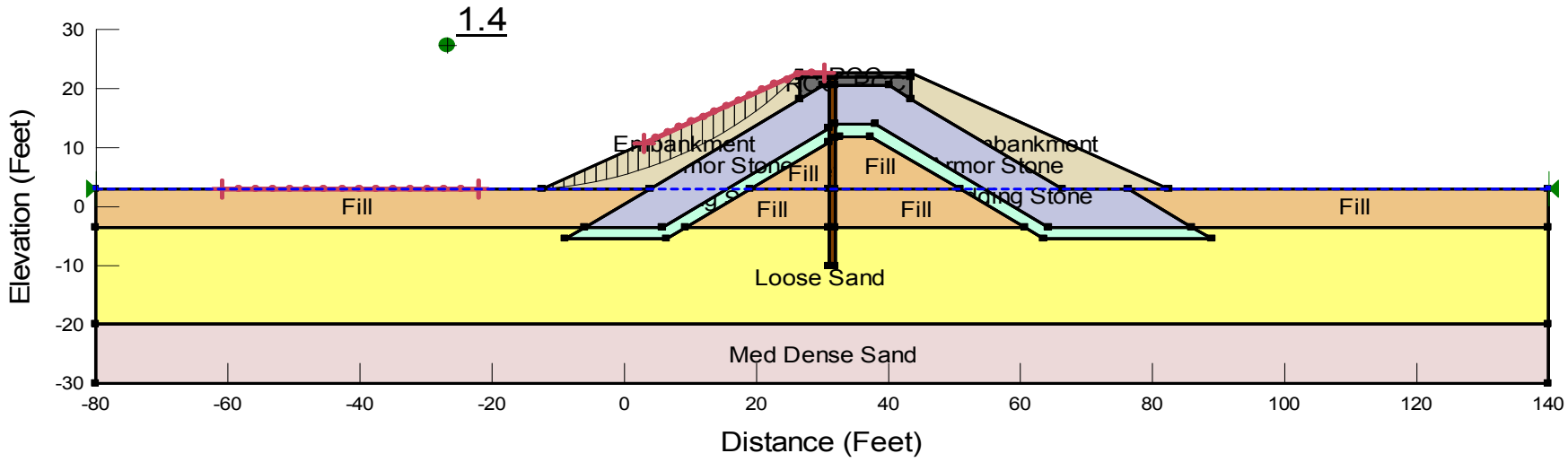
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 28

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 28

Stability: End of Construction (Downstream Slope, No Organics)

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 ° Piezometric Line: 1
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 ° Piezometric Line: 1
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 1
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 ° Piezometric Line: 1
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for End of Construction analysis **without** the Organic soil layer
2. Analysis on the Upstream Stability yielded same Factor of Safety (FOS).

Buried Seawall (Reach A-4)
Slope Stability Case I Results
Staten Island, New York

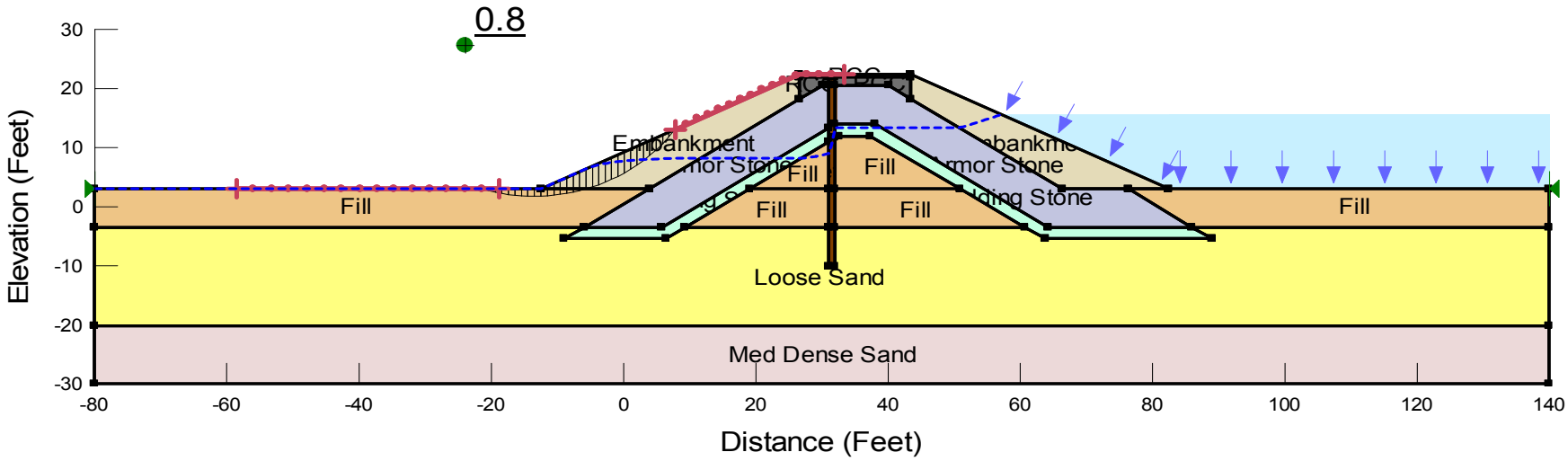
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 29

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 29

Stability: Long Term (No Organics)

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 °
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 °
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 °
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 °
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 °
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 °



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for Steady Seepage analysis **without** the Organic soil layer

Buried Seawall (Reach A-4)
Slope Stability Case 2 Results
Staten Island, New York

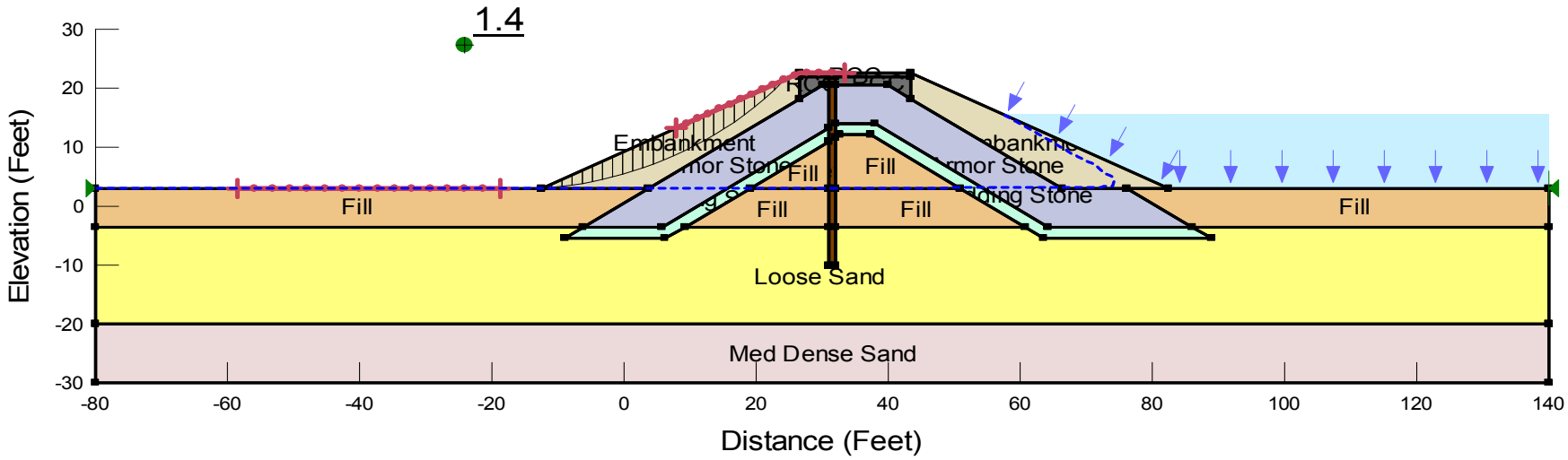
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 30

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 30

Stability: Long Term (Transient Seepage)

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 °
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 °
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 °
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 °
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 °
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 °



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for Transient Seepage analysis **without** the Organic soil layer

Buried Seawall (Reach A-4)
Slope Stability Case 2 Results
Staten Island, New York

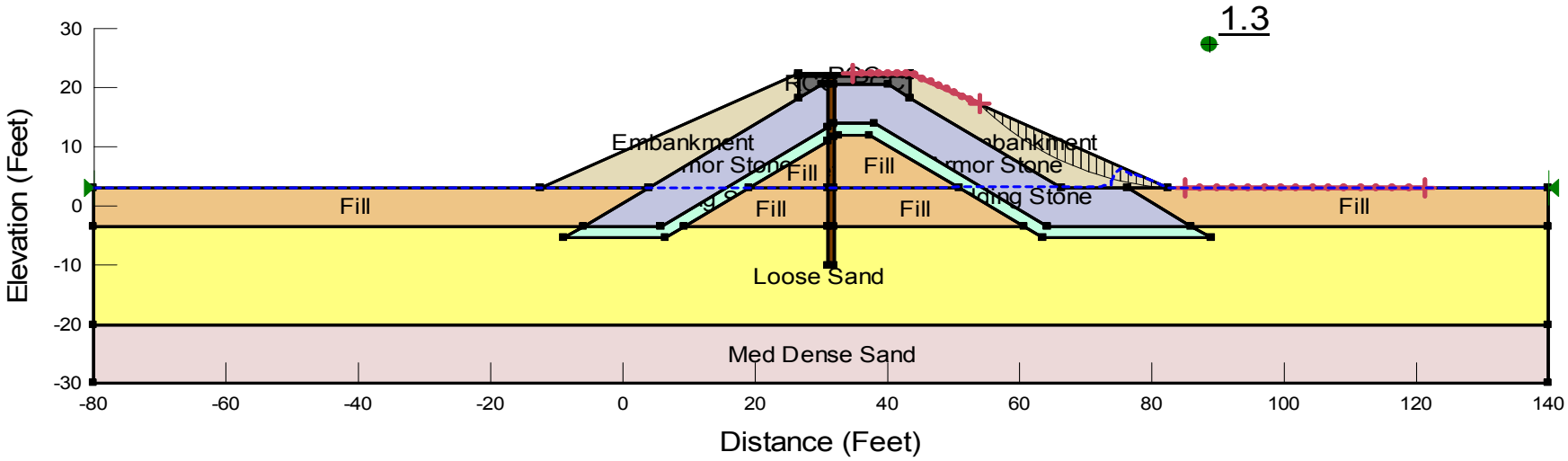
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 31

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 31

Stability: Rapid Drawdown

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 °
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 °
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 °
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 °
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 °
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 °
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 °



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for Rapid Drawdown analysis **without** the Organic soil layer

Buried Seawall (Reach A-4)
Slope Stability Case 3 Results
Staten Island, New York

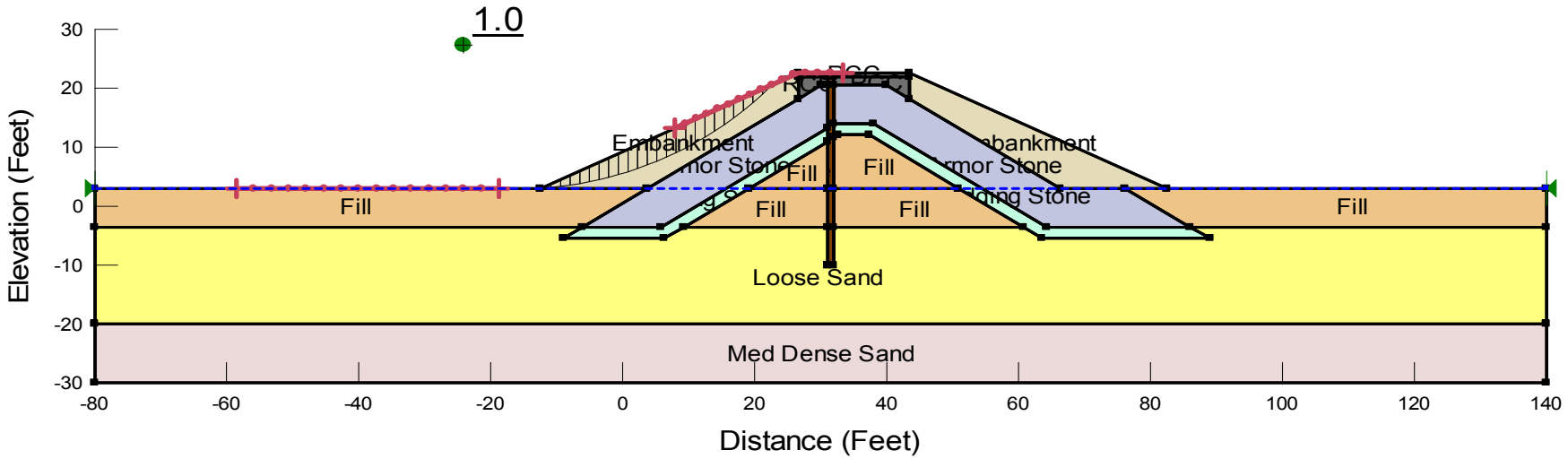
URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 32

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 32

Stability: Seismic Loading

Name: Loose Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Piezometric Line: 1
Name: Med Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Armor Stone Unit Weight: 145 pcf Cohesion: 0 psf Phi: 38 ° Piezometric Line: 1
Name: Bedding Stone Unit Weight: 140 pcf Cohesion: 0 psf Phi: 36 ° Piezometric Line: 1
Name: Embankment Unit Weight: 125 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1
Name: RCC Unit Weight: 150 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 1
Name: sheet pile Unit Weight: 150 pcf Cohesion: 1000 psf Phi: 0 ° Piezometric Line: 1
Name: Fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 ° Piezometric Line: 1



Directory: I:\Projects\11020302(South Shore of Staten Island)\Slope Stability Analysis\Analyses_withNewAlignment\C2_BuriedSeawall_SWL15-6ft_ExGradeEl-3'.gsz

Note:

1. The above results are for Seismic Stability analysis **without** the Organic soil layer

Buried Seawall (Reach A-4)
Slope Stability Case 4 Results
Staten Island, New York

URS
CLIFTON, NEW JERSEY

DR. BY: SK	SCALE: As Shown	PROJ: 11020302
	DATE: September, 2014	FIG NO: 33

I:\Projects\11020302(South Shore of Staten Island)\Report\Figures\Figure 33

ATTACHMENT A – TEST BORING LOGS (USACE)

SS02-4

140339

20.0'

South Shore SI

951280

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	5, 7, 10, 10	S1		Brown, fine to coarse SAND, some fine to coarse Gravel, little Silt (SM)	
	2					
	3	6, 4, 3, 7	S2		Black-brown, fine to coarse SAND, some fine to coarse Gravel, little Silt (SM)	Debris (glass)
	4					
15	5	5, 5, 4, 3	S3		Brown, fine to coarse SAND, some Silt, little fine to medium Gravel (SM)	
	6	2, 2, 6, 7	S4			
	7					
	8	4, 3, 2, 2	S5		Black, fine to coarse SAND, some fine to coarse Gravel, little Silt (SP)	
10	9					
	10	2, 3, 5, 4	S6		Brown, fine-coarse SAND, some Clayey Silt, little fine to medium Gravel (SM)	
	11					
	12				Brown, fine to coarse SAND, some Silt, little fine to medium Gravel (SP-SW)	
	13					
	14					
5	15	6, 6, 6, 8	S7		Brown, Clayey SILT, little fine Sand, little fine Gravel (CL)	
	16					
	17					
	18					
	19					
0	20	3, 5, 6, 2	S8		Red-brown, fine to coarse SAND, some fine to coarse Gravel, trace Silt (SP-GP)	
	21					
	22					
	23					
	24					
-5	25	8, 6, 7, 8	S9		Red-brown, fine to coarse SAND, little fine to coarse Gravel, trace Silt (SP)	
	26					
	27	8, 7, 8, 10	S10			
	28					
	29					TD = -29'
-10	30					
	31					
	32					
	33					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
4-6'	SM	28	53	19				4.6	2.64	89.6
15-17'	SM	19	51	30				23.7		63.8

SS02-5

139575

8.0'

South Shore SI

951641

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	2, 4, 8, 10	S1		Brown, fine to coarse SAND, some Silt, trace fine Gravel (SM)	
	2	9, 11, 8, 7	S2		Red-brown, fine-coarse SAND, some fine-med Gravel, little Silt (SM)	
5	3					
	4	4, 3, 3, 3	S3		Brown, fine to coarse SAND, some fine-med Gravel, little Silt (SW-SM)	
	5					
	6	1, 1, 1, 1	S4		Black, Silty CLAY (CL)	Roots
	7					
0	8		U/T			
	9					
	10	3, 3, 4, 3	S5		Red-brown, fine to coarse SAND, some fine to coarse Gravel, little Silt (SP)	
	11					
	12					
-5	13					
	14					
	15	4, 5, 10, 9	S6			
	16					
	17					
-10	18					
	19					
	20	2, 4, 3, 3	S7		Red-brown, fine to coarse SAND, some Silt, trace fine Gravel (SM)	
	21					
	22					
-15	23					
	24					
	25	3, 3, 8, 7	S8			
	26					
	27					
-20	28	5, 8, 11, 16	S9			
	29					TD = -22'
	30					
	31					
	32					
-25	33					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
2-4'	SW-SM	33	59	8				6.5		
8-10'	CL-ML				23	18	5			108.1

SS02-6

139461

10.0'

South Shore SI

952130

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	5, 5, 8, 13	S1		Brown, fine to coarse SAND, some Silt (SM)	Top Soil
	2	25, 19, 14, 8	S2			
	3					No Recovery
	4	5, 3, 3, 4	S3			
5	5					
	6	13, 7, 5, 4	S4		Brown, fine to coarse SAND, some Clayey Silt, trace fine Gravel (SM)	
	7					
	8	4, 3, 3, 4	S5			
	9					
0	10	WOH, 1, 1, 1	S6		Brown, fine to coarse SAND, little Silt, trace fine Gravel (SM)	
	11					
	12	1, 1, 1, 1	S7			
	13					Peat on rotor bit
	14					
-5	15					
	16					
	17					
	18		U/X/T			Shelby Tube (No Recovery)
	19					
-10	20	2, 10, 11, 12	S8		Brown, fine to coarse SAND, little fine Gravel, little Silt (SP-SM)	
	21					
	22					
	23					
	24					
-15	25	5, 8, 9, 7	S9			
	26					
	27					
	28	3, 9, 9, 11	S10			
	29					
-20	30					TD --30'
	31					
	32					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
20-22'	SP-SM	11	83	6				18.0		

SS02-7

139500

8.0'

South Shore SI

952636

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	3,4,5,3	S1		Brown, Clayey SILT, some fine to medium Sand (CL-ML)	Roots
	2					
5	3	7,3,3,2	S2		Brown, Clayey SILT, some fine to med Sand, little fine Gravel (SM)	
	4					
	5	3,4,4,5	S3		Brown, fine to coarse SAND, some Silt, little fine-med Gravel (SM)	
	6					
	7	3,3,2,4	S4		Gray-brown, fine to coarse SAND, some Silt, trace fine Gravel (SM)	
0	8					
	9	5,7,7,8	S5		Red-brown, fine to coarse SAND, little Silt, little fine to medium Gravel (SM-SP)	
	10					
	11	2,4,3,4	S6			
	12					
-5	13					
	14					
	15					
	16	3,3,5,5	S7			
	17					
-10	18					
	19					
	20					
	21	1,2,2,3	S8			
	22					
-15	23					
	24					
	25					
	26	3,5,6,7	S9		Red-brown, fine to coarse SAND, little Silt (SM-SP)	
	27					
-20	28	4,4,5,4	S10			
	29					TD = -21'
	30					
	31					
	32					
-25	33					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
20-22'	SP-SM	3	92	5				4.2		

SS02-8

141760

6.0'

South Shore SI

955498

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
5	1	1, 4, 8, 12	S1		Brown, fine to medium SAND, trace Silt (SP)	
	2	11, 12, 17, 17	S2			
	3					
	4	15, 19, 23, 22	S3		Brown, fine to coarse SAND, little fine Gravel, trace Silt (SP)	
0	5					
	6	12, 9, 9, 10	S4		Gray-black Clayey SILT (OL)	
	7					
	8	4, 5, 8, 10	S5		Gray, fine to coarse SAND, some fine to coarse Gravel, trace Silt (SP-GP)	
	9					
	10	4, 6, 9, 11	S6		Red-brown, fine to coarse SAND, some fine to medium Gravel, trace Silt (SP-GP)	
-5	11					
	12					
	13					
	14					
	15	5, 7, 9, 10	S7		Red-brown, fine to coarse SAND, trace fine Gravel, trace Silt (SP)	
-10	16					
	17					
	18					
	19					
	20	5, 6, 7, 8	S8		Brown, fine to medium SAND, trace Silt (SP)	
-15	21					
	22					
	23					
	24					
	25	5, 9, 13, 13	S9		Red-brown, fine to medium SAND, little fine Gravel, trace Silt (SP)	
-20	26					
	27	3, 9, 12, 16	S10			
	28					TD = -23'
	29					
	30					
-25	31					
	32					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
2-4'	SW	26	69	5				2.3		
8-10'	SM	45	41	14				15.7		109.8

SS02-9

143132

14.0'

South Shore SI

956265

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	2, 3, 7, 8	S1		Brown, fine to medium SAND, trace Silt (SP)	
	2	8, 10				
	3	13, 13	S2			
10	4	15, 18				
	5	19, 26	S3			
	6	20, 23				
	7	18, 18	S4			
	8	7, 12				
5	9	18, 15	S5			
	10	10, 32			Gray-brown, fine to coarse SAND, some fine to coarse Gravel, trace Silt (SP-GP)	
	11	32, 20	S6			
	12					
	13					
0	14					
	15	6, 8			Red-brown, fine to coarse SAND, some fine to medium Gravel, trace Silt (SP-GP)	
	16	11, 11	(S7)			
	17					
	18					
-5	19					
	20	6, 10			Red-brown, fine SAND, trace Silt (SP)	
	21	10, 12	S8			
	22	12, 13			Red-brown, fine to medium SAND, trace fine Gravel, trace Silt (SP)	
	23	14, 18	S9			
-10	24					TD = -10'
	25					
	26					
	27					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
15-17'	SP-SM	12	82	6				20.4	2.68	102.1

SS02-10

144078

12.0'

South Shore SI

957301

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	1, 3, 4	S1		Brown, fine to medium SAND, trace Silt (SP)	
10	2	4, 7				
	3	10, 11, 13	S2		Red-brown, fine to coarse SAND, little fine Gravel, trace Silt (SP)	
	4	8				
	5	10, 8, 10	S3			
	6	6				
5	7	6, 8	S4			
	8	8, 6				
	9	8, 8, 12	S5			
	10	5				
	11	8, 9, 12	S6		Red-brown, fine to medium SAND, trace Silt (SP)	
0	12					
	13					
	14					
	15	9				
	16	11, 15, 15	S7		Red-brown, fine to coarse SAND, some fine Gravel, trace Silt (SP)	
-5	17					
	18					
	19					
	20	6				
	21	9, 10, 11	S8		Red-brown, fine to medium SAND, trace Silt (SP)	
-10	22	7				
	23	9, 10, 10	S9			
	24					TD = -12'
	25					
	26					
-15	27					
	28					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
2-4'	SM	24	62	14				9.7		

SS02-11

144545

10.0'

