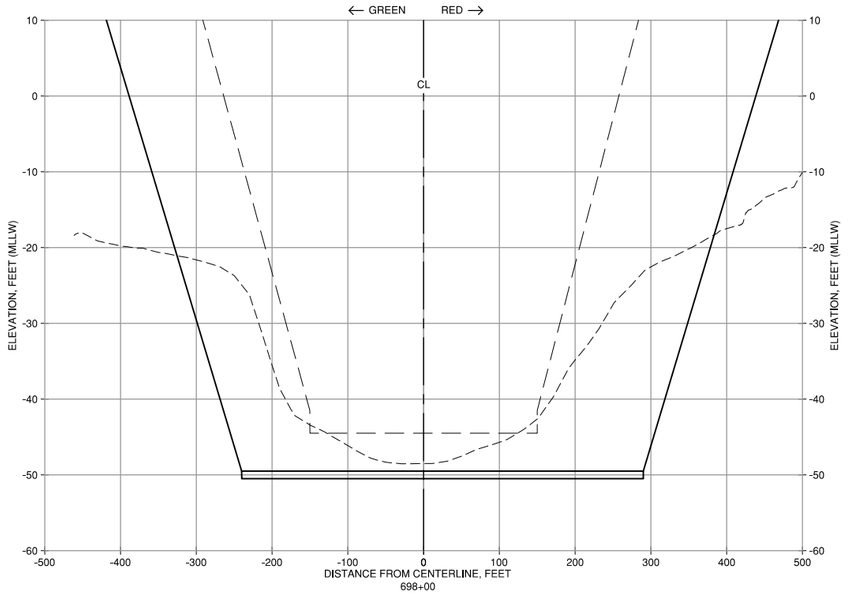
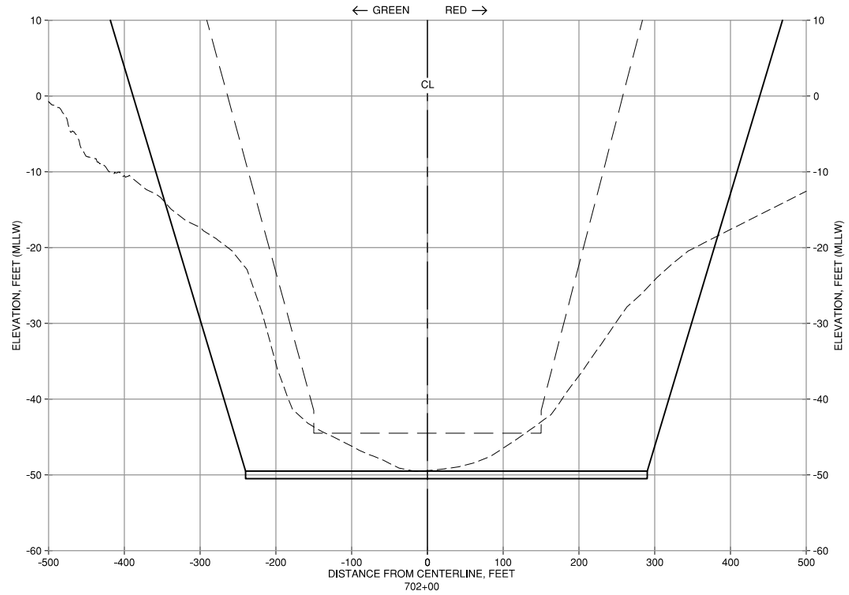
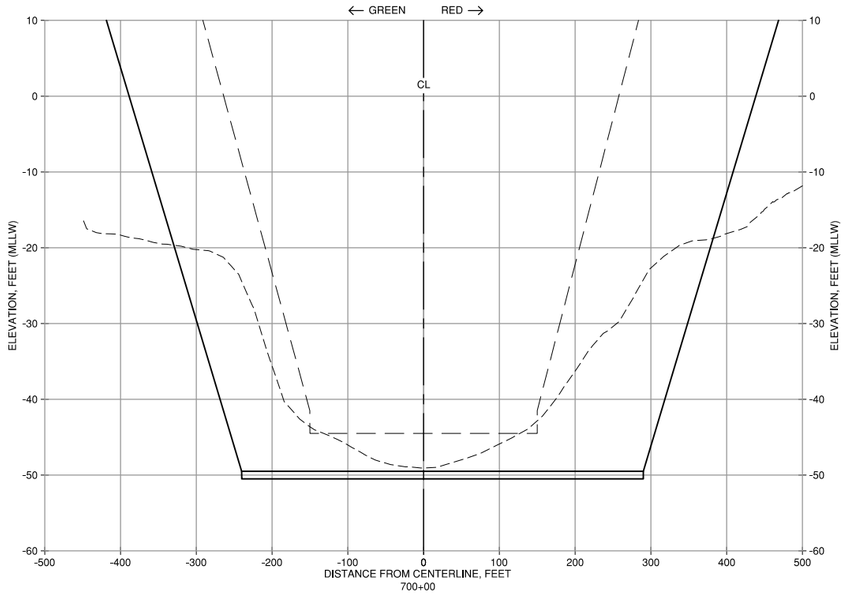
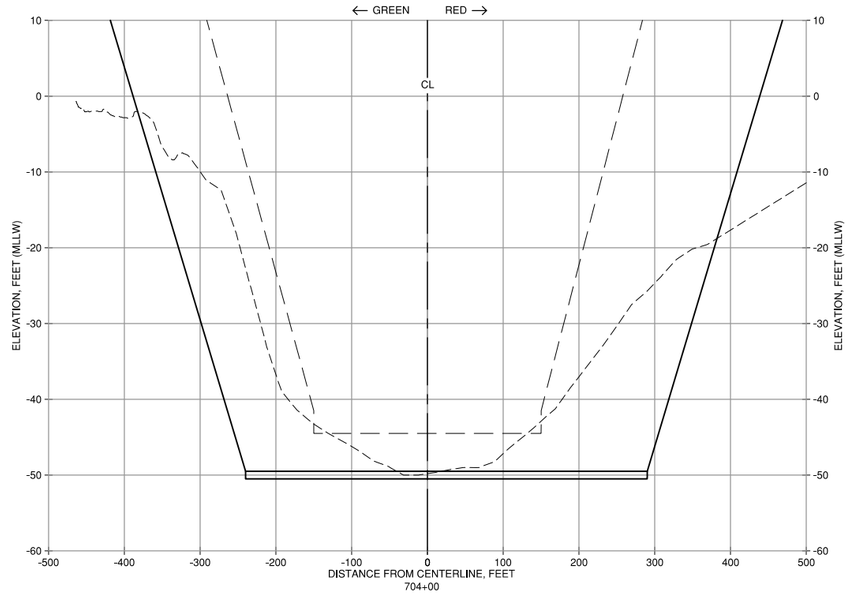
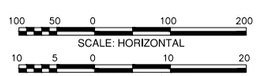








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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:

SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 4 OF 34

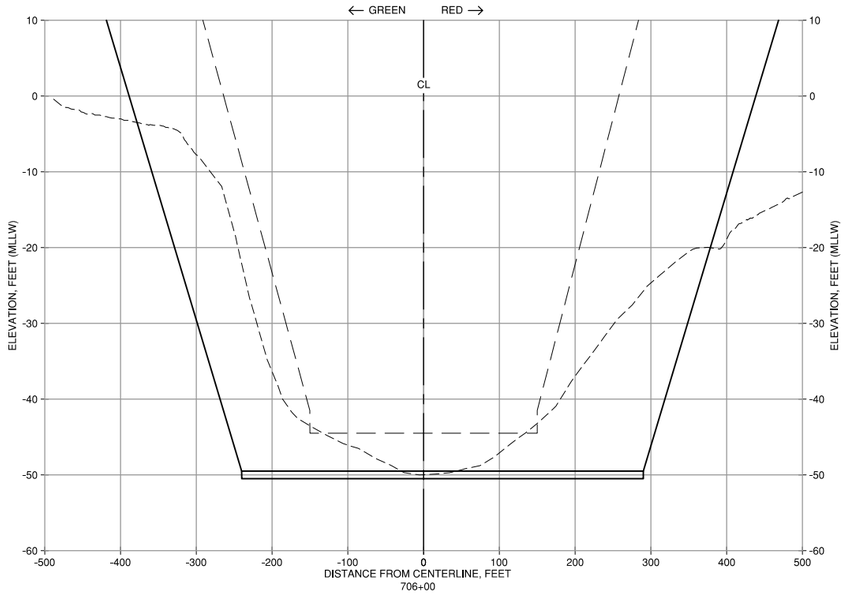
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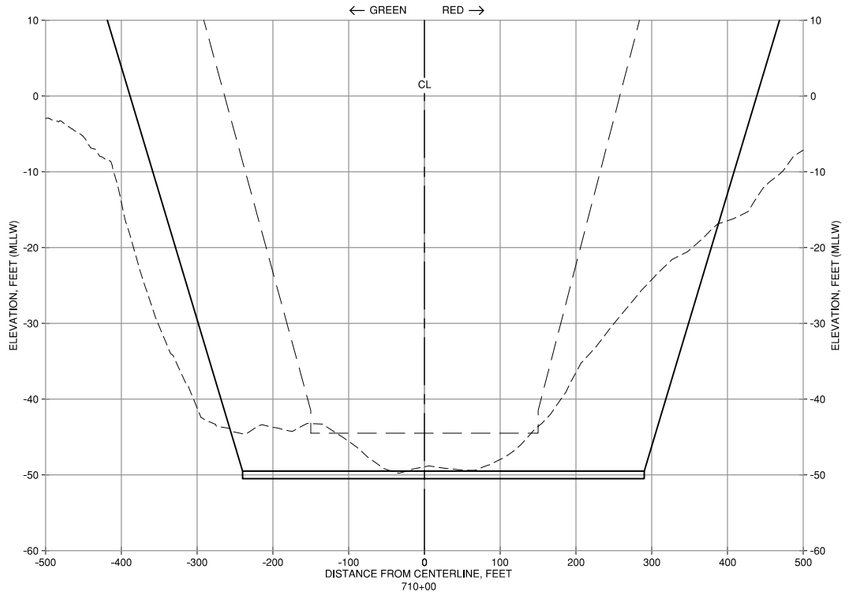
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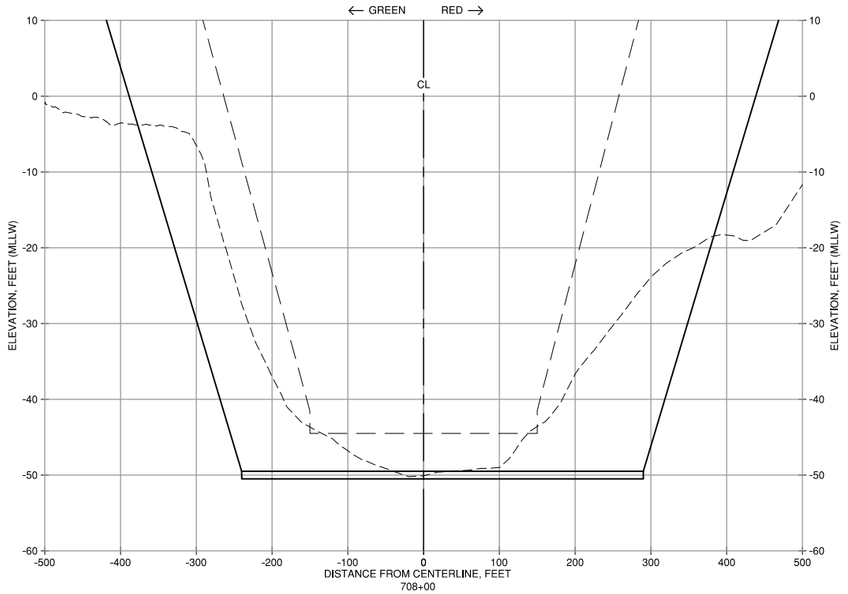
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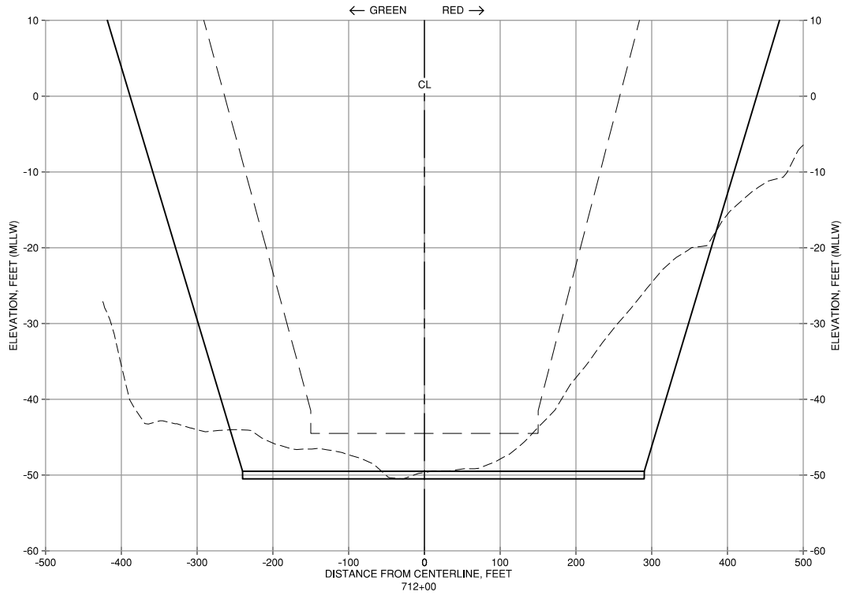
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 5 OF 34

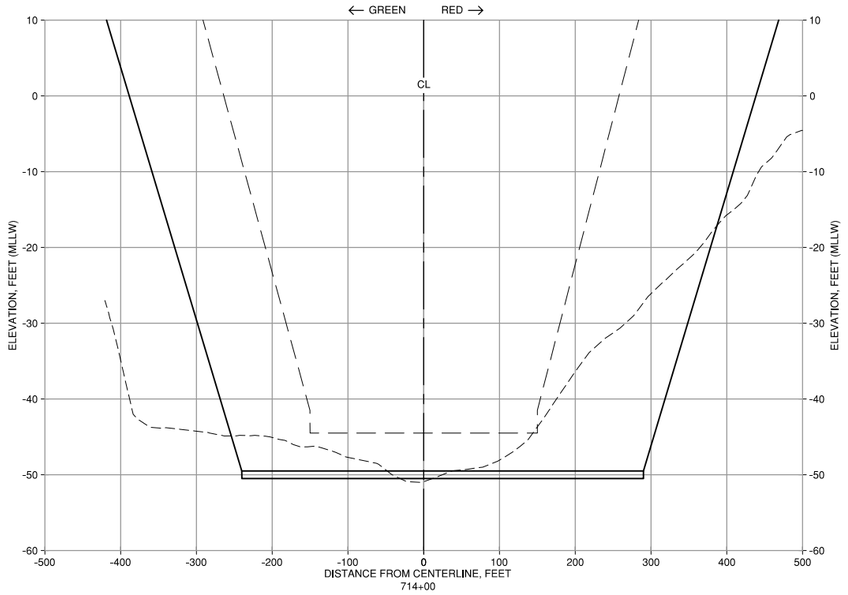
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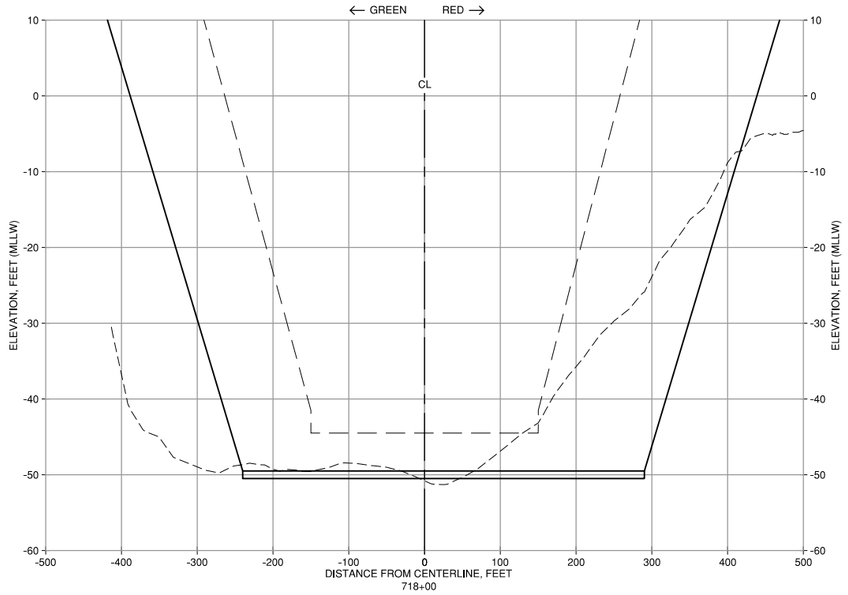
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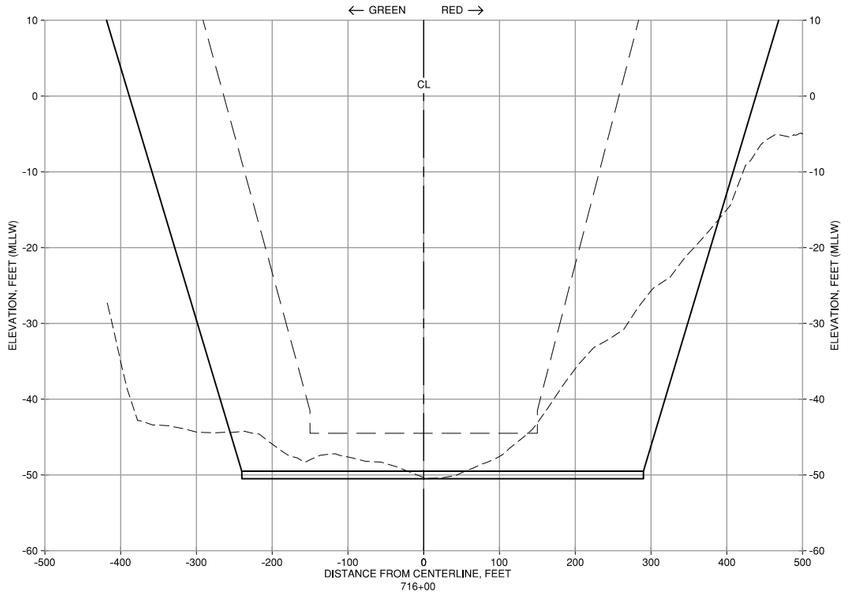
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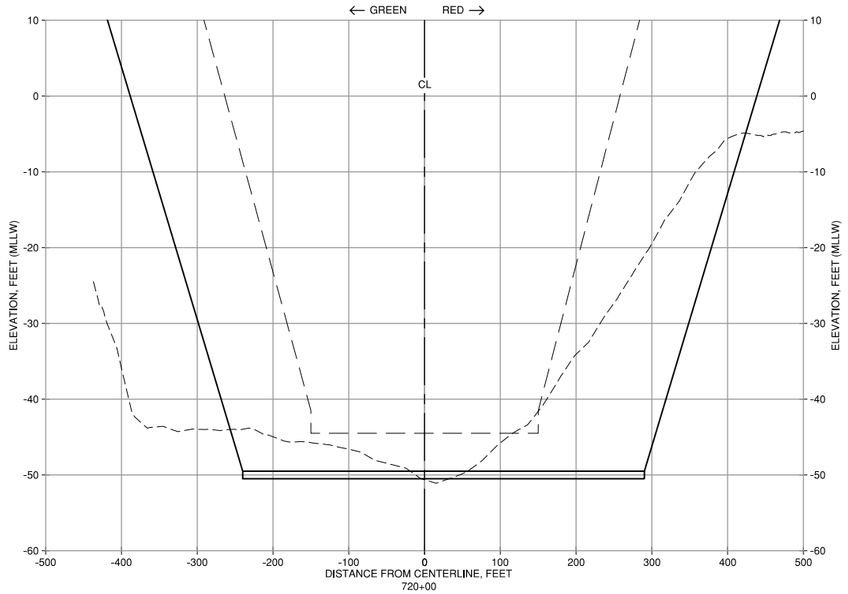
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 6 OF 34

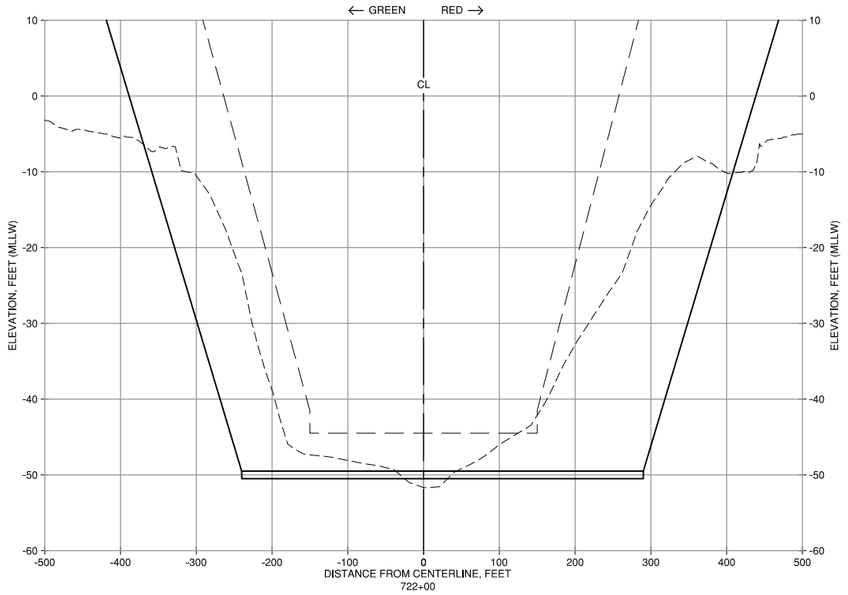
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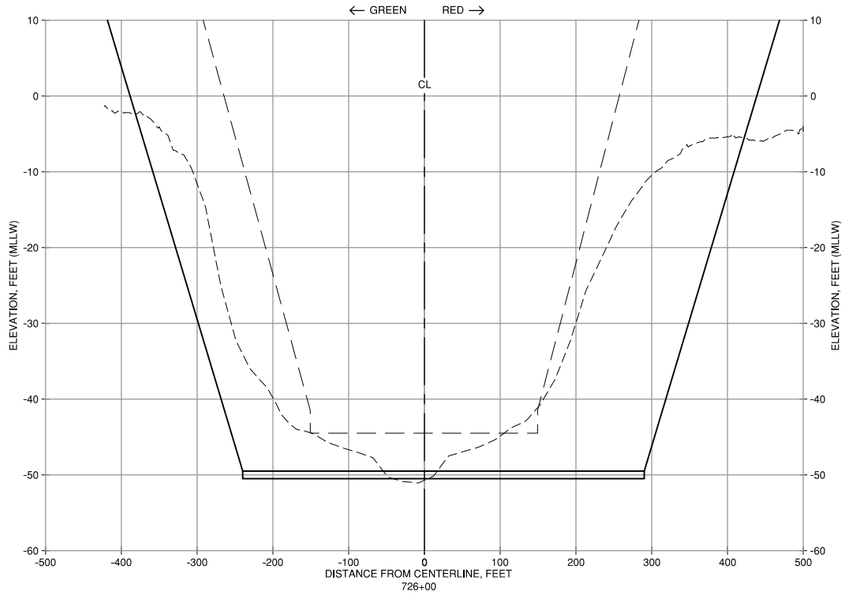
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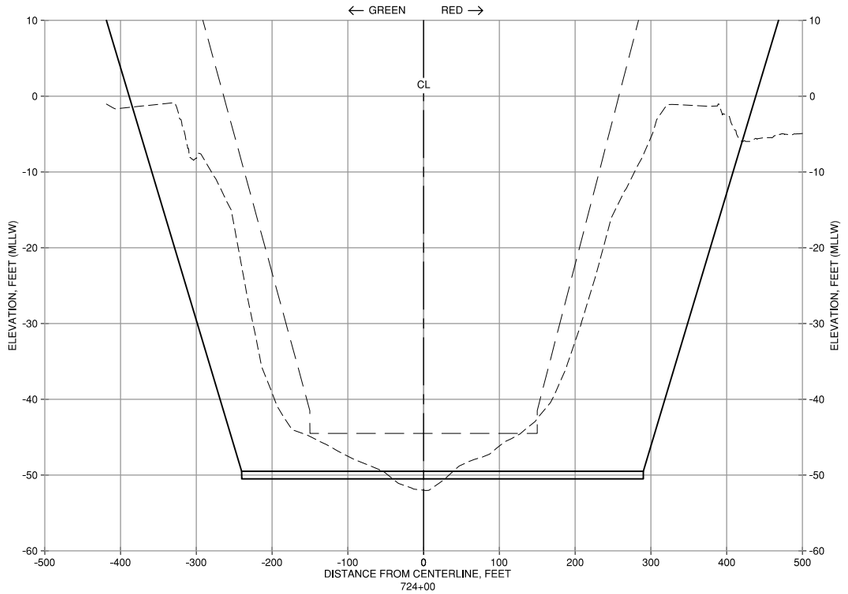
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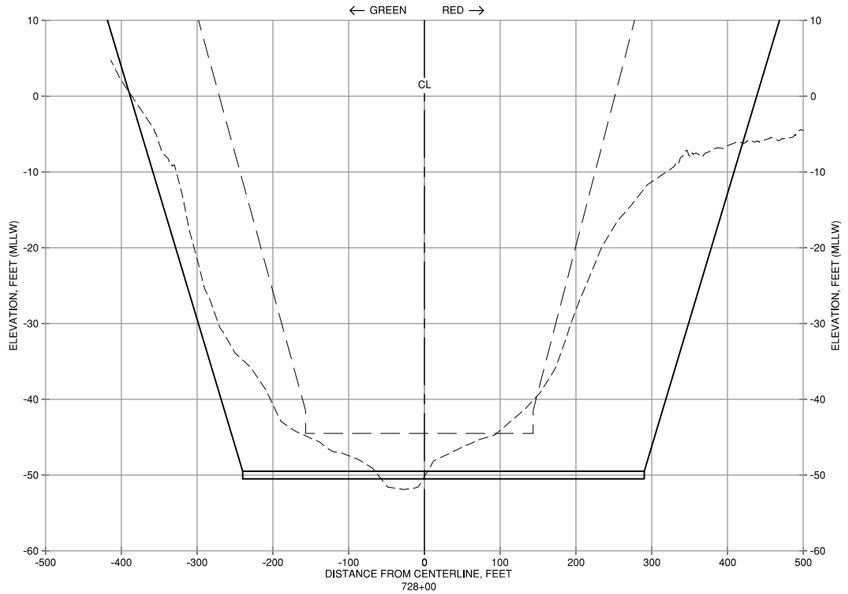
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PORT CONTRACT REPRESENTATIVE
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 7 OF 34

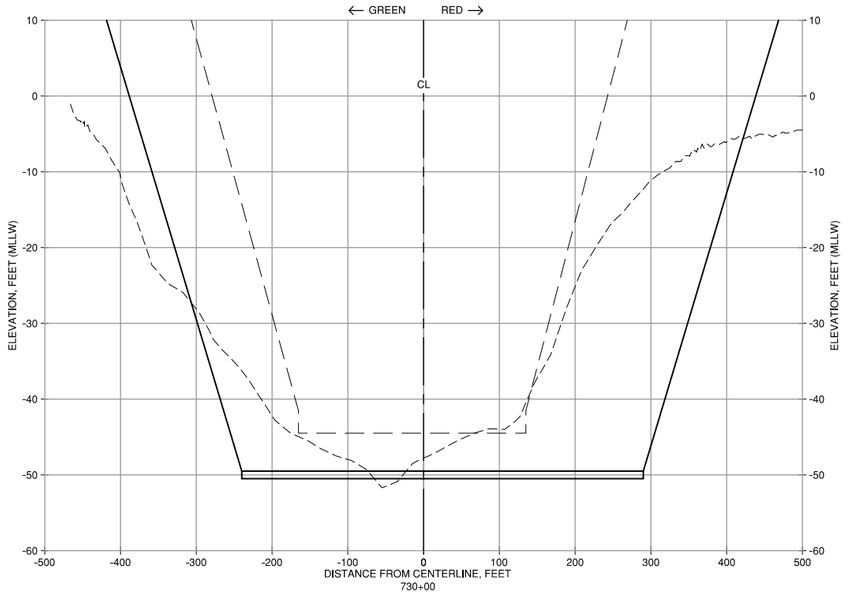
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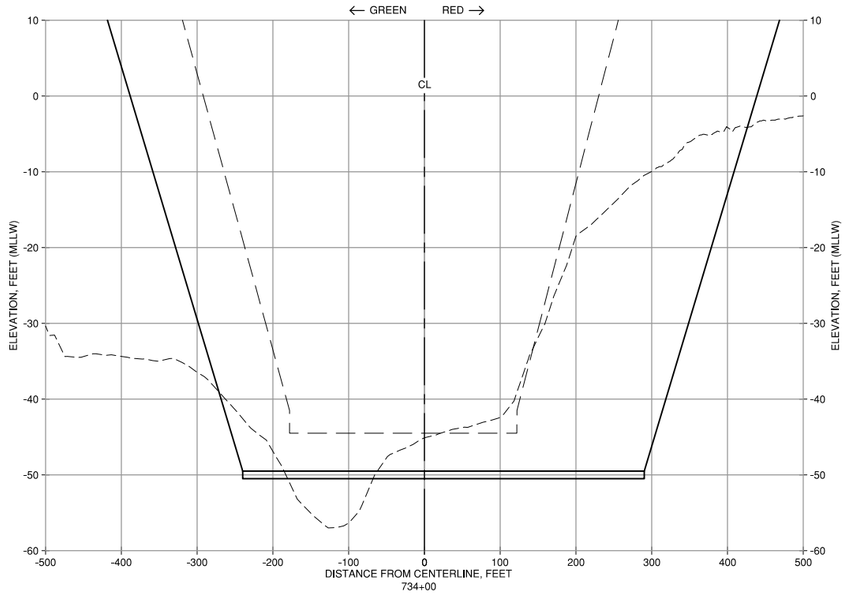
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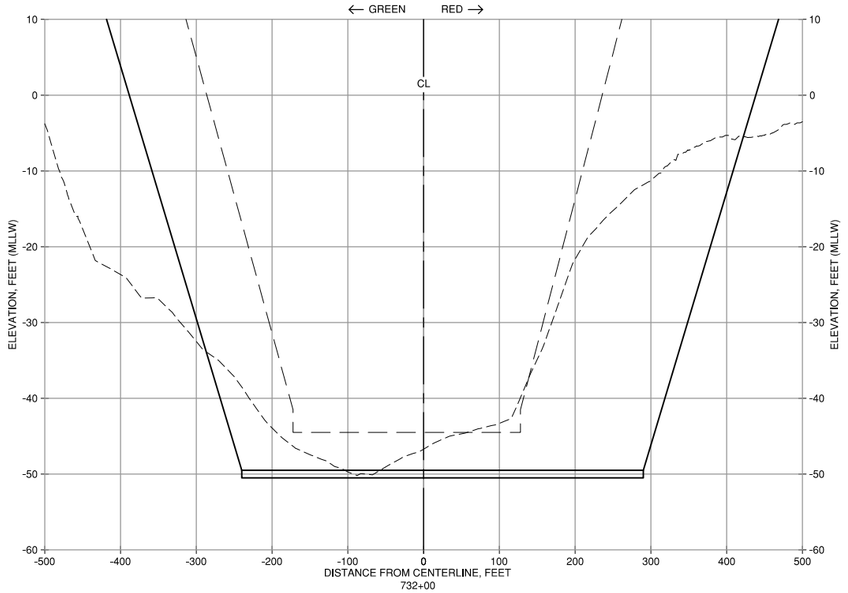
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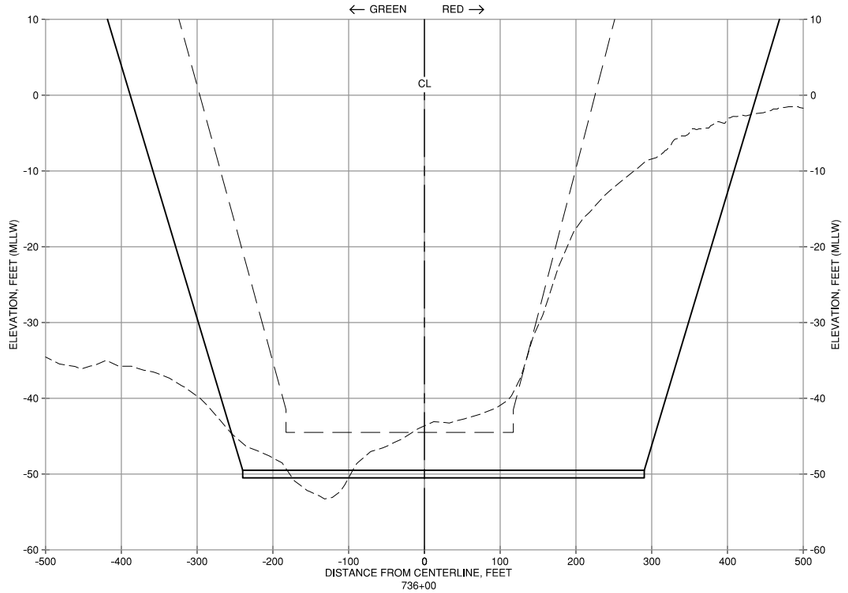
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 8 OF 34

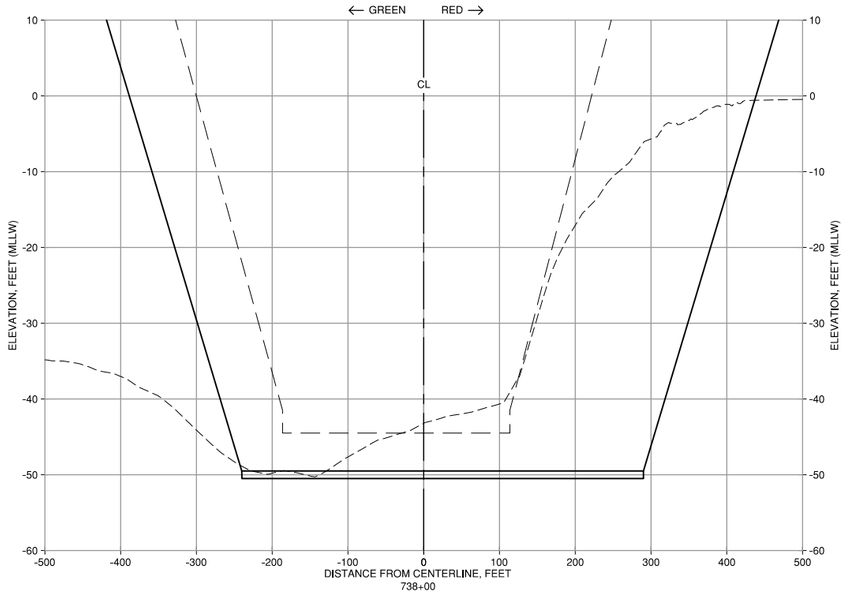
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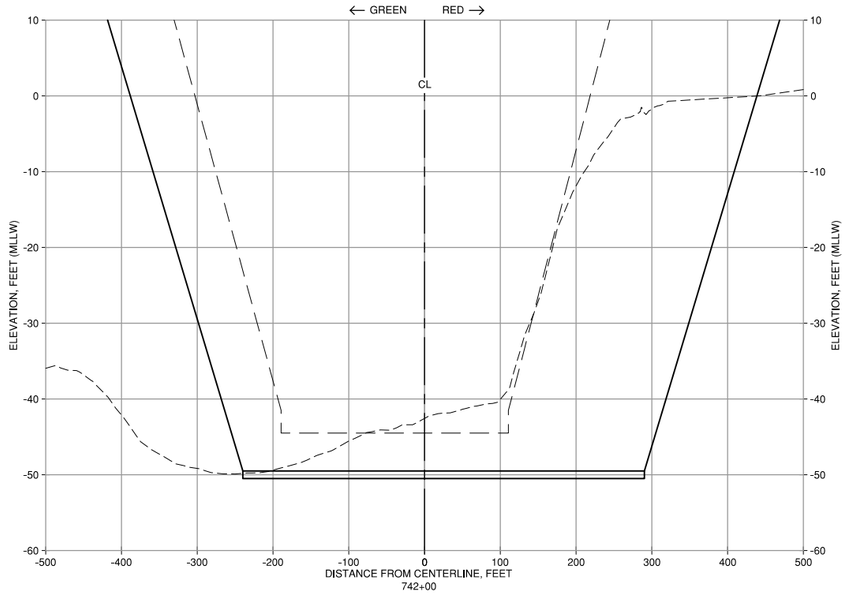
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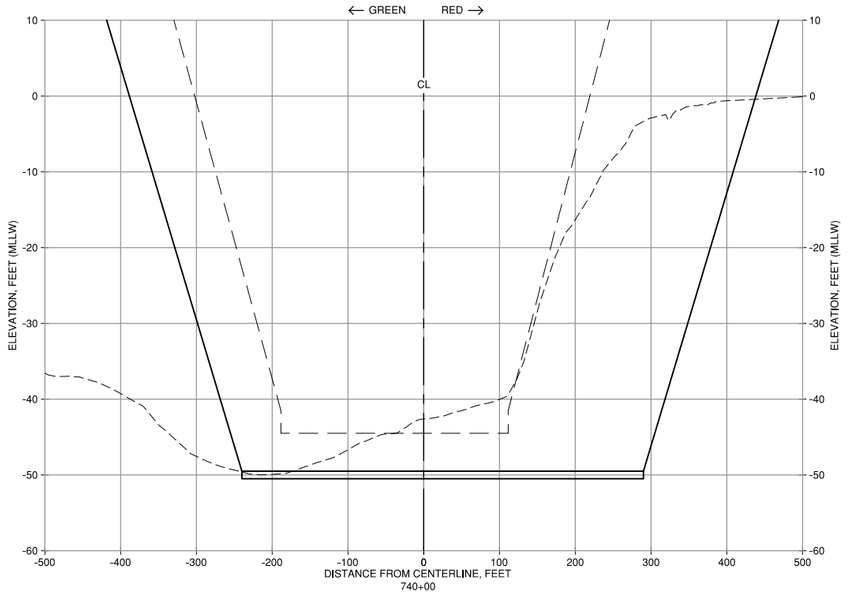
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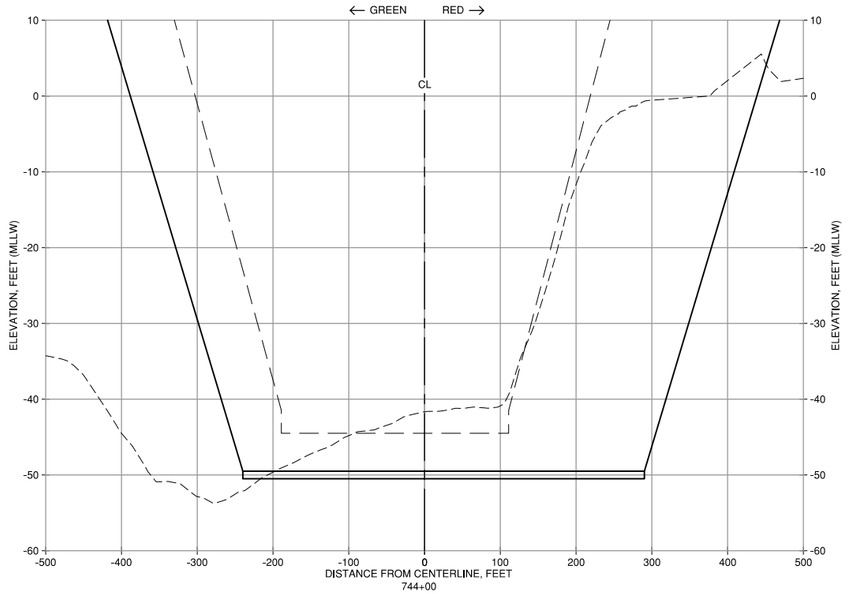
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PORT CONTRACT REPRESENTATIVE
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PROJECT TITLE:
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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 9 OF 34

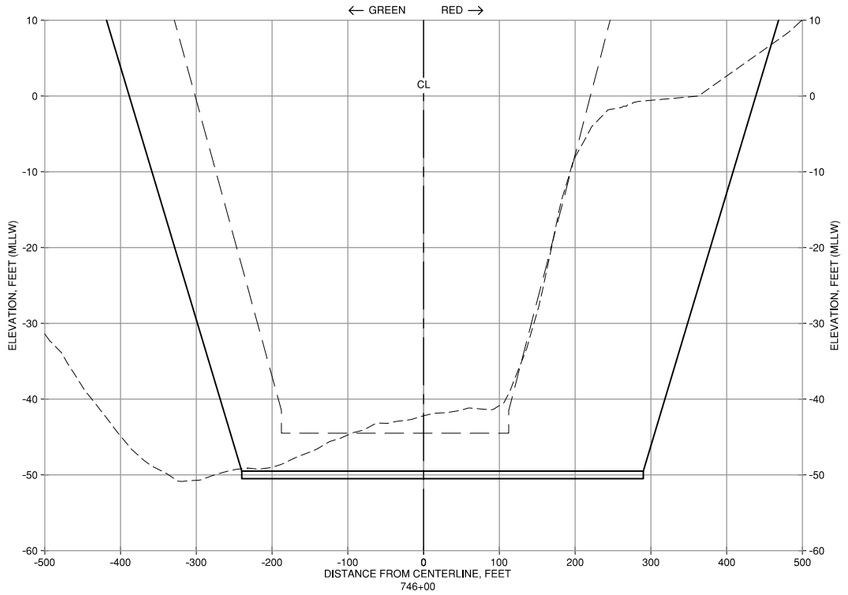
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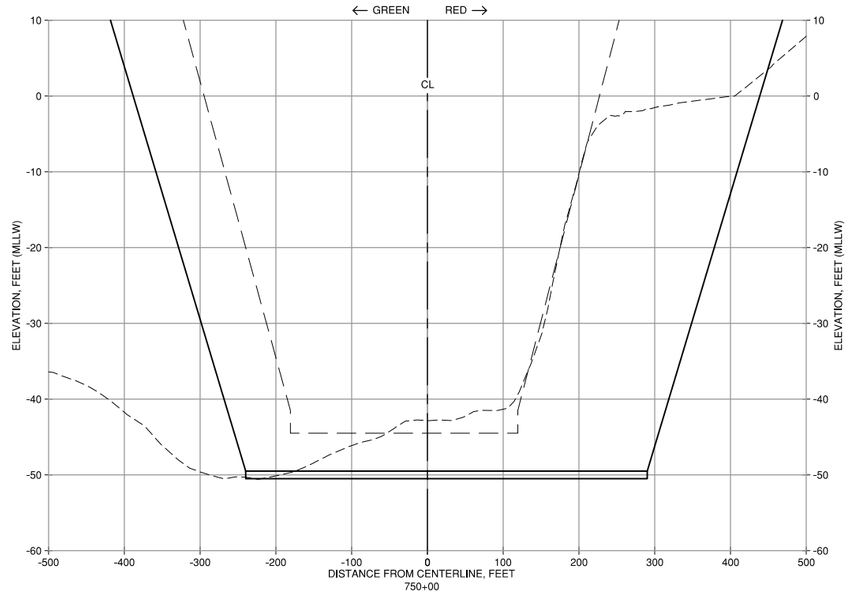
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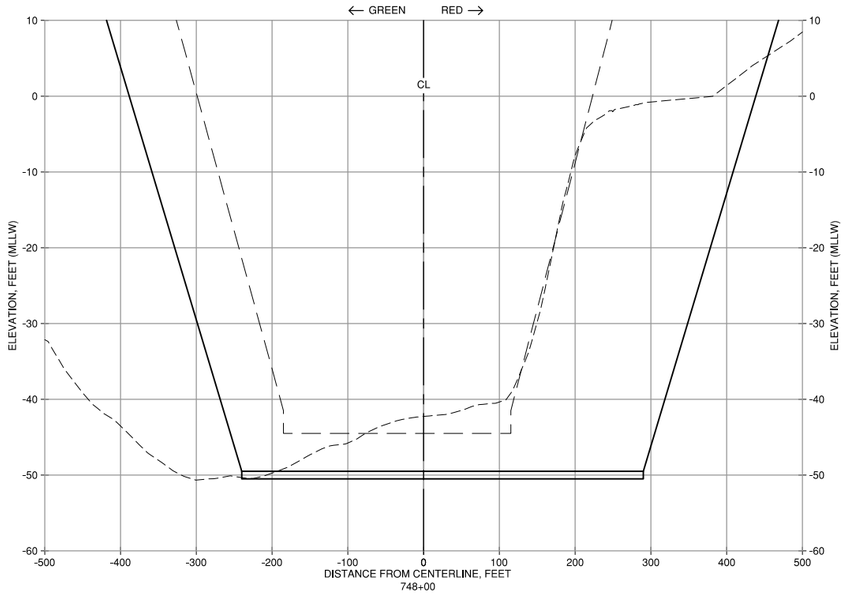
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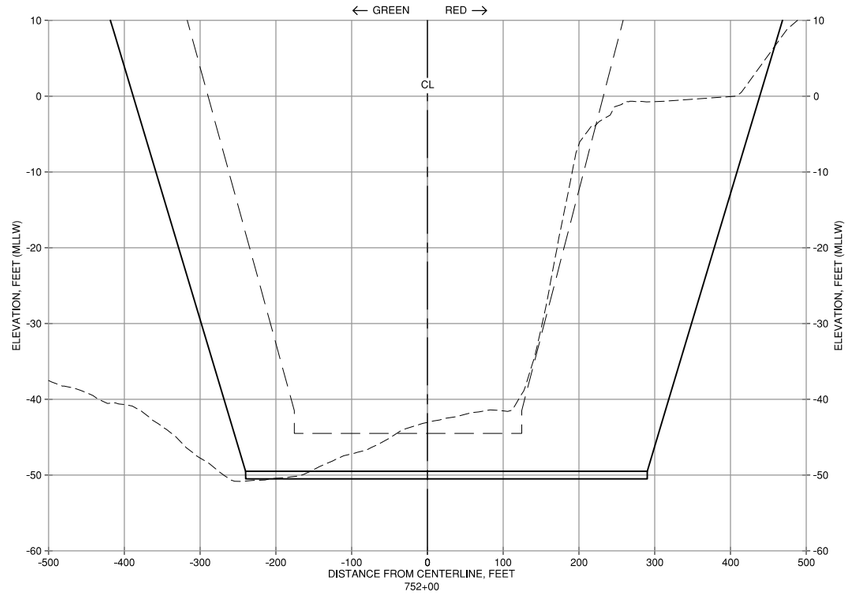
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 10 OF 34

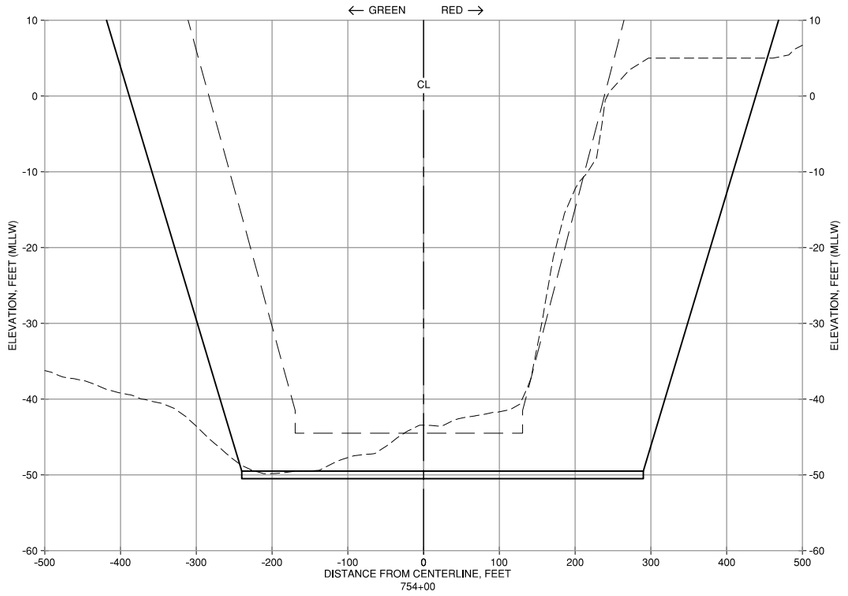
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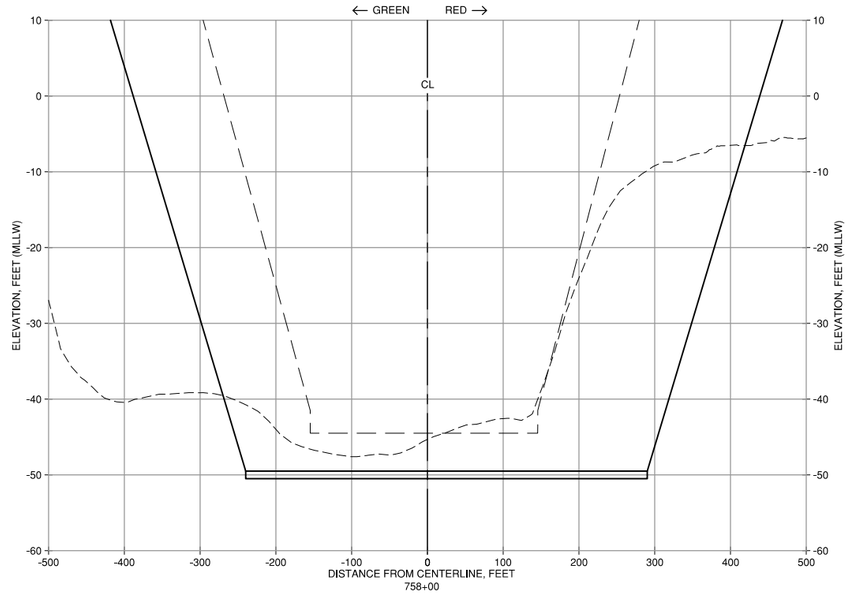
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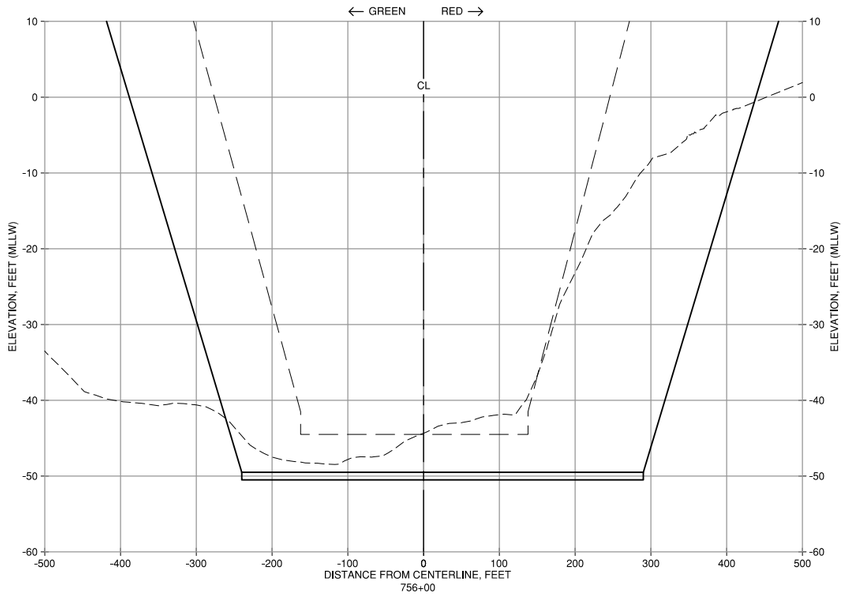
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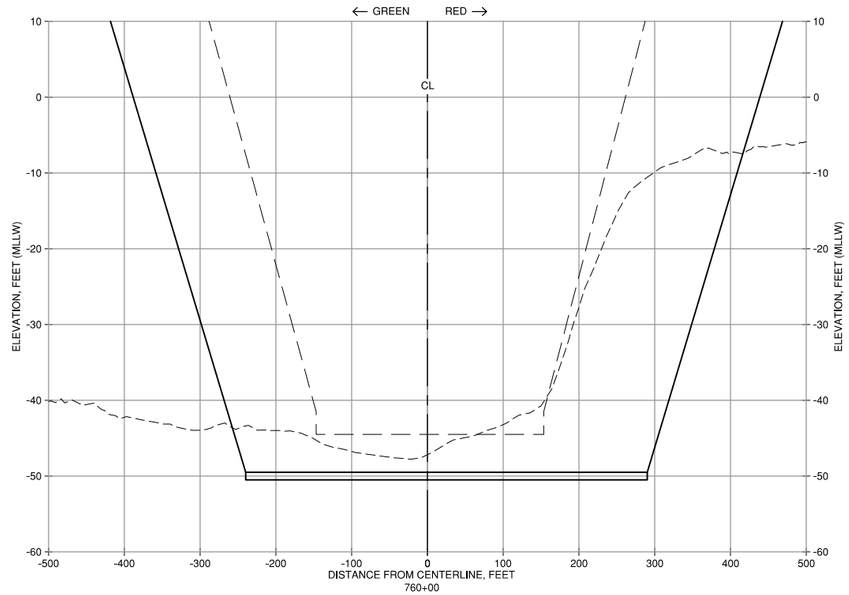
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 11 OF 34

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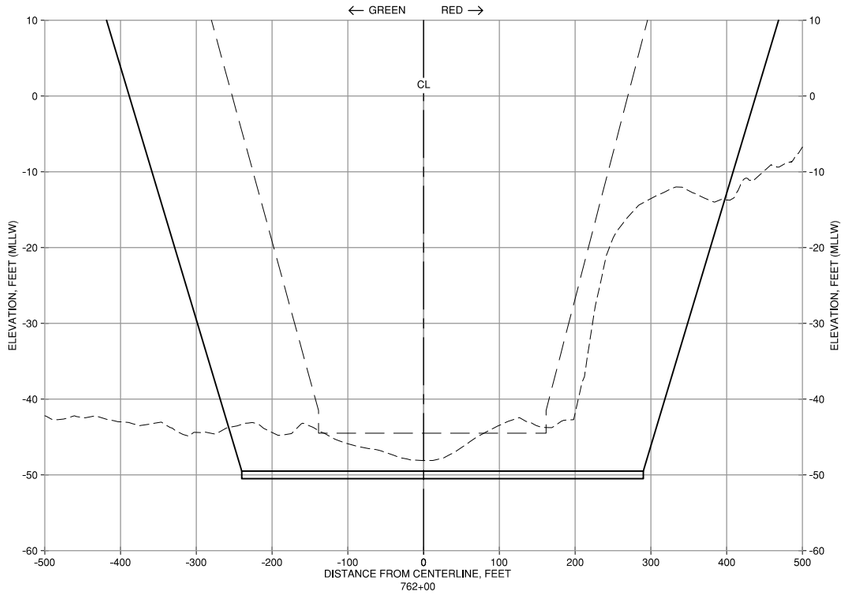
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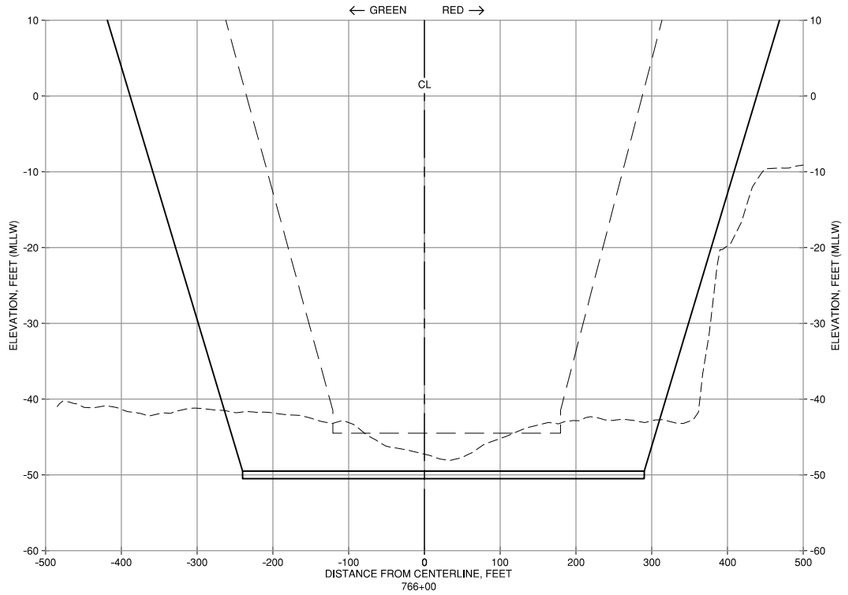
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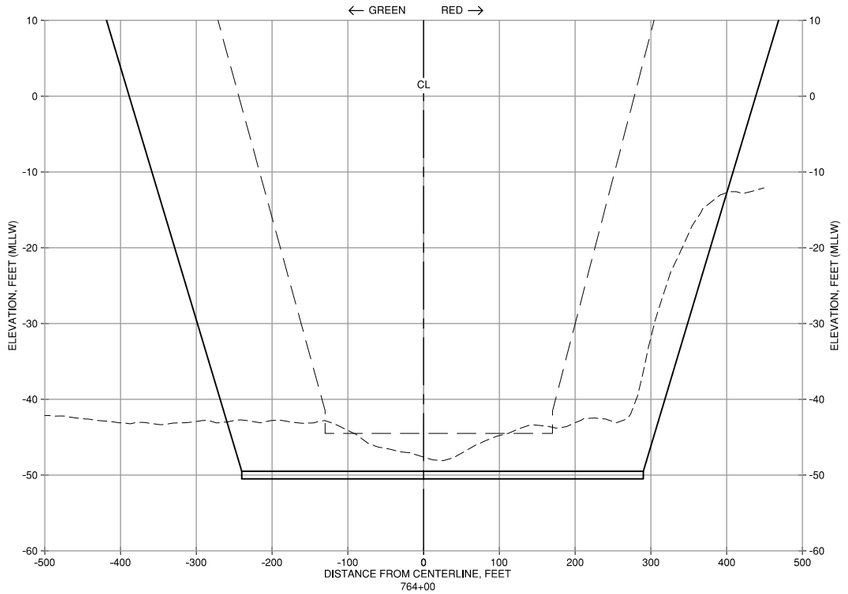
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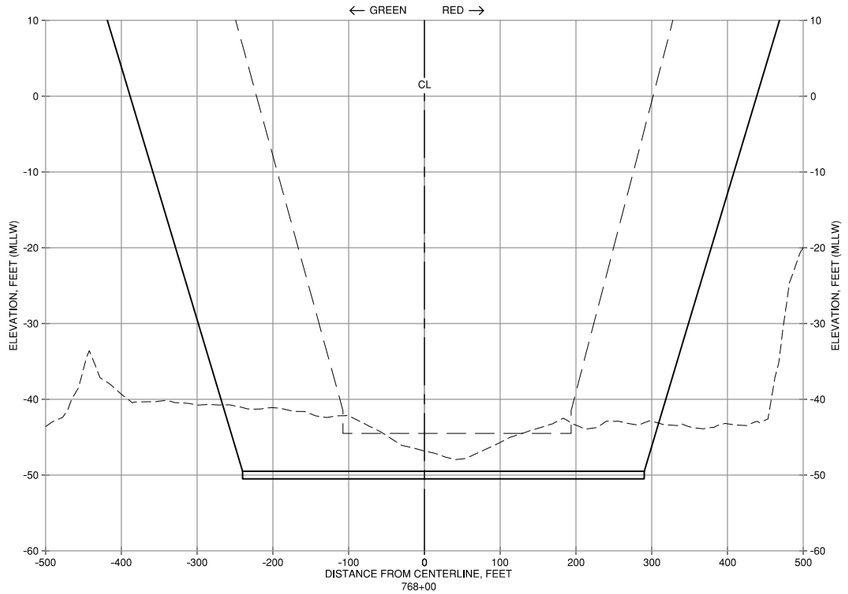
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CONSULTANT:

DESIGN PREPARED BY:
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Texas P.E. Firm
Registration No. F-754

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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 12 OF 34

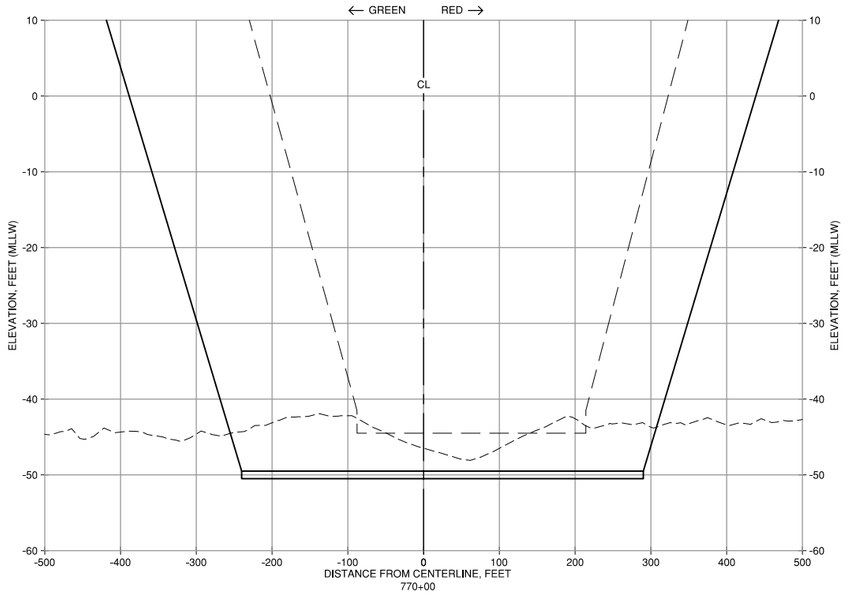
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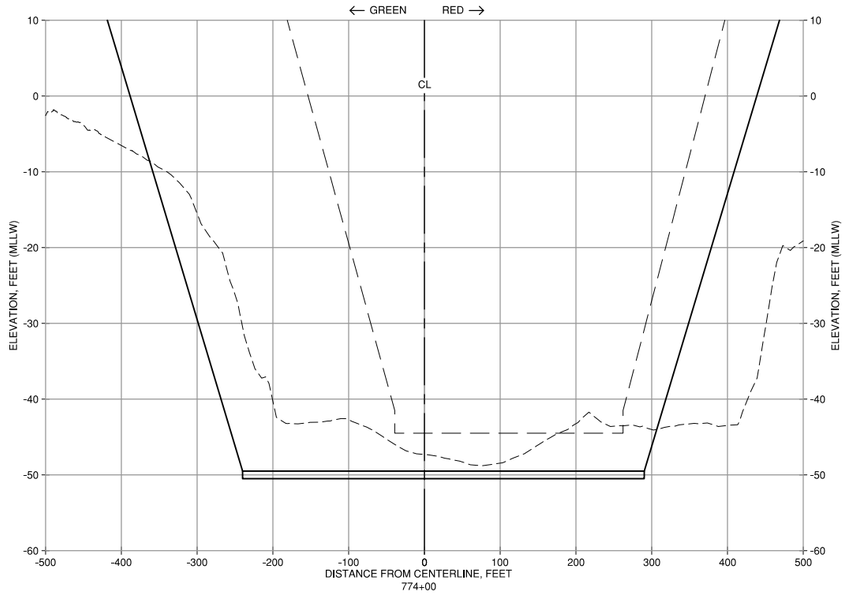
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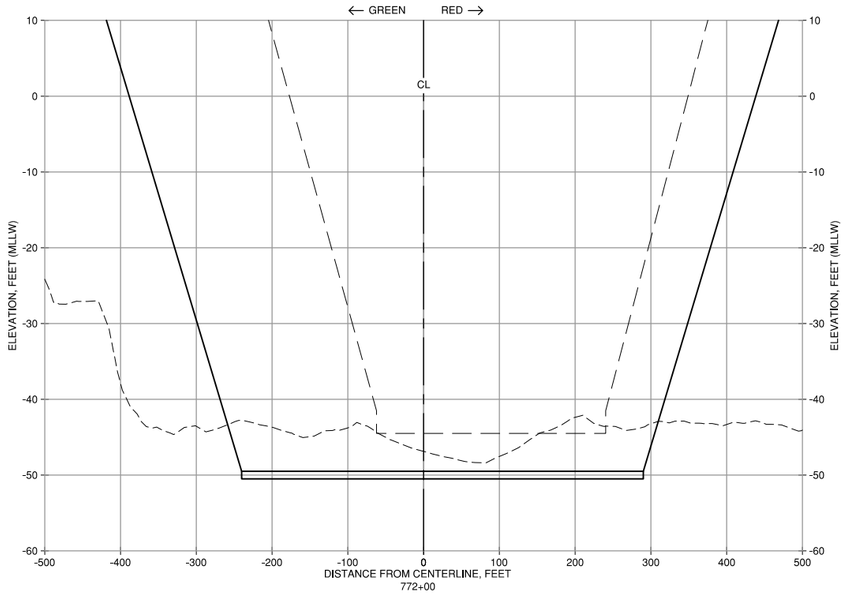
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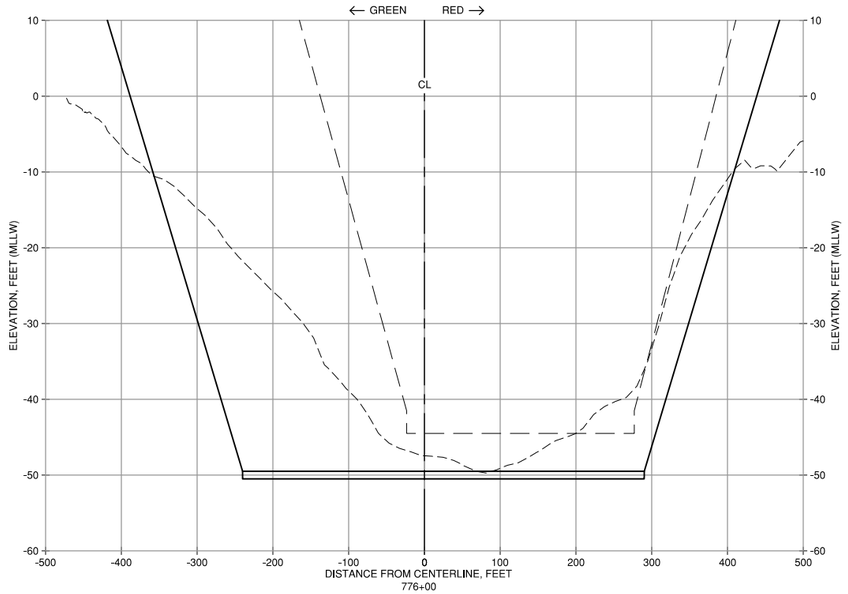
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 13 OF 34

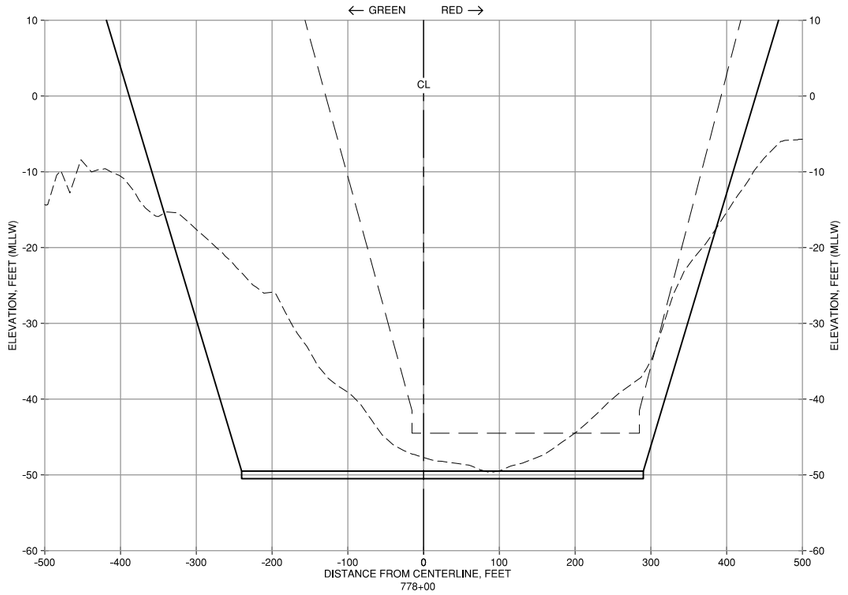
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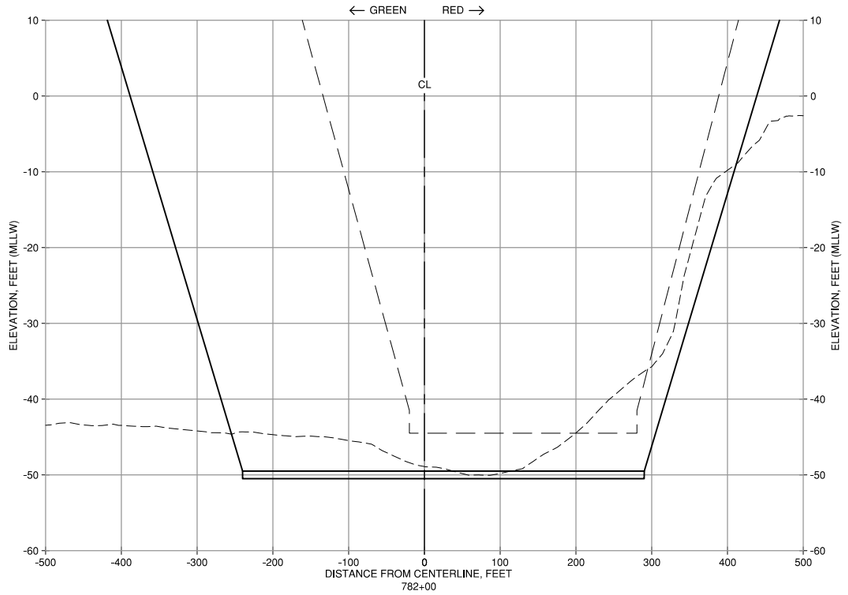
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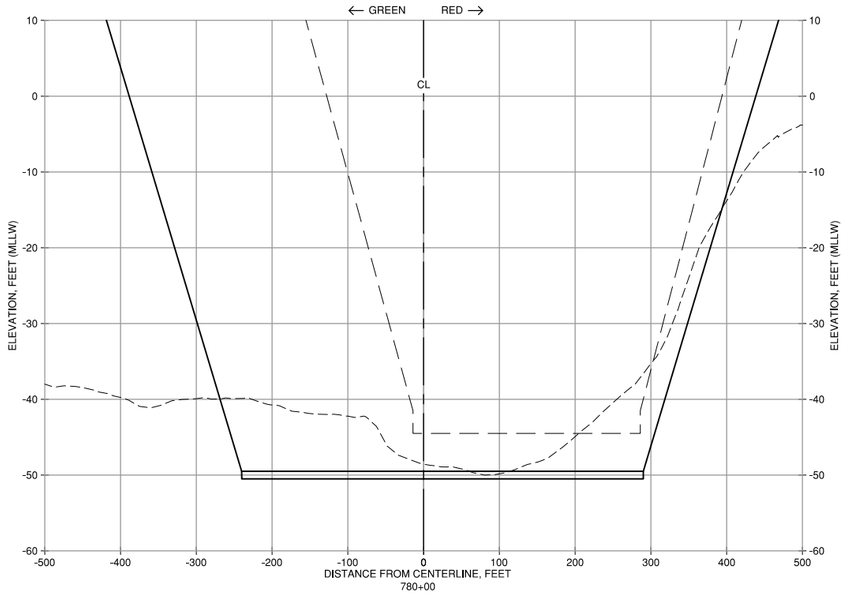
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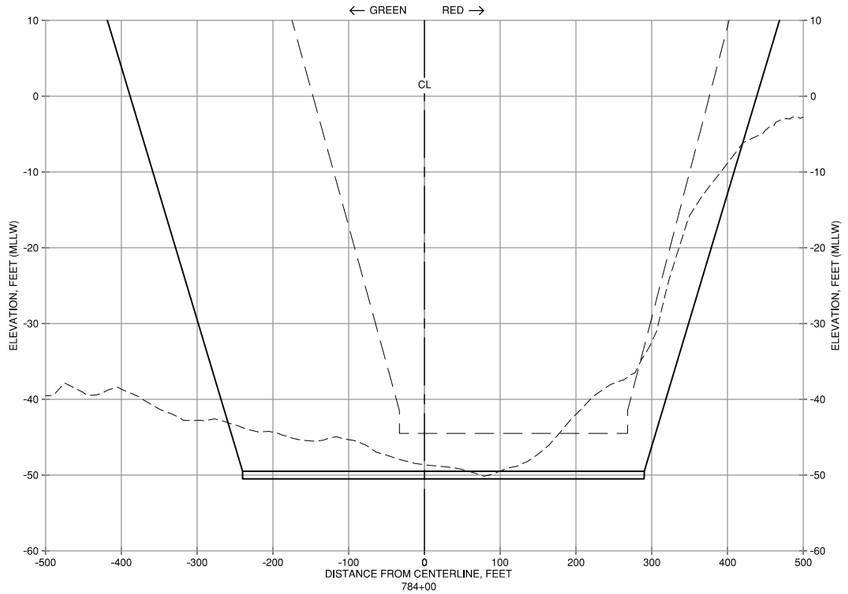
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C-213	A

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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 14 OF 34

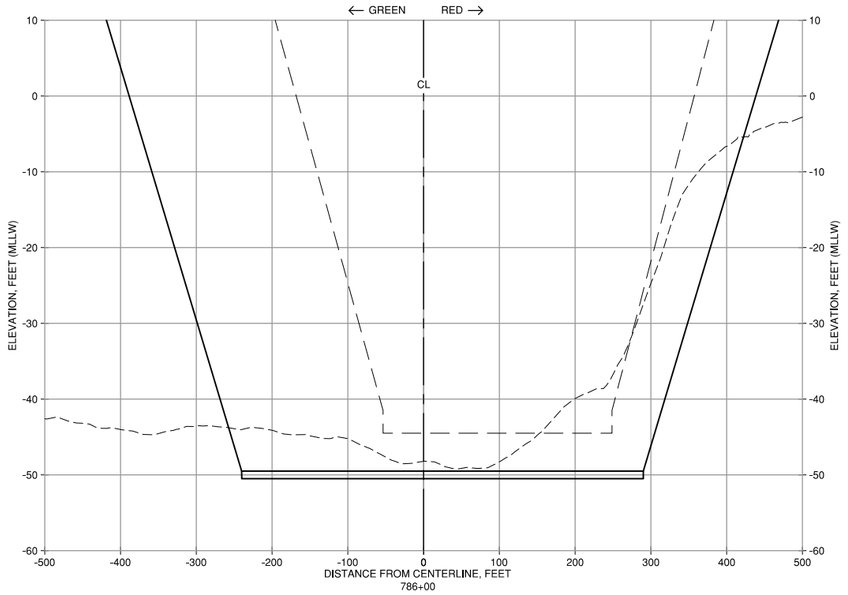
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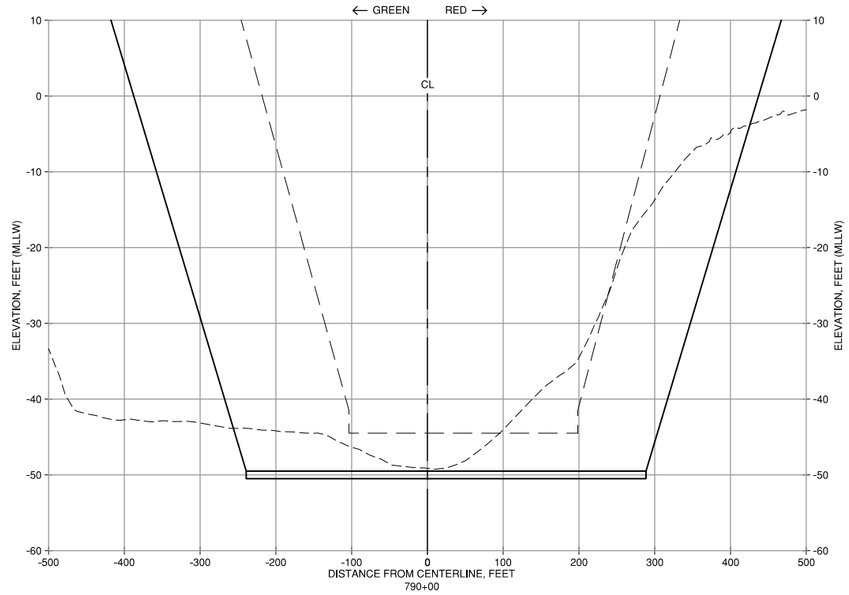
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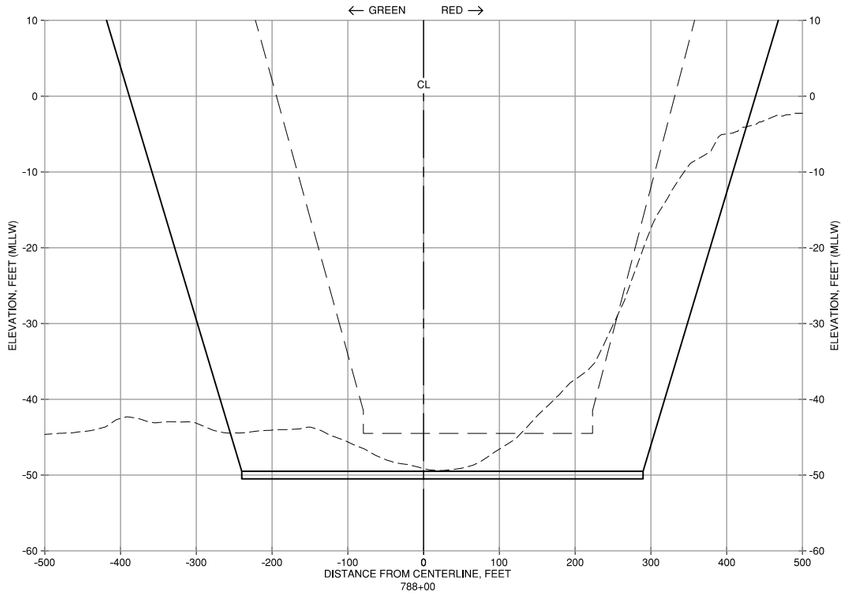
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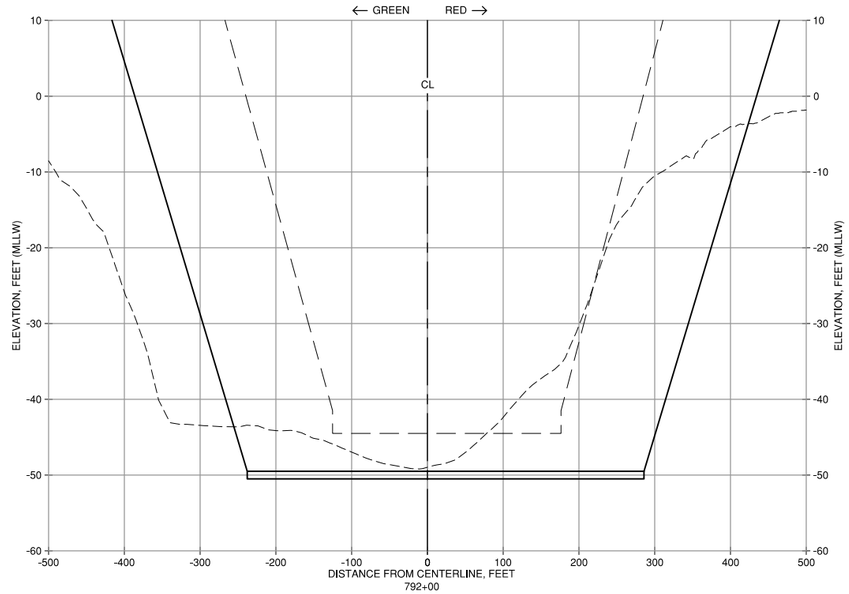
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 15 OF 34

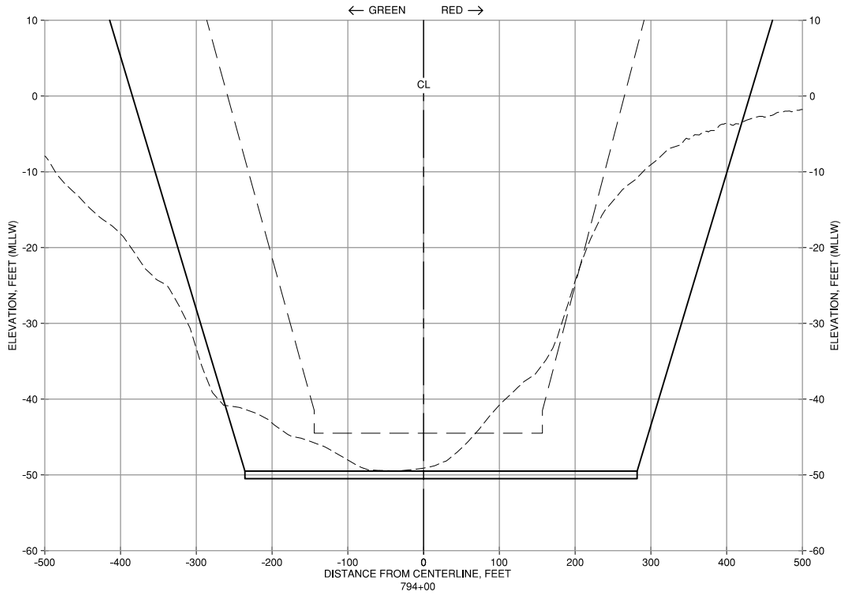
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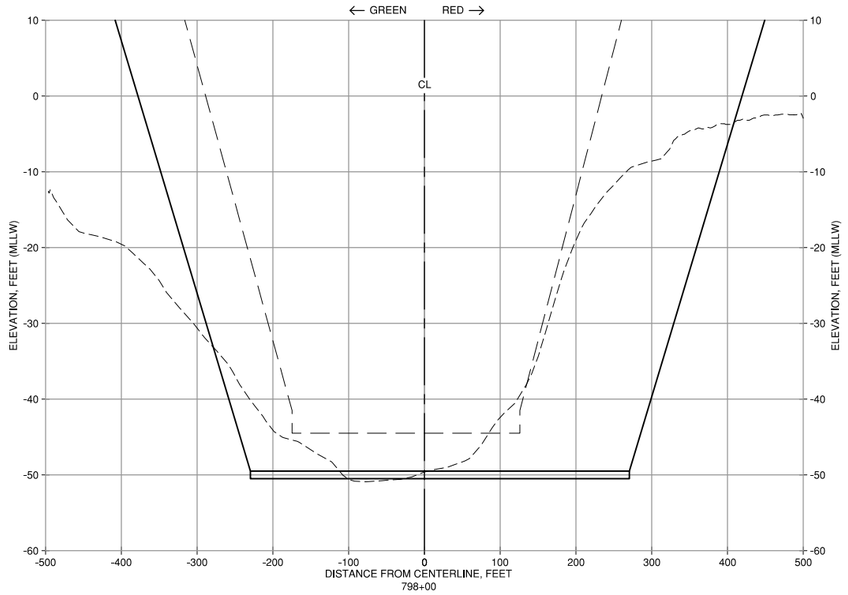
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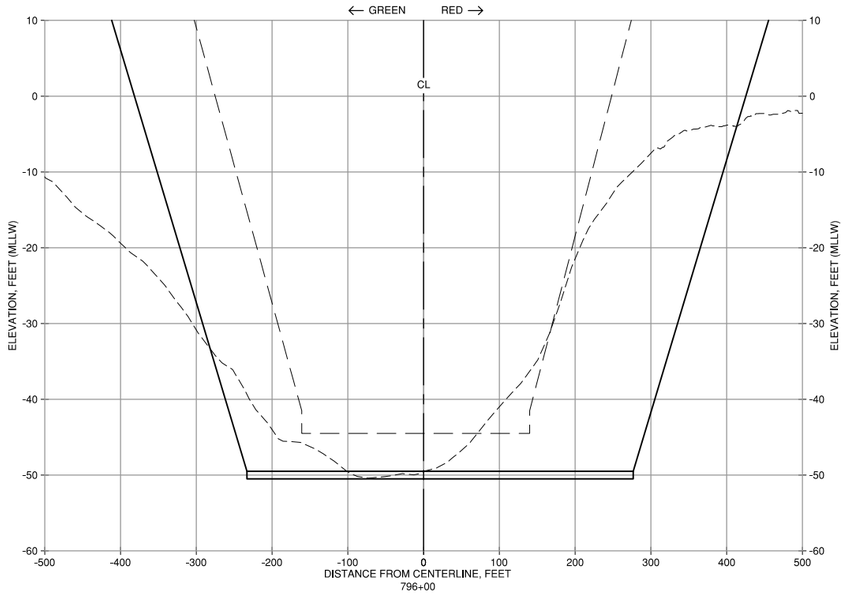
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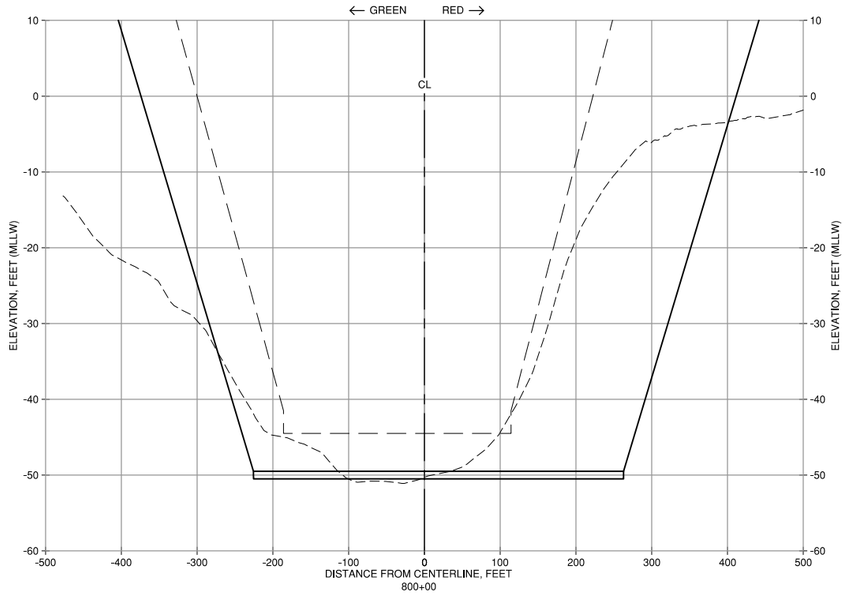
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C-215	A