South Shore SI

957784

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	2, 6, 12, 12	S1		Brown, fine to medium SAND, trace Silt (SP)	
	2	9, 9, 12, 13	S2			
	3					
	4	9, 12, 12, 12	S3			
5	5					
	6	11, 12, 12, 15	S4		Brown, fine to coarse SAND, trace Silt (SP)	
	7					
	8	10, 12, 12, 13	S5		Brown, fine to coarse SAND, little fine Gravel, trace Silt (SP)	
0	9					
	10	9, 10, 10, 12	S6			
	11					
	12					
	13					
	14					
-5	15	7, 10, 13, 15	S7		Brown, fine SAND, trace Silt (SP)	
	16					
	17					
	18					
	19					
-10	20	10, 11, 11, 14	S8			
	21					
	22					
	23					
	24					
-15	25	8, 12, 17, 17	S9		Brown, fine to coarse SAND, little fine to medium Gravel, trace Silt (SP)	
	26					
	27	8, 11, 15, 15	S10			
	28					
	29					TD = -19'
-20	30					
	31					
	32					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
2-4'	SP-SW	6	85	9				49.8	2.70	93.3
25-27'	SP-SM	19	74	7				17.1		

SS02-12

145244

11.0'

South Shore SI

958431

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
10	1	2 2 6 8	S1		Brown, fine to medium SAND, trace Silt (SP)	
	2	6 8 12 16	S2			
	3	9 11 11 12	S3			
	4	8 12 17 21	S4			
5	5	14 17 20 20	S5			
	6	5 12 19 20	S6			
	7					
	8					
0	9					
	10					
	11					
	12					
	13					
	14					
	15	10 19 18 18	S7		Brown, fine SAND, trace fine Gravel, trace Silt (SP)	
-5	16					
	17					
	18					
	19					
	20	8 12 12 13	S8		Brown, fine to medium SAND, trace fine Gravel, trace Silt (SP)	
-10	21					
	22	11 14 15 17	S9A S9B			
	23					
	24					TD = -14'
	25					
-15	26					
	27					
	28					
	29					
	30					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
6-8'	SP		98	2				5.8	2.68	104.1

SS02-13

147153

12.0'

South Shore SI

959647

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	3, 11, 9, 10	S1		Red, fine to coarse SAND, little fine Gravel, trace Silt (SW)	Top Soil & Fill
10	2	9				
	3	8, 8, 9	S2			
	4	5			Brown, fine to coarse SAND, trace Silt (SW)	
	5	6, 7, 6	S3			
	6	4				
5	7	5, 4, 6	S4			
	8	4				
	9	4, 3, 4	S5			
	10	2			Red-brown, fine to coarse SAND, some fine to medium Gravel, trace Silt (SP-GP)	
	11	2, 8, 6	S6			
0	12					
	13					
	14	1			No Recovery	
	15	WOH, WOH			Silty CLAY, some fine to coarse Sand (CL-SC)	
	16	1, 1	S7			
-5	17				Fine to coarse SAND, some Silt, little fine Gravel (SM)	
	18					
	19					
	20					
	21					
-10	22	1			Brown, fine to coarse SAND, little Silt, trace fine Gravel (SM)	
	23	2, 3, 3	S8			
	24					
	25	2				
	26	3, 7, 7	S9			
-15	27					
	28	2				
	29	6, 7, 8	S10			
	30					TD = -18'
	31					
-20	32					
	33					
	34					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
2-4'	SP	2	95	3				5.0		
15-17'	SW-SM	26	62	12	25	21	4	24.7		92.9
22-24'	SP-SM	1	89	10				25.5	2.68	97.4

SS02-14

148917

11.0'

South Shore SI

961615

ELEVATION	DEPTH	BLOWS/6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
		2			Clayey SILT (ML)	Top Soil
10	1	2 5 7	S1		Red-brown, fine to coarse SAND, little Silt, little fine Gravel (SM)	
	2	8				
	3	8 3 5	S2		Red-brown, fine to coarse SAND, little fine to medium Gravel, trace Silt (SP)	
	4	3				
	5	6 5 4	S3			
5	6	4				
	7	3 3	S4			
	8	4 3				
	9	2 4 3	S5			
	10	2				
0	11	2 3 4	S6			
	12					
	13					
	14					
	15	1				
-5	16	2 2 4	S7		Gray SILT (ML)	
	17					
	18					
	19					
	20		U T		No Recovery	
-10	21					
	22					
	23		U T			
	24					
	25	1			Red-brown, fine to medium SAND, some Silt, little fine to medium Gravel (SM)	
-15	26	3 3 4	S8			
	27	3				
	28	4 6 5	S9			
	29					TD = -18'
	30					
-20	31					
	32					
	33					
	34					
	35					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
15-17'	SM		79	21				25.1		

SS02-15

151395

11.0'

South Shore SI

963919

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
10	1	3, 7, 9, 11	S1		Brown, fine to coarse SAND, trace Silt (SW)	
	2	11				
	3	11, 12, 13	S2		Brown, fine to coarse SAND, little fine Gravel, trace Silt (SW)	
	4	10				
	5	9, 9, 10	S3		Brown, fine to coarse SAND, little fine-medium Gravel, trace Silt (SW)	
5	6	9				
	7	10, 10, 12	S4		Brown, fine to medium SAND, trace fine Gravel, trace Silt (SW)	
	8	6				
	9	8, 8, 9	S5		Brown, fine to medium SAND, little fine Gravel, trace Silt (SW)	
	10	5				
0	11	5, 6, 8	S6		Brown, fine to medium SAND, trace Silt (SW)	
	12					
	13					
	14					
	15	2				
-5	16	10, 15, 16	S7		Gray, fine SAND, trace fine Gravel, trace Silt (SP)	
	17					
	18					
	19					
	20	15				
-10	21	11, 15, 16	S8		Gray, fine SAND, trace Silt (SP)	
	22					
	23					
	24					
	25	5				
-15	26	3, 3	S9		Gray, Silty CLAY (CL)	
	27	3				
	28	4, 5, 6	S10			
	29					TD= -18'
	30					
-20	31					
	32					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
4-6'	SW	40	56	4				3.8	2.64	79.5
25-27'	CL		35	65	25			36.0		107.4

SS02-16

153816

8.0'

South Shore SI

965838

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	1 3 7 12	S1		Brown, fine to medium SAND, trace Silt (SP)	
	2	9				
5	3	8 11 12	S2			
	4	8				
	5	8 8	S3			
	6	9 7				
	7	6 5	S4			
0	8	5 5				
	9	6 6 8	S5			
	10	3			Gray-brown, fine to coarse SAND, trace Silt (SP)	
	11	8 17 26	S6			
	12					
-5	13					
	14					
	15	9 12			Gray-brown, fine to medium SAND, trace Silt (SP)	
	16	11 13	S7			
	17					
-10	18					
	19					
	20	10 10			Gray-brown, fine to coarse SAND and fine to coarse GRAVEL, trace Silt (GW)	
	21	6 20	S8			
	22					
-15	23					
	24					
	25	13 13			Red-brown, fine SAND, trace Silt (SP)	
	26	13 16	S9			
	27	15 20				
-20	28	22 25	S10			
	29					TD = -21'
	30					
	31					
	32					

DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
0-2'	SW	3	93	4				4.2	2.68	104.5
20-22'	GW	67	32	1				13.5		

SS02-17

155794

8.0'

South Shore SI

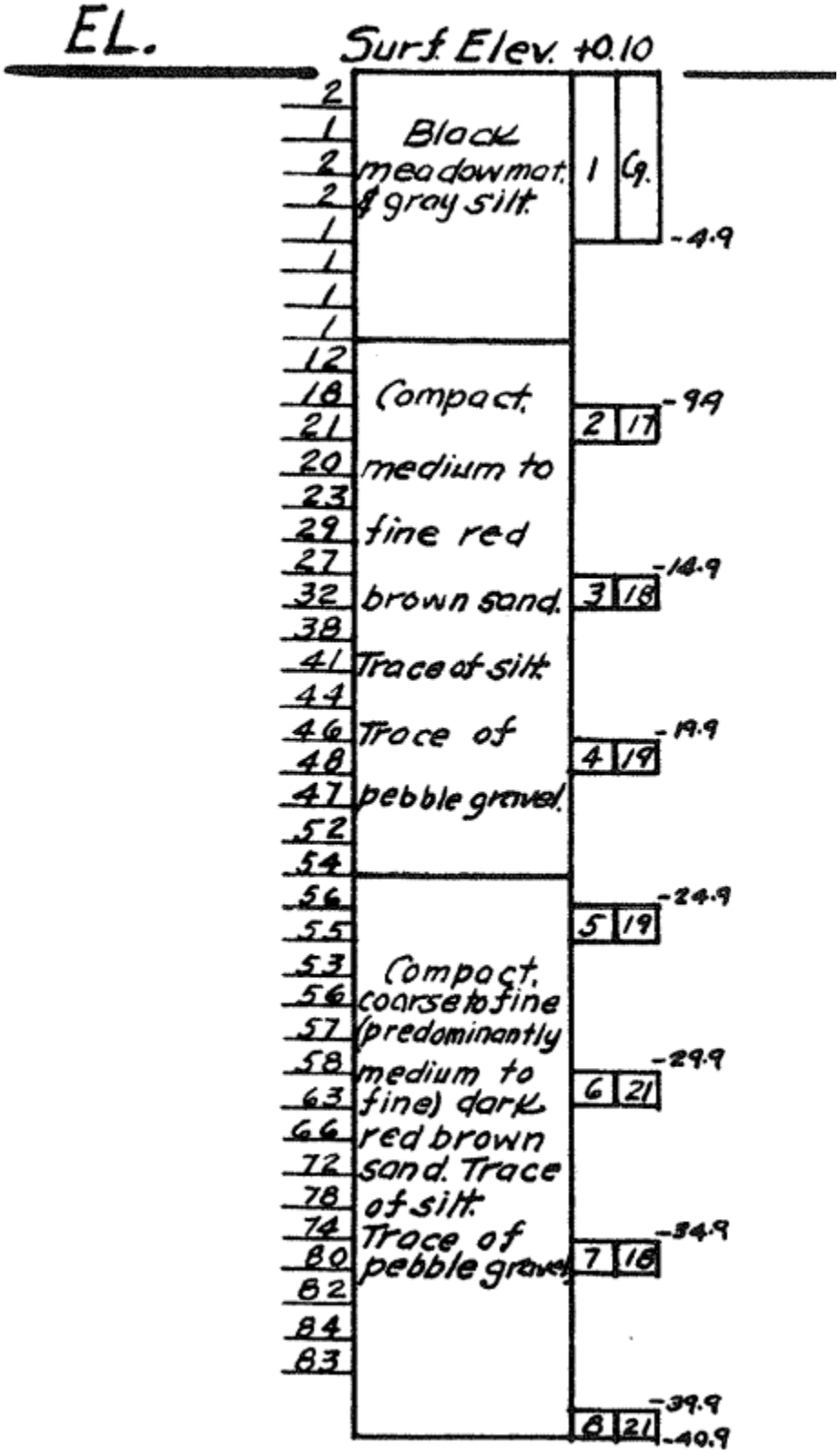
967367

ELEVATION	DEPTH	BLOWS 6"	SAMPLE NUMBER	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
	1	1 2 3 6	S1		Brown, fine to medium SAND, little Clayey Silt (SP-SM)	Roots
	2	4				
5	3	5 9 14	S2		Brown, fine to medium SAND, trace Silt (SP)	
	4	15				
	5	18 20 28	S3			
	6	10				
	7	14 20 20	S4			
0	8	7				
	9	9 4 3	S5		Red-brown, fine to coarse SAND, little f. Gravel, trace Silt (SW)	
	10	5				
	11	8 14 18	S6		Gray, fine to coarse SAND, little fine Gravel, trace Silt (SW)	
	12					
-5	13					
	14					
	15	10				
	16	20 13 13	S7		Red-brown, fine SAND, little Silt (SP-SM)	
	17					
-10	18					
	19					
	20	15				
	21	28 32 32	S8		Red-brown, fine to medium SAND, trace Silt (SP)	
	22	20				
-15	23	25 29 34	S9		Red-brown, fine to coarse SAND, trace Silt (SP)	
	24					TD = -16'
	25					
	26					
	27					

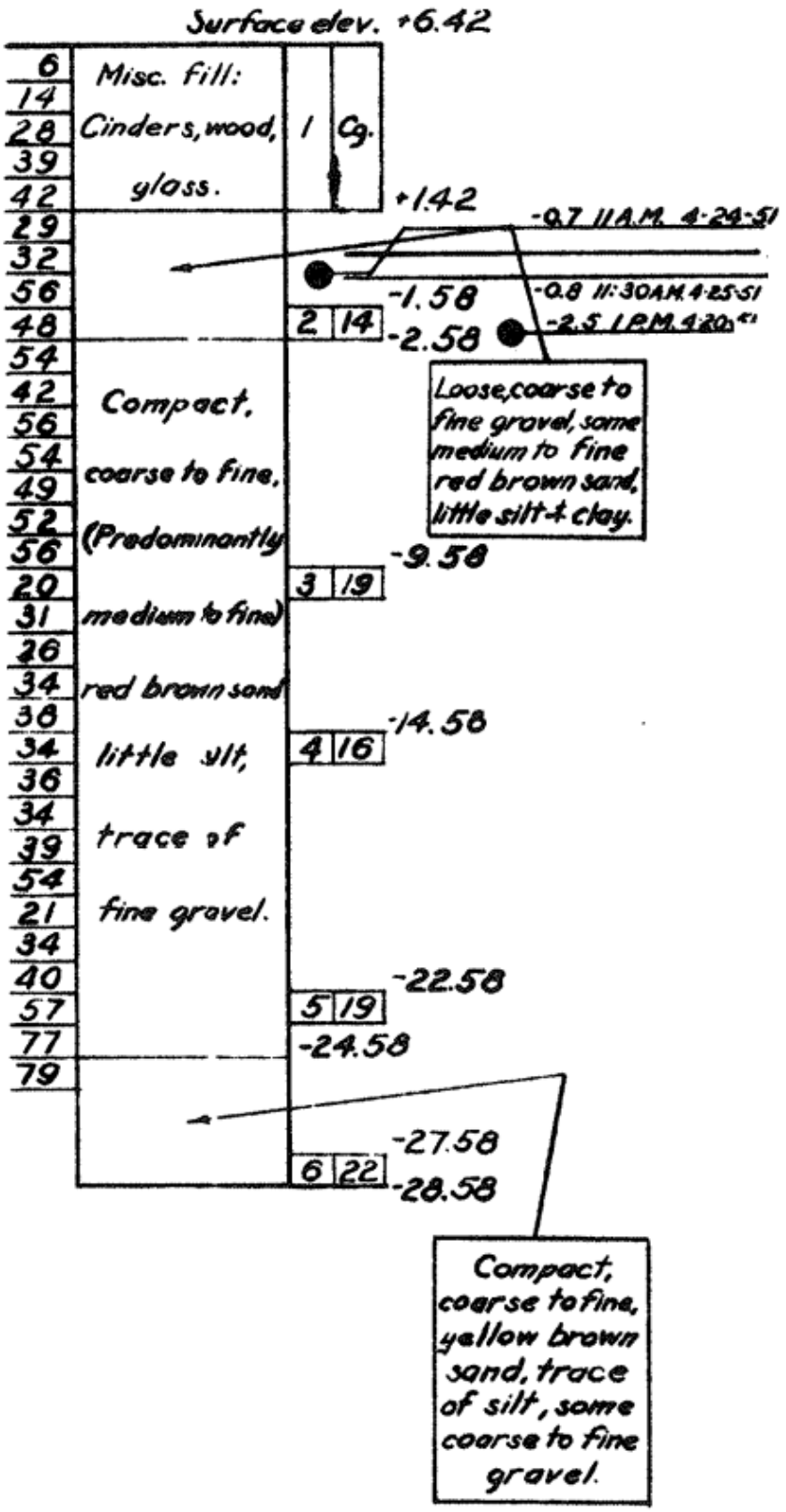
DEPTH	USCS	%G	%S	%F	LL	PL	PI	%H2O	SG	UnitWt
10-12'	SP-SM	2	92	6				20.2	2.69	100.2

ATTACHMENT B – TEST BORING LOGS (NYCDEP)

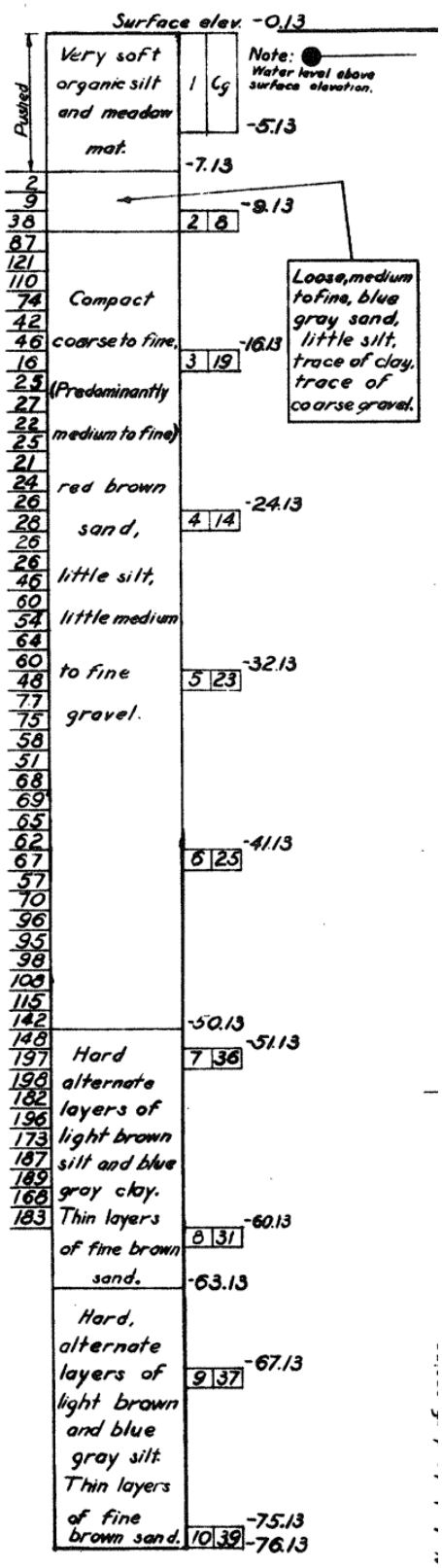
Boring A


EL.
Surf. Elev. +0.10
2
1
2
2
1
1
1
1
Black meadow mat. & gray silt.
1
Cy.
-4.9
12
18
21
20
23
29
27
32
38
41
44
46
48
47
52
54
Compact. medium to fine red brown sand. Trace of silt. Trace of pebble gravel.
2
17
-9.9
3
18
-14.9
4
19
-19.9
56
55
53
56
57
58
63
66
72
78
74
80
82
84
83
Compact. coarse to fine (predominantly medium to fine) dark red brown sand. Trace of silt. Trace of pebble gravel
5
19
-24.9
6
21
-29.9
7
18
-34.9
8
21
-39.9
-40.9

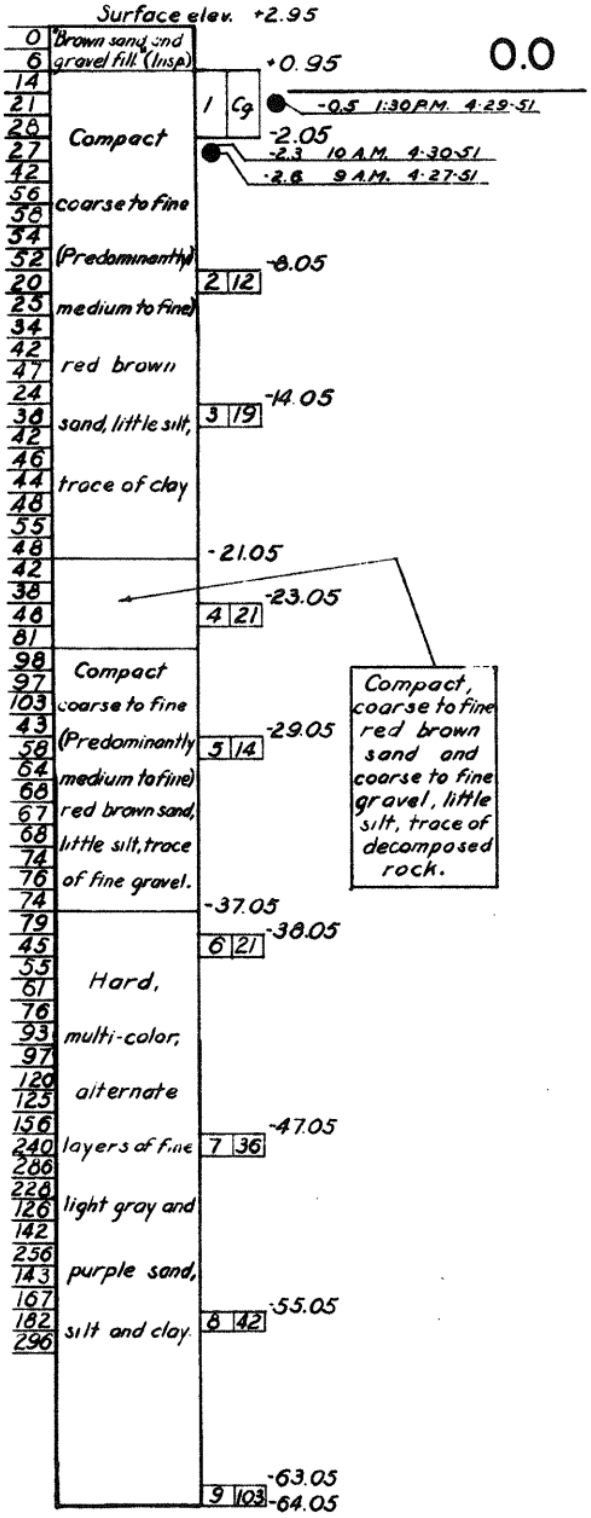
Boring B-2


Surface elev. +6.42
6
14
28
39
42
Misc. fill:
Cinders, wood,
glass.
1
Cg.
+1.42
-0.7 11 A.M. 4-24-51
29
32
56
48
-1.58
-0.8 11:30 A.M. 4-25-51
-2.5 1 P.M. 4-26-51
2
14
-2.58
Loose, coarse to fine gravel, some medium to fine red brown sand, little silt & clay.
54
42
56
54
49
52
56
Compact,
coarse to fine,
(Predominantly
-9.58
20
31
26
34
38
3
19
medium to fine)
red brown sand
little silt,
-14.58
34
36
34
39
54
21
34
4
16
trace of
fine gravel.
40
57
77
79
-22.58
5
19
-24.58
-27.58
6
22
-28.58
Compact, coarse to fine, yellow brown sand, trace of silt, some coarse to fine gravel.