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HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 16 OF 34

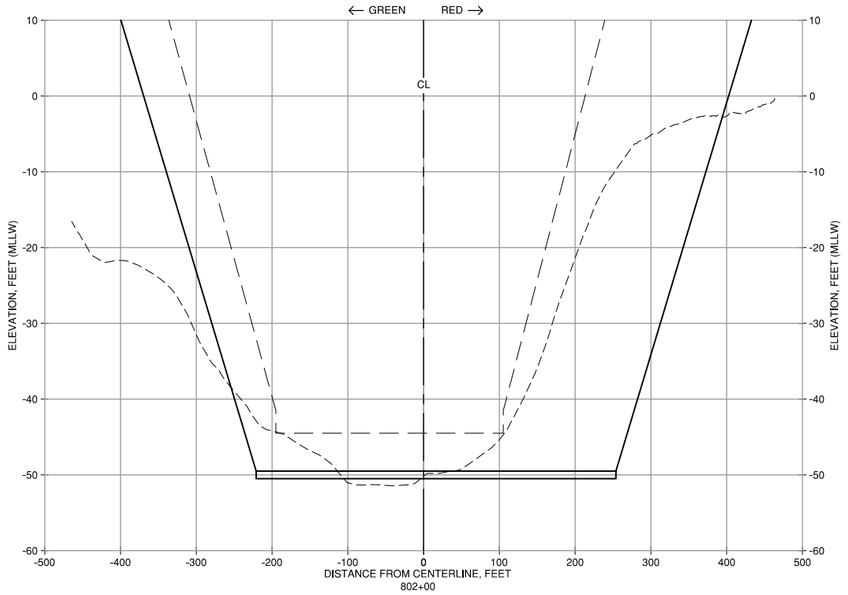
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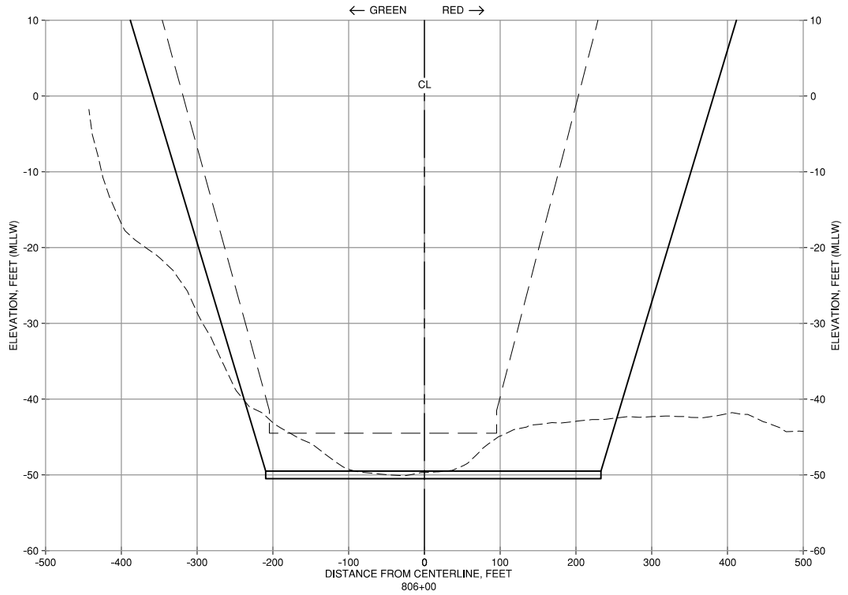
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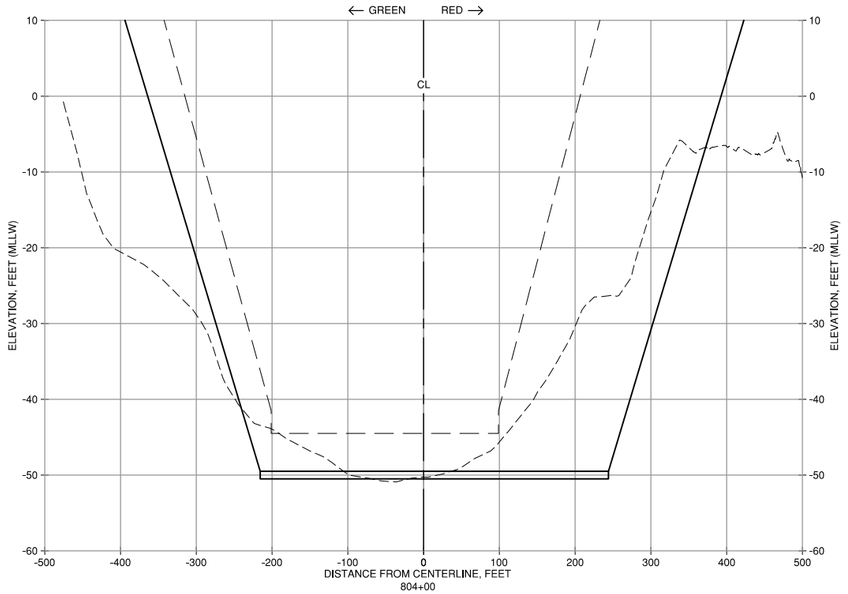
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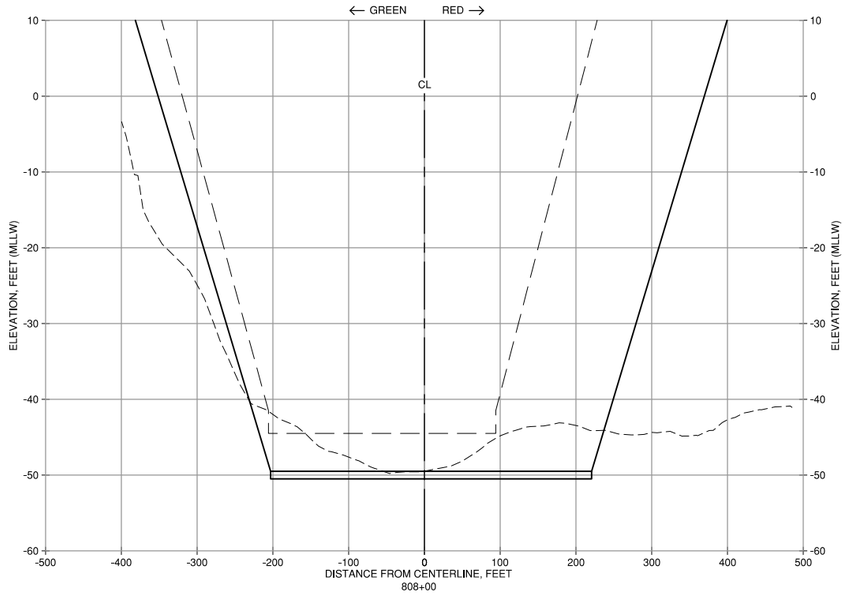
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C-216	A

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PROJECT TITLE:
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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 17 OF 34

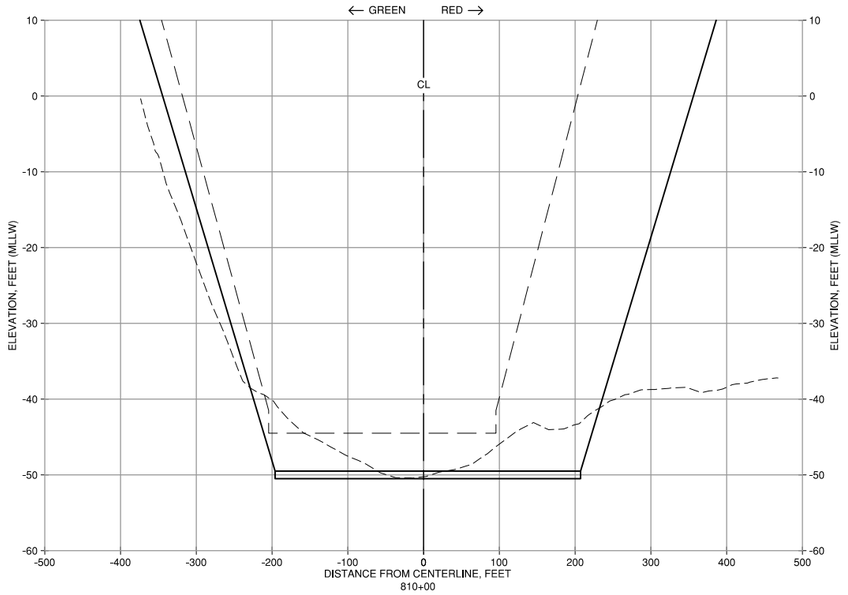
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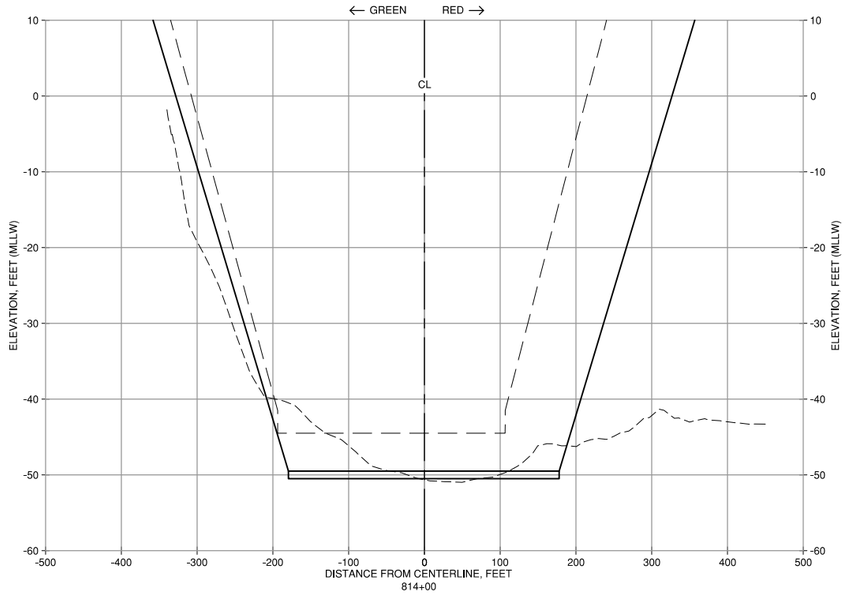
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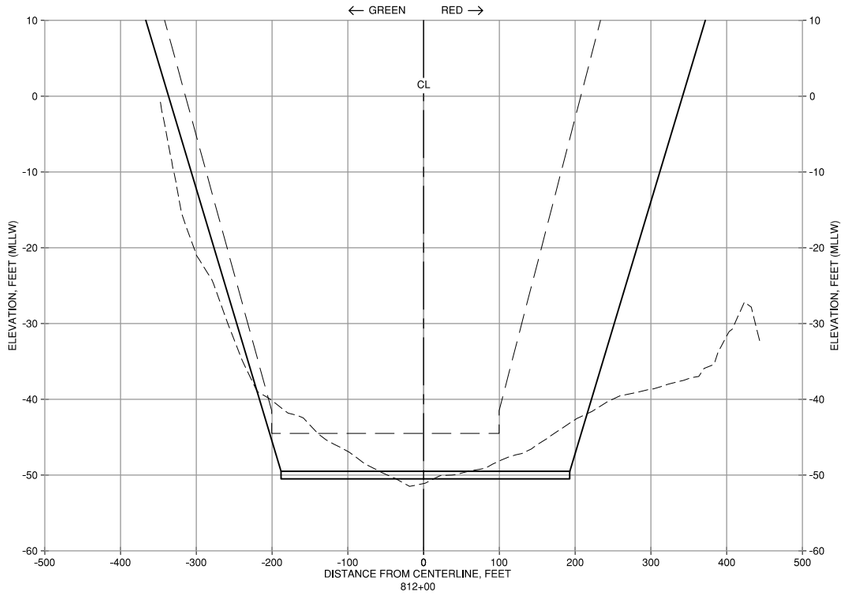
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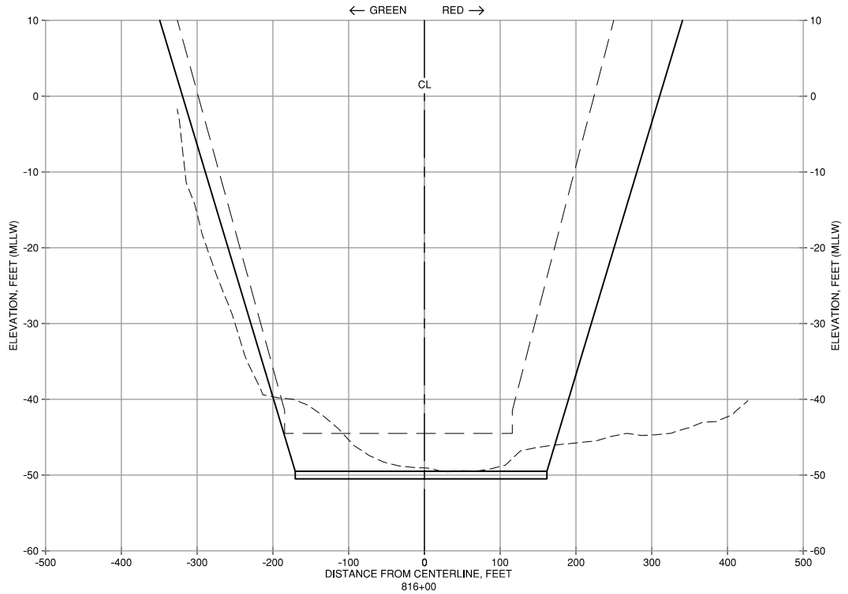
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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 18 OF 34

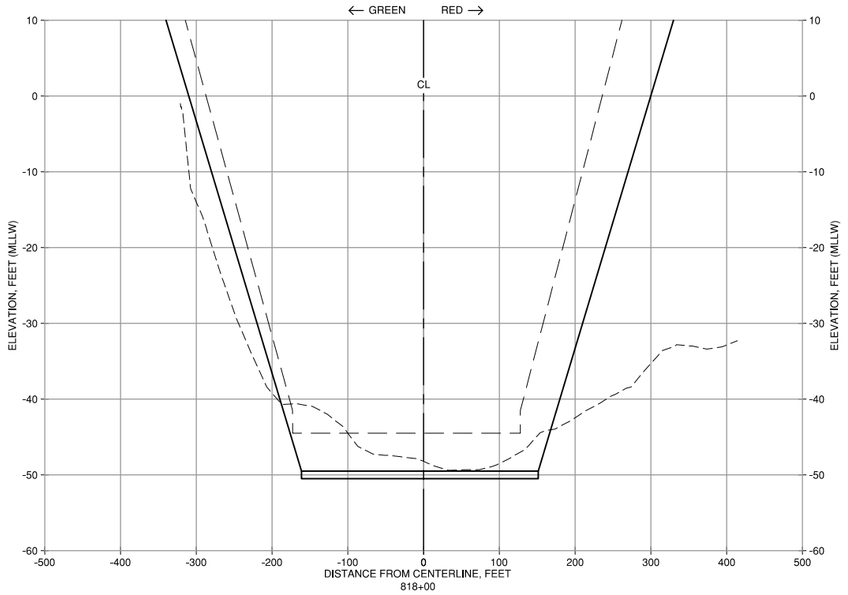
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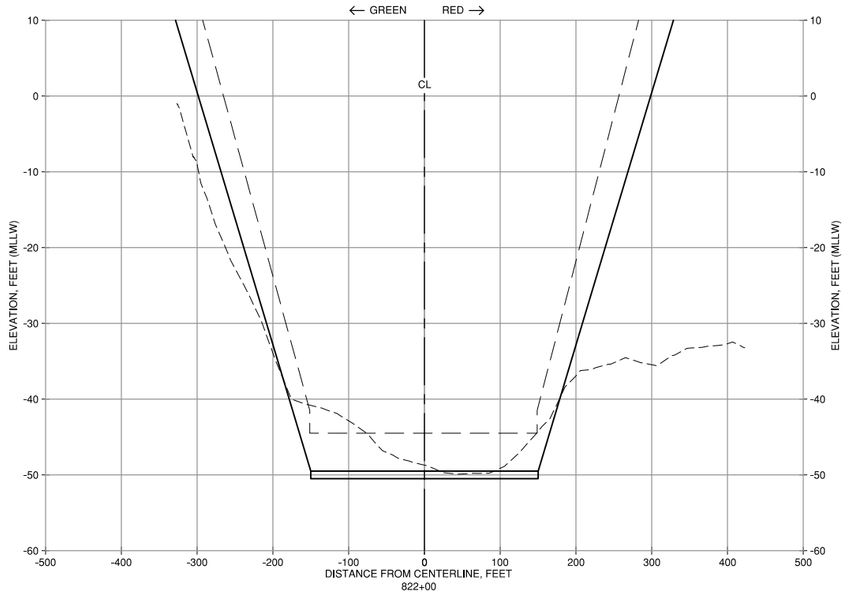
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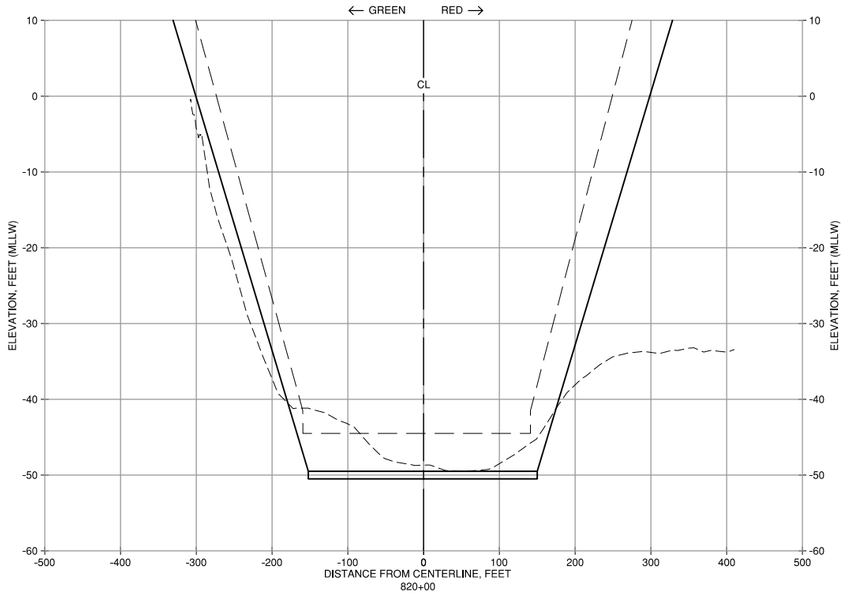
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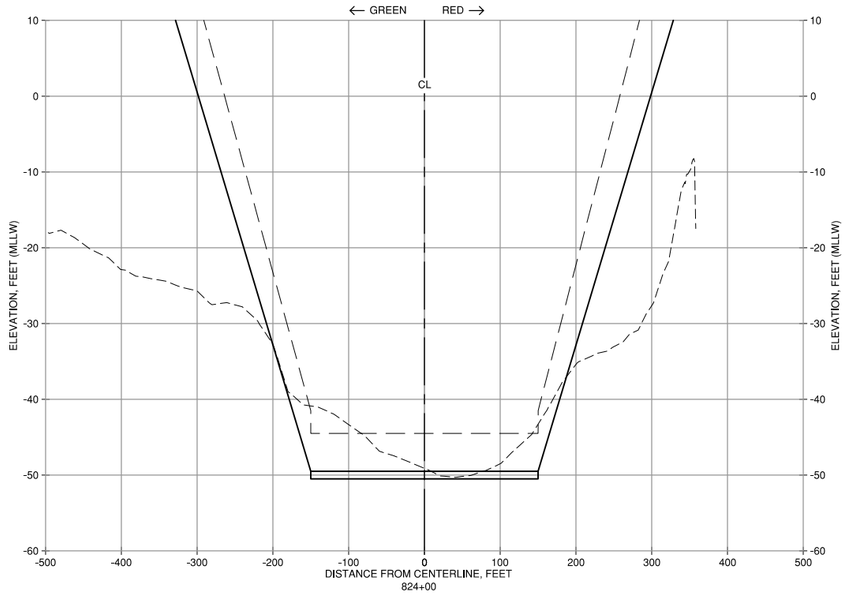
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SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 19 OF 34

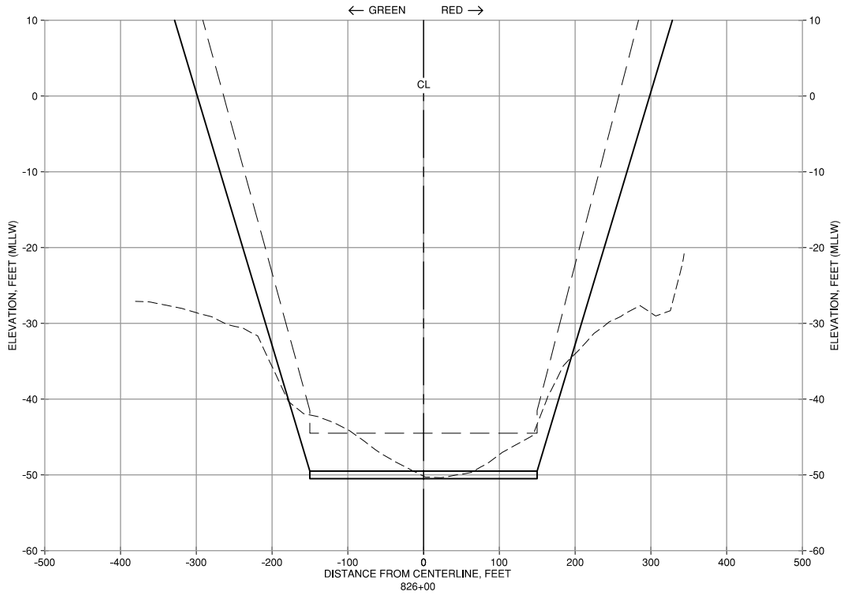
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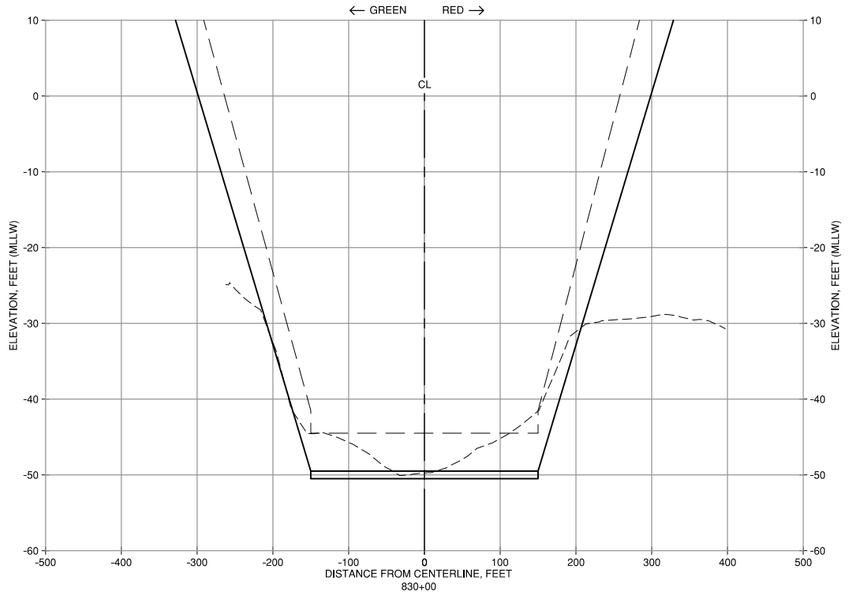
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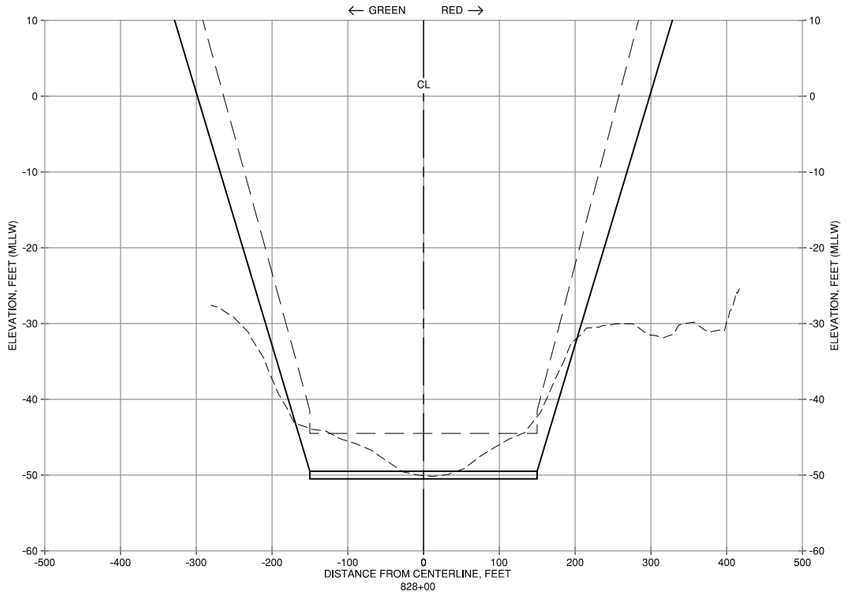
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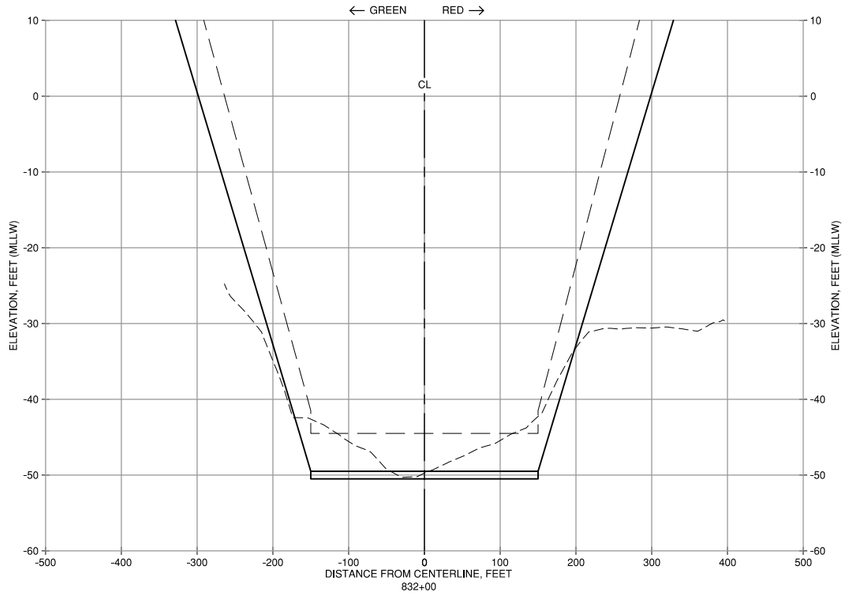
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SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 20 OF 34

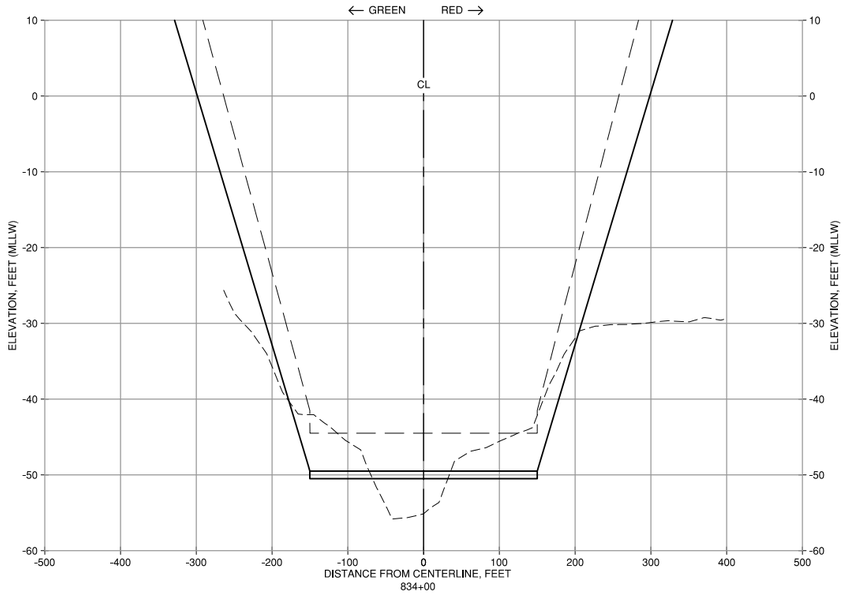
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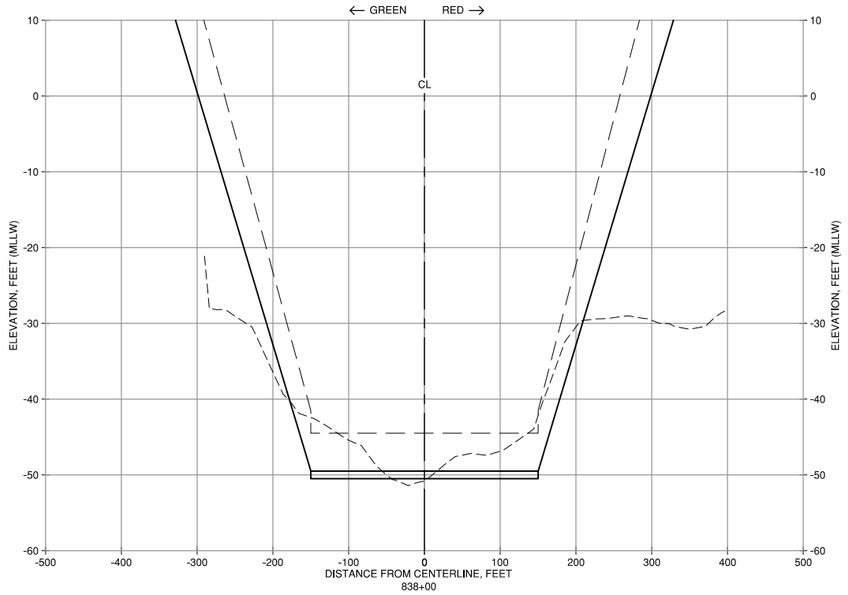
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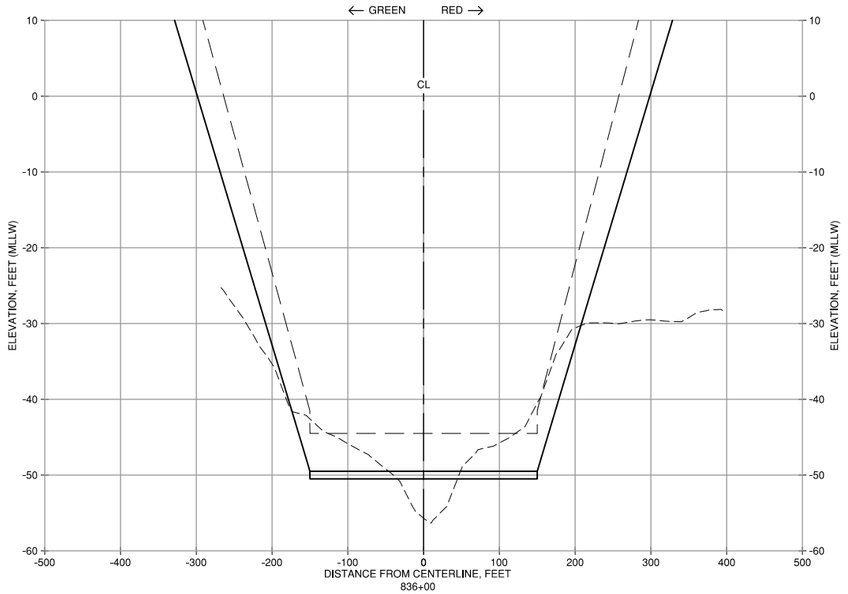
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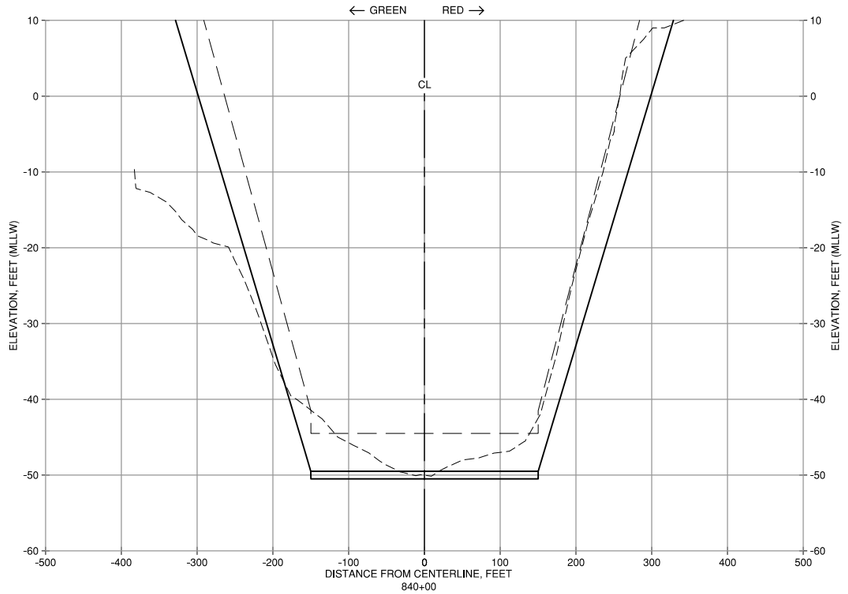
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 21 OF 34

REV	DATE	DESCRIPTION
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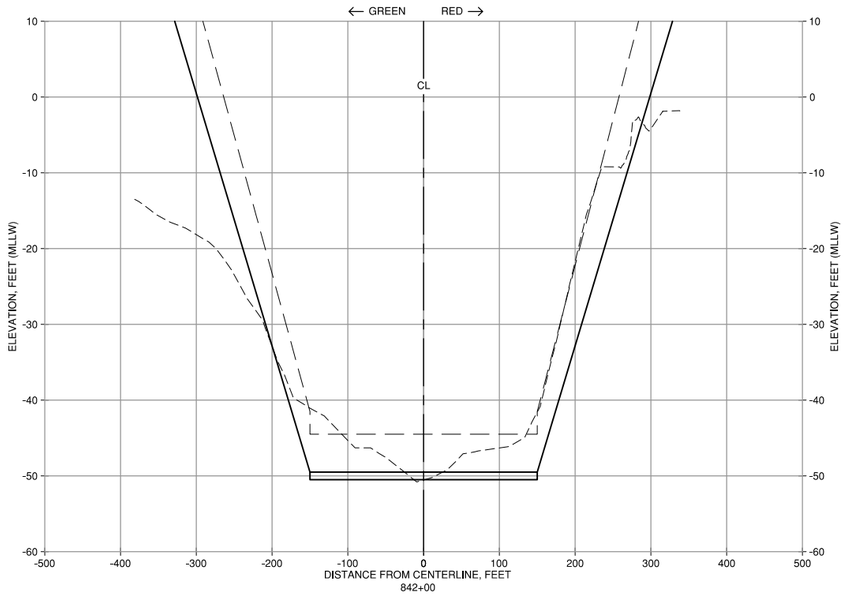
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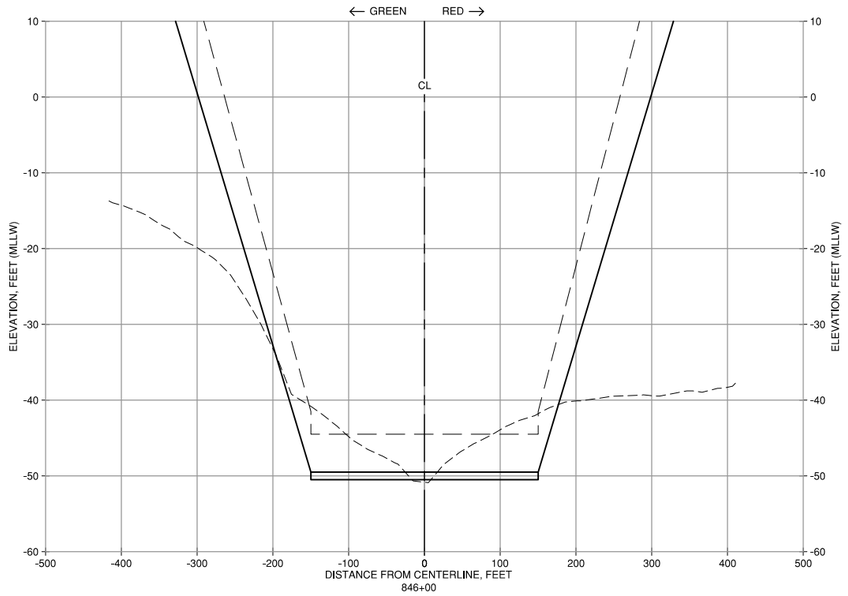
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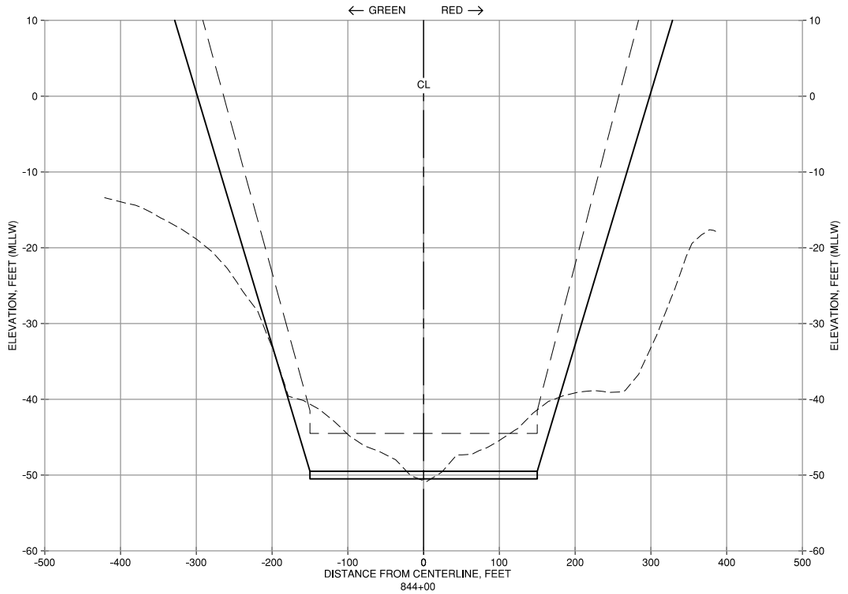
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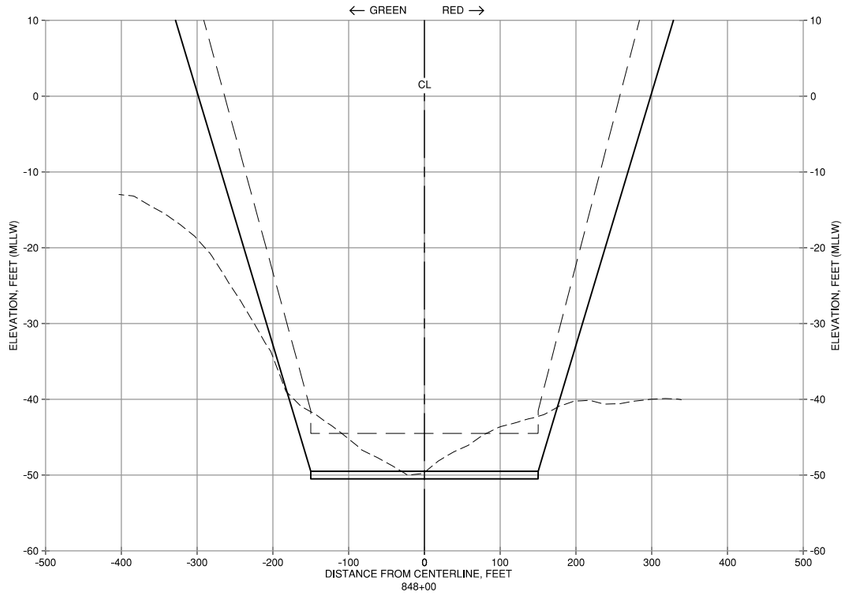
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 22 OF 34

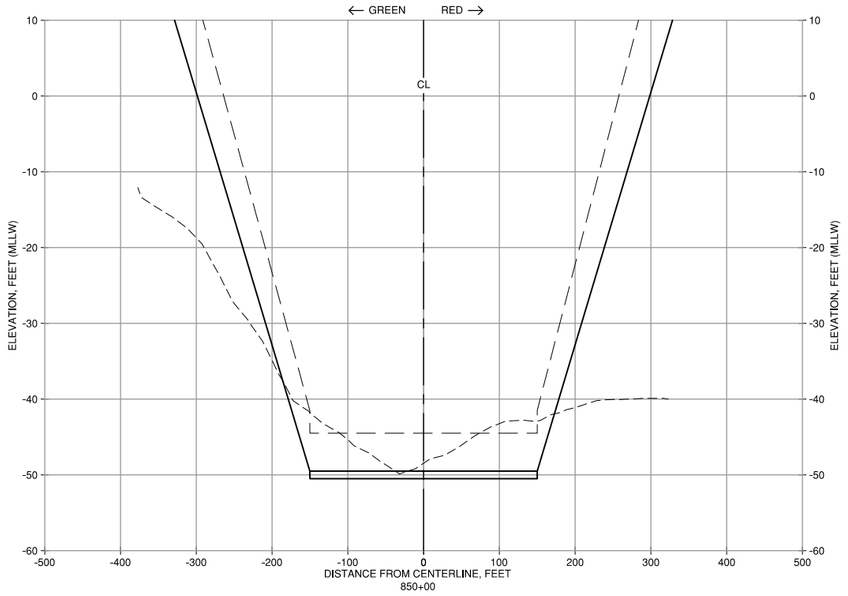
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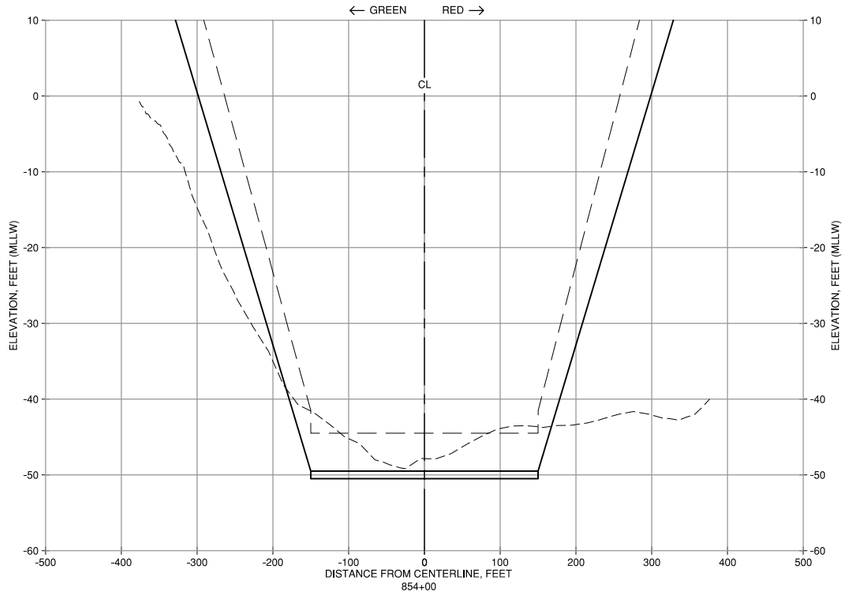
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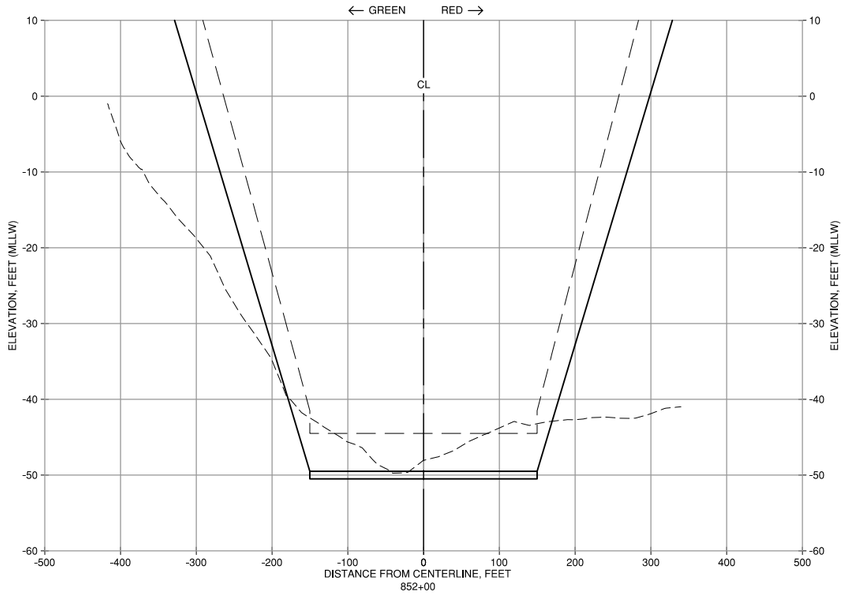
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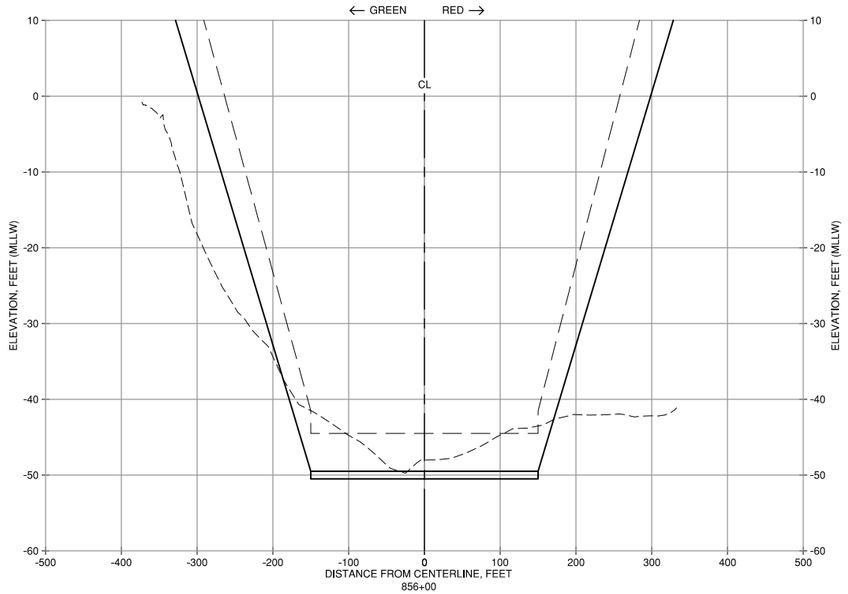
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 23 OF 34

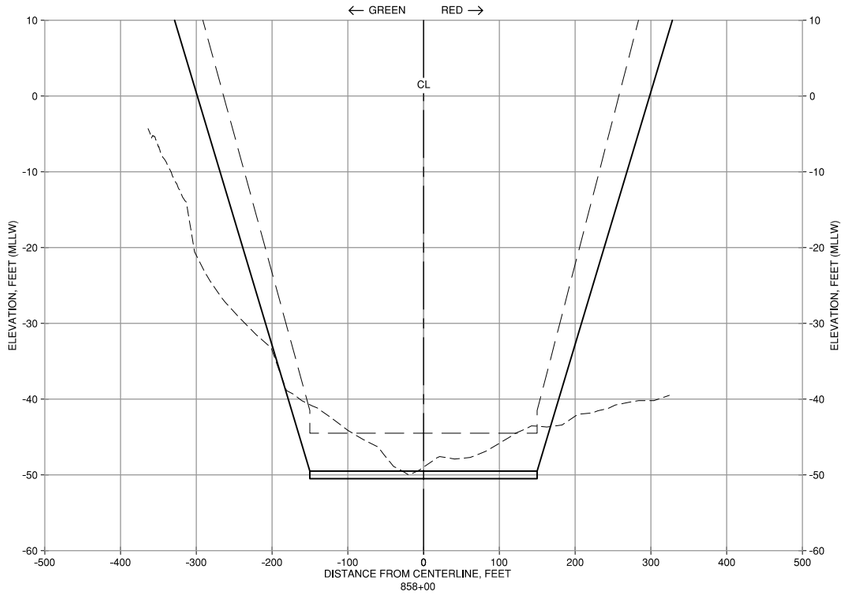
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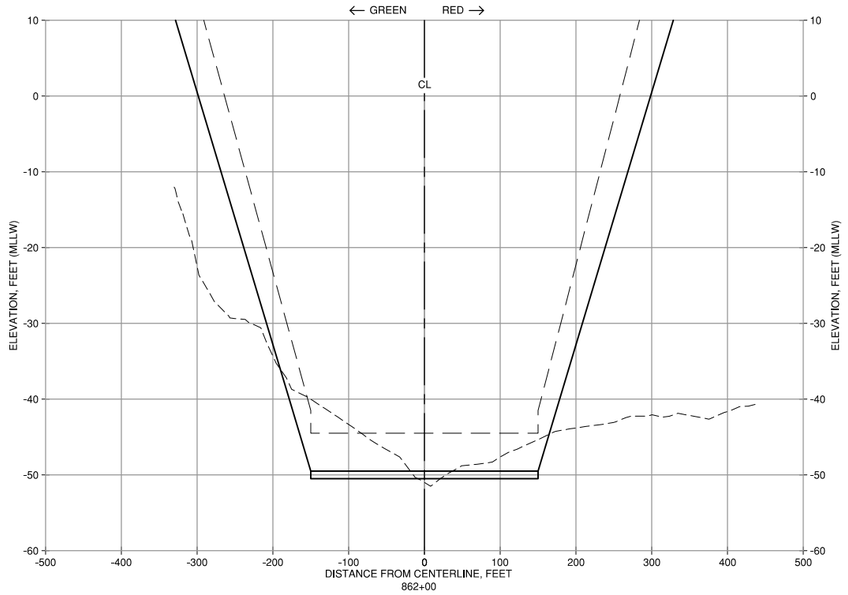
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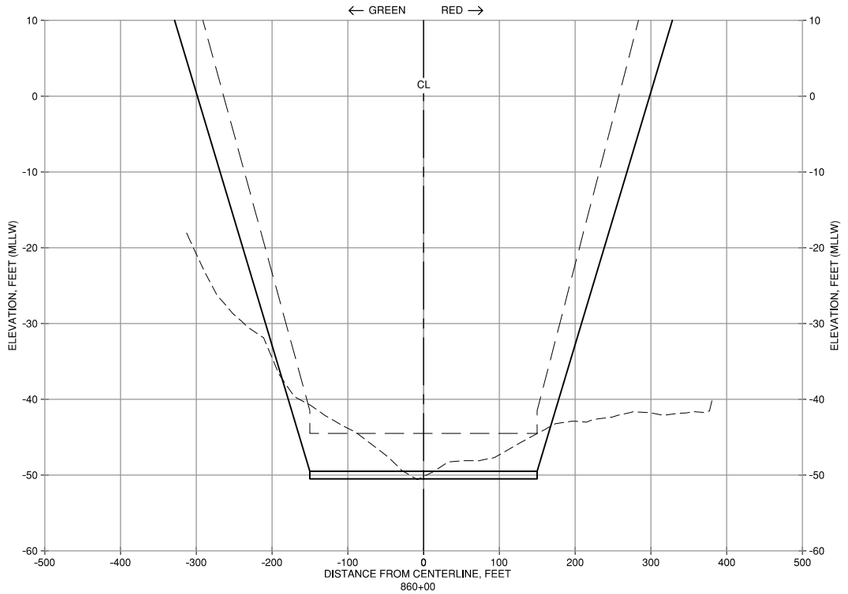
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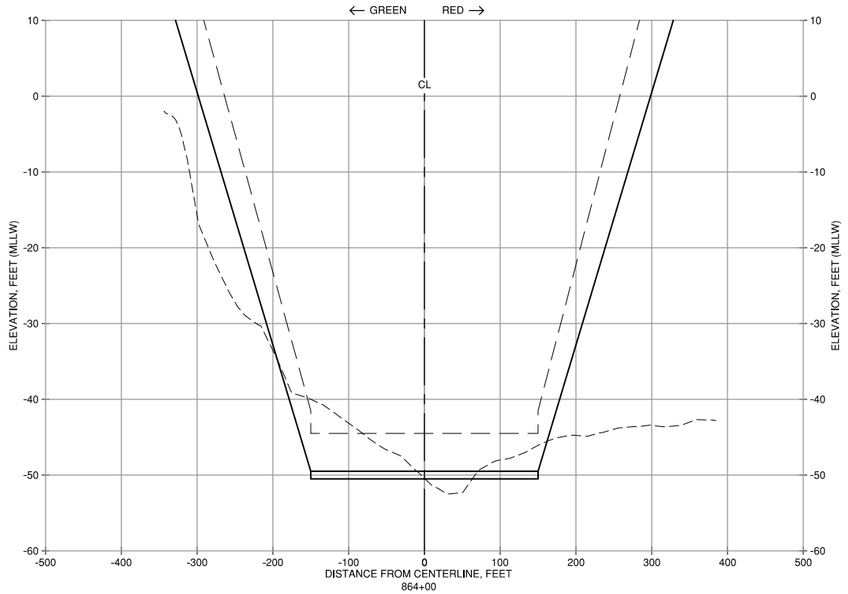
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PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 24 OF 34

REV	DATE	DESCRIPTION
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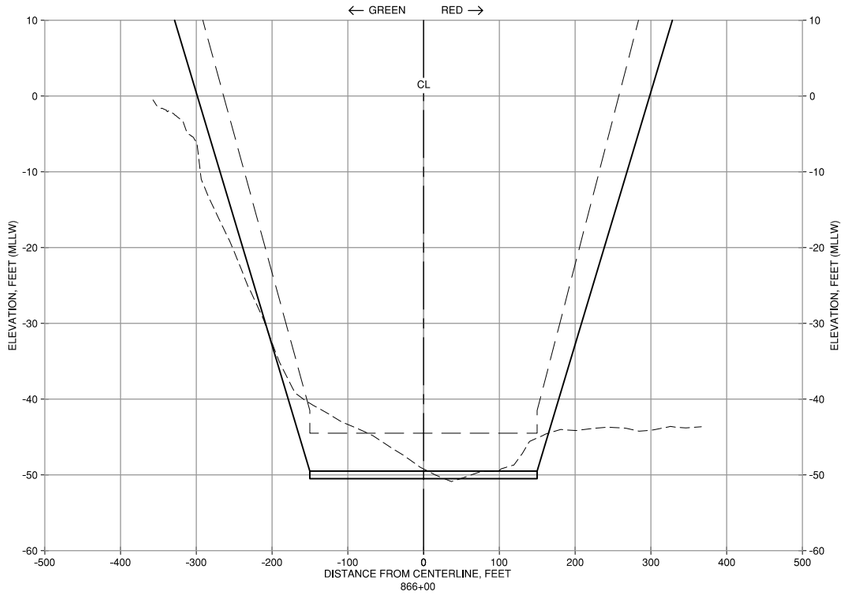
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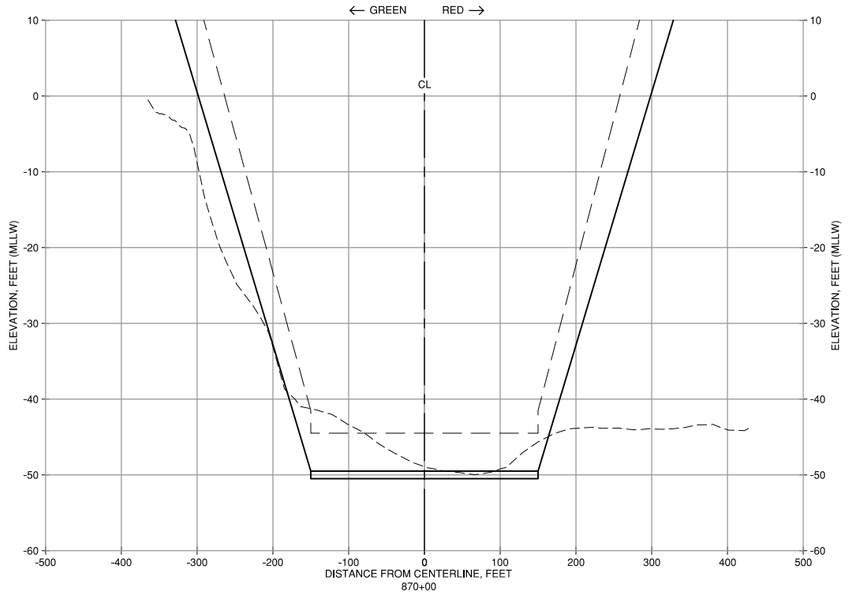
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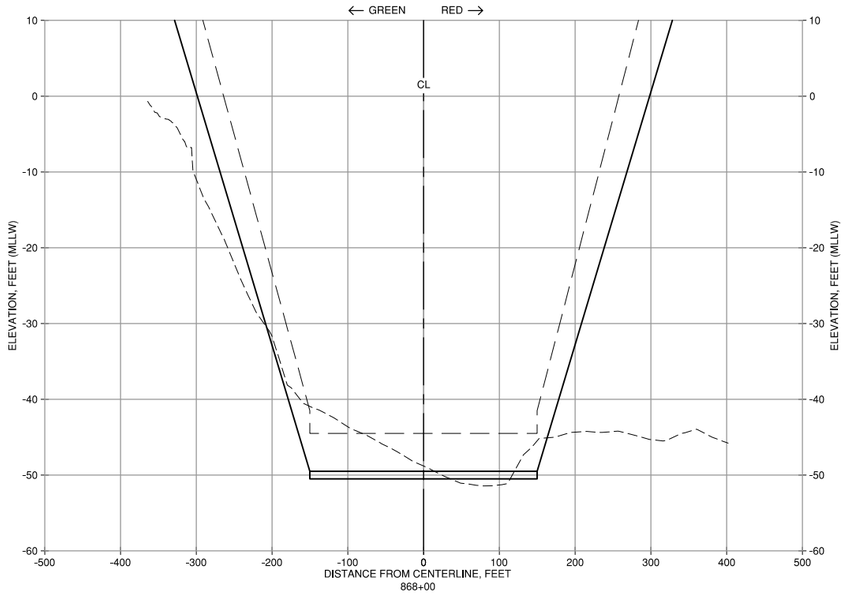
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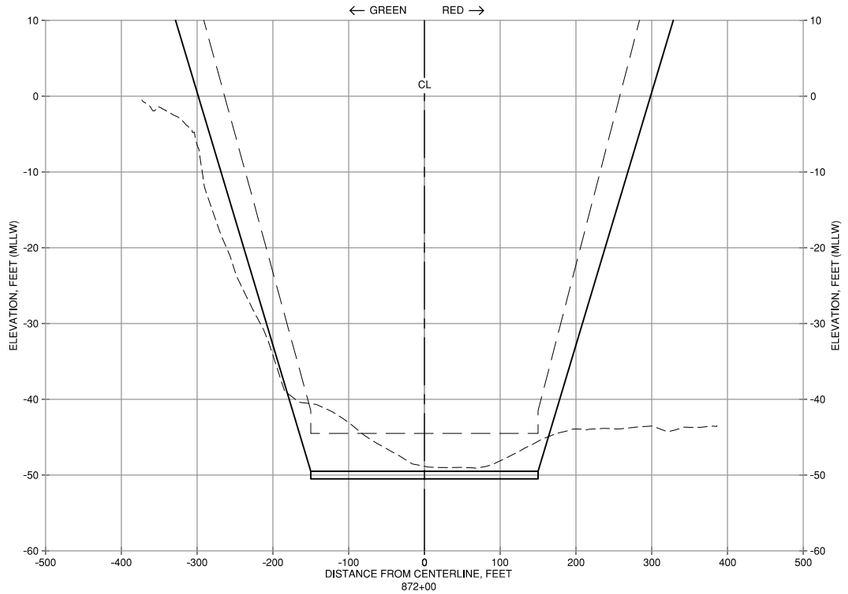
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 25 OF 34

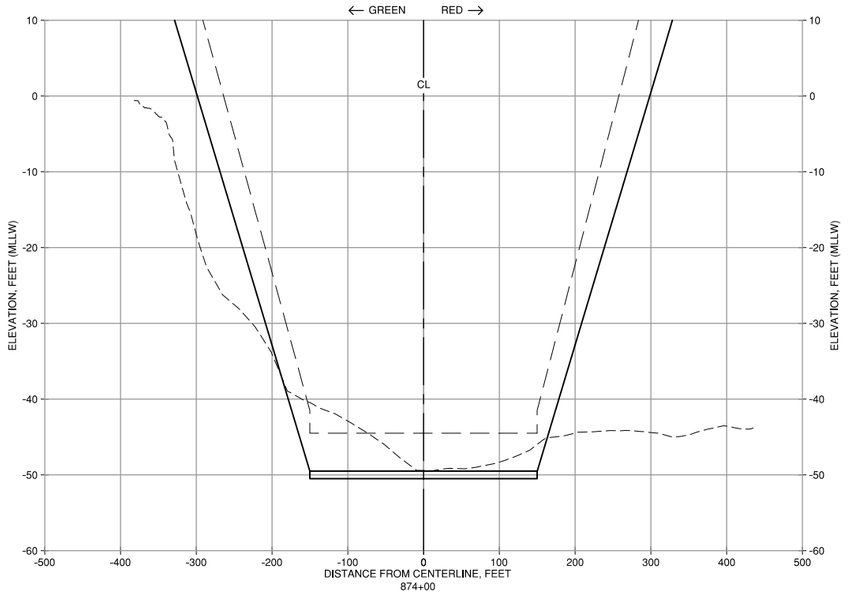
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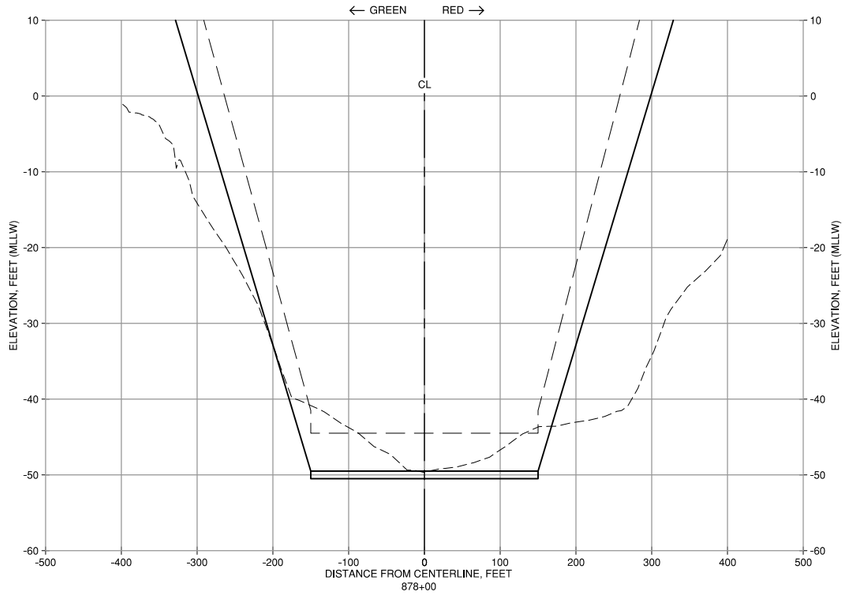
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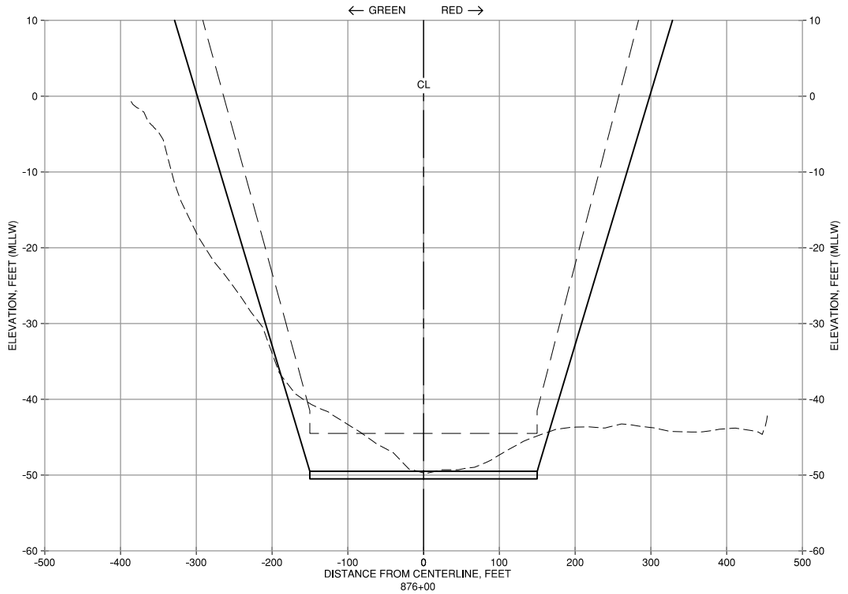
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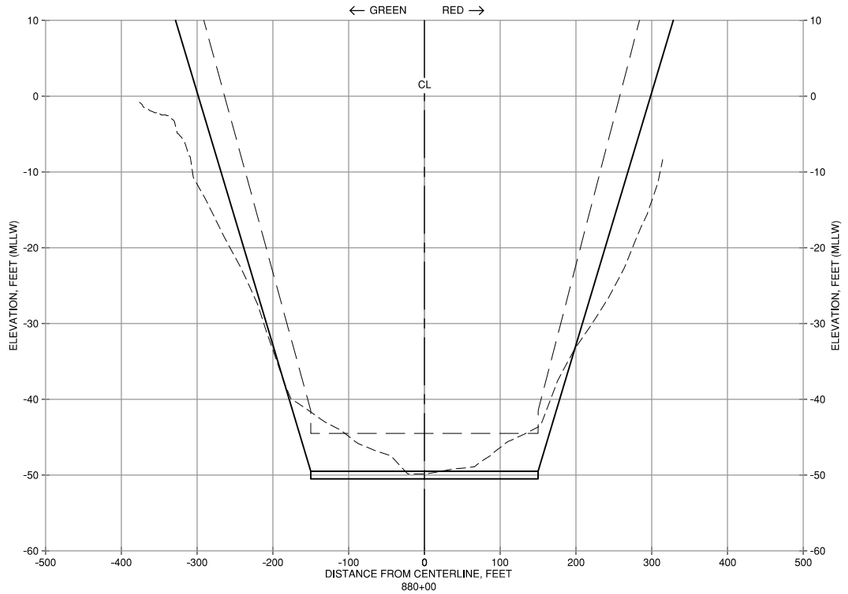
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C-225	A

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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 26 OF 34

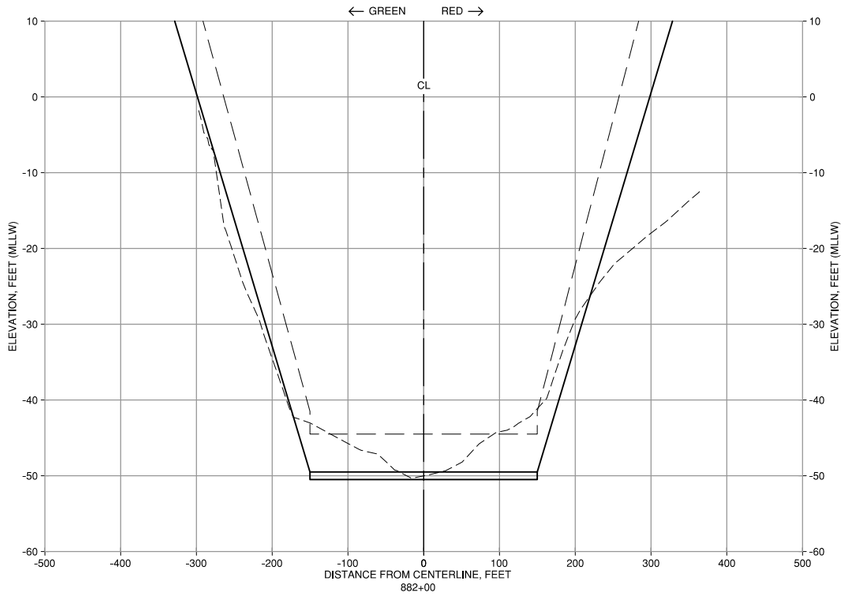
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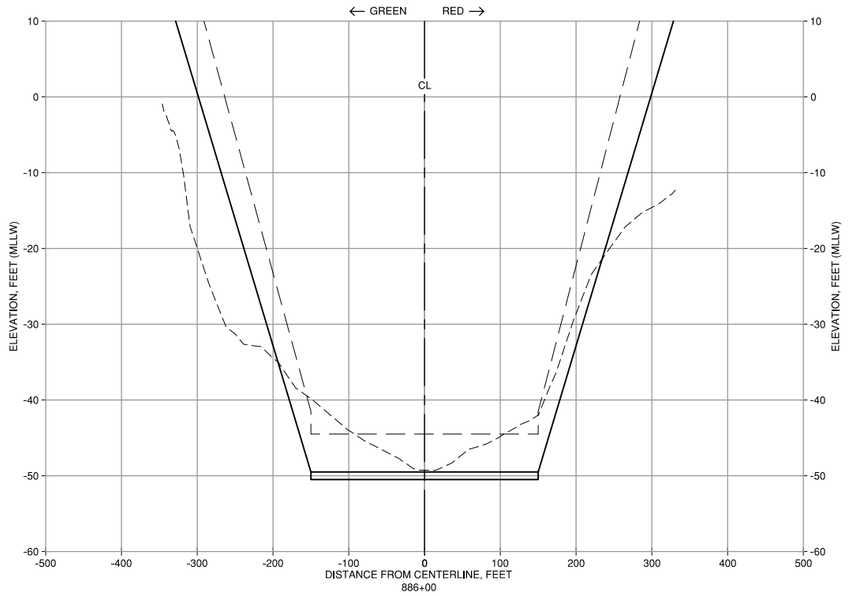
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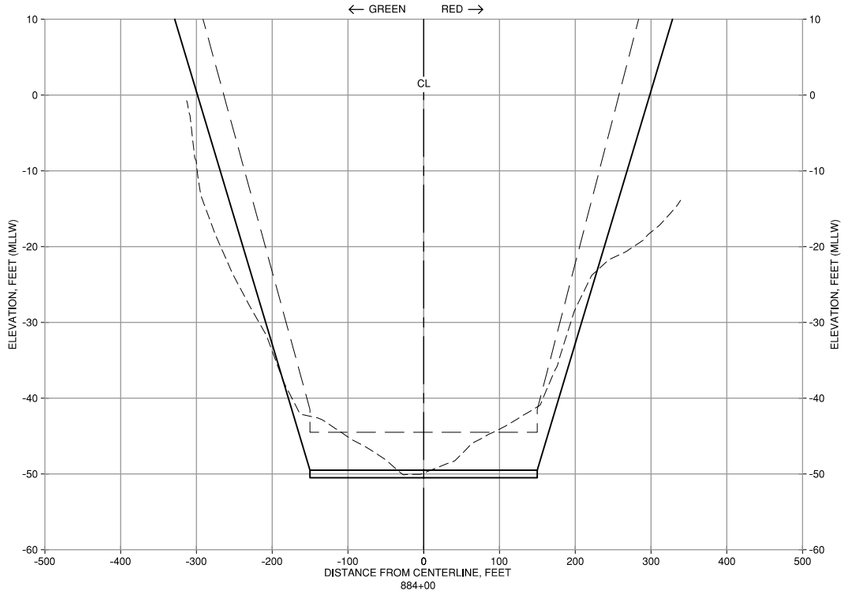
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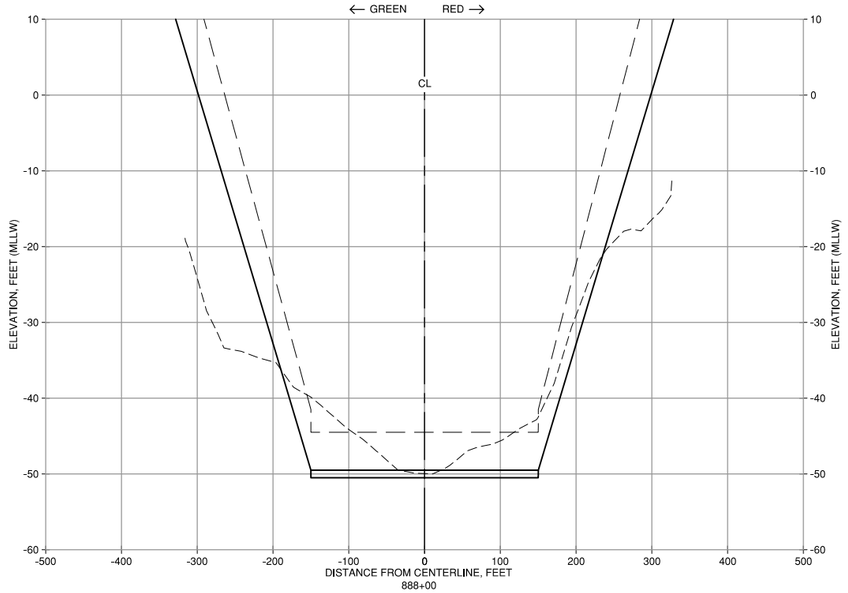
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:

SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 27 OF 34

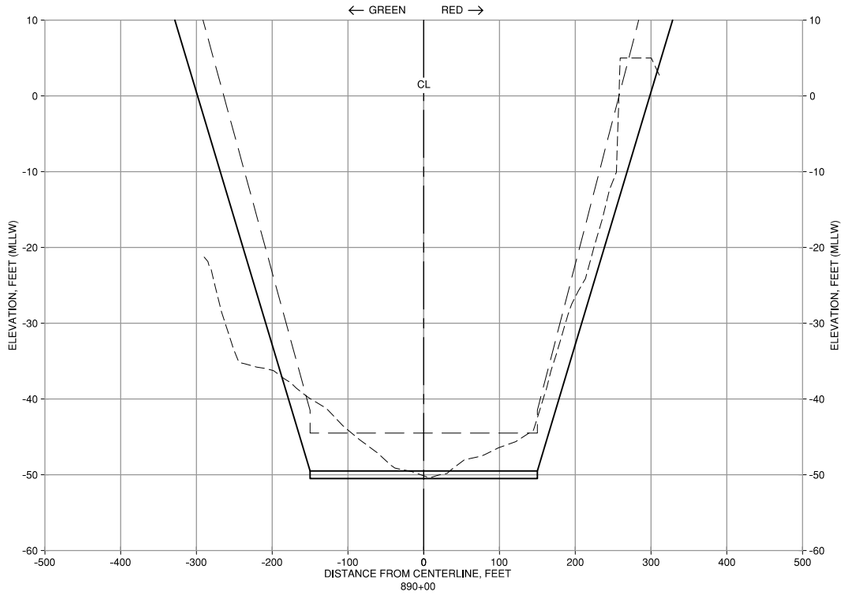
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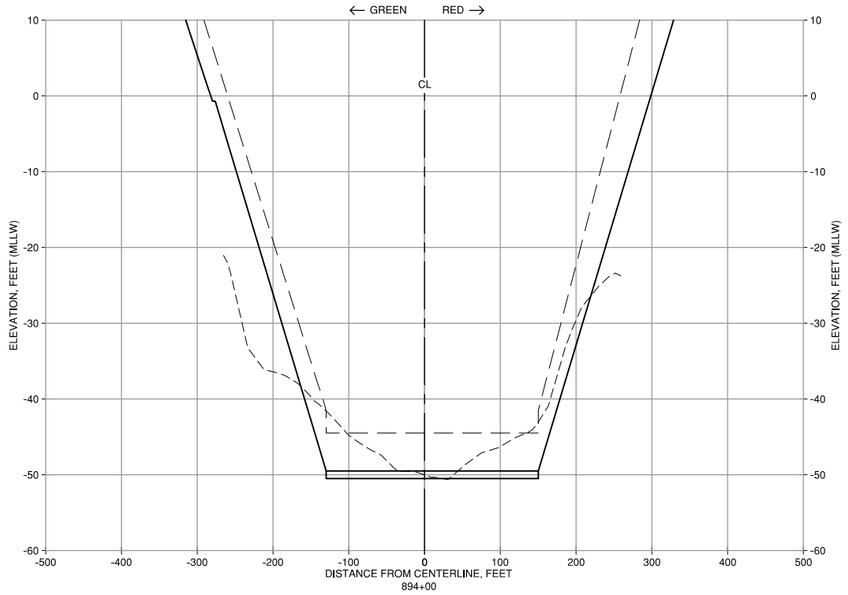
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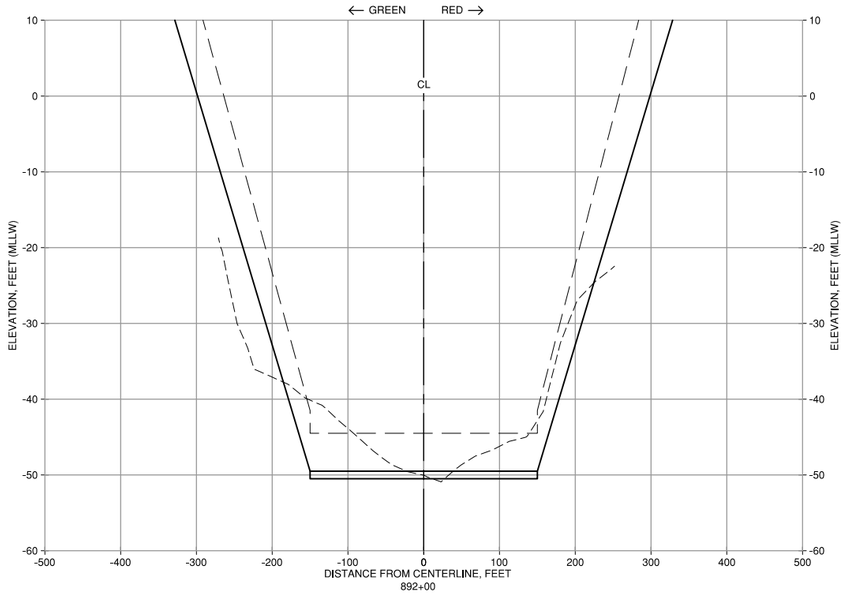
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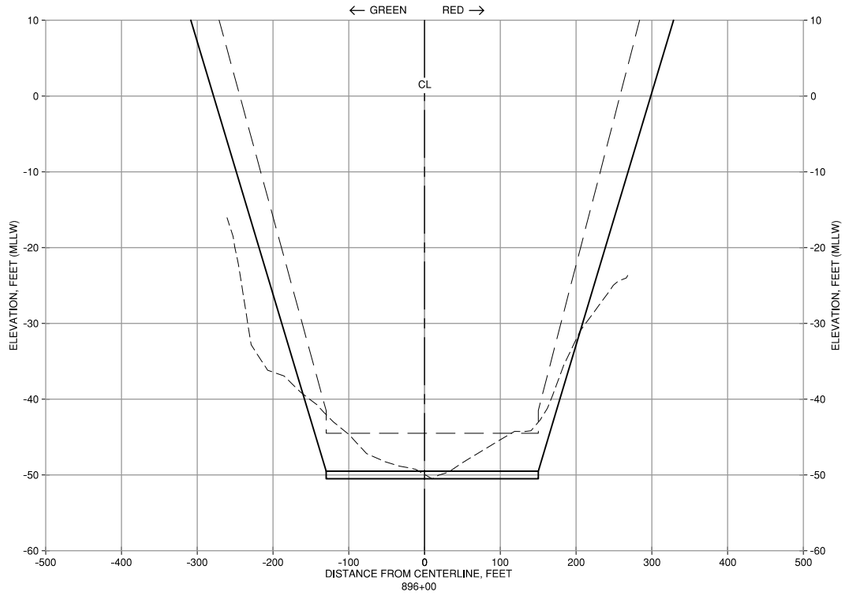
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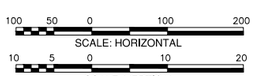








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PROJECT TITLE:

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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:

SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 28 OF 34

REV	DATE	DESCRIPTION
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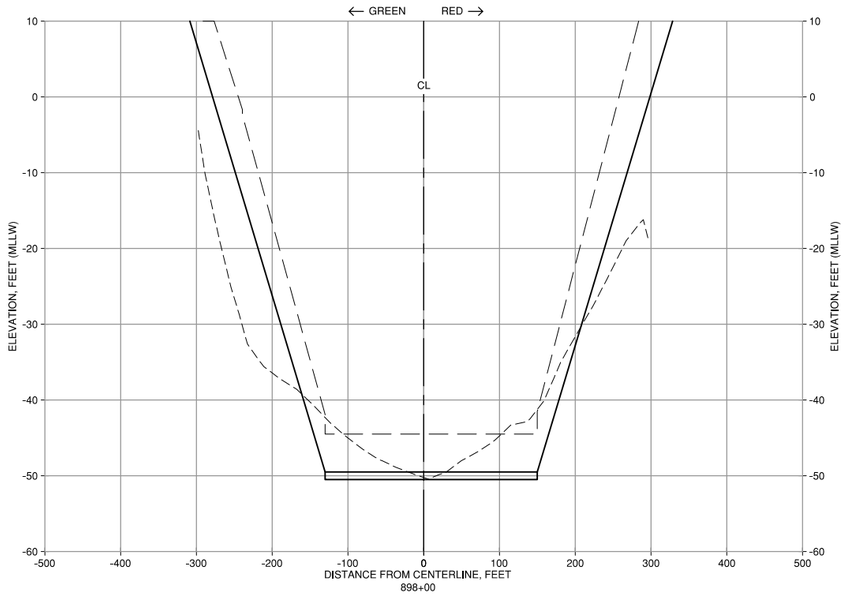
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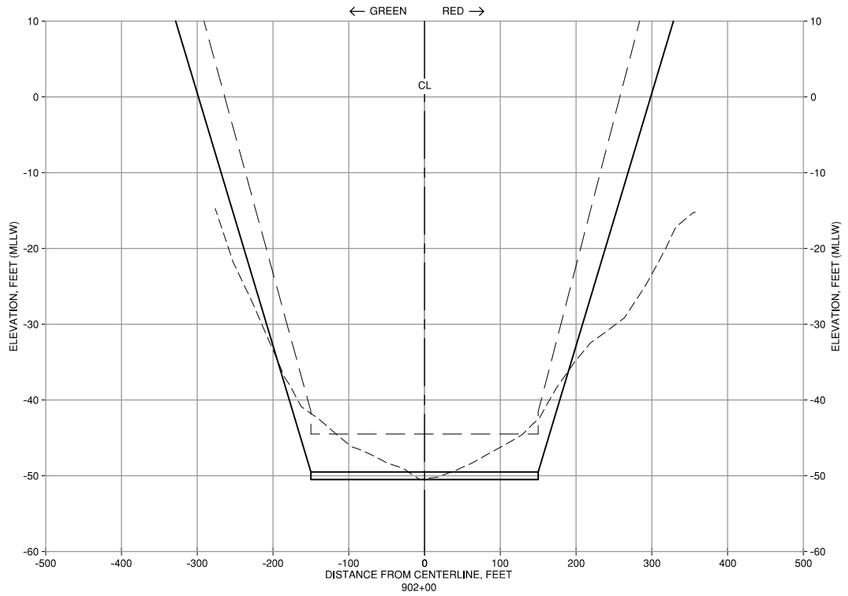
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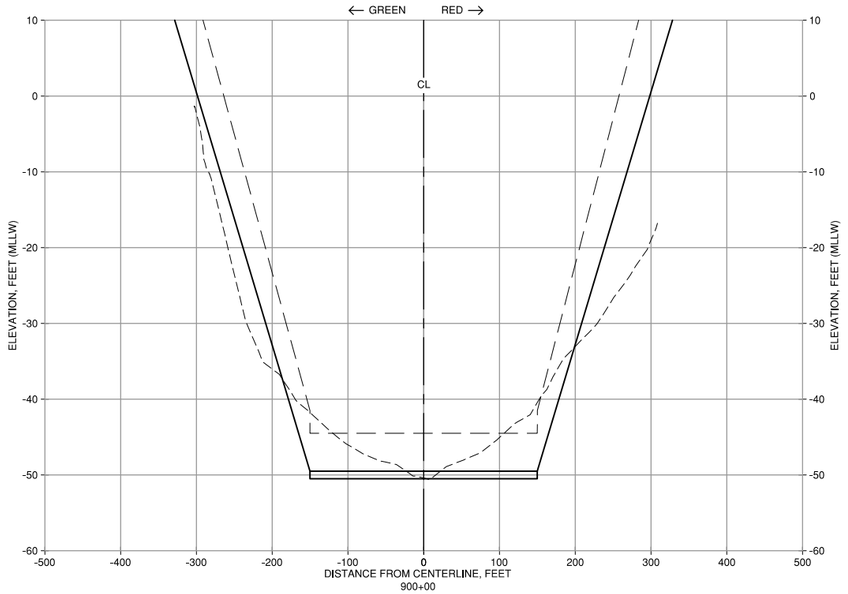
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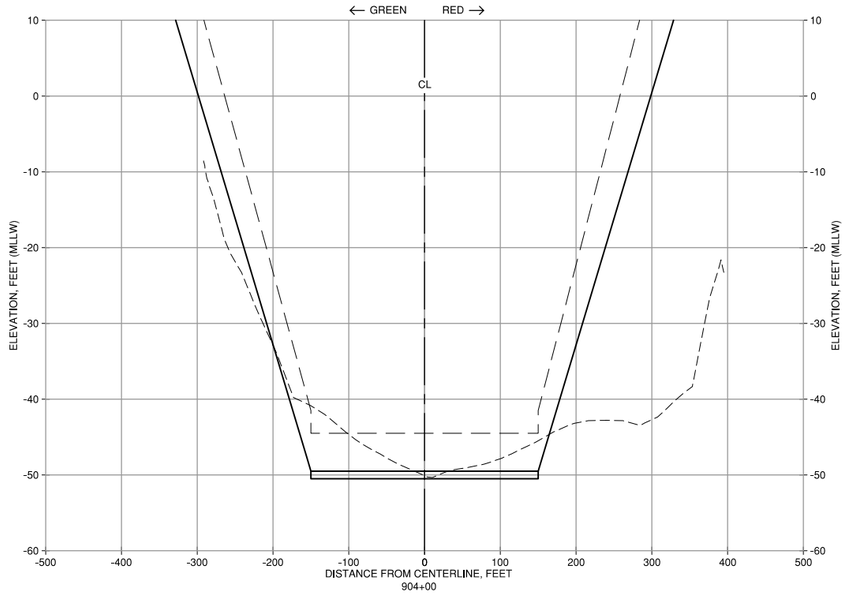
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SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 29 OF 34

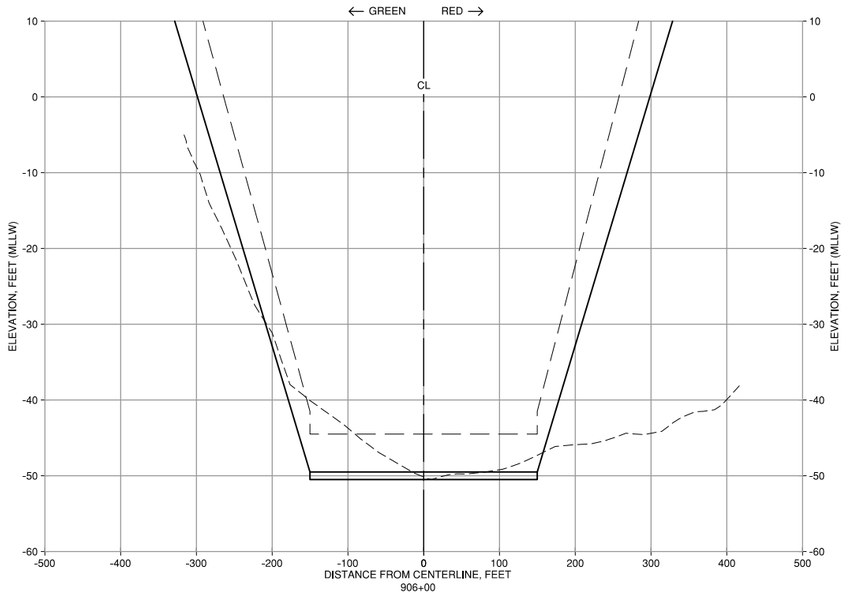
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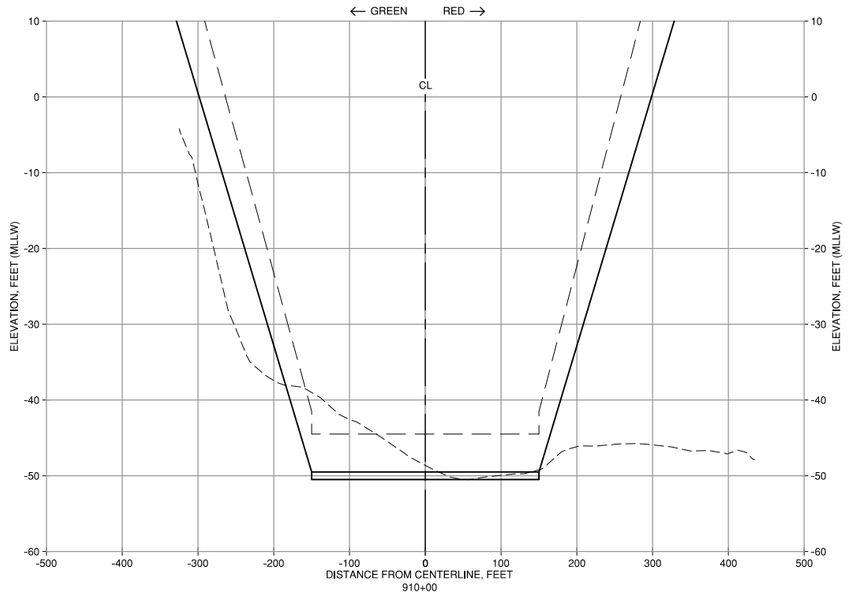
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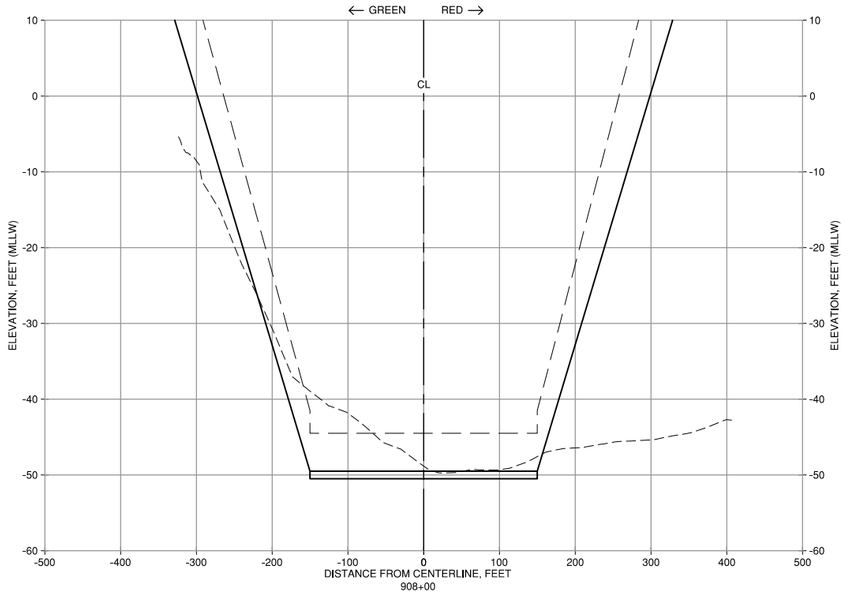
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C90-D13-P11-002

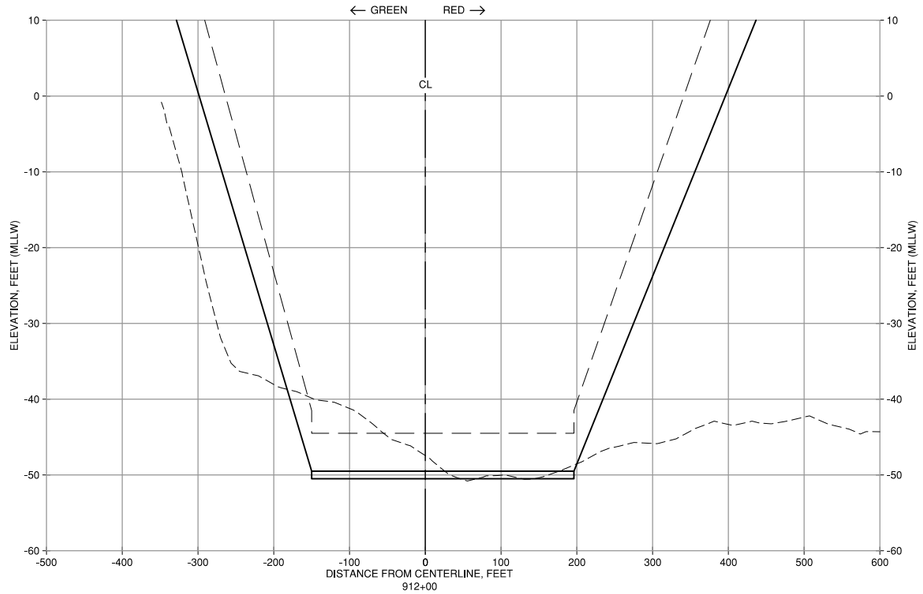
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CONSULTANT:

DESIGN PREPARED BY:
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PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:

SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 30 OF 34

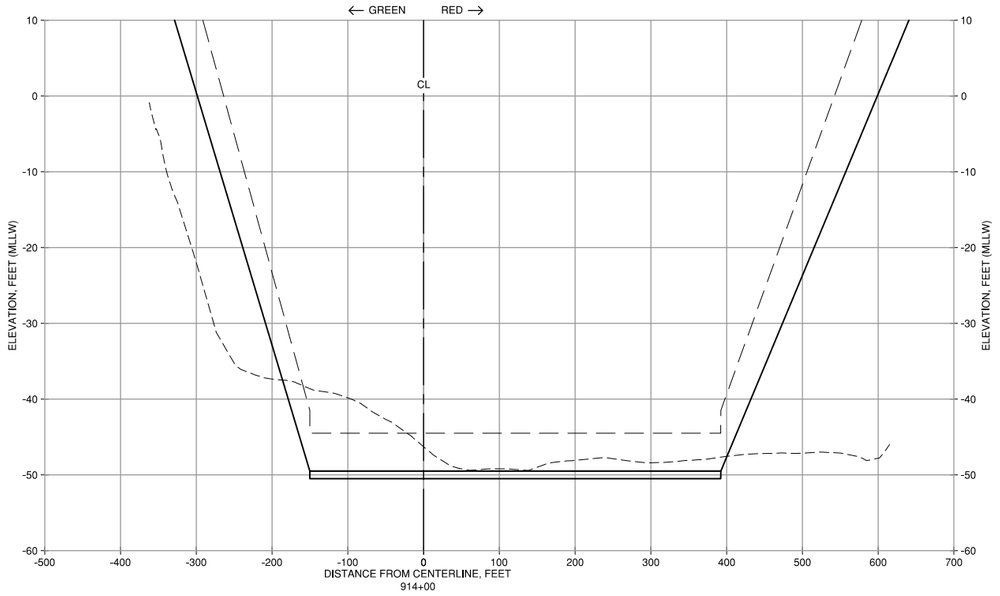
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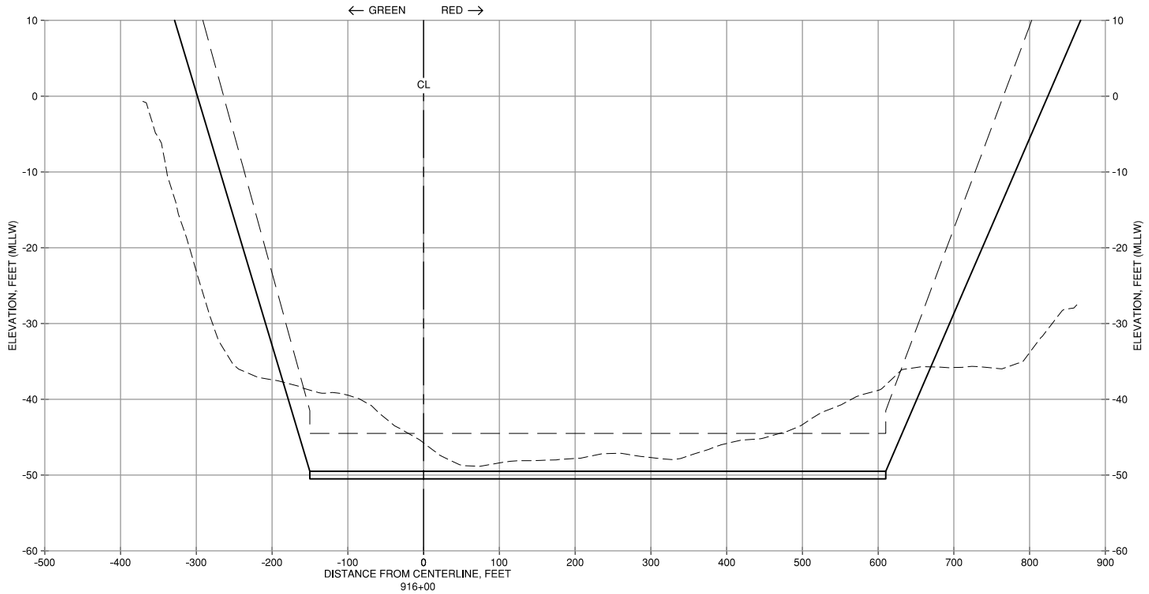
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MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 31 OF 34

REV	DATE	DESCRIPTION
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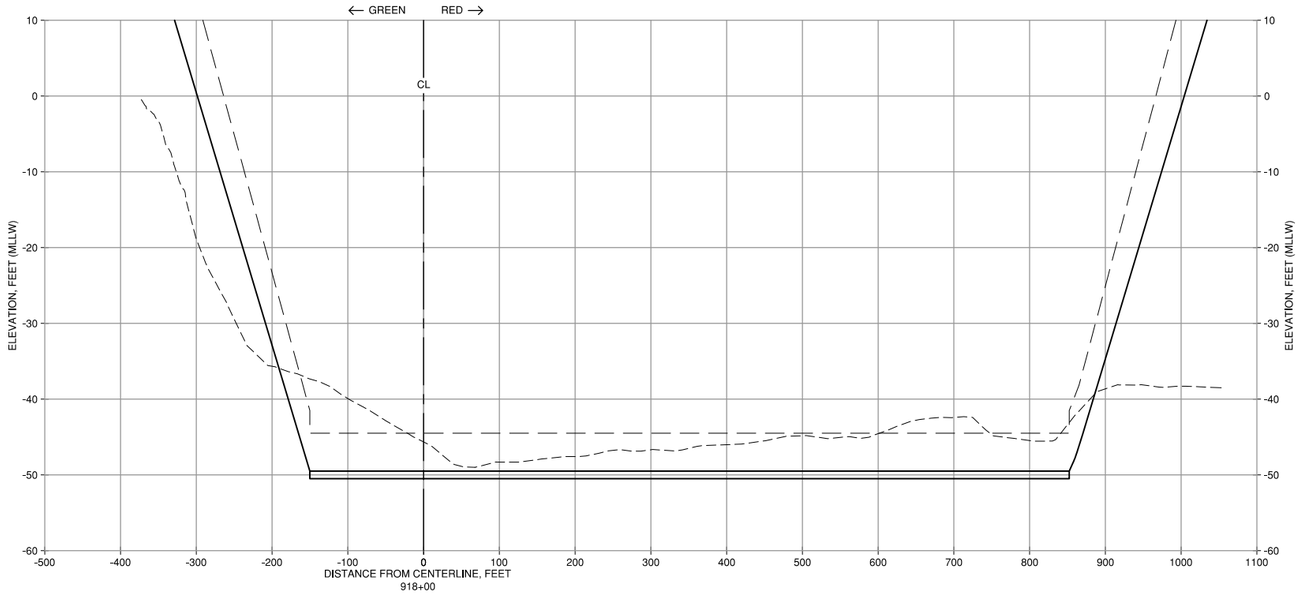
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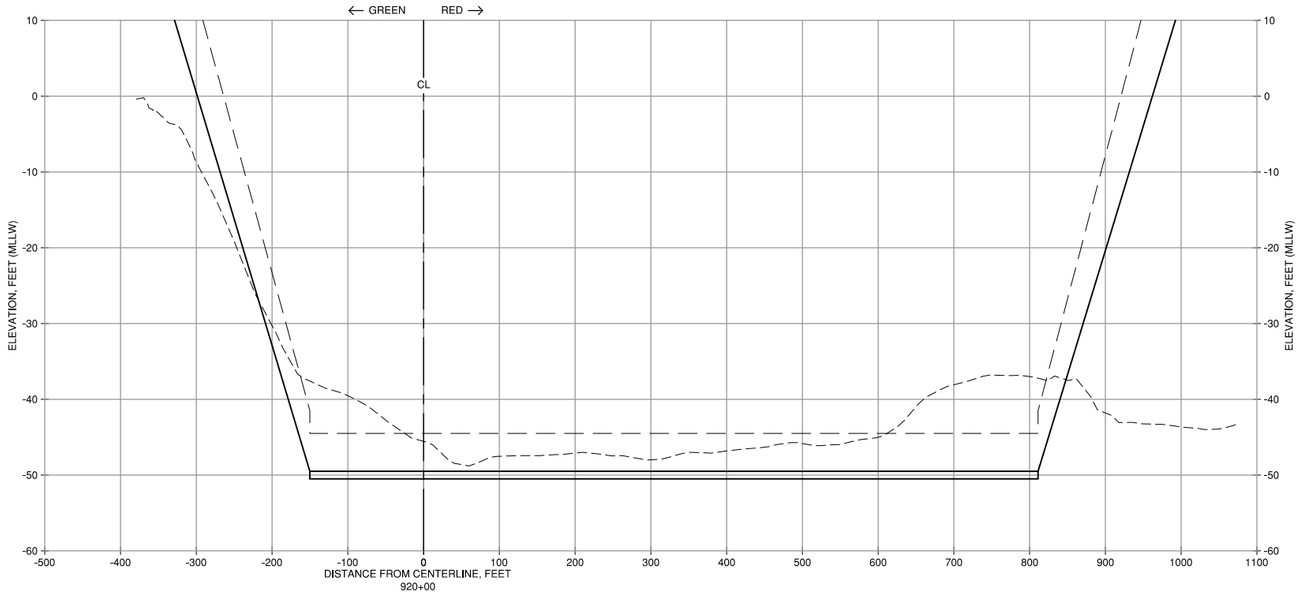
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CROSS-SECTIONS 32 OF 34

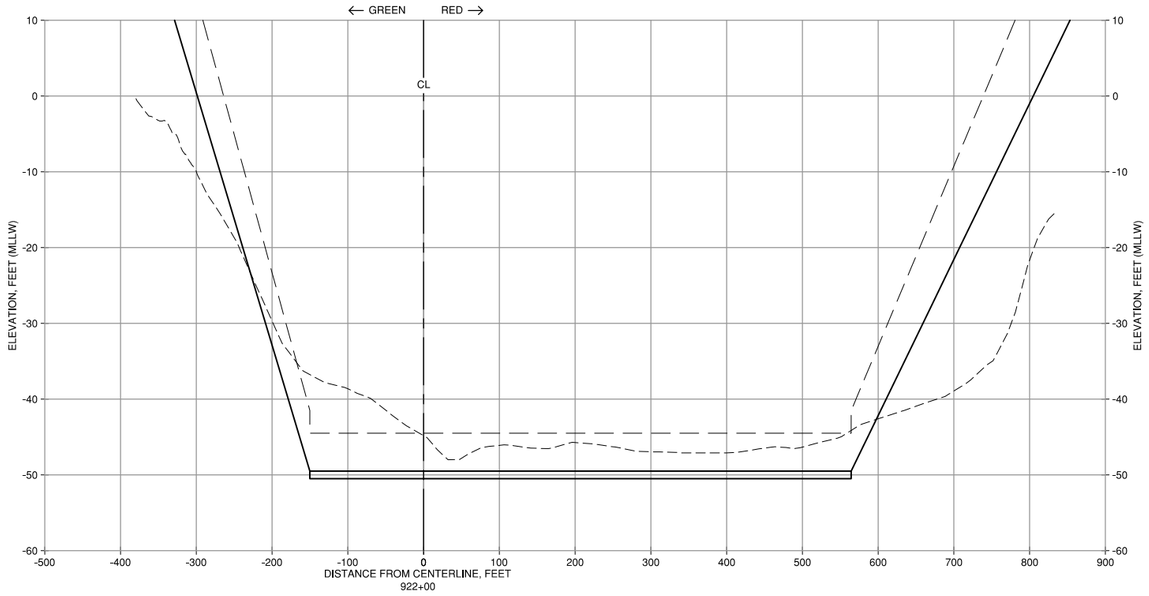
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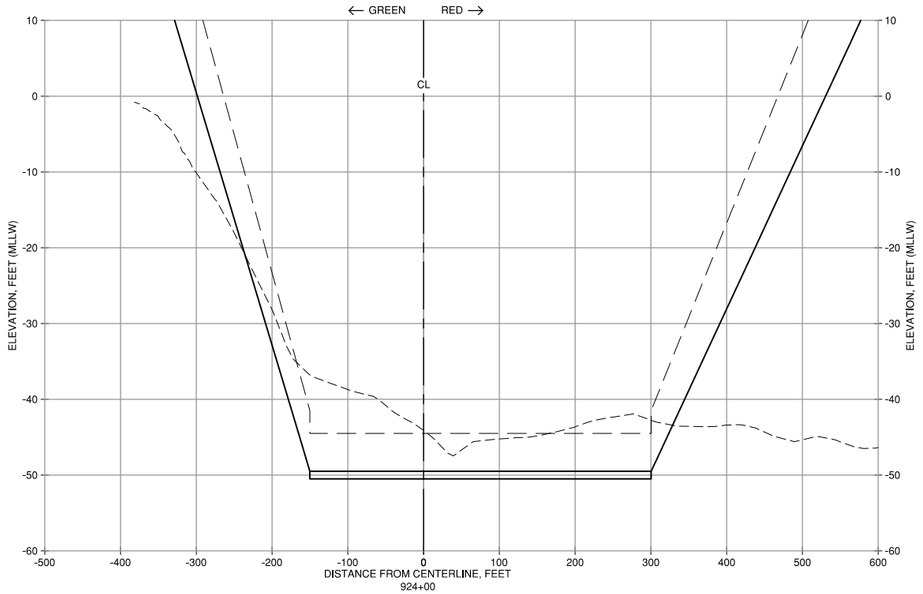
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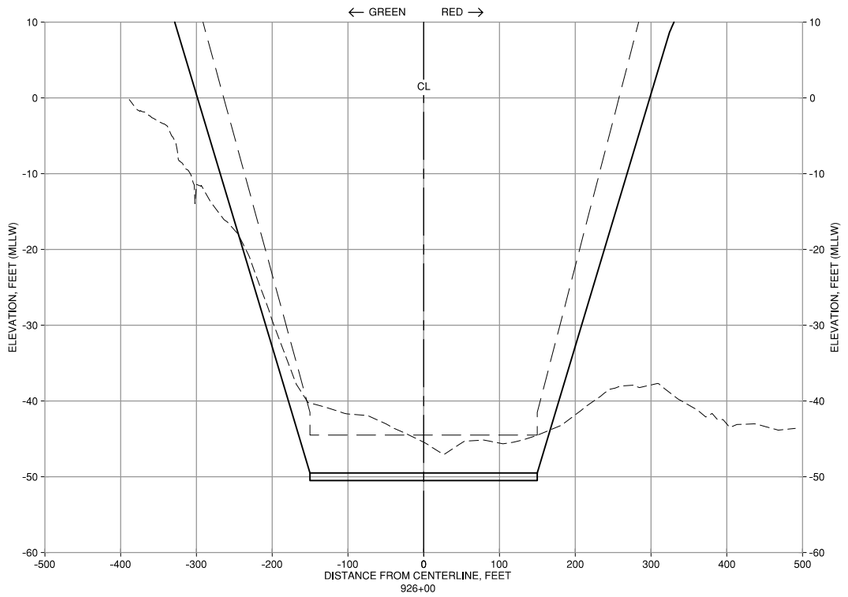
CROSS-SECTIONS 33 OF 34

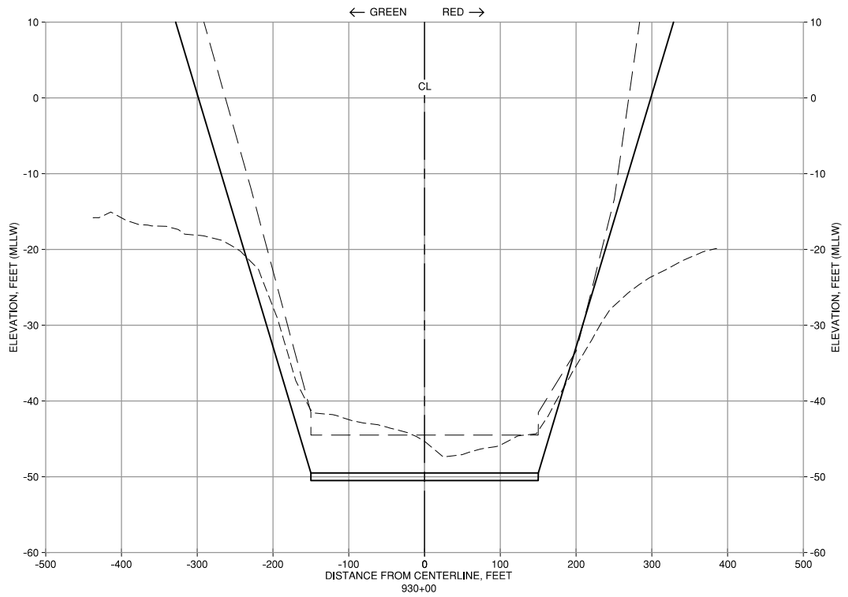
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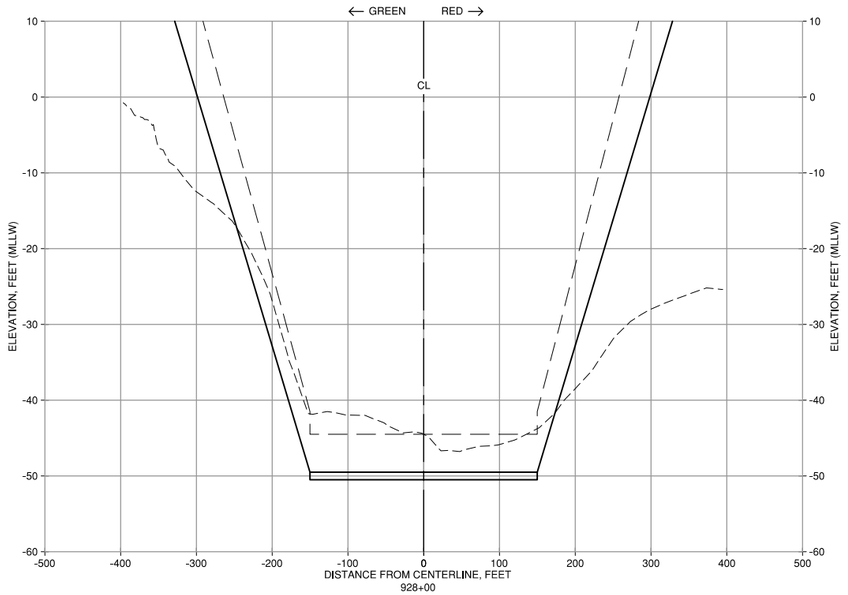
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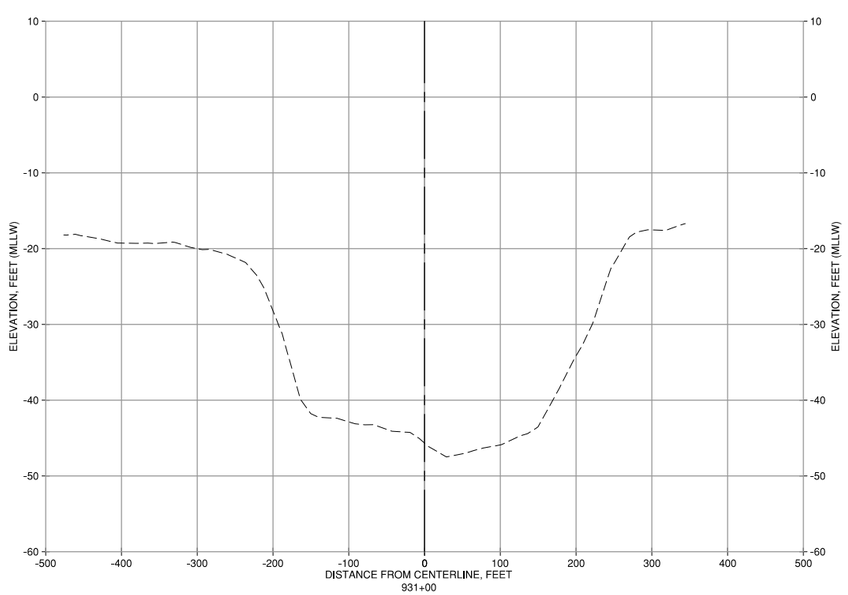
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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:

SEGMENT 4 - BOGGY BAYOU TO SIMS BAYOU

CROSS-SECTIONS 34 OF 34

REV	DATE	DESCRIPTION
A	8/15/20	65% SUBMITTAL

DESIGNER:	DJH
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REV. NO. A

65% REVIEW

Soil Parameters for Slope Stability Analyses – HSC Bayou Reach							
Section Profile (Soil Conditions)	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Short Term**	**Long Term**	
		Top	**Bottom**		**Undrained Shear Strength, psf**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Sta. 702+00 Green Side (Boring ECP-403D)	Lean Clay	0	-22.5	110	660	20	24
	Lean Clay	-22.5	-35.5	130	2,100	340	30
	Lean Clay	-35.5	-42.5	130	3,120	340	30
	Sand	-42.5	-60	120	0	0	36
Sta. 720+00 Red Side (Boring ECP-405D)	Sand	-5	-13.8	110	0	0	26
	Fat Clay	-13.8	-23.8	110	140	20	21
	Lean Clay	-23.8	-31.8	110	500	20	24
	Lean Clay	-31.8	-60	120	2,800	340	30
Sta. 742+00 Red Side (Boring ECP-407D)	Lean Clay	0	-17.9	120	550	40	24
	Fat Clay	-17.9	-25.9	110	320	20	21
	Lean Clay	-25.9	-35.9	120	540	40	24
	Sand	-35.9	-41.9	110	0	0	30
	Lean Clay	-41.9	-51.9	130	1,640	340	30
	Sand	-51.9	-60	120	0	0	32
Sta. 760+00 Red Side (Boring ECP-409D)	Fat Clay	-6	-29	130	2,420	340	27
	Sand	-29	-41	120	0	0	36
	Lean Clay	-41	-51	130	3,120	340	30
	Sand	-51	-60	120	0	0	35
Sta. 800+00 Red Side (Boring ECP-413D)	Lean Clay	-2	-25.7	100	6 psf/ft 50 psf - 150 psf	20	24
	Lean Clay	-25.7	-29.7	110	340	20	24
	Fat Clay	-29.7	-33.7	110	340	20	21
	Lean Clay	-33.7	-51.7	130	2,800	340	30
	Fat Clay	-51.7	-57.7	130	3,000	340	27
	Lean Clay	-57.7	-60	125	2,420	340	30

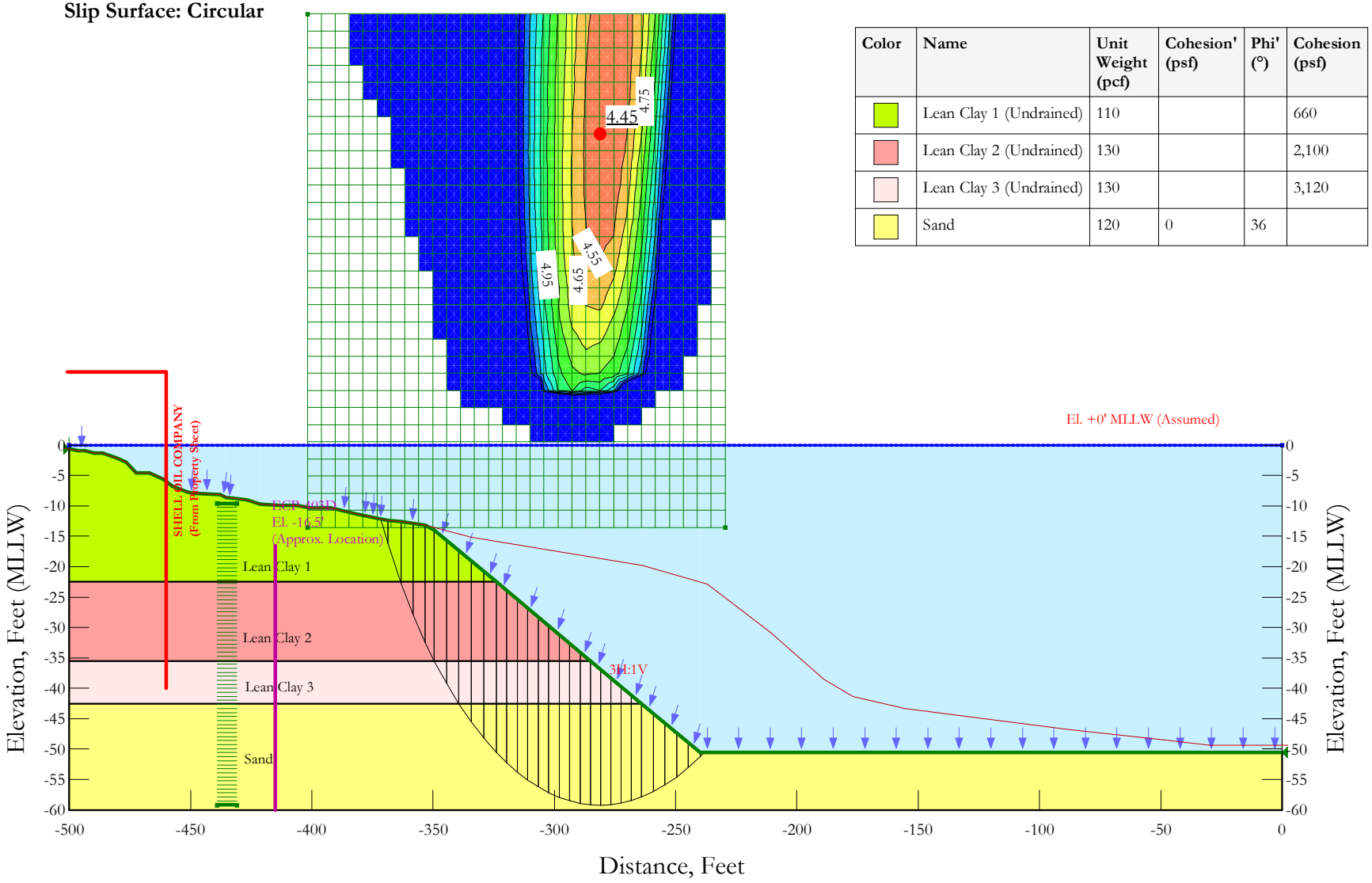
Soil Parameters for Slope Stability Analyses – HSC Bayou Reach							
Section Profile (Soil Conditions)	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Short Term**	**Long Term**	
		Top	**Bottom**		**Undrained Shear Strength, psf**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Sta. 800+00 Red Side (Boring ECP-413D)	Lean Clay	8	-2	100	500	20	24
	Lean Clay	-2	-25.7	100	6 psf/ft (50 psf - 150 psf)	20	24
	Lean Clay	-25.7	-29.7	110	340	20	24
	Fat Clay	-29.7	-33.7	110	340	20	21
	Lean Clay	-33.7	-51.7	130	2,800	340	30
	Fat Clay	-51.7	-57.7	130	3,000	340	27
	Lean Clay	-57.7	-60	125	2,420	340	30
Sta. 808+00 Green Side (Boring ECP-414D)	Fat Clay	-4	-26.5	100	50	20	21
	Lean Clay	-26.5	-28.5	100	200	20	24
	Fat Clay	-28.5	-36.5	130	3,000	340	27
	Lean Clay	-36.5	-40.5	130	3,000	340	30
	Silt	-40.5	-50.5	120	0	0	32
	Sand	-50.5	-56.5	120	0	0	37
	Fat Clay	-56.5	-60.5	130	3,000	340	27
Sta. 830+00 Green Side (Boring ECP-416D)	Fat Clay	-25	-42.5	100	6 psf/ft (50 psf - 150 psf)	20	21
	Lean Clay	-42.5	-60	125	2,100	340	30
Sta. 876+00 Green Side (Boring ECP-421D)	Fat Clay	-2	-42.1	100	100	20	21
	Fat Clay	-42.1	-54.1	125	3,000	340	27
	Lean Clay	-54.1	-58.1	125	3,000	340	30
	Fat Clay	-58.1	-60	125	3,000	340	27
Sta. 918+00 Green Side (Boring ECP-425D)	Sand	0	-43.7	120	0	0	32
	Fat Clay	-43.7	-60	125	2,200	340	27

HSC SLOPE STABILITY RESULTS – 3H:1V TEMPLATE

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 702+00 - Green Side
HVJ Project Number: HG1910092.2.1

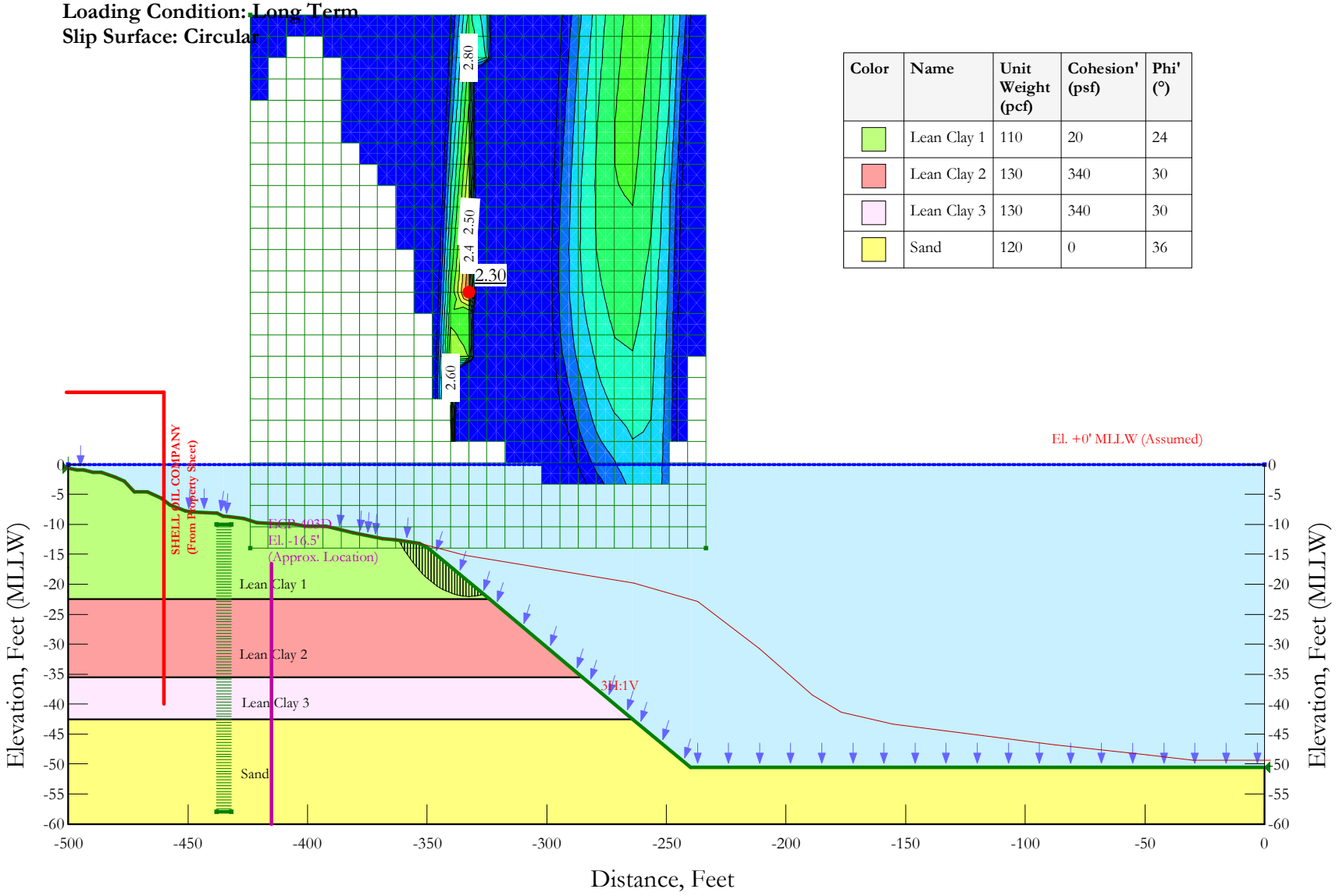
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Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Lean Clay 1 (Undrained)	110			660
	Lean Clay 2 (Undrained)	130			2,100
	Lean Clay 3 (Undrained)	130			3,120
	Sand	120	0	36	



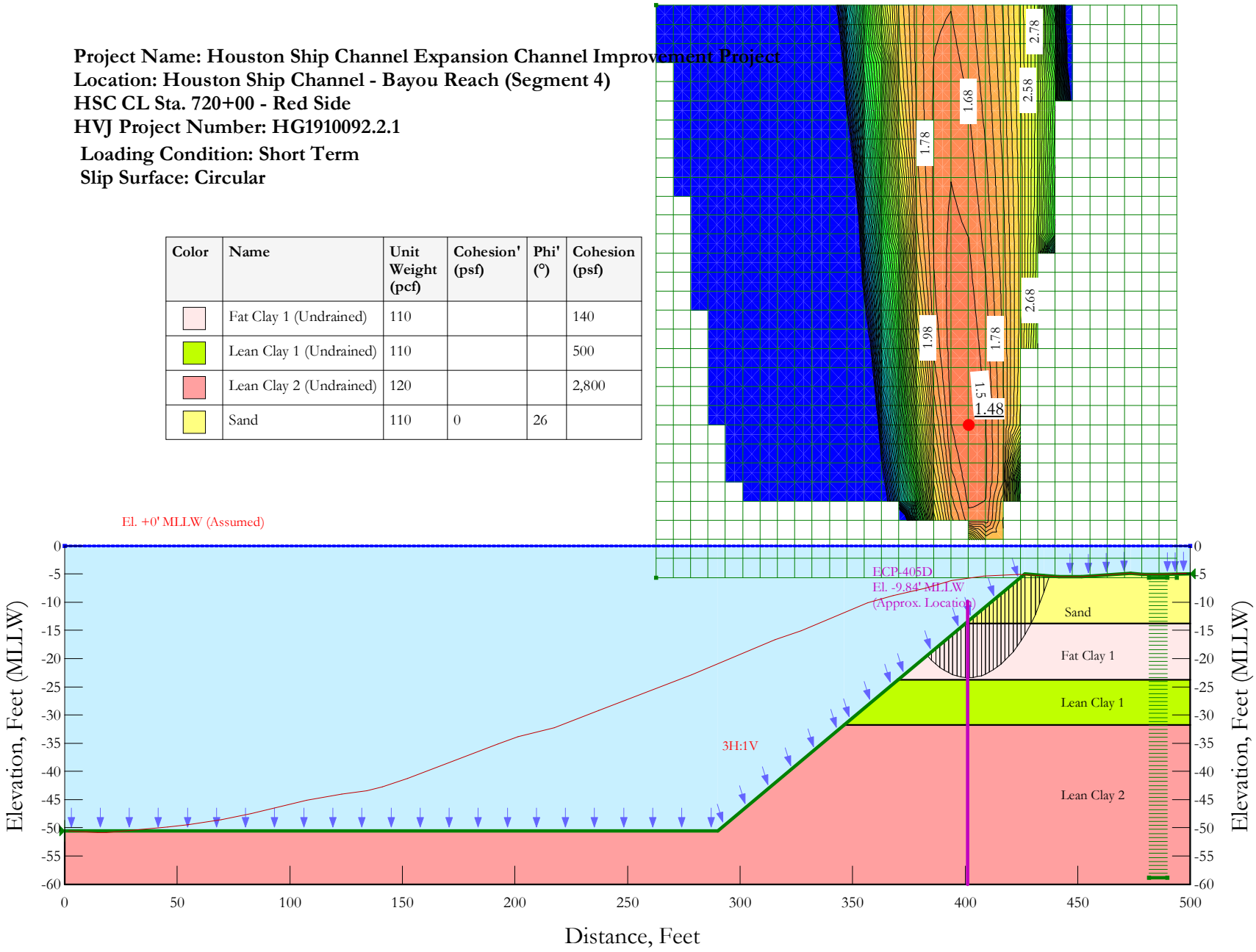
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 702+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Lean Clay 1	110	20	24
	Lean Clay 2	130	340	30
	Lean Clay 3	130	340	30
	Sand	120	0	36



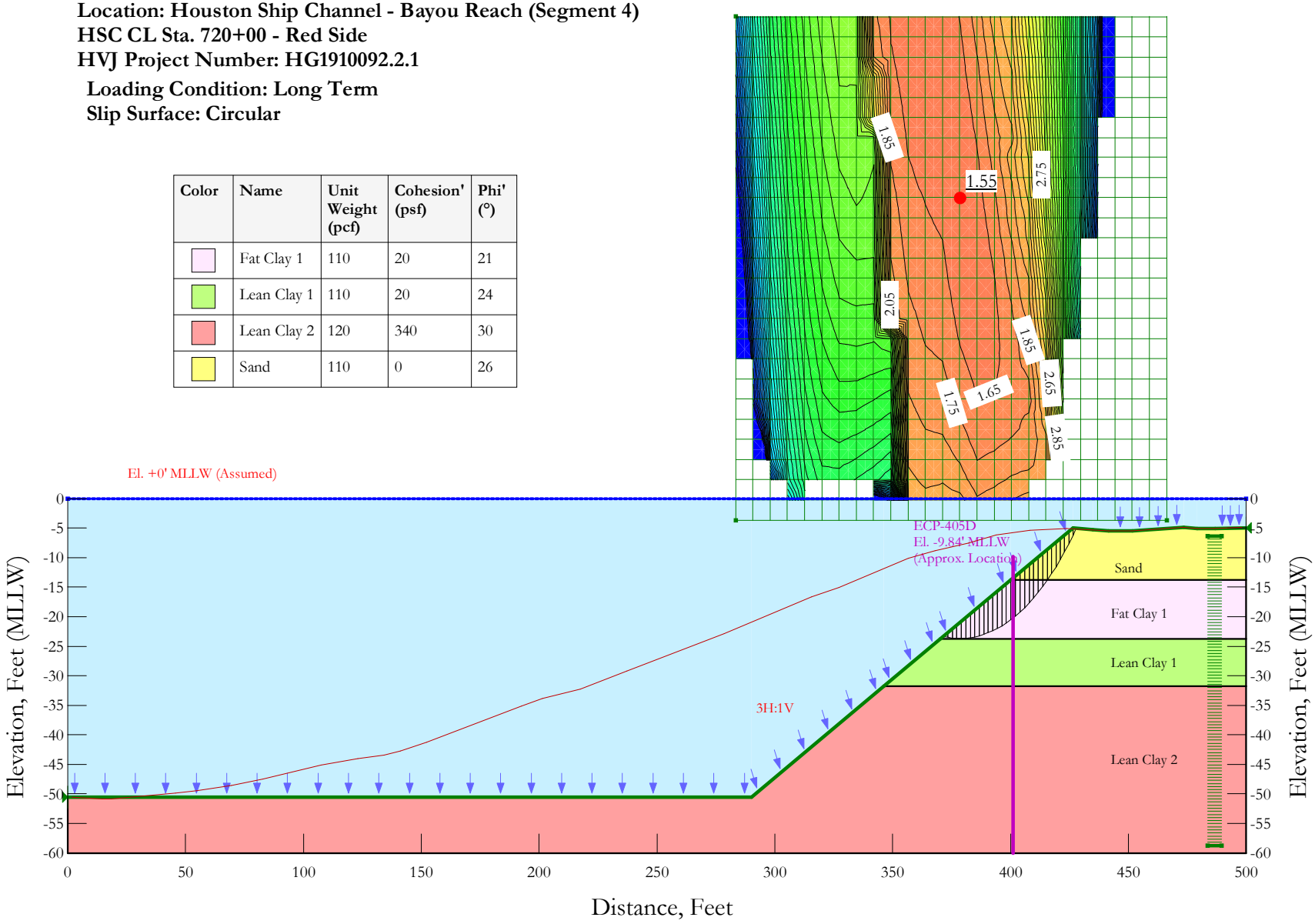
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Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 720+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110			140
	Lean Clay 1 (Undrained)	110			500
	Lean Clay 2 (Undrained)	120			2,800
	Sand	110	0	26	



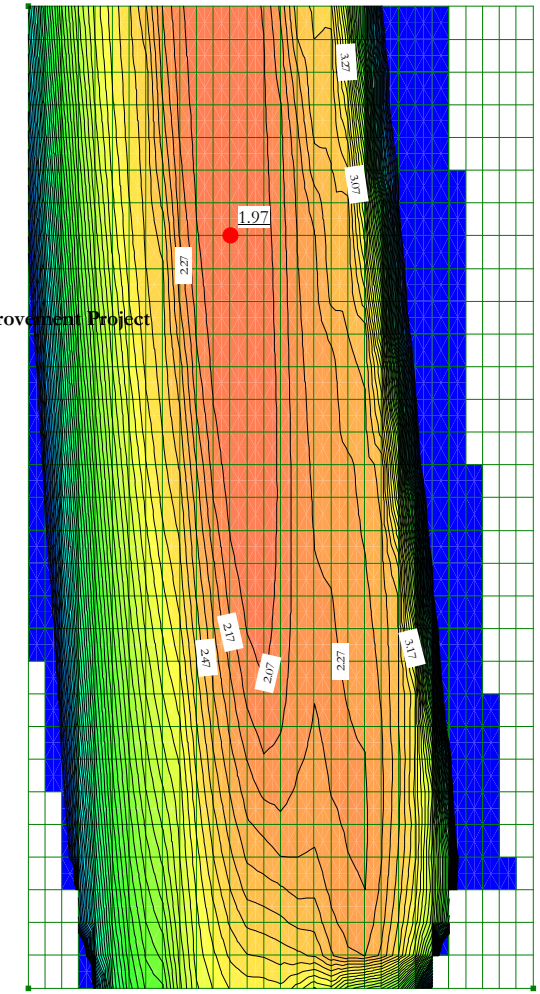
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Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 720+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Lean Clay 1	110	20	24
	Lean Clay 2	120	340	30
	Sand	110	0	26

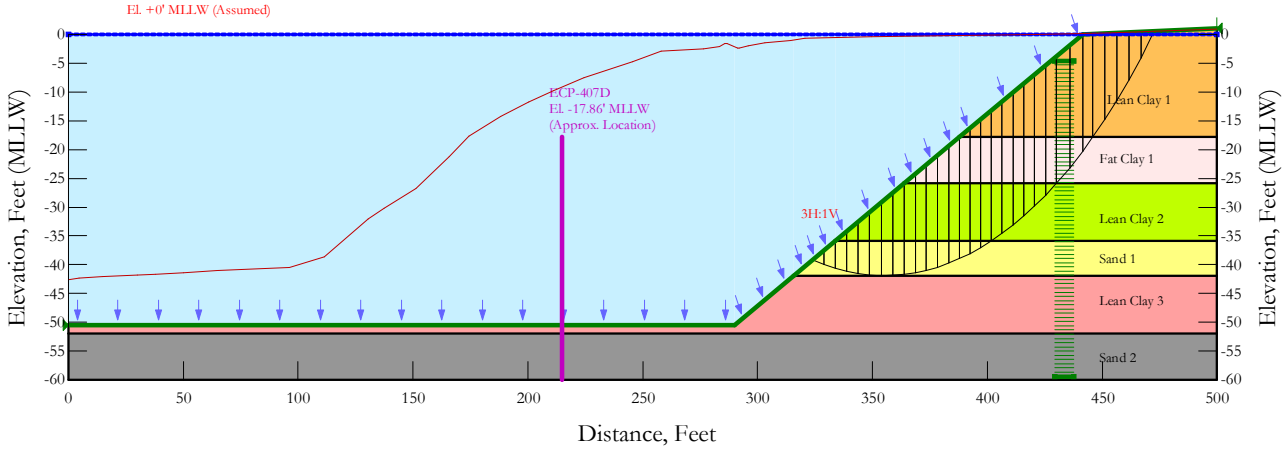


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 742+00 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular



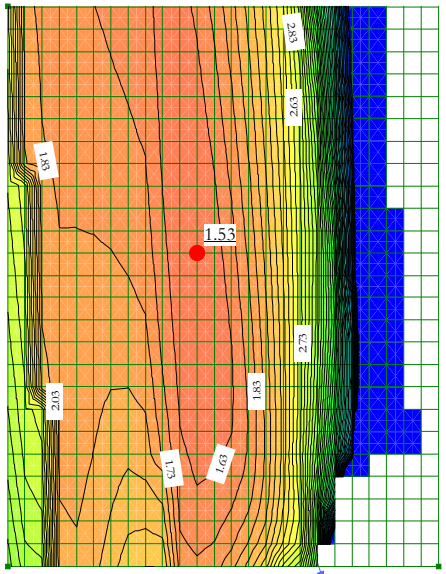
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110			320
	Lean Clay 1 (Undrained)	130			550
	Lean Clay 2 (Undrained)	120			540
	Lean Clay 3 (Undrained)	130			1,640
	Sand 1	110	0	30	
	Sand 2	120	0	32	

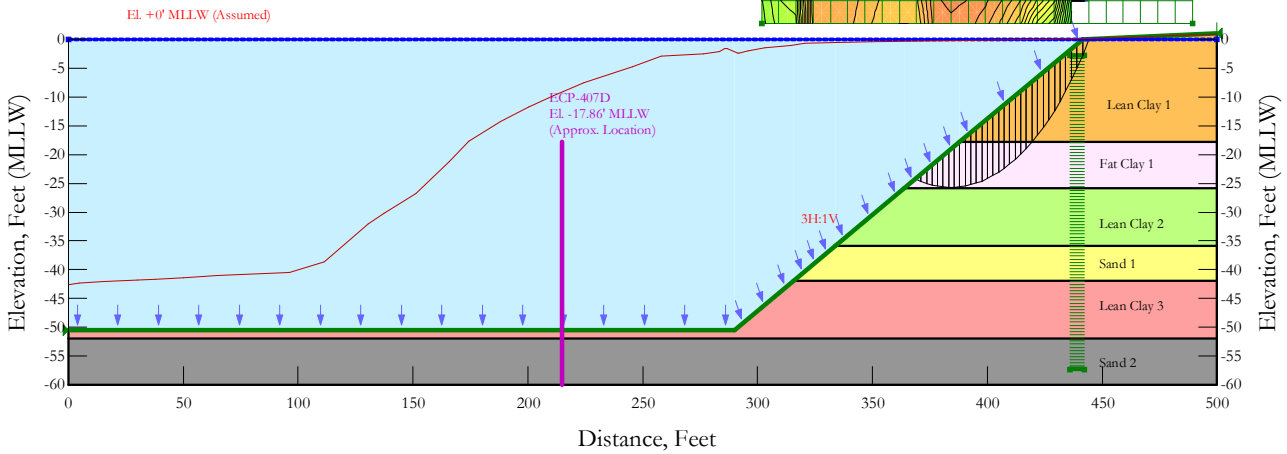


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HSC CL Sta. 742+00 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Long Term
Slip Surface: Circular

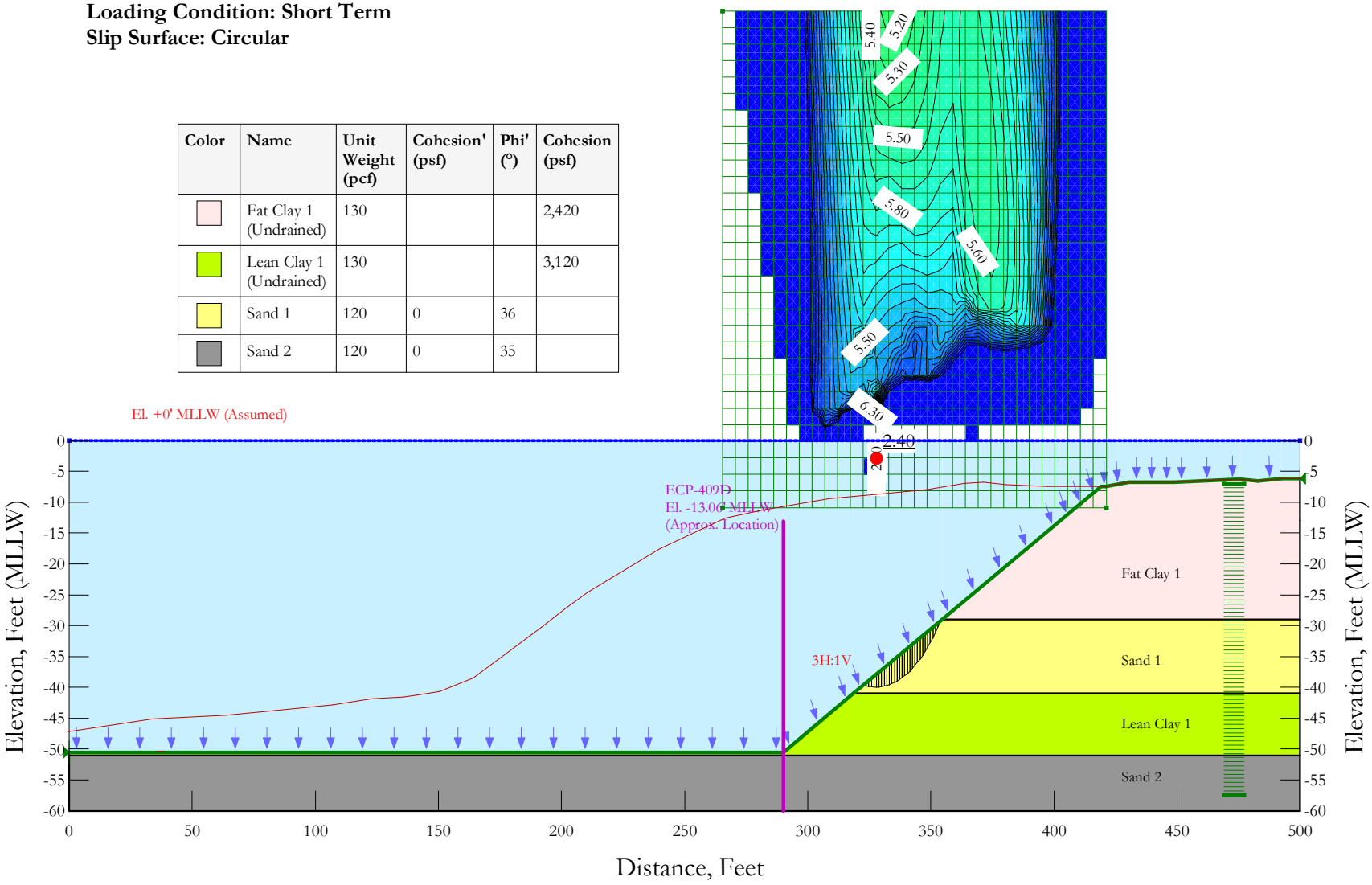
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Lean Clay 1	120	40	24
	Lean Clay 2	120	40	24
	Lean Clay 3	130	340	30
	Sand 1	110	0	30
	Sand 2	120	0	32





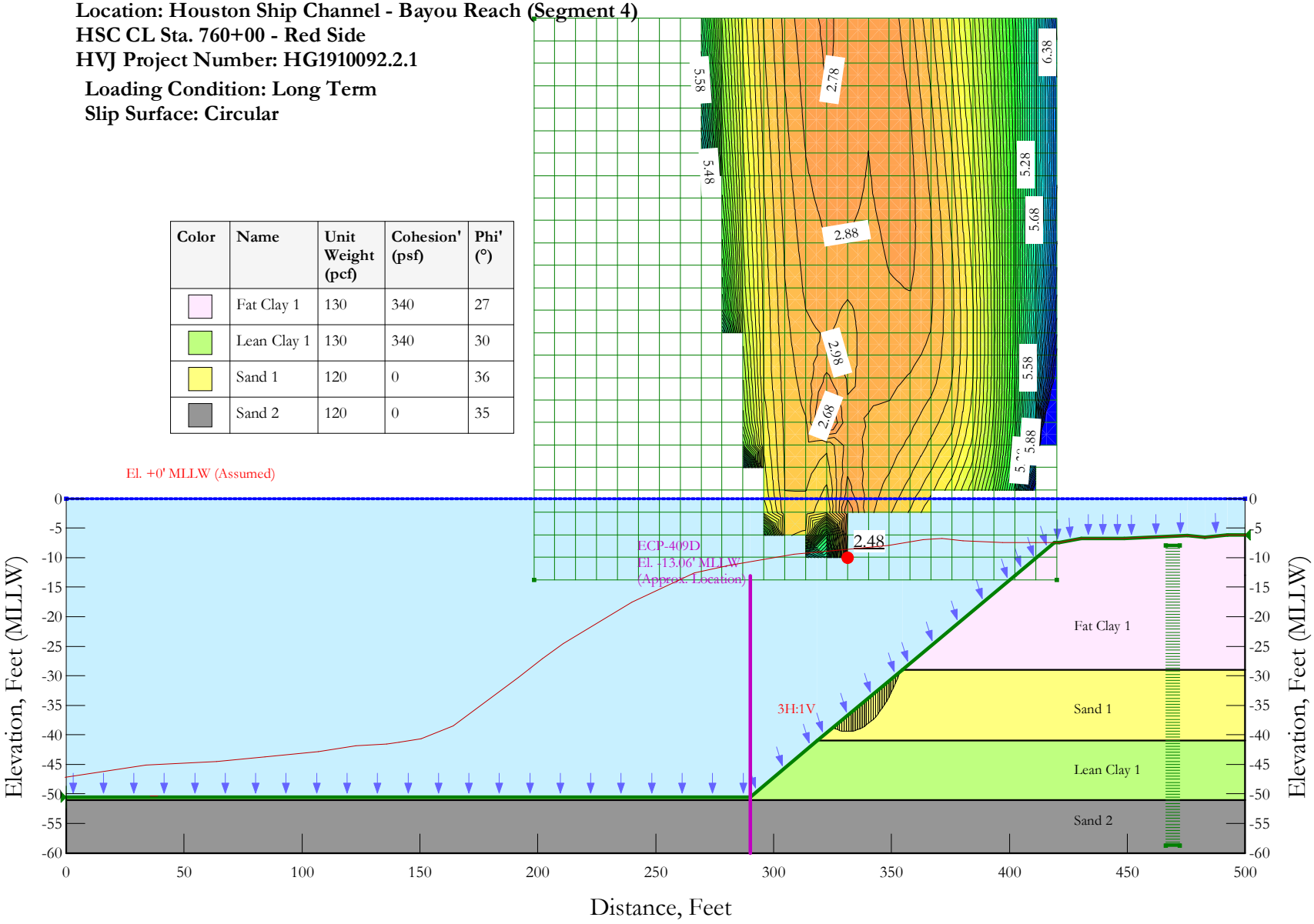
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 760+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	130			2,420
	Lean Clay 1 (Undrained)	130			3,120
	Sand 1	120	0	36	
	Sand 2	120	0	35	



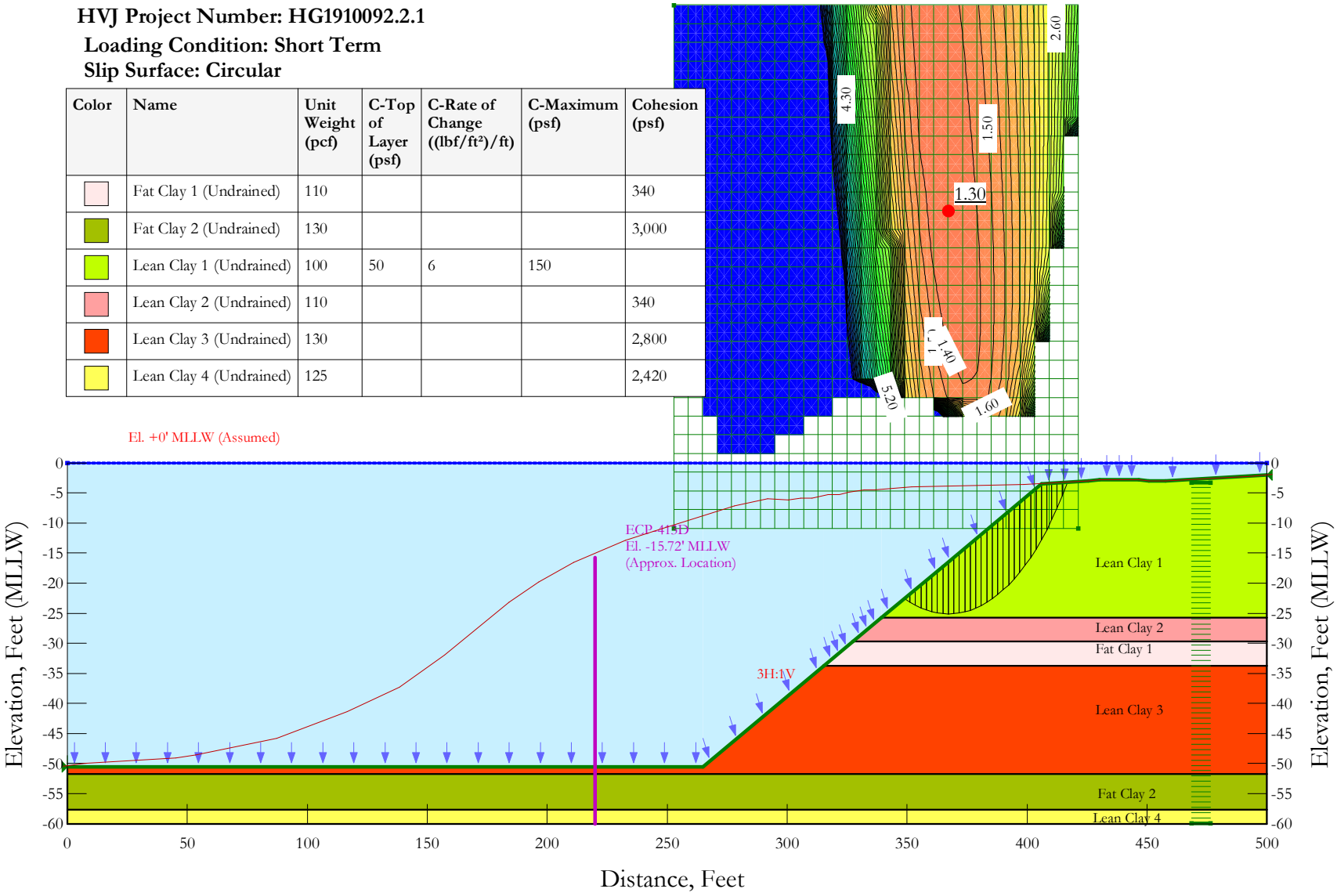
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HSC CL Sta. 760+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	130	340	27
	Lean Clay 1	130	340	30
	Sand 1	120	0	36
	Sand 2	120	0	35



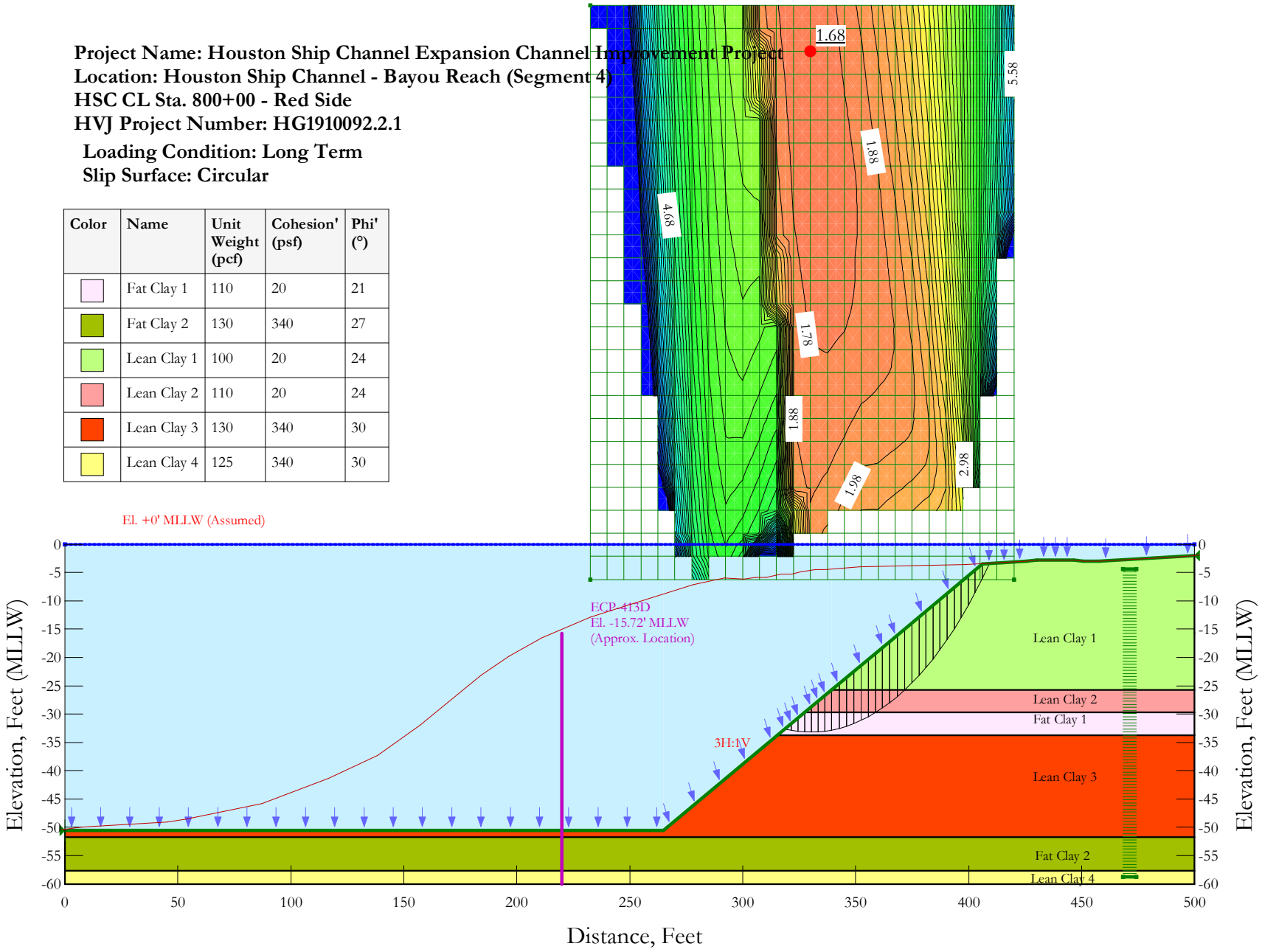
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 800+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110				340
	Fat Clay 2 (Undrained)	130				3,000
	Lean Clay 1 (Undrained)	100	50	6	150	
	Lean Clay 2 (Undrained)	110				340
	Lean Clay 3 (Undrained)	130				2,800
	Lean Clay 4 (Undrained)	125				2,420



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 800+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

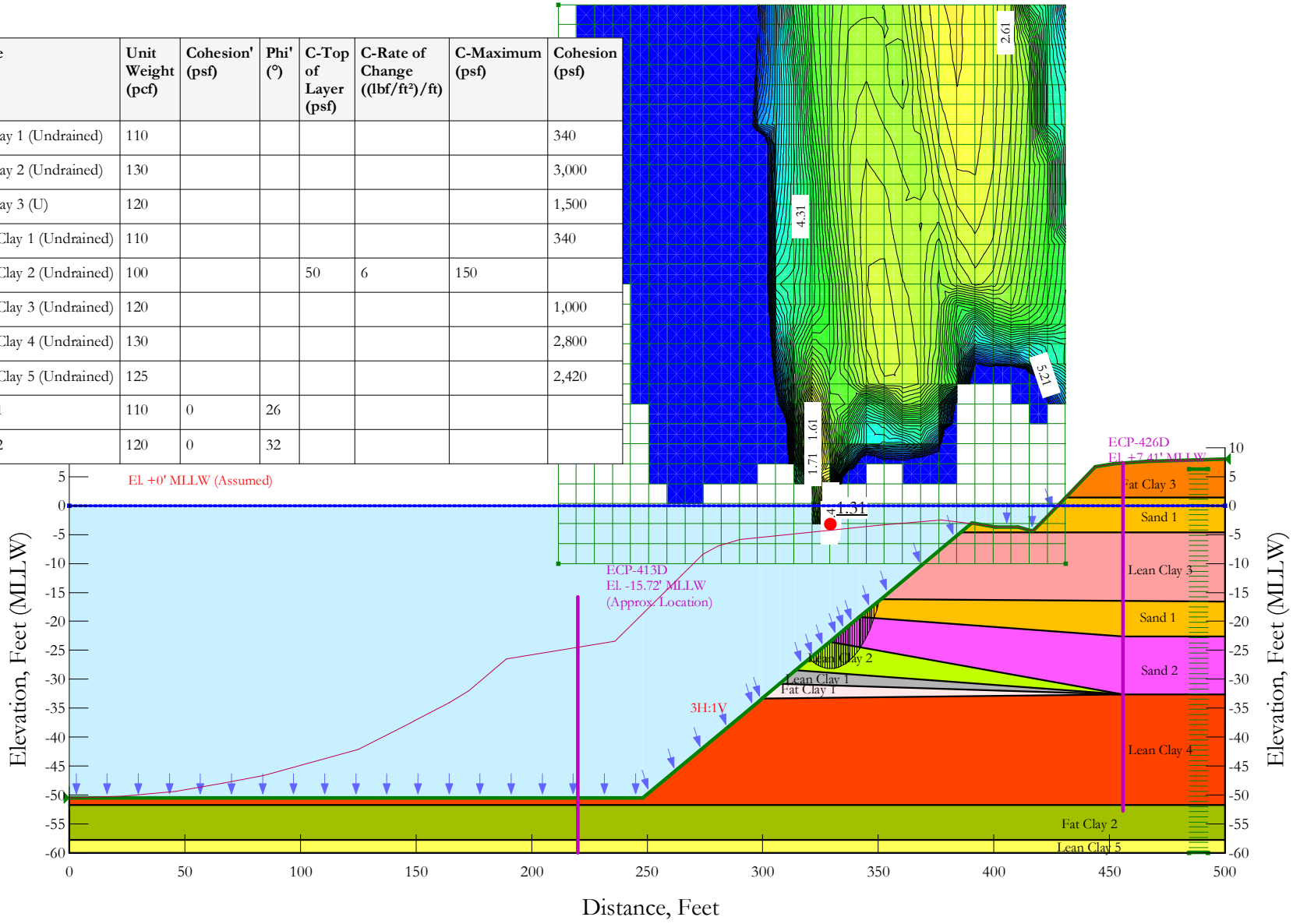
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Fat Clay 2	130	340	27
	Lean Clay 1	100	20	24
	Lean Clay 2	110	20	24
	Lean Clay 3	130	340	30
	Lean Clay 4	125	340	30



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 803+26 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular

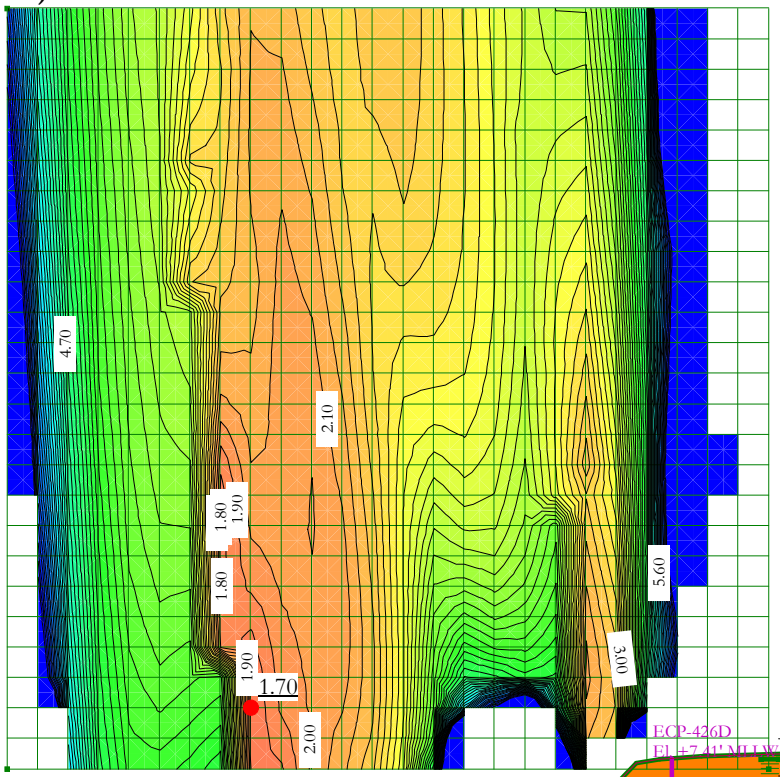
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110						340
	Fat Clay 2 (Undrained)	130						3,000
	Fat Clay 3 (U)	120						1,500
	Lean Clay 1 (Undrained)	110						340
	Lean Clay 2 (Undrained)	100			50	6	150	
	Lean Clay 3 (Undrained)	120						1,000
	Lean Clay 4 (Undrained)	130						2,800
	Lean Clay 5 (Undrained)	125						2,420
	Sand 1	110	0	26				
	Sand 2	120	0	32				

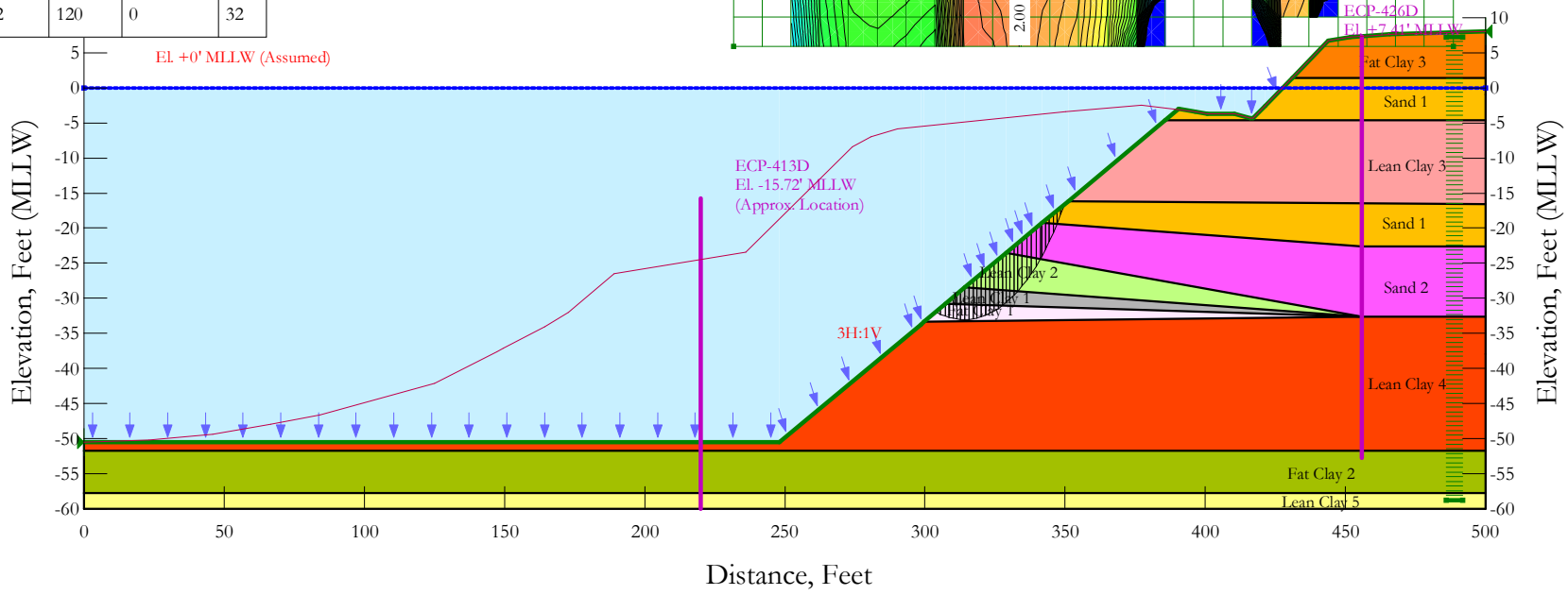


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 803+26 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Long Term
Slip Surface: Circular

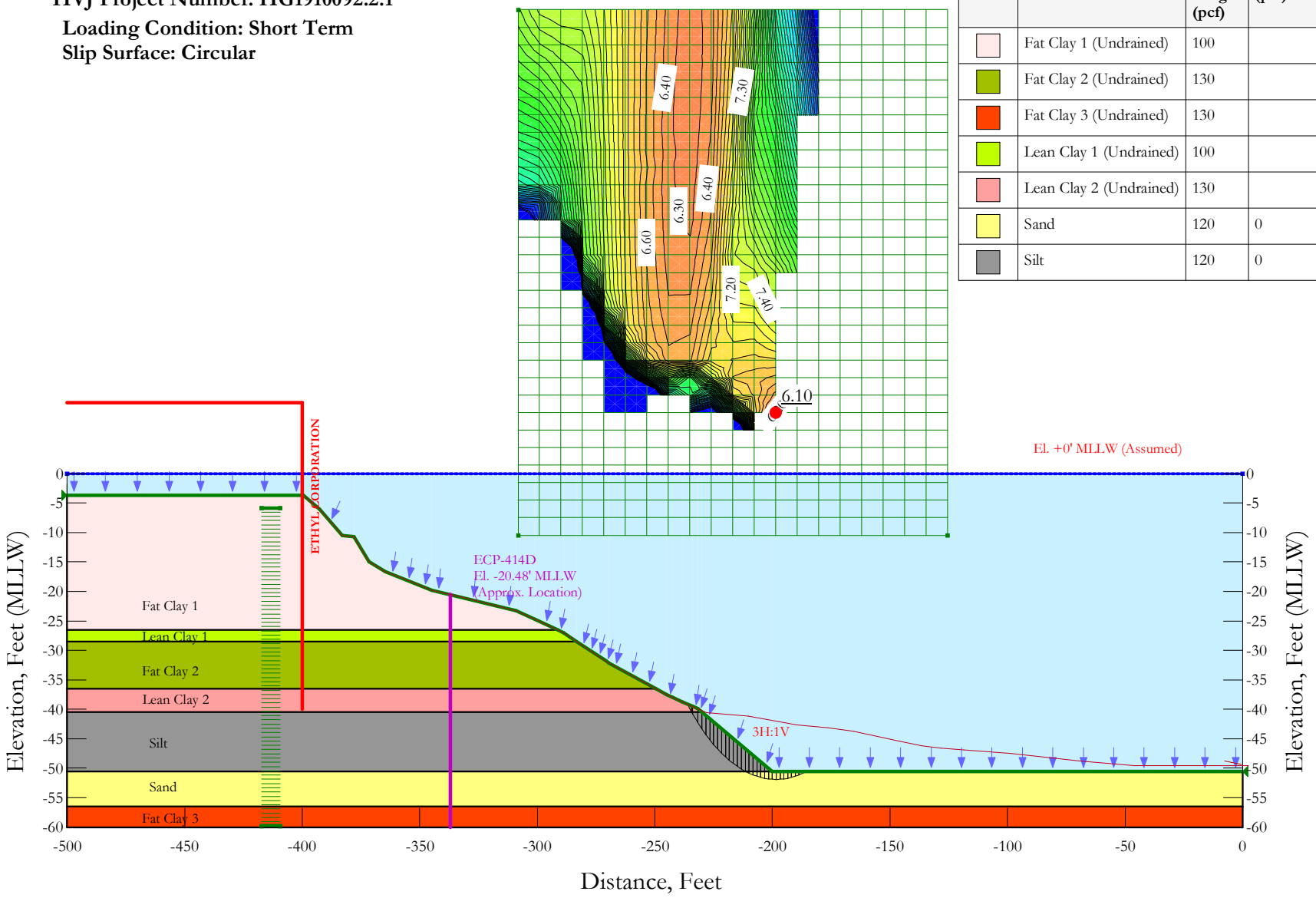
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Fat Clay 2	130	340	27
	Fat Clay 3	120	340	27
	Lean Clay 1	110	20	24
	Lean Clay 2	100	20	24
	Lean Clay 3	120	340	30
	Lean Clay 4	130	340	30
	Lean Clay 5	125	340	30
	Sand 1	110	0	26
	Sand 2	120	0	32