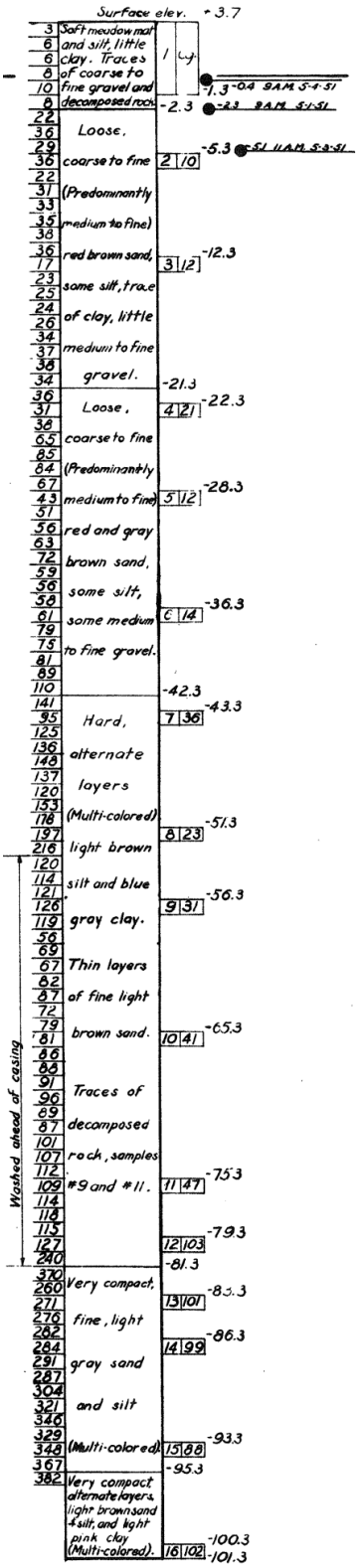
Boring B-3


Surface elev. -0.13
Note: Water level above surface elevation.
Pushed
Very soft organic silt and meadow mat.
1 Cg
-5.13
-7.13
2 9 38
2 8
-9.13
87 121 110 74 42 46 16 25 27 22 25 21 24 26 28 26 26 46 60 54 64 60 48 77 75 58 51 68 69 65 62 67 57 70 96 95 98 109 115 142
Compact coarse to fine. (Predominantly medium to fine) red brown sand, little silt, little medium to fine gravel.
Loose, medium to fine, blue gray sand, little silt, trace of clay, trace of coarse gravel.
3 19
-16.13
4 14
-24.13
5 23
-32.13
6 25
-41.13
-50.13
148 197 198 182 196 173 187 189 168 183
Hard alternate layers of light brown silt and blue gray clay. Thin layers of fine brown sand.
7 36
-51.13
8 31
-60.13
-63.13
Hard, alternate layers of light brown and blue gray silt. Thin layers of fine brown sand.
9 37
-67.13
10 39
-75.13
-76.13

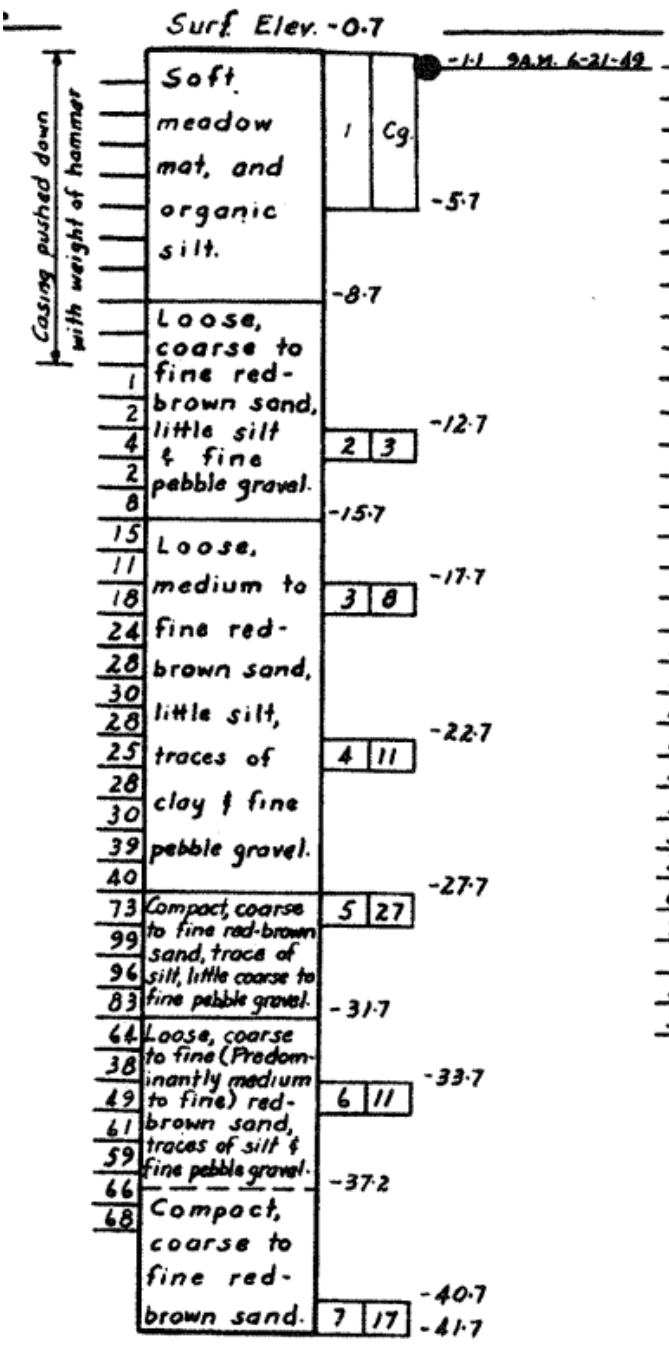
Boring B-4


Surface elev. +2.95
0 6 Brown sand and gravel fill (Insp.)
+0.95
0.0
14 21 28 27 42 56 58 Compact coarse to fine (Predominantly) medium to fine) red brown sand, little silt, trace of clay
1 Cg
-0.5 1:30 P.M. 4-29-51
-2.05
-2.3 10 A.M. 4-30-51
-2.6 9 A.M. 4-27-51
2 12
-8.05
34 52 20 23 34 42 47 24 36 42 46 44 48 55 48
3 19
-14.05
-21.05
42 38 46 81
4 21
-23.05
Compact, coarse to fine red brown sand and coarse to fine gravel, little silt, trace of decomposed rock.
98 97 103 43 58 64 68 67 68 74 76 Compact coarse to fine (Predominantly medium to fine) red brown sand, little silt, trace of fine gravel.
5 14
-29.05
74
-37.05
79 45 55 61 76 93 97 120 125 156 240 286 220 126 142 256 143 167 182 296 Hard, multi-color, alternate layers of fine light gray and purple sand, silt and clay.
6 21
-38.05
7 36
-47.05
8 42
-55.05
9 103
-63.05
-64.05

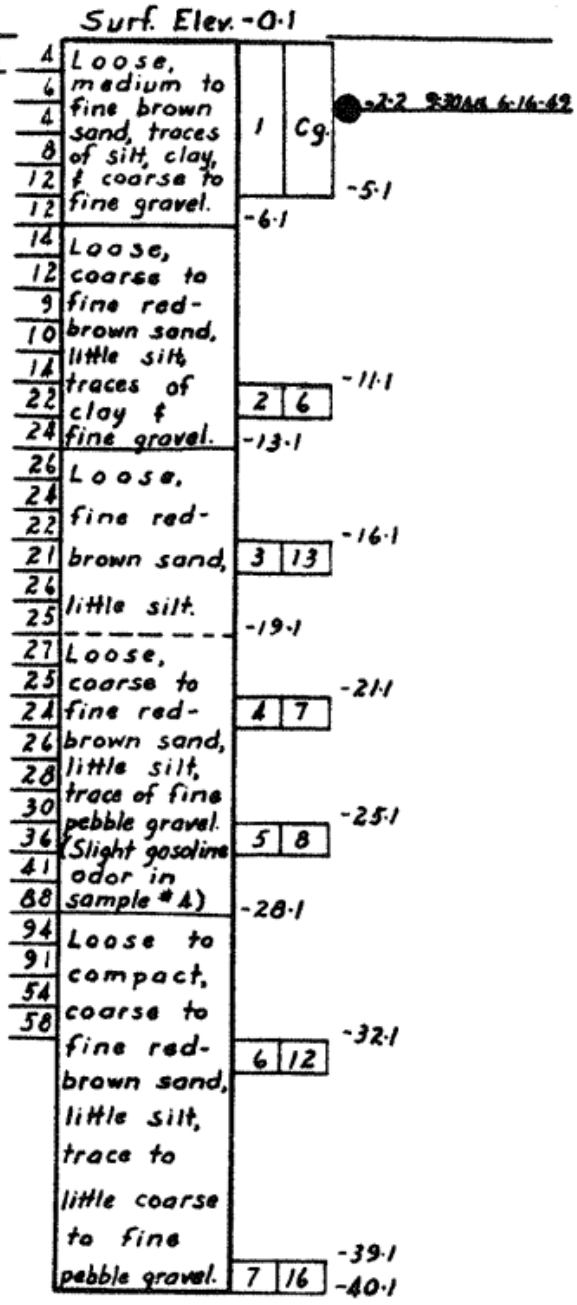
Boring B-5


Surface elev. +3.7
3 6 6 8 10 8 Soft meadow mat and silt, little clay. Traces of coarse to fine gravel and decomposed rock.
1 Ly
-1.3 -0.4 9 A.M. 5-4-51
-2.3 -2.3 8 A.M. 5-5-51
-2.3
22 36 29 36 22 31 33 35 38 Loose, coarse to fine (Predominantly medium to fine)
-5.3 -5.1 11 A.M. 5-8-51
2 10
36 17 23 25 24 26 34 37 38 red brown sand, some silt, trace of clay, little medium to fine gravel.
3 12
-12.3
-21.3
36 31 38 65 85 84 67 Loose, coarse to fine (Predominantly medium to fine)
4 21
-22.3
-28.3
43 51 56 63 72 59 56 58 61 79 75 81 89 110 red and gray brown sand, some silt, some medium to fine gravel.
5 12
6 14
-36.3
-42.3
141 95 125 136 148 137 120 133 118 197 216 Hard, alternate layers (Multi-colored) light brown
7 36
8 23
-43.3
-51.3
120 114 121 126 119 56 69 67 82 87 72 79 81 86 88 91 96 89 87 101 107 112 109 114 118 115 127 240 silt and blue gray clay. Thin layers of fine light brown sand. Traces of decomposed rock, samples #9 and #11.
9 31
10 41
11 47
12 103
-56.3
-65.3
-75.3
-79.3
-81.3
Washed ahead of casing
370 260 271 276 282 284 291 287 304 321 346 329 348 367 382 Very compact, fine, light gray sand and silt (Multi-colored)
13 101
14 99
15 88
-83.3
-86.3
-93.3
-95.3
Very compact alternate layers light brown sand & silt, and light pink clay (Multi-colored).
16 102
-100.3
-101.3