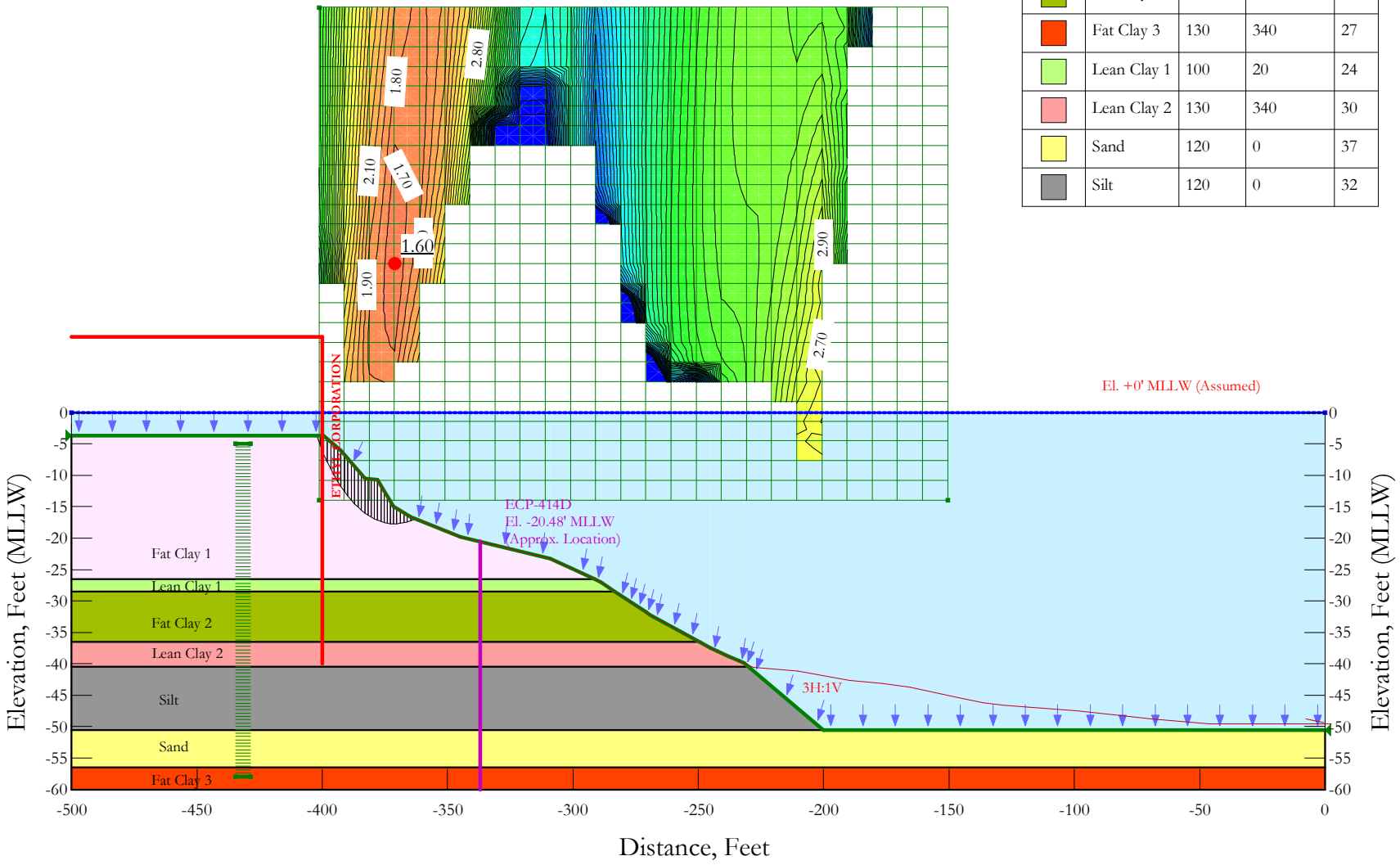
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 808+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	100			50
	Fat Clay 2 (Undrained)	130			3,000
	Fat Clay 3 (Undrained)	130			3,000
	Lean Clay 1 (Undrained)	100			200
	Lean Clay 2 (Undrained)	130			3,000
	Sand	120	0	37	
	Silt	120	0	32	



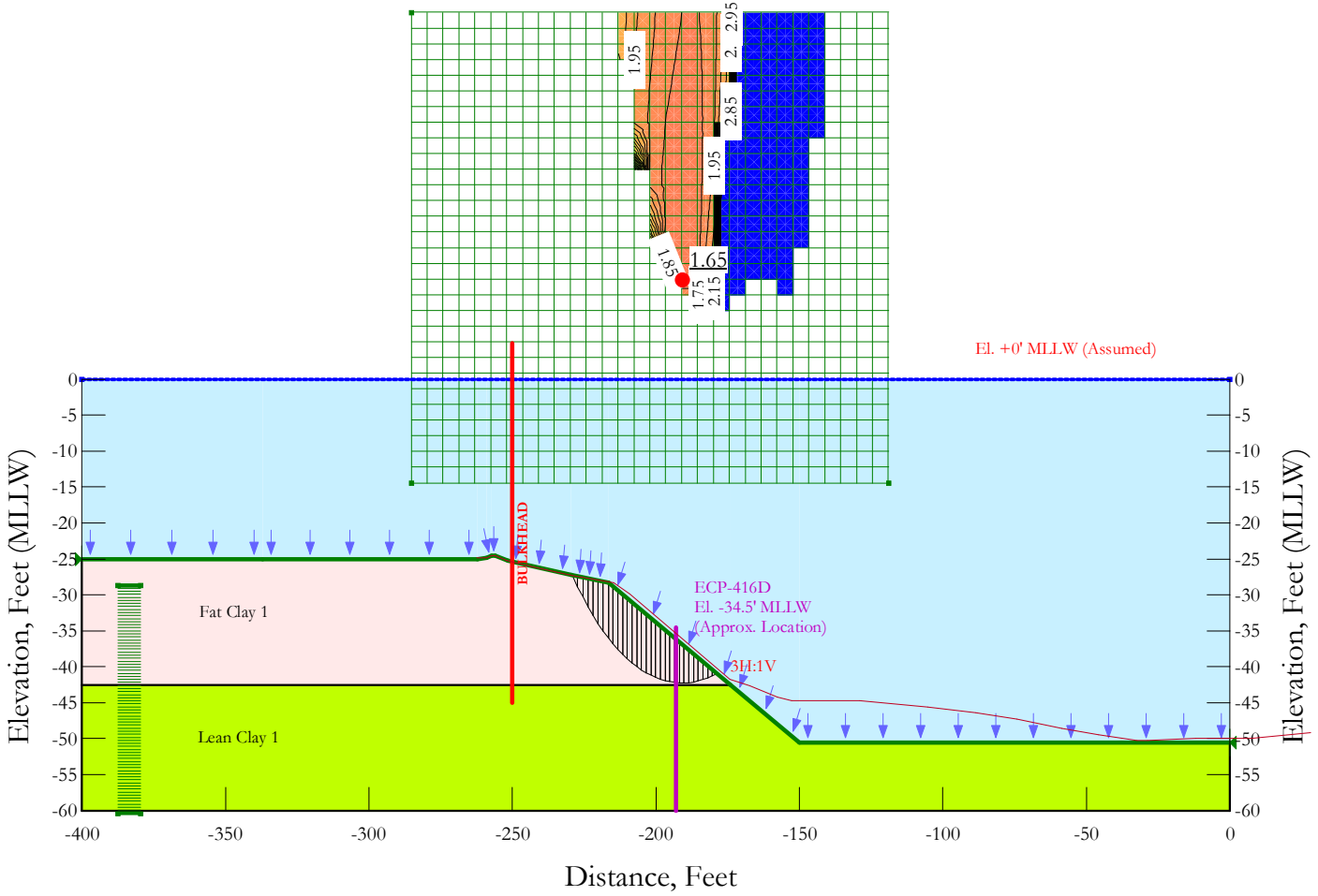
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 808+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Fat Clay 2	130	340	27
	Fat Clay 3	130	340	27
	Lean Clay 1	100	20	24
	Lean Clay 2	130	340	30
	Sand	120	0	37
	Silt	120	0	32



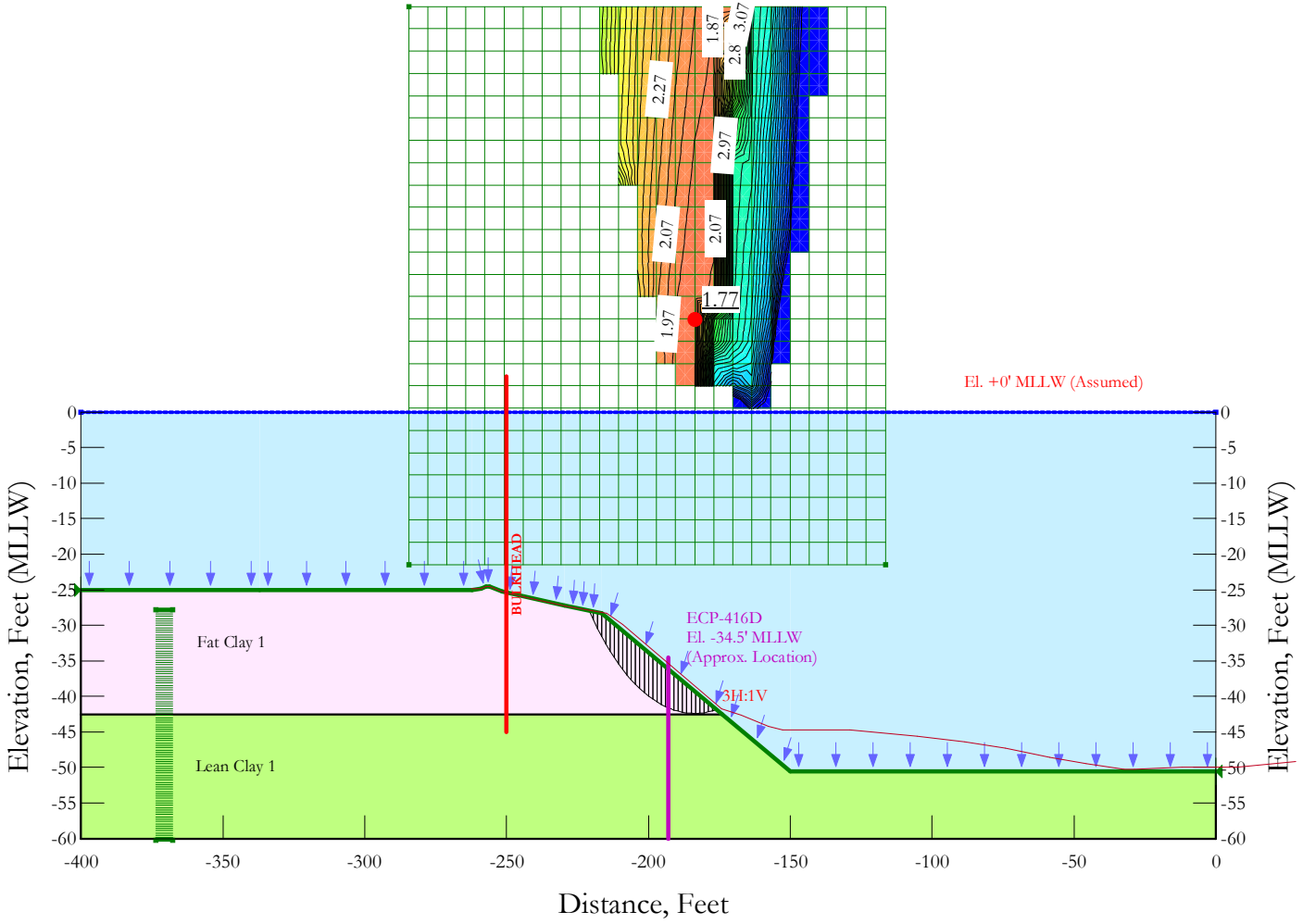
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 830+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)
	Fat Clay 1 (Undrained)	100		50	6	150
	Lean Clay 1 (Undrained)	125	2,100			



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 830+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

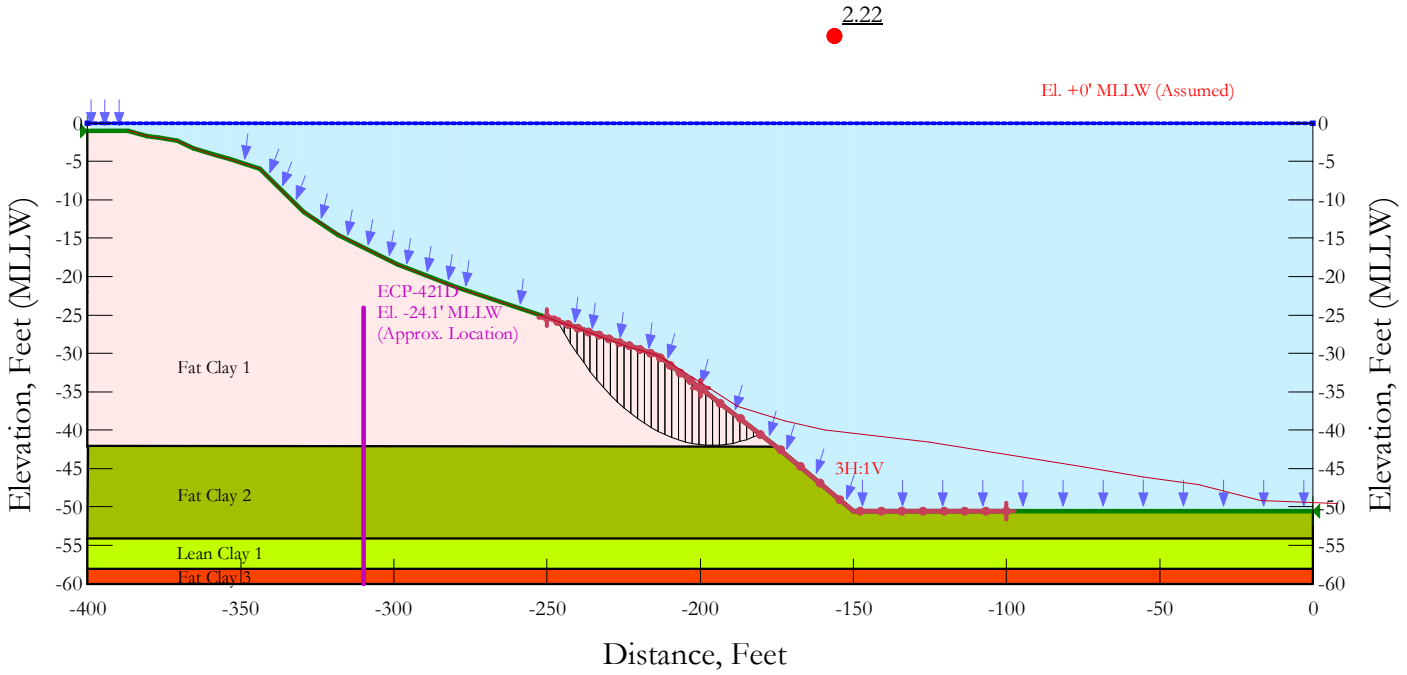
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Lean Clay 1	125	340	30



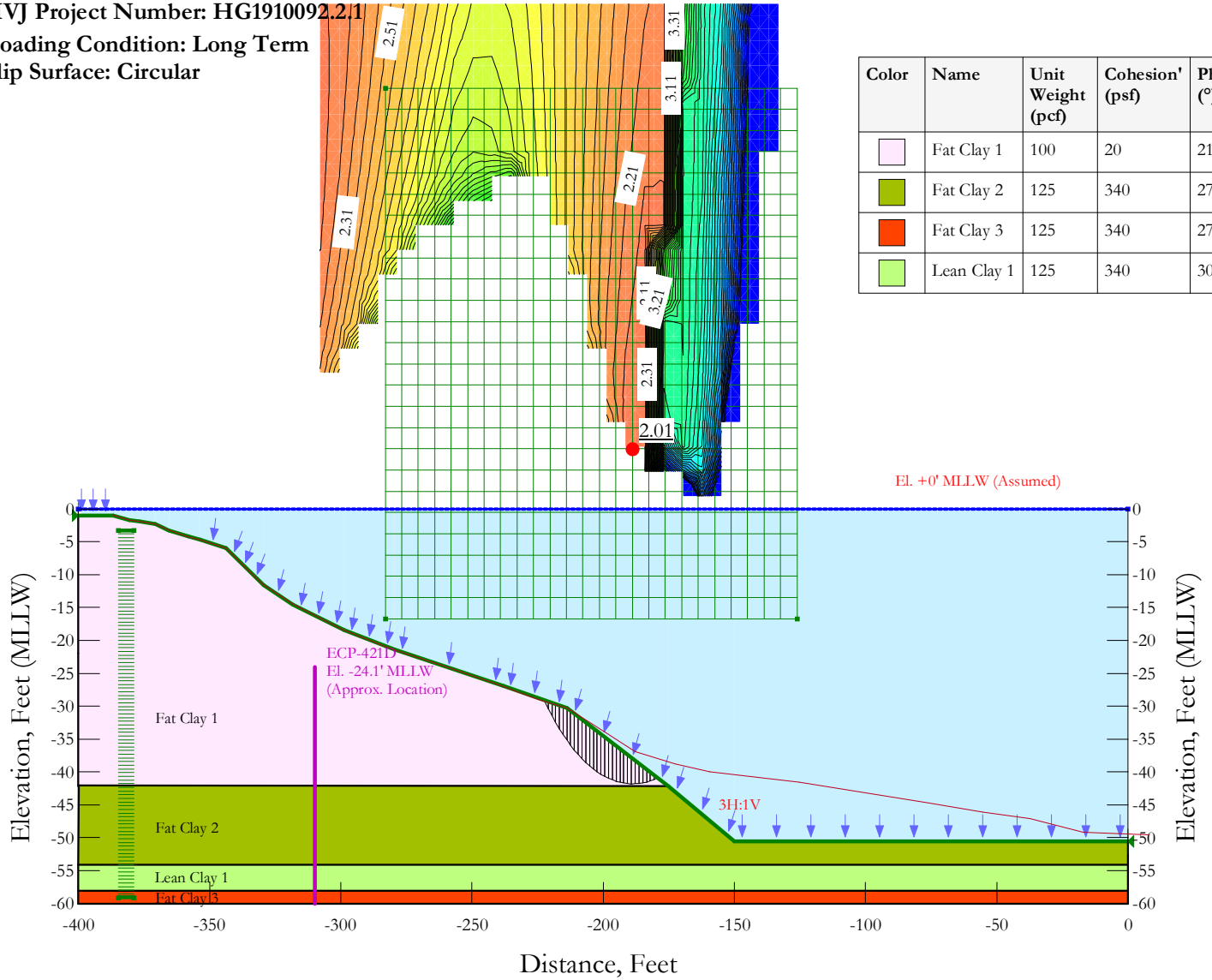
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 876+00 - Green Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)
	Fat Clay 1 (Undrained)	100	100
	Fat Clay 2 (Undrained)	125	3,000
	Fat Clay 3 (Undrained)	125	3,000
	Lean Clay 1 (Undrained)	125	3,000

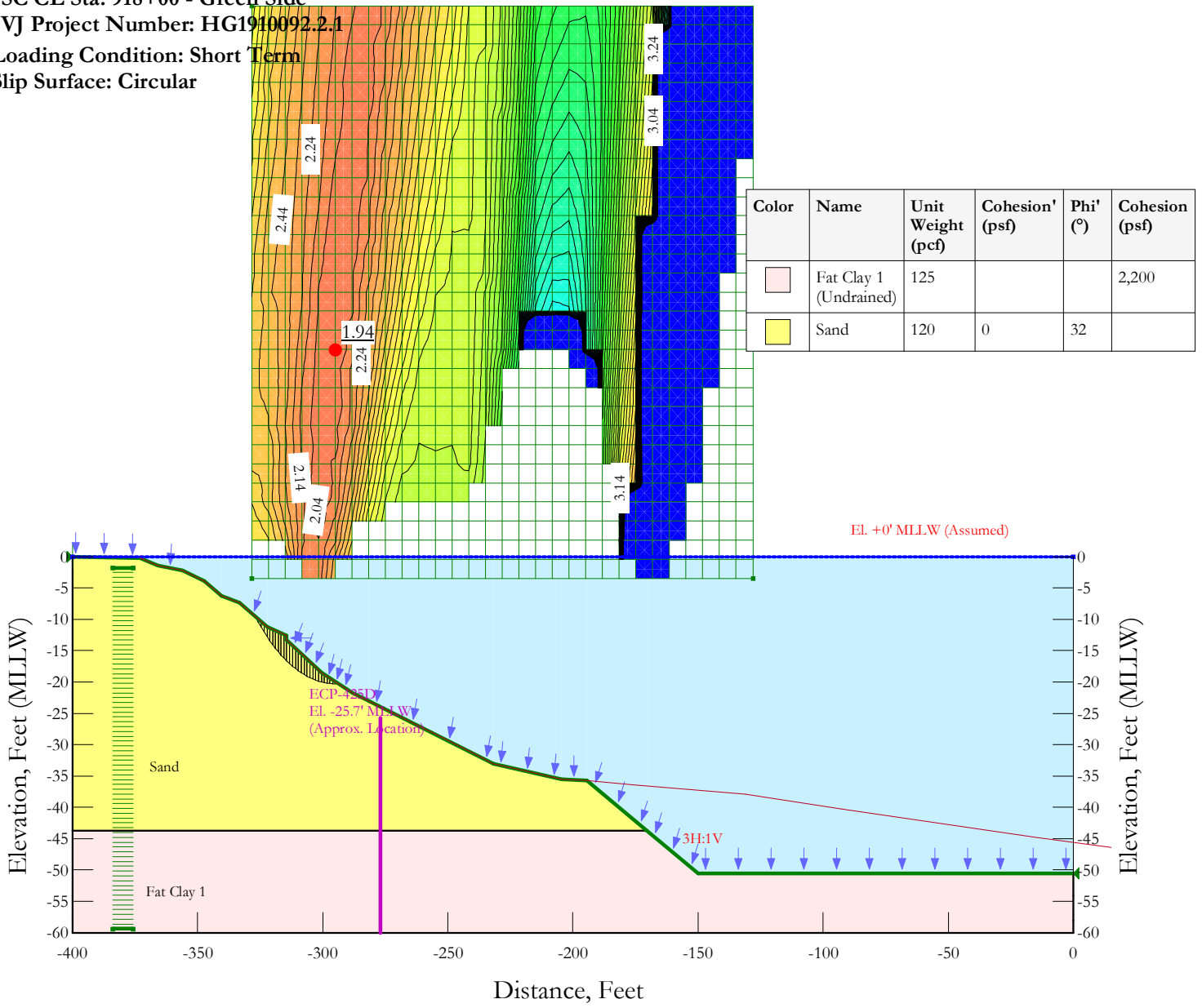


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 876+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Fat Clay 2	125	340	27
	Fat Clay 3	125	340	27
	Lean Clay 1	125	340	30

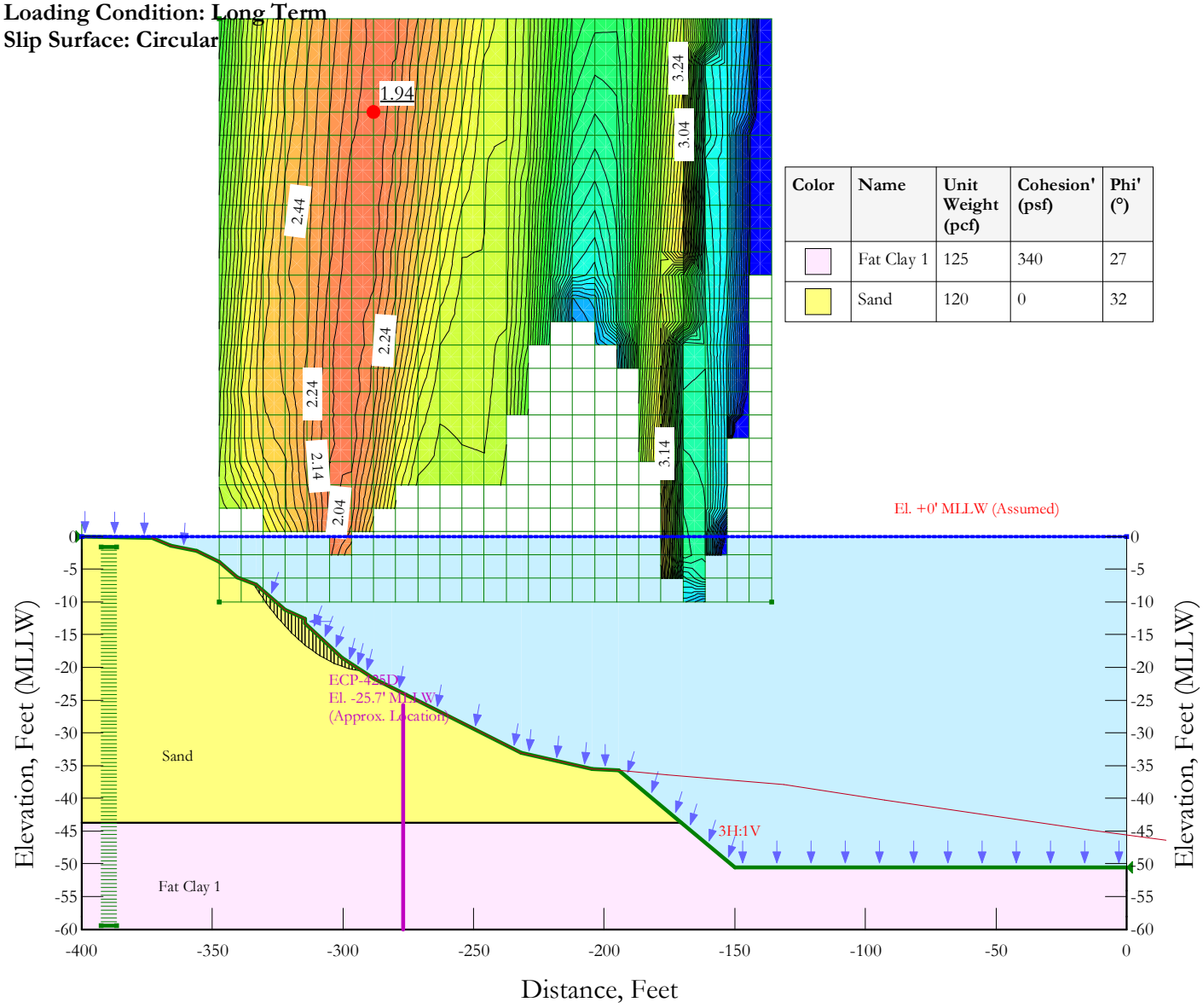
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 918+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	125			2,200
	Sand	120	0	32	

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 918+00 - Green Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Long Term
Slip Surface: Circular



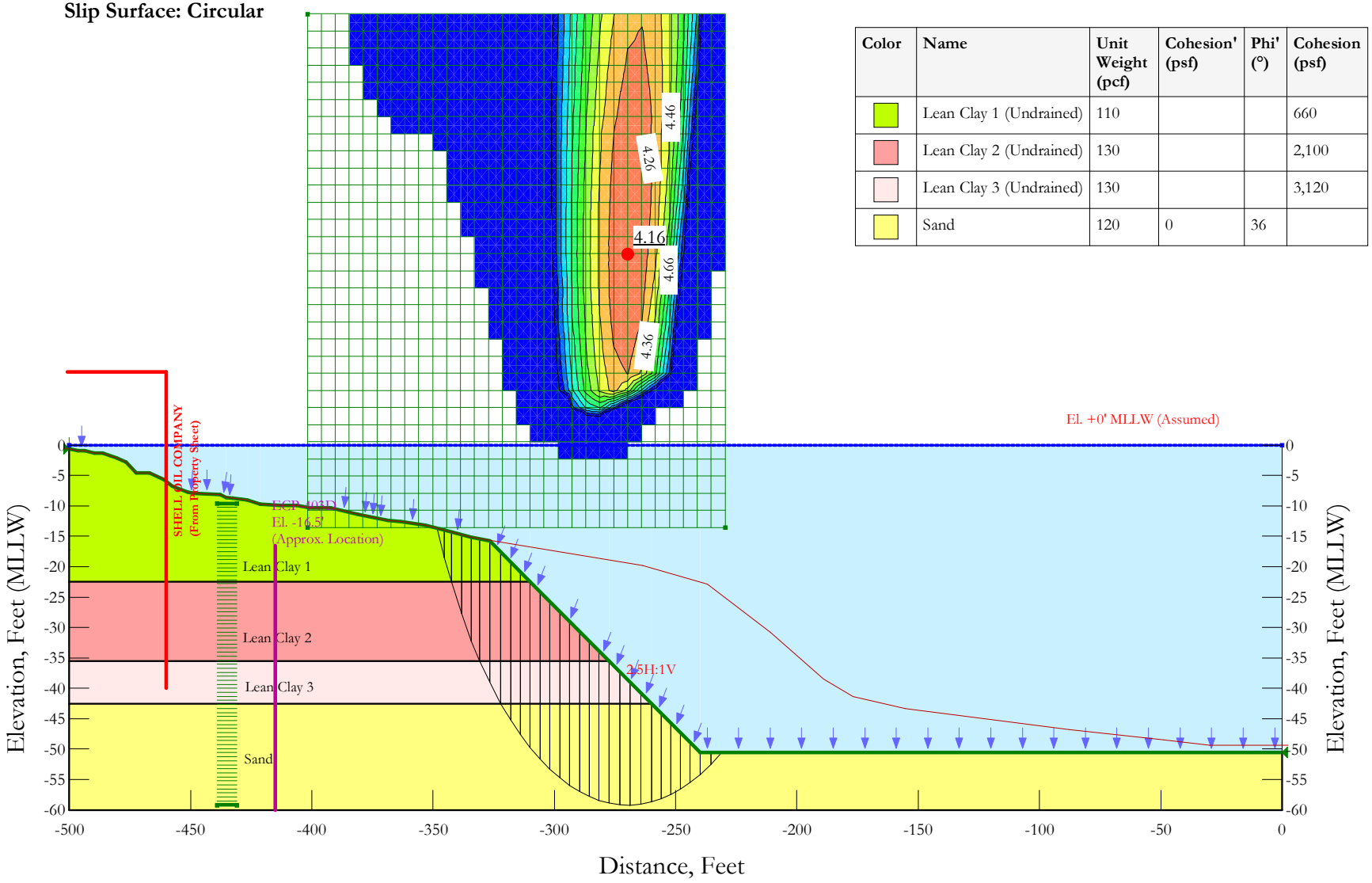
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	125	340	27
	Sand	120	0	32

HSC SLOPE STABILITY RESULTS – 2.5H:1V TEMPLATE

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 702+00 - Green Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular

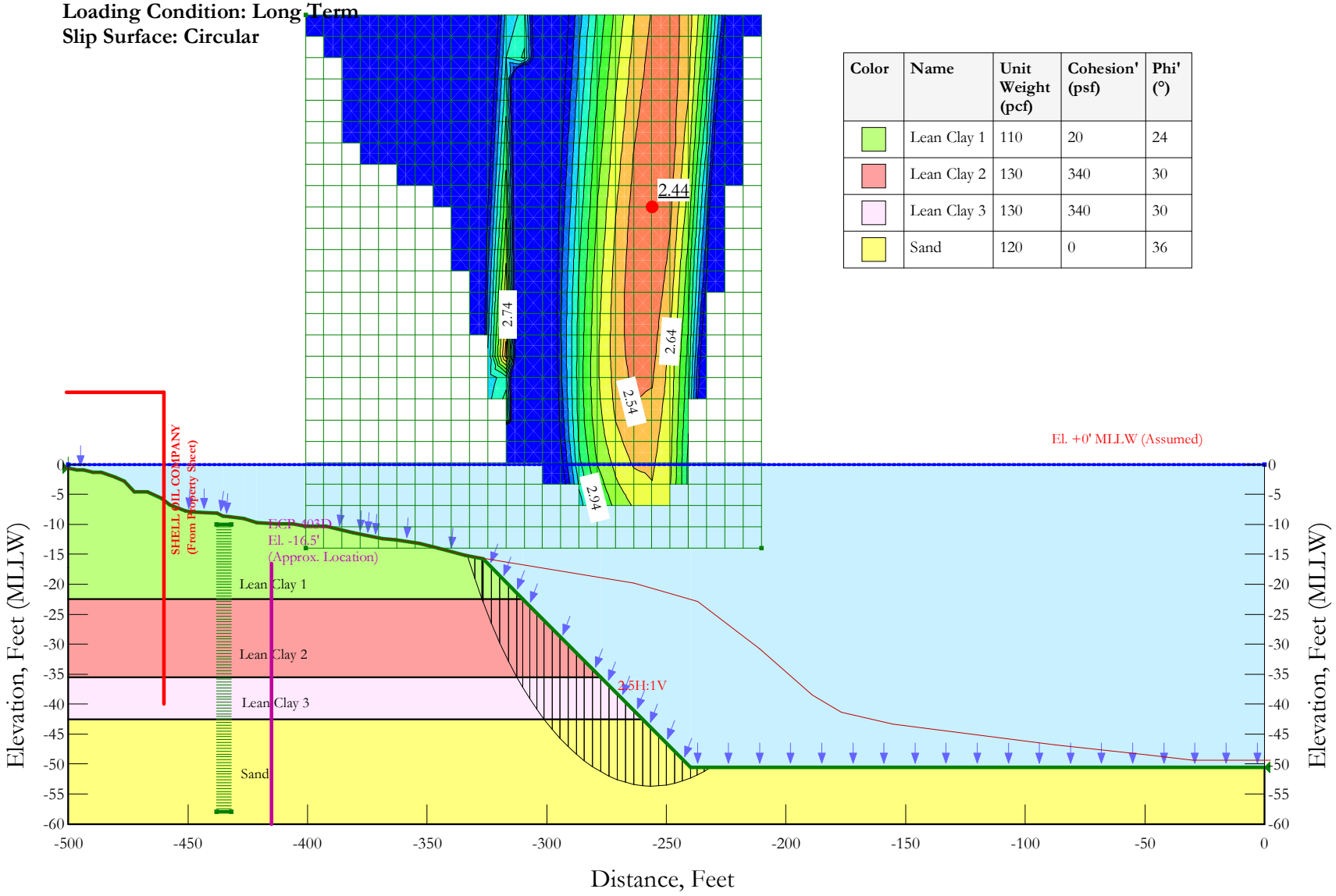
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Lean Clay 1 (Undrained)	110			660
	Lean Clay 2 (Undrained)	130			2,100
	Lean Clay 3 (Undrained)	130			3,120
	Sand	120	0	36	



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 702+00 - Green Side
HVJ Project Number: HG1910092.2.1

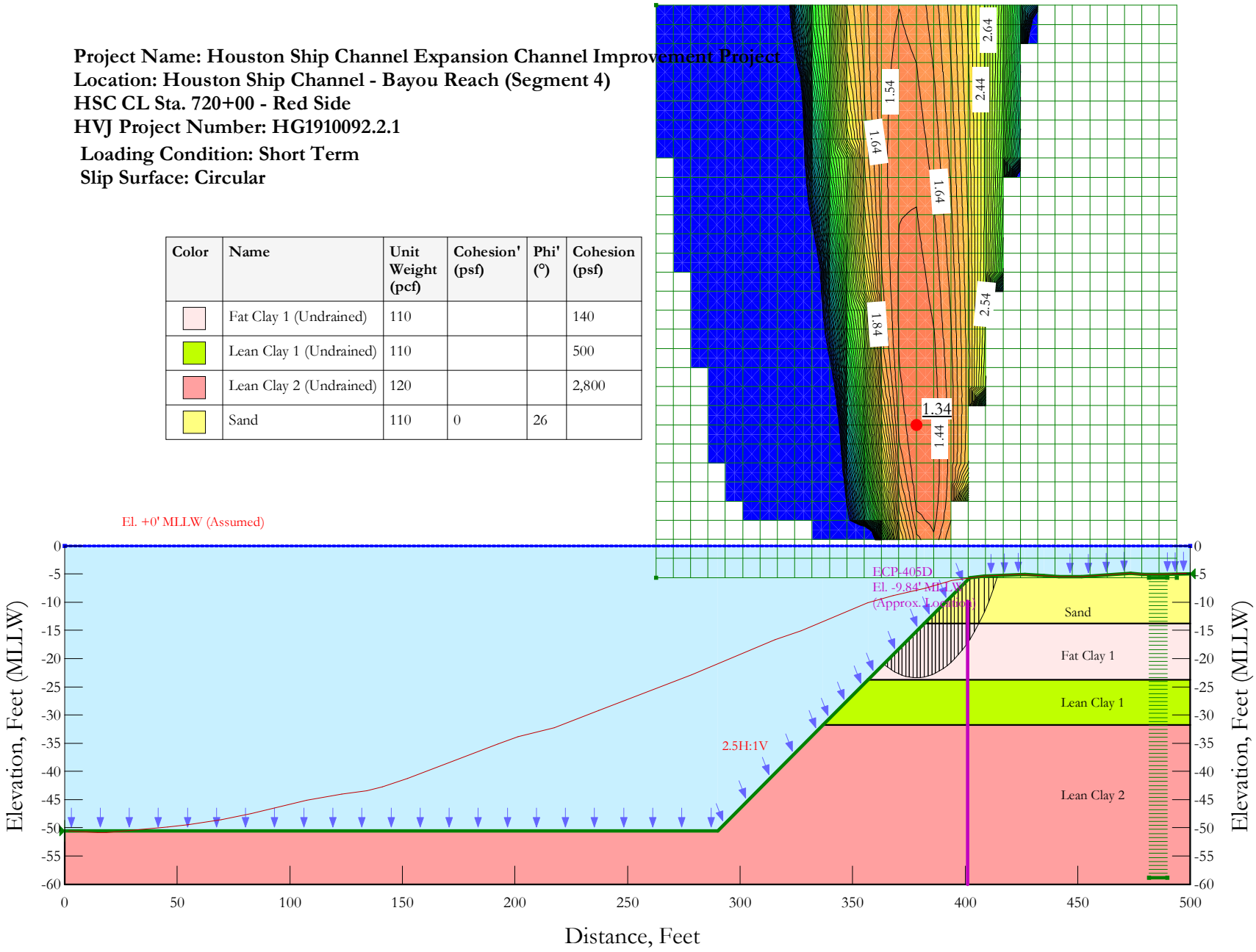
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Lean Clay 1	110	20	24
	Lean Clay 2	130	340	30
	Lean Clay 3	130	340	30
	Sand	120	0	36



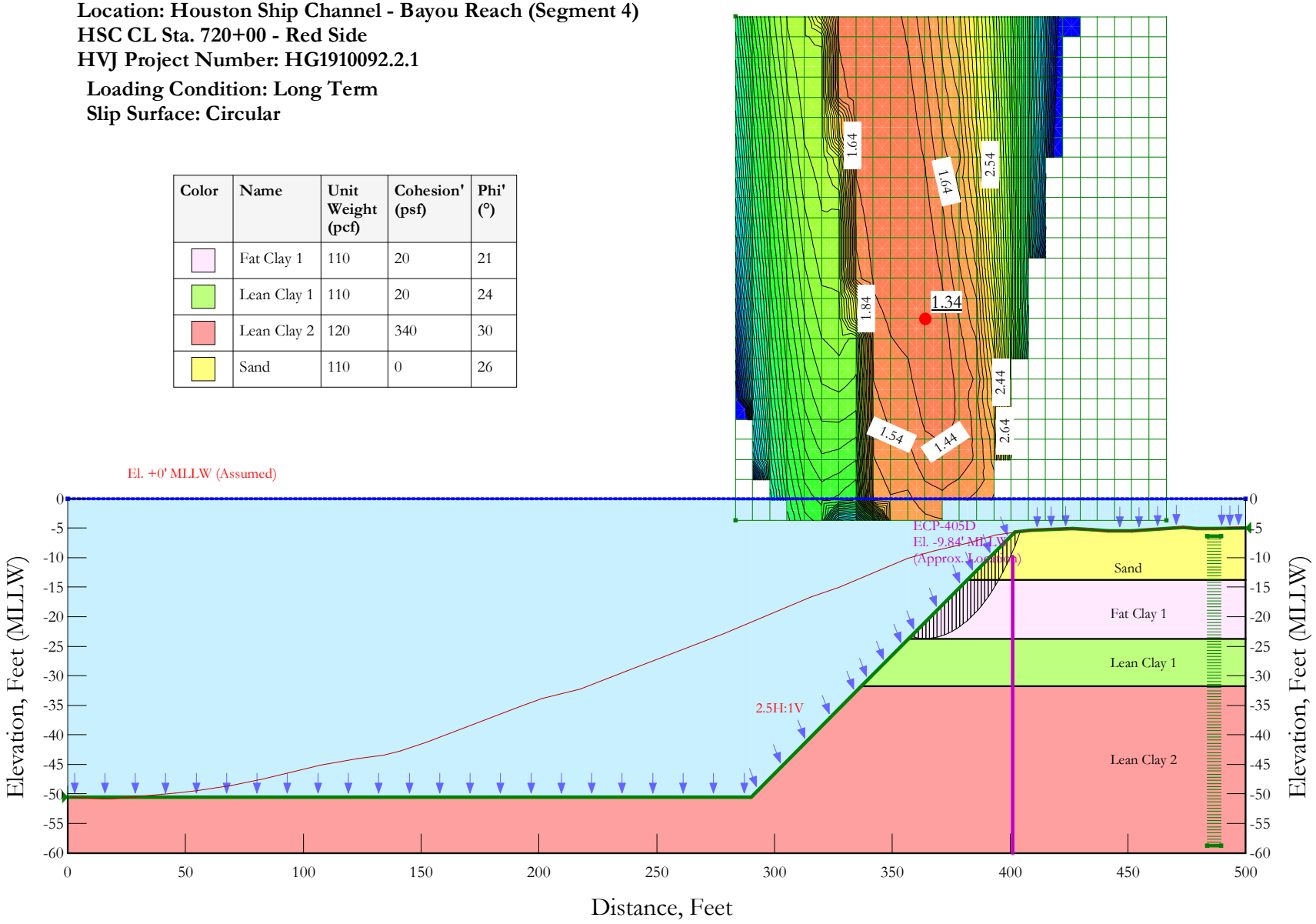
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 720+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110			140
	Lean Clay 1 (Undrained)	110			500
	Lean Clay 2 (Undrained)	120			2,800
	Sand	110	0	26	



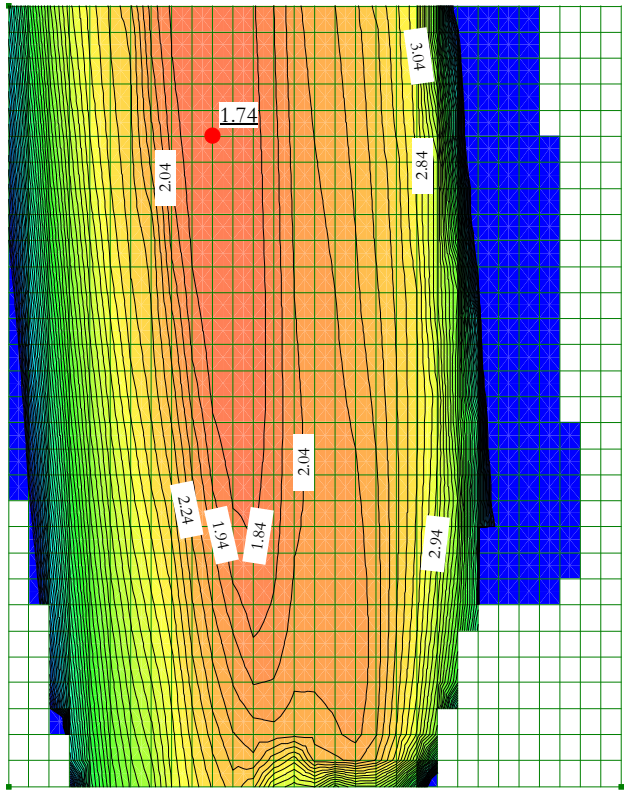
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 720+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Lean Clay 1	110	20	24
	Lean Clay 2	120	340	30
	Sand	110	0	26

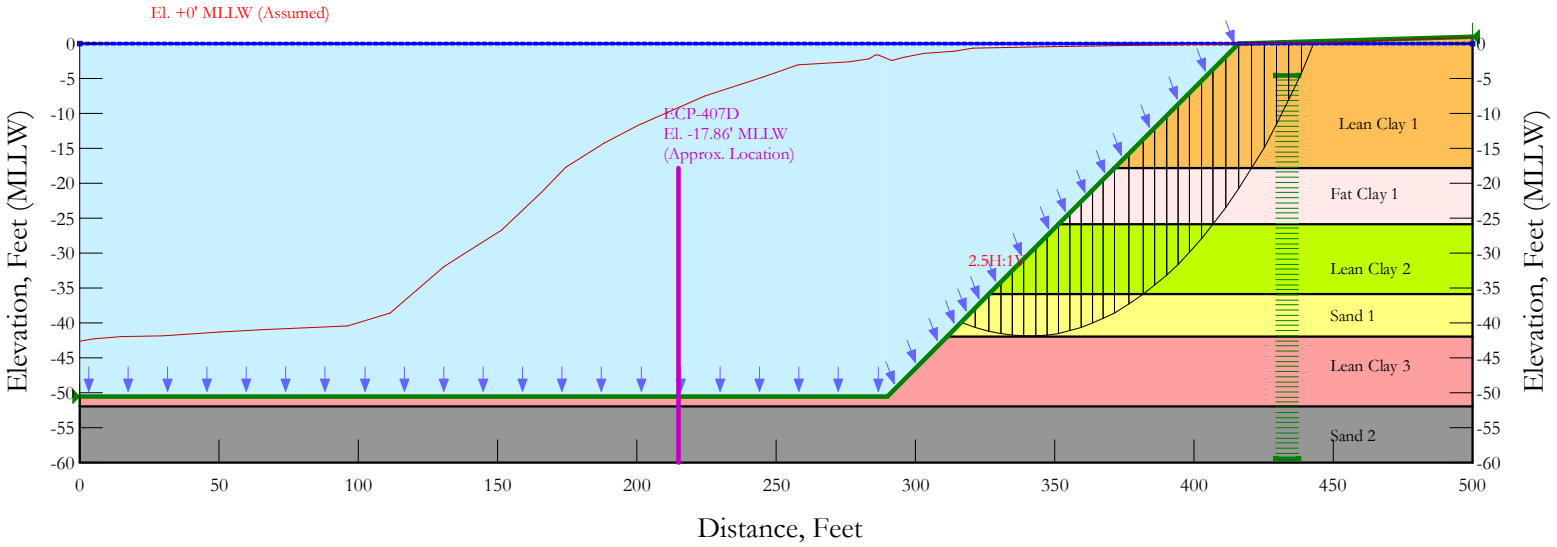


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 742+00 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular



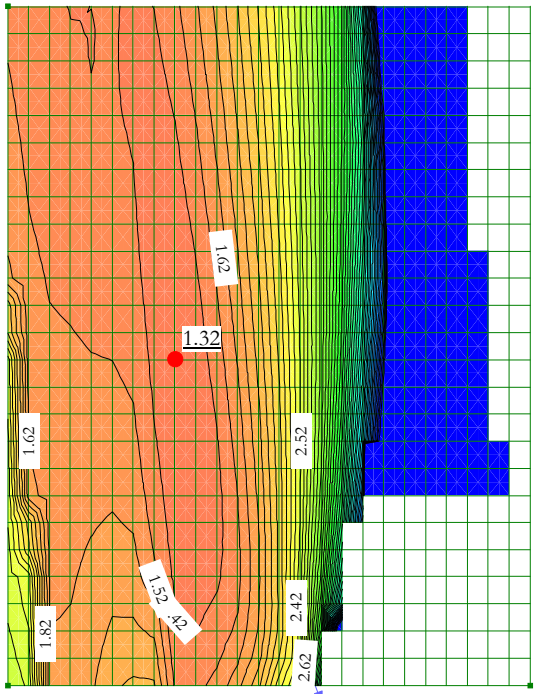
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110			320
	Lean Clay 1 (Undrained)	130			550
	Lean Clay 2 (Undrained)	120			540
	Lean Clay 3 (Undrained)	130			1,640
	Sand 1	110	0	30	
	Sand 2	120	0	32	

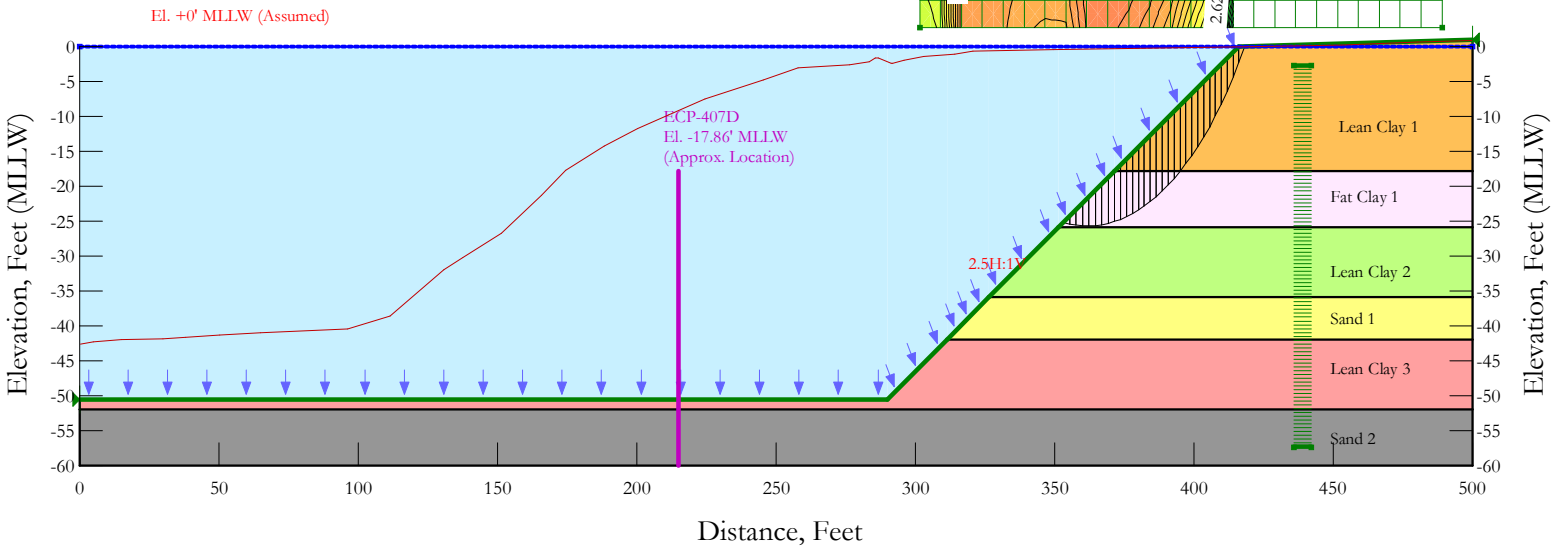


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 742+00 - Red Side
HVJ Project Number: HG1910092.2.1

Loading Condition: Long Term
Slip Surface: Circular

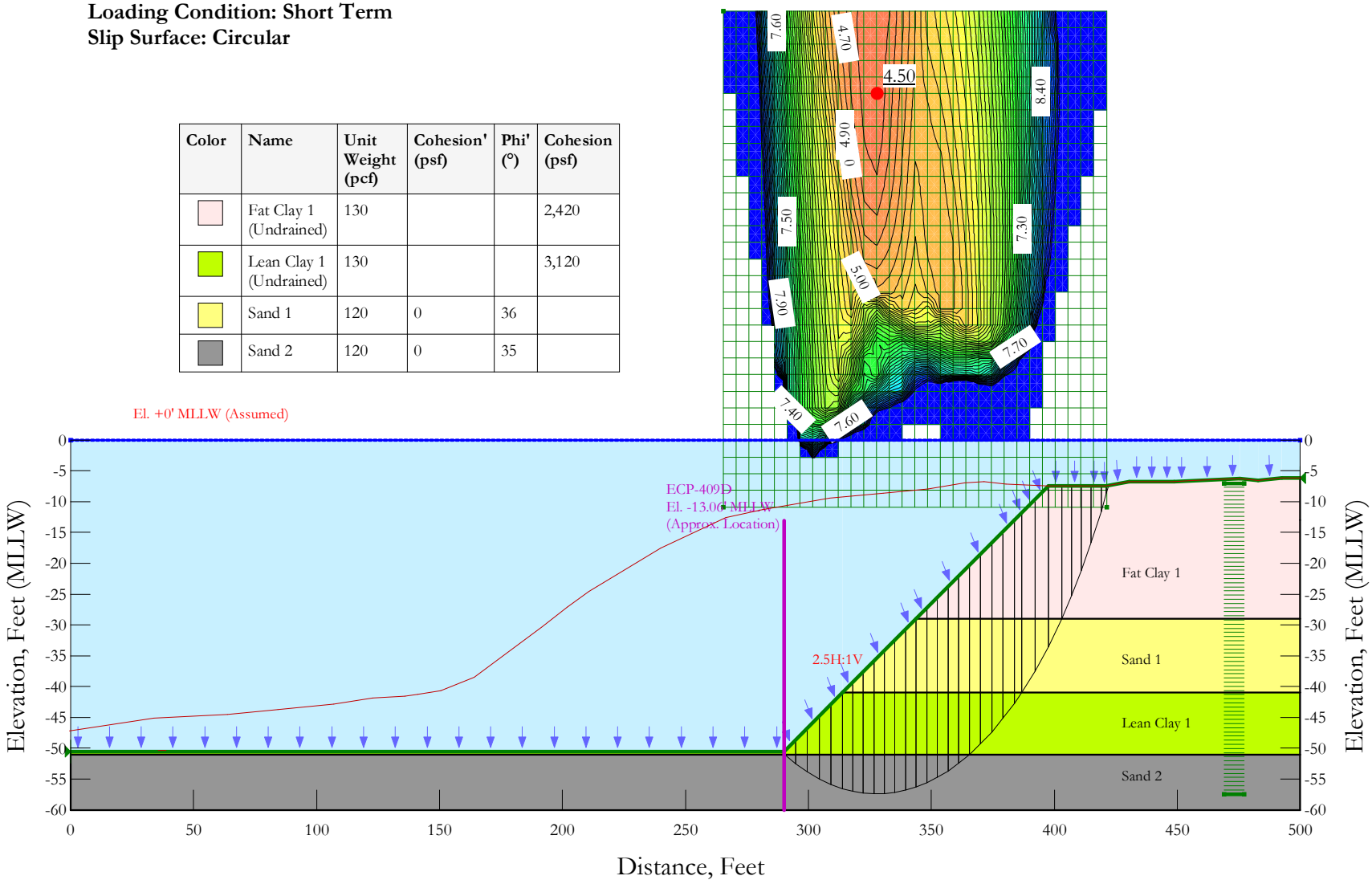
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Lean Clay 1	120	40	24
	Lean Clay 2	120	40	24
	Lean Clay 3	130	340	30
	Sand 1	110	0	30
	Sand 2	120	0	32





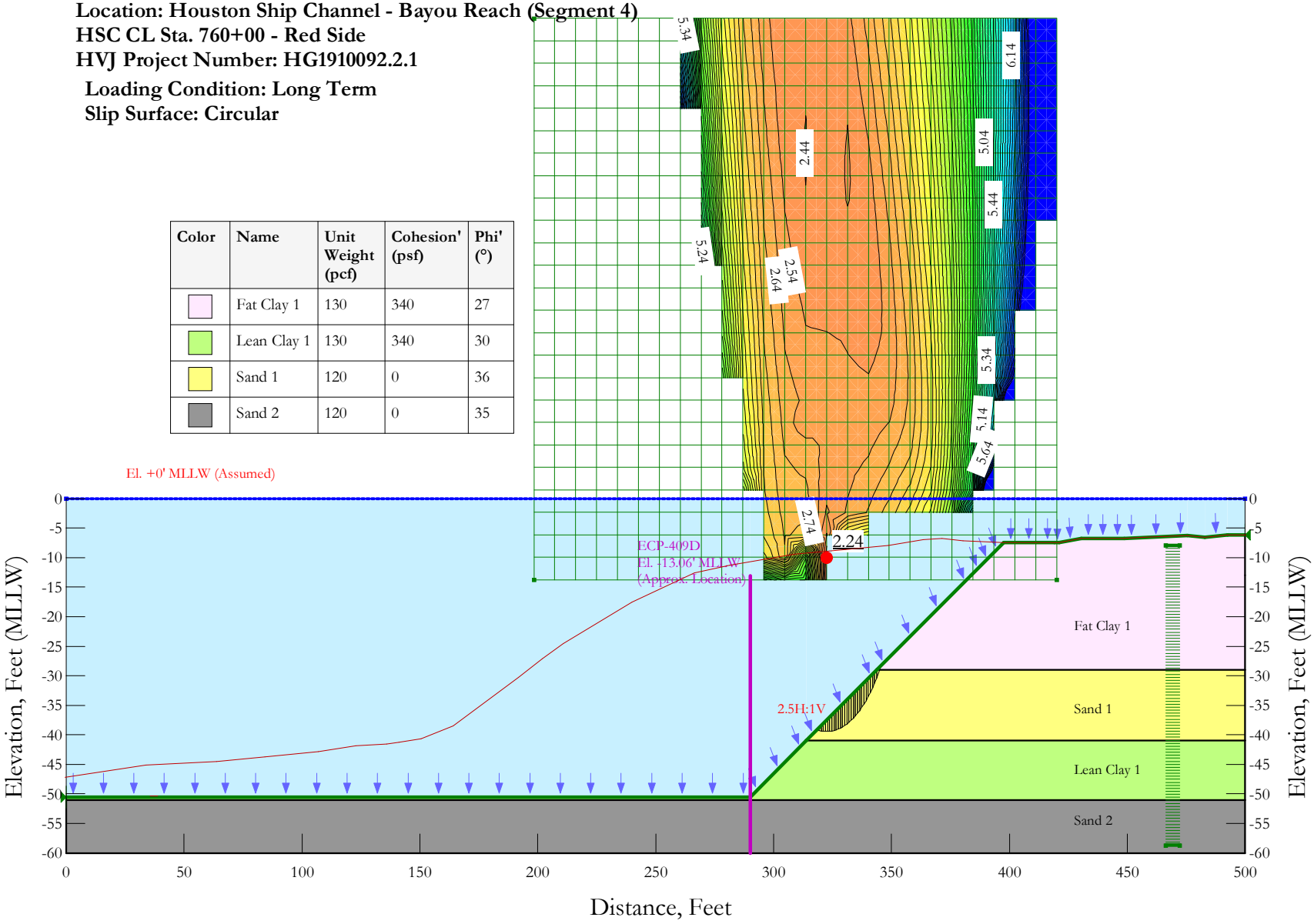
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 760+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	130			2,420
	Lean Clay 1 (Undrained)	130			3,120
	Sand 1	120	0	36	
	Sand 2	120	0	35	



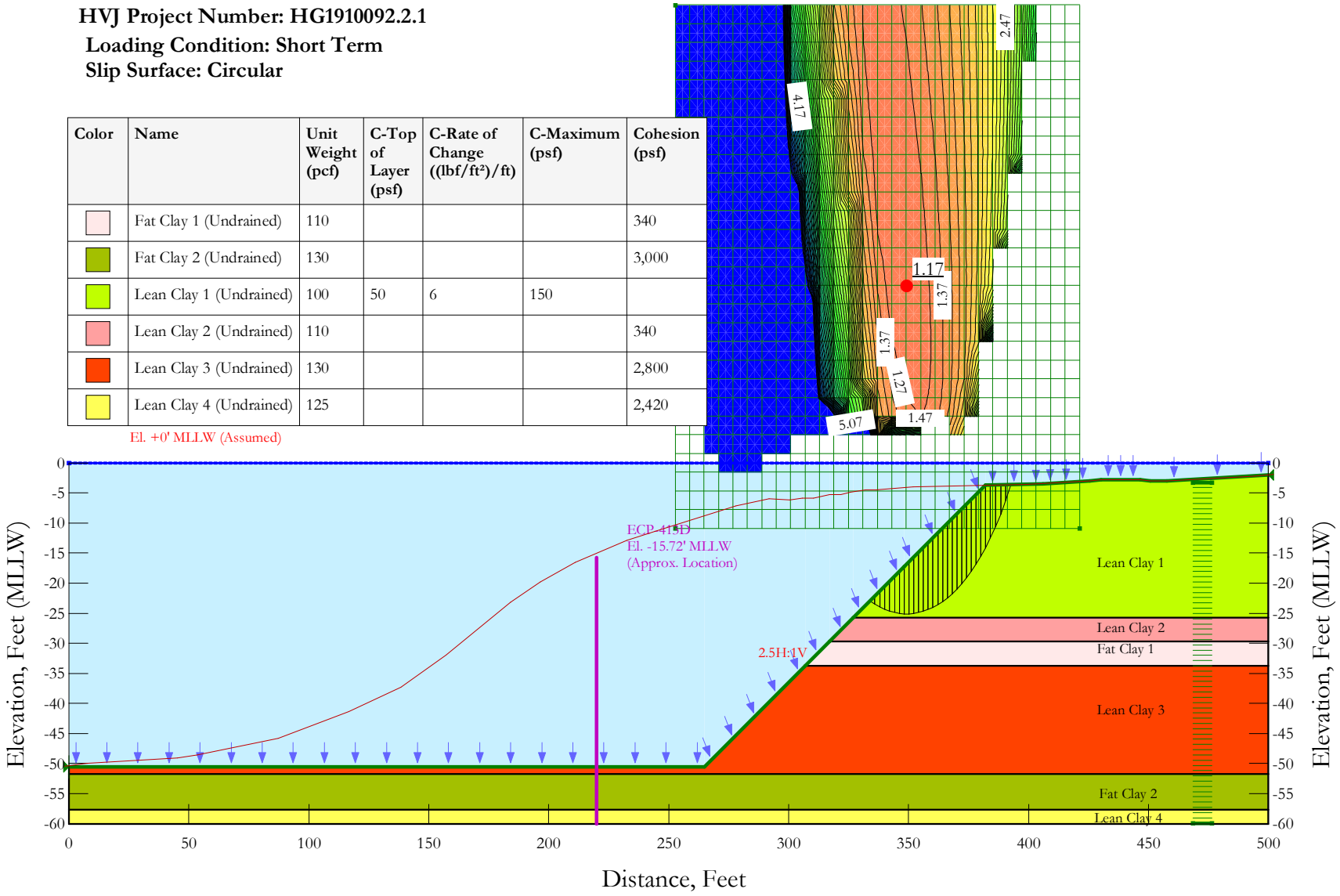
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 760+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	130	340	27
	Lean Clay 1	130	340	30
	Sand 1	120	0	36
	Sand 2	120	0	35



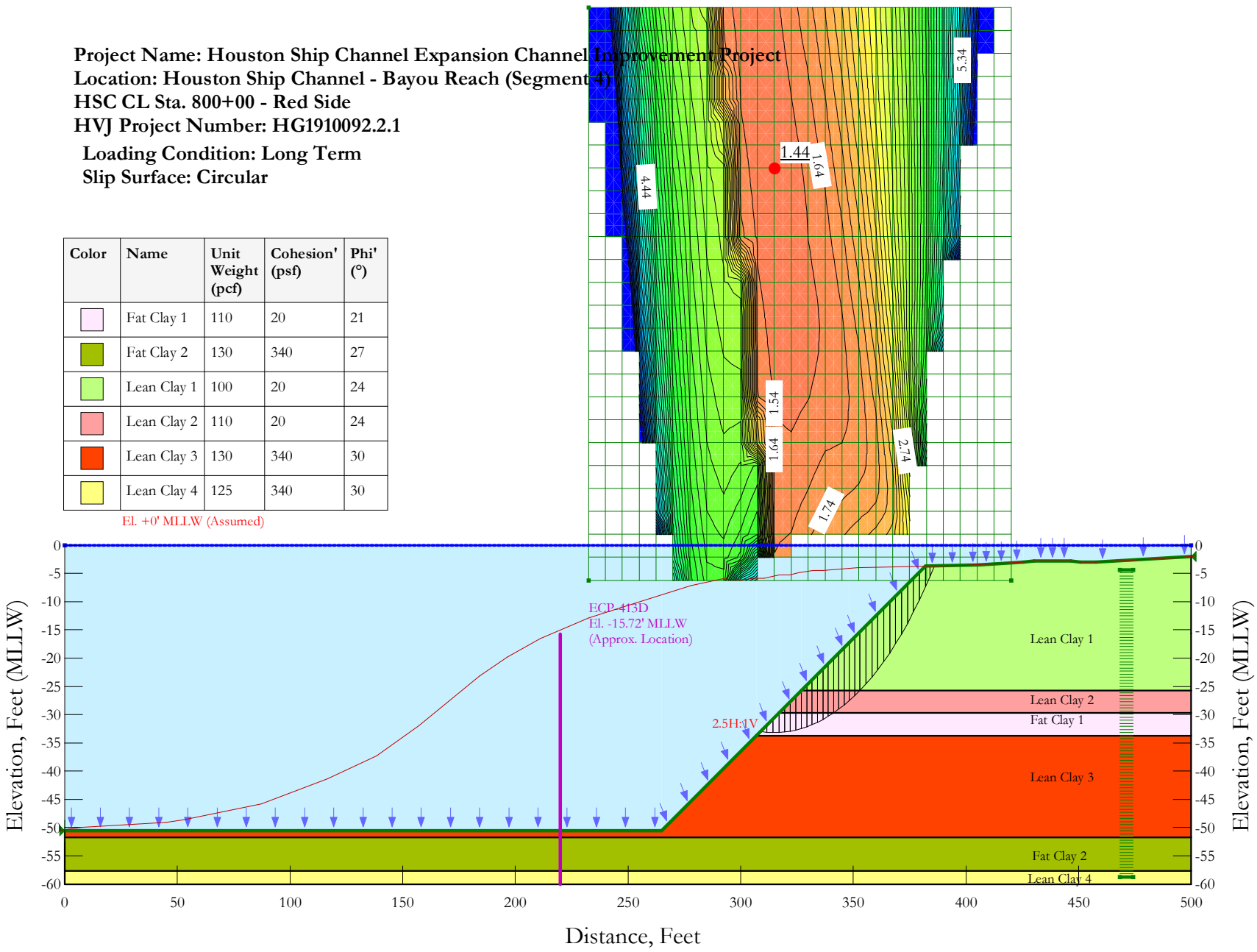
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 800+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)
	Fat Clay 1 (Undrained)	110				340
	Fat Clay 2 (Undrained)	130				3,000
	Lean Clay 1 (Undrained)	100	50	6	150	
	Lean Clay 2 (Undrained)	110				340
	Lean Clay 3 (Undrained)	130				2,800
	Lean Clay 4 (Undrained)	125				2,420



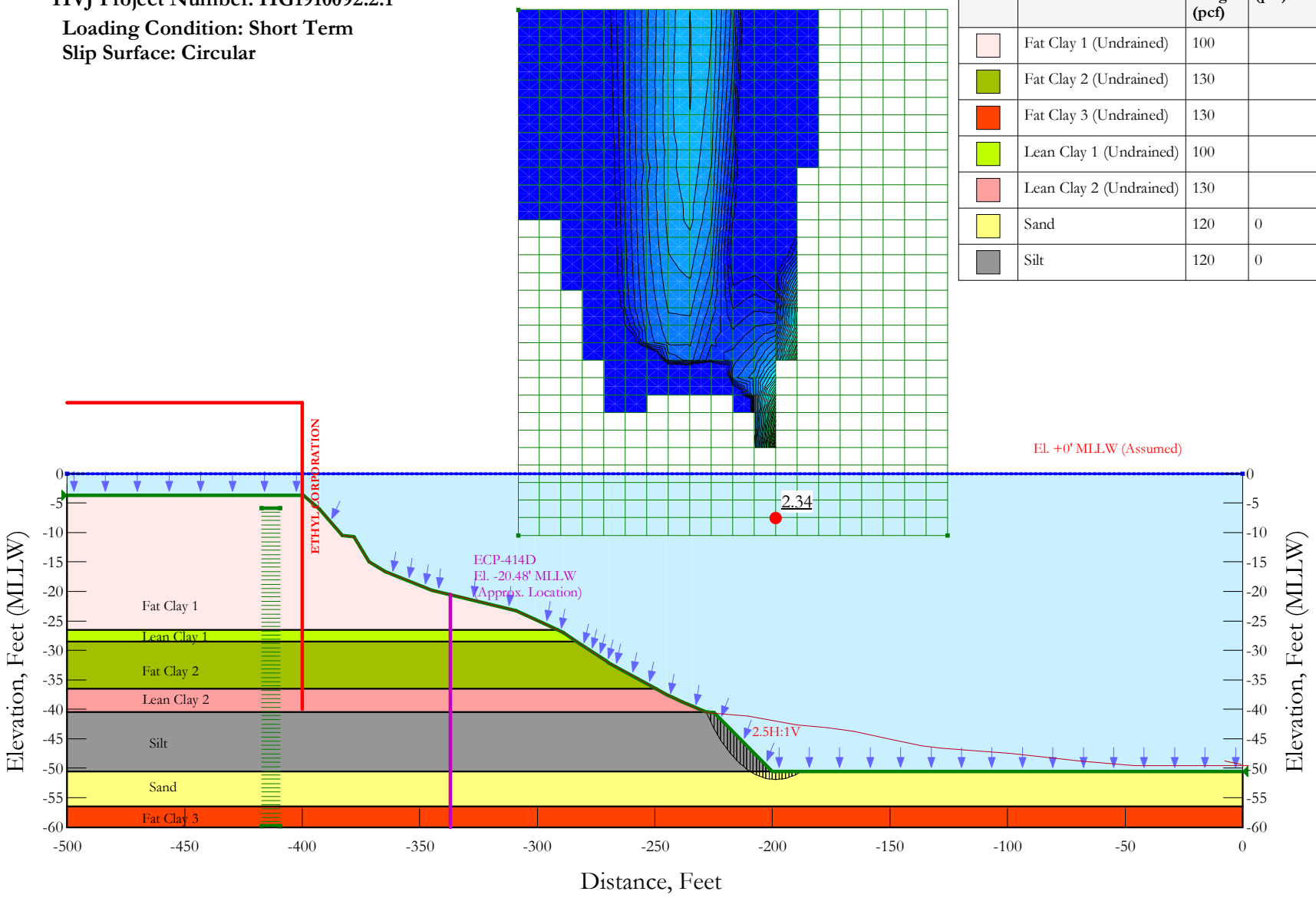
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 800+00 - Red Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	110	20	21
	Fat Clay 2	130	340	27
	Lean Clay 1	100	20	24
	Lean Clay 2	110	20	24
	Lean Clay 3	130	340	30
	Lean Clay 4	125	340	30



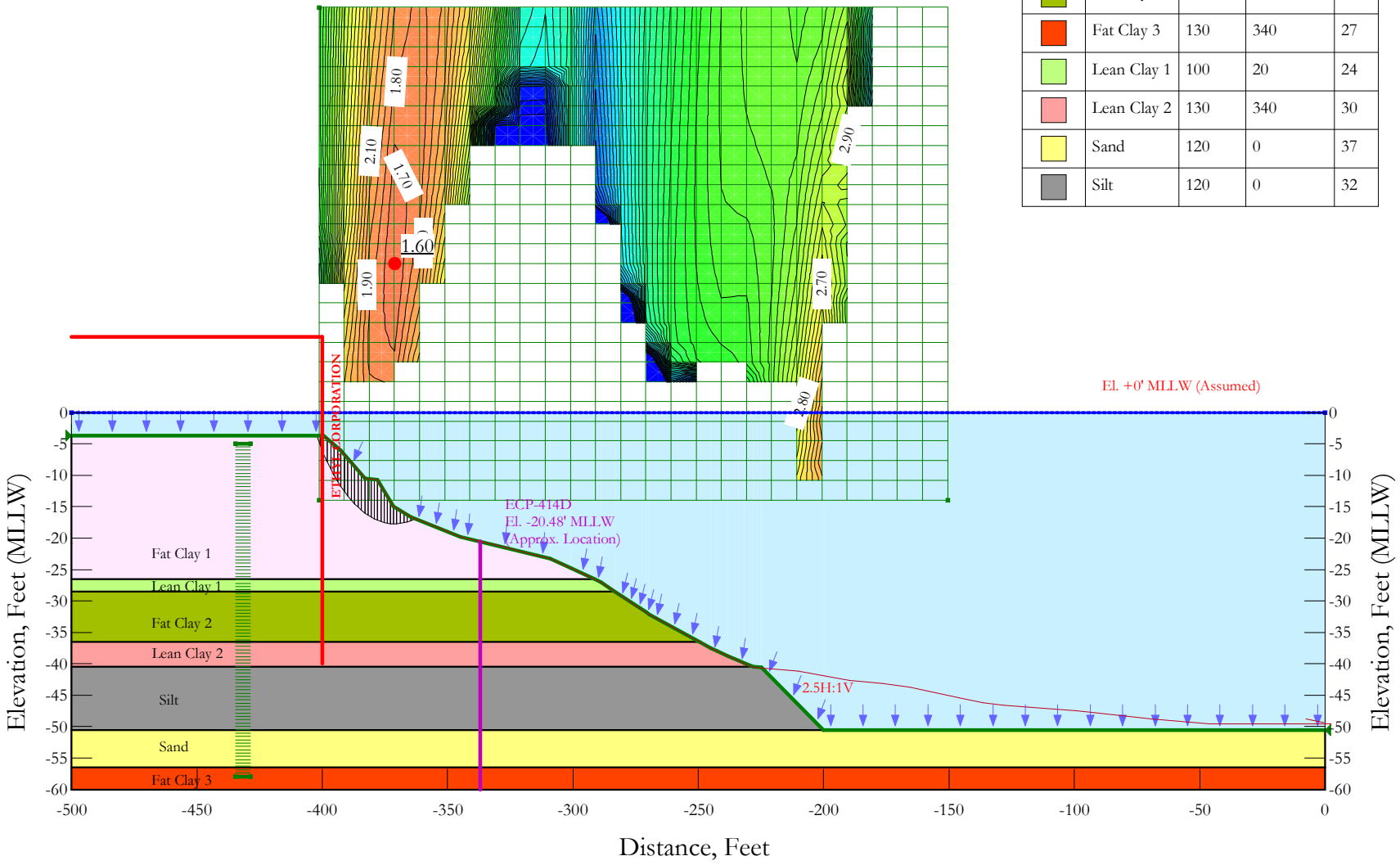
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 808+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	100			50
	Fat Clay 2 (Undrained)	130			3,000
	Fat Clay 3 (Undrained)	130			3,000
	Lean Clay 1 (Undrained)	100			200
	Lean Clay 2 (Undrained)	130			3,000
	Sand	120	0	37	
	Silt	120	0	32	



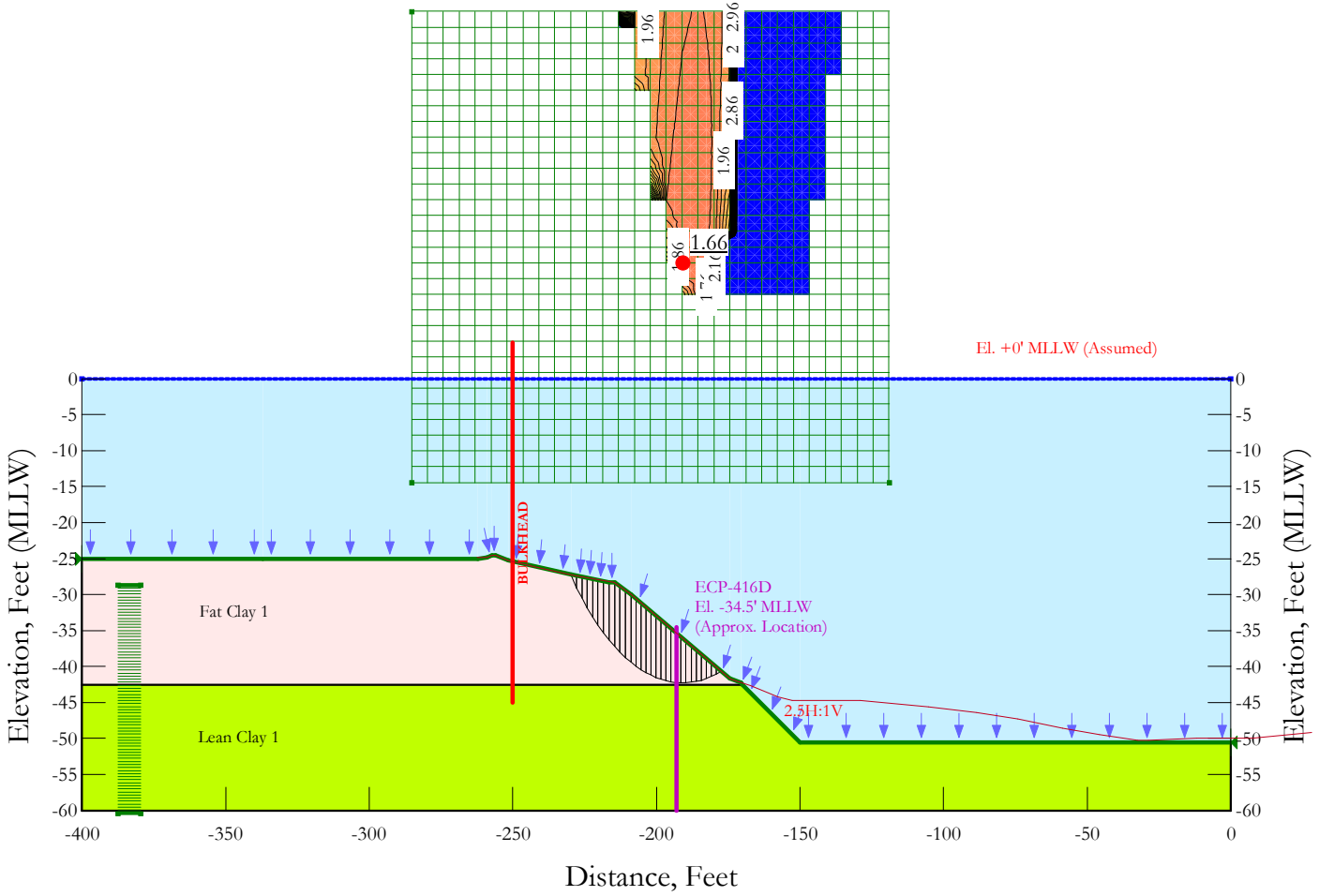
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 808+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Fat Clay 2	130	340	27
	Fat Clay 3	130	340	27
	Lean Clay 1	100	20	24
	Lean Clay 2	130	340	30
	Sand	120	0	37
	Silt	120	0	32



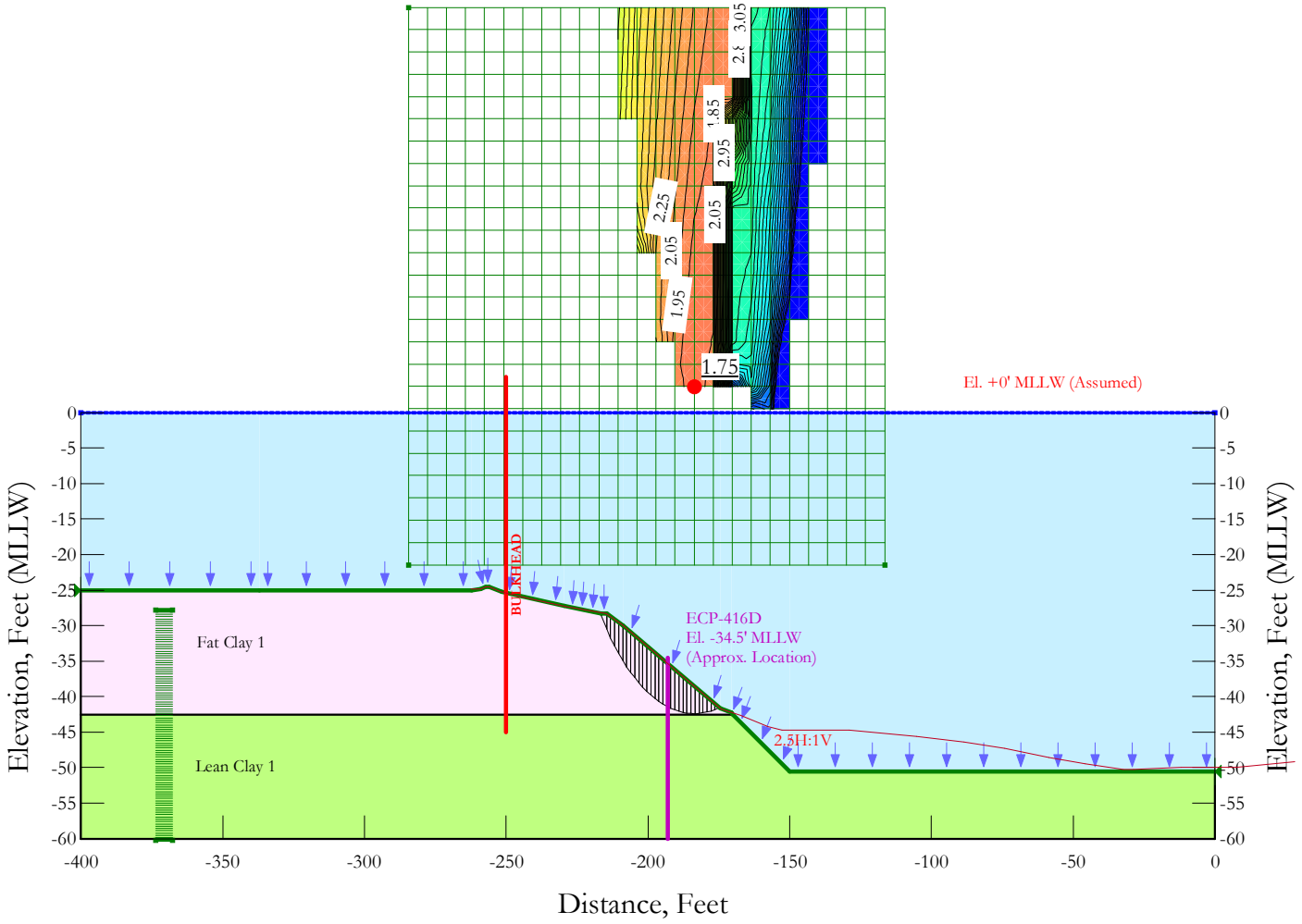
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 830+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)
	Fat Clay 1 (Undrained)	100		50	6	150
	Lean Clay 1 (Undrained)	125	2,100			



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 830+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

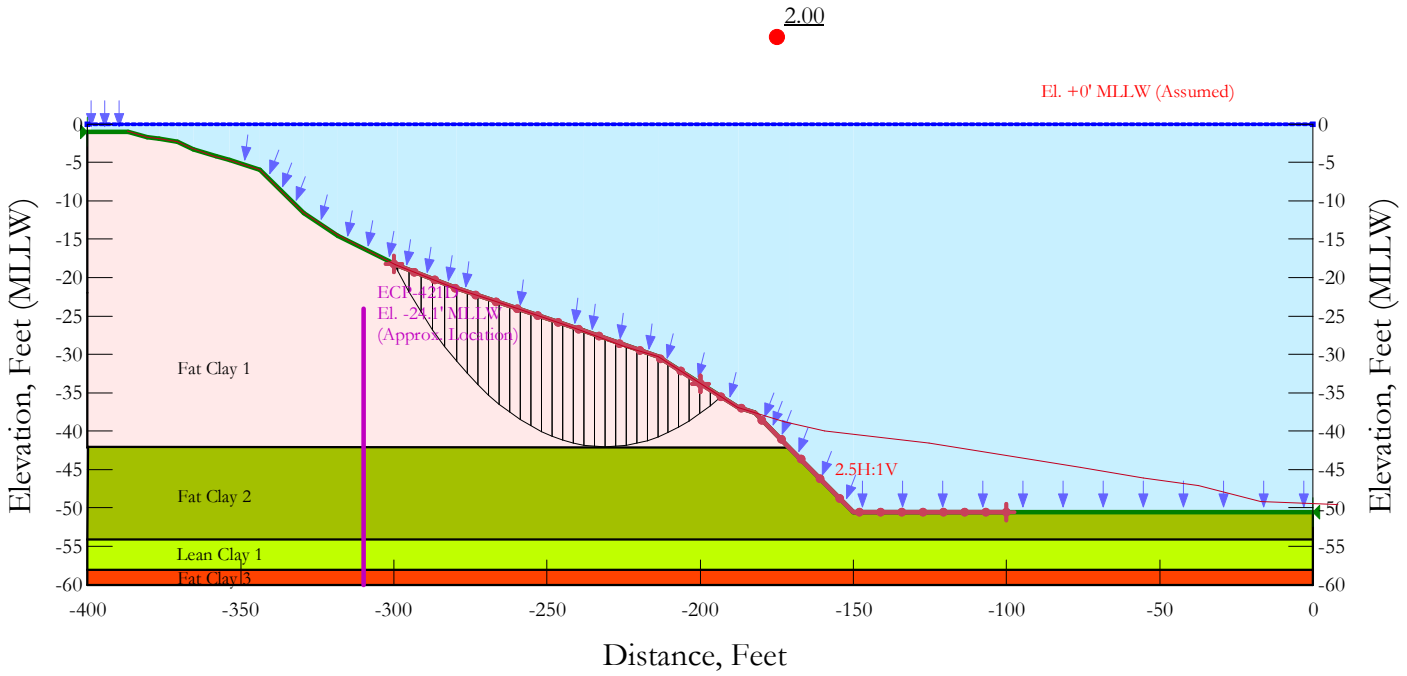
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Lean Clay 1	125	340	30



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 876+00 - Green Side
HVJ Project Number: HG1910092.2.1

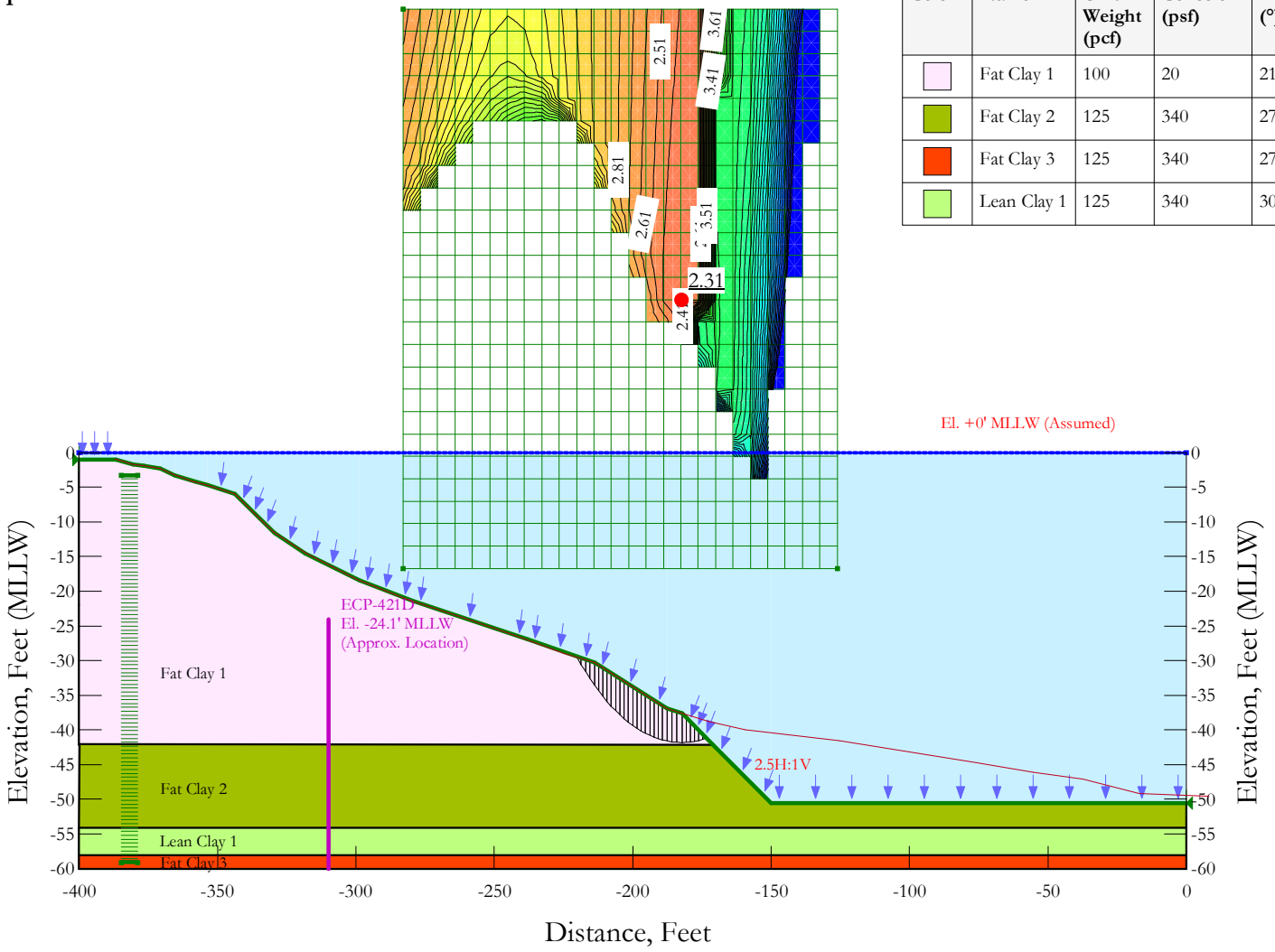
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)
	Fat Clay 1 (Undrained)	100	100
	Fat Clay 2 (Undrained)	125	3,000
	Fat Clay 3 (Undrained)	125	3,000
	Lean Clay 1 (Undrained)	125	3,000

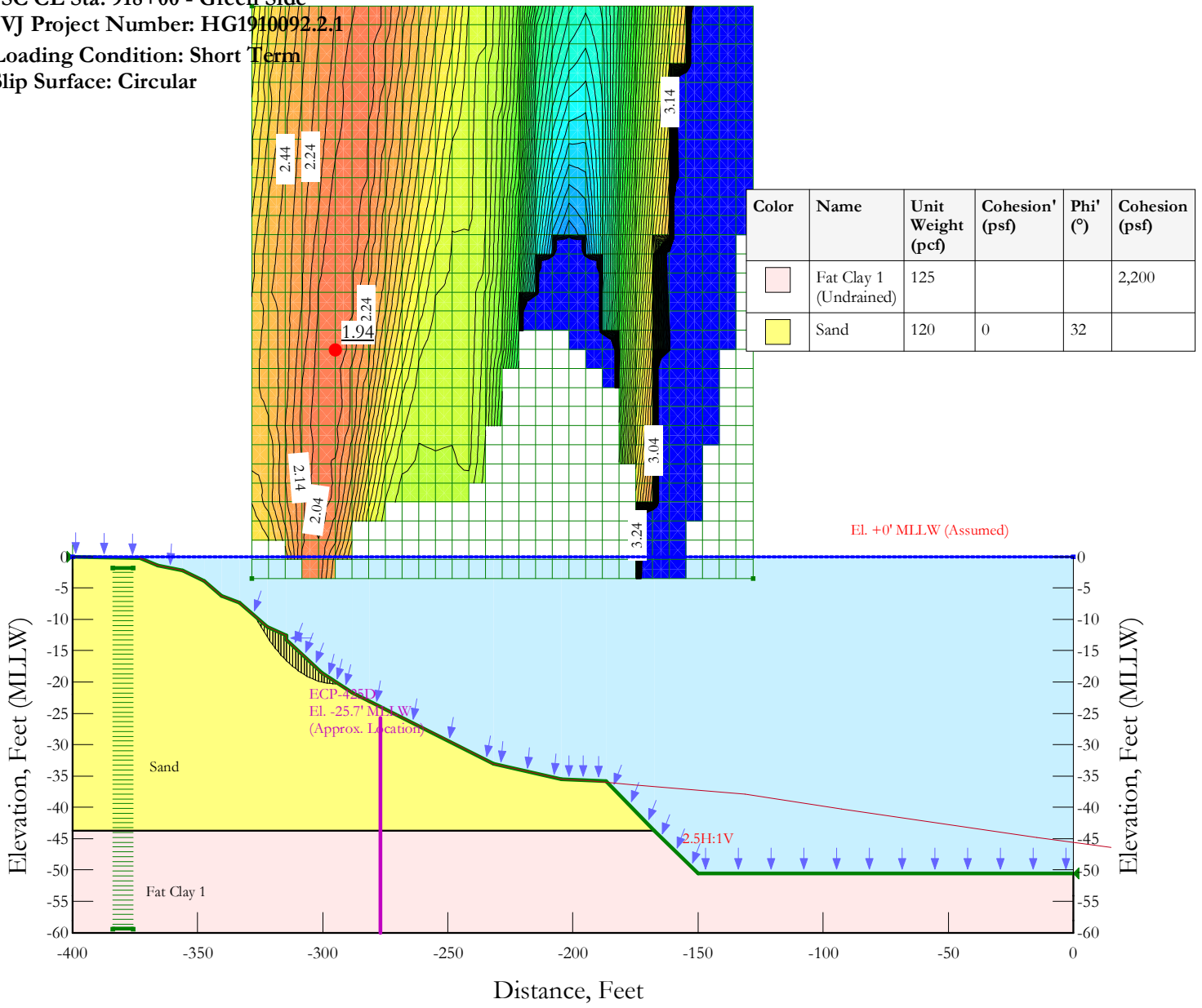


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 876+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	100	20	21
	Fat Clay 2	125	340	27
	Fat Clay 3	125	340	27
	Lean Clay 1	125	340	30



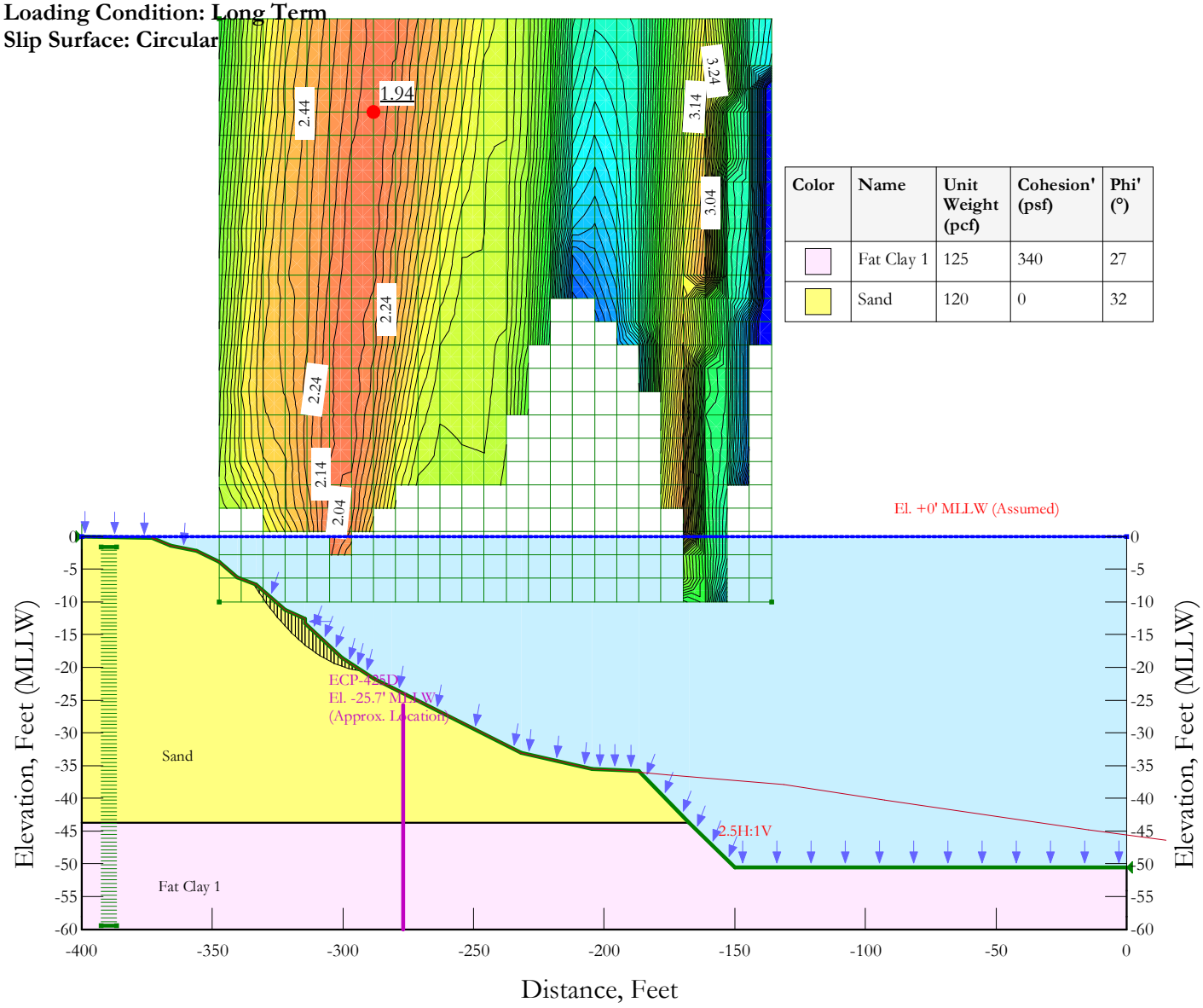
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Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 918+00 - Green Side
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	125			2,200
	Sand	120	0	32	

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Houston Ship Channel - Bayou Reach (Segment 4)
HSC CL Sta. 918+00 - Green Side
HVJ Project Number: HG1910092.2.1

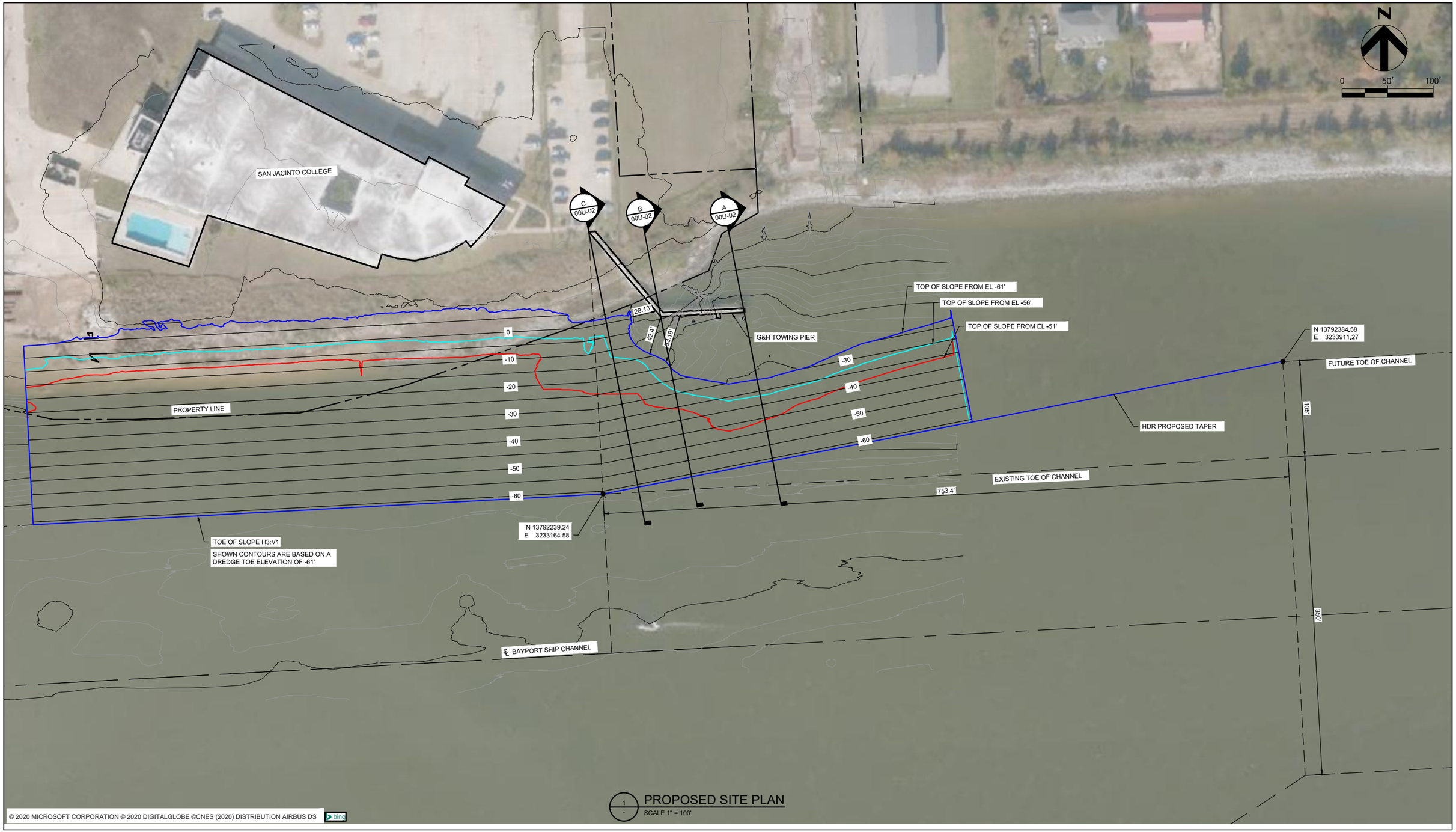
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	125	340	27
	Sand	120	0	32

APPENDIX B

SLOPE STABILITY ANALYSIS: BAYPORT SHIP CHANNEL



1
-

PROPOSED SITE PLAN

SCALE 1" = 100'

U.S. Army Corps of Engineers
Galveston District

HDR Engineering, INC
Texas P.E. Firm
Registration No. F-754

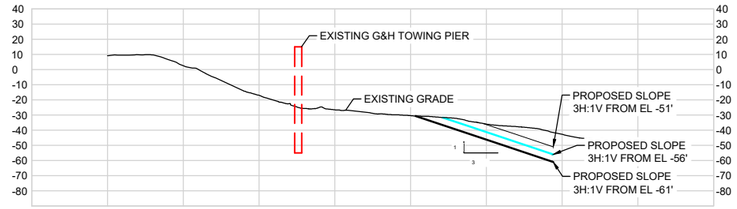
HOUSTON SHIP CHANNEL, TEXAS
EXPANSION CHANNEL IMPROVEMENT PROJECT
SEGMENT 2 - BAYPORT SHIP CHANNEL
SAN JACINTO COLLEGE
PROPOSED SITE PLAN

DATE
APRIL 2020

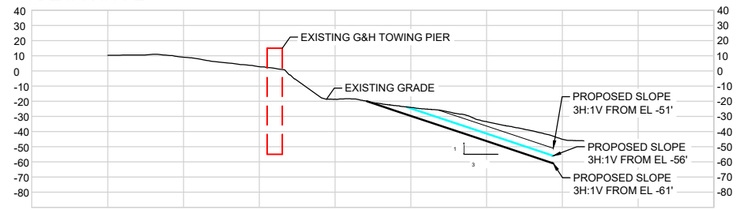
FIGURE
00U-01

SCALE:
HORIZONTAL 1"=100'
VERTICAL 1"=100'

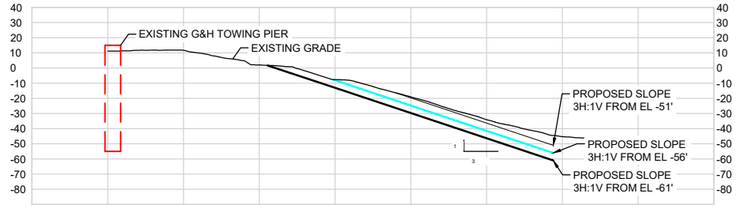
SECTION A



SECTION B



SECTION C



U.S. Army Corps of Engineers
Galveston District

HDR Engineering, INC
Texas P.E. Firm
Registration No. F-754

HOUSTON SHIP CHANNEL, TEXAS
EXPANSION CHANNEL IMPROVEMENT PROJECT
SEGMENT 2 - BAYPORT SHIP CHANNEL
SAN JACINTO COLLEGE
CROSS SECTIONS

DATE
APRIL 2020

FIGURE
00U-02

SAN JACINTO COLLEGE

37+00

40+00

43+50

COLLEGE DOCK

N 13792370,24
E 3233645,44

FUTURE TOE OF CHANNEL

105'

PROPERTY LINE

PROPOSED TAPER

300'

EXISTING TOE OF CHANNEL

N 13792249.24
E 3233351.53

TOE OF SLOPE H3:V1

350'

℄ BAYPORT SHIP CHANNEL

SL-59

SL-60

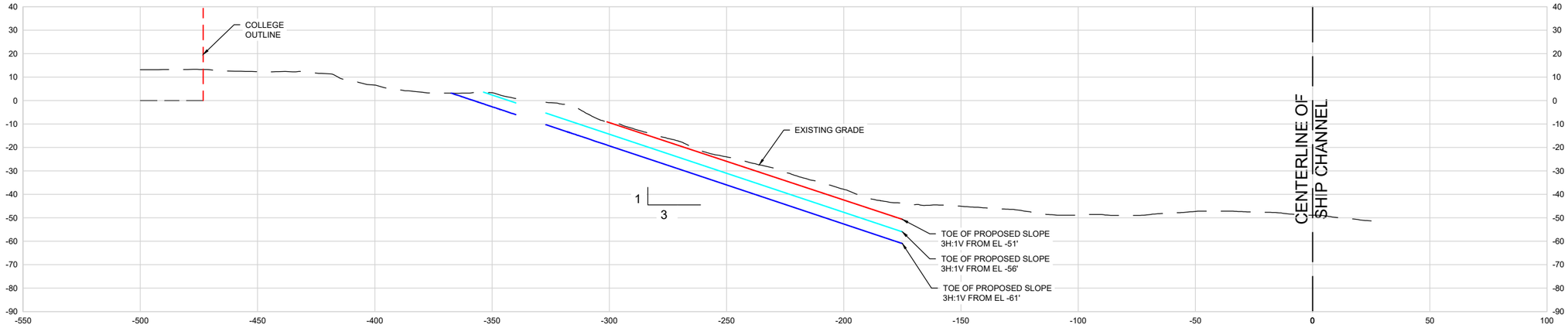
SL-61

SAN JACINTO COLLEGE

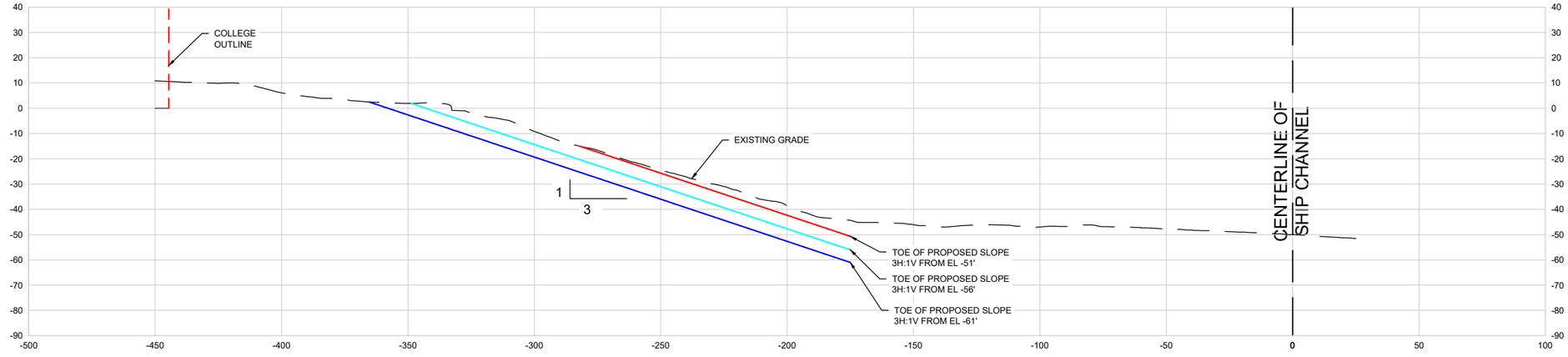
SCALE: 1"=100'

SCALE
HORIZONTAL 1"=50'
VERTICAL 1"=50'

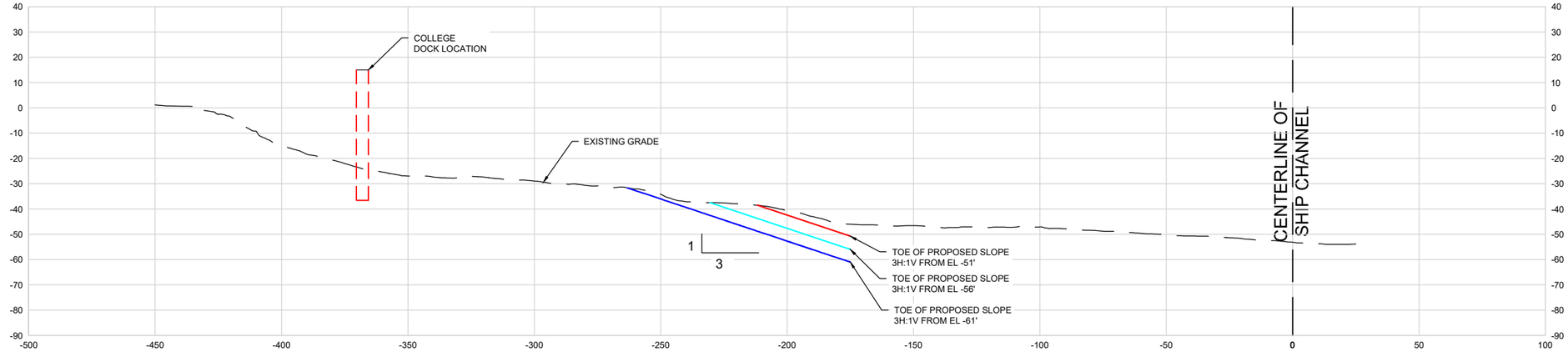
37+00



40+00



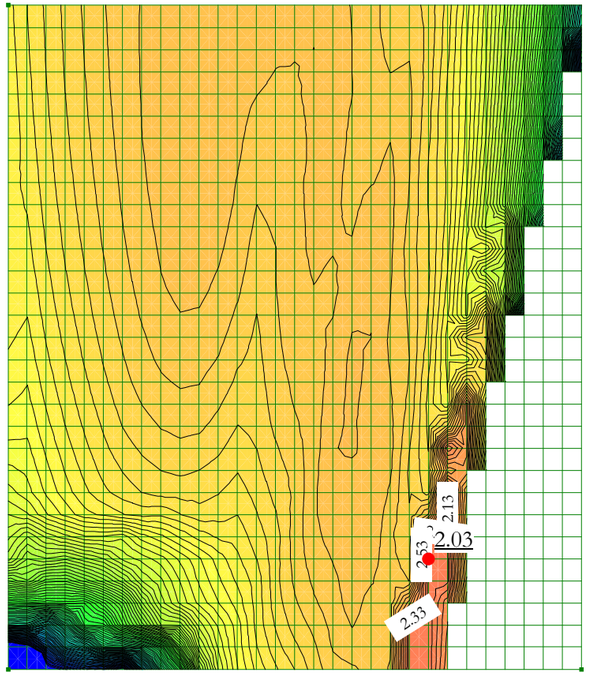
43+50

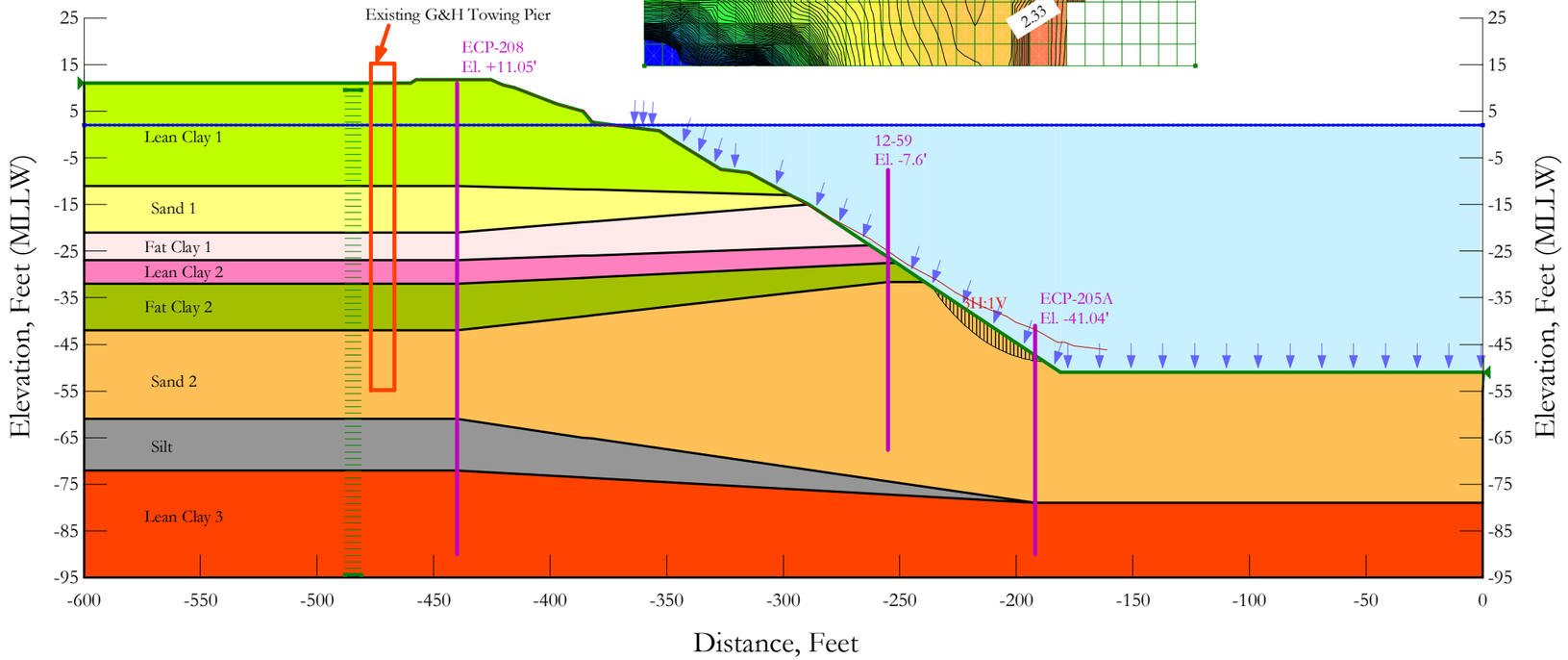


Soil Parameters for Slope Stability Analysis – Bayport Ship Channel							
Section (Boring)	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Undrained Shear Strength, psf**	**Long Term**	
		Top	**Bottom**			**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Sta. 213+00 Red Side (Boring ECP-201)	Lean Clay	-17.7	-27.7	120	500	200	23
	Fat Clay	-27.7	-39.7	125	2,000	200	17
	Lean Clay	-39.7	-45.7	125	1,000	200	23
	Fat Clay	-45.7	-60	120	1,560	200	17
Sta. 141+00 Red Side (Boring ECP-203A)	Sand	-17.2	-23.2	100	0	0	26
	Fat Clay	-23.2	-47.2	115	1,120	200	17
	Lean Clay	-47.2	-51.2	120	2,600	200	23
	Sand	-51.2	-60	110	0	0	32
Sta. 37+00 and Sta. 40+00 (ECP-207, B-18 & ECP-206A)	Fat Clay	+5	-10.8	120	1,160	360	22
	Silty Clay	-10.8	-17.8	120	1,000	200	26
	Fat Clay	-17.8	-32.8	120	2,600	360	22
	Lean Clay	-32.8	-37.8	120	2,000	200	26
	Sand	-37.8	-82.8	120	0	0	31
	Silt	-82.8	-92.8	120	0	0	33
	Fat Clay	-92.8	-97.8	130	2,900	360	22
Sta. 42+20/Section C (ECP-208, 12-59 & ECP-205A)	Lean Clay	+11	-11	120	1,460	200	26
	Sand	-11	-21	120	0	0	32
	Fat Clay	-21	-27	120	1,000	360	22
	Lean Clay	-27	-32	120	660	200	26
	Fat Clay	-32	-42	125	1,900	360	22
	Sand	-42	-61	120	0	0	33
	Silt	-61	-72	120	0	0	33
	Lean Clay	-72	-99	130	2,200	200	26

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
Approximate BSC CL Sta. 42+20 - Section C
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

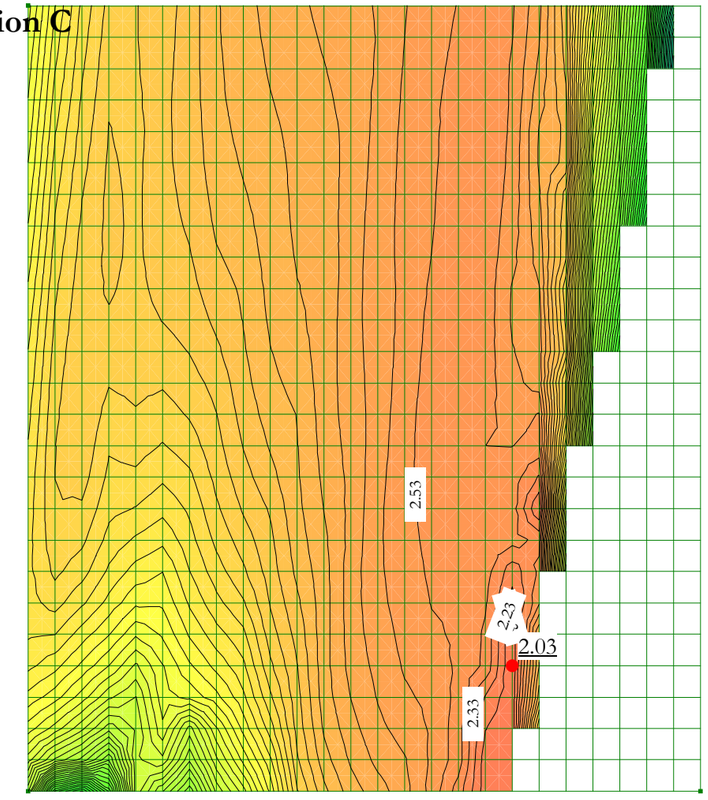
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	120			1,000
	Fat Clay 2 (Undrained)	125			1,900
	Lean Clay 1 (Undrained)	120			1,460
	Lean Clay 2 (Undrained)	120			660
	Lean Clay 3 (Undrained)	125			2,200
	Sand 1	120	0	32	
	Sand 2	120	0	33	
	Silt	120	0	33	

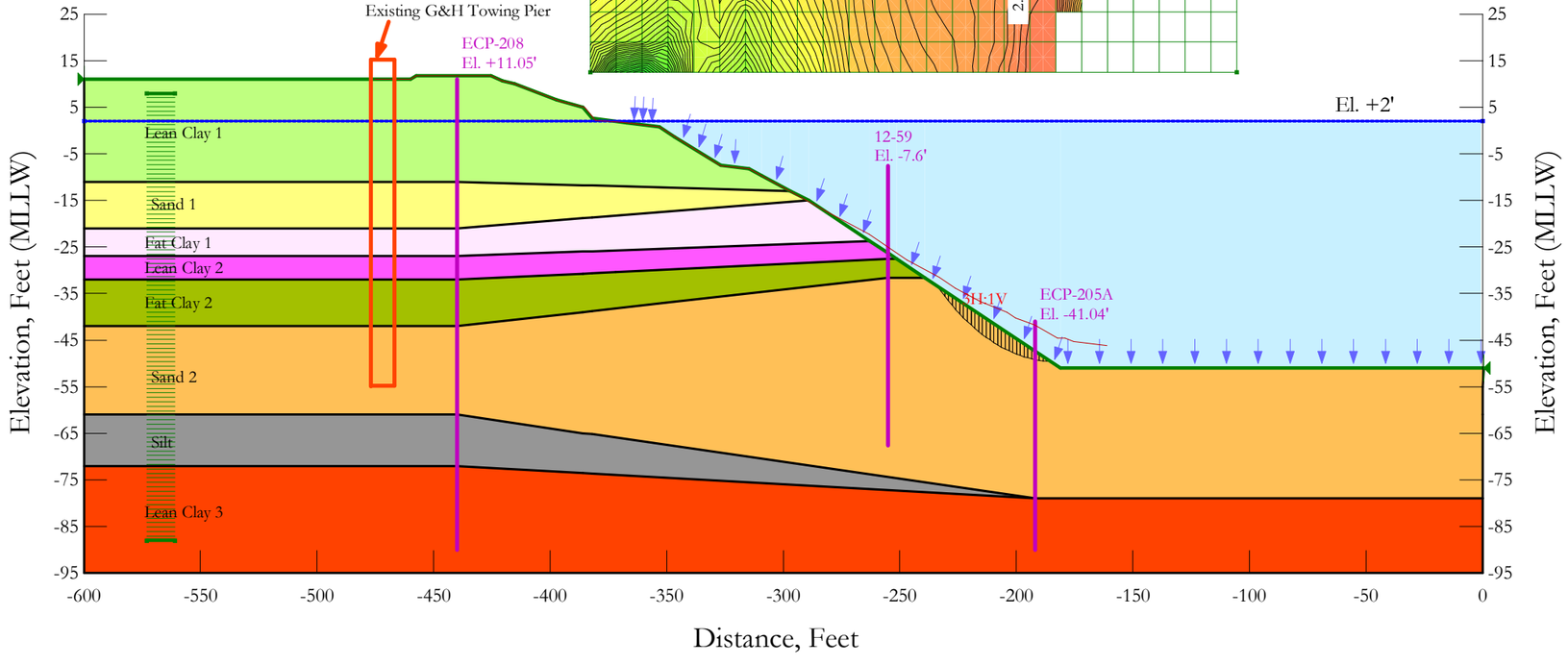




Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
Approximate BSC CL Sta. 42+20 - Section C
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	120	360	22
	Fat Clay 2	125	360	22
	Lean Clay 1	120	200	26
	Lean Clay 2	120	200	26
	Lean Clay 3	125	200	26
	Sand 1	120	0	32
	Sand 2	120	0	33
	Silt	120	0	33

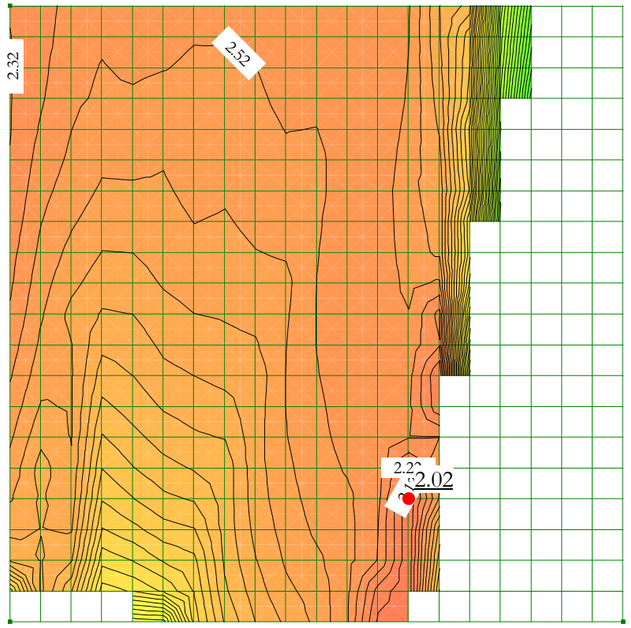


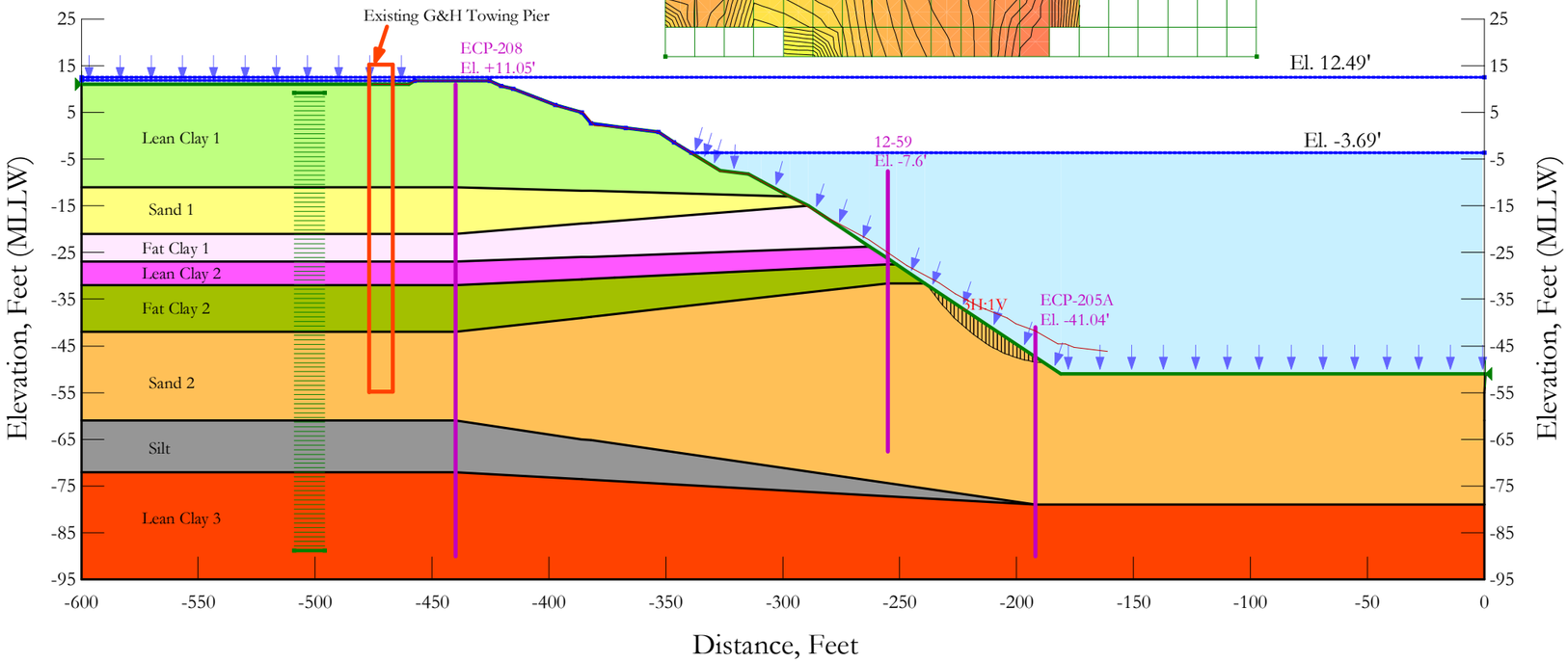


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
Approximate BSC CL Sta. 42+20 - Section C
HVJ Project Number: HG1910092.2.1

Loading Condition: Rapid Drawdown
Slip Surface: Circular

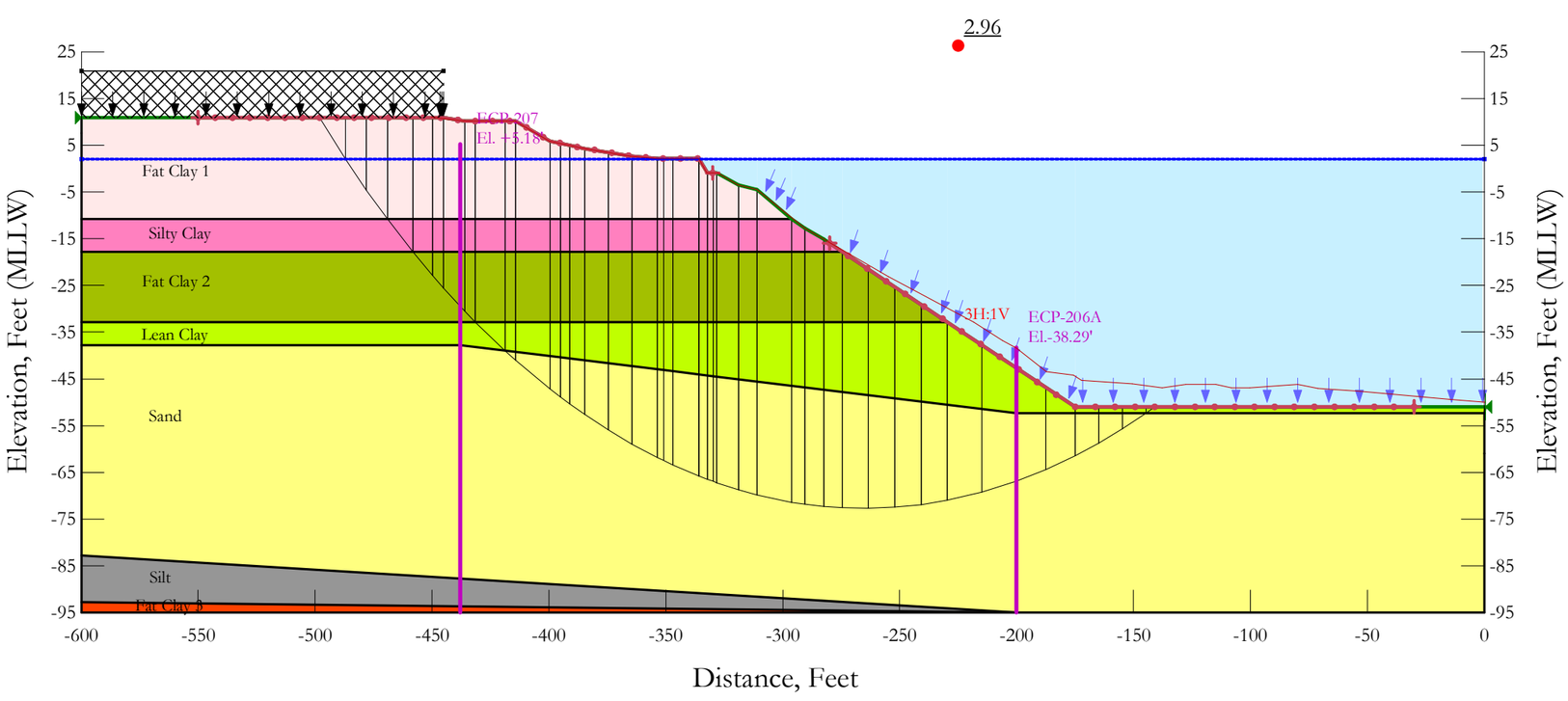
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	Fat Clay 1	120	360	22	475	15	1
	Fat Clay 2	125	360	22	475	15	1
	Lean Clay 1	120	200	26	270	24	1
	Lean Clay 2	120	200	26	270	24	1
	Lean Clay 3	125	200	26	270	24	1
	Sand 1	120	0	32	0.1	31.9	1
	Sand 2	120	0	33	0.1	32.9	1
	Silt	120	0	33	0.1	32.9	1





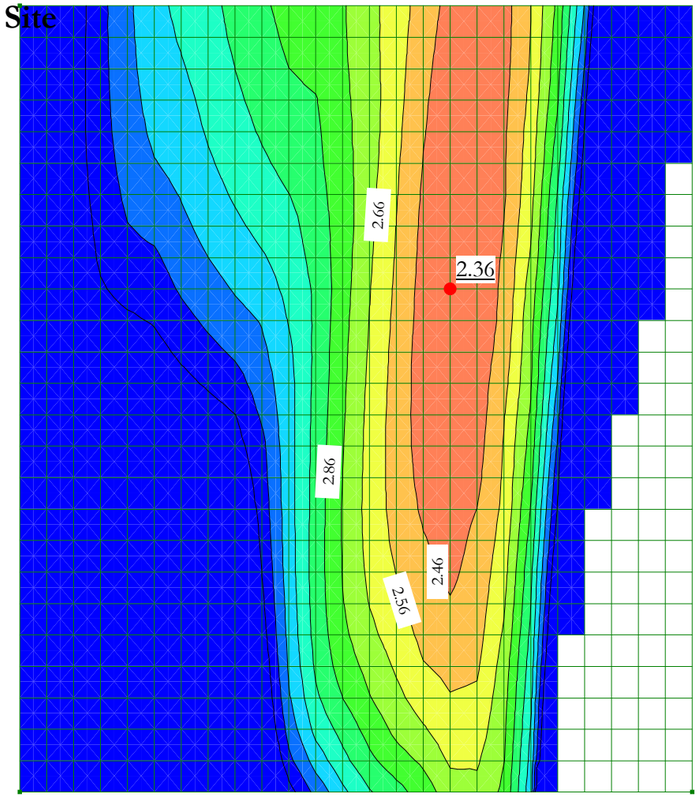
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 40+00
HVJ Project Number: HG1910092.2.1
Loading Condition: Short Term
Slip Surface: Circular

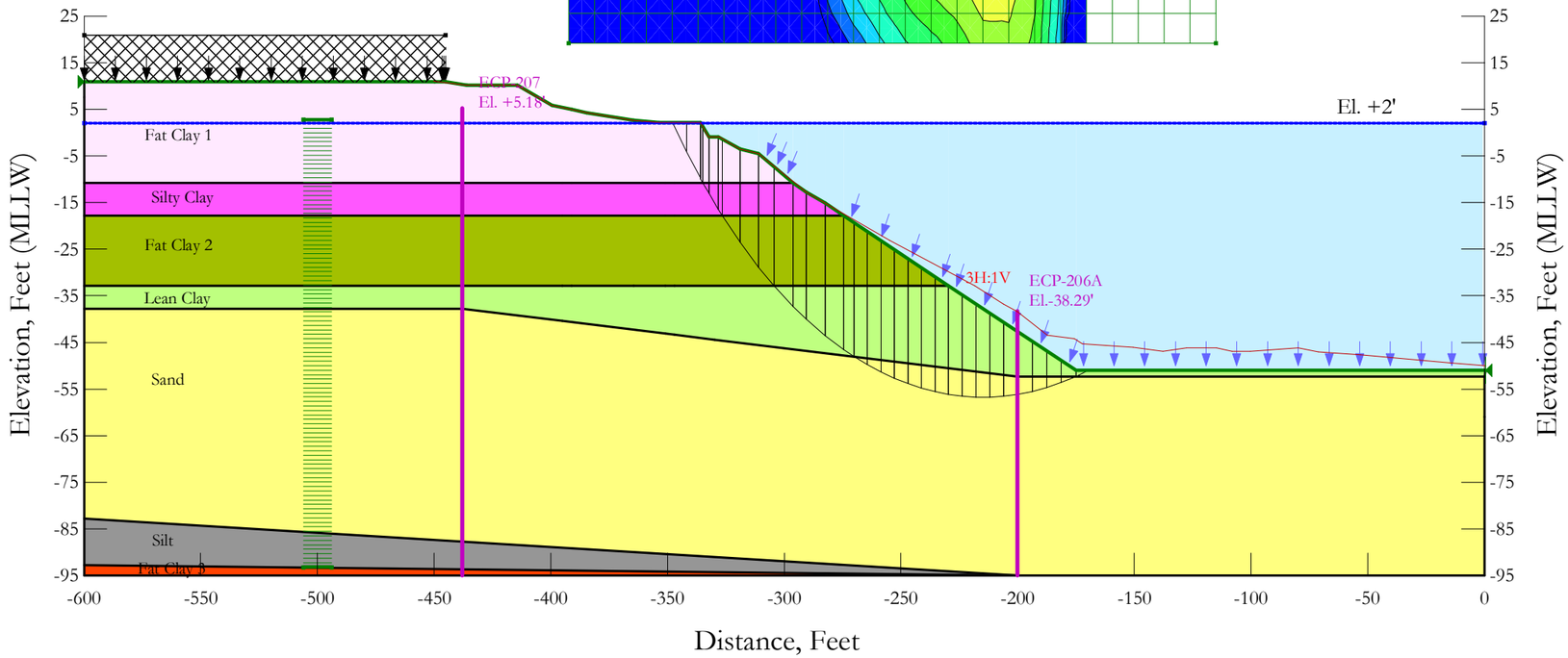
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	120			1,160
	Fat Clay 2 (Undrained)	120			2,600
	Fat Clay 3 (Undrained)	130			2,900
	Lean Clay (Undrained)	120			2,000
	Sand	120	0	31	
	Silt	120	0	33	
	Silty Clay (Undrained)	120			1,000



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 40+00
HVJ Project Number: HG1910092.2.1
Loading Condition: Long Term
Slip Surface: Circular

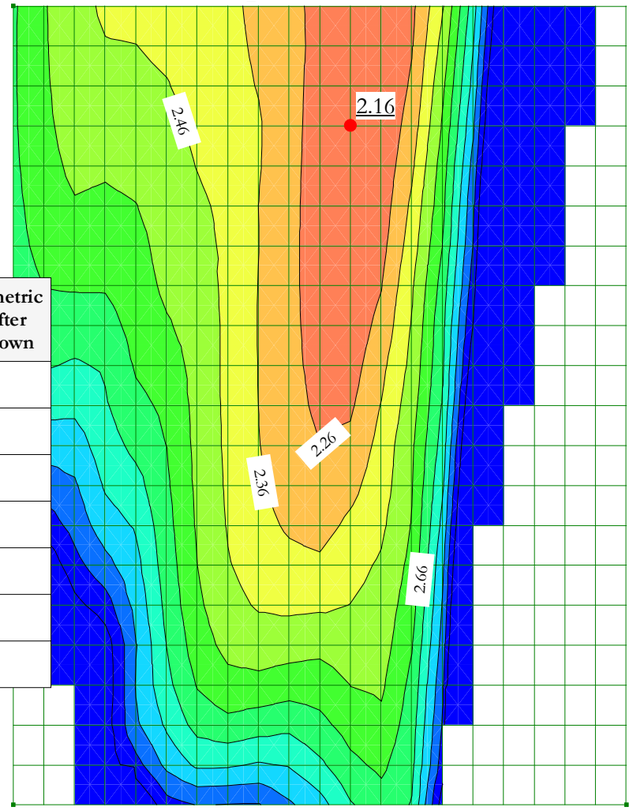
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	120	360	22
	Fat Clay 2	120	360	22
	Fat Clay 3	130	360	22
	Lean Clay	120	200	26
	Sand	120	0	31
	Silt	120	0	33
	Silty Clay	120	200	26



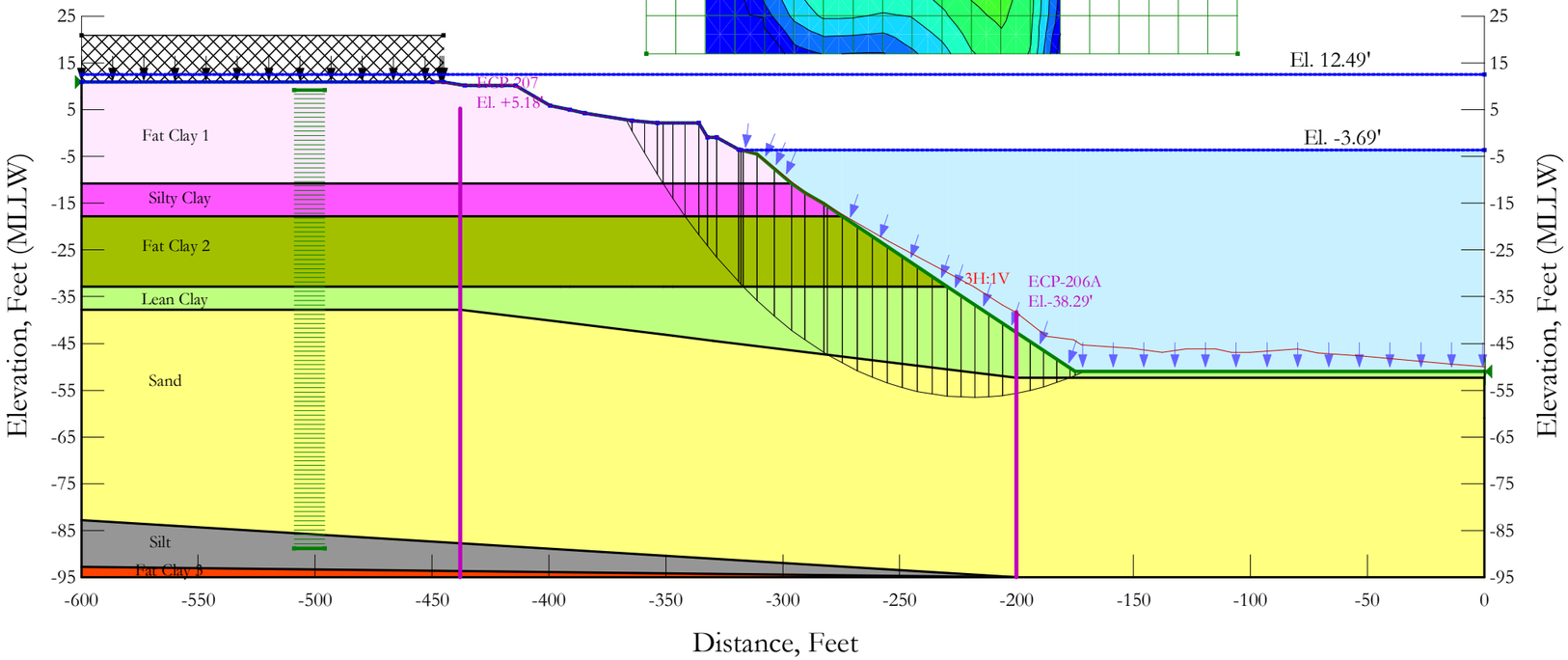


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 40+00
HVJ Project Number: HG1910092.2.1

Loading Condition: Rapid Drawdown
Slip Surface: Circular



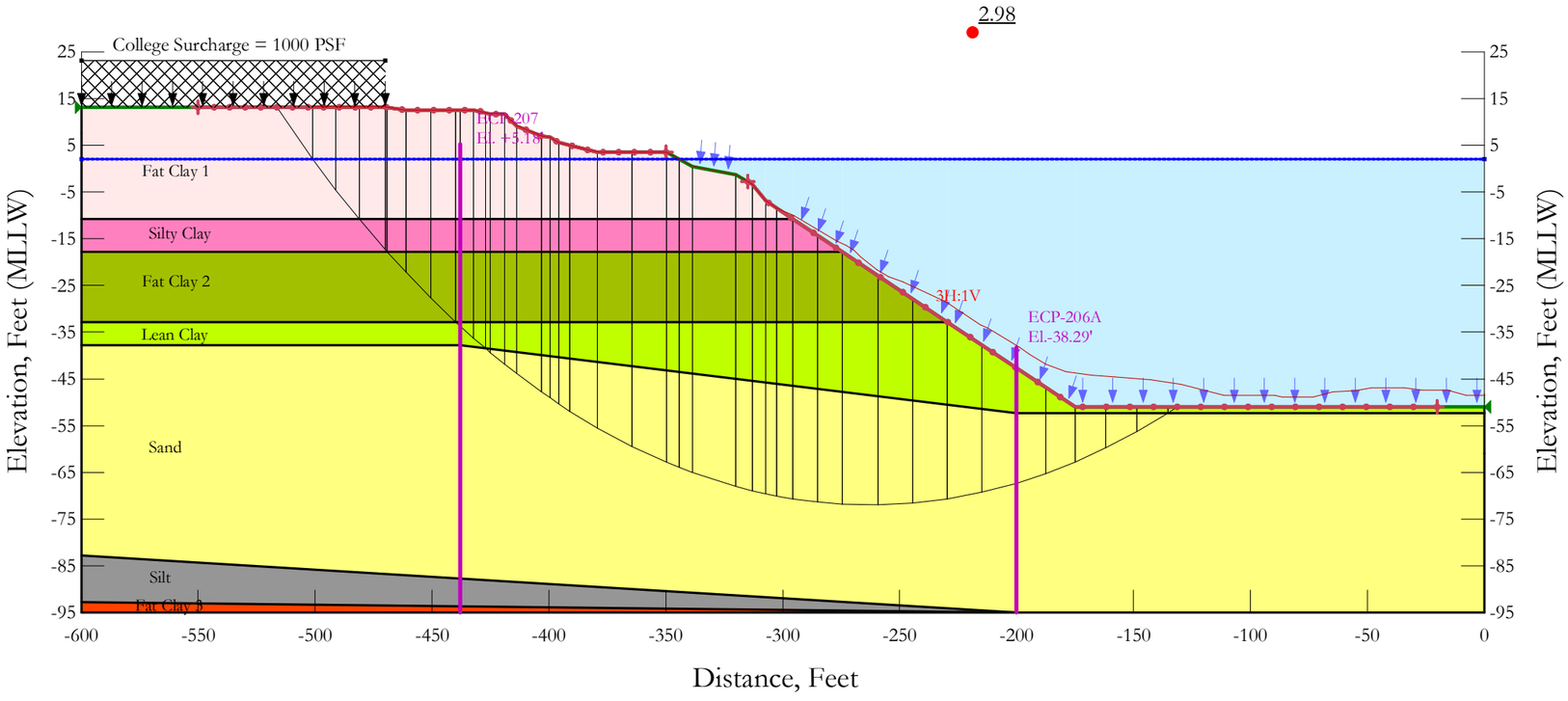
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	Fat Clay 1	120	360	22	475	15	1
	Fat Clay 2	120	360	22	475	15	1
	Fat Clay 3	130	360	22	475	15	1
	Lean Clay	120	200	26	270	24	1
	Sand	120	0	31	0.1	30.9	1
	Silt	120	0	33	0.1	32.9	1
	Silty Clay	120	200	26	270	24	1



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 37+00
HVJ Project Number: HG1910092.2.1

Loading Condition: Short Term
Slip Surface: Circular

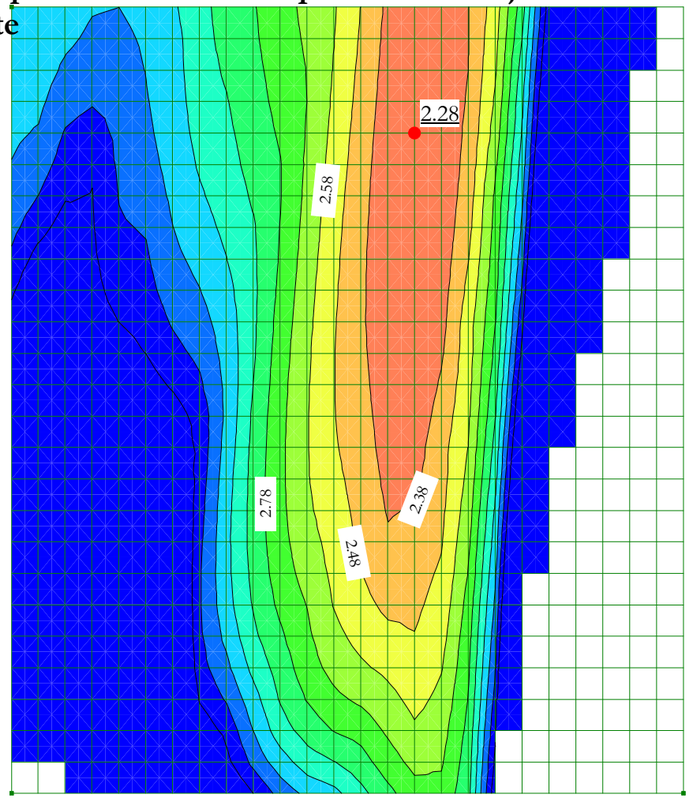
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	Fat Clay 1 (Undrained)	120			1,160
	Fat Clay 2 (Undrained)	120			2,600
	Fat Clay 3 (Undrained)	130			2,900
	Lean Clay (Undrained)	120			2,000
	Sand	120	0	31	
	Silt	120	0	33	
	Silty Clay (Undrained)	120			1,000

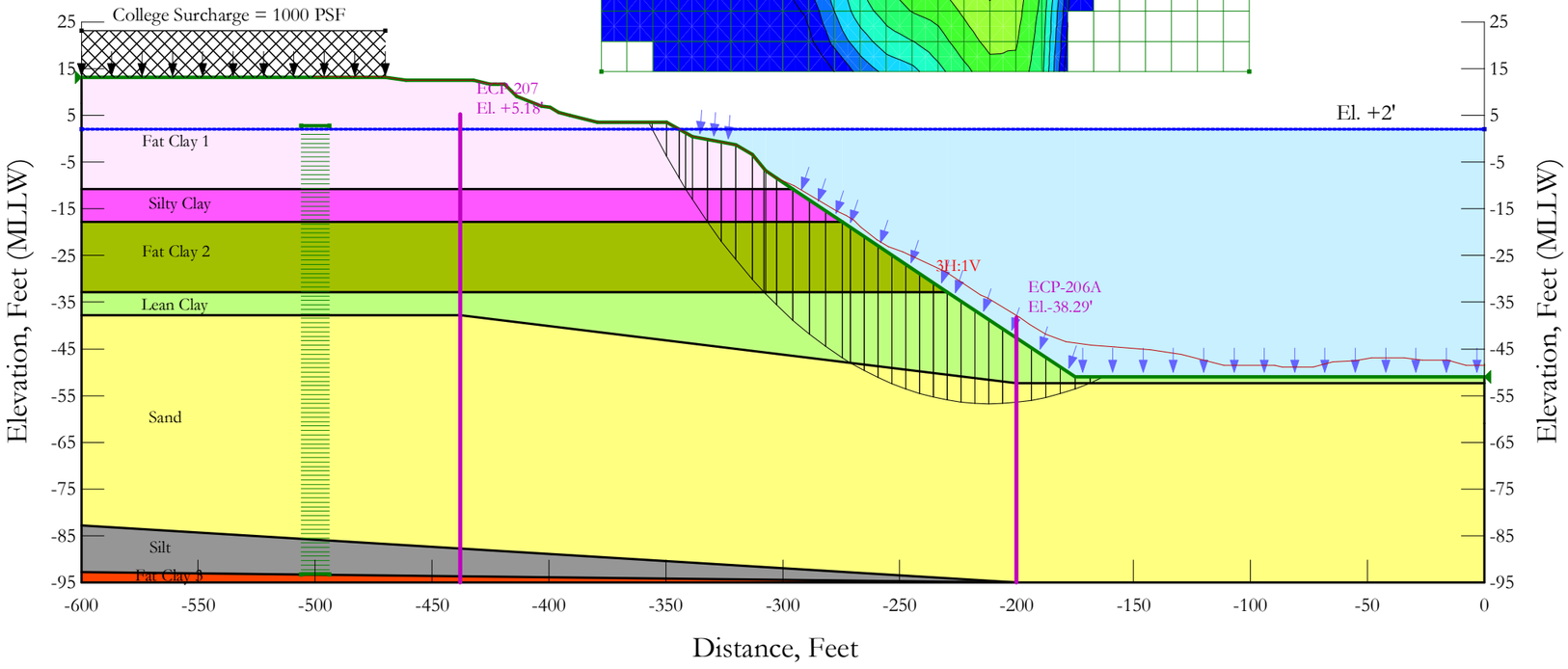


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 37+00
HVJ Project Number: HG1910092.2.1

Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Fat Clay 1	120	340	18
	Fat Clay 2	120	340	18
	Fat Clay 3	130	340	18
	Lean Clay	120	200	26
	Sand	120	0	31
	Silt	120	0	33
	Silty Clay	120	200	26

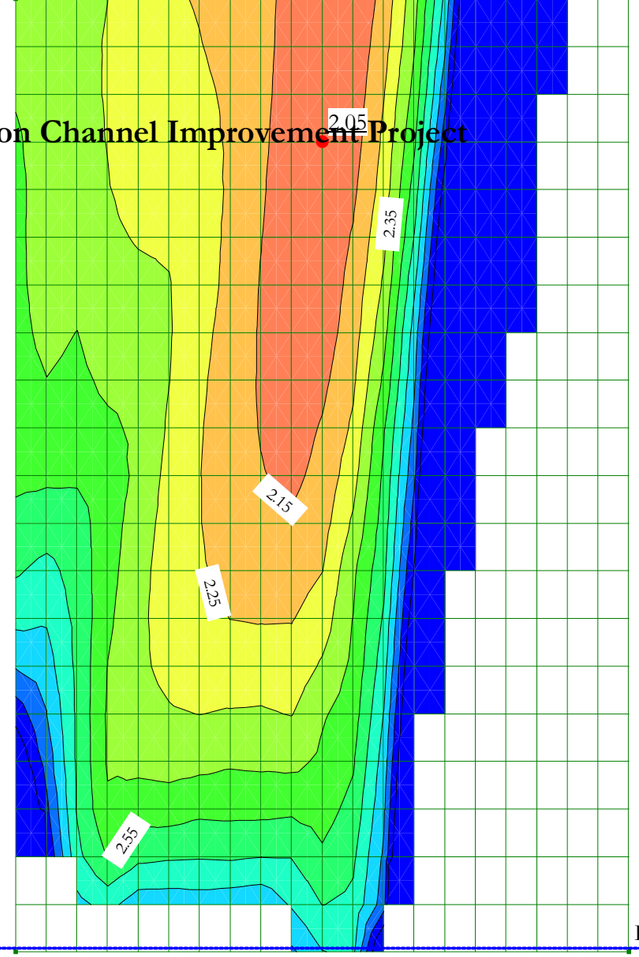


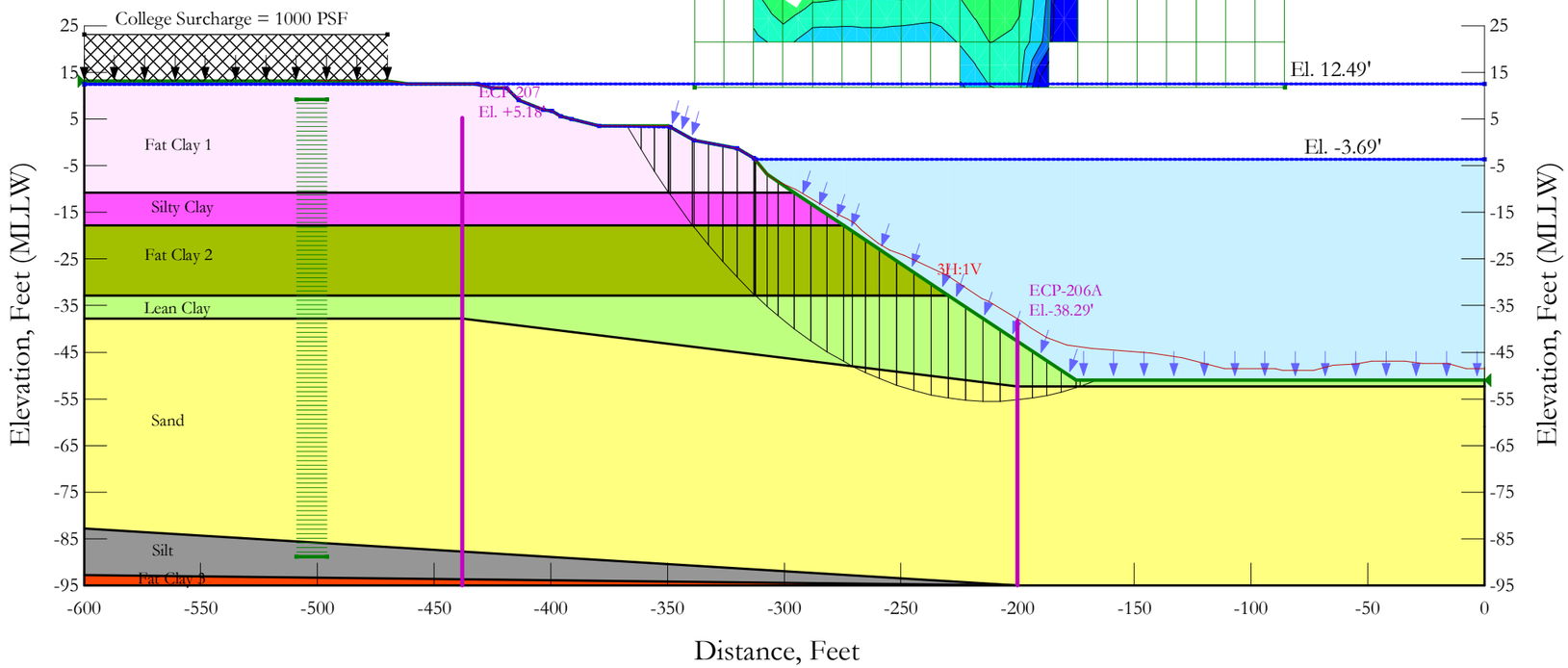


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Bayport Ship Channel - SJC Site
BSC CL Sta. 37+00
HVJ Project Number: HG1910092.2.1

Loading Condition: Rapid Drawdown
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	Fat Clay 1	120	340	18	341	14	1
	Fat Clay 2	120	340	18	341	14	1
	Fat Clay 3	130	340	18	341	14	1
	Lean Clay	120	200	26	270	24	1
	Sand	120	0	31	0.1	30.9	1
	Silt	120	0	33	0.1	32.9	1
	Silty Clay	120	200	26	270	24	1





APPENDIX C

SLOPE STABILITY ANALYSIS: BARBOURS CUT SHIP CHANNEL

SPILMANS ISLAND



N

GENERAL NOTES

1. FOR EARTHWORK CROSS SECTIONS SEE SHEETS C-302 THRU C-305.

A OVERALL PROPOSED EARTHWORK SITE KEY PLAN

SCALE: 1"=200'

200 100 0 200 400

PORT OF HOUSTON AUTHORITY

CONSULTANT:

DESIGN PREPARED BY:

HDR Engineering, INC
TBPELS Firm
Registration No. F-754

SEAL:

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65% REVIEW

APPROVED: DATE

PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

OVERALL PROPOSED EARTHWORK SITE KEY PLAN

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	1" = 200'

DRAWING NO.
C90-D13-P11-007

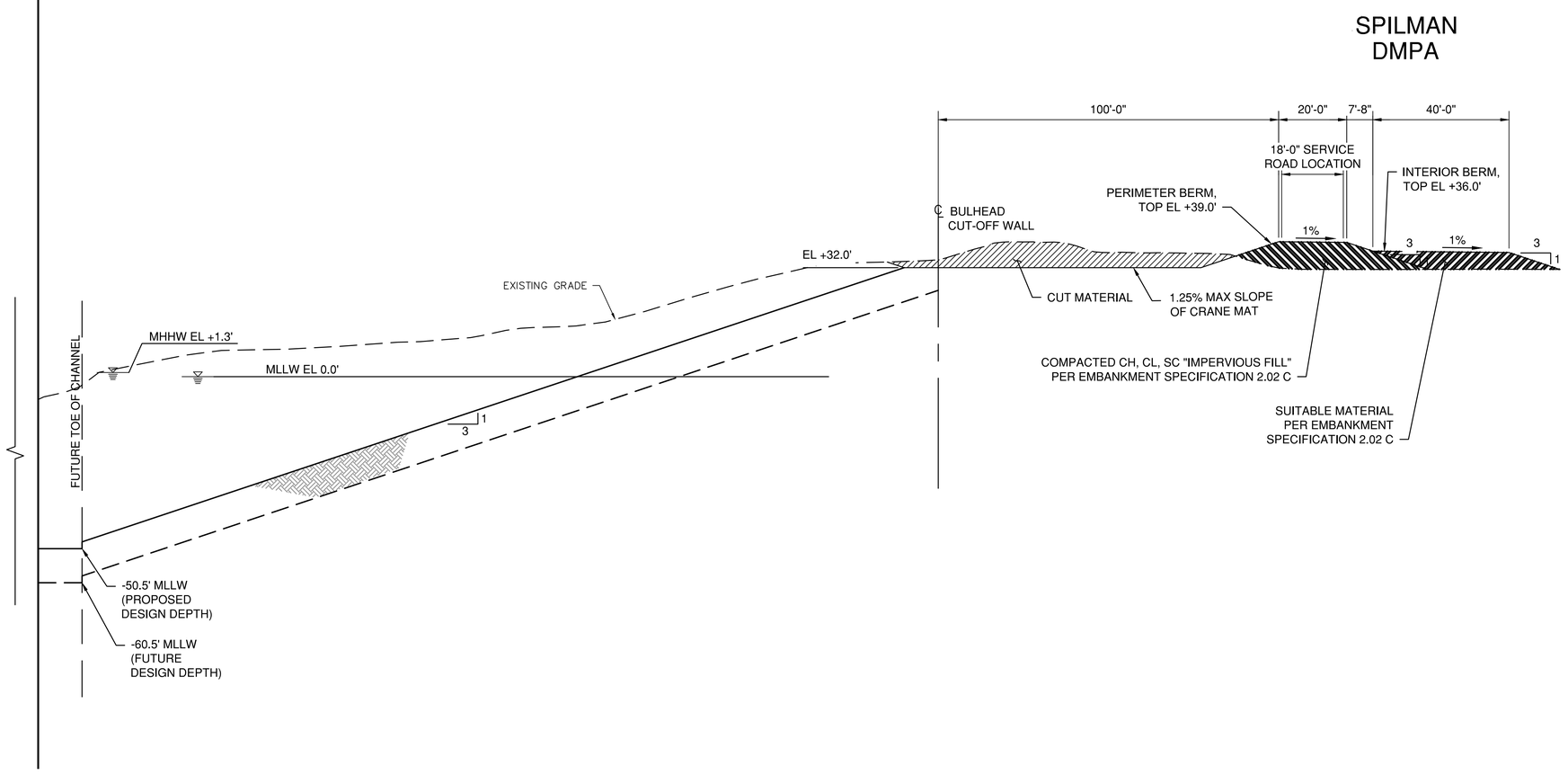
SHEET NO. C-101

REV. NO. A

65% REVIEW

TIME: 8-07-20 - 12:49pm User: OSALAS DWG: C:\pwworking\central01\d1709989\C90-D13-P11-007-C-101.dwg

SPILMAN
DMPA



A TYPICAL SECTION - BERM RELOCATION

SCALE: 1"=20'

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TIME: 8-07-20 - 12:56pm User: OSALAS DWG: C:\pwworking\central01\d1709989\C90-D13-P11-007-C-301.dwg

PORT OF HOUSTON AUTHORITY

CONSULTANT:

DESIGN PREPARED BY:

HDR Engineering, INC
TBPELS Firm
Registration No. F-754

SEAL:

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65% REVIEW

APPROVED: DATE

PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

TYPICAL SECTION - BERM RELOCATION

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

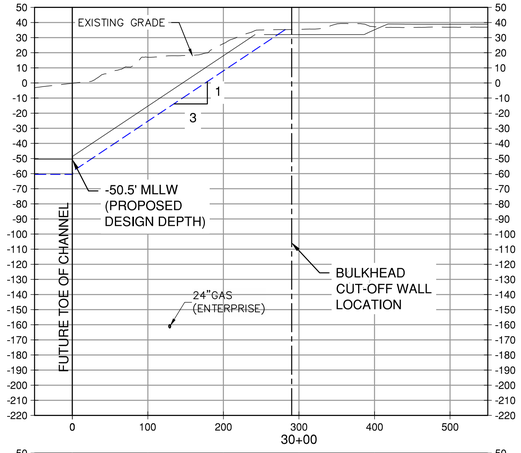
DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	AS NOTED

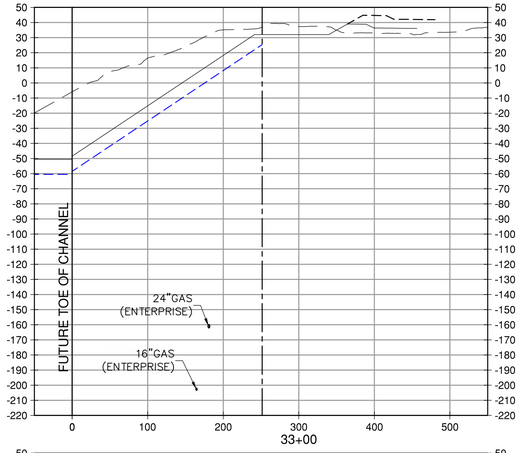
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C90-D13-P11-007

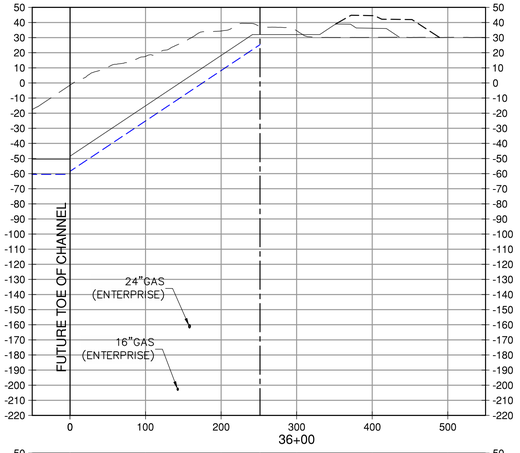
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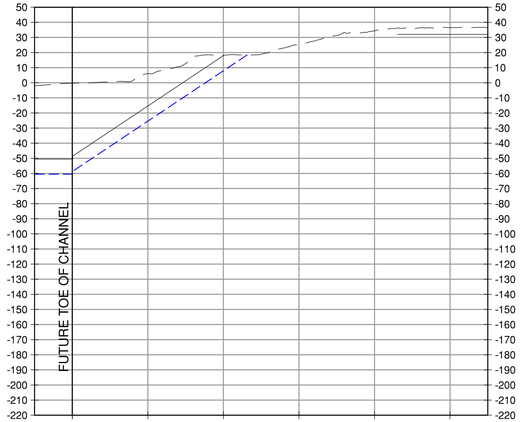
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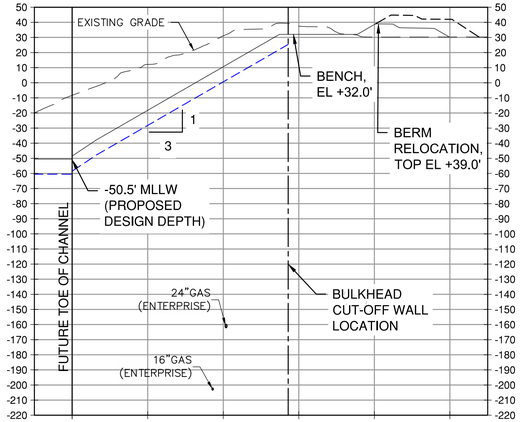
65% REVIEW

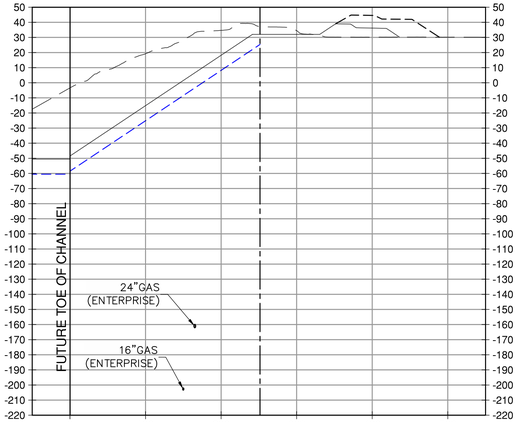


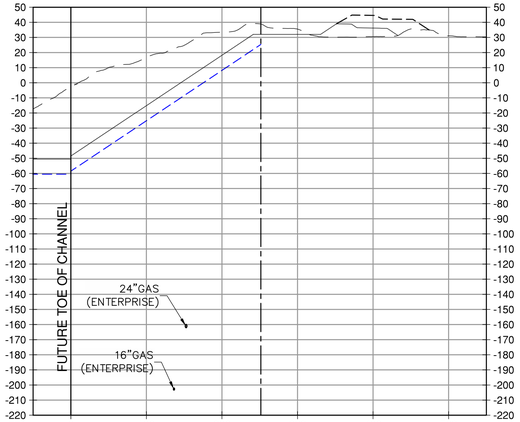


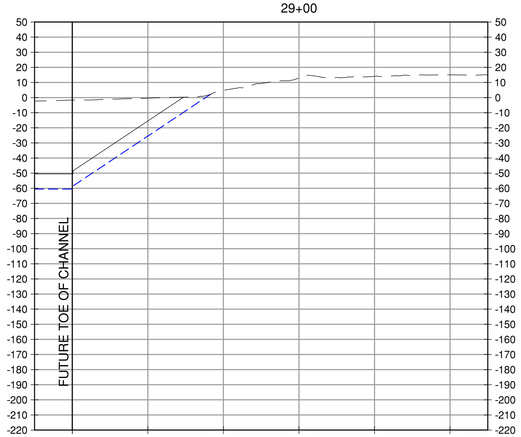


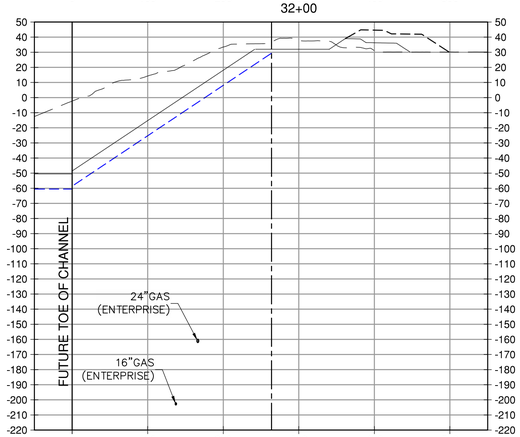


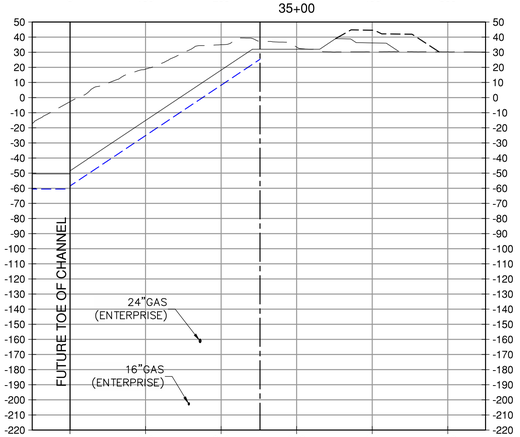


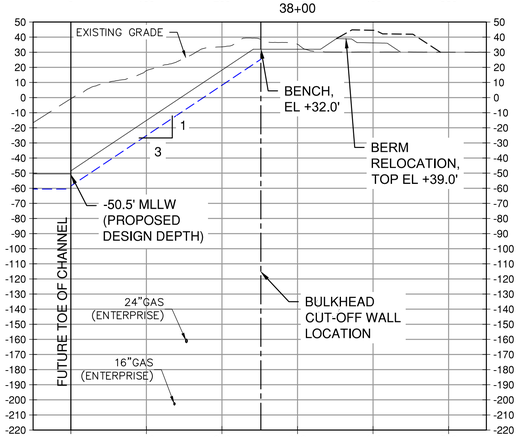












NOTES:

1. ALL ELEVATIONS SHOWN IN FEET TO MEAN LOW LOW WATER (MLLW).
2. CROSS SECTIONS CUT FACING UP STATION.

GRAPHIC SCALES

HORIZONTAL 1"=100'

100 50 0 100 200

VERTICAL 1"=50'

50 25 0 50 100

PORT OF HOUSTON AUTHORITY

CONSULTANT:

DESIGN PREPARED BY:

HDR Engineering, INC
TBPELS Firm
Registration No. F-754

SEAL:

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65% REVIEW

APPROVED: _____ DATE

PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

EARTHWORK CROSS SECTIONS (1 OF 4)

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	AS NOTED

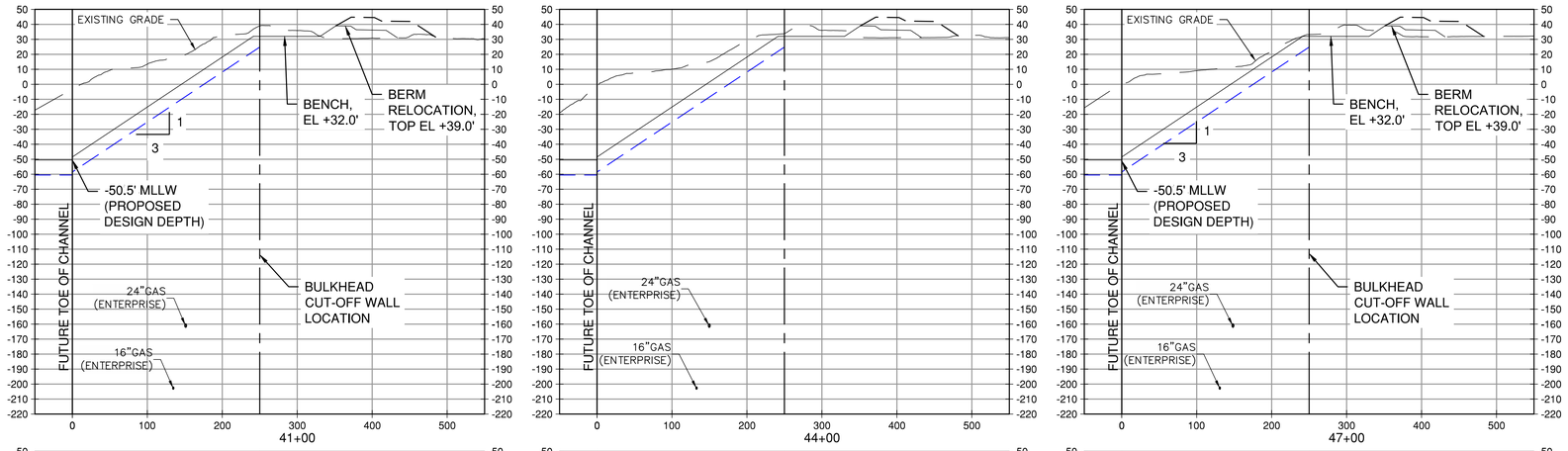
DRAWING NO.