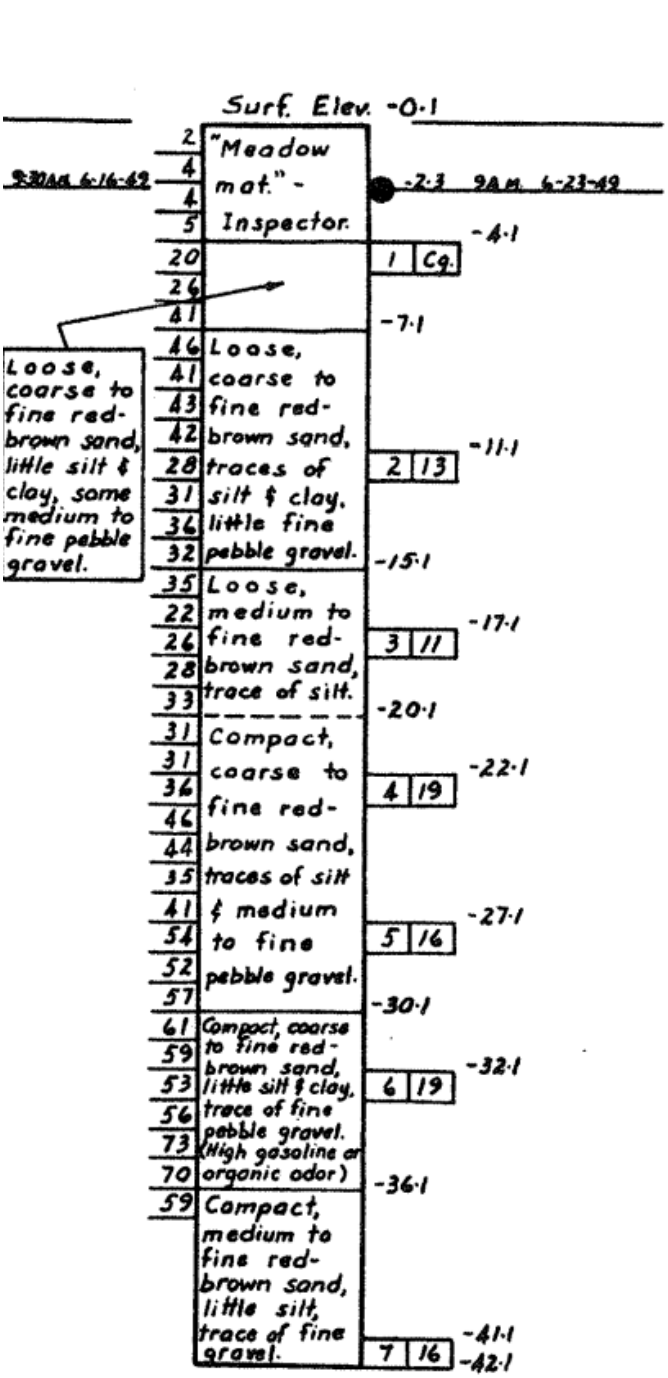
Boring P7



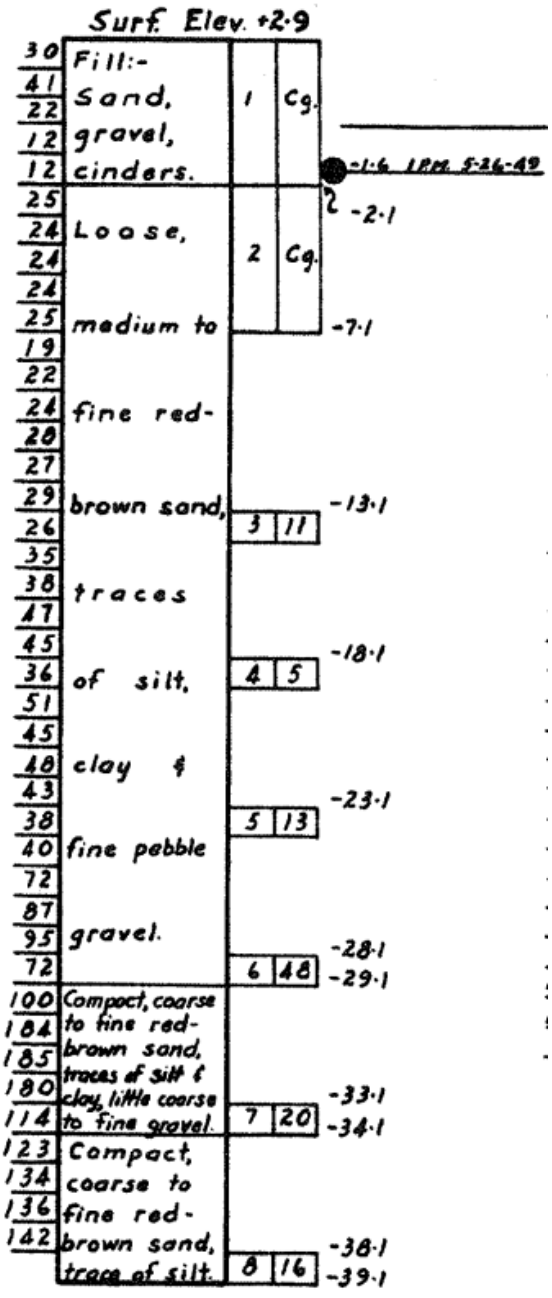
Boring P5



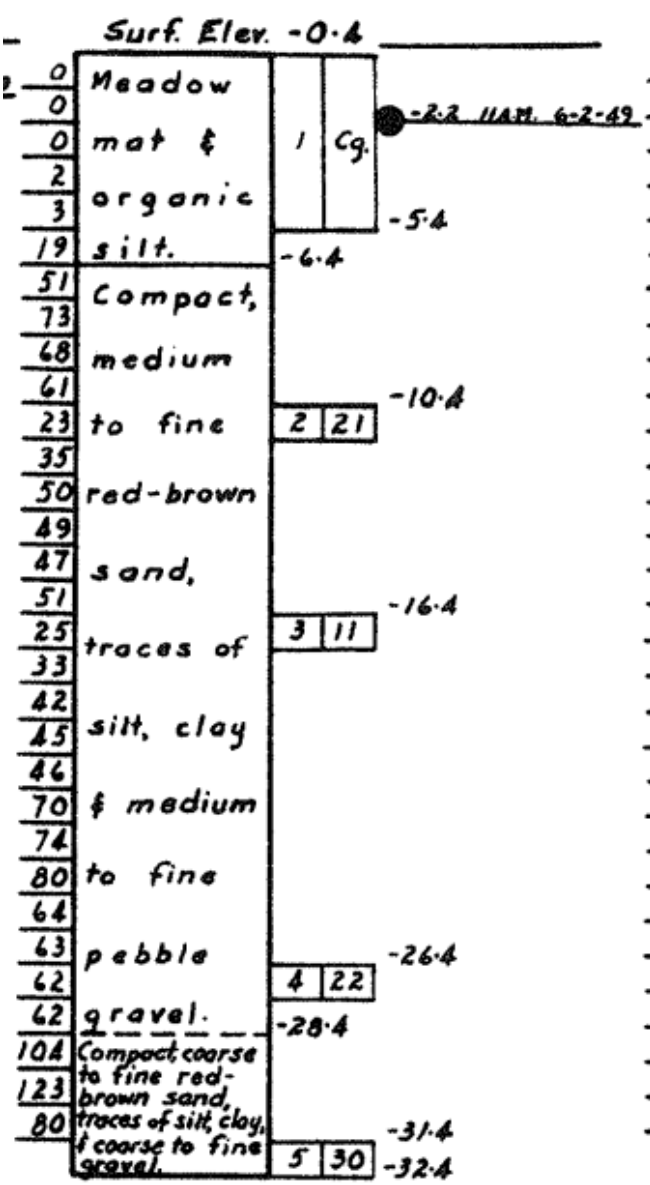
Boring P8



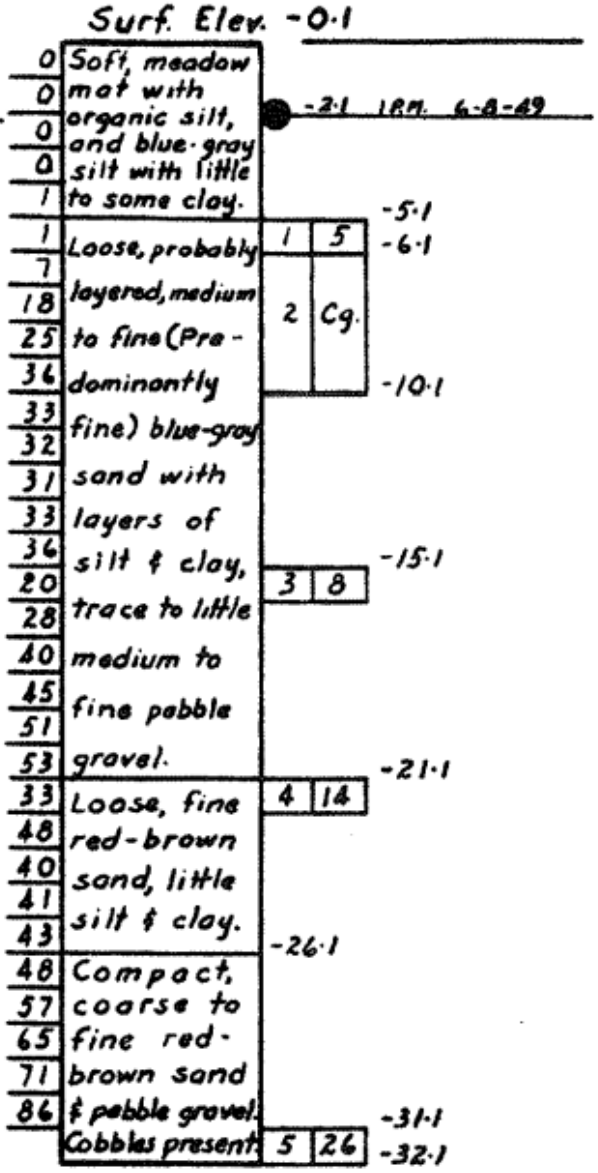
Boring B-29



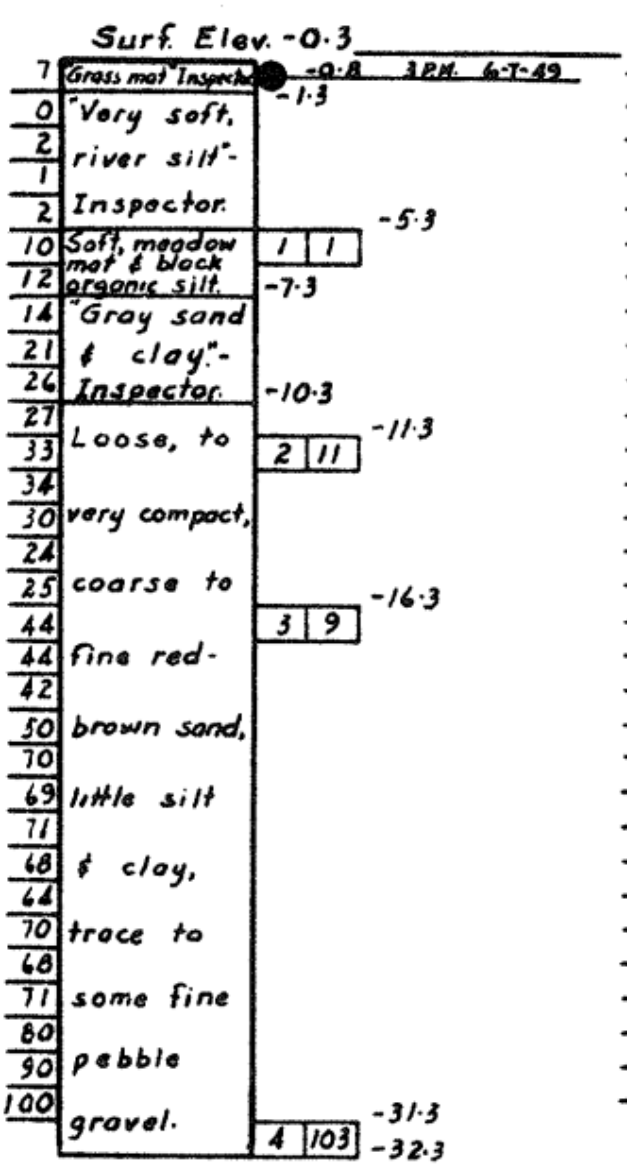
Boring B-28



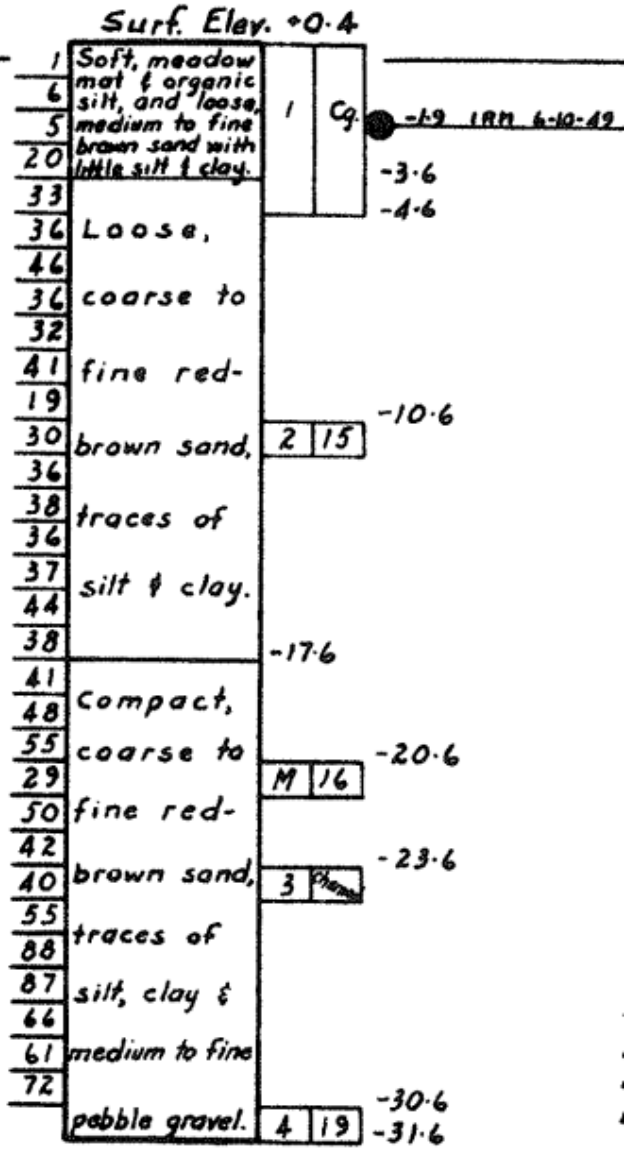
Boring B-27



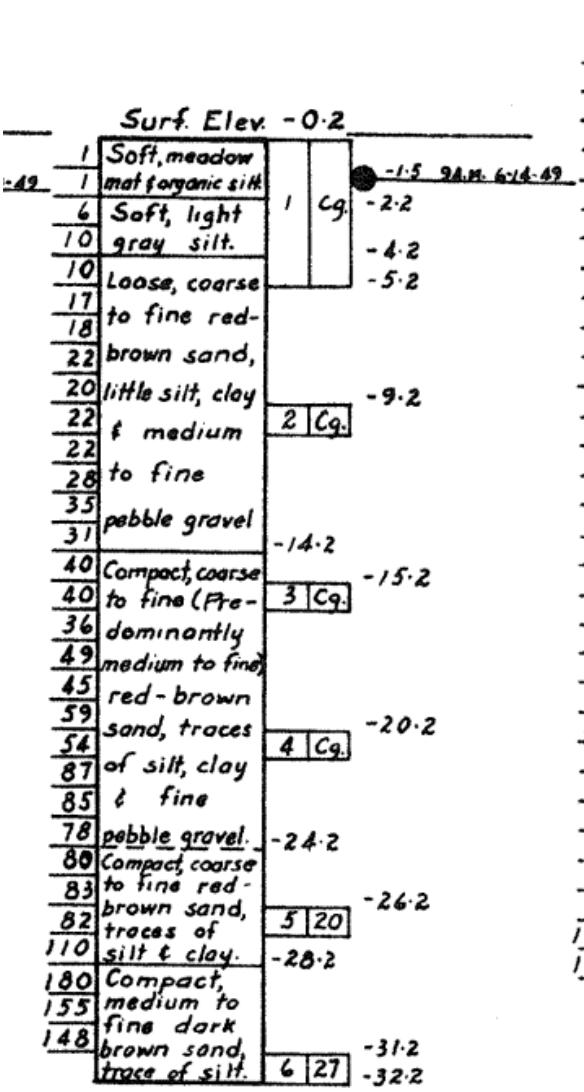
Boring B-26



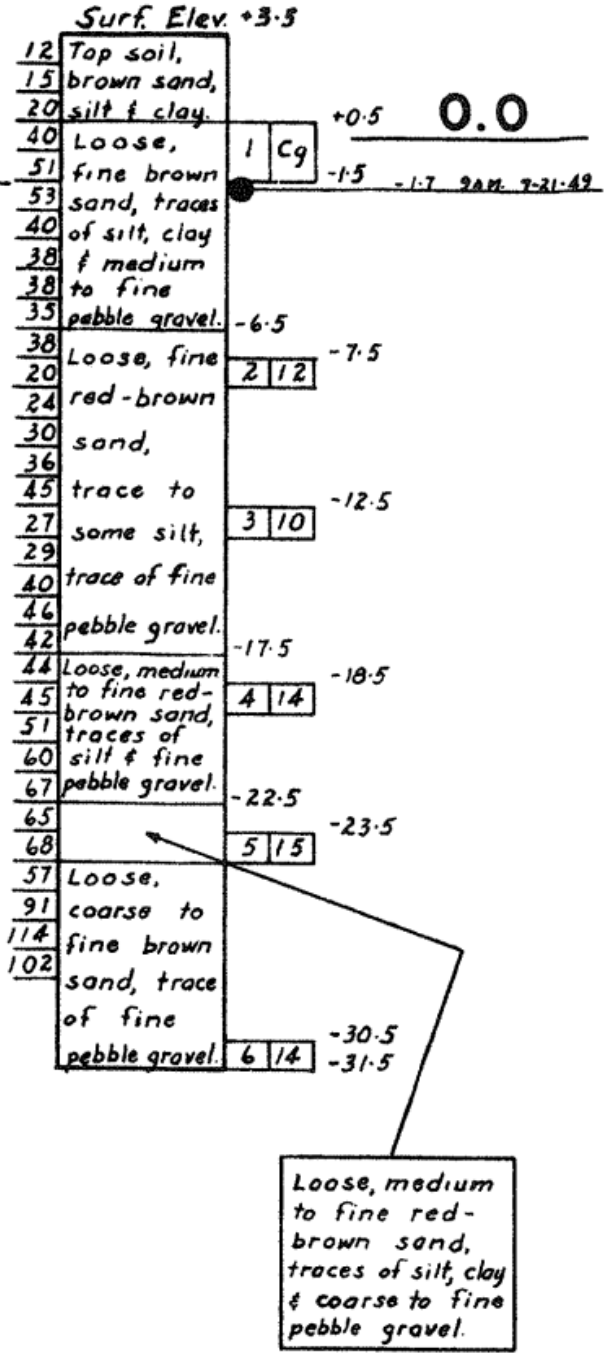
Boring B-25

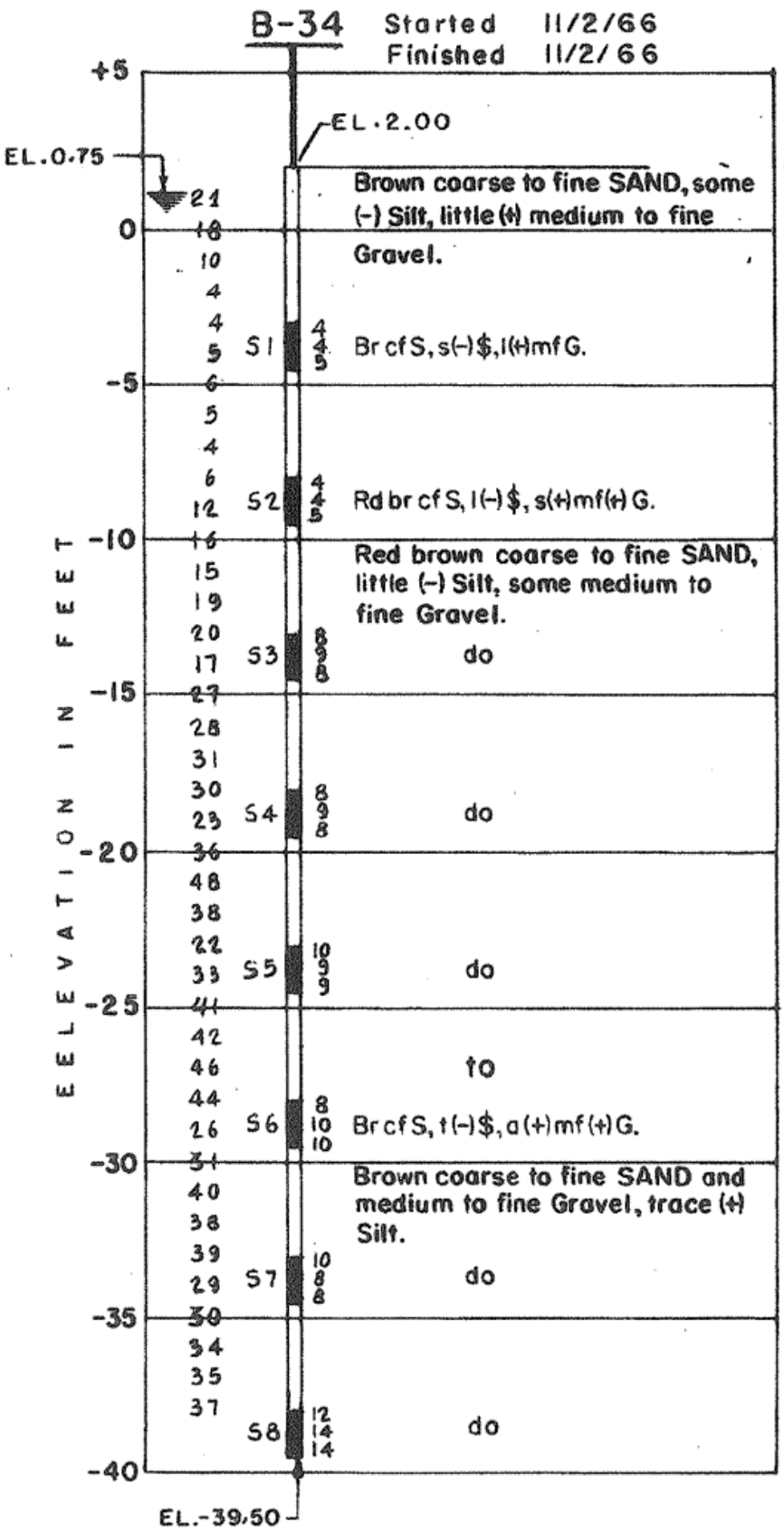


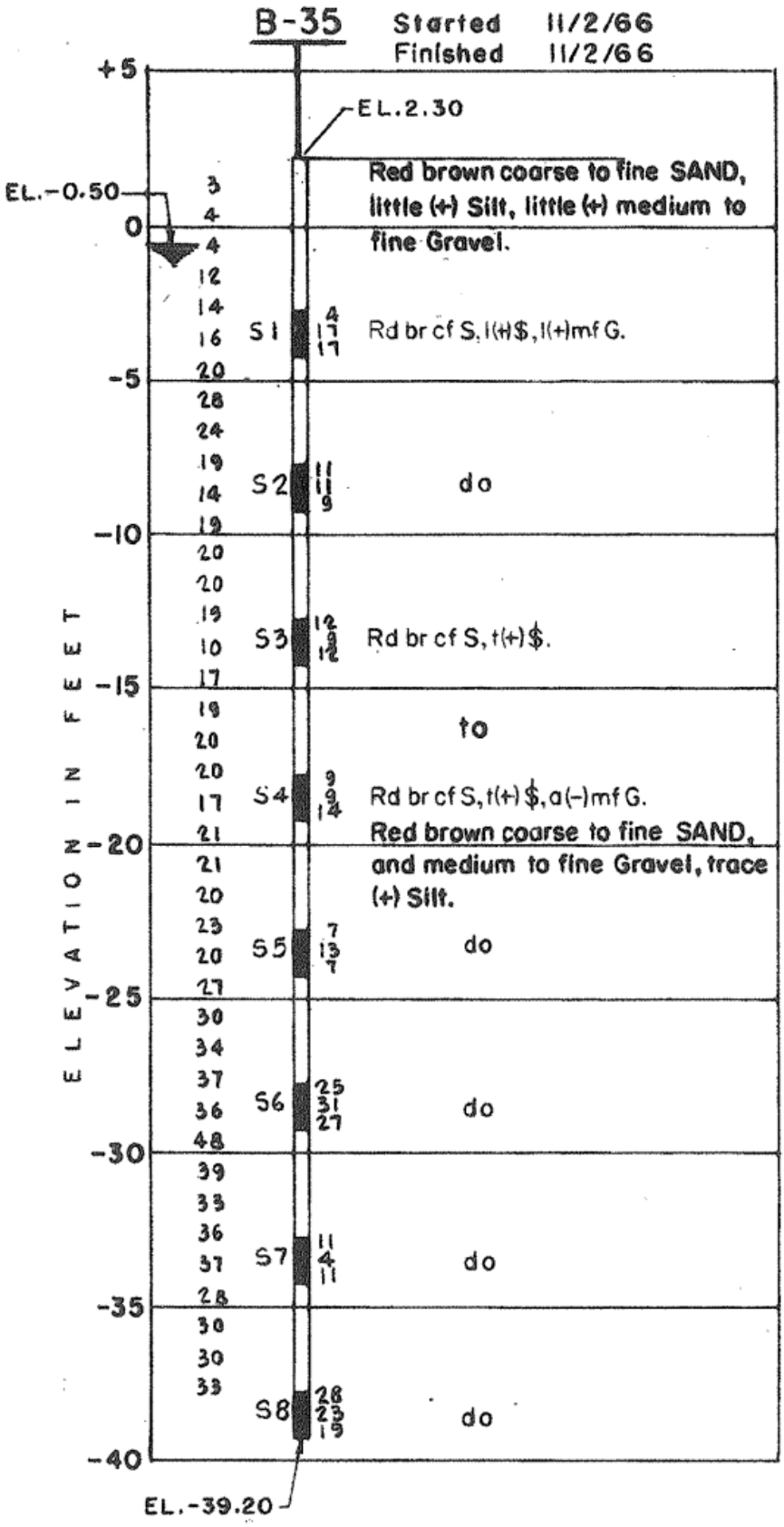
Boring B-24

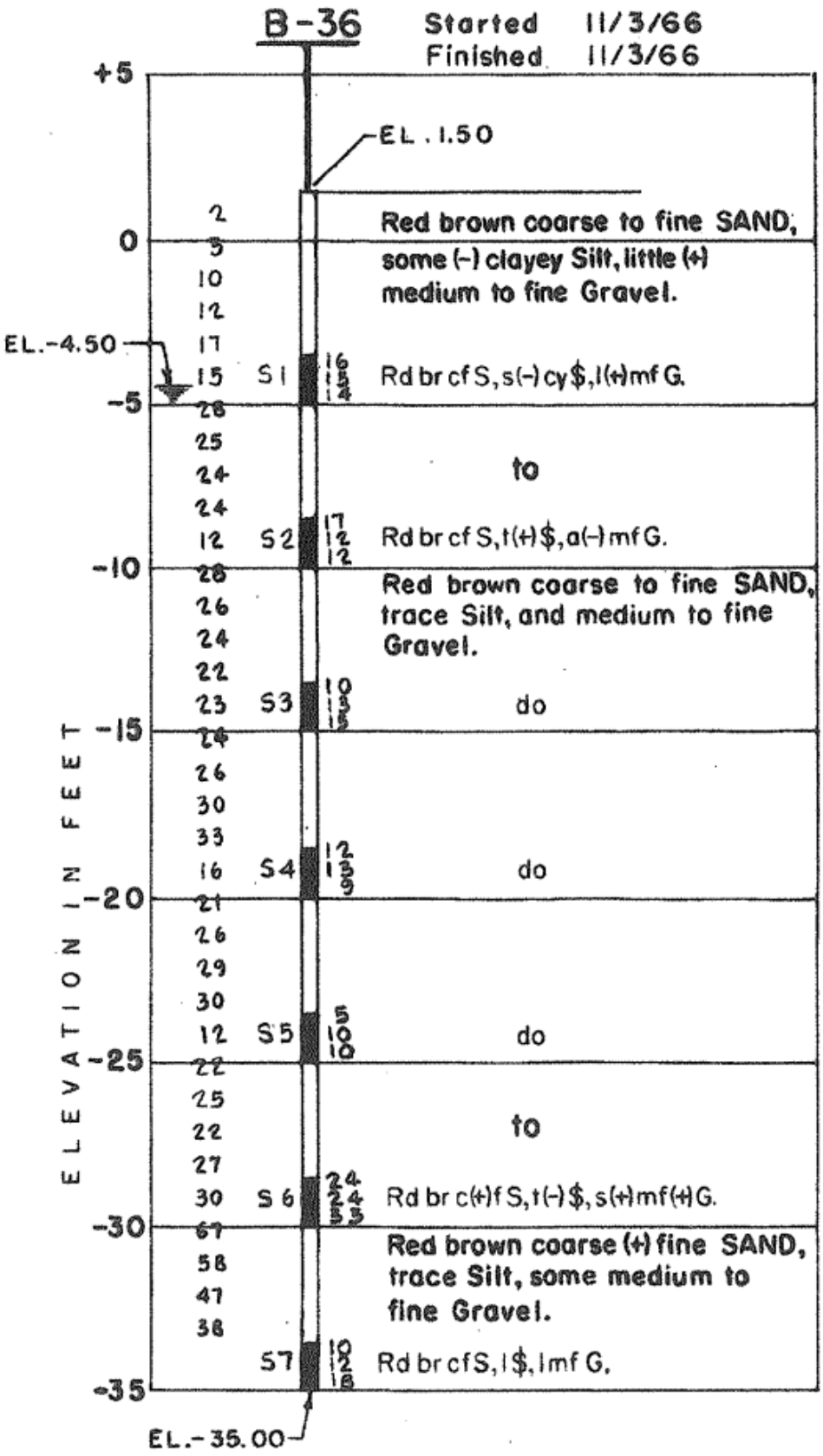


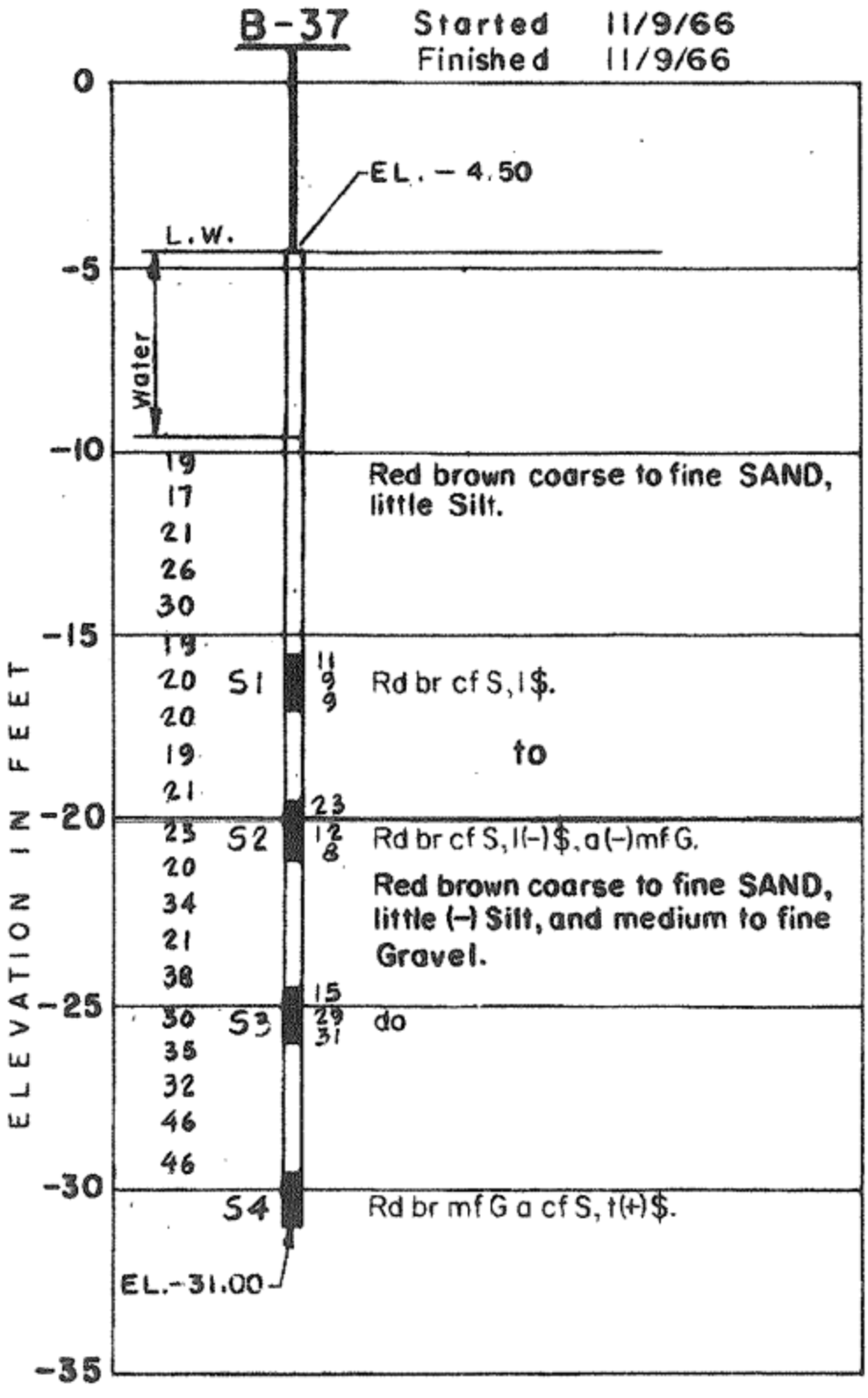
Boring B-23

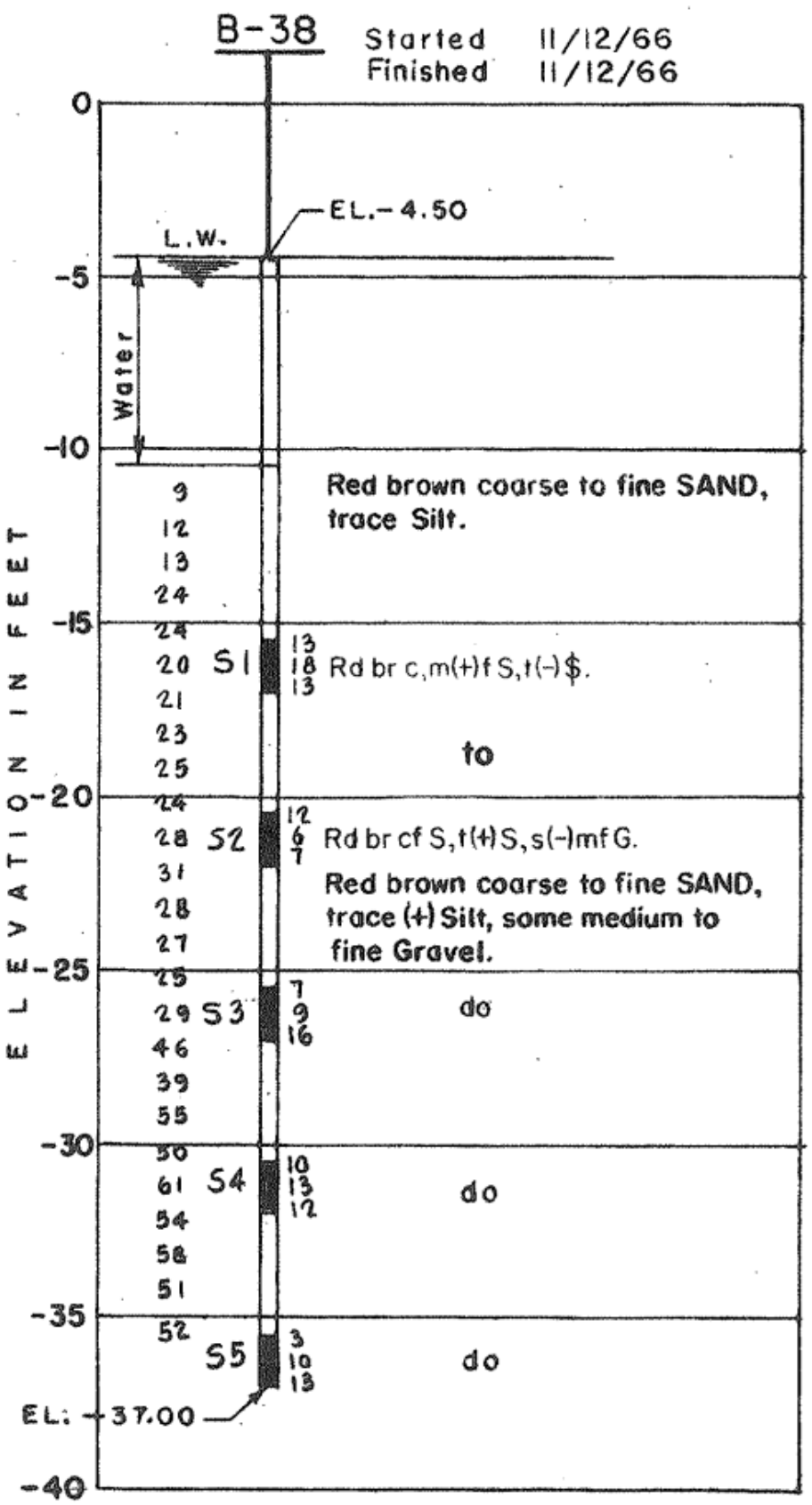



B-34
Started 11/2/66
Finished 11/2/66
EL. 2.00
EL. 0.75
+5
0
-5
-10
-15
-20
-25
-30
-35
-40
ELEVATION IN FEET
21
18
10
4
4
5
S1
4
4
5
Brown coarse to fine SAND, some (-) Silt, little (+) medium to fine Gravel.
Br cf S, s(-)$, l(+)mf G.
6
5
4
6
12
S2
4
4
5
Rd br cf S, l(-)$, s(+)mf(+) G.
16
15
19
20
17
S3
8
9
8
Red brown coarse to fine SAND, little (-) Silt, some medium to fine Gravel.
do
27
28
31
30
23
S4
8
9
8
do
36
48
38
22
33
S5
10
9
9
do
41
42
46
44
26
S6
8
10
10
to
Br cf S, t(-)$, a(+)mf(+) G.
31
40
38
39
29
S7
10
8
8
Brown coarse to fine SAND and medium to fine Gravel, trace (+) Silt.
do
30
34
35
37
S8
12
14
14
do
EL. -39.50