C90-D13-P11-007

SHEET NO.	REV. NO.
C-302	A

65% REVIEW

TIME: 8-07-20 – 12:56pm User: OSALAS DWG: C:\pwworking\central01\d1709989\C90-D13-P11-007-C-302.dwg



NOTES:

1. ALL ELEVATIONS SHOWN IN FEET TO MEAN LOW LOW WATER (MLLW).
2. CROSS SECTIONS CUT FACING UP STATION.

GRAPHIC SCALES

HORIZONTAL 1"=100'

100 50 0 100 200

VERTICAL 1"=50'

50 25 0 50 100

PORT OF HOUSTON AUTHORITY

CONSULTANT:

DESIGN PREPARED BY:

HDR Engineering, INC
TBPELS Firm
Registration No. F-754

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_____
PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:

HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

EARTHWORK CROSS SECTIONS (2 OF 4)

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	AS NOTED

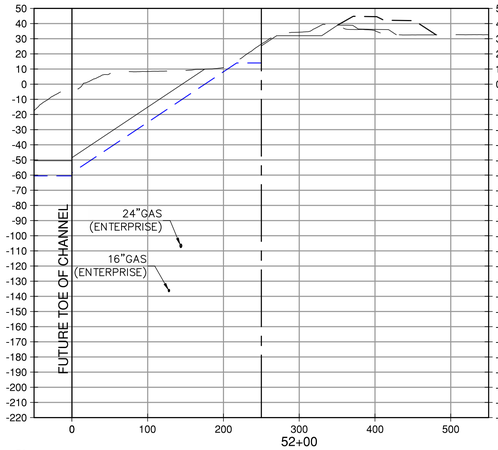
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C90-D13-P11-007

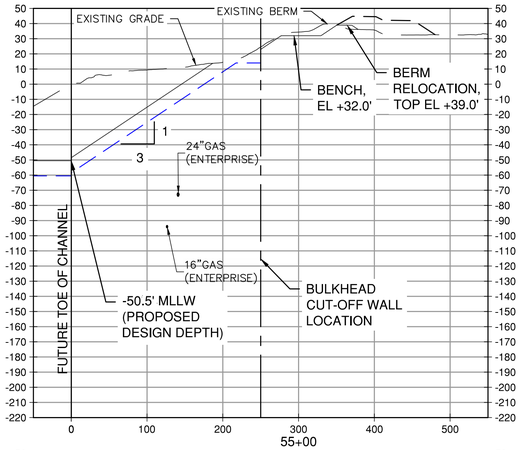
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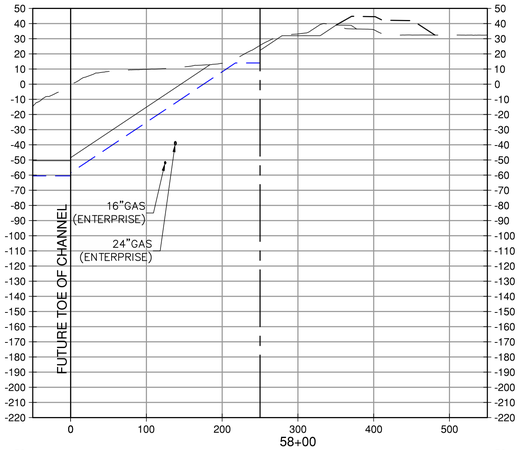
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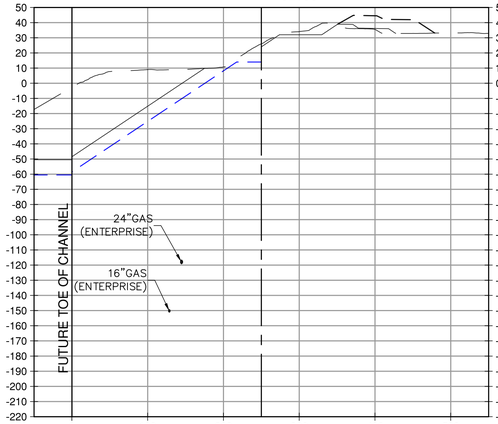
65% REVIEW

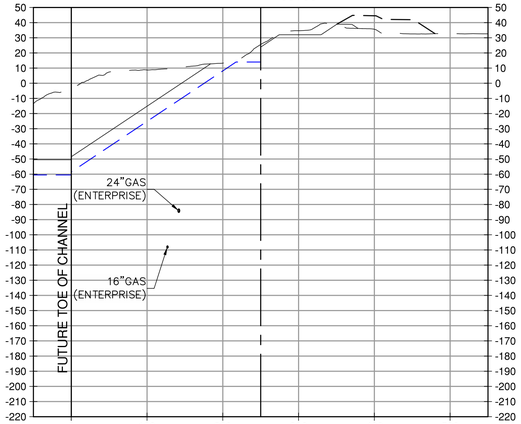
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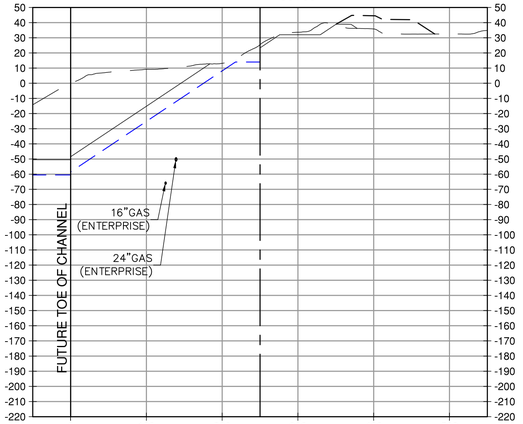


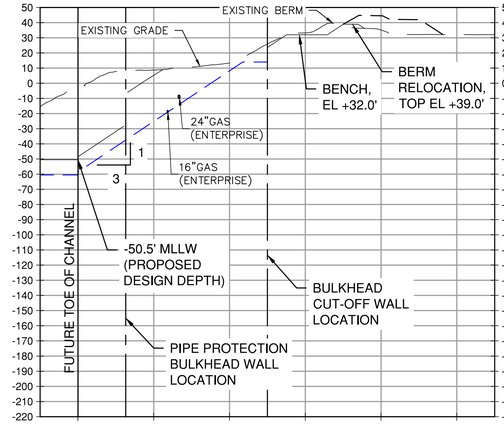


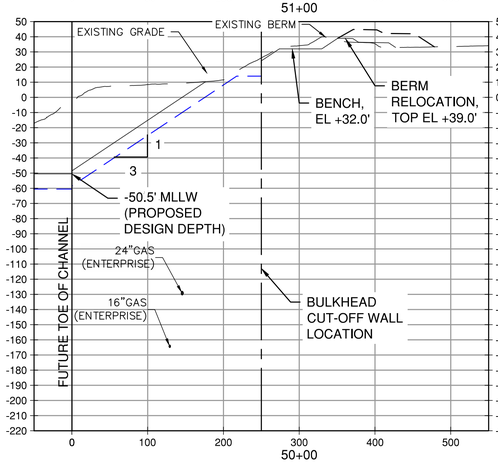


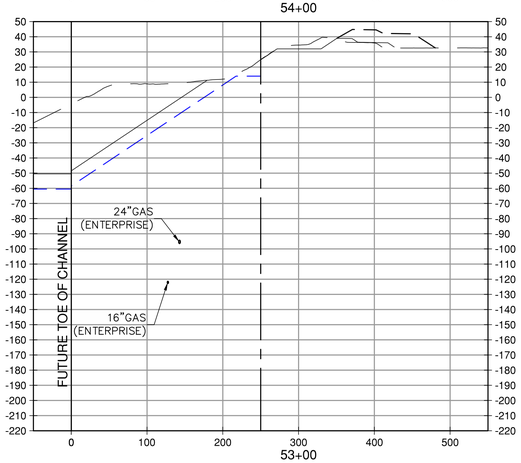


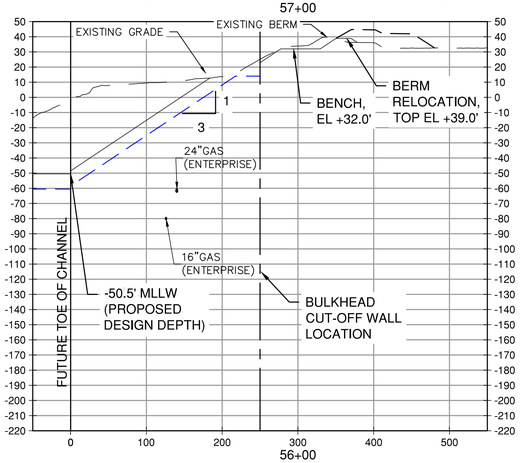


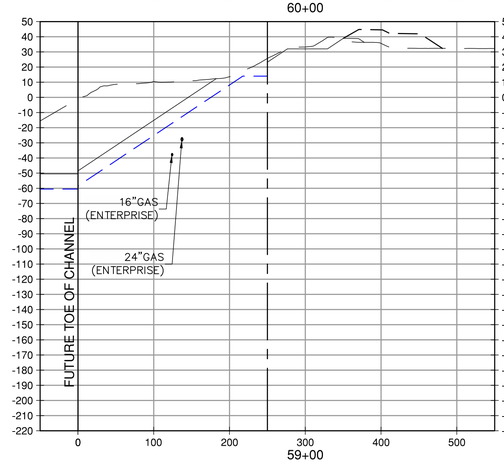












NOTES:

1. ALL ELEVATIONS SHOWN IN FEET TO MEAN LOW LOW WATER (MLLW).
2. CROSS SECTIONS CUT FACING UP STATION.

GRAPHIC SCALES

HORIZONTAL 1"=100'

100 50 0 100 200

VERTICAL 1"=50'

50 25 0 50 100

PORT OF HOUSTON AUTHORITY

CONSULTANT:

DESIGN PREPARED BY:

HDR Engineering, INC
TBPELS Firm
Registration No. F-754

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MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

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PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

EARTHWORK CROSS SECTIONS (3 OF 4)

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	AS NOTED

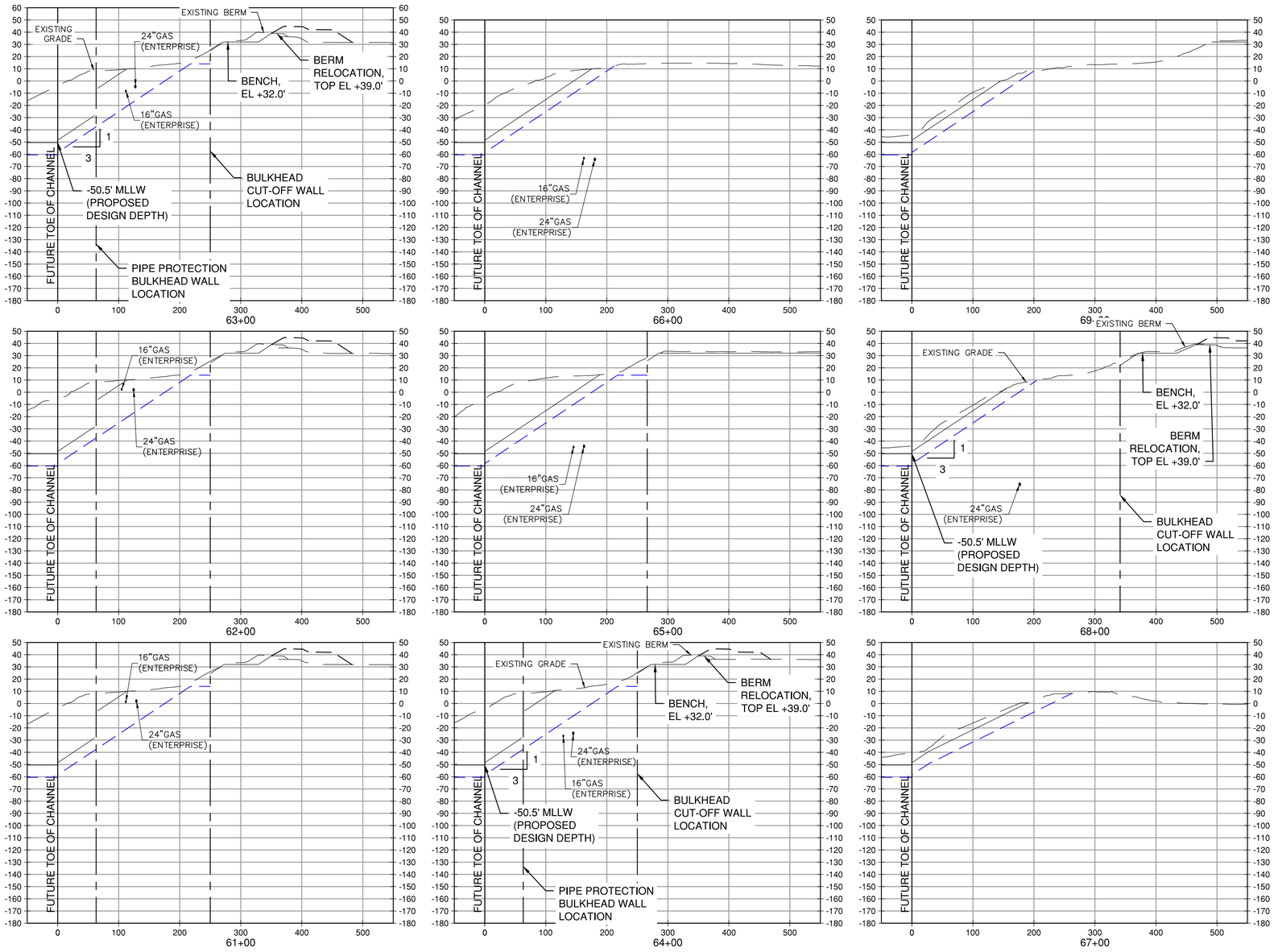
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SHEET NO. C-304

REV. NO. A

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TIME: 8-07-20 – 12:56pm User: OSALAS DWG: C:\pwworking\central01\d1709989\C90-D13-P11-007-C-304.dwg



NOTES:

1. ALL ELEVATIONS SHOWN IN FEET TO MEAN LOW LOW WATER (MLLW).
2. CROSS SECTIONS CUT FACING UP STATION.

GRAPHIC SCALES

HORIZONTAL 1"=100'

100 50 0 100 200

VERTICAL 1"=50'

50 25 0 50 100

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CONSULTANT:

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MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

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EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

PROJECT 11 PACKAGE #3

SHEET TITLE:

SEGMENT 3 - BARBOURS CUT CHANNEL, SPILMAN ISLAND BULKHEAD

EARTHWORK CROSS SECTIONS (4 OF 4)

REV	DATE	DESCRIPTION
A	8/14/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	AS NOTED

DRAWING NO.
C90-D13-P11-007

SHEET NO. C-305

REV. NO. A

65% REVIEW

TIME: 8-07-20 – 12:57pm User: OSALAS DWG: C:\pwworking\central01\d1709989\C90-D13-P11-007-C-305.dwg

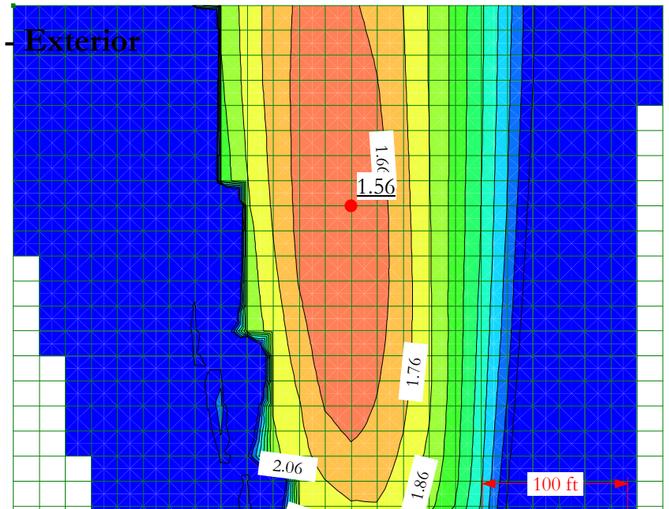
Soil Parameters for Slope Stability Analyses – Barbours Cut Channel, Spilmans Island										
Station & Boring Numbers	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Short Term**		**Long Term**		**Rapid Drawdown**	
		Top	**Bottom**		**Cohesion, psf**	**Friction Angle (ϕ'), degrees**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Sta. 34+00 S-04, L-08, L-04, ECP-C1, ECP-312	Dike	45	30	125	400	0	100	25	150	22
	Dredge Fill	42	30	90	Not Applicable		16	15	50	0
	Fat Clay 1	36	30	125	1200	0	300	22	500	15
	Clayey Sand	30	24	110	0	30	0	30	0	30
	Soft Fat Clay	24	14	115	280	0	100	15	150	10
	Loose Clayey Sand	14	5	120	0	28	0	28	0	28
	Fill	30	20	110	10 psf/ft (50 psf – 150 psf)				100	20
	Fat Clay 1	5	-21.3	125	1200	0	300	22	500	15
	Fat Clay 2	-21.3	-42.8	125	2200	0	300	22	500	15
	Clayey Sand	-42.8	-85.3	110	0	30	0	30	0	30
	Fat Clay 2	-85.3	-120	125	2200	0	300	22	500	15
Sta. 44+00 S-03, L-07, L-03, ECP-C3, ECP-311	Fat Clay 3	35	26	125	600	0	300	22	500	15
	Fill	26	0.7	110	300	0	100	20	150	15
	Fat Clay 1	0.7	-31.3	125	1000	0	300	22	500	15
	Fat Clay 2	-31.3	-41.3	125	2200	0	300	22	500	15
	Clayey Sand	-41.3	-66.4	120	0	30	0	30	0	30
	Fat Clay 2	-66.4	-120	125	2200	0	300	22	500	15
Sta. 56+00 S-02, L-06, L-02, ECP-C2, ECP-312	Lean Clay 2	34.5	15	125	700	0	100	25	150	20
	Lean Clay 1	15	0	125	500	0	100	25	150	20
	Lean Clay 2	0	-16.1	125	700	0	100	25	150	20
	Fat Clay 1	-16.1	-31.3	125	1000	0	300	22	500	15
	Fat Clay 2	-31.3	-49.5	125	2200	0	300	22	500	15
	Clayey Sand	-49.5	-77	120	0	30	0	30	0	30
	Fat Clay 2	-77	-120	125	2200	0	300	22	500	15

Soil Parameters for Slope Stability Analyses – Barbours Cut Channel, Spilmans Island										
Station & Boring Numbers	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Short Term**		**Long Term**		**Rapid Drawdown**	
		Top	**Bottom**		**Cohesion, psf**	**Friction Angle (ϕ'), degrees**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Sta. 64+00 S-01, L-05, L-01, ECP-309	Fat Clay 3	33.7	26	125	800	0	300	22	500	15
	Clayey Sand	26	22	120	0	30	0	30	0	30
	Lean Clay	26	-6	125	500	0	100	25	150	20
	Fat Clay 1	-6	-26.5	125	1000	0	400	18	500	14
	Fat Clay 2	-26.5	-49.6	125	2200	0	300	22	500	15
	Clayey Sand	-49.6	-69.6	120	0	30	0	30	0	30
	Fat Clay 2	-69.6	-120	125	2200	0	300	22	500	15

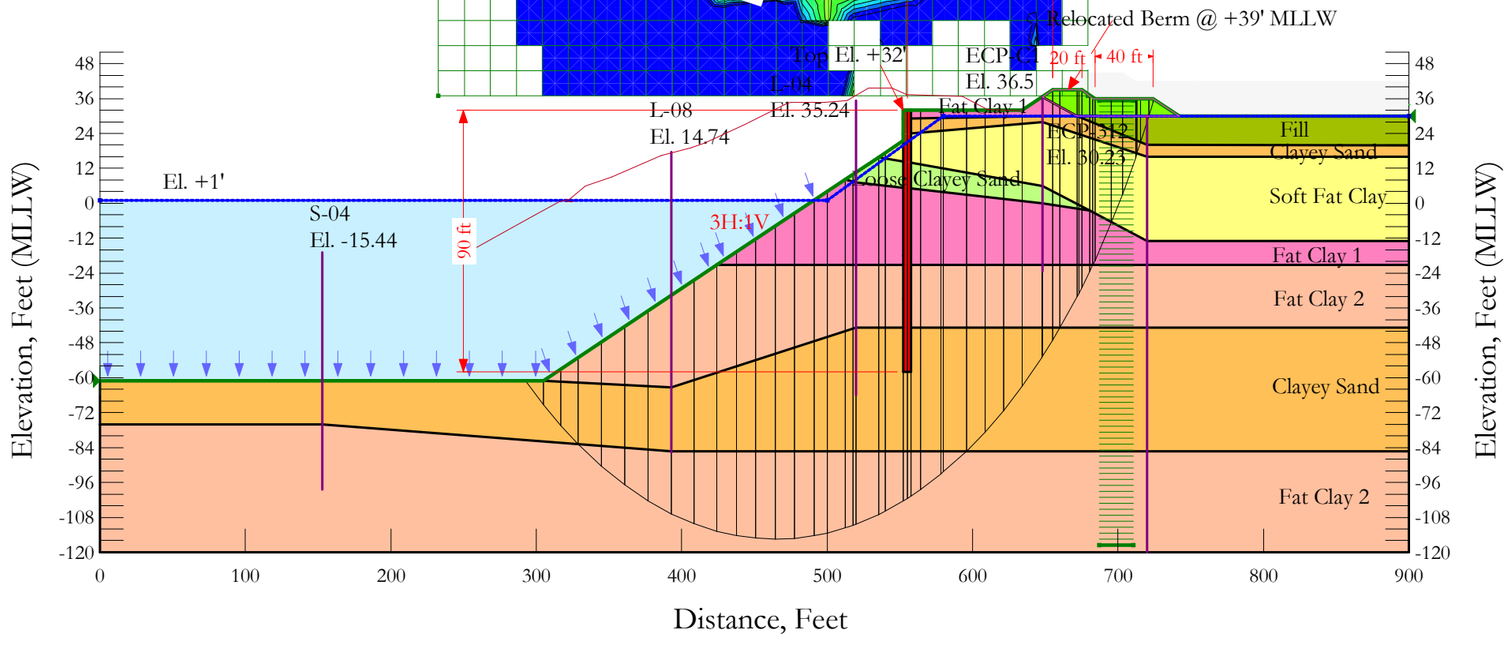
Soil Parameters for Pipeline Protection Wall Design - Barbours Cut Channel, Spilmans Island							
Location & Boring Numbers	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Undrained Shear Strength, psf**	**Drained Parameters**	
		Top	**Bottom**			**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
Pipeline Protection Wall ECP-316	Clay	0	-26.5	125	1,000	400	18
	Clay	-26.5	-54	125	2,800	300	22
	Clay	-54	-59	125	1,000	100	25
	Sand	-59	-64	120	0	0	30
	Clay	-64	-90	125	2,800	300	22
	Clay	-90	-110	125	2,000	100	25
	Clay	-110	-134	125	1,200	100	25
Soil Parameters for Cutoff Wall Design - Barbours Cut Channel, Spilmans Island							
Cutoff Wall at East End ECP-312	Clay	32	20	125	340	100	25
	Clay	24	20	125	340	100	15
	Sand	20	16	120	0	0	28
	Clay	16	-12	115	280	100	25
	Clay	-12	-20	125	1200	300	22
	Clay	-20	-33	125	2800	300	22
	Clay	-33	-63	125	2800	100	25
	Sand	-63	-85	120	0	0	34
Cutoff Wall at West End ECP-313	Clay	25	14	120	300	300	22
	Clay	14	-4	125	800	100	25
	Clay	-4	-9	125	800	300	22
	Clay	-9	-14	125	800	100	25
	Clay	-14	-19	125	800	300	22
	Clay	-19	-53	125	1800	300	22
	Clay	-53	-64	125	1000	100	25
	Sand	-64	-78	120	0	0	31

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular



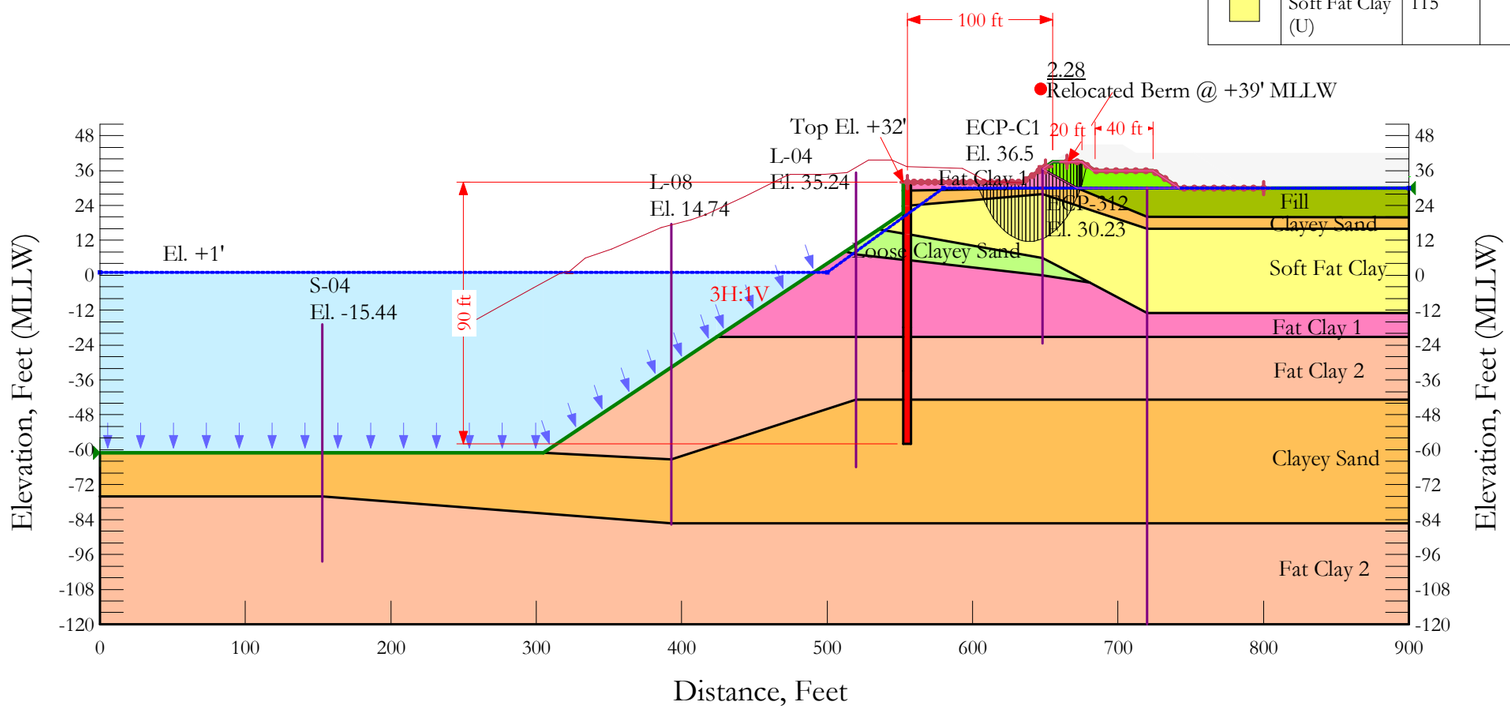
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular

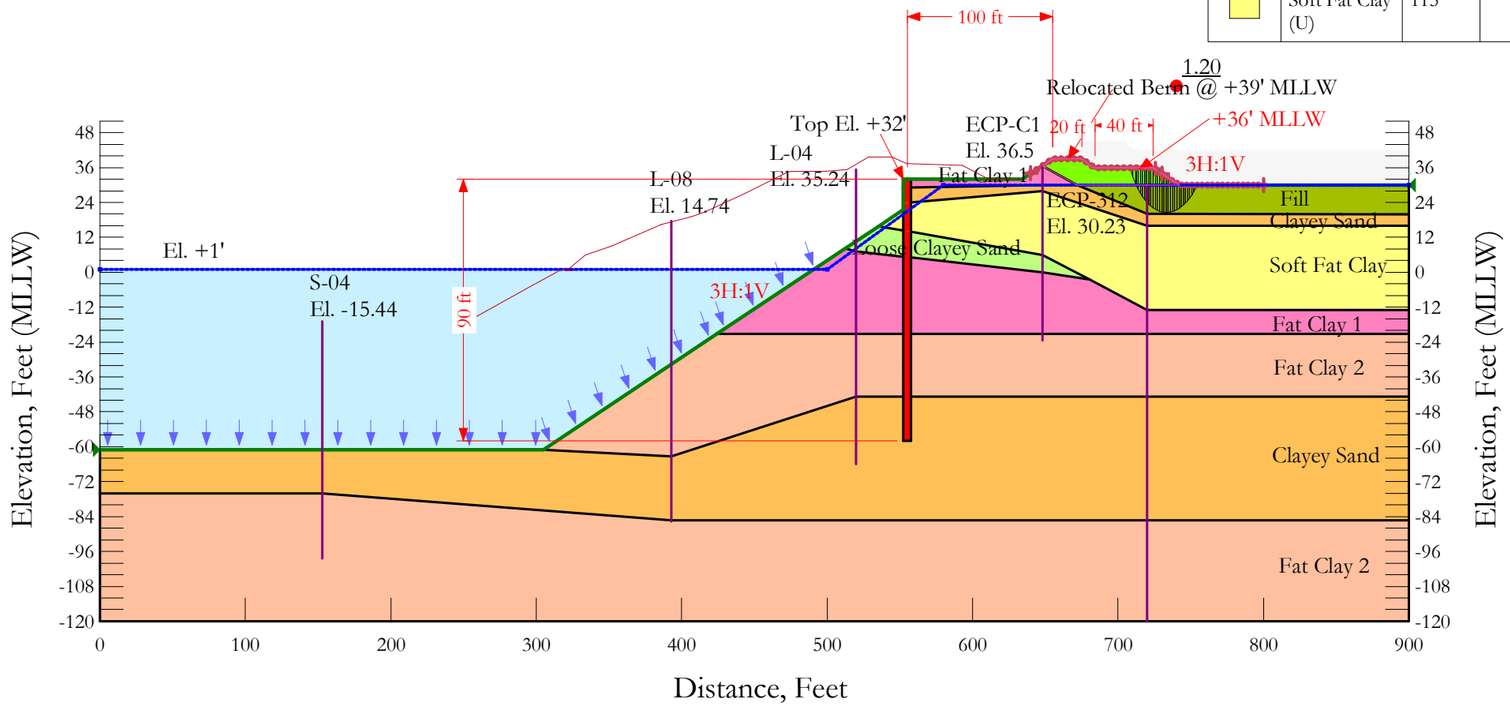
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

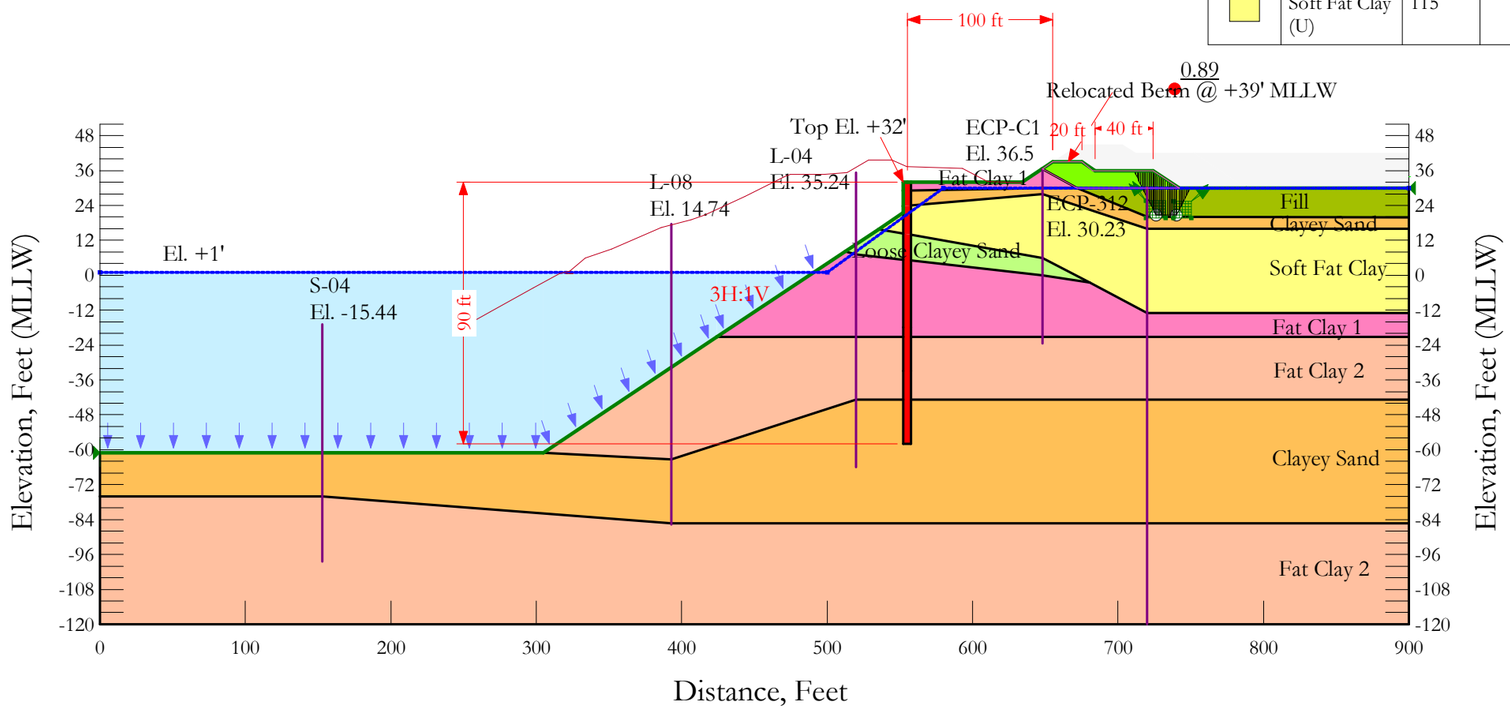
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

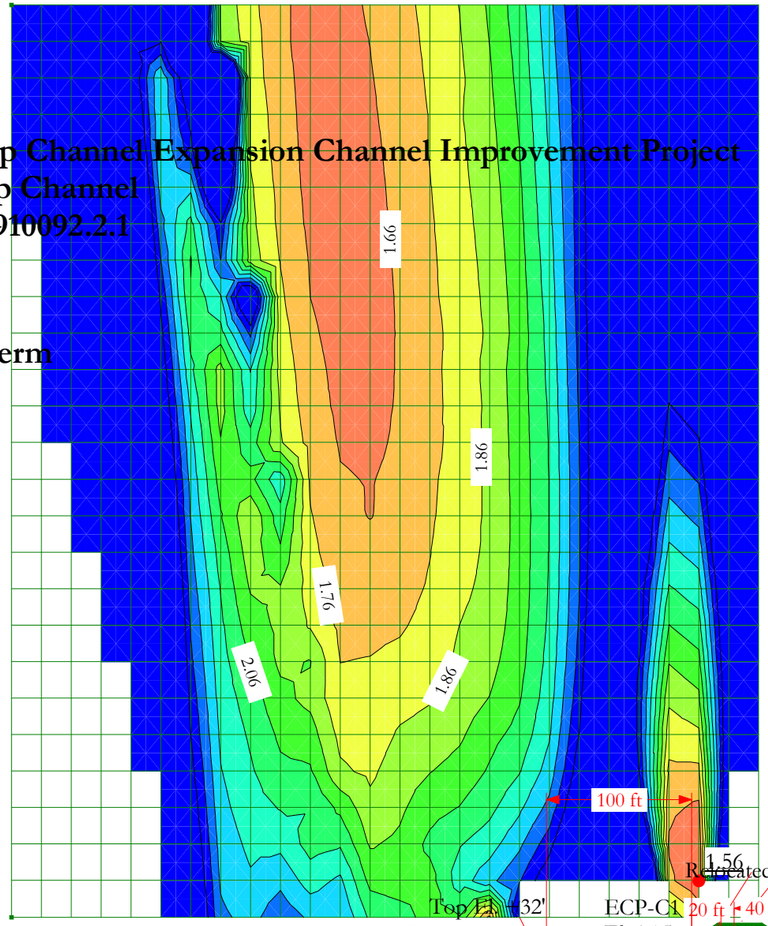
Loading Condition: Short Term - Dike Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		

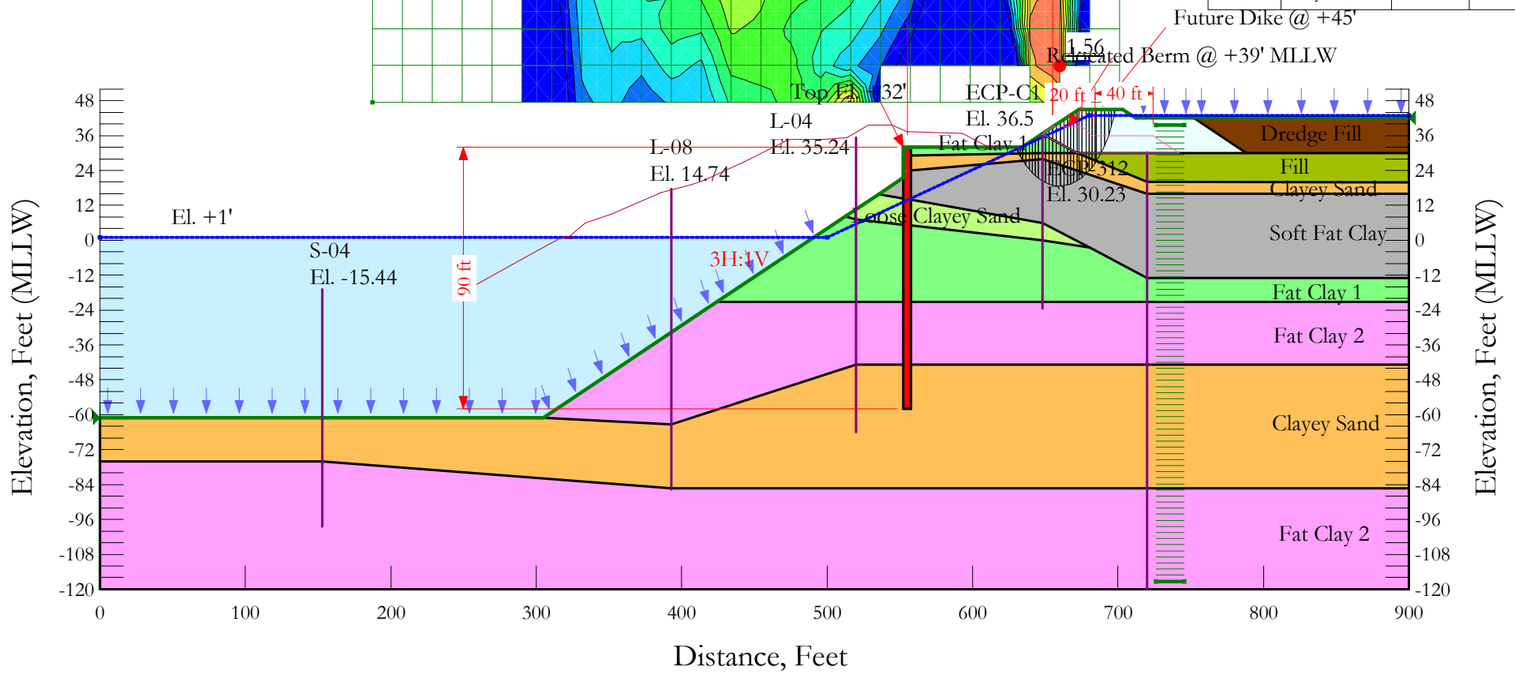


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

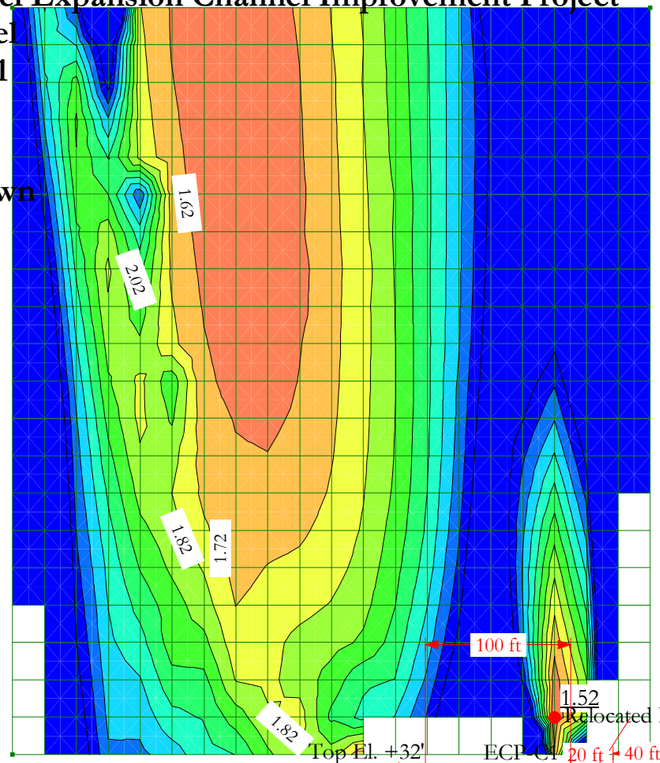
Loading Condition: Long Term
Slip Surface: Circular



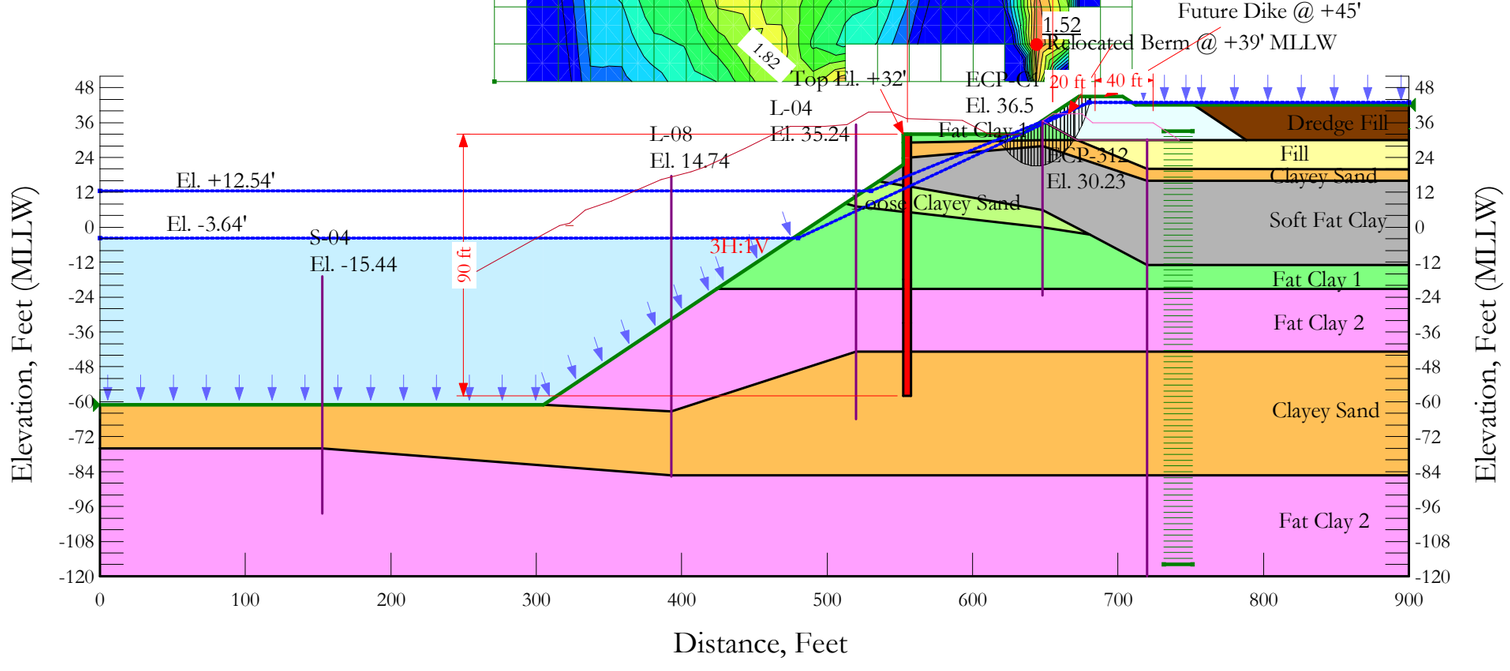
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150					
	Clayey Sand	120				0	30
	Dike	125				100	25
	Dredge Fill	90				16	15
	Fat Clay 1	125				300	22
	Fat Clay 2	125				300	22
	Fill	110	50	10	150		
	Loose Clayey Sand	110				0	28
	Soft Fat Clay	115				100	15



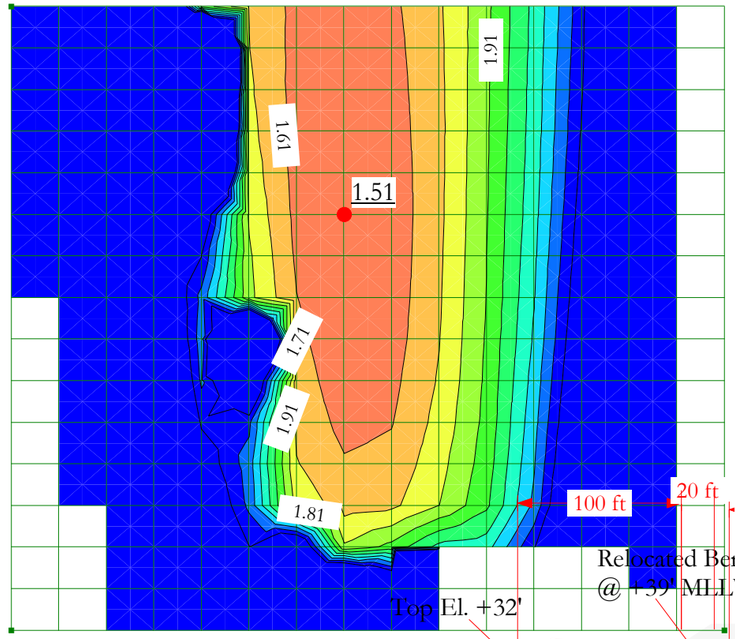
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular



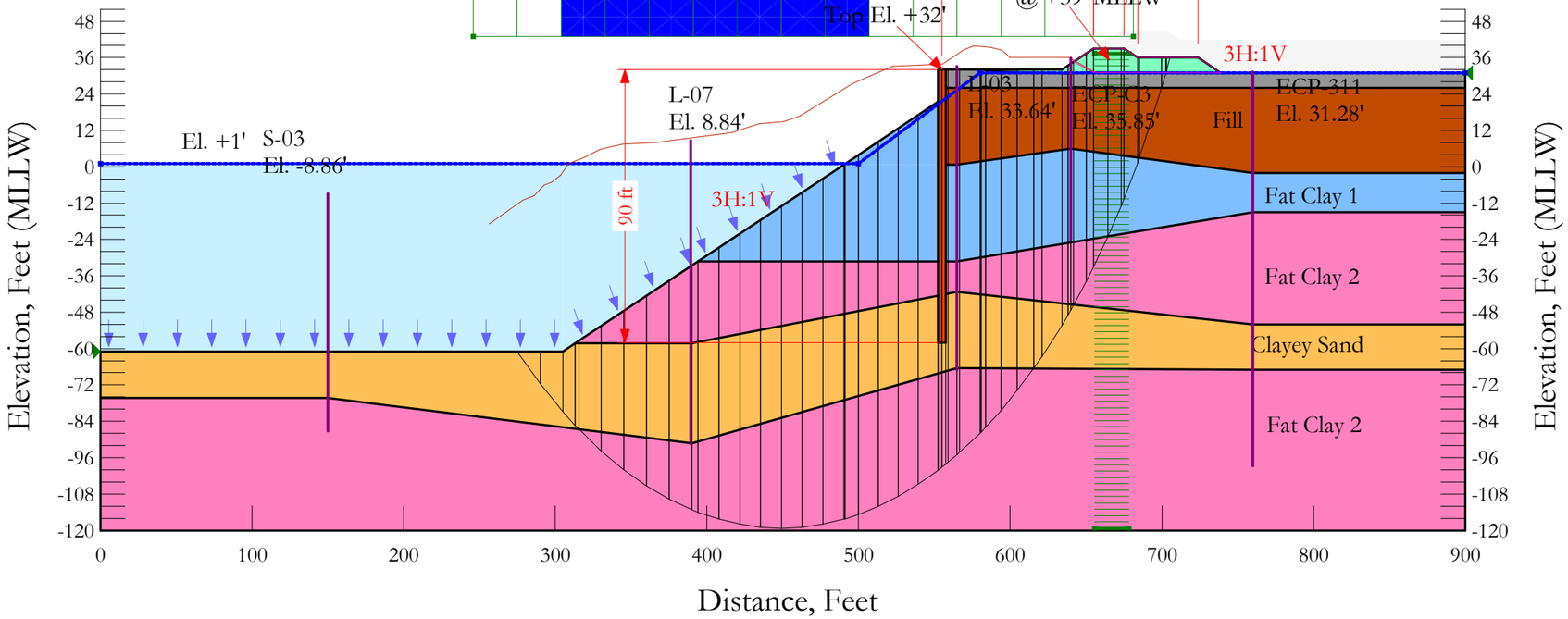
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Fill (RDD)	110	50	25	100	20
	Loose Clayey Sand	110	0	28	0	28
	Soft Fat Clay	115	100	15	150	10



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Circular

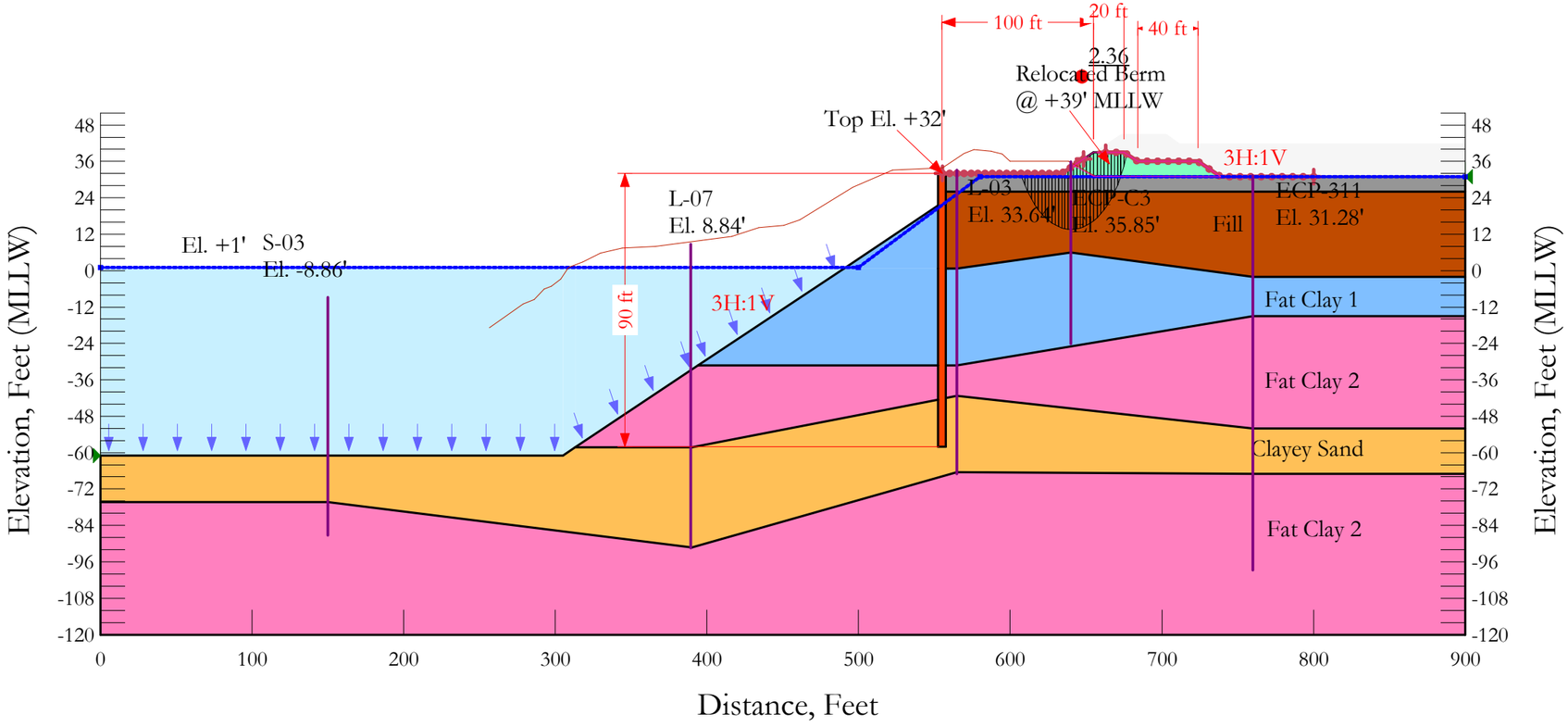


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



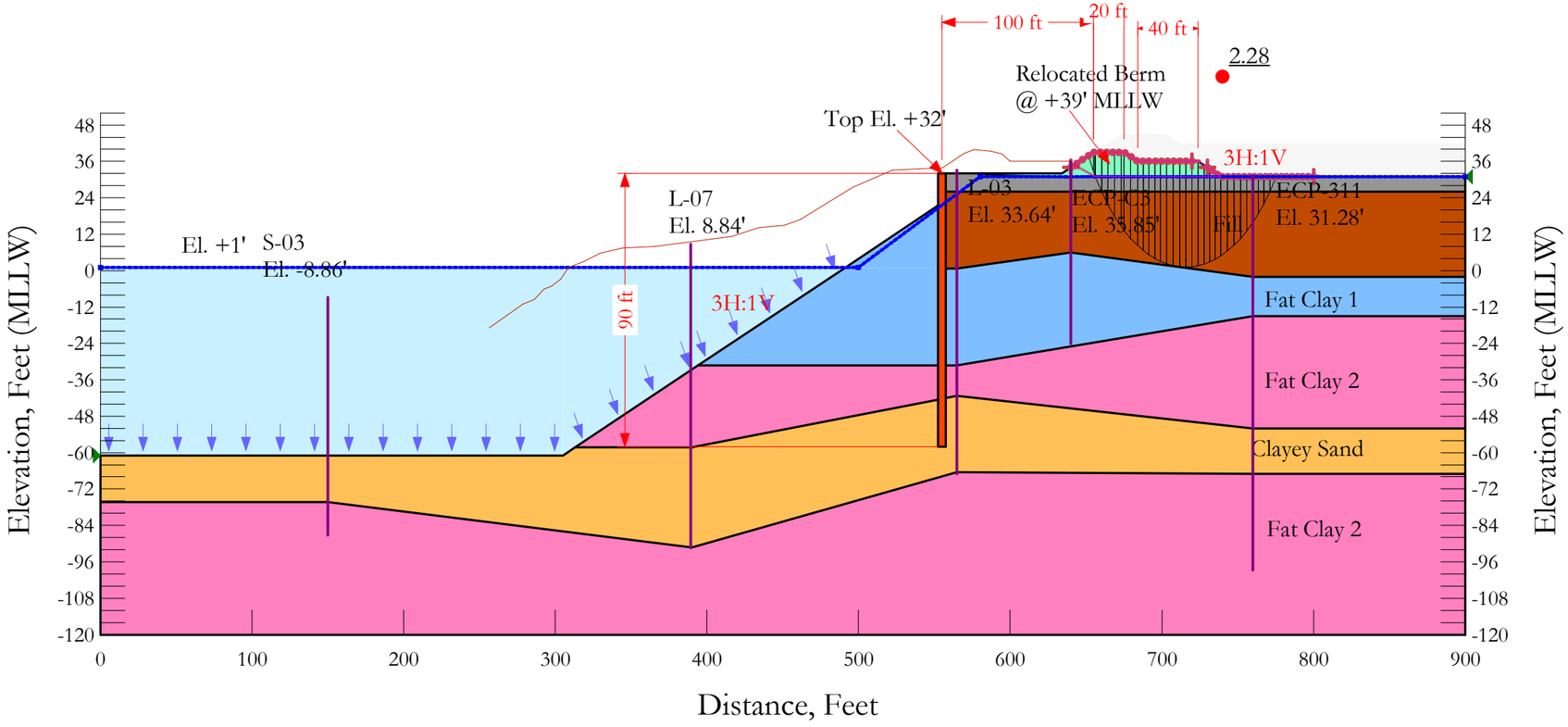
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior Local
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



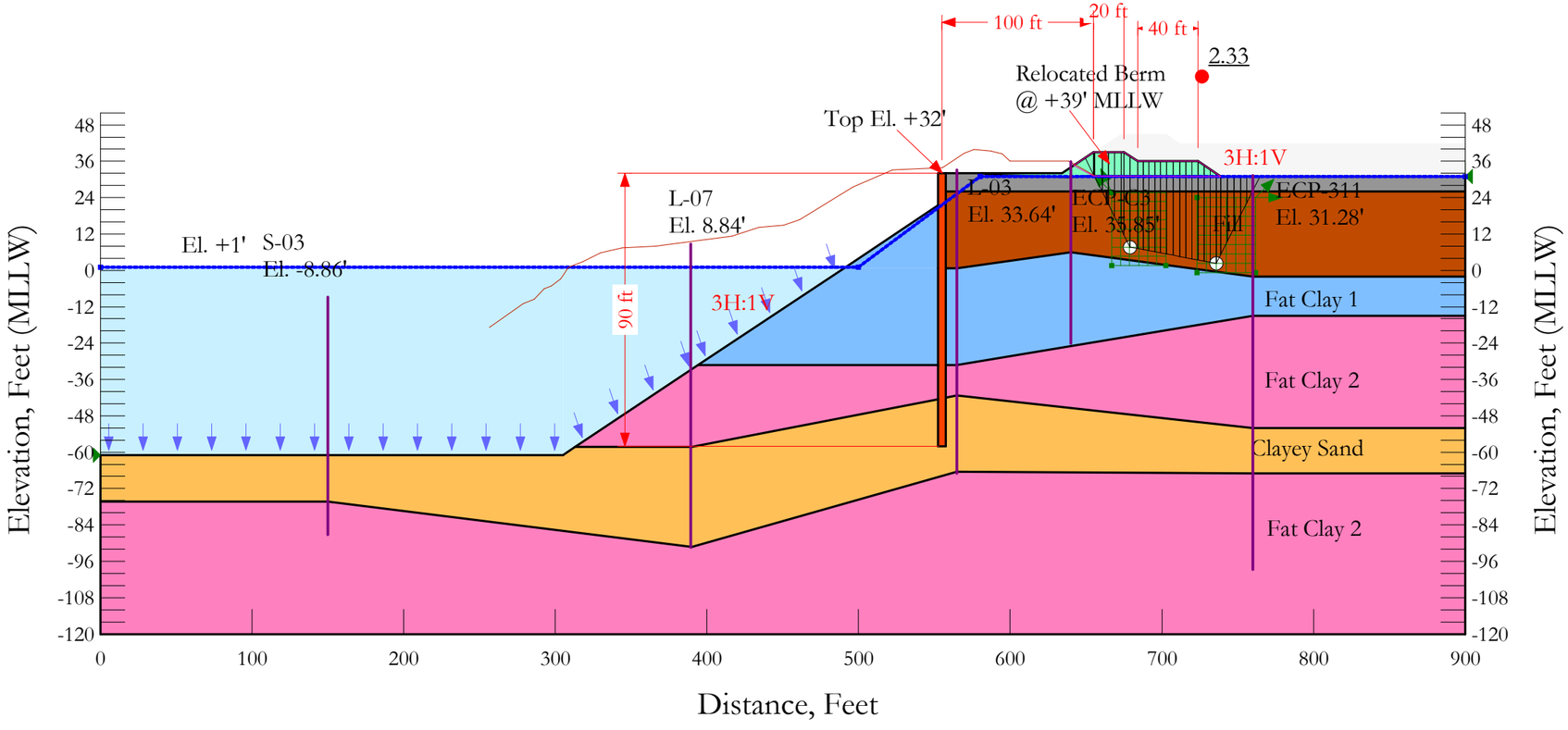
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



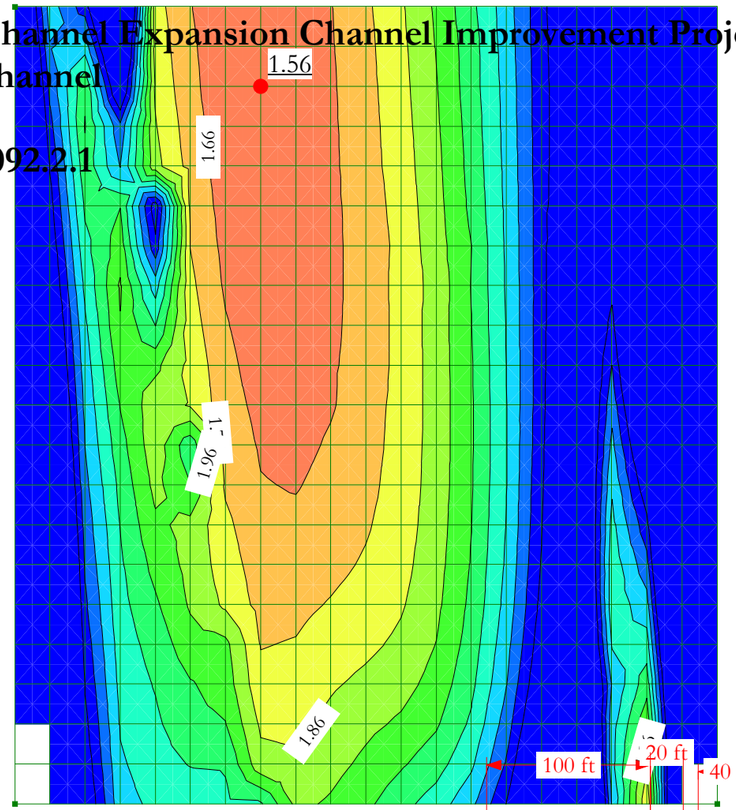
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		

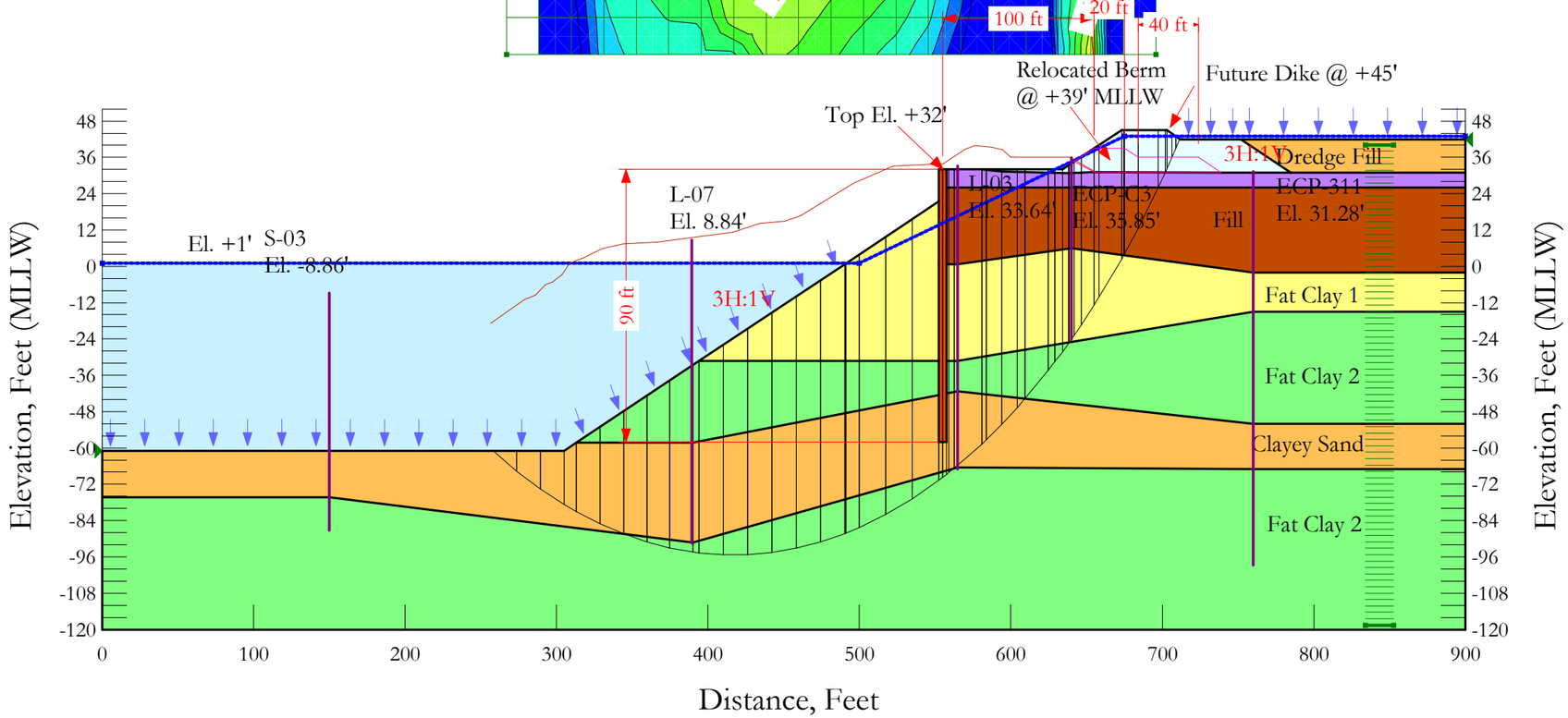


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Long Term
Slip Surface: Circular

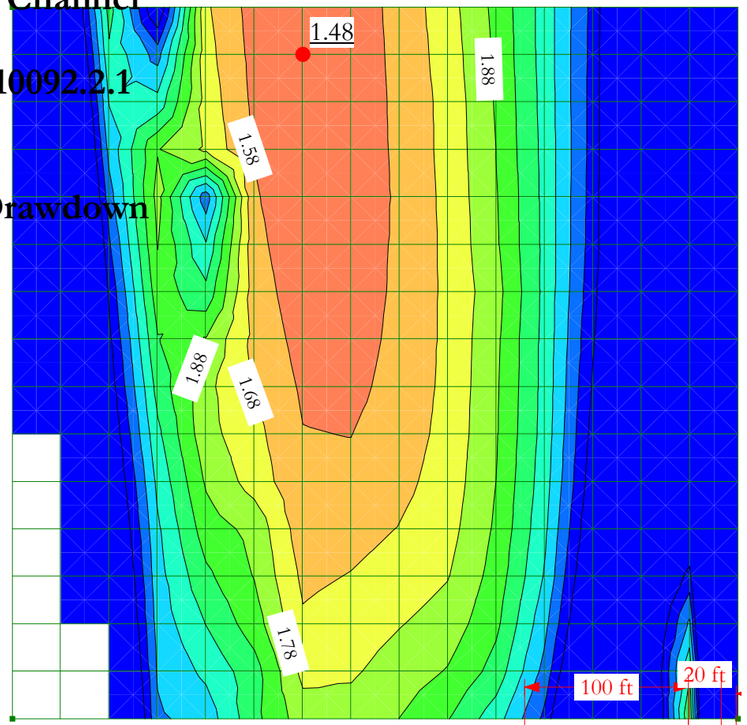


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay (3)	125	300	22
	Fat Clay 1	125	300	22
	Fat Clay 2	125	300	22
	Fill	110	100	20

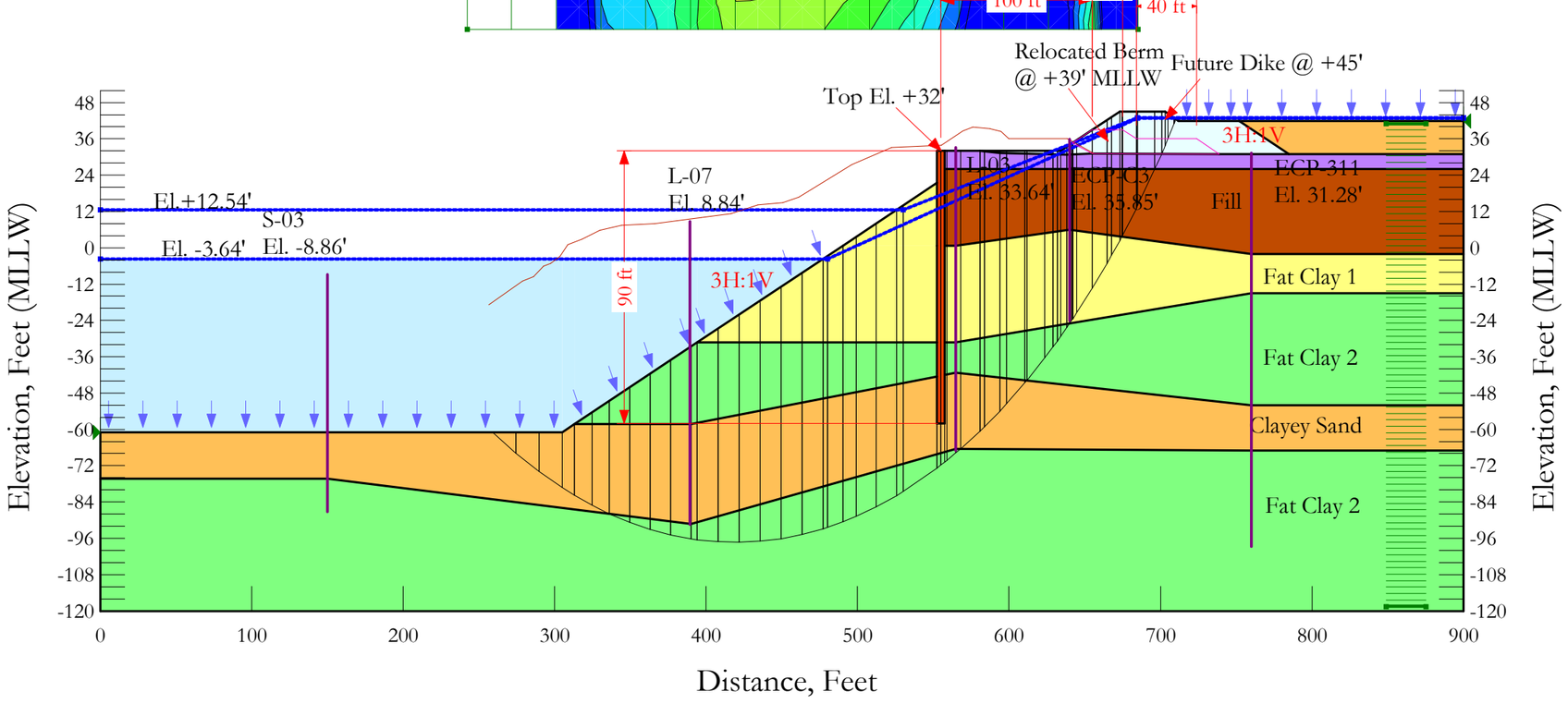


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

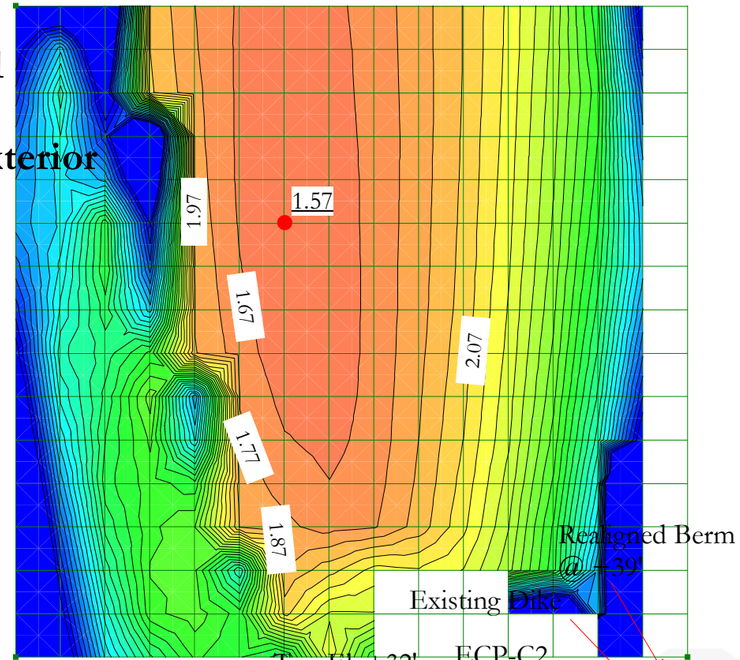
Loading Condition: Rapid Drawdown
Slip Surface: Circular



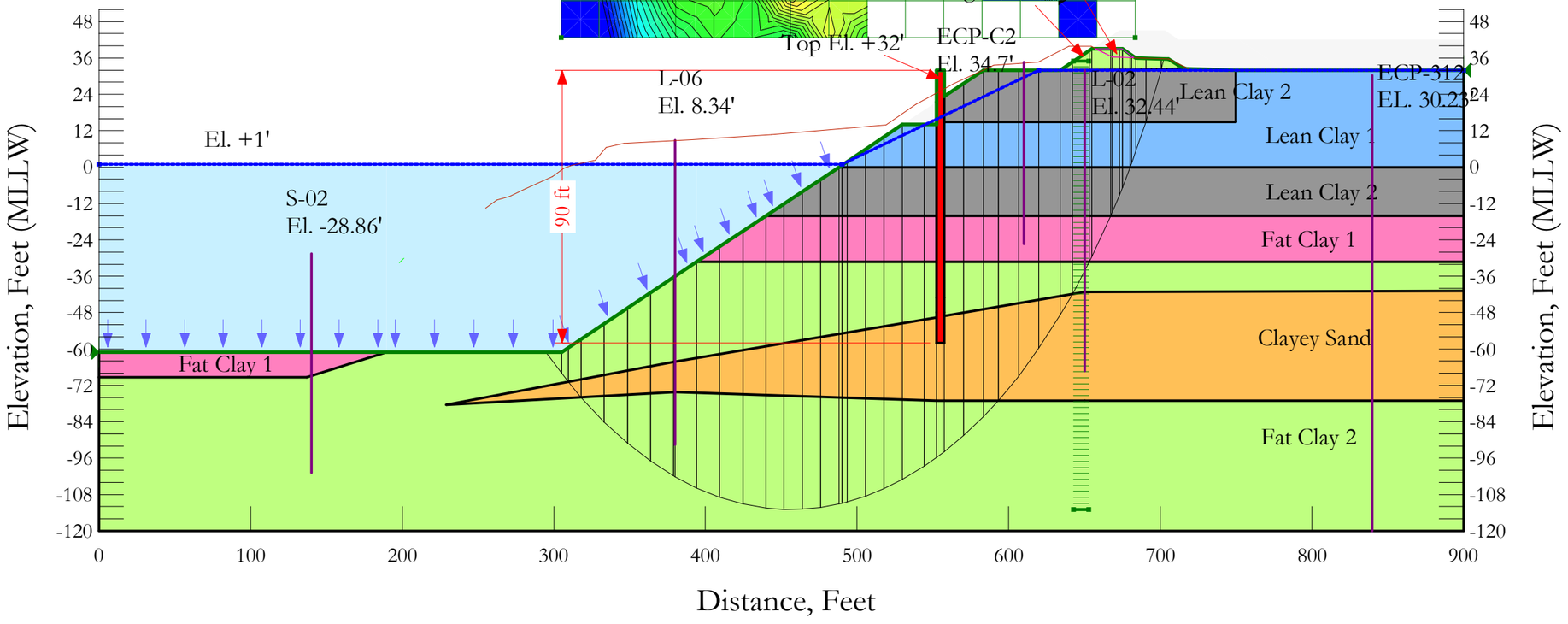
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay (3)	125	300	22	500	15
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Fill	110	100	20	150	15



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Circular

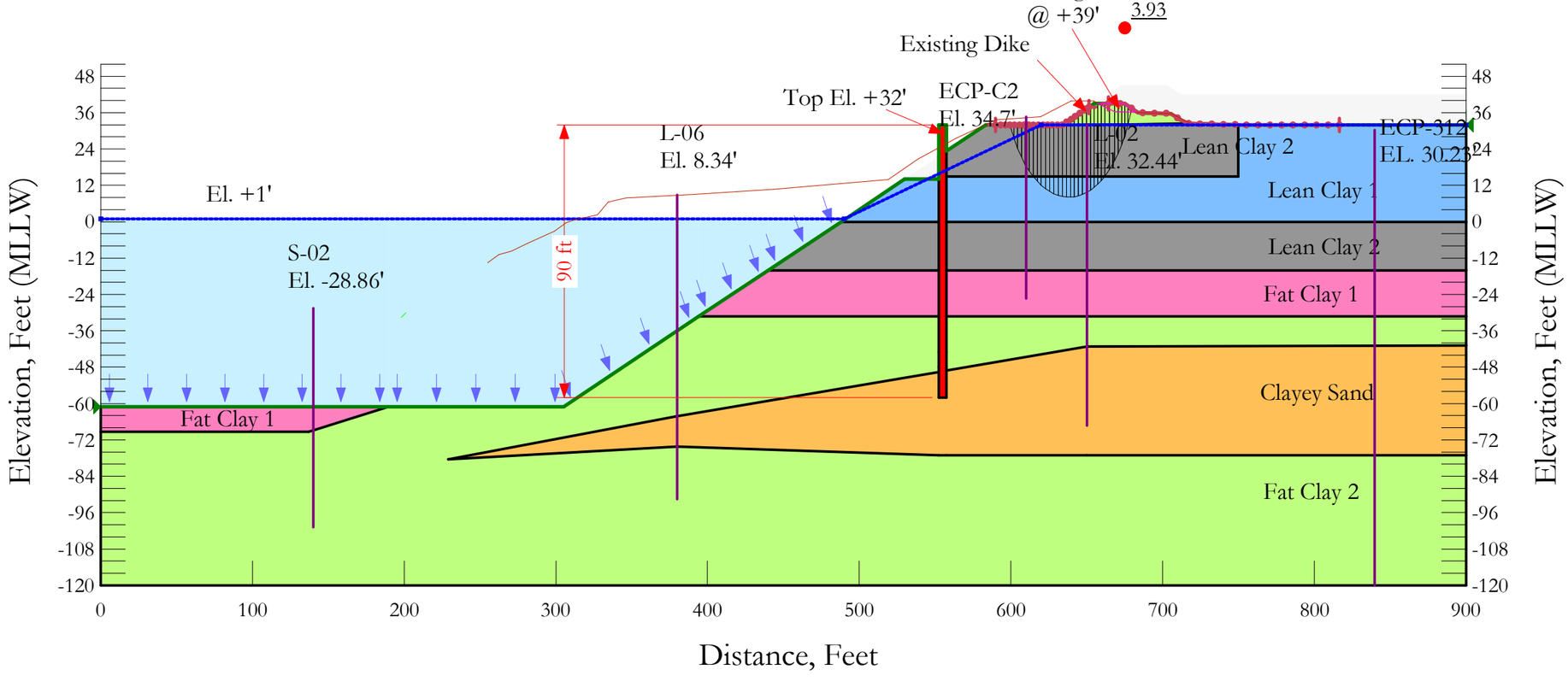


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



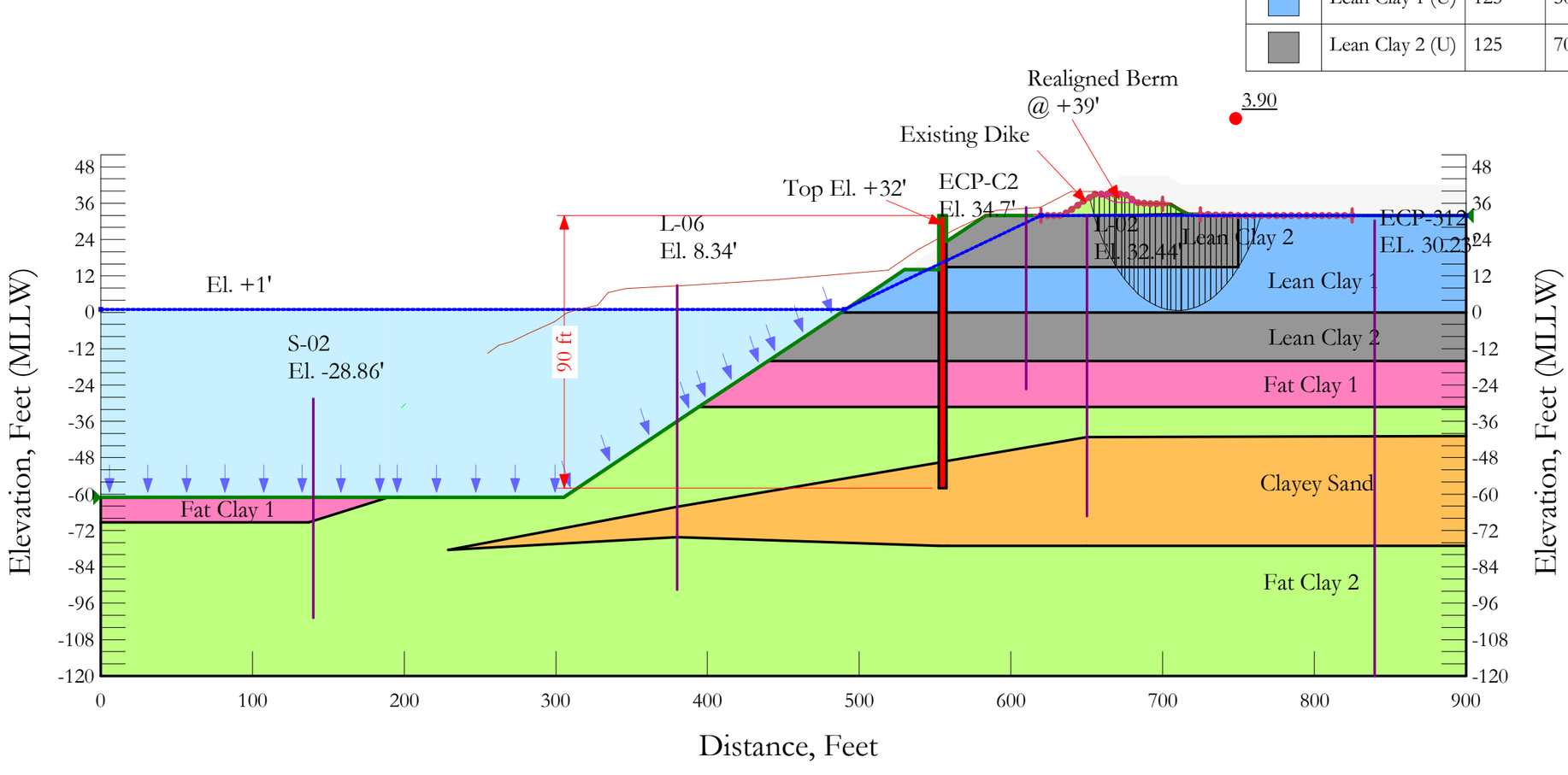
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior Local
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



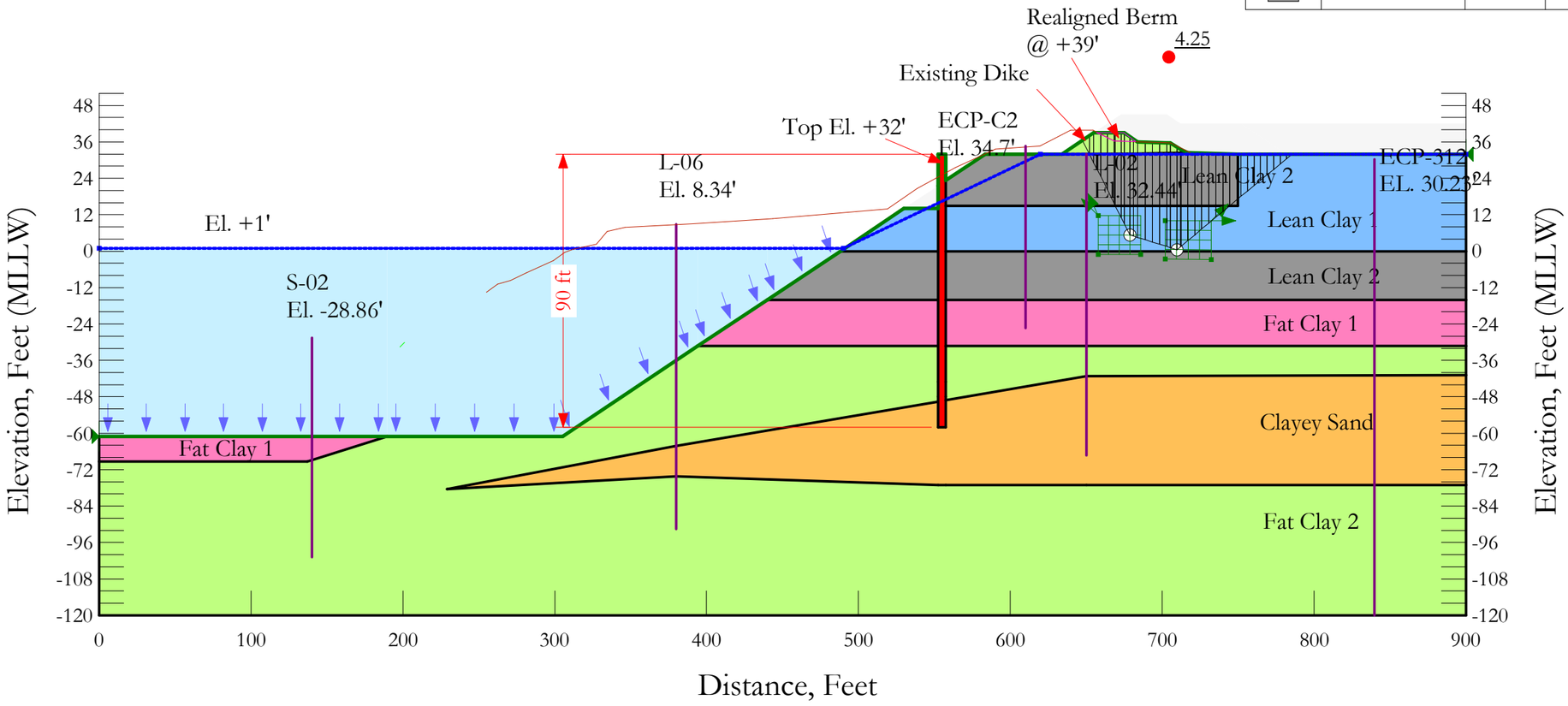
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		

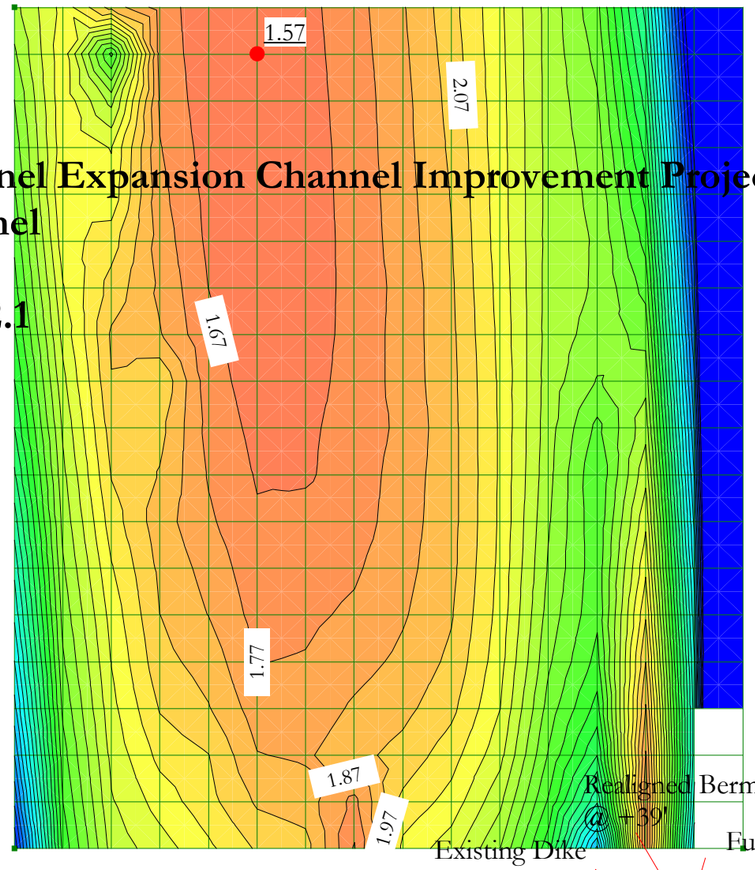


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Dike Interior
Slip Surface: Block

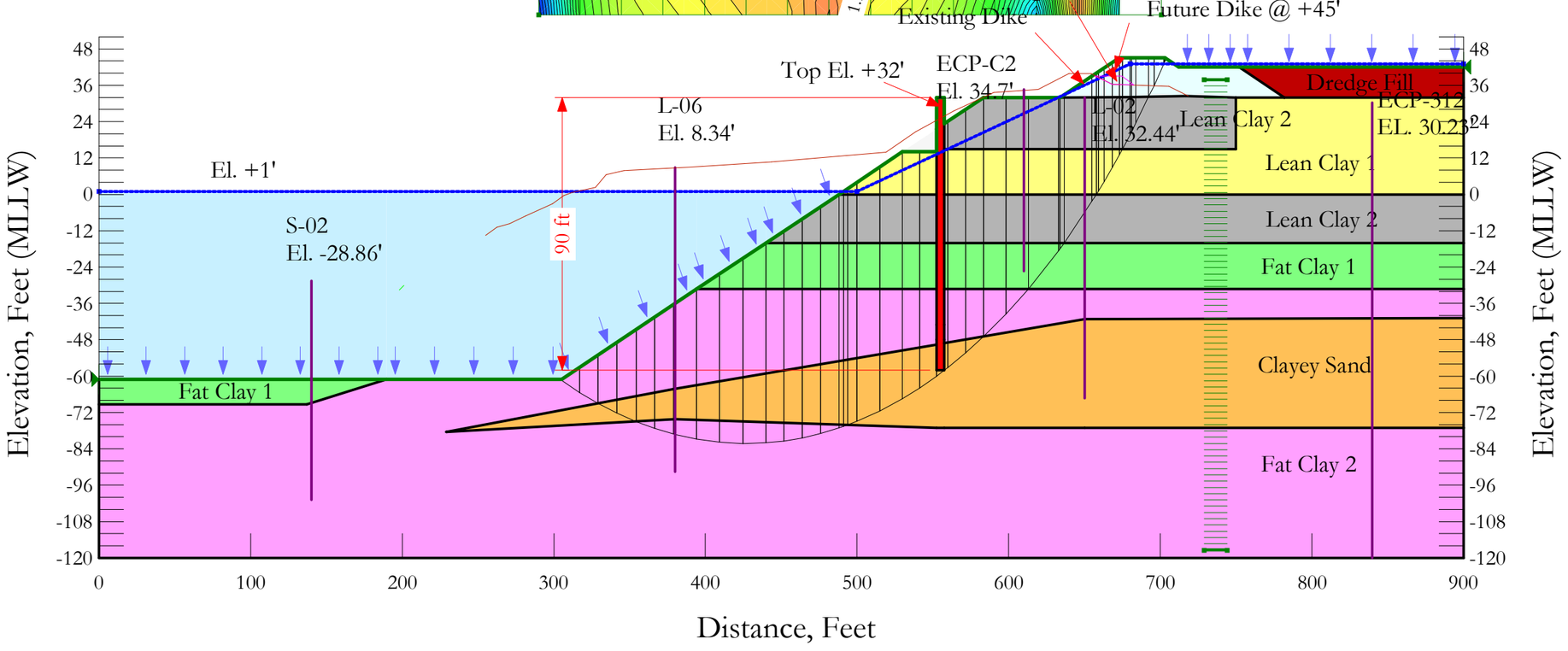
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Long Term
Slip Surface: Circular

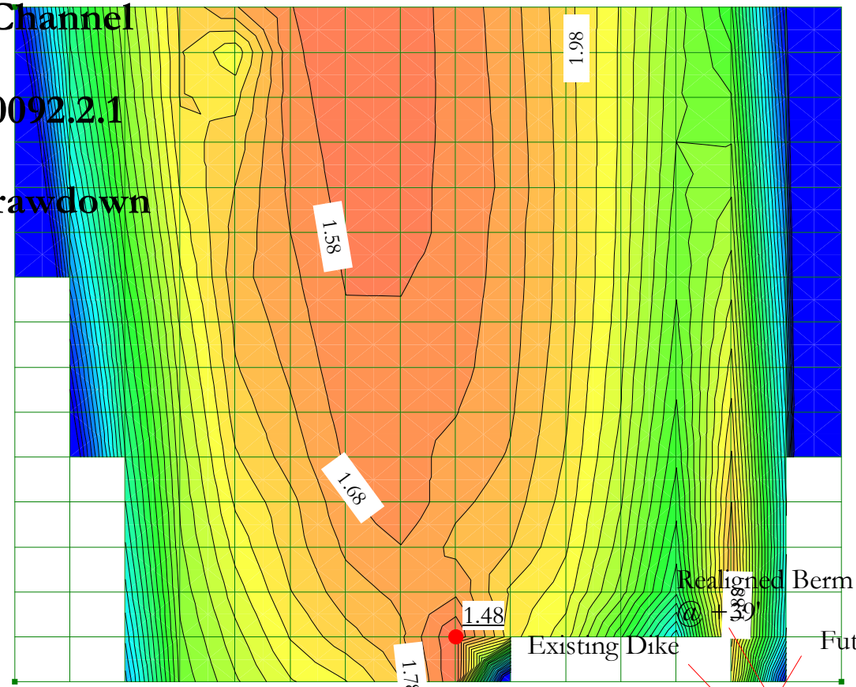


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay 1	125	300	22
	Fat Clay 2	125	300	22
	Lean Clay 1	125	100	25
	Lean Clay 2	125	100	25

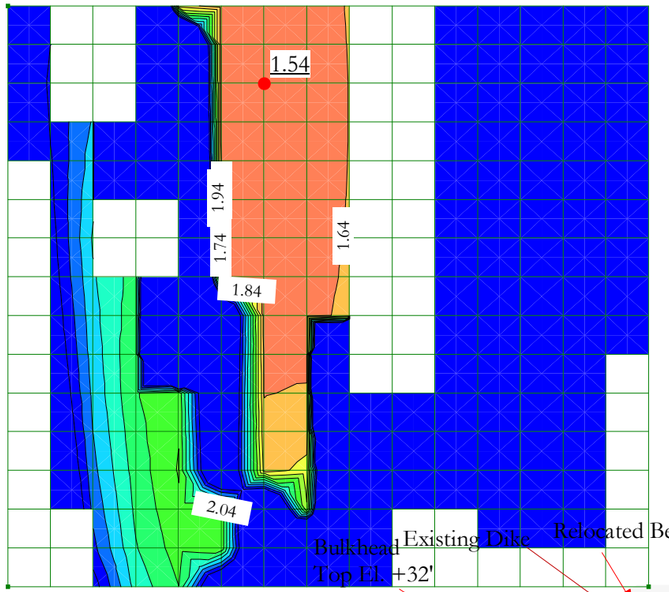


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular

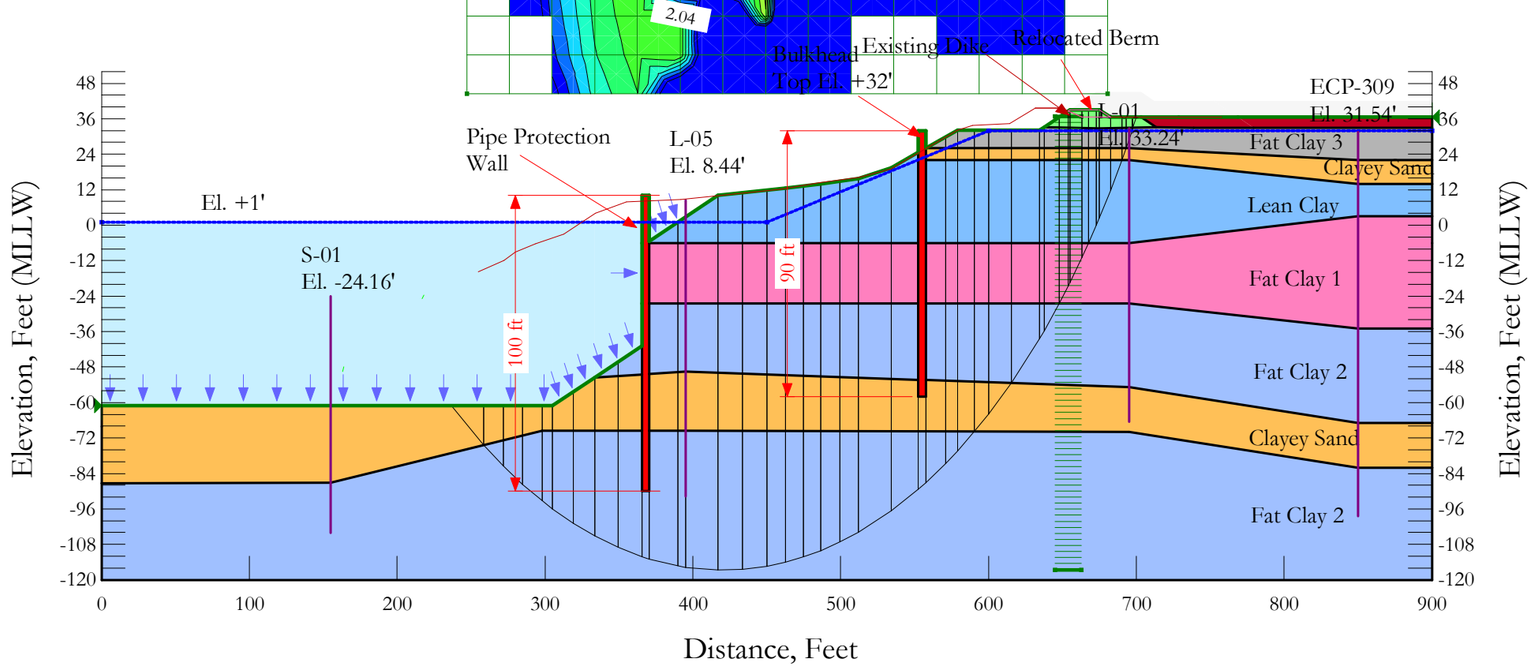
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Lean Clay 1	125	100	25	150	20
	Lean Clay 2	125	100	25	150	20



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Circular

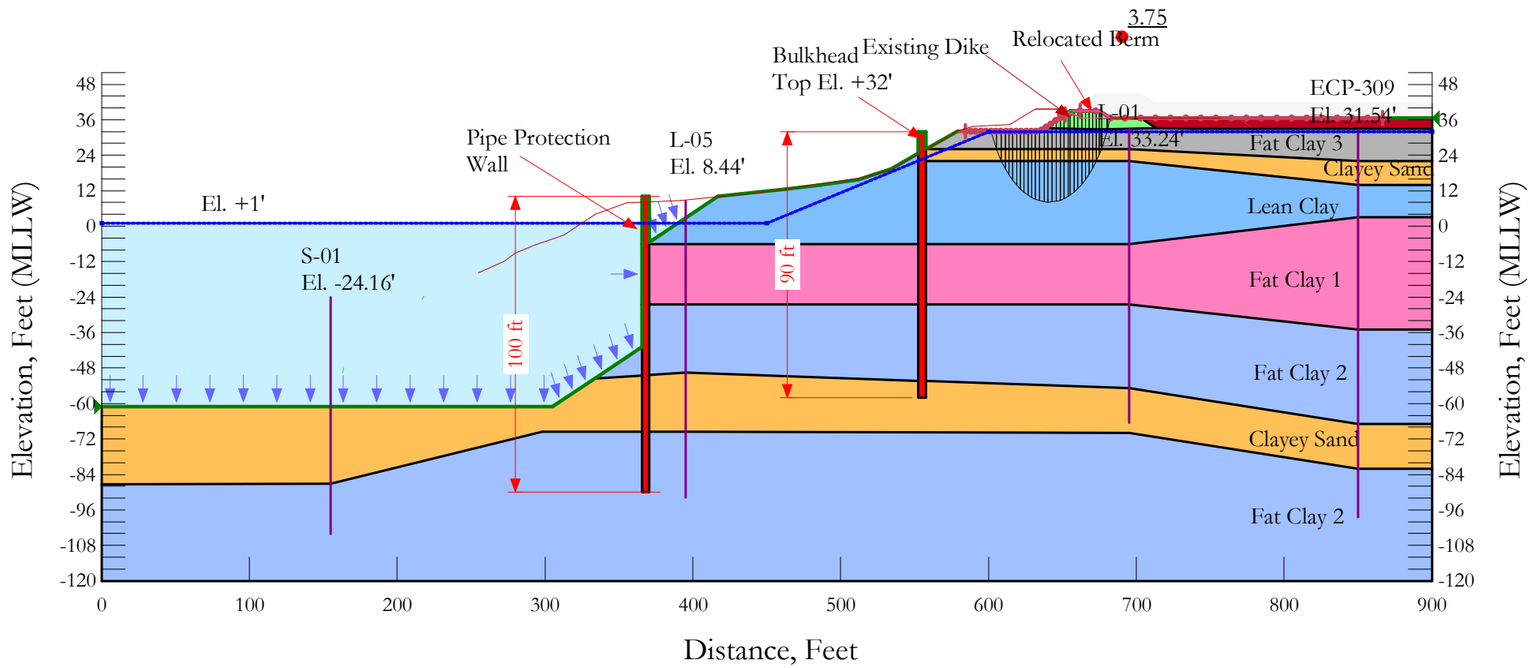


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



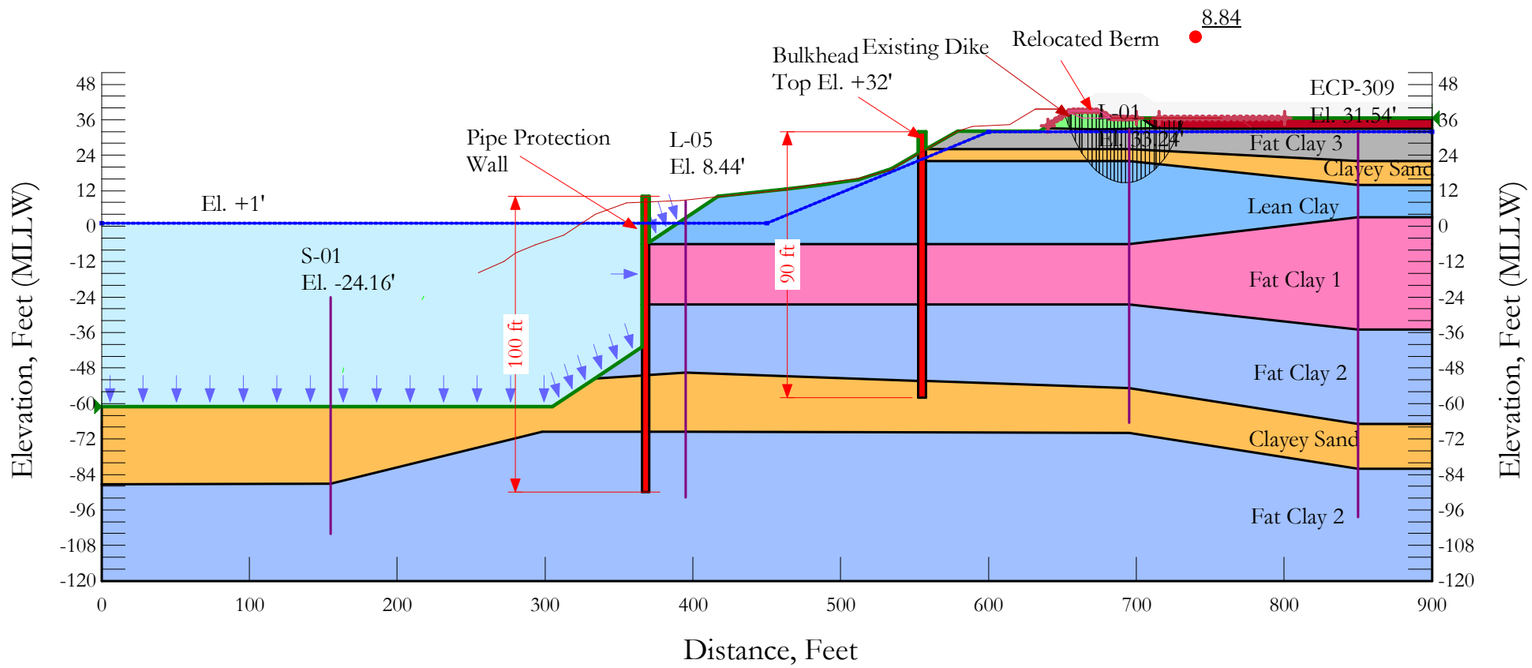
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior Local
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



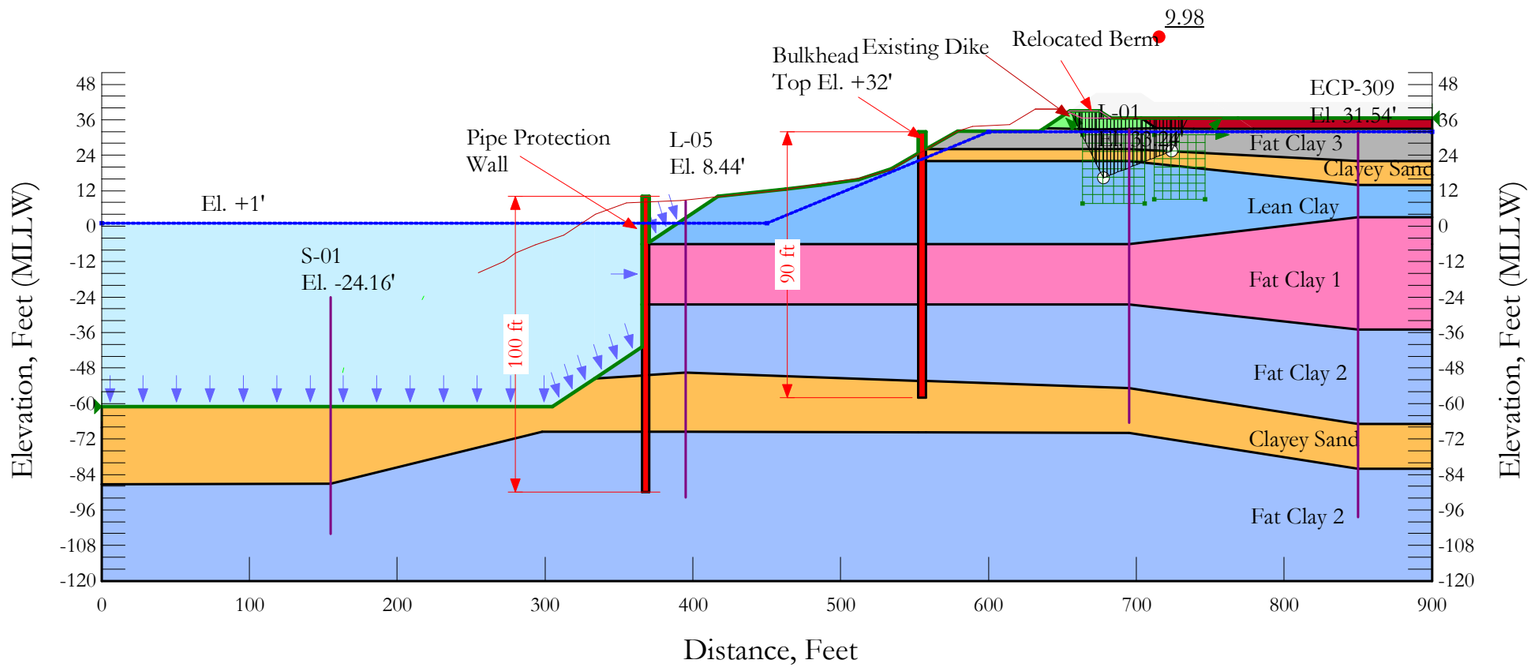
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

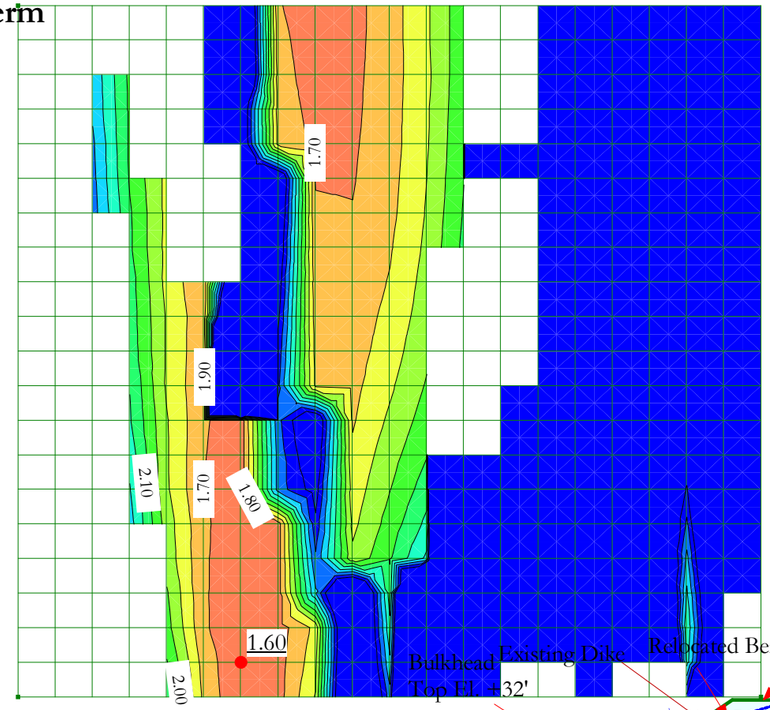


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Block

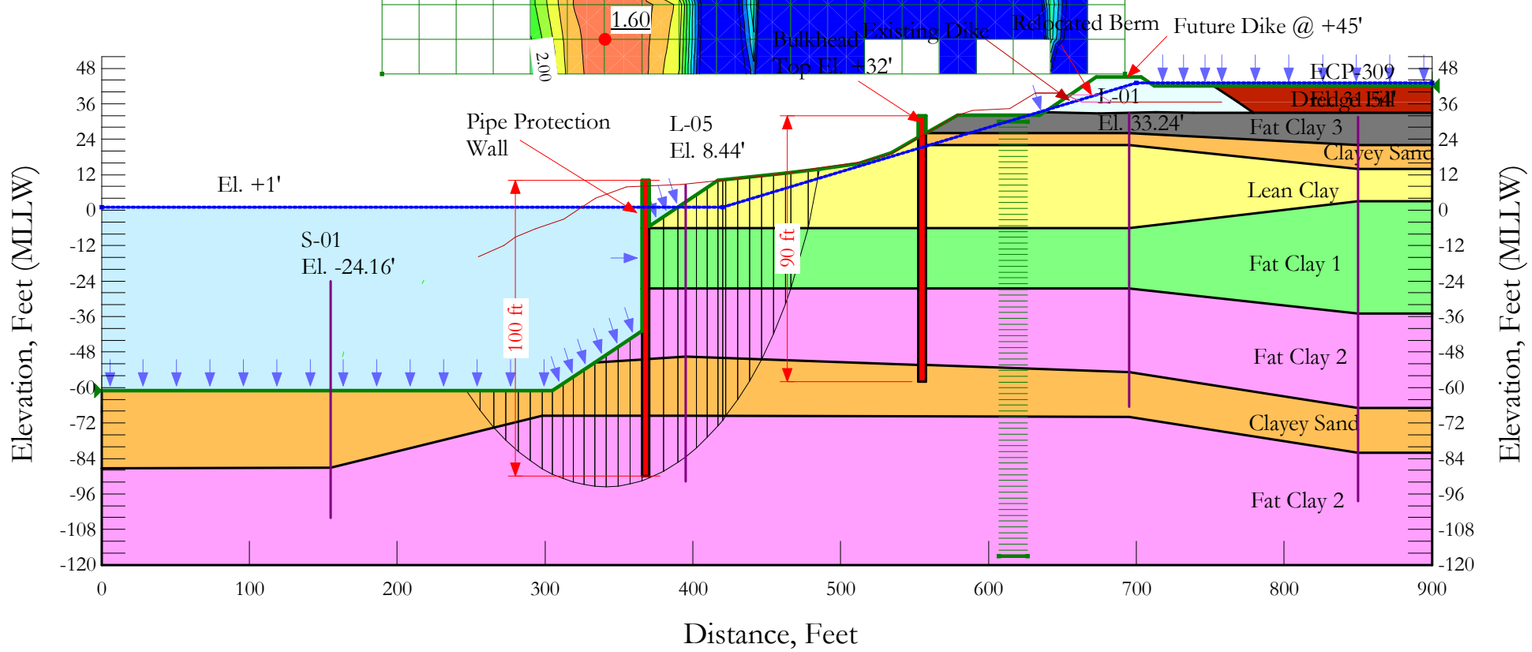
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



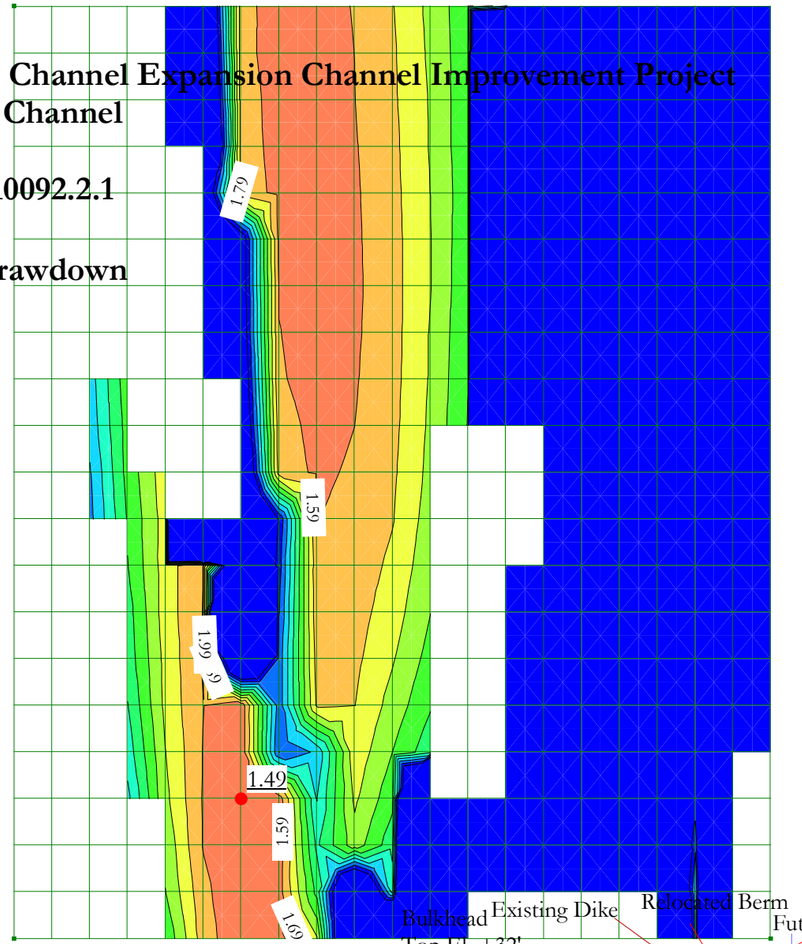
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Long Term
Slip Surface: Circular



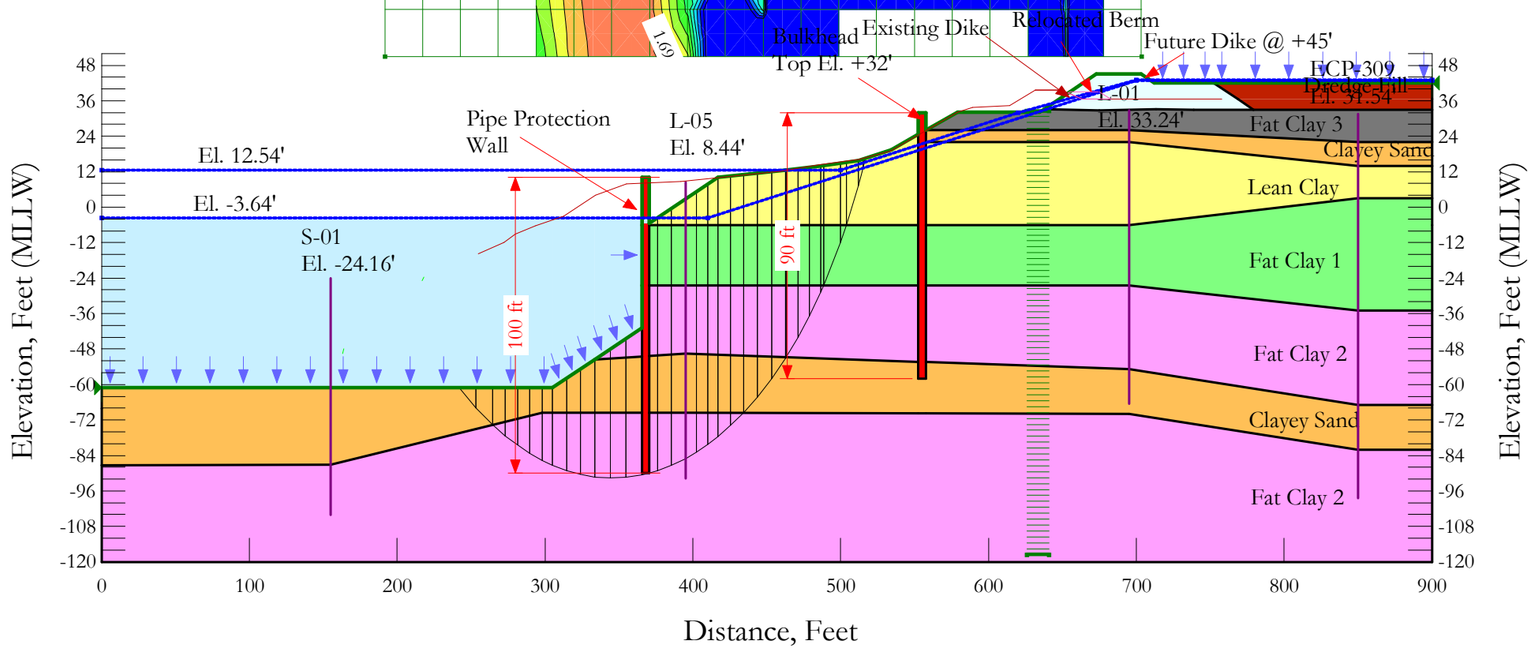
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay 1	125	400	18
	Fat Clay 2	125	300	22
	Fat Clay 3	125	300	22
	Lean Clay	125	100	25



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular



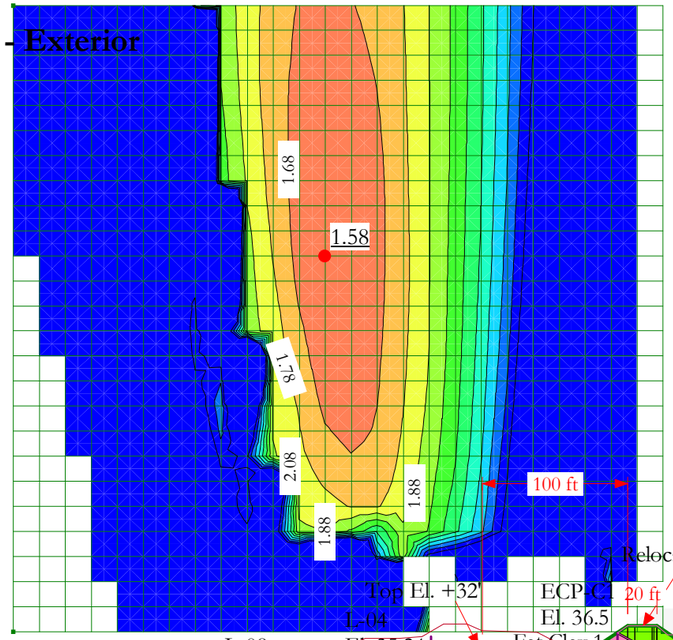
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	400	18	500	14
	Fat Clay 2	125	300	22	500	15
	Fat Clay 3	125	300	22	500	15
	Lean Clay	125	100	25	150	20

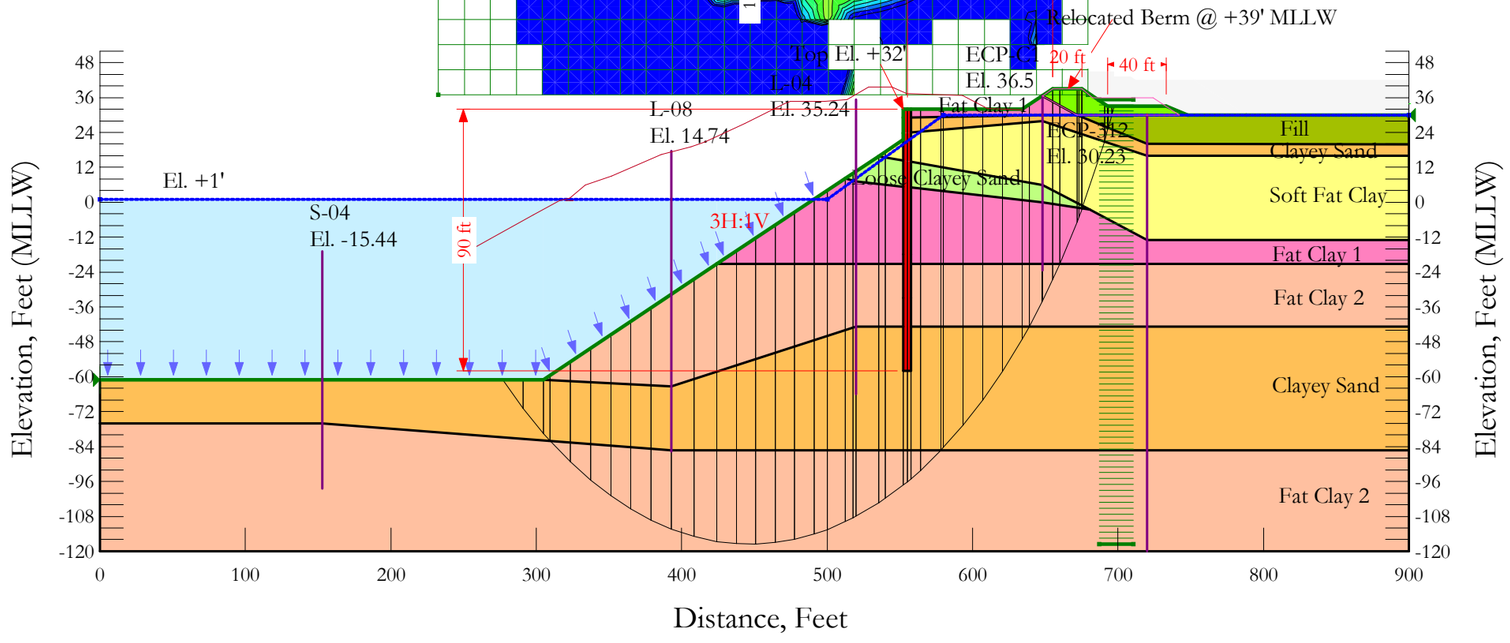


SLOPE STABILITY ANALYSIS:
REALIGNED BERM AT EL. +39 FEET MLLW
RECOMMENDED SLOPE AT STATION 34+00

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular



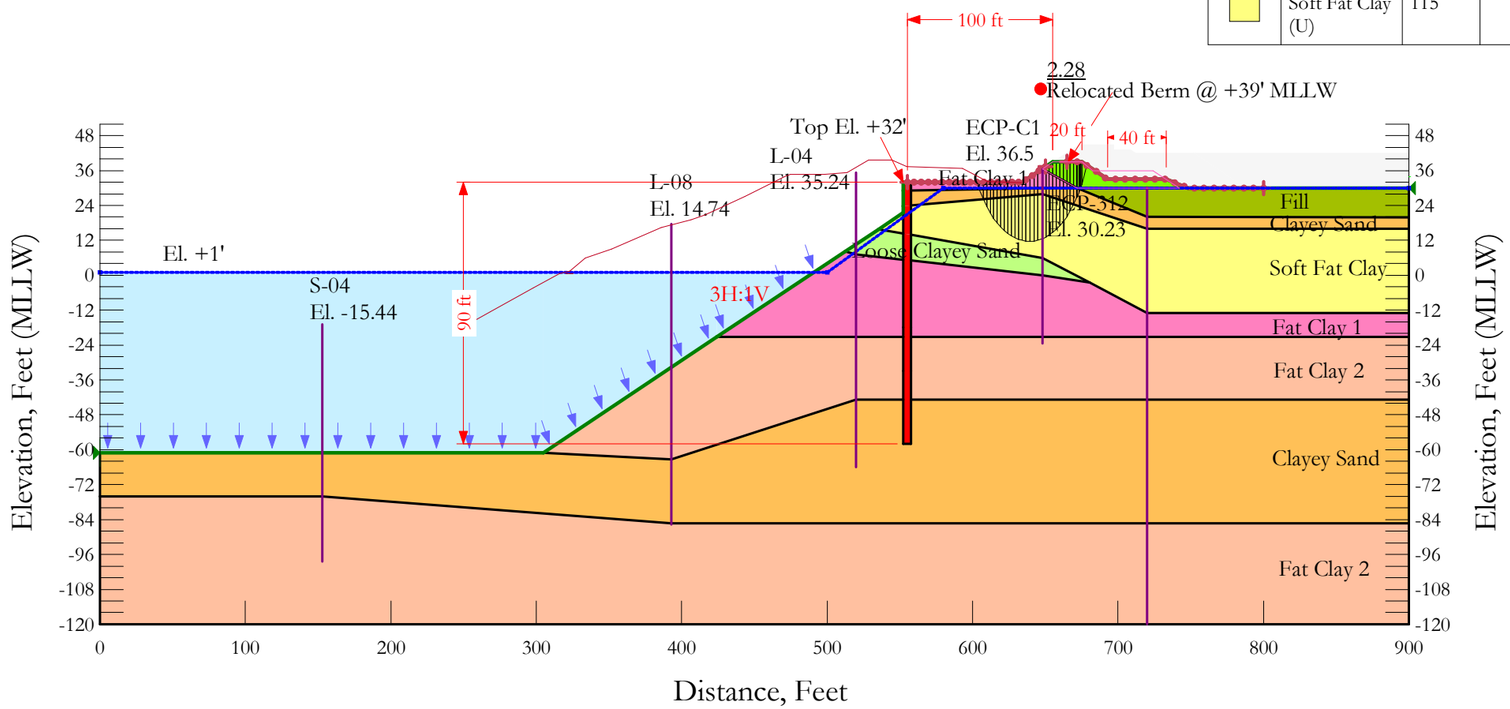


Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular

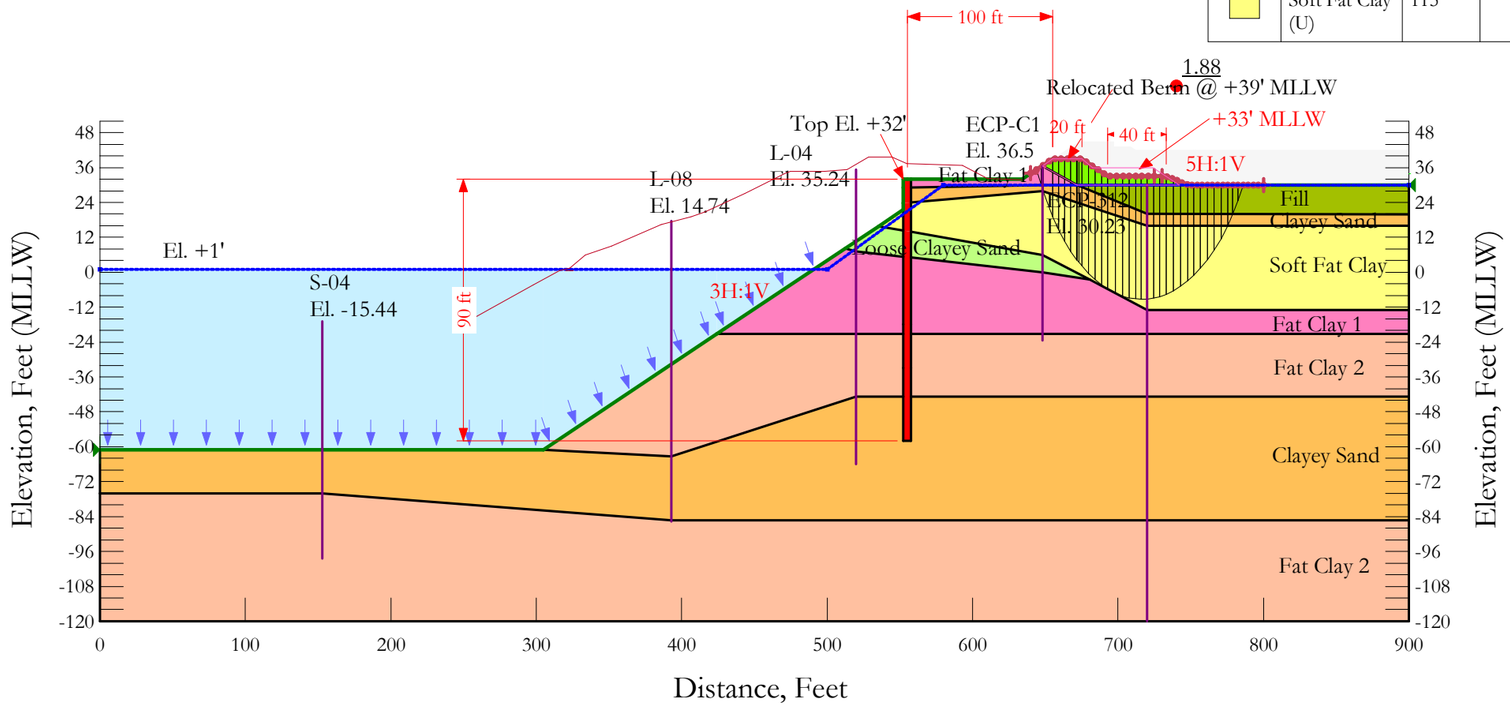
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

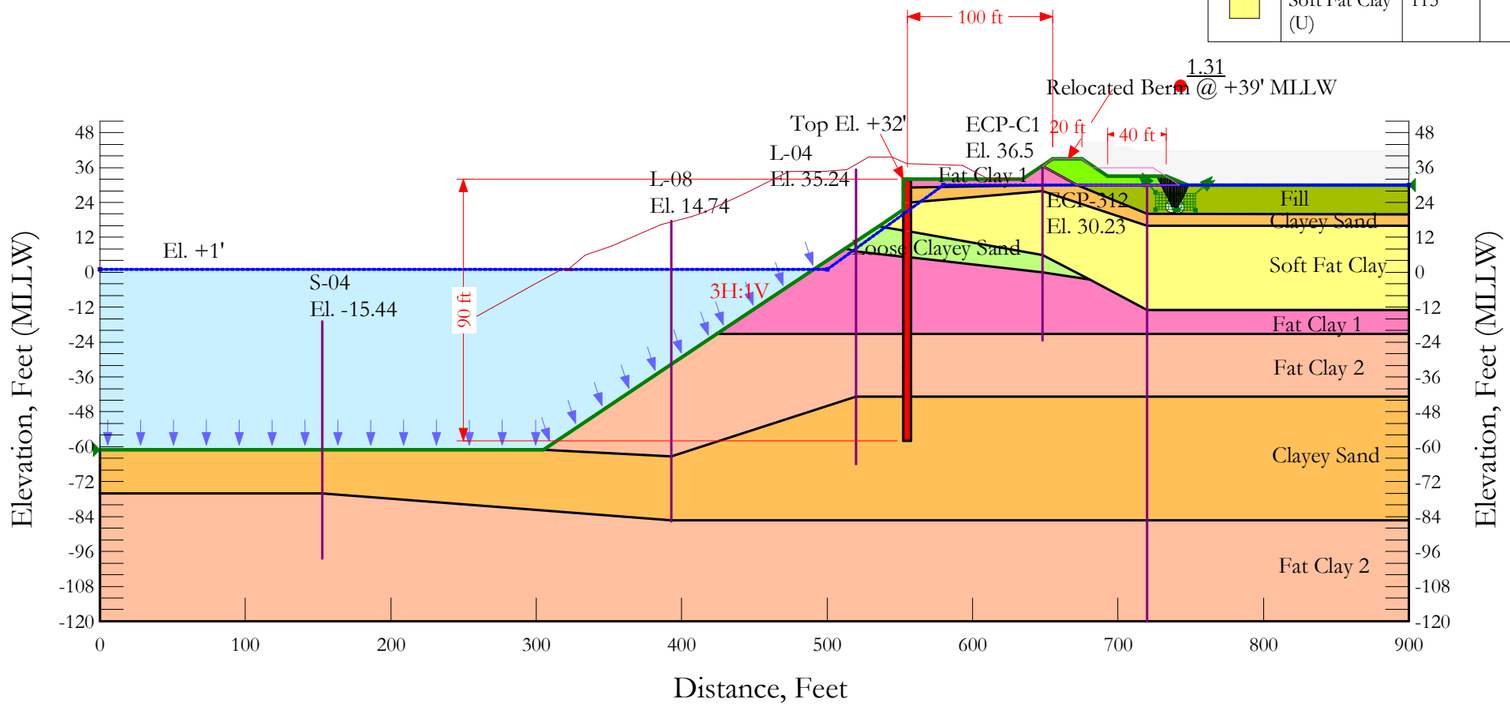
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

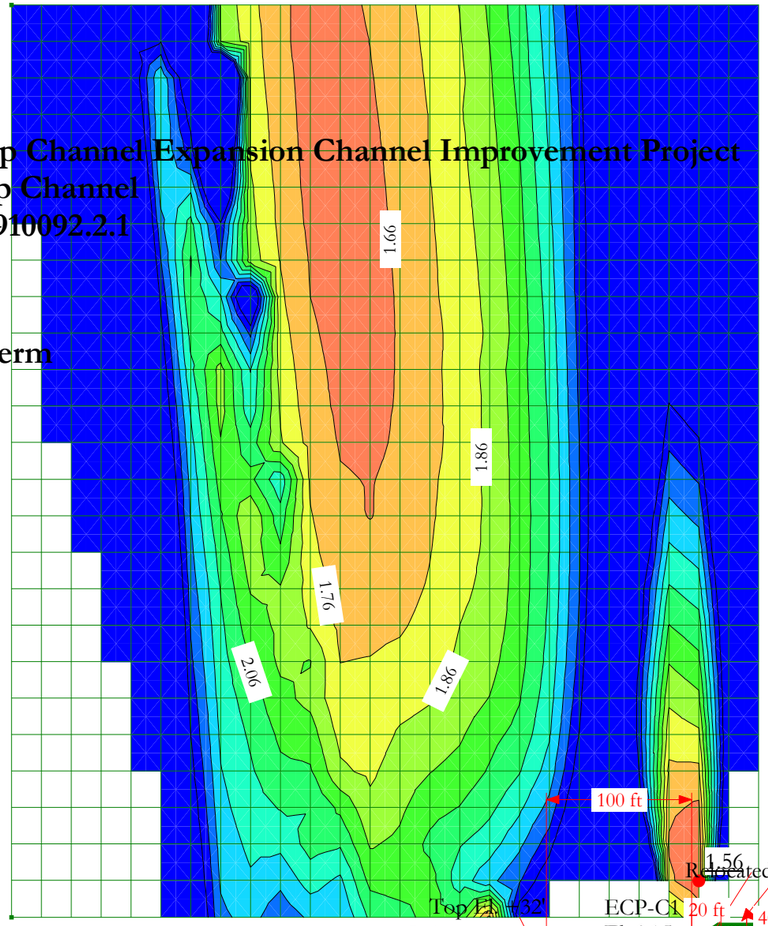
Loading Condition: Short Term - Dike Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		

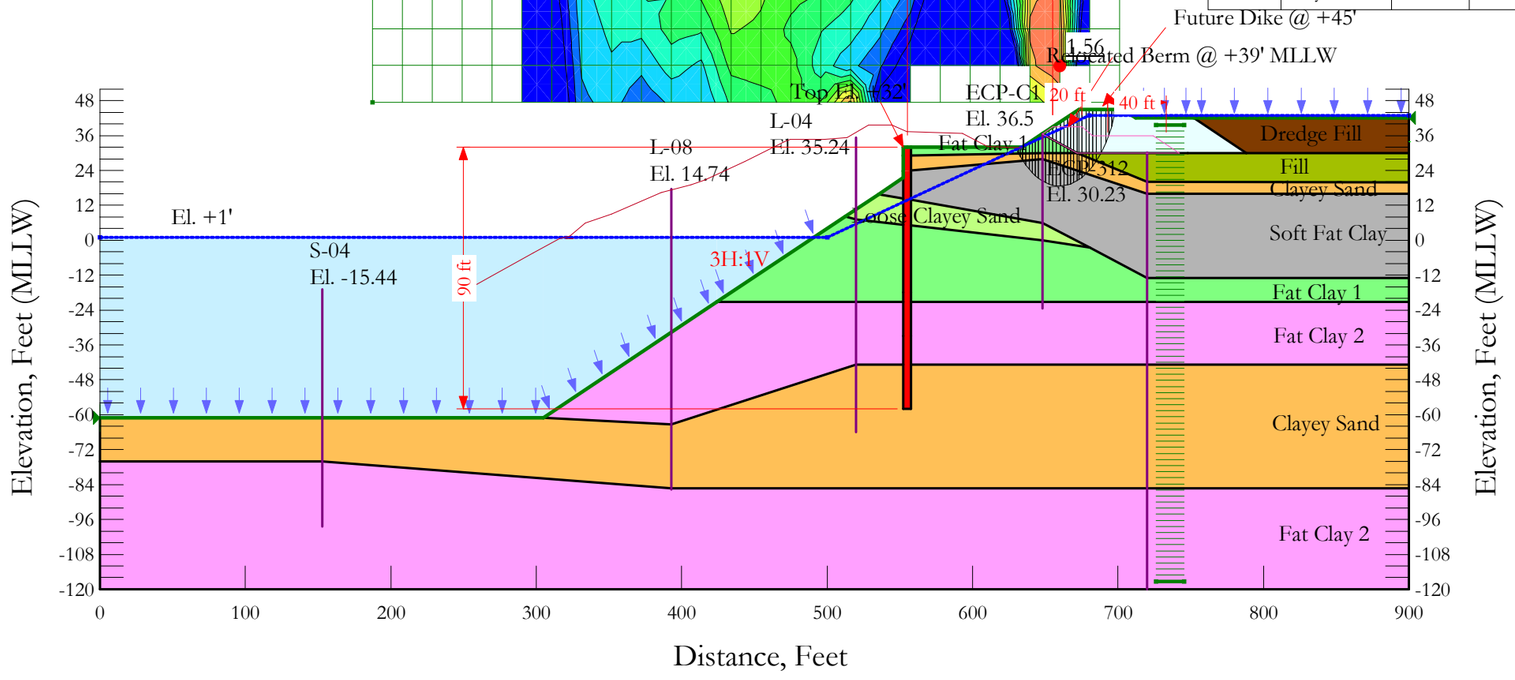


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

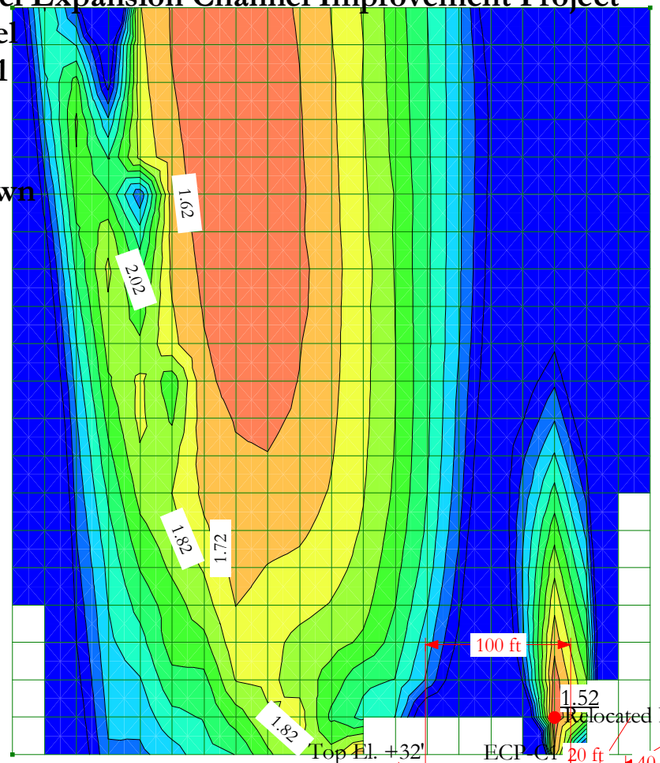
Loading Condition: Long Term
Slip Surface: Circular



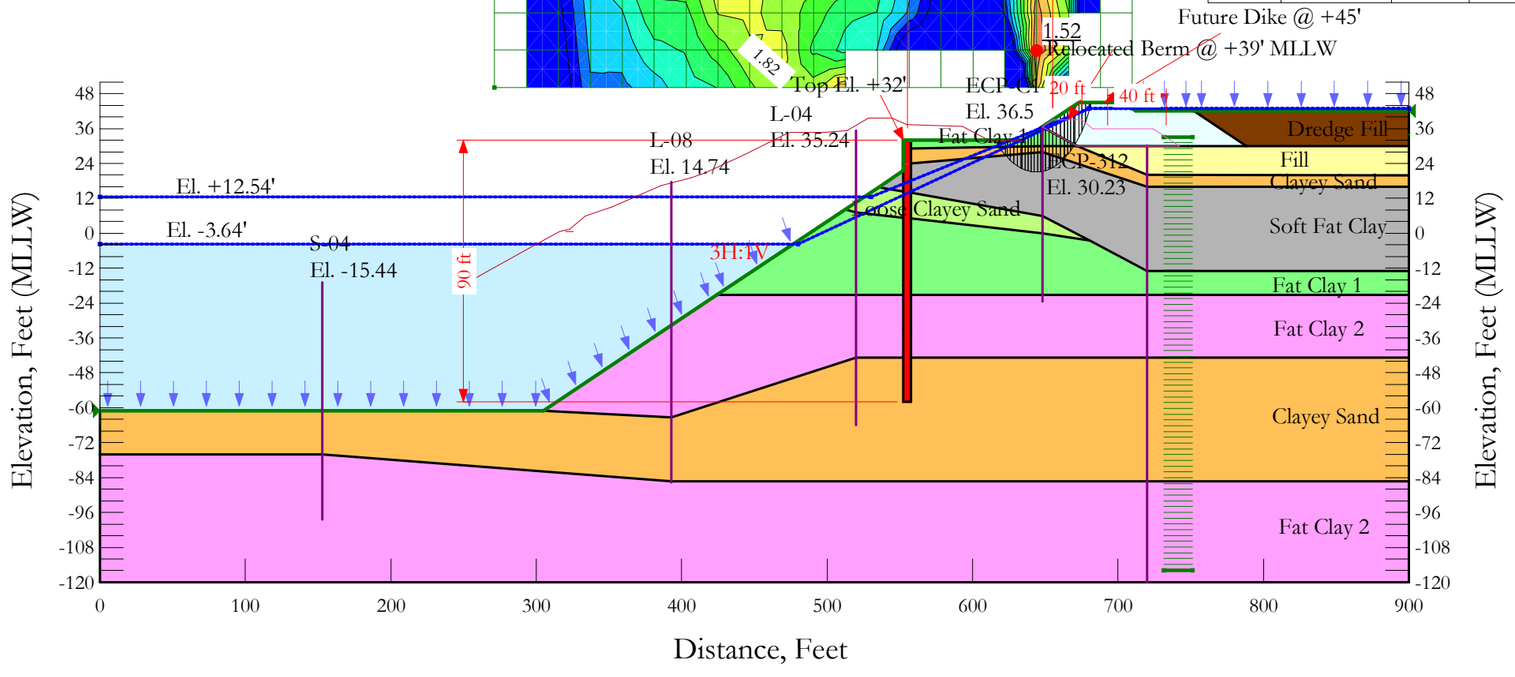
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150					
	Clayey Sand	120				0	30
	Dike	125				100	25
	Dredge Fill	90				16	15
	Fat Clay 1	125				300	22
	Fat Clay 2	125				300	22
	Fill	110	50	10	150		
	Loose Clayey Sand	110				0	28
	Soft Fat Clay	115				100	15



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Fill (RDD)	110	50	25	100	20
	Loose Clayey Sand	110	0	28	0	28
	Soft Fat Clay	115	100	15	150	10

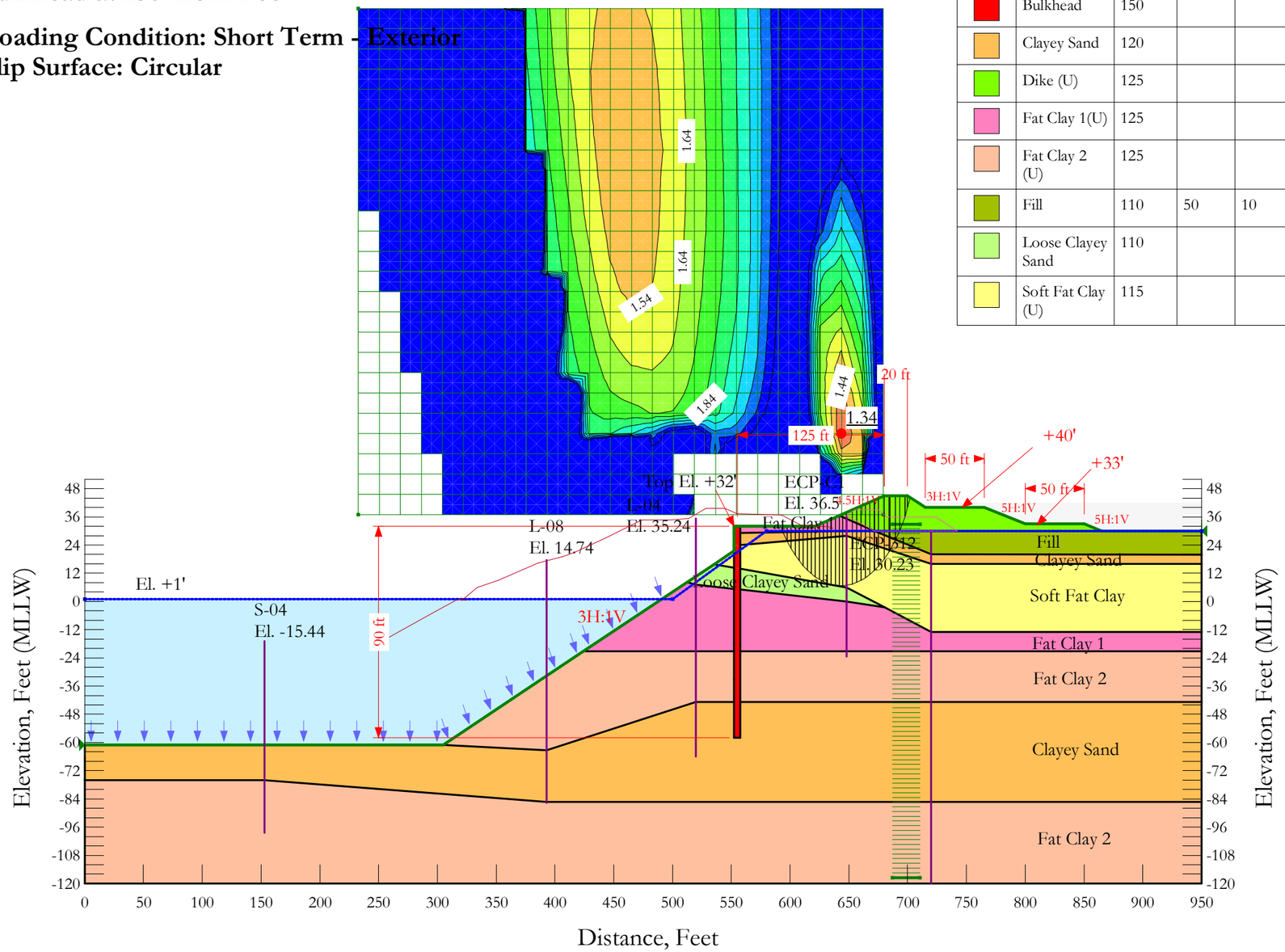


SLOPE STABILITY ANALYSIS:
REALIGNED BERM AT EL. +45 FEET MLLW
RECOMMENDED SLOPE CONFIGURATION

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular

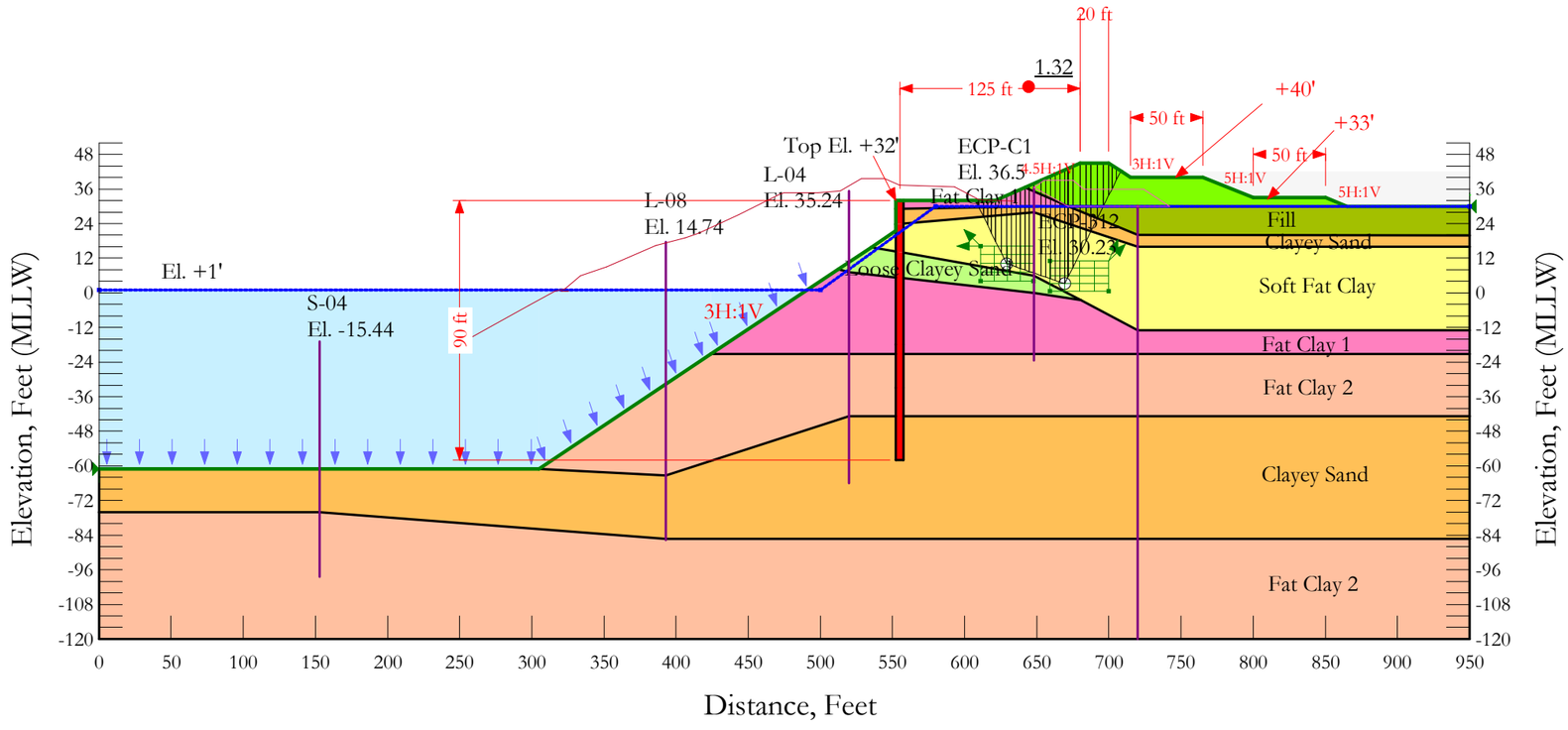
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Block

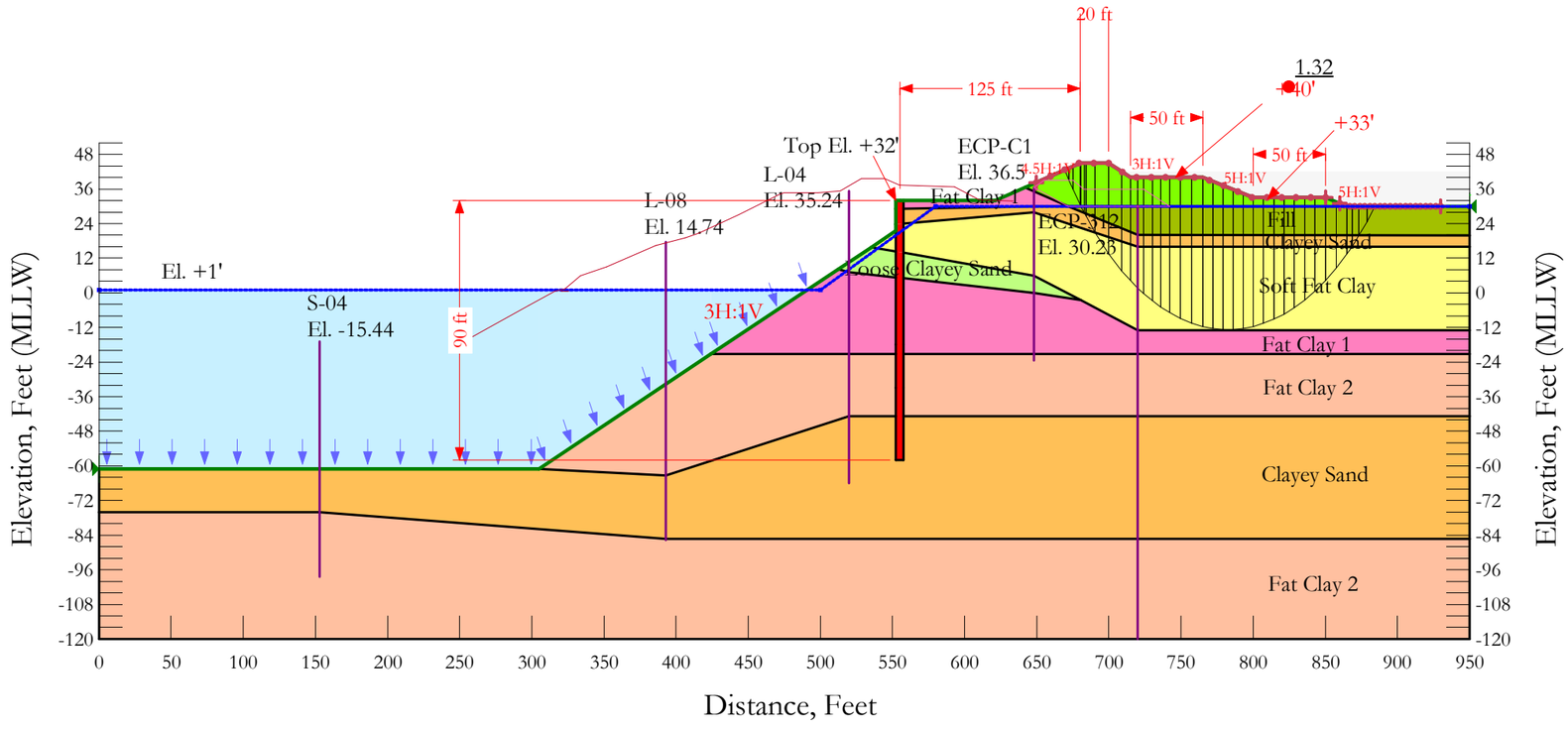
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

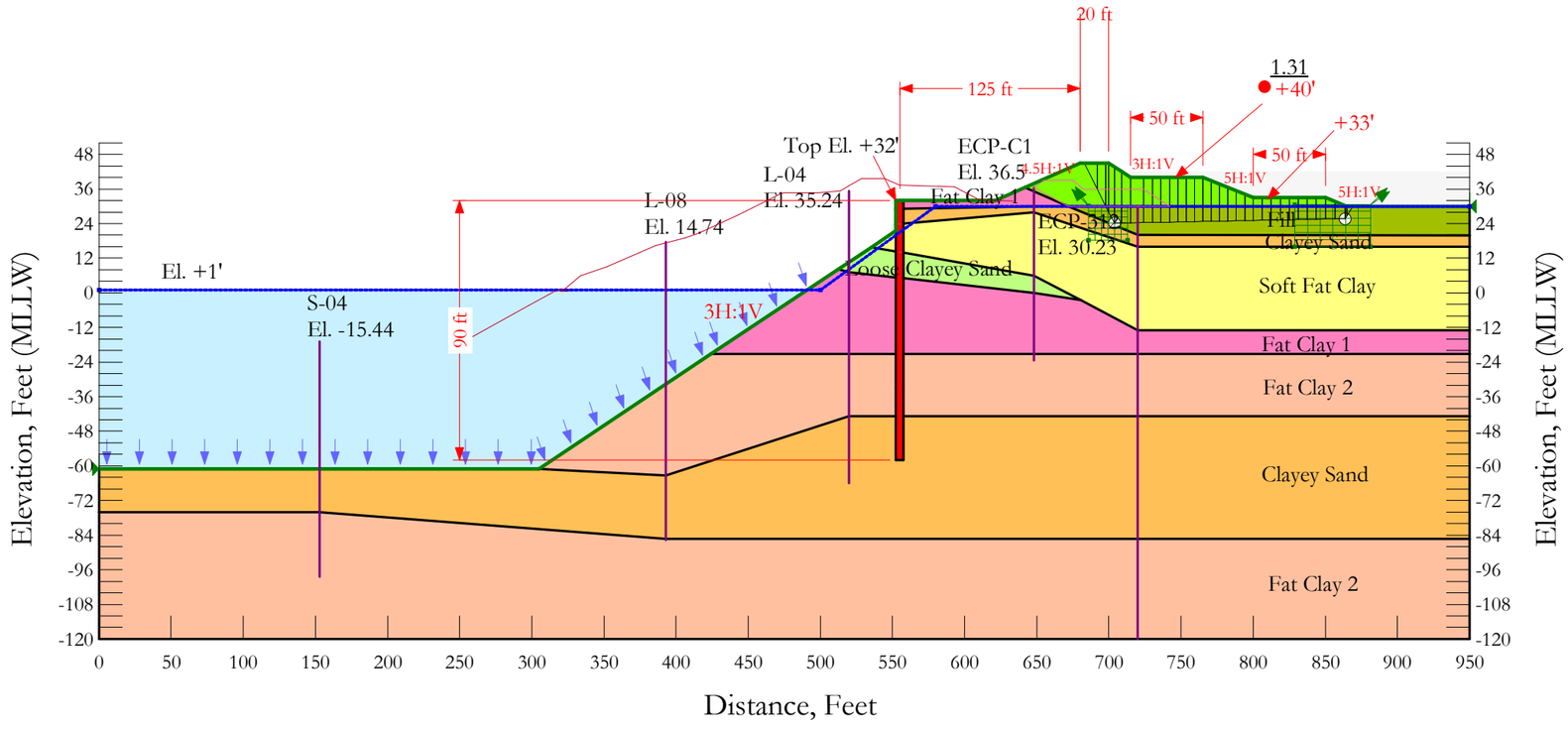
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

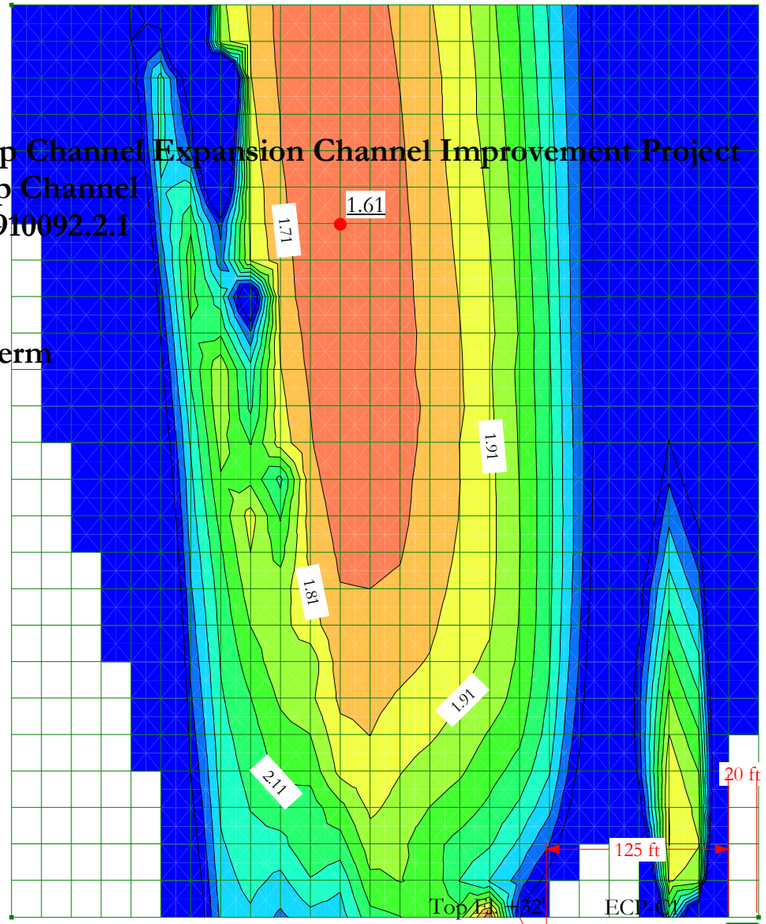
Loading Condition: Short Term - Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150						
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		

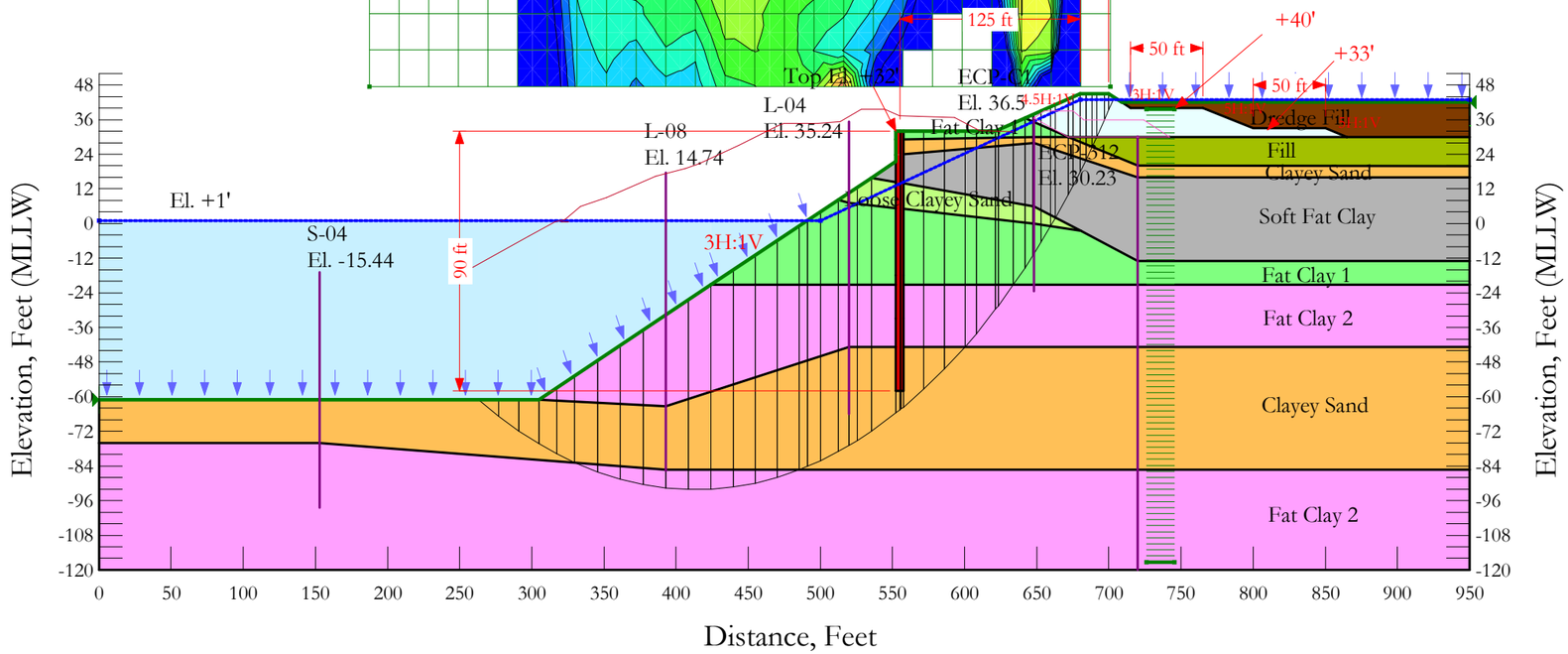


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe

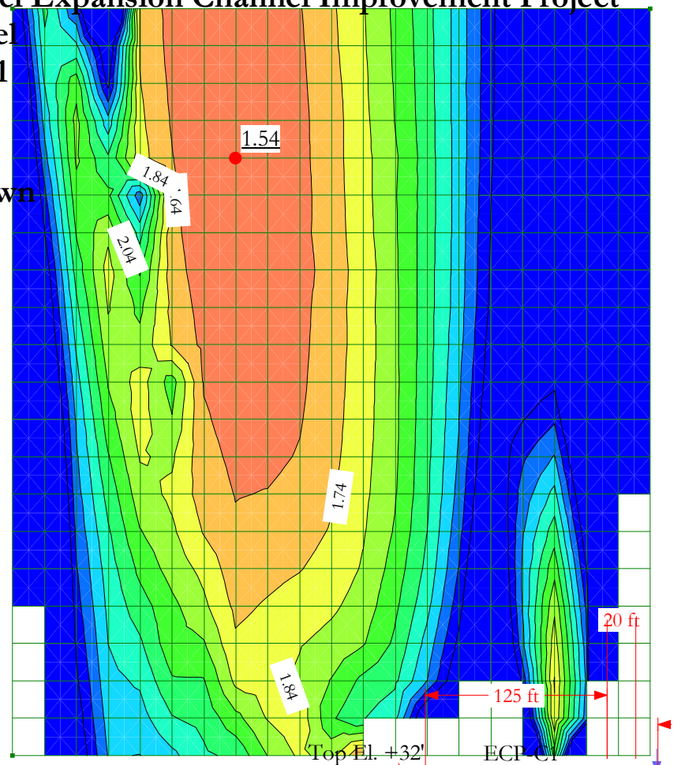
Loading Condition: Long Term
Slip Surface: Circular