B-35
Started 11/2/66
Finished 11/2/66
EL. 2.30
EL.-0.50
Red brown coarse to fine SAND, little (+) Silt, little (+) medium to fine Gravel.
S1
Rd br cf S, l(+)$, l(+)mf G.
S2
do
S3
Rd br cf S, t(+)$.
to
S4
Rd br cf S, t(+)$, a(-)mf G.
Red brown coarse to fine SAND, and medium to fine Gravel, trace (+) Silt.
S5
do
S6
do
S7
do
S8
do
EL.-39.20
ELEVATION IN FEET
+5
0
-5
-10
-15
-20
-25
-30
-35
-40


B-36
Started 11/3/66
Finished 11/3/66
+5
0
-5
-10
-15
-20
-25
-30
-35
EL. 1.50
EL.-4.50
EL.-35.00
ELEVATION IN FEET
2
5
10
12
17
15
S1
16 15 14
Rd br cf S, s(-) cy $, l(+) mf G.
28
25
24
24
to
12
S2
17 12 12
Rd br cf S, t(+) $, a(-) mf G.
28
26
24
22
Red brown coarse to fine SAND, trace Silt, and medium to fine Gravel.
23
S3
10 15 15
do
24
26
30
33
16
S4
12 13 9
do
21
26
29
30
12
S5
5 10 10
do
22
25
22
27
to
30
S6
24 24 33
Rd br c(+) f S, t(-) $, s(+) mf(+) G.
67
58
47
38
Red brown coarse (+) fine SAND, trace Silt, some medium to fine Gravel.
S7
10 12 18
Rd br cf S, l $, l mf G.

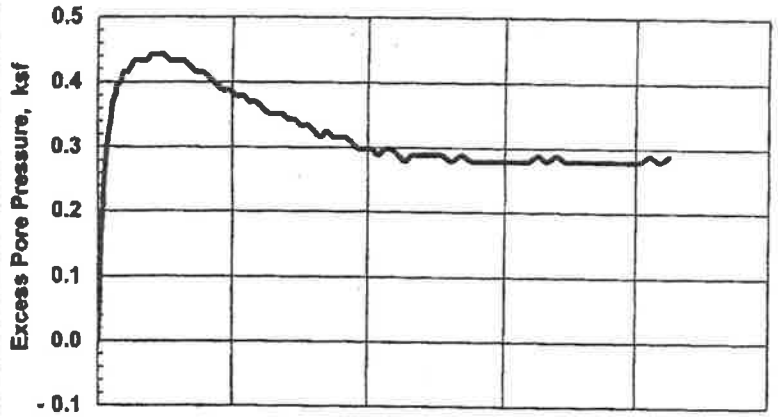

B-37
Started 11/9/66
Finished 11/9/66
EL. – 4.50
L.W.
Water
0
-5
-10
-15
-20
-25
-30
-35
ELEVATION IN FEET
19
17
21
26
30
19
20
20
19
21
25
20
34
21
38
30
35
32
46
46
S1
S2
S3
S4
11
9
9
23
12
8
15
29
31
Red brown coarse to fine SAND, little Silt.
Rd br cf S, l$.
to
Rd br cf S, l(-)$, a(-)mf G.
Red brown coarse to fine SAND, little (-) Silt, and medium to fine Gravel.
do
Rd br mf G a cf S, t(+)$.
EL.-31.00

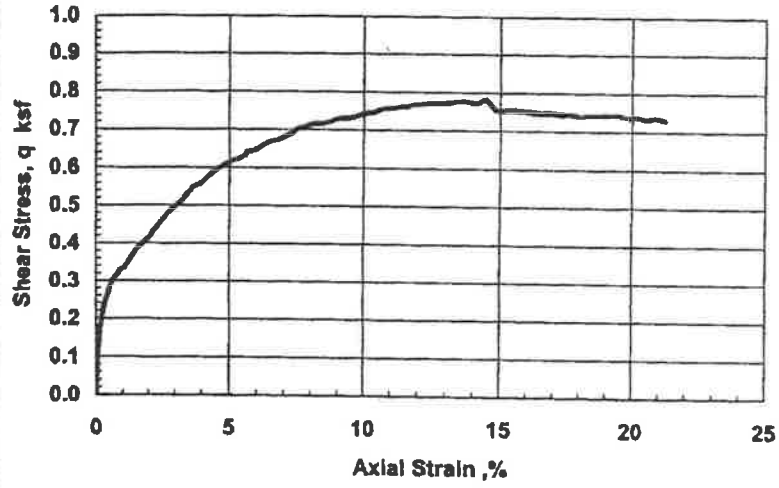

B-38
Started 11/12/66
Finished 11/12/66
EL.- 4.50
L.W.
Water
ELEVATION IN FEET
0
-5
-10
-15
-20
-25
-30
-35
-40
9
12
13
24
Red brown coarse to fine SAND, trace Silt.
24
20
21
23
25
S1
13
18
13
Rd br c,m(+)f S,t(-)$.
to
24
28
31
28
27
S2
12
6
7
Rd br cf S,t(+)S,s(-)mf G.
Red brown coarse to fine SAND, trace (+) Silt, some medium to fine Gravel.
25
29
46
39
55
S3
7
9
16
do
50
61
54
58
51
S4
10
13
12
do
52
S5
3
10
13
do
EL: -37.00

ATTACHMENT C – LABORATORY TEST RESULTS

Table showing laboratory results from soil samples

Boring	Depth (feet)	USCS	% Gravel	% Sand	% Fines	Moisture Content (%)	Specific Gravity	Unit Weight (p.c.f)	LL	PL	PI
CB02-1	10-12	SM	28.3	42.2	29.5	16.1					
	25-27	SM	0.0	81.2	18.8	24.0	2.71	72.1			
CB02-2	2-4	SW	32.2	66.1	1.7	8.0					
CB02-3	10-12	GW-GM	78.2	15.4	6.4	13.8	2.70	78.9			
CB02-4	4-6	CL-ML						76.0	24	19	5
	15-17	SM/CL-ML	0.0	31.2	68.8	20.7		78.3	23	18	5
CB02-5	4-6	SM/CL	0.0	47.6	52.4	22.5		76.5	25	17	8
CB02-6	2-4	SM	17.6	55.3	27.1	44.4	2.71				
	4-6	SM/CL	0.0	38.4	61.6	5.6	2.53	77.4	30	21	9
CB02-7	20-22	SP-SM	9.7	84.0	6.3	19.8	2.67	103.0			
CB02-8	10-12	SM	0.0	85.6	14.4	15.2	2.67				
CB02-9	6-8	SM/ML	0.0	32.7	67.3	25.5		88.0	19	17	2
CB02-11	2-4	SP	1.2	97.7	1.1	4.4	2.84	97.2			
CB02-12	4-6	SP	2.9	93.2	3.9	5.4					
	8-10	SW-SM	26.2	66.1	7.7	24.6	2.67	106.2			
SS02-3	2-4	SM	10.7	36.8	52.5	31.4	2.52	71.1			
	8-10	SM	41.6	40.5	17.9	30.8					
SS02-4	4-6	SM	27.6	53.0	19.4	4.6	2.64	89.6			
	15-17	SM	19.3	51.3	29.4	23.7		63.8			
SS02-5	2-4	SW-SM	32.8	59.4	7.8	6.5					
(UT)	8-10	CL-ML						108.1	23	18	5
SS02-6	20-22	SP-SM	11.4	83.0	5.6	18.0					
SS02-7	20-22	SP-SM	3.2	91.5	5.3	4.2					
SS02-8	2-4	SW	26.3	68.9	4.8	2.3					
	8-10	SM	45.2	40.9	13.9	15.7		109.8			
SS02-9	15-17	SP-SM	11.9	82.5	5.6	20.4	2.68	102.1			
SS02-10	2-4	SM	23.9	62.4	13.7	9.7					
(UT)	5-7	ML						98.4	22	19	3
SS02-11	2-4	SW-SM	5.7	84.8	9.5	49.8	2.70	93.3			
	25-27	SP-SM	19.1	74.4	6.5	17.1					
SS02-12	6-8	SP	0.0	97.8	2.2	5.8	2.68	104.1			
SS02-13	2-4	SP	2.3	94.9	2.8	5.0					
	15-17	SW-SM/ CL-ML	25.6	62.6	11.8	24.7		92.9	25	21	4
	22-24	SP-SM	0.7	89.4	9.9	25.5	2.68	97.4			
SS02-14	15-17	SM	0.0	78.9	21.1	25.1					
(UT)	23-25	SW-SM/ML	50.2	40.7	9.1	20.5		107.5	26	22	4
SS02-15	4-6	SW	40.3	56.1	3.6	3.8	2.64	79.5			
	25-27	SM	0.0	34.9	65.1	36.0		107.4	25		
SS02-16	0-2	SW-SP	3.1	93.1	3.8	4.2	2.68	104.5			
	20-22	GW	66.9	32.6	0.5	13.5					
SS02-17	10-12	SP-SM	2.4	91.4	6.2	20.2	2.69	100.2			





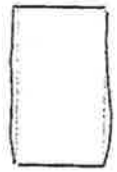
SPECIMEN INFORMATION (Initial)

Height: 6.02 inch Diameter: 2.81 Inch Area: 6.21 in²
Water Content: 28.0 % Total Unit Weight: 126.0 pcf

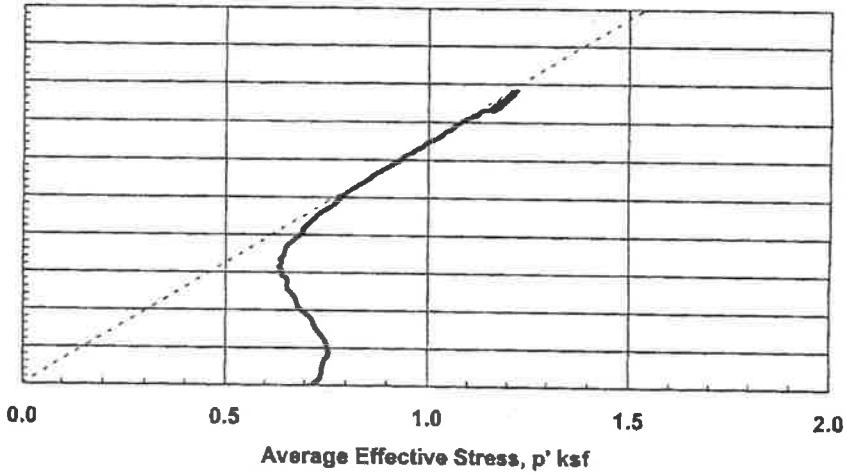
TEST SUMMARY

Consolidation Stresses: 0.72 ksf vertical, 0.72 ksf lateral
Water Content: 25.4 % Total Unit Weight: 128.4 pcf
B Coefficient: 99.4 Strain Rate: 0.020 %/min
Peak Shear Strength: 0.78 ksf @ 14.5 % Strain
Peak Effective Friction Angle: 40.4°

REMARKS:



Failure Sketch

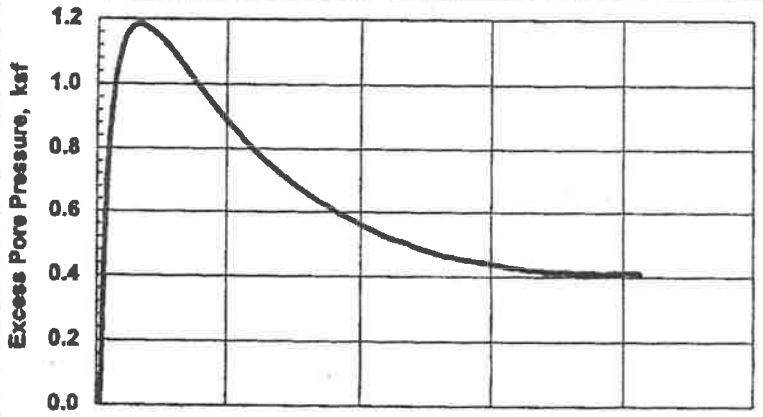


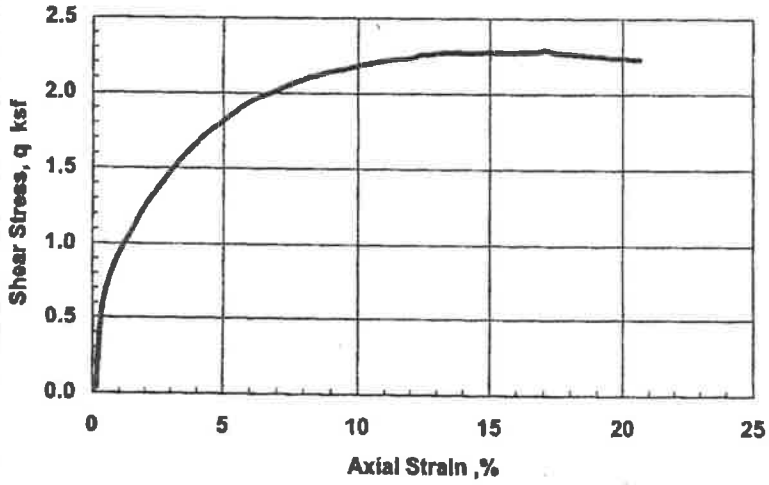
SOR TESTING LABORATORIES, INC.

98 Sand Park Road - Cedar Grove, NJ 07009
(973) 239-6001

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

PROJECT	Crescent Beach & South Shore ACOE Project	JOB NO.	02-481
SAMPLE NO.	CB 02-10 U1 (5'-7') SOIL : ML (Sandy Silt)	DATE	11/19/02





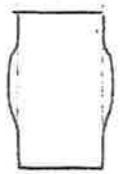
SPECIMEN INFORMATION (Initial)

Height: 6.02 inch Diameter: 2.83 Inch Area: 6.30 in²
Water Content: 20.5 % Total Unit Weight: 129.5 pcf

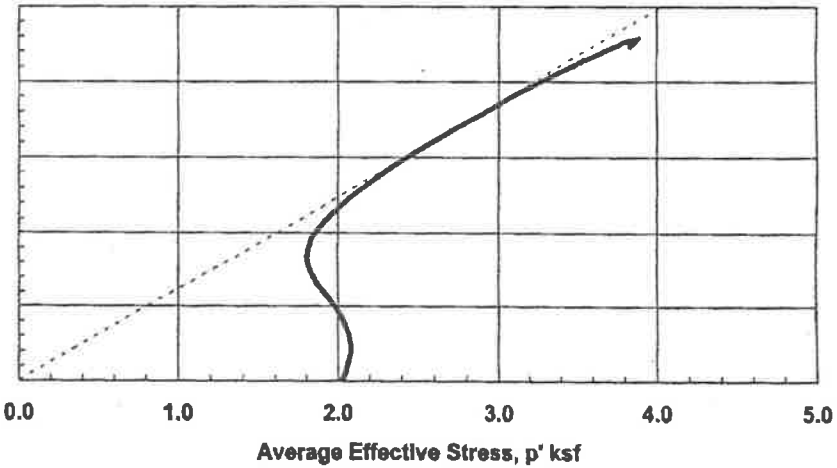
TEST SUMMARY

Consolidation Stresses: 2.02 ksf vertical, 2.02 ksf lateral
Water Content: 18.8 % Total Unit Weight: 134.1 pcf
B Coefficient: 100.2 Strain Rate: 0.020 %/min
Peak Shear Strength: 2.29 ksf @ 17.1 % Strain
Peak Effective Friction Angle: 38.3°

REMARKS:



Failure Sketch



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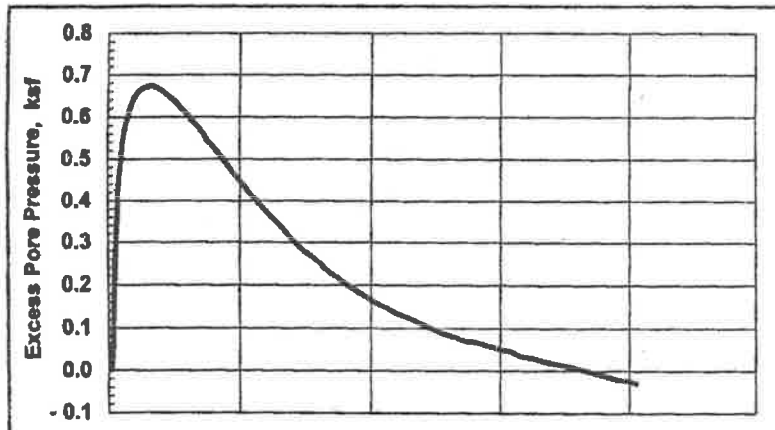
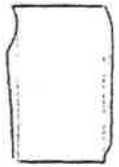
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

PROJECT	Crescent Beach & South Shore ACOE Project	**JOB NO.**	02-481
SAMPLE NO.	SS 02-14 U2 (23'-25') **SOIL** : SM (Silty Sand)	**DATE**	11/19/02



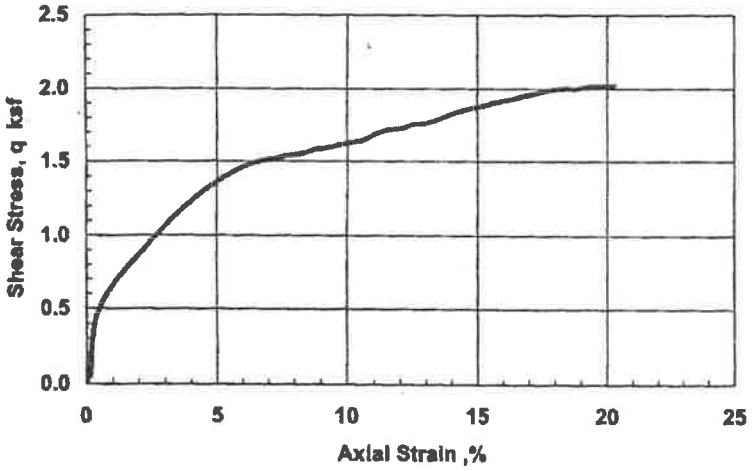
SPECIMEN INFORMATION (Initial)
Height: 6.02 inch Diameter: 2.82 inch Area: 6.26 in²
Water Content: 20.8 % Total Unit Weight: 130.6 pcf

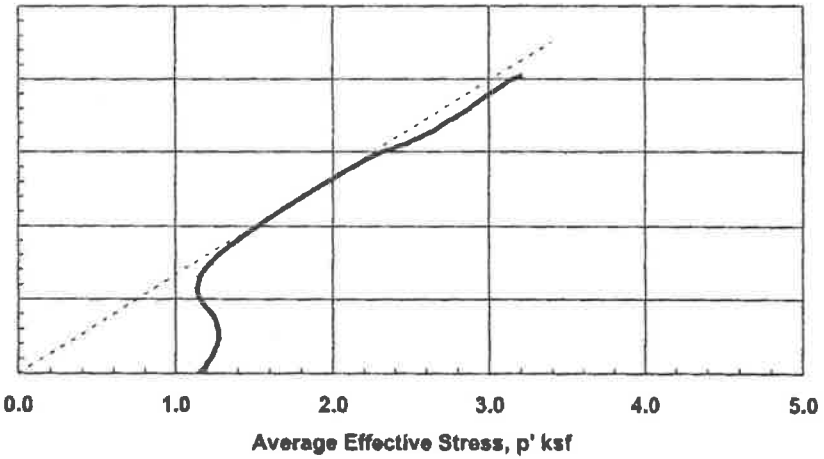
TEST SUMMARY
Consolidation Stresses: 1.15 ksf vertical, 1.15 ksf lateral
Water Content: 18.9 % Total Unit Weight: 134.3 pcf
B Coefficient: 99.9 Strain Rate: 0.031 %/min
Peak Shear Strength: 2.02 ksf @ 20.3 % Strain
Peak Effective Friction Angle: 41.6°



Failure Sketch

REMARKS:





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CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

PROJECT	Crescent Beach & South Shore ACOE Project	**JOB NO.**	02-481
SAMPLE NO.	SS 02-5 U1 (8'-10') **SOIL** : SC (Clayey Sand)	**DATE**	11/19/02

ATTACHMENT D – URS MEMORANDUM

URS

M E M O R A N D U M

To: Michael G. Cannon

From: Vai Navaratnam

Date: July 22, 2011

Subject: **Preliminary - Seepage / Slope Stability Analyses Hurricane and Storm Damage Reduction Feasibility Study for the South Shore of Staten Island, NY**

The purpose of this memorandum is to summarize preliminary seepage and slope stability analyses results for selected cases performed for the referenced project.

BACKGROUND

There are primarily five types of hurricane and storm damage reduction structures along the line of protection (approximately 4.75 miles long). These structures consist of a buried seawall, stone seawall, earth embankment levee, single sheetpile wall and a double sheetpile wall. In accordance with USACE design manuals EM 1110-2-1913 and EM 1110-2-2502, seepage and stability analyses have been performed for all structures along the line of protection. The details and results of these analyses will be reported in the draft report to be submitted to the USACE. As per EM 1110-2-1913 (Design and Construction of Levees), slope stability analyses need to be performed for four loading conditions as follows: Case I, end of construction; Case II, sudden drawdown; Case III, steady-state seepage from full flood stage; and Case IV, earthquake.

Typically, it is our standard practice to conservatively use the fully developed phreatic surface obtained from a steady-state seepage analysis to perform the slope stability analysis under Case III loading condition. This condition occurs when the water remains at or near flood stage for a sufficient period of time to result in full embankment saturation and a condition of steady seepage. However, considering the relatively short duration (less than 6 hours) of the design storm, this condition will most likely not occur during the design storm. Therefore, the results of transient and steady seepage analyses along with corresponding results of Case III slope stability analyses are presented below for Buried Seawalls and Stone Seawalls. It should be noted that analyses of the other slope stability loading conditions, and other wall types are not presented here because they are not relevant considering the purpose of this memorandum.

URS

BURIED SEAWALL

The total length of the buried seawall is approximately 2 miles (10, 655 ft) and the height of the wall varies from approximately 10 ft to 11.5 ft for a 500 year design storm. The representative cross section selected for the buried seawall analyses is shown in Figure 1. The 500 year storm still water elevation of 14.3 ft (NGVD 29) was used in the seepage analyses. The storm hydrographs used in the transient seepage analyses are presented in Figures 2 and 3. In addition, the storm hydrograph used to determine the duration of the storm to develop a steady-state seepage condition is presented in Figure 4. The seepage and slope stability analyses were performed using the commercially available software programs SEEP/W and SLOPE/W, respectively. In SLOPE/W, the pore pressures obtained from the results of the SEEP/W analyses were used to simulate the pore pressures within the embankment.

Transient Analyses

Based on the transient analyses performed using the storm hydrograph shown in Figure 2, the maximum phreatic surface was obtained at the end of 15 hours. The slope stability analysis performed using pore pressures obtained for this case (see Figure 5) resulted in an estimated factor of safety (FOS) of 1.7 during the flood (Case III). This is greater than the acceptable FOS of 1.4 (EM 1110-2-1913). In addition, as shown in Figure 6 the total seepage flow for an approximately 5,200 ft long Reach A3 is estimated to be about 0.1 cfs (45 gpm for 5200 ft), with a corresponding maximum exit hydraulic gradient of 0.25 (Figure 7).

In order to determine the duration of the storm required to develop a steady-state condition, a hypothetical hydrograph (see Figure 4) was developed assuming that after reaching the maximum water level of el. +14.3 ft it will remain constant for about two weeks. Based on the transient seepage analyses performed using this hydrograph, it will take more than a week (about 192 hrs) to fully develop the steady-state seepage condition (see Figure 8). Slope stability FOS values corresponding to times ranging from 15 hrs to 192 hrs were computed as follows: 15 hrs, FOS = 1.7; 48 hrs, FOS = 1.4; 60 hrs, FOS = 1.3; 192 hrs, FOS = 1.1 (see Figures 9 to 12). Therefore, if the flood level remains at an elevation of approximately 14.3 ft for about 48 hours, the slope stability FOS value will become less than 1.4. Since the design storm duration of 6 hours is much shorter than 48 hrs, based on the results of the transient analyses, the slope stability FOS value for Case III loading condition will be greater than the acceptable value of 1.4.

Steady-State Analysis

Steady-state seepage analyses were performed independently and the results were compared with transient (hypothetical hydrograph in Figure 4) analyses results after 192 hrs (8 days). As expected, the results were comparable. As shown in Figure 13, the FOS is 1.1 and the exit hydraulic gradient is about 0.6 (Figure 14). Although this FOS value is less than 1.4, the steady-state seepage condition is not expected to develop during the design storm. Therefore, steady-state seepage analyses are not appropriate for this design storm.

URS

STONE SEAWALL

The total length of the stone seawall is about 4,765 ft and the maximum height is about 23 ft (see Figure 15). As shown in Figure 15, the bottom of the grouted armor stone will be at approximately el. +16 ft. The 500 year storm still water elevation is 14.3 ft (NGVD 29). Therefore, armor stone below the design storm elevation will not be grouted. Based on our analyses the slope stability FOS of the stone wall is about 1.4 for both the steady-state and transient seepage conditions. The estimated seepage flow using the transient seepage analyses is about 0.1 cfs/ft (45 gpm/ft); and using the steady state seepage analyses is about 0.13 cfs/ft (60 gpm/ft). The stone seawall in Reach A-8 is about 3,165 ft long. Therefore, as an example, the estimated seepage flow for Reach A-8 will be about 320 cfs and 410 cfs based on the transient and steady-state seepage analyses, respectively. In addition, the exit hydraulic gradients are estimated to be less than 0.2 for both transient and steady-state seepage analyses.

CONCLUSION:

Typically, for the earth embankment levees and seawalls with relatively impermeable cores which are constructed on suitable foundation, the estimated slope stability FOS values are greater or equal to 1.4 as per EM 1110-2-1913 under Case III (steady-state seepage from full flood stage) loading condition. However, in this project since the buried seawalls does not have relatively impermeable core, the estimated FOS value under steady seepage for Case III loading condition is 1.1. Based on the results of transient seepage analyses, the estimated FOS for Case III loading condition is 1.7 for the 6 hrs design storm and the duration of a hypothetical storm to develop steady-seepage is about 192 hours (8 days). Therefore, considering that the design storm is only about 6 hrs, it very unlikely that stead-seepage condition will develop. Hence, slope-stability analyses based on the fully developed phreatic surface is not warranted. If USACE also agrees with this conclusion, URS will use phreatic surfaces obtained from transient seepage analyses to estimate the slope stability FOS values for buried seawalls and stonewalls.

Enclosures

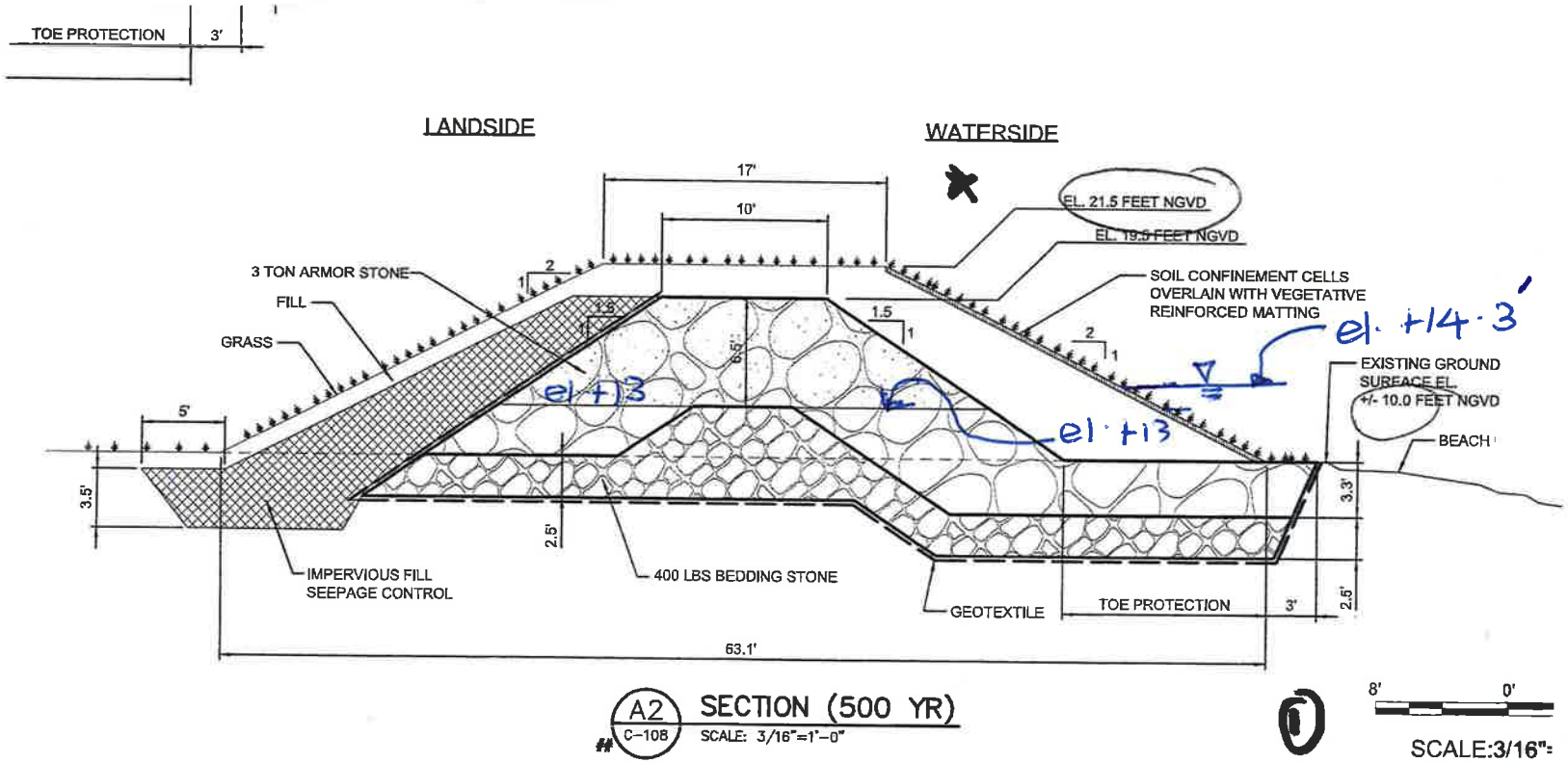
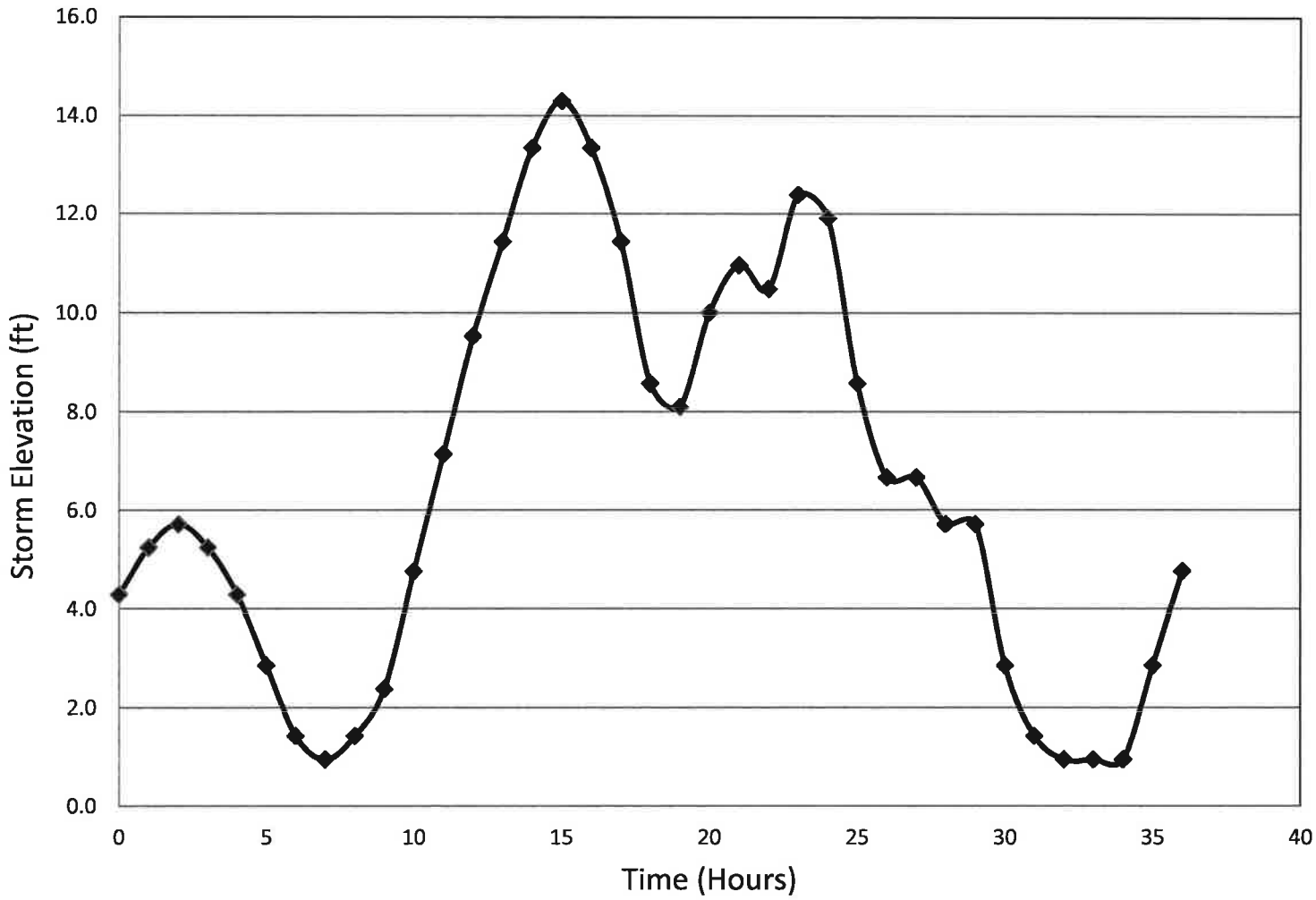


FIGURE-1

FIGURE-1



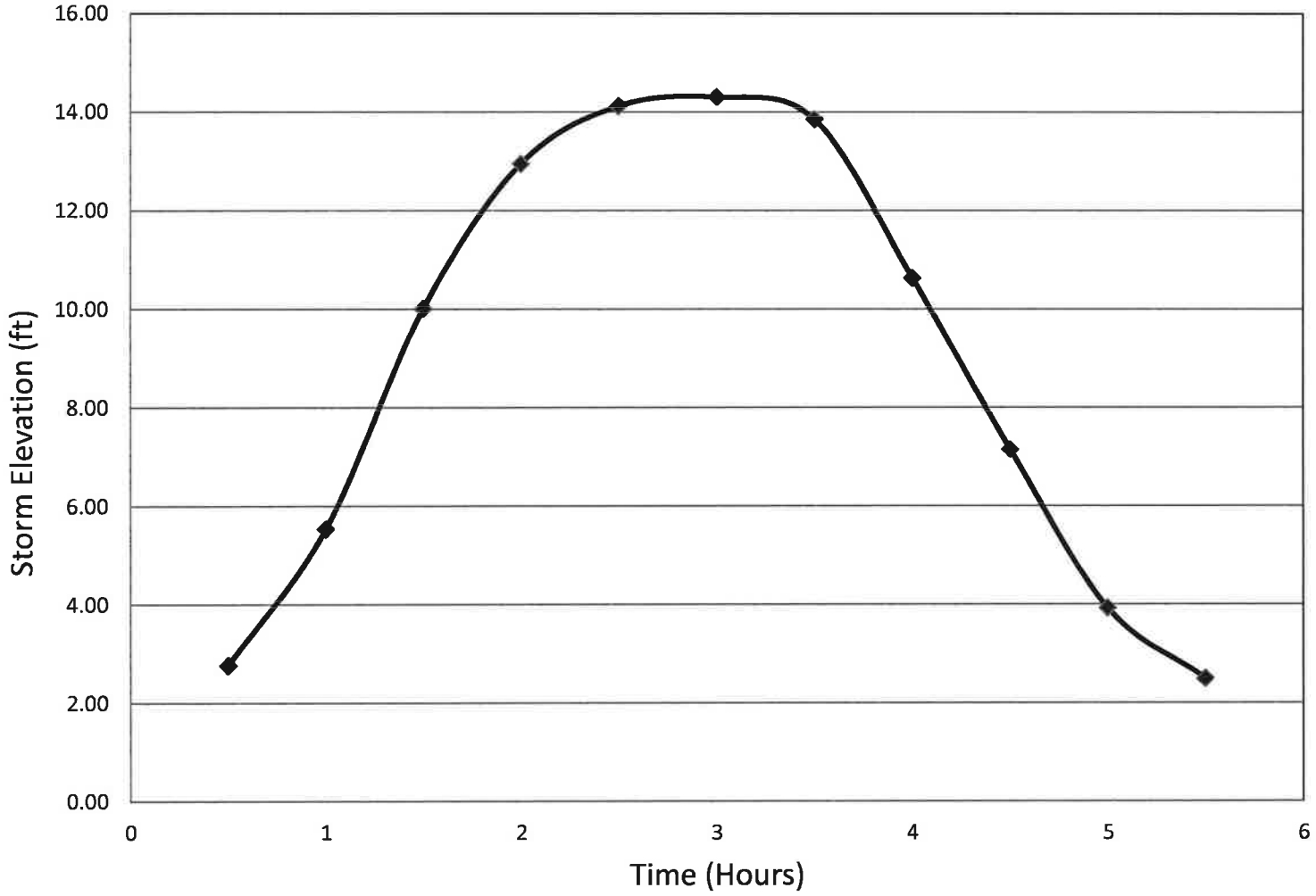
Source:
November 1950 nor'easter in NYC, peak water elevation modified to match the design storm elevation

Storm (Nor'Easter) Hydrograph
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
WAYNE, NEW JERSEY

DR. BY: VN	SCALE: As Shown	PROJ: 11020302
	DATE: July, 2011	FIG NO: 2

i:\projects\92c4235\task3\Tide and Surge History nor-easter



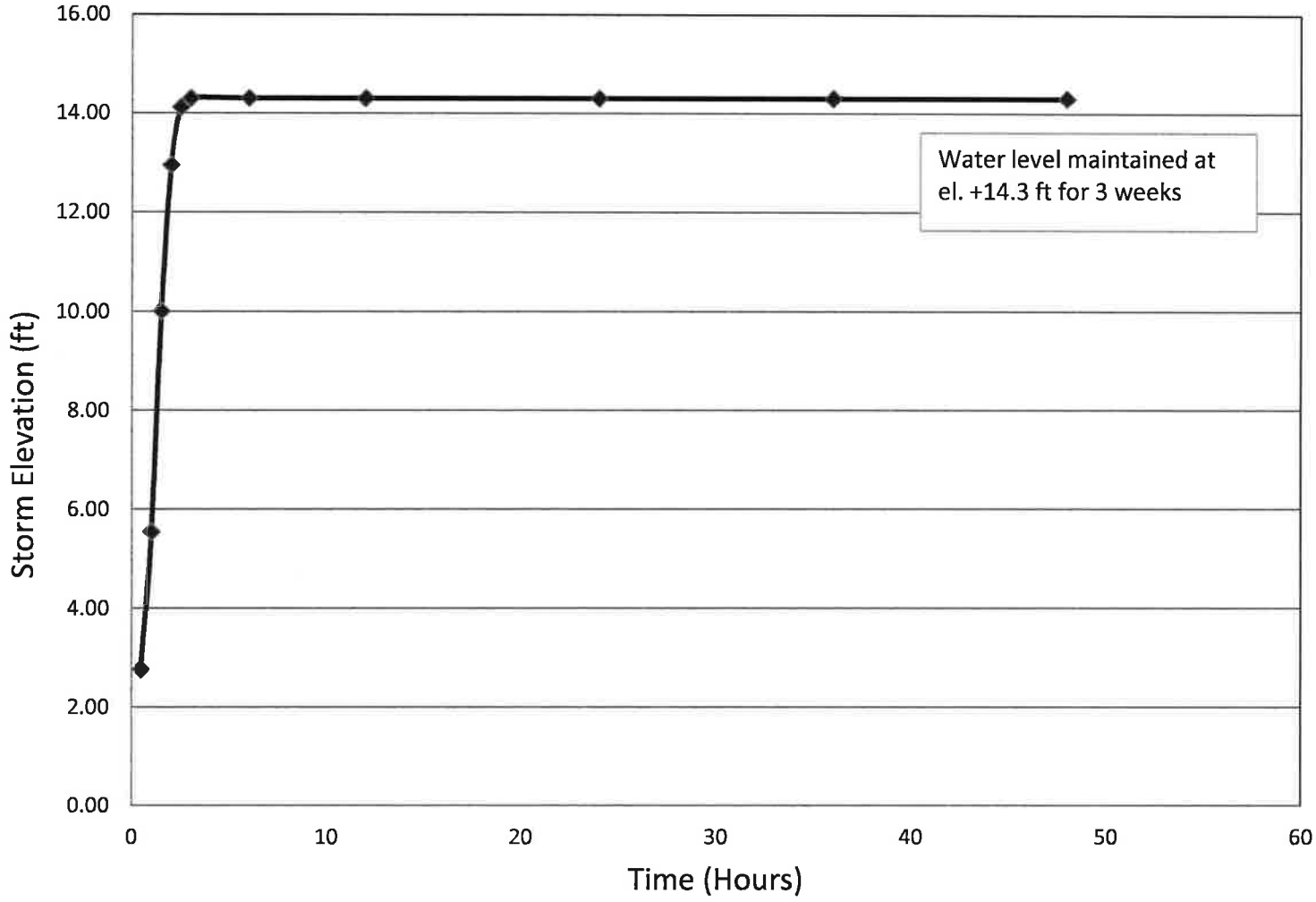
Source:
Huricane hydrograph from another location, peak water elevation modified to match the design storm elevation

Hurricane Hydrograph
Storm Damage Reduction Feasibility Study
Staten Island, New York

URS
WAYNE, NEW JERSEY

DR. BY: VN	SCALE: As Shown	PROJ: 11020302
	DATE: July, 2011	FIG NO: 3

i:\projects\92c4235\task3\Tide and Surge History new-bedford



NOTE:
Maximum still water level hypothetically maintained for about 3 weeks

Hypothetical Hurricane Hydrograph
Storm Damage Reduction Feasibility Study
Staten Island, New York

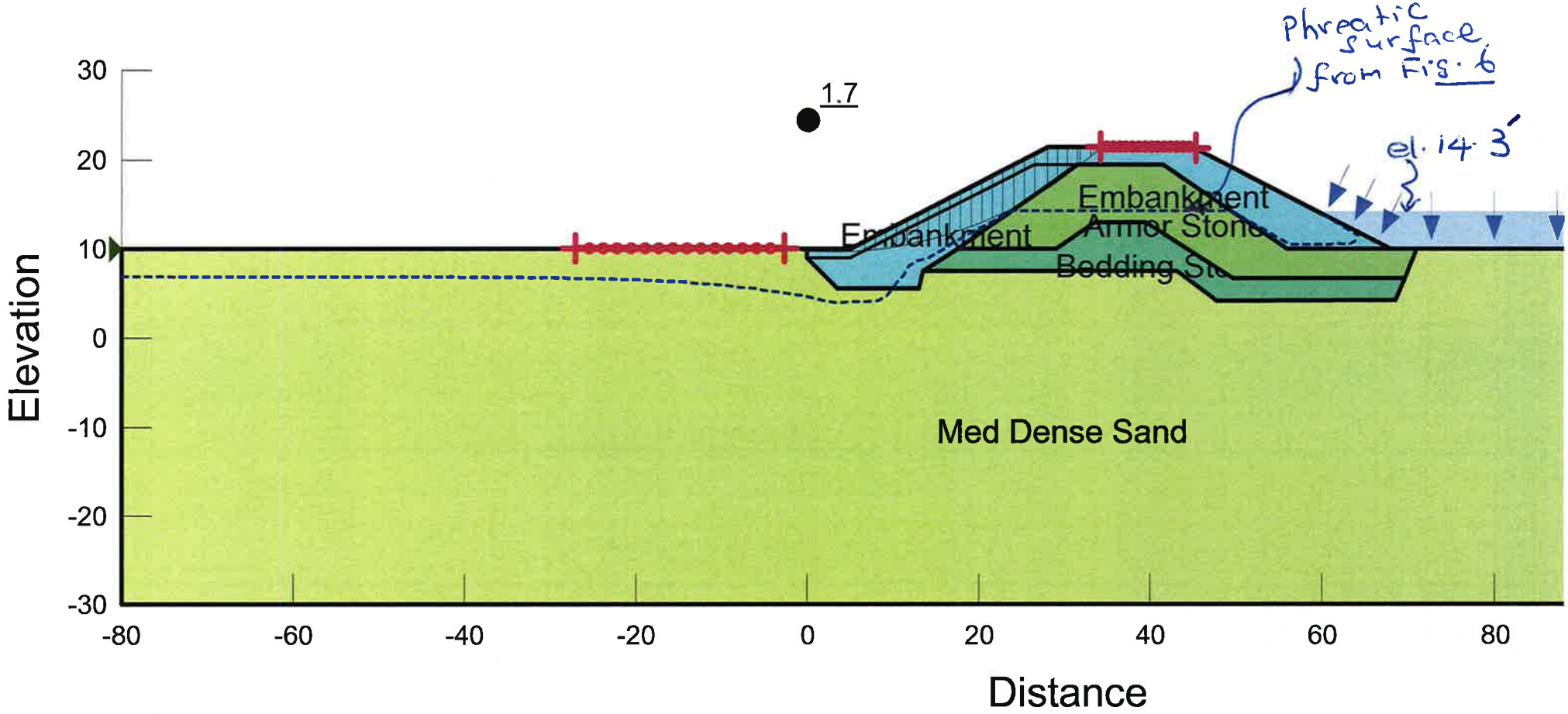
URS
WAYNE, NEW JERSEY

DR. BY: VN	SCALE: As Shown	PROJ: 11020302
	DATE: July, 2011	FIG NO: 4

i:\projects\92c4235\task3\Tide and Surge History new-bedford (2)

Case: Transien Analyses Hydrograph in Figure 2, t=15 hrs

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °

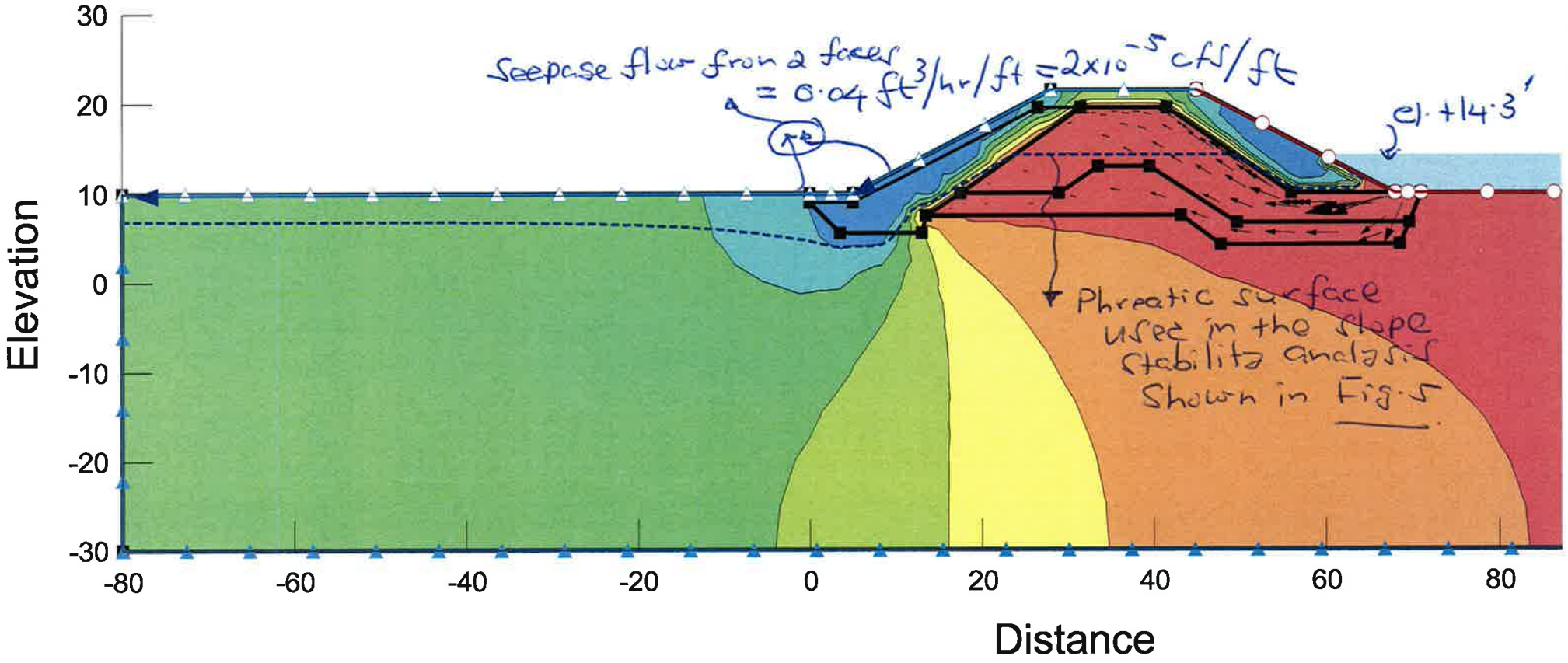


Reach A-7_WT El. 14_transient_k2-constant-long-flood.gsz

FIGURE-5

case:- Transient Analysis, hydrograph in Fig. 2, t=15hrs.

Name: Med Dense Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Wat
Name: Armor Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol. W
Name: Bedding Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol.
Name: Embankment Model: Saturated / Unsaturated K-Function: k=1x10-5cm/s V



Reach A-7_WT El. 14_transient_k2-constant-long-flood.gsz

FIGURE -6

Exit gradient

at Various t-values

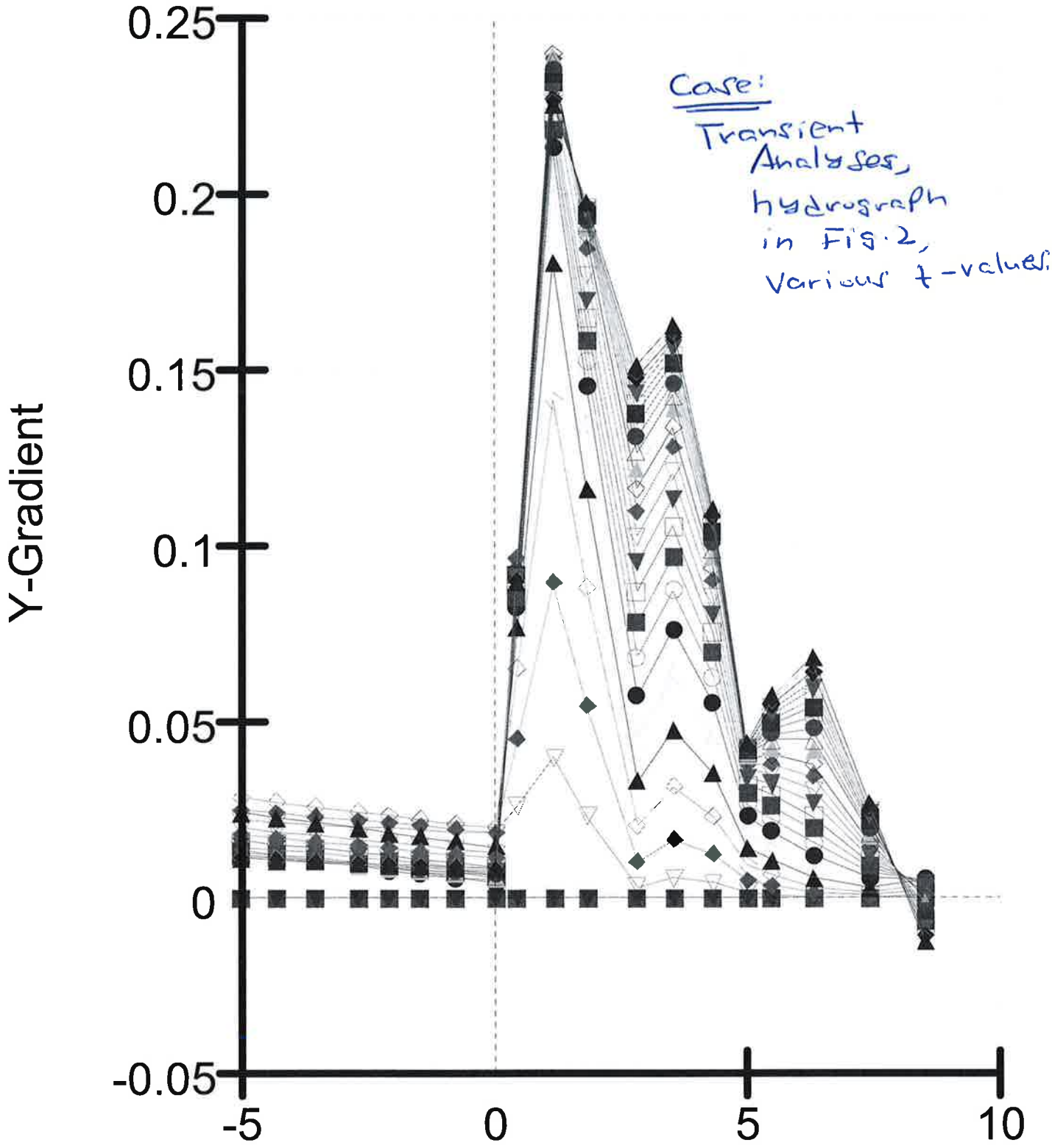
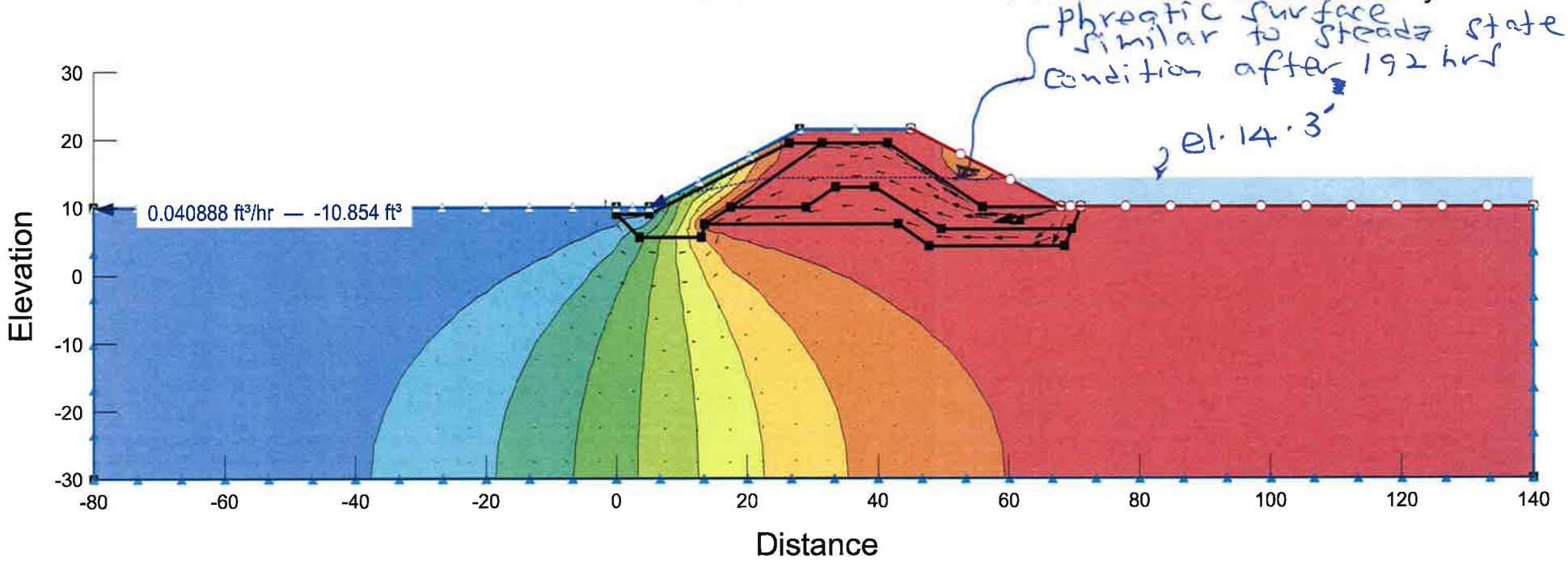


FIGURE-7

Case: Transient Analyses hypothetical hydrograph in Figure 4.
t=192 hrs

Name: Med Dense Sand Model: Saturated Only K-Sat: 0.0118 ft/hr Volumetric Water Content: 0 ft³/ft³
Name: Armor Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol. WC. Function: Silty Sand
Name: Bedding Stone Model: Saturated / Unsaturated K-Function: k=10cm/s Vol. WC. Function: Silty Sand
Name: Embankment Model: Saturated / Unsaturated K-Function: k=1x10-5cm/s Vol. WC. Function: Silty Sand

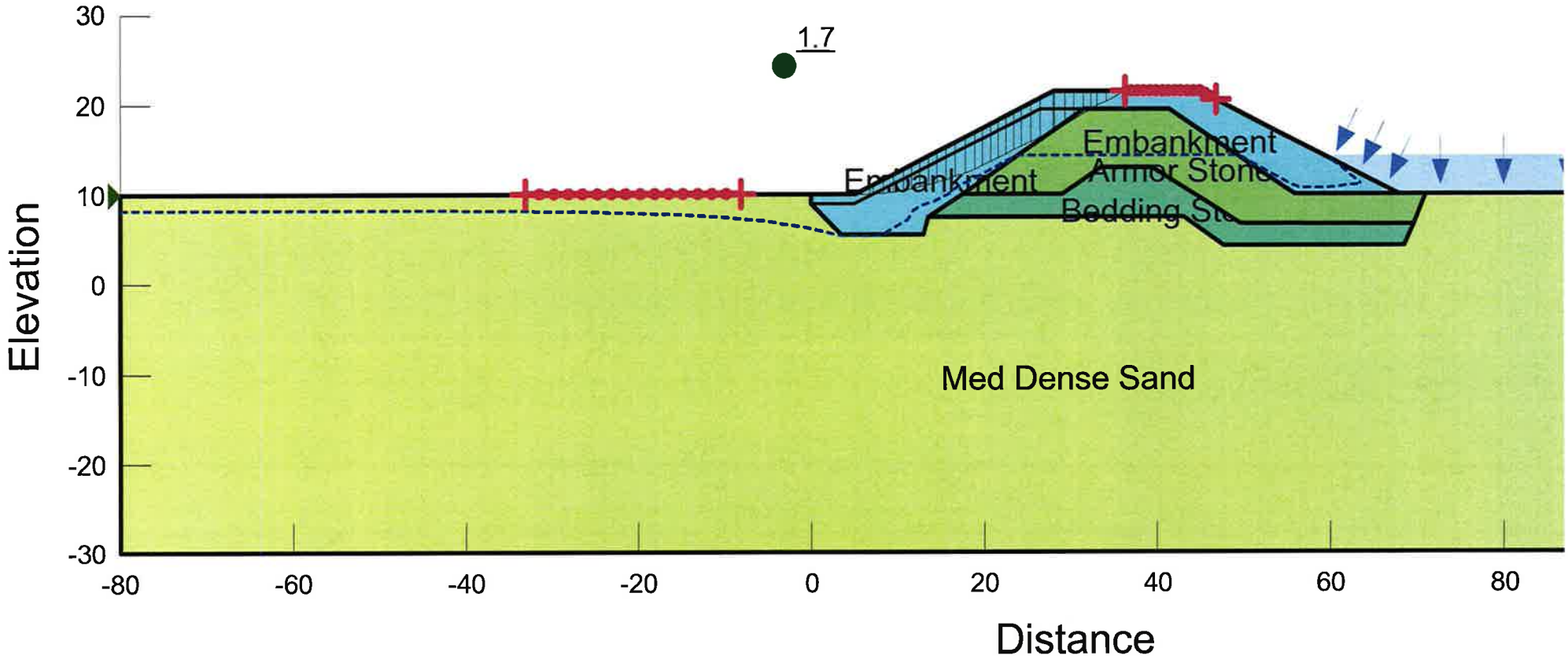


Reach A-7_WT El. 14_transient_k-constant_TimeToSS.gsz

FIGURE-8

Case: Transient analyses hypothetical hydrograph in Fig. 4
t = 15 hr

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °

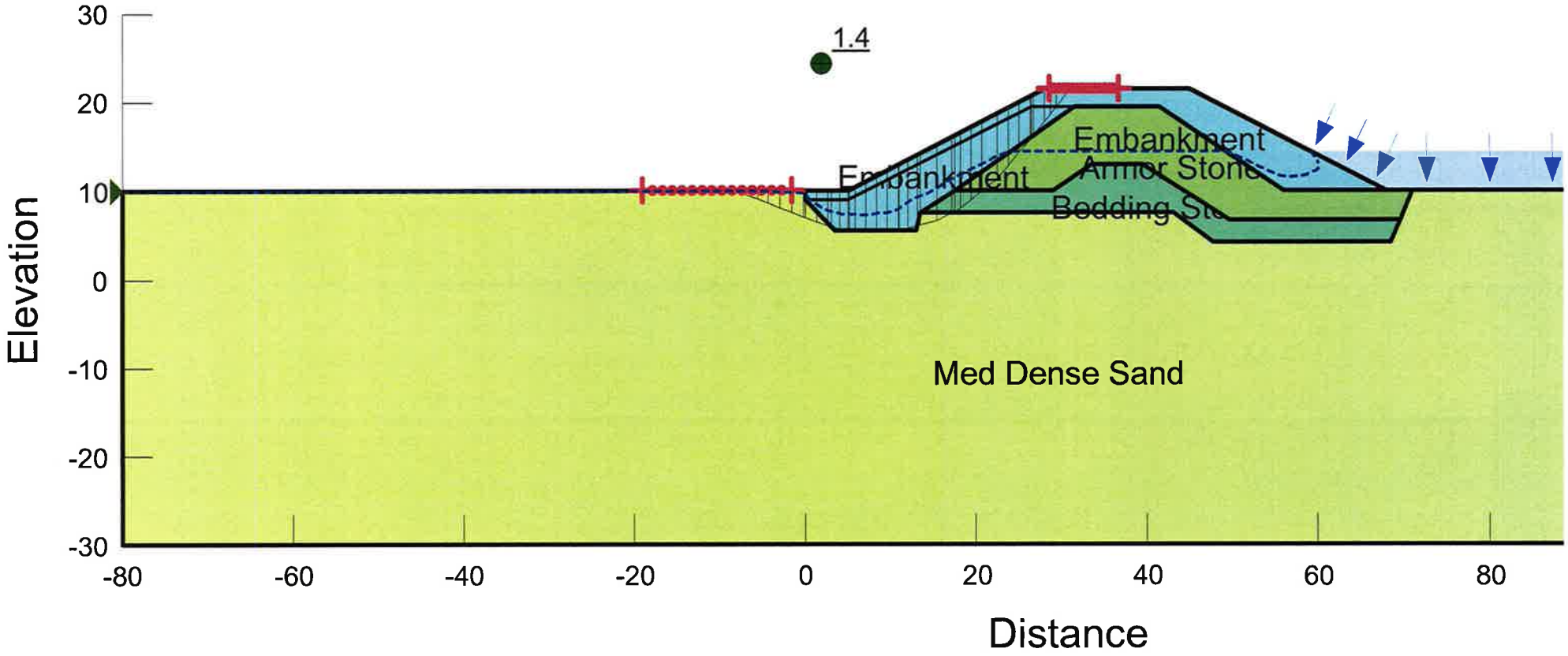


Reach A-7_WT El. 14_transient_k-constant_TimeToSS.gsz

FIGURE - 9

Case: Transient Analyses, hypothetical hydrograph in Fig-4
t = 48 hrs

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °

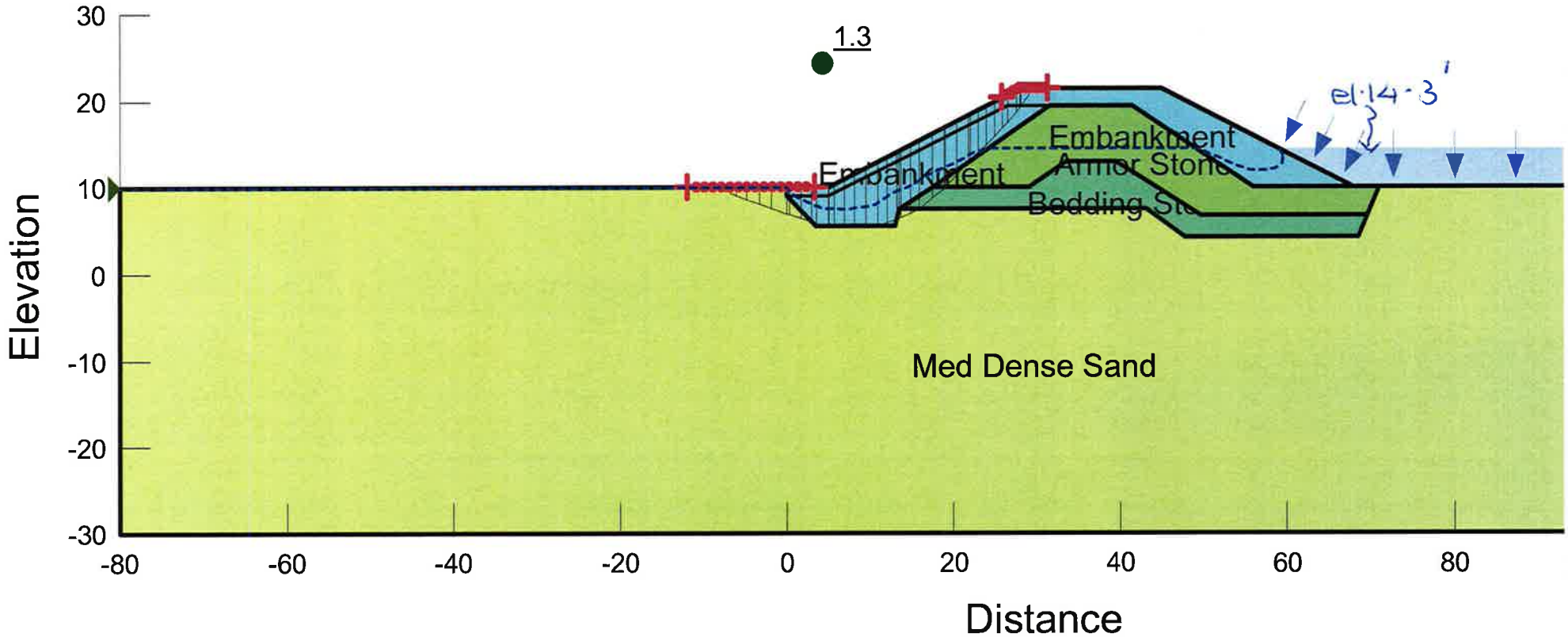


Reach A-7_WT El. 14_transient_k-constant_TimeToSS.gsz

FIGURE-10

Case: Transient analyses, hypothetical hydrograph in Fig. 4
t = 60 hrs

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °

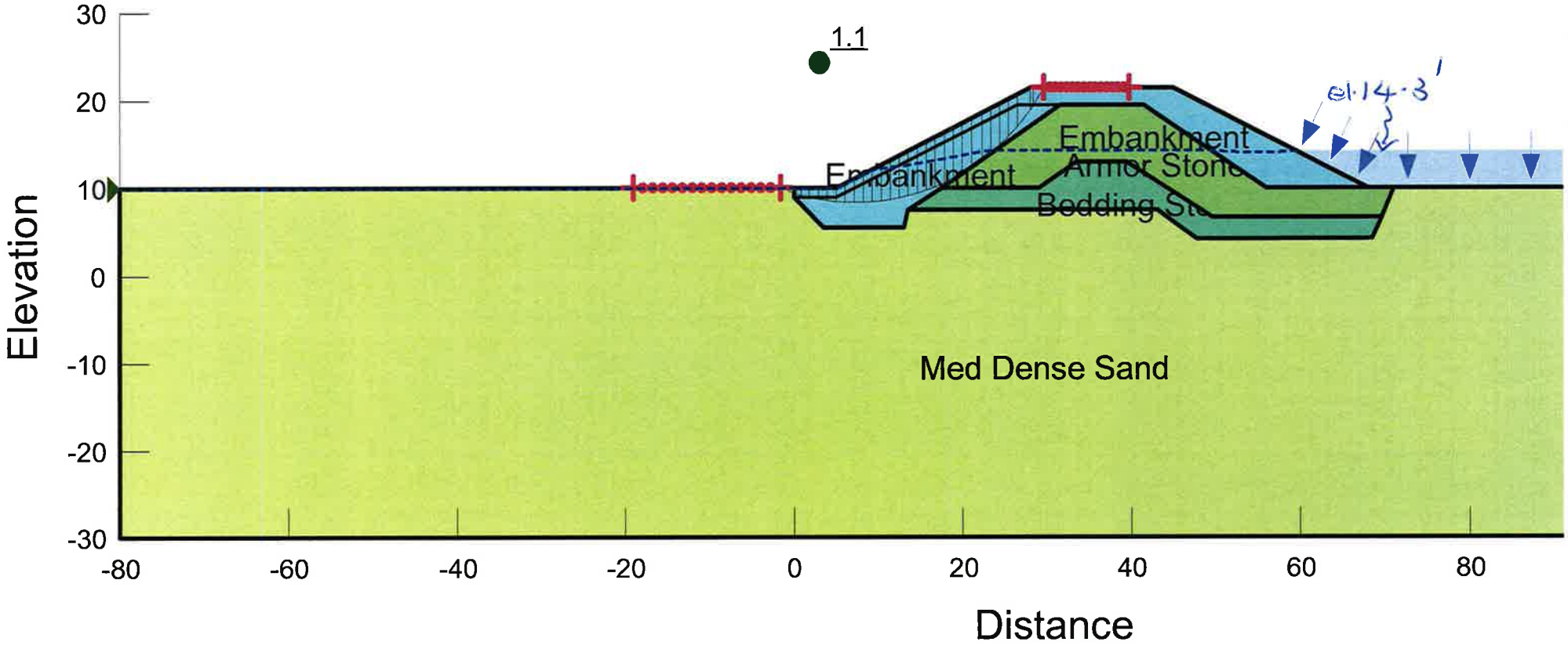


Reach A-7_WT El. 14_transient_k-constant_TimeToSS.gsz

FIGURE-11

Case: Transient Analyses, hypothetical hydrograph in Fig-4
t = 192 hrs

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °

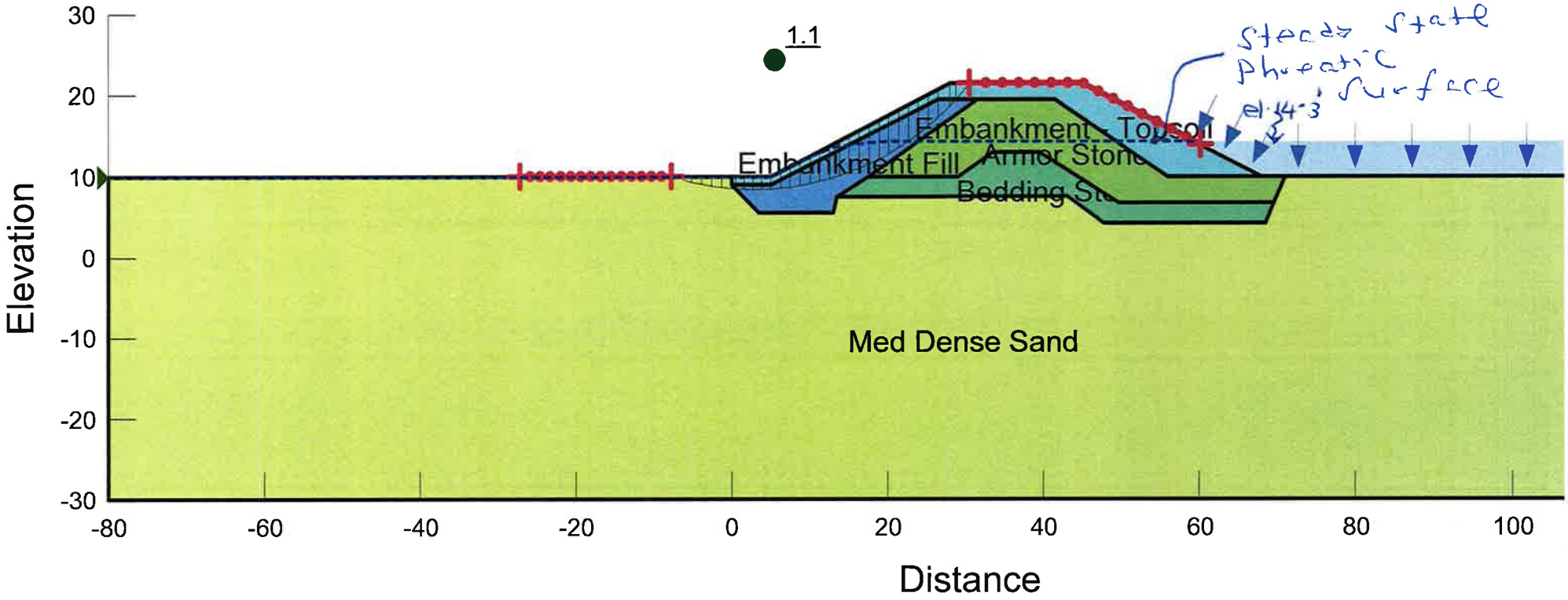


Reach A-7_WT El. 14_transient_k-constant_TimeToSS.gsz

FIGURE-12

Case: Phreatic surface from Steady State Seepage Analysis

Name: Med Dense Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Phi: 30 °
Name: Armor Stone Model: Mohr-Coulomb Unit Weight: 145 pcf Phi: 38 °
Name: Bedding Stone Model: Mohr-Coulomb Unit Weight: 140 pcf Phi: 36 °
Name: Embankment - Topsoil Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °
Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Phi: 32 °



Reach A-7_WT El. 14.3_No_Grout(AR3).gsz

FIGURE-13

Exit gradient

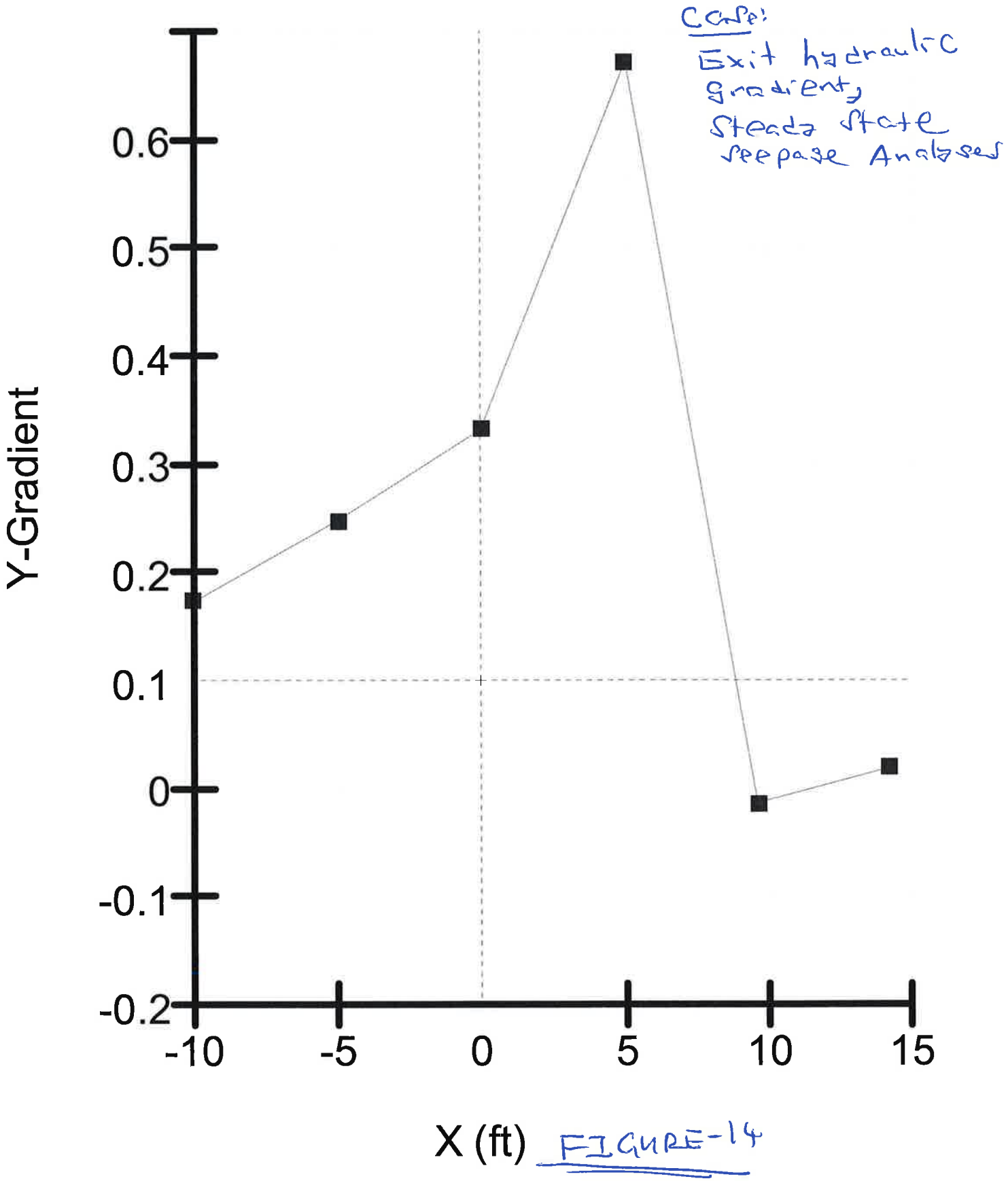


FIGURE-14

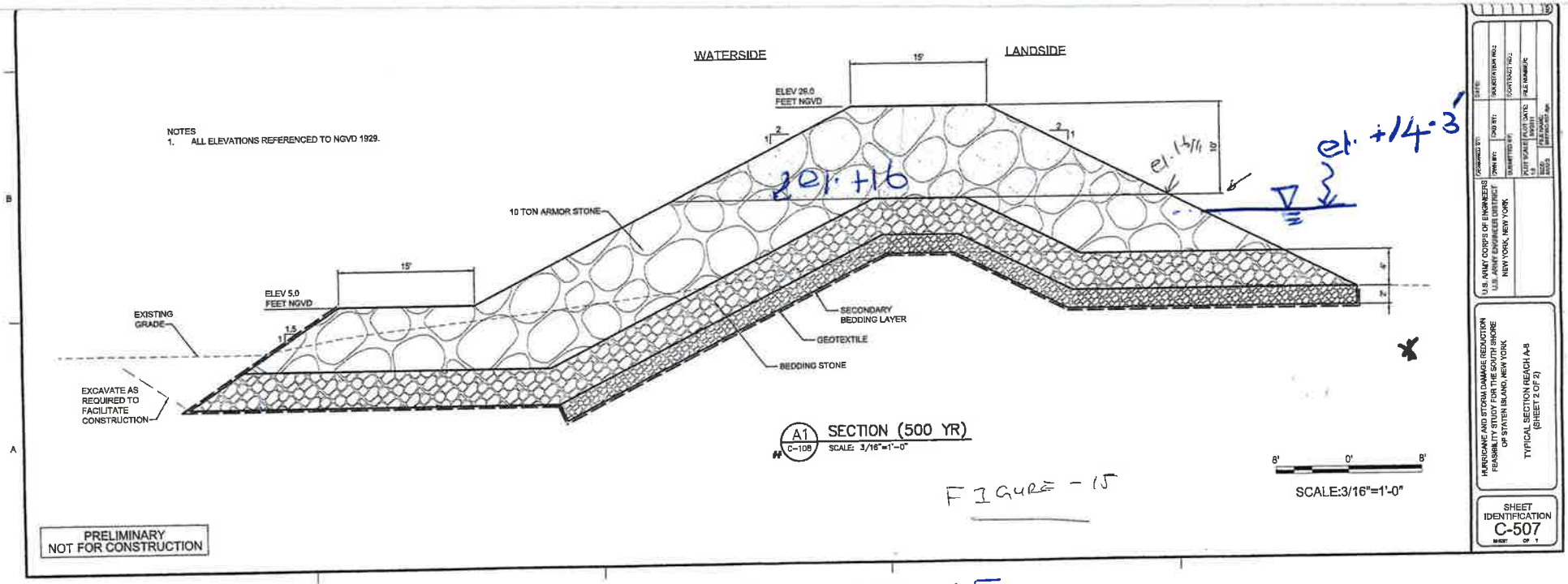


FIGURE - 15

FIGURE 15

ATTACHMENT E – SETTLEMENT ANALYSES RESULTS

Levee Settlement Analysis:

Given:

Width of Levee (ft)	Length of Levee (ft)	Depth of Levee Base (ft)	Average N-Value over Depth
$B := 65$	$L := 1$	$D := 0$	$N_{ave} := 14$

Depth to GWT (ft)	Bearing Pressure (tsf)	Saturated Unit Weight (pcf)
$D_w := 0$	$q_{tsf} := 1.2$	$\gamma_{pcf} := 120$

Find:

Immediate settlement by:

1. "Modified Terzaghi and Peck Approximation"

2. "Burland and Burbidge Approximation"

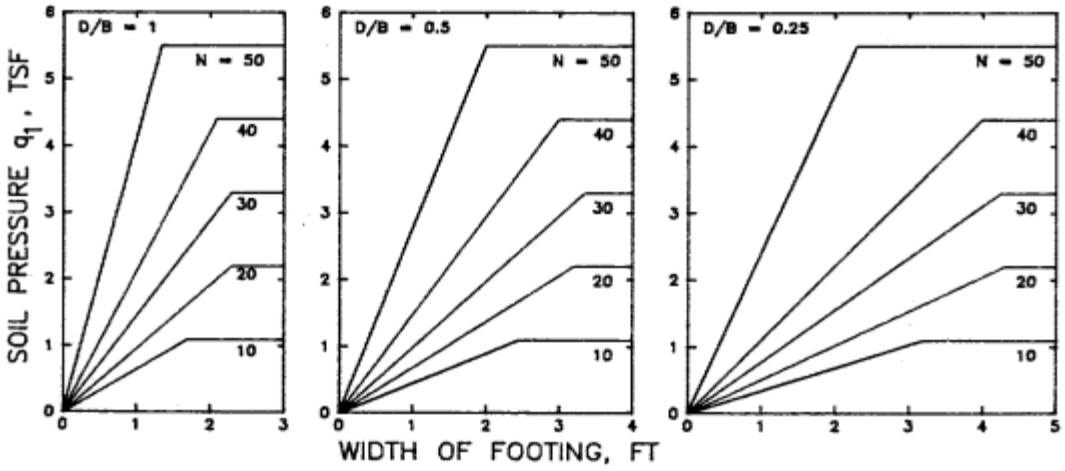
according to the:

"U.S. Army Corps of Engineers, September 30 1990 "Engineer Manual 1110-1-1904 - SETTLEMENT ANALYSIS".

1. Modified Terzaghi and Peck Approximation (ρ_{it}):

$$\rho_{it}(q_1) := \frac{q_{tsf}}{(18 \cdot q_1)}$$

where q_1 = soil pressure from Figure 3-3a using corrected blowcount N' and the ratio of embedment depth D to footing width B , tsf.



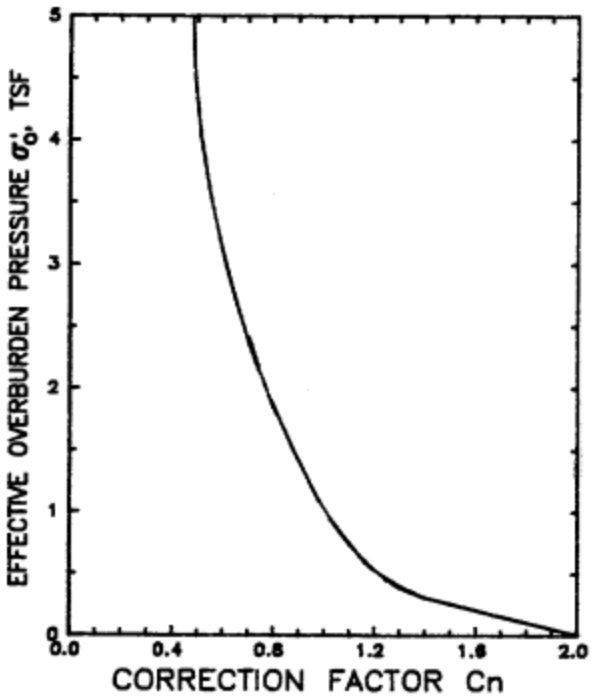
a. EVALUATION OF SOIL PRESSURE q_1 FROM CORRECTED BLOWCOUNT N' AND EMBEDMENT DEPTH/FOOTING WIDTH RATIO D/B

$$N_{prime}(C_w, C_n) := N_{ave} \cdot C_w \cdot C_n$$

$$C_w := \begin{cases} 0.5 & \text{if } D_w = 0 \\ 1 & \text{if } D_w > D + B \\ 0.5 + 0.5 \cdot \dfrac{D_w}{D + B} & \text{otherwise} \end{cases}$$

$$C_w = 0.5$$

(2) Overburden pressure correction. The correction factor Cn is found from Figure 3-3b as a function of the effective vertical overburden pressure σ'_o .



b. CORRECTION Cn FOR EFFECTIVE OVERBURDEN PRESSURE σ'_o

$$\sigma_o := \gamma_{pcf} \cdot \frac{D}{2000}$$

$$\sigma_o = 0$$

$$C_n := 1.6$$

$$N_{prime}(C_w, C_n) = 11$$

$$\frac{D}{B} = 0$$

$$q_1 := 2.2$$

$$\rho_{ifeet} := \rho_{it}(q_1)$$

$$\rho_{ifeet} = 0.0303$$

$\rho_{iinches} := \rho_{ifeet} \cdot 12$ Convert feet to inches

$\rho_{iinches} = 0.4$ Final answer in inches; approximately 0.5 inches

2. Burland and Burbidge Approximation (p_{ib}):

$\rho_{ibmm}(q_{Kpa}, B_m, I_c) := \left(q_{Kpa} \cdot B_m^{0.7} \cdot I_c\right)$ Gives settlement in mm

$q_{Kpa} := q_{tsf} \cdot 95.76$ Convert tsf to Kpa

$$q_{Kpa} = 114.912$$

$B_m := \frac{B}{3.28}$ Convert feet to meters

$$B_m = 19.817$$

Note that Nave is identical to the average SPT blowcount measured over a depth of $B_m^{0.75}$

$$I_c := \frac{1.7}{N_{ave}^{1.4}}$$

$$I_c = 0.042$$

$$\rho_{ibmm1} := \rho_{ibmm}(q_{Kpa}, B_m, I_c) = 39.279$$

$\rho_{ib} := \rho_{ibmm1} \cdot \frac{12 \cdot 3.28}{1000}$ Convert mm to inches

$\rho_{ib} = 1.5$ Final answer in inches; approximately 1.5 inches

Note:

1. Stress at the bottom of the embankment will be less than γh (full stress) because of the slopes. But, in this analysis, the full stress was conservatively considered. The embankment base width, B, was considered as the width between mid of slopes (65ft <= 50/2 + 15 + 50/2).

ATTACHMENT F – FLOODWALL PILE ANALYSIS RESULTS

Summary of Floodwall Pile Designs

It is our understanding that the floodwall is to be supported on piles. Based on the subsurface conditions and DRIVEN pile capacity analyses, we recommend HP14x89 friction piles driven to sandy stratum for this purpose. As per the DRIVEN analysis results, attached, the following recommendations are provided:

1) **70 tons (Tension/Compression):**
   - 70 tons Tension = 115 feet
   - 70 tons Compression = 95 feet

2) **50 tons (Tension/Compression):**
   - 50 tons Tension = 95 feet
   - 50 tons Compression = 80 feet

3) **35 tons (Tension/Compression):**
   - 35 tons Tension = 80 feet
   - 35 tons Compression = 70 feet

It should be noted that the maximum depths of available soils borings is only about 50 feet, and the above preliminary results were estimated without any deep boring details. Also note that when the required tension and compression capacities are same, the pile length should be determined based on the length corresponding to the tension capacity.

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\PROGRA~1\DRIVEN\SSSI.DVN
Project Name: SSSI
Project Date: 07/31/2014
Project Client: USACE
Computed By: VN
Project Manager: VN

01/20/15
VN

PILE INFORMATION

Pile Type: H Pile - HP14X89
Top of Pile: 0.00 ft
Perimeter Analysis: Box
Tip Analysis: Pile Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	0.00 ft
	- Driving/Restrike	0.00 ft
	- Ultimate:	0.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesionless	100.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
2	Cohesionless	50.00 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
9.01 ft	4.01 Kips	1.64 Kips	5.65 Kips
18.01 ft	16.03 Kips	2.41 Kips	18.45 Kips
27.01 ft	36.06 Kips	2.41 Kips	38.47 Kips
36.01 ft	64.09 Kips	2.41 Kips	66.51 Kips
45.01 ft	100.13 Kips	2.41 Kips	102.55 Kips
54.01 ft	144.18 Kips	2.41 Kips	146.59 Kips
63.01 ft	196.23 Kips	2.41 Kips	198.65 Kips
72.01 ft	256.29 Kips	2.41 Kips	258.71 Kips
81.01 ft	324.36 Kips	2.41 Kips	326.78 Kips
90.01 ft	400.44 Kips	2.41 Kips	402.85 Kips
99.01 ft	484.52 Kips	2.41 Kips	486.93 Kips
99.99 ft	494.16 Kips	2.41 Kips	496.57 Kips
100.01 ft	494.38 Kips	5.98 Kips	500.36 Kips
109.01 ft	608.07 Kips	5.98 Kips	614.05 Kips
118.01 ft	731.56 Kips	5.98 Kips	737.54 Kips
127.01 ft	864.83 Kips	5.98 Kips	870.82 Kips
136.01 ft	1007.90 Kips	5.98 Kips	1013.88 Kips
145.01 ft	1160.76 Kips	5.98 Kips	1166.74 Kips
149.99 ft	1249.55 Kips	5.98 Kips	1255.53 Kips