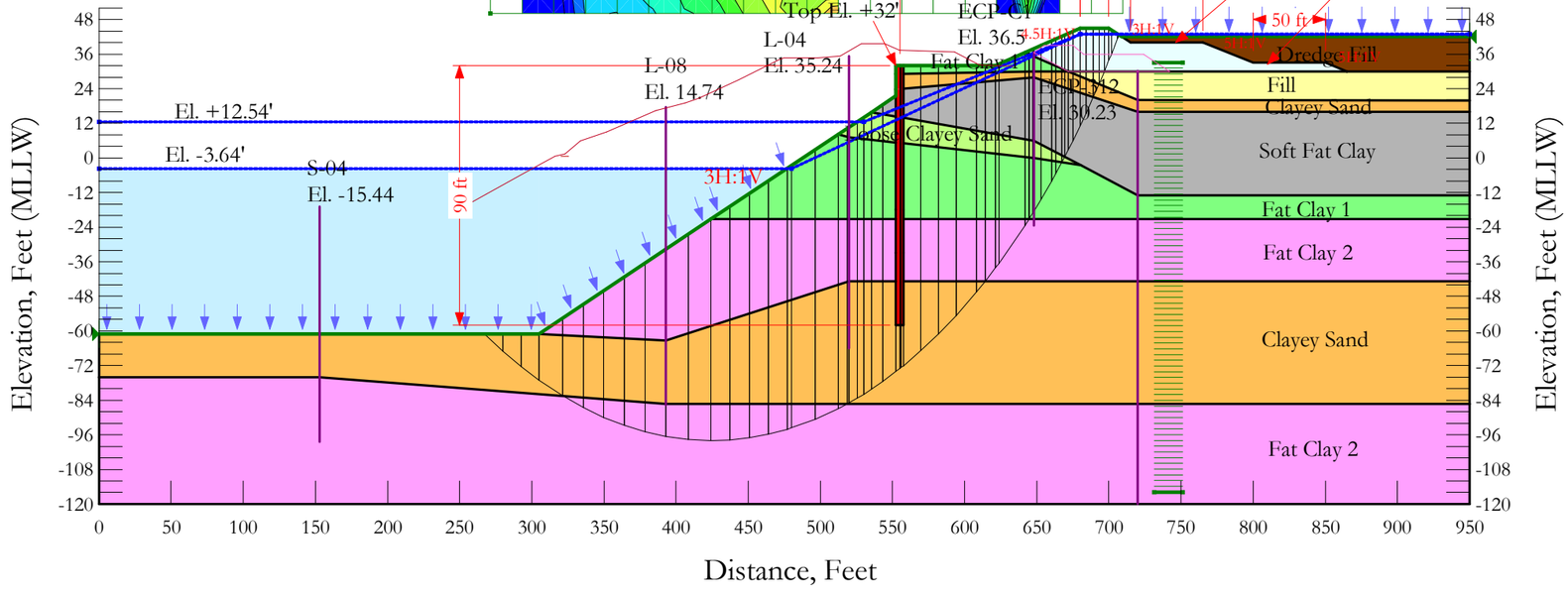
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150					
	Clayey Sand	120				0	30
	Dike	125				100	25
	Dredge Fill	90				16	15
	Fat Clay 1	125				300	22
	Fat Clay 2	125				300	22
	Fill	110	50	10	150		
	Loose Clayey Sand	110				0	28
	Soft Fat Clay	115				100	15



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular

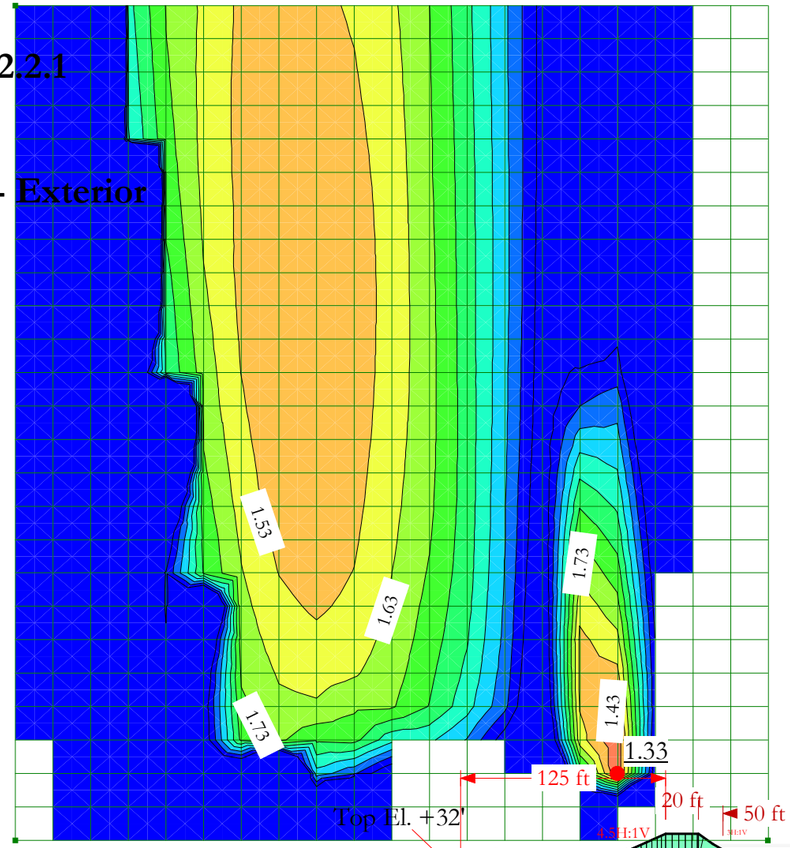


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Fill (RDD)	110	50	25	100	20
	Loose Clayey Sand	110	0	28	0	28
	Soft Fat Clay	115	100	15	150	10

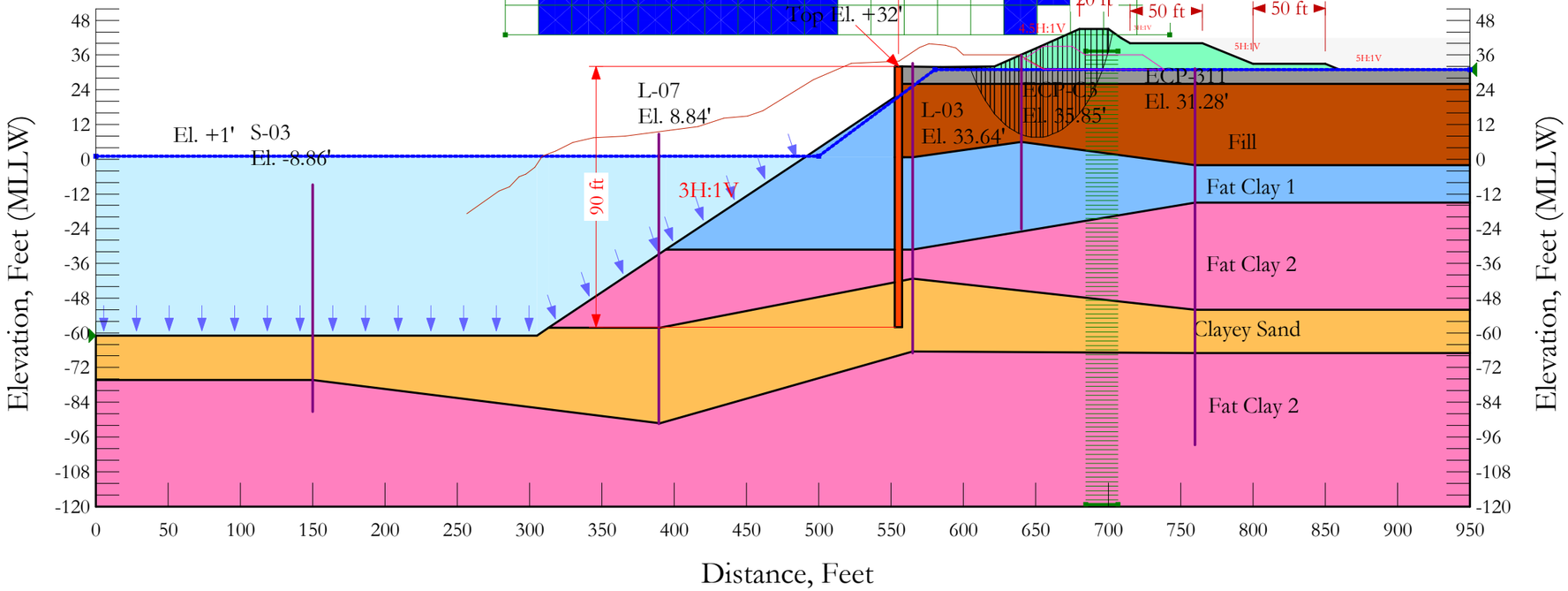


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Short Term - Exterior
Slip Surface: Circular



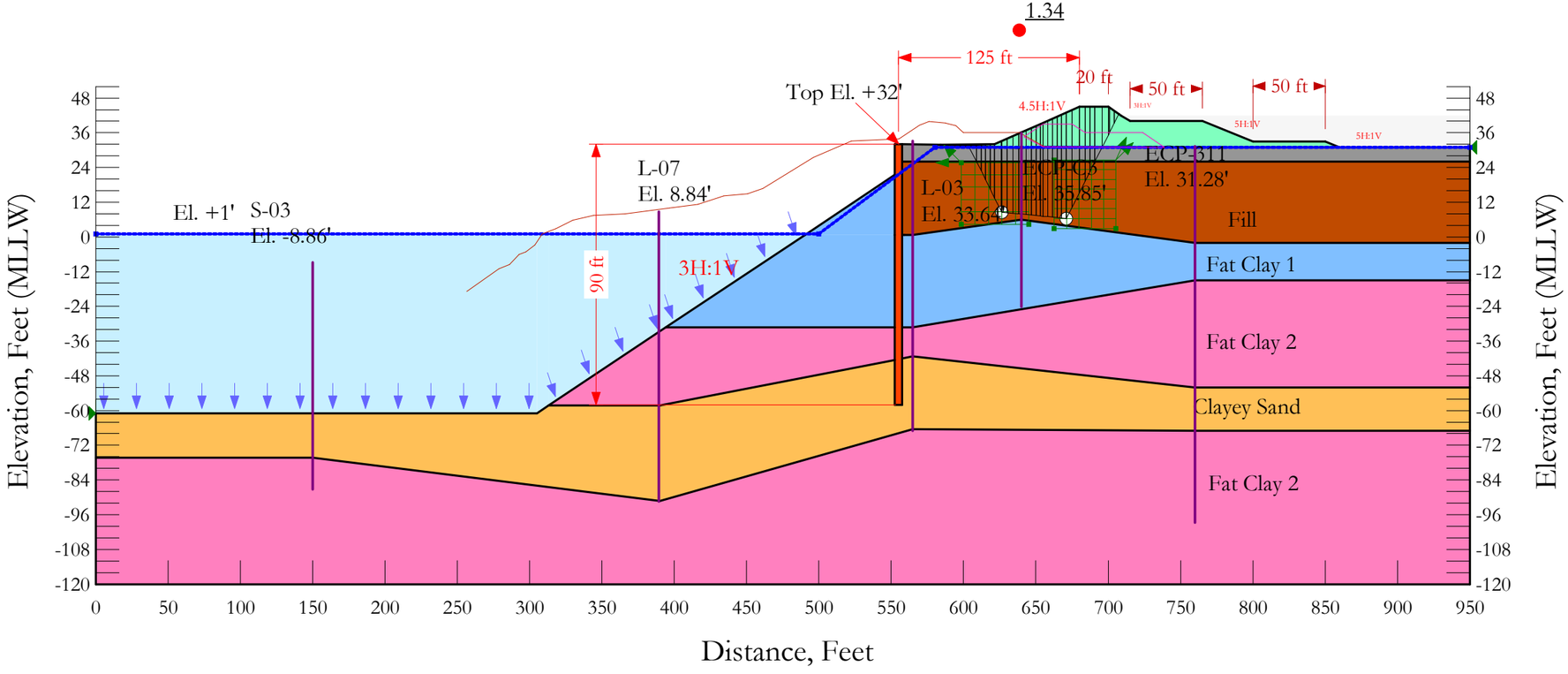
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Short Term - Dike Exterior
Slip Surface: Circular

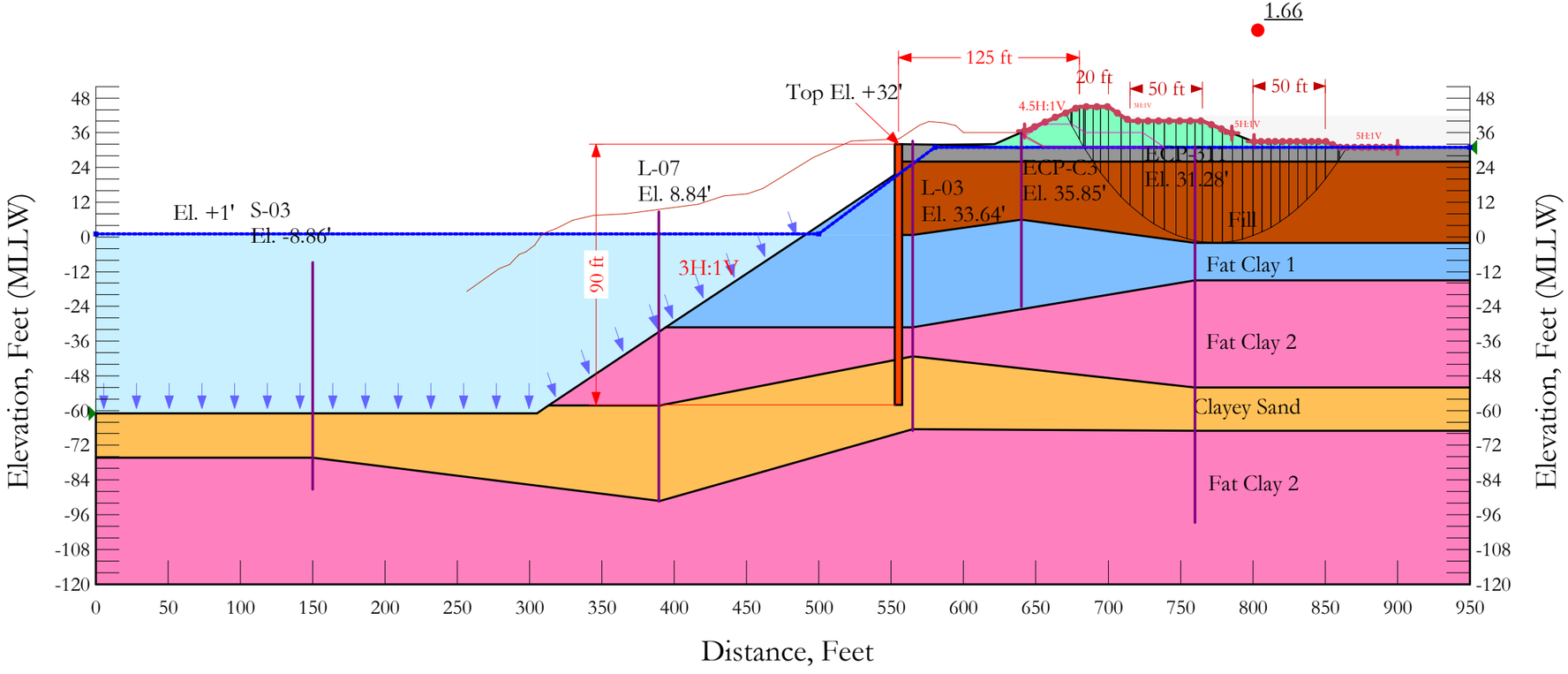
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

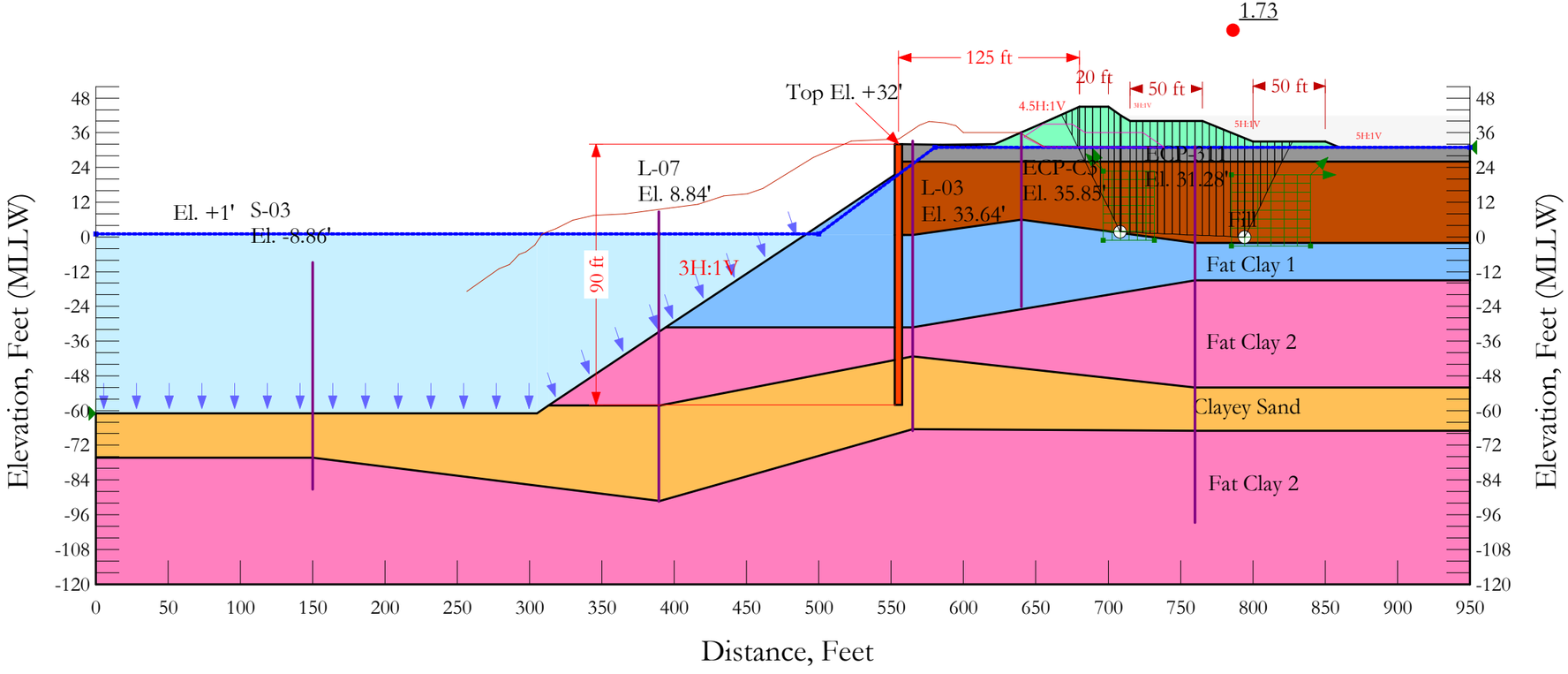
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

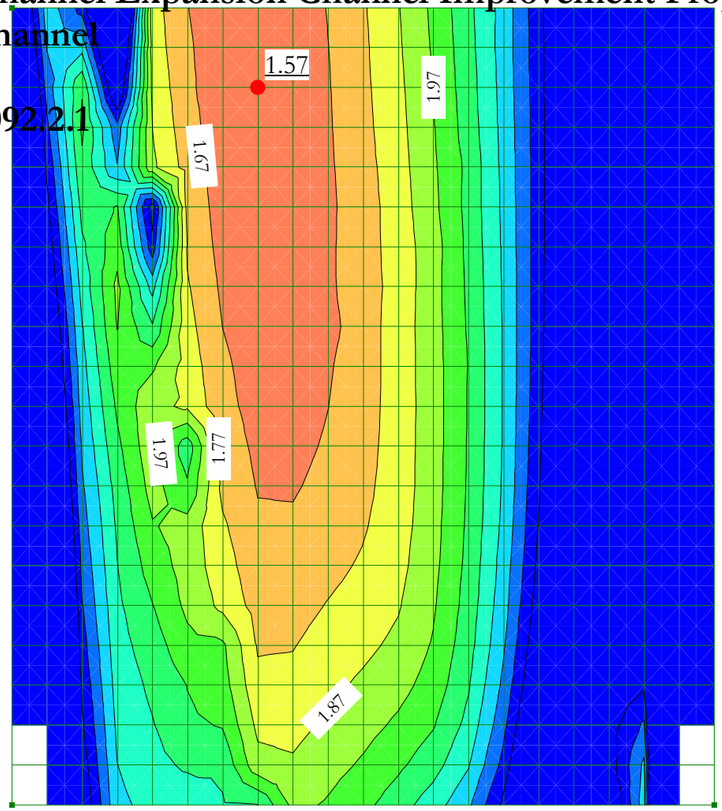
Loading Condition: Short Term - Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		

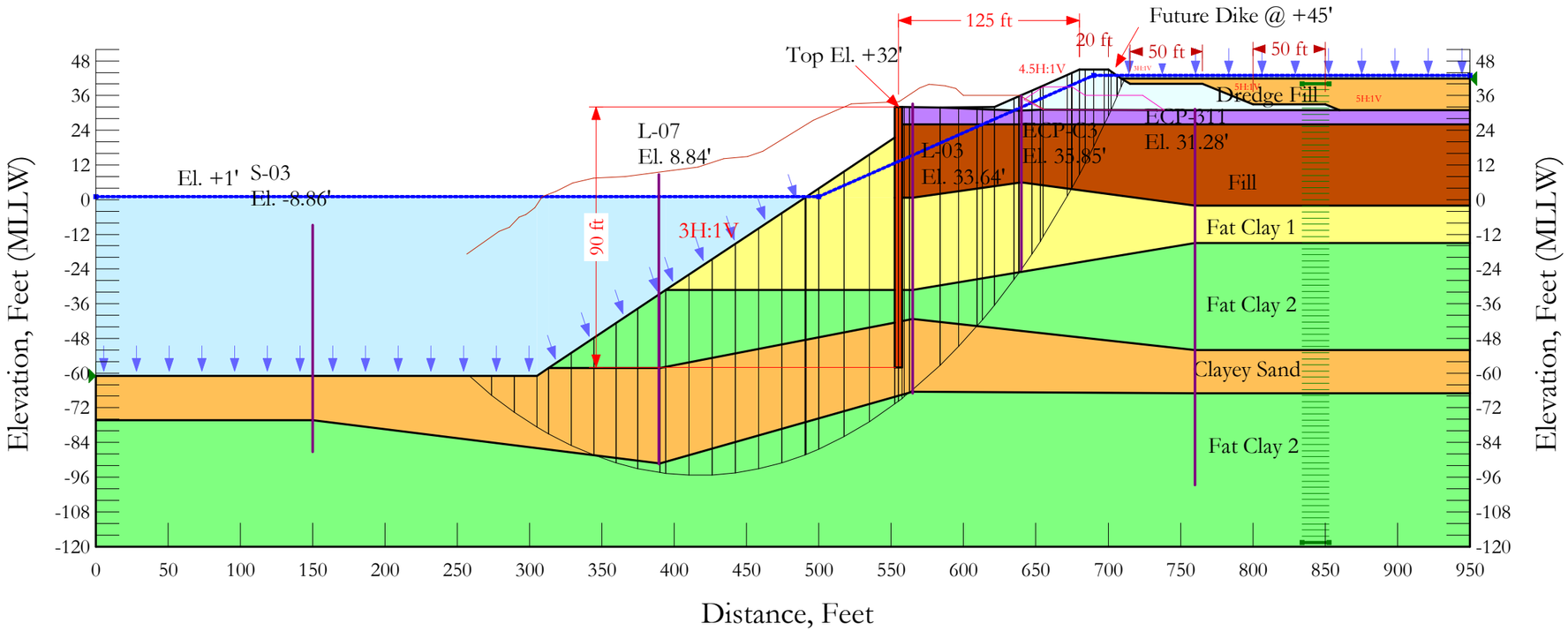


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Long Term
Slip Surface: Circular

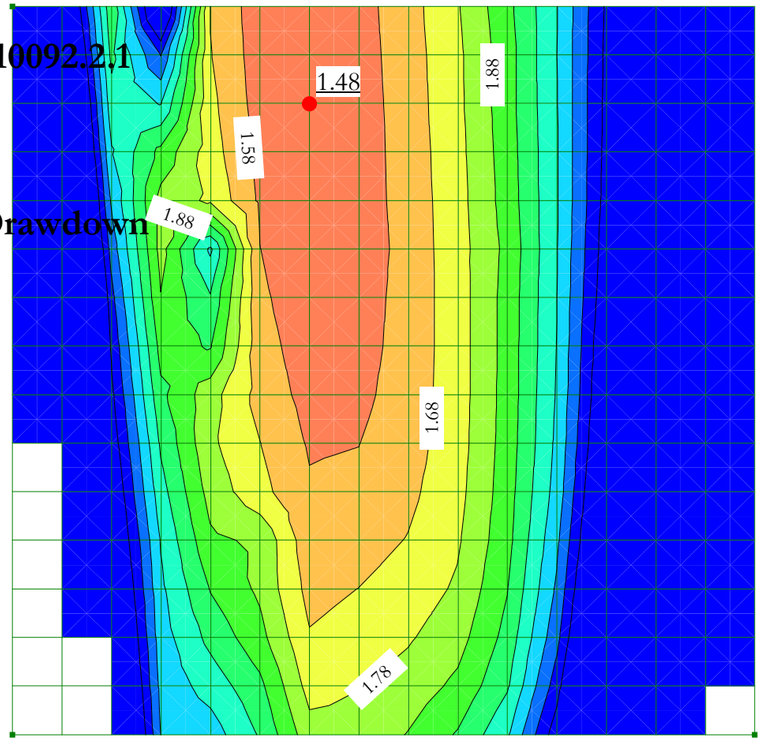


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay (3)	125	300	22
	Fat Clay 1	125	300	22
	Fat Clay 2	125	300	22
	Fill	110	100	20

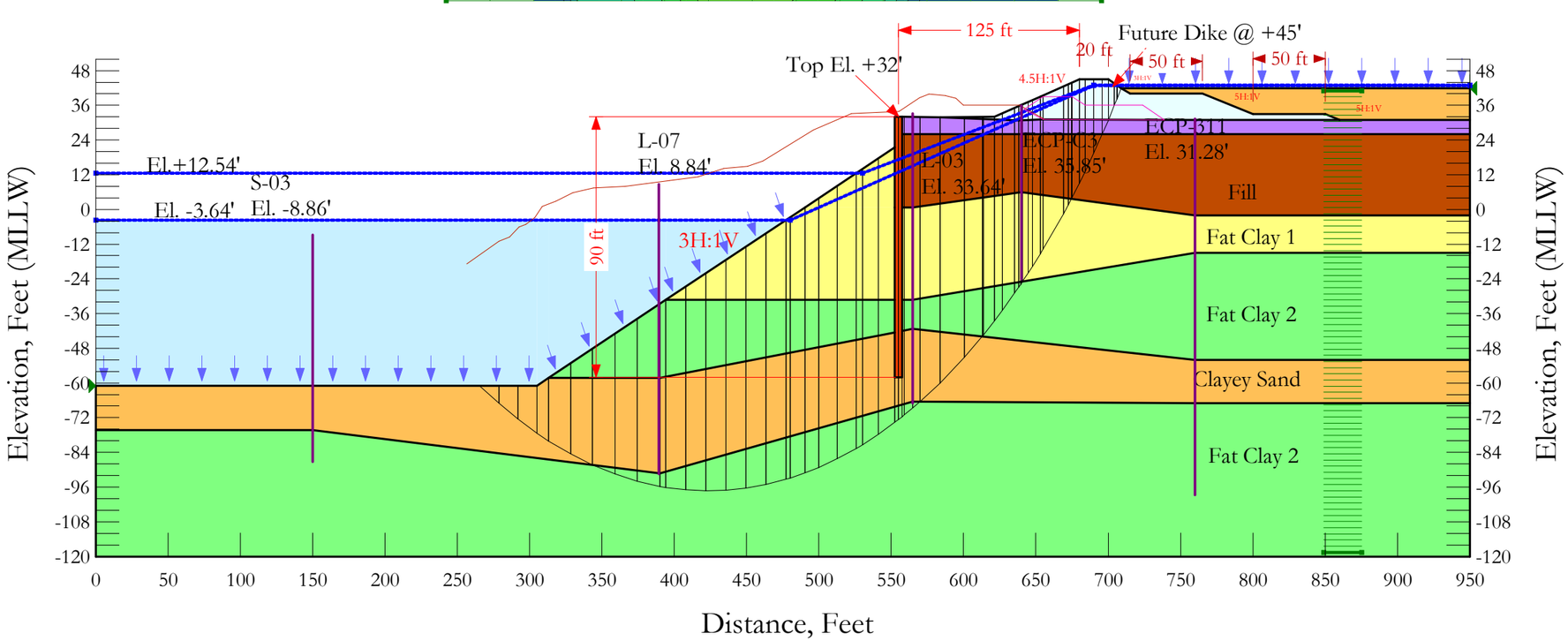


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe

Loading Condition: Rapid Drawdown
Slip Surface: Circular

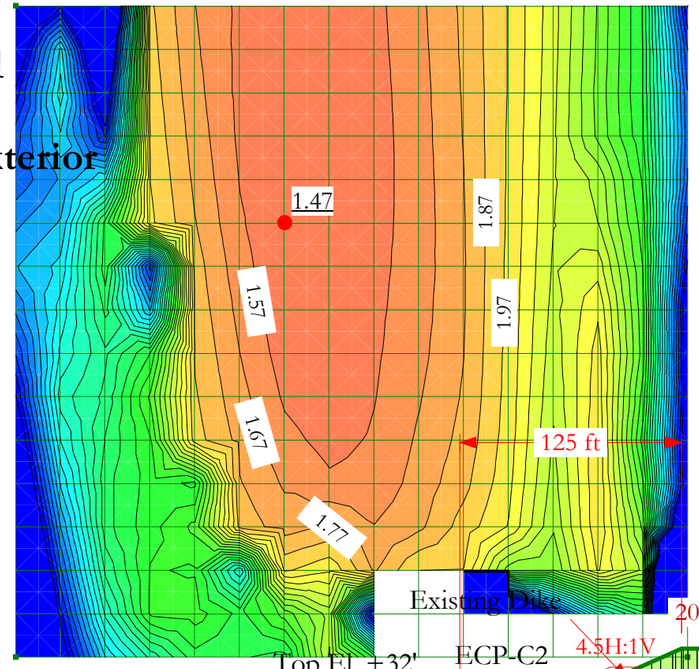


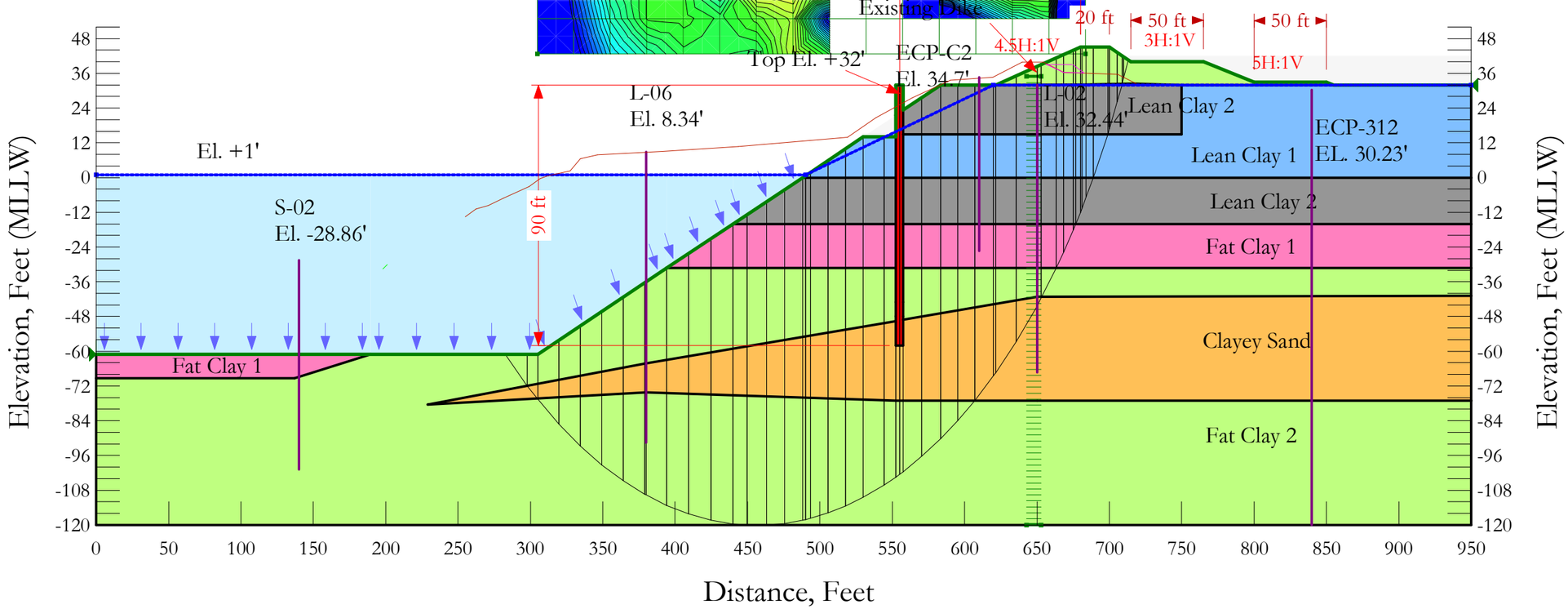
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay (3)	125	300	22	500	15
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Fill	110	100	20	150	15



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Circular

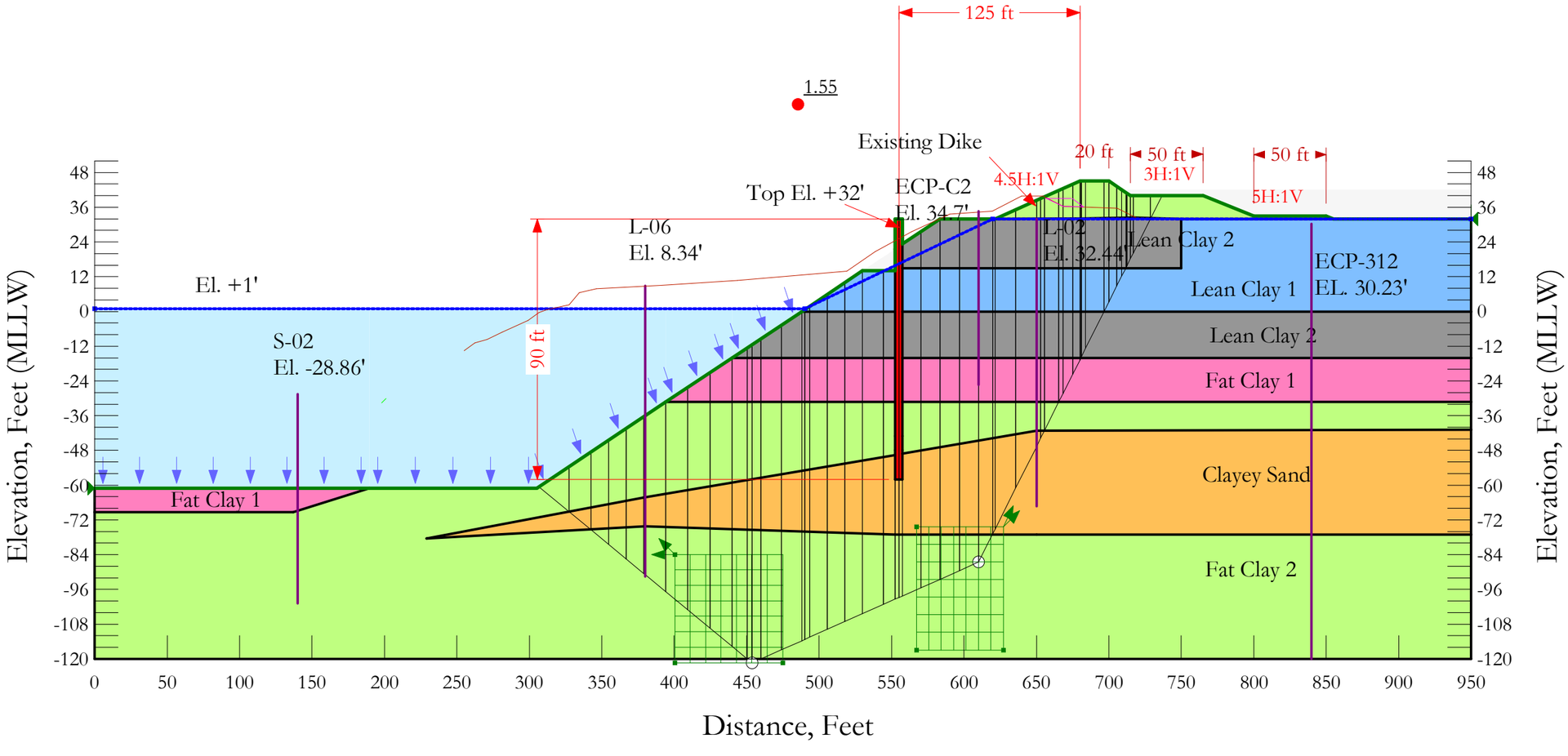
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		





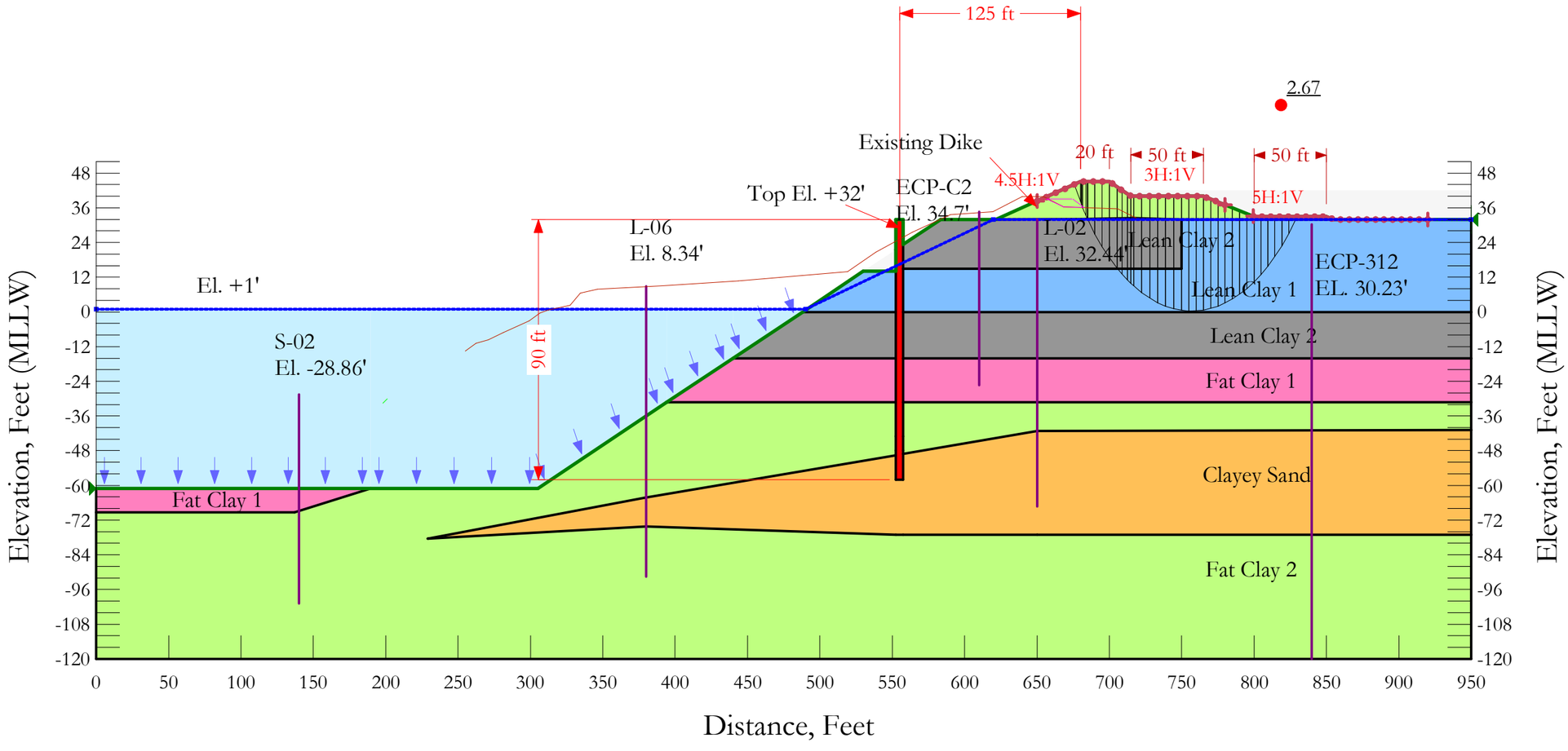
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



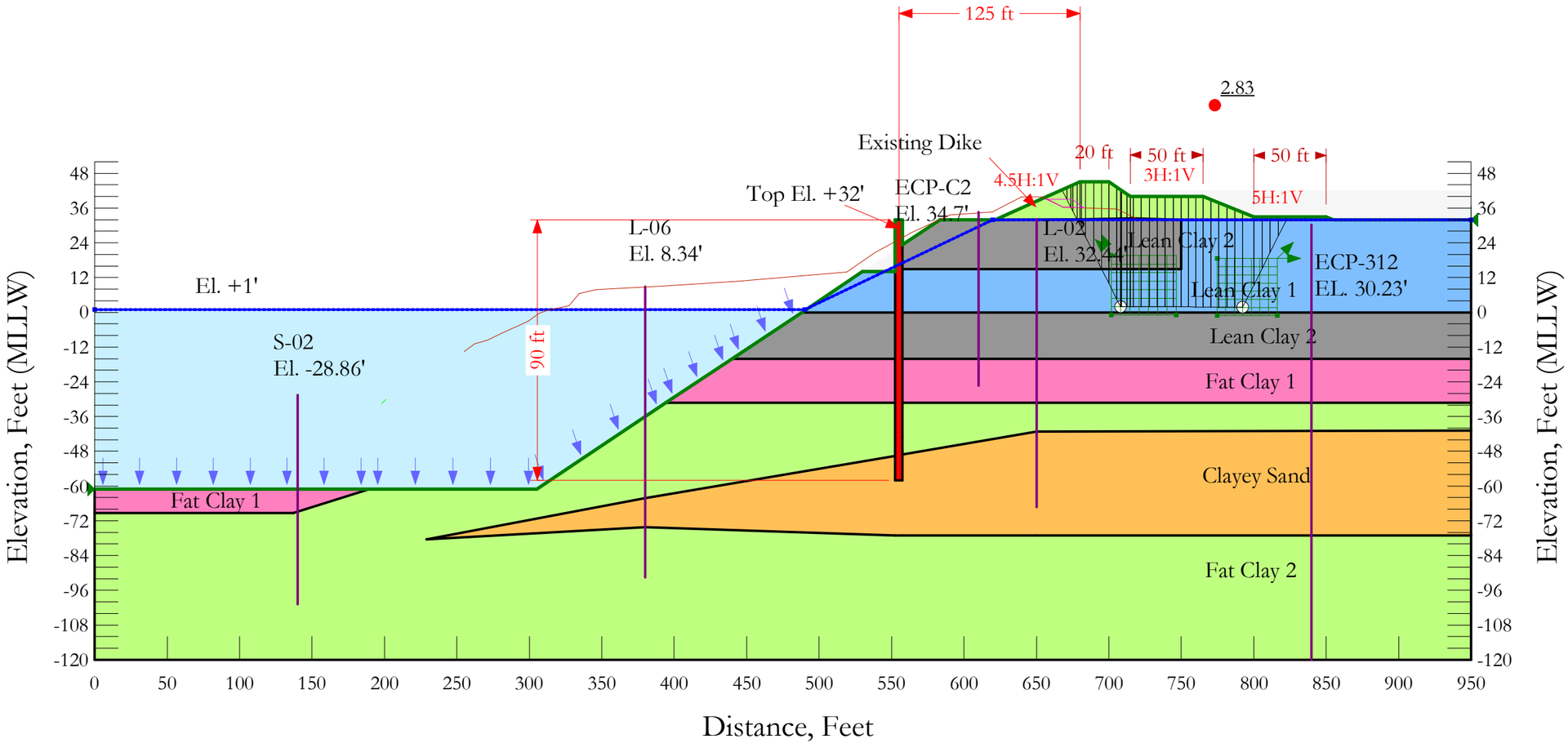
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Dike Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		

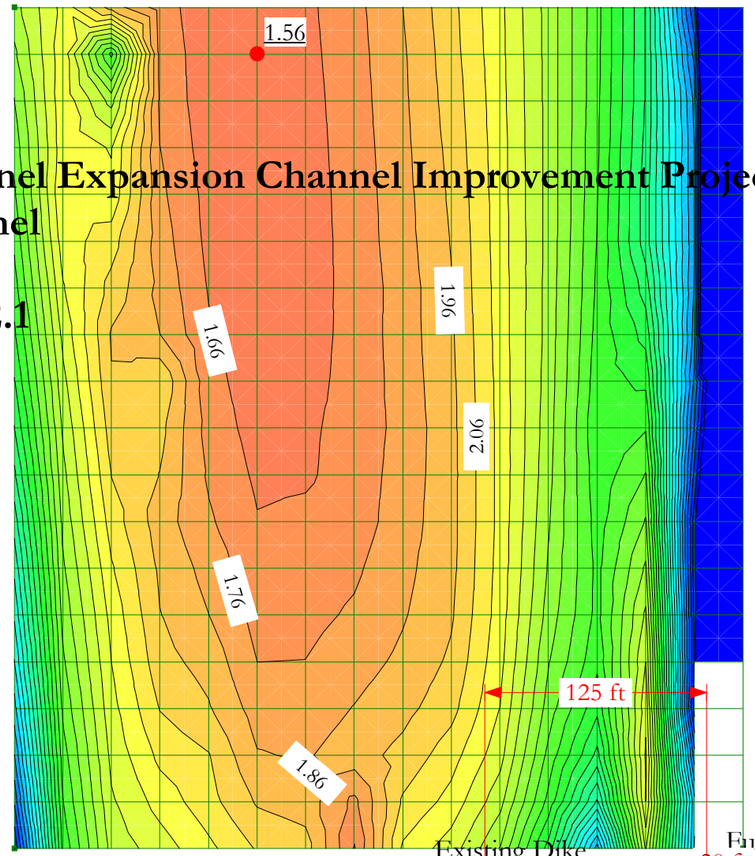


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Dike Interior
Slip Surface: Block

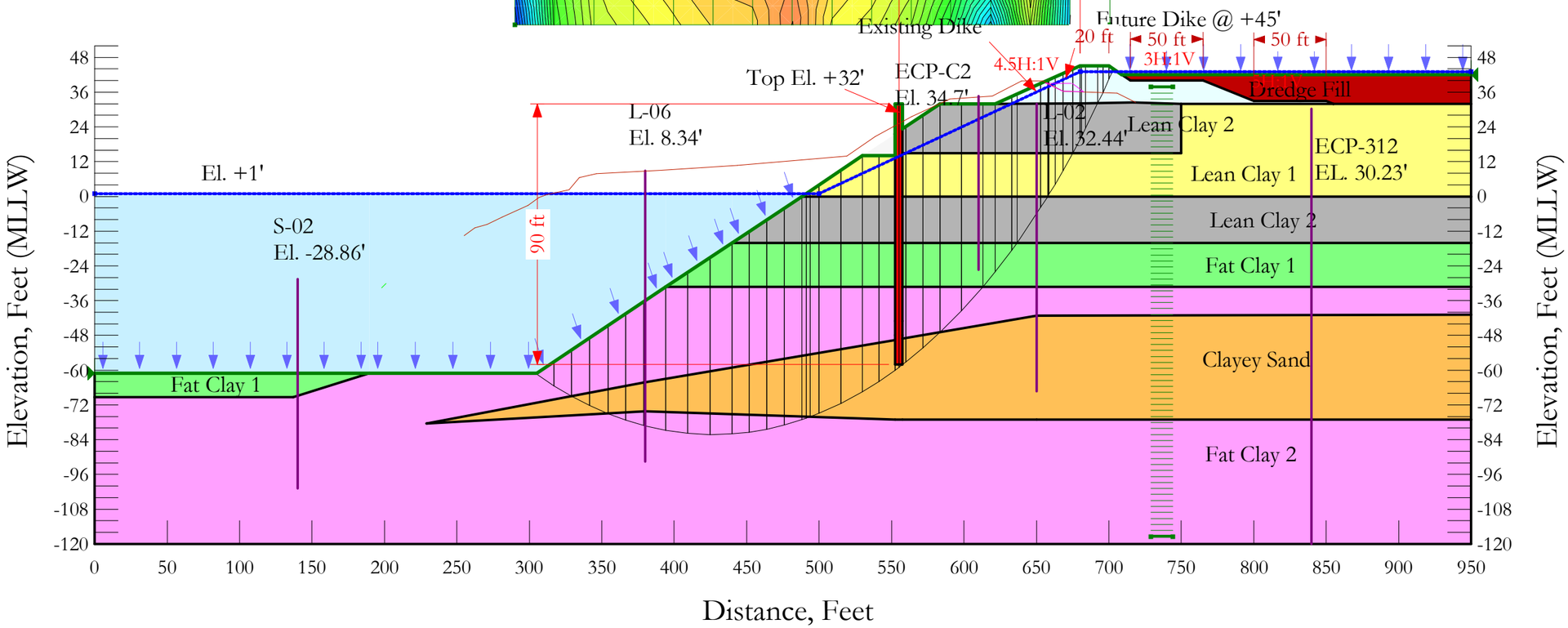
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Long Term
Slip Surface: Circular

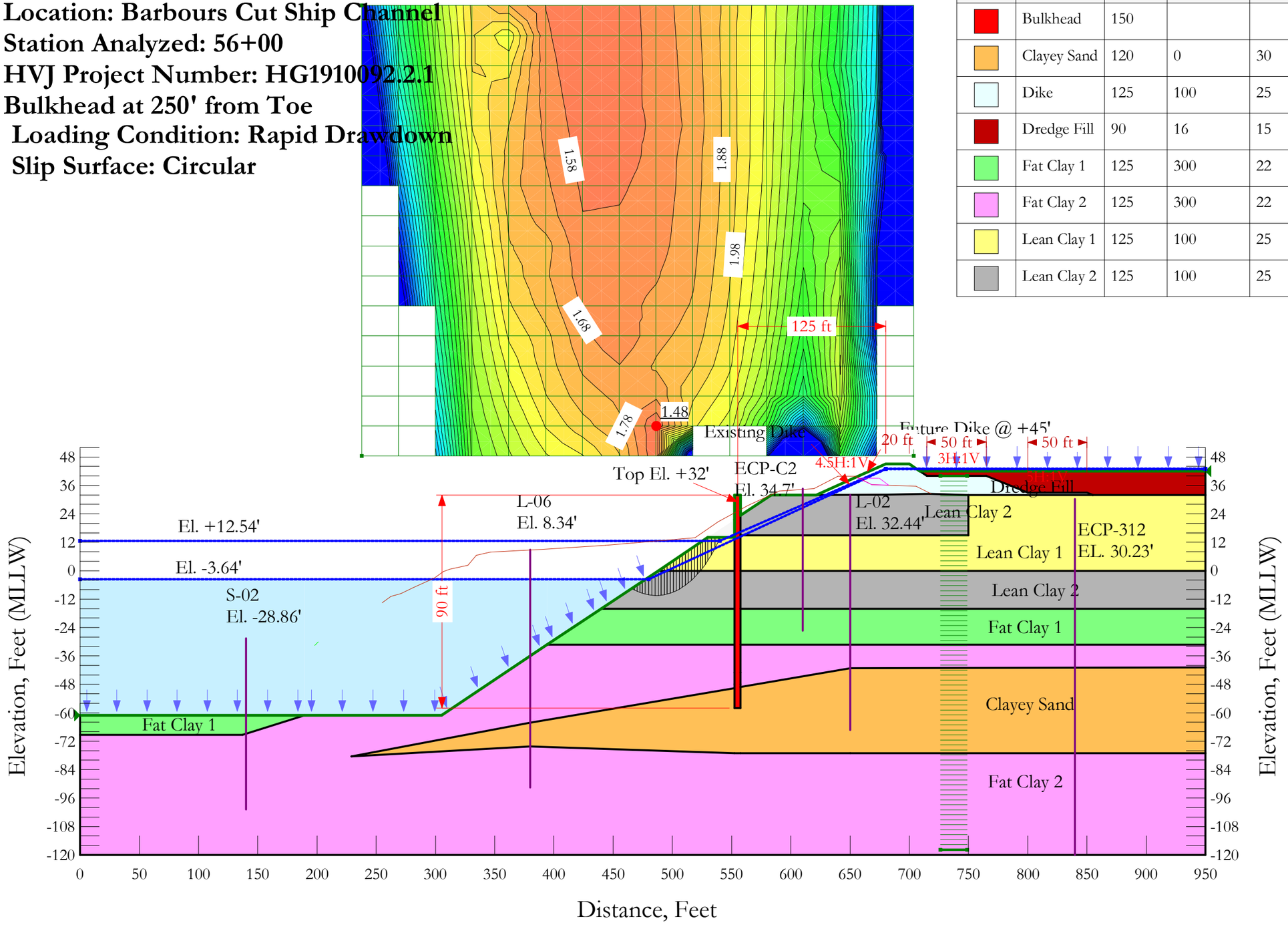


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay 1	125	300	22
	Fat Clay 2	125	300	22
	Lean Clay 1	125	100	25
	Lean Clay 2	125	100	25

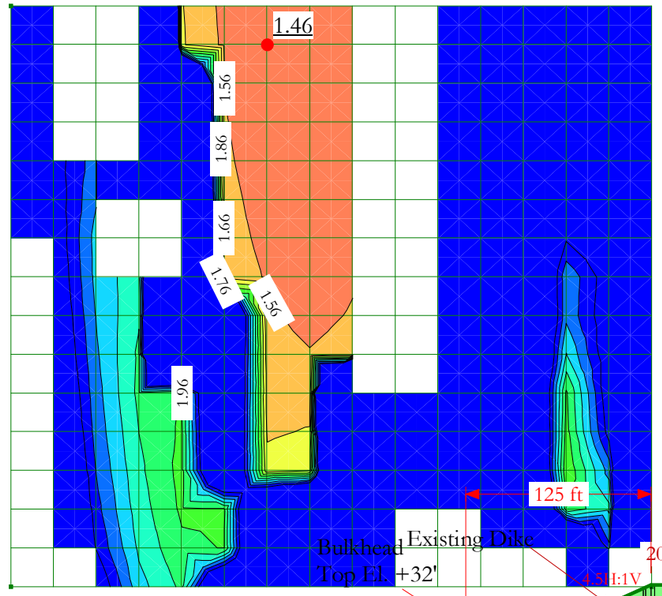


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular

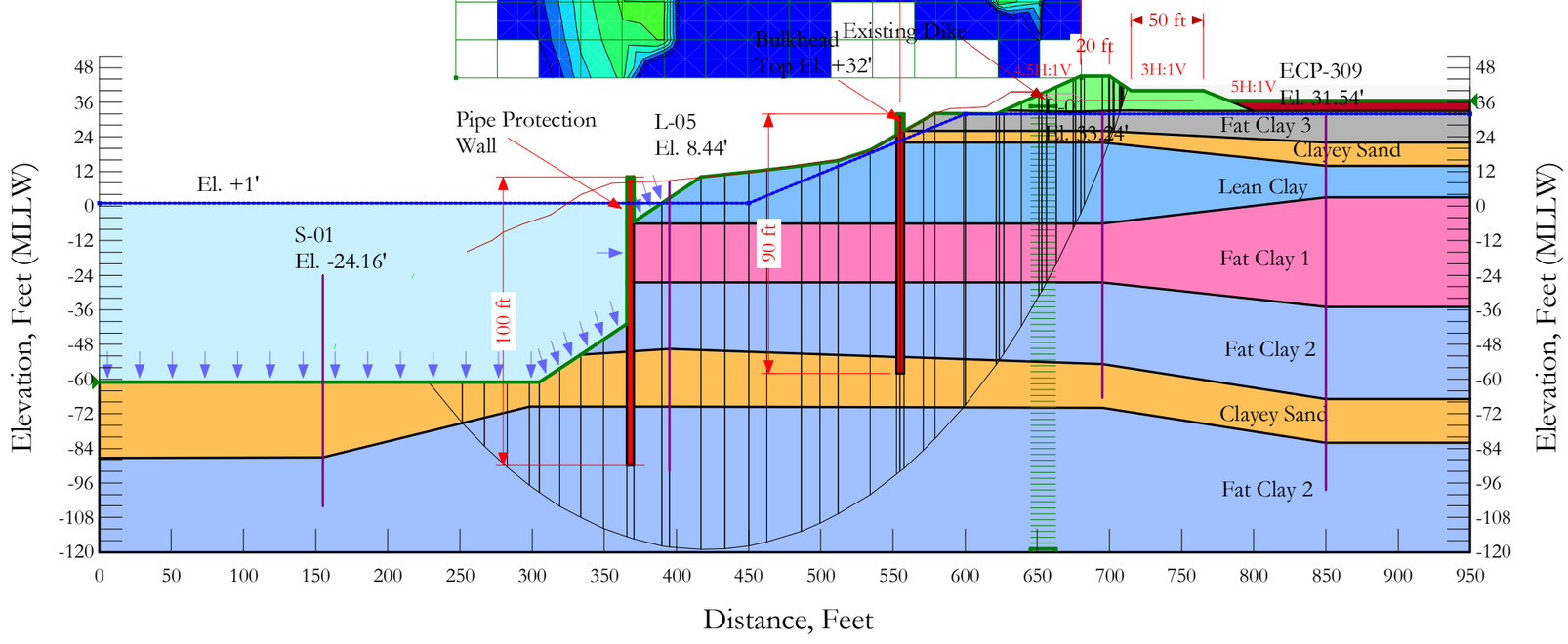
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	300	22	500	15
	Fat Clay 2	125	300	22	500	15
	Lean Clay 1	125	100	25	150	20
	Lean Clay 2	125	100	25	150	20



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Exterior
Slip Surface: Circular

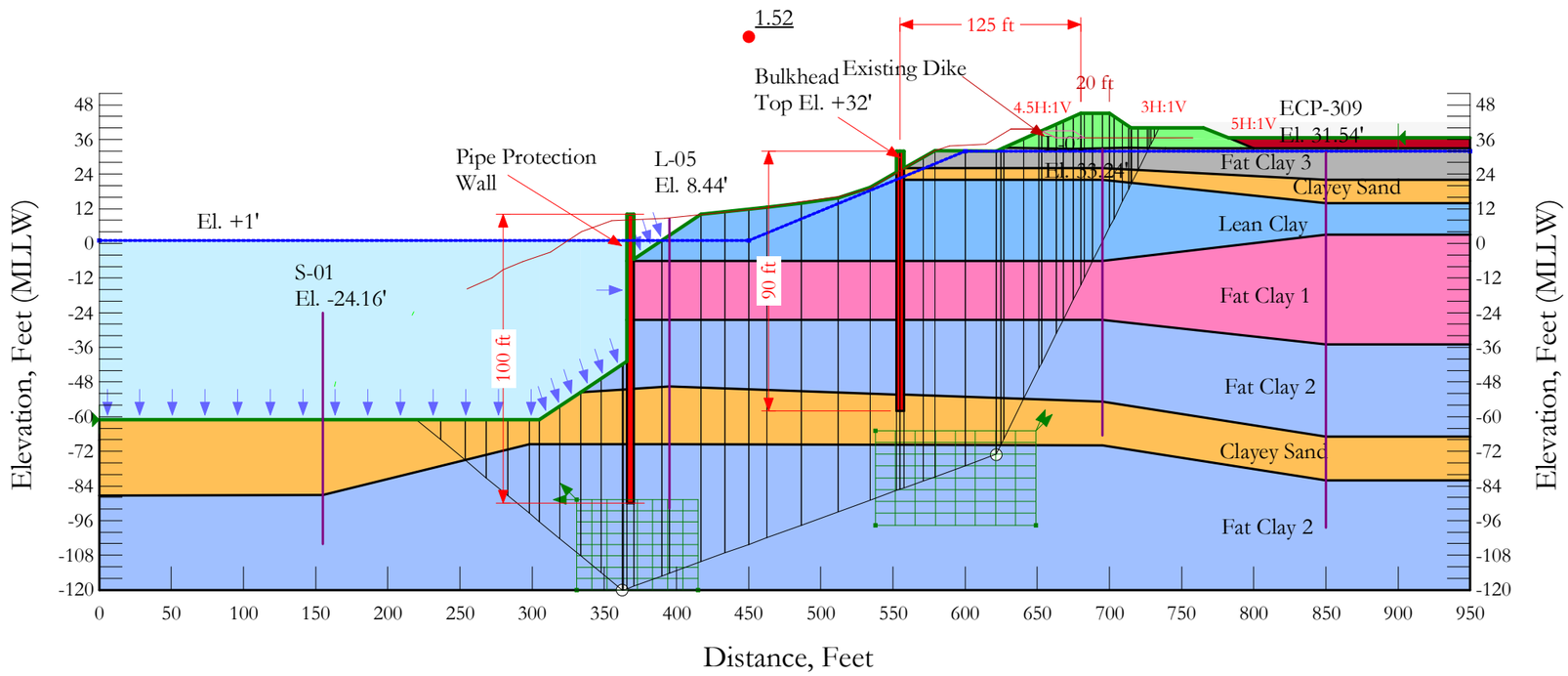


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



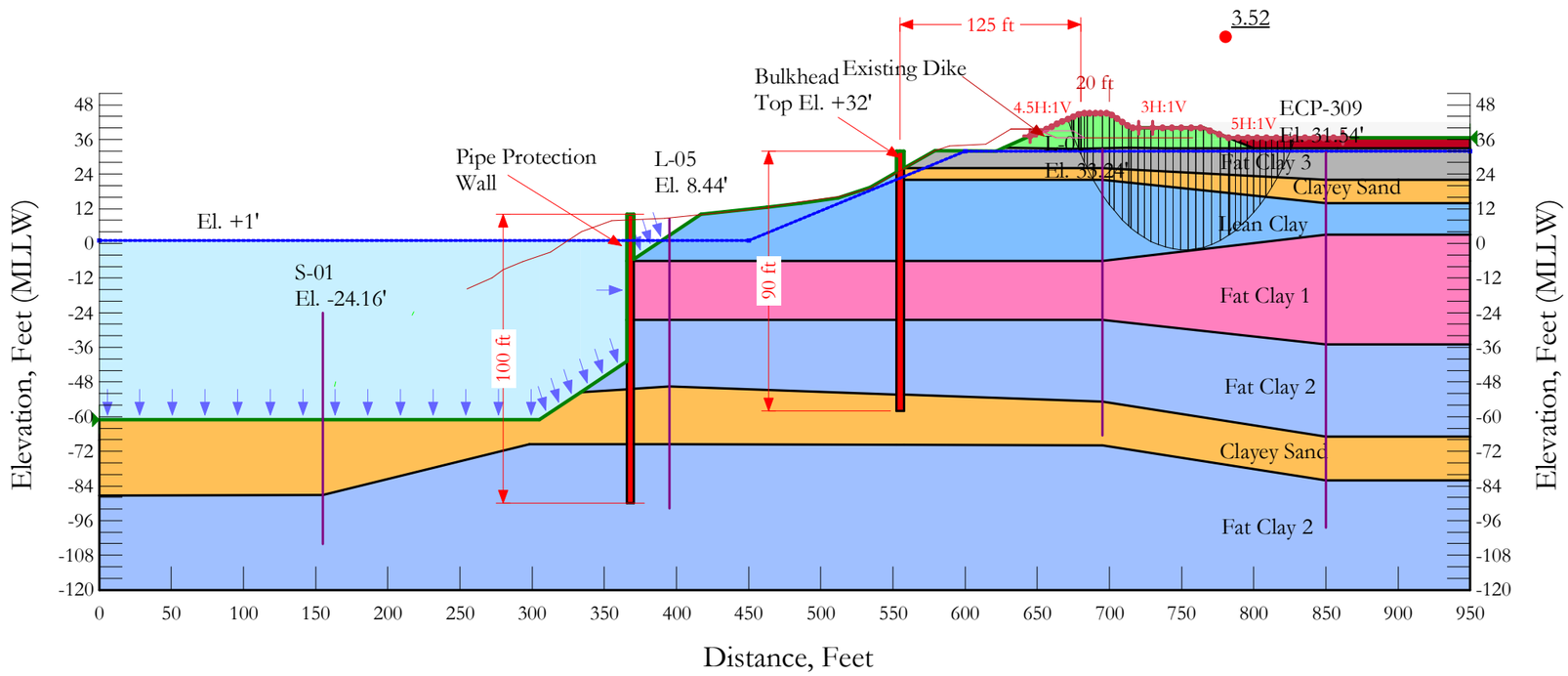
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



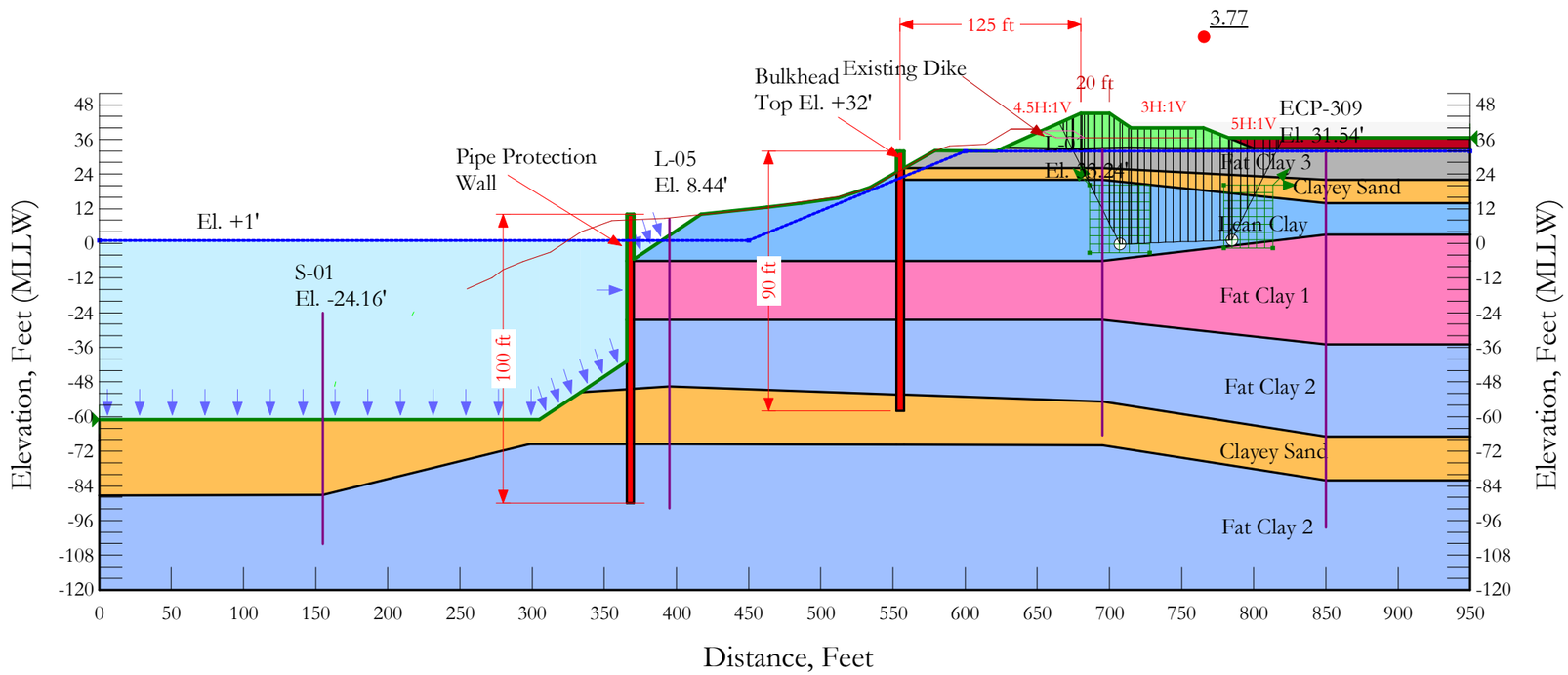
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

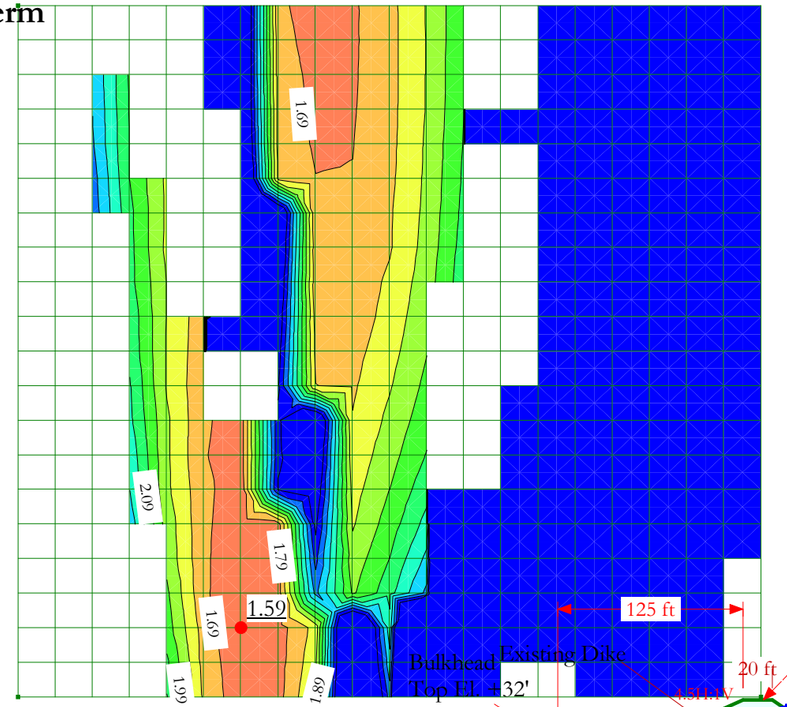


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Short Term - Interior
Slip Surface: Block

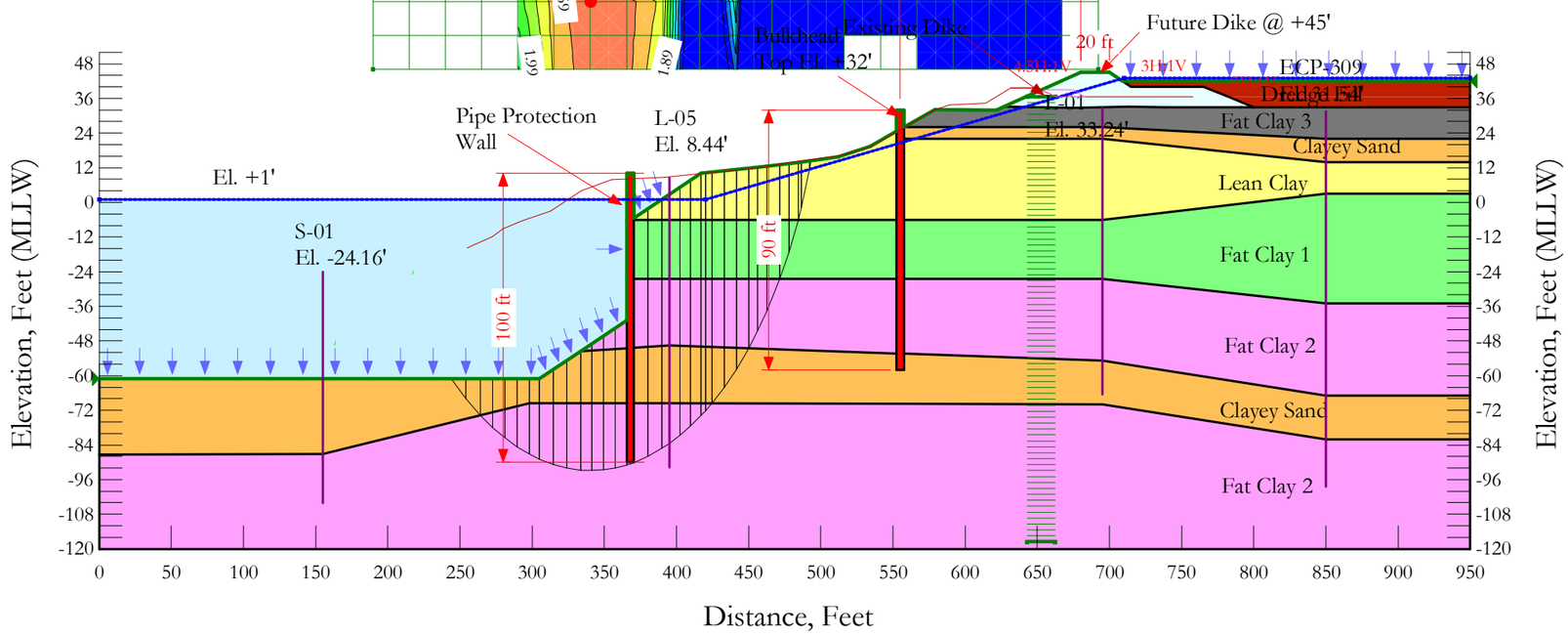
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150			
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



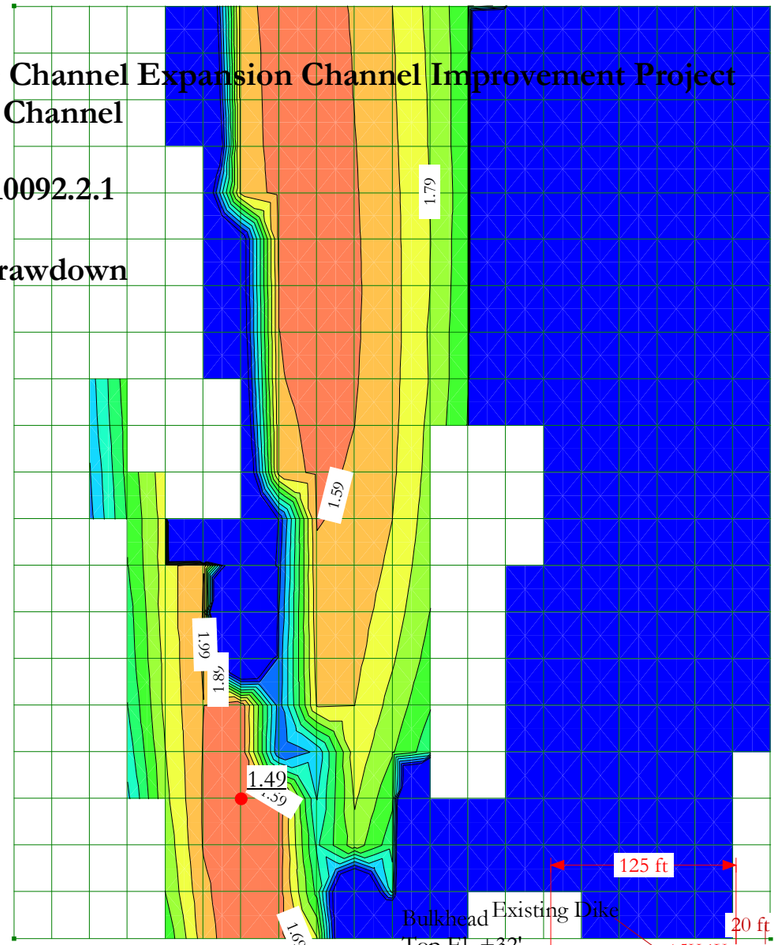
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Long Term
Slip Surface: Circular



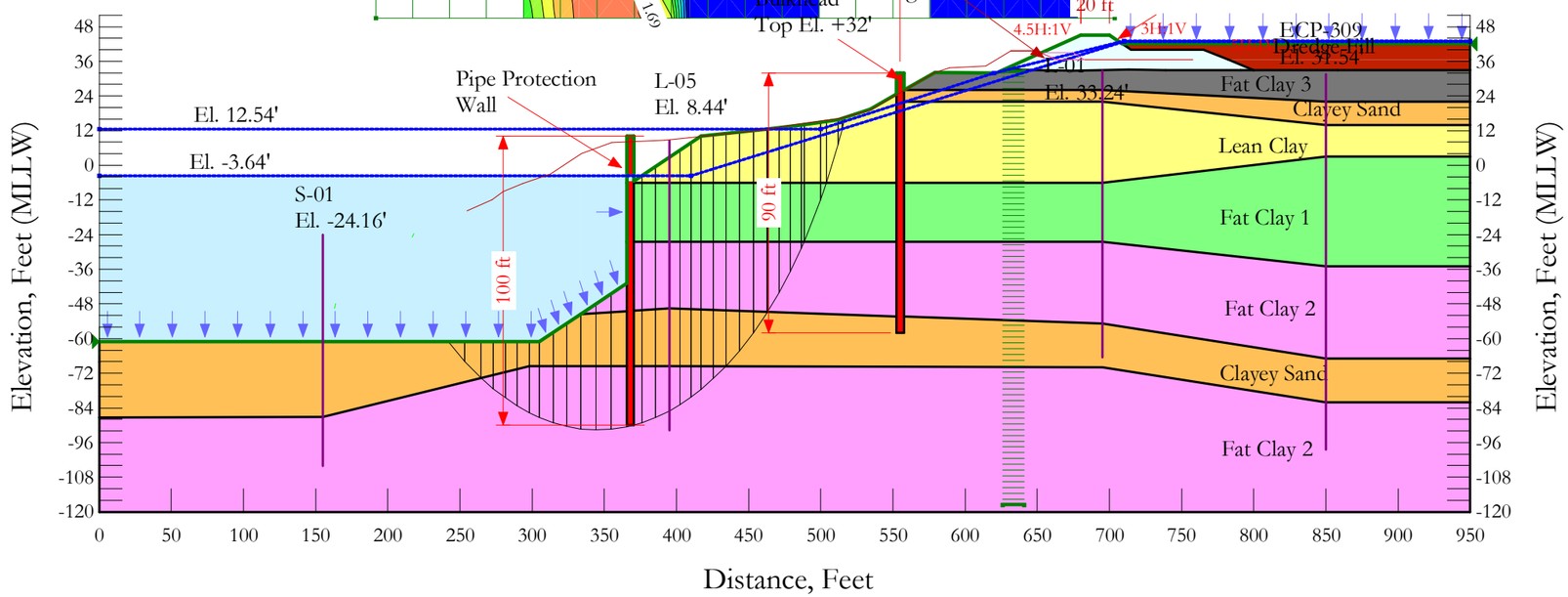
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bulkhead	150		
	Clayey Sand	120	0	30
	Dike	125	100	25
	Dredge Fill	90	16	15
	Fat Clay 1	125	400	18
	Fat Clay 2	125	300	22
	Fat Clay 3	125	300	22
	Lean Clay	125	100	25



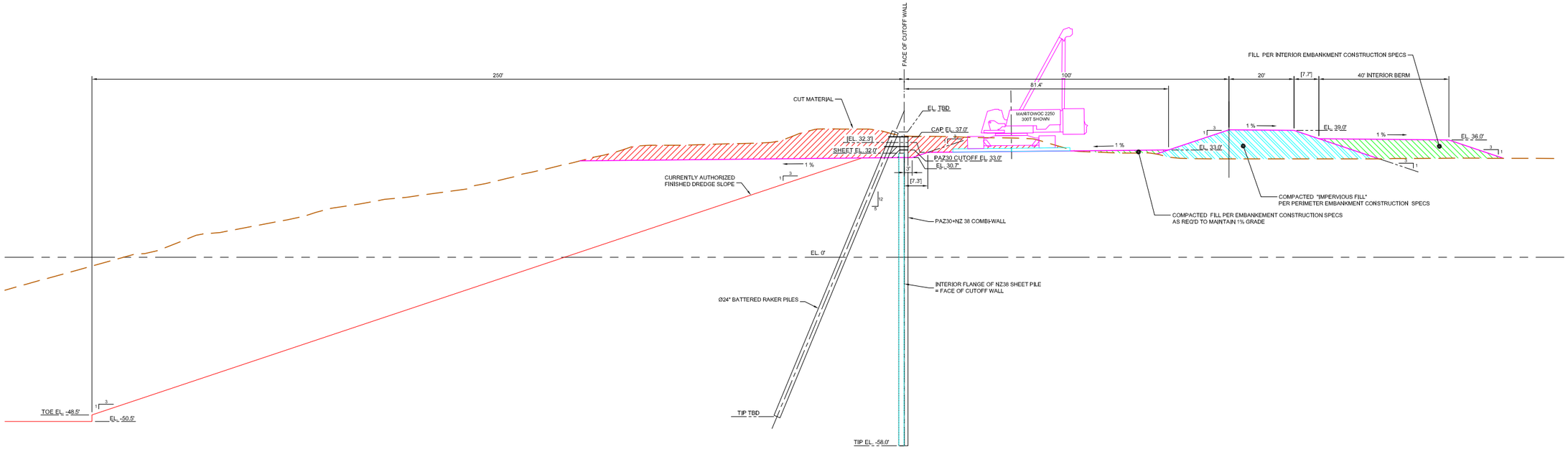
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1910092.2.1
Bulkhead at 250' from Toe
Loading Condition: Rapid Drawdown
Slip Surface: Circular



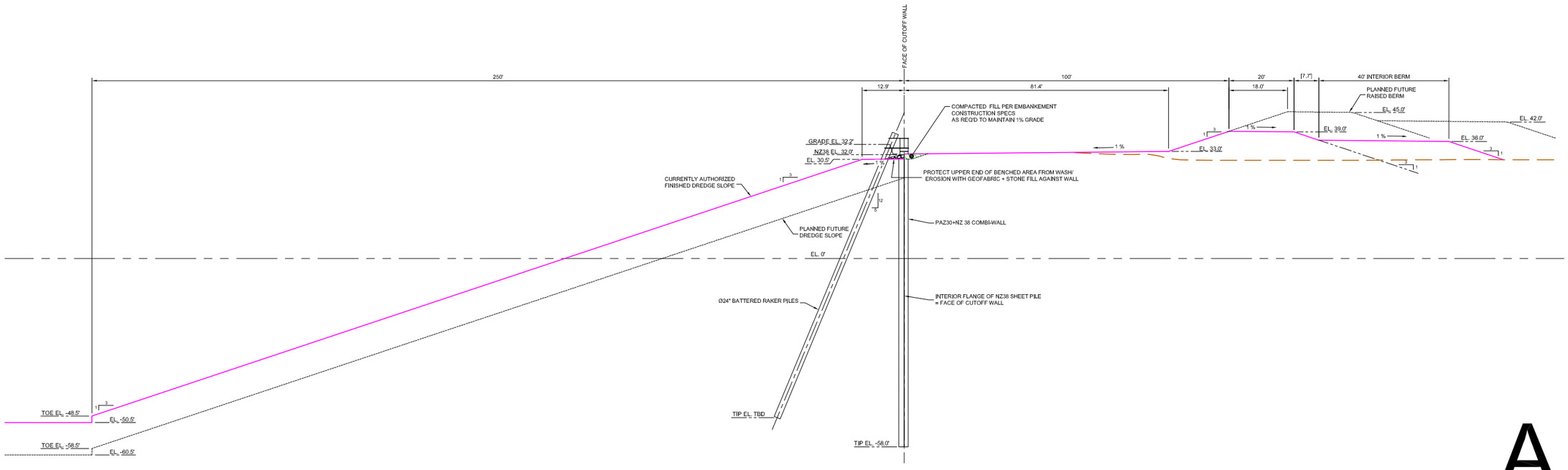
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)
	Bulkhead	150				
	Clayey Sand	120	0	30	0	30
	Dike	125	100	25	150	22
	Dredge Fill	90	16	15	50	0
	Fat Clay 1	125	400	18	500	14
	Fat Clay 2	125	300	22	500	15
	Fat Clay 3	125	300	22	500	15
	Lean Clay	125	100	25	150	20



SLOPE STABILITY ANALYSIS:
CUTOFF WALL AND PIPELINE PROTECTION WALL CONSTRUCTION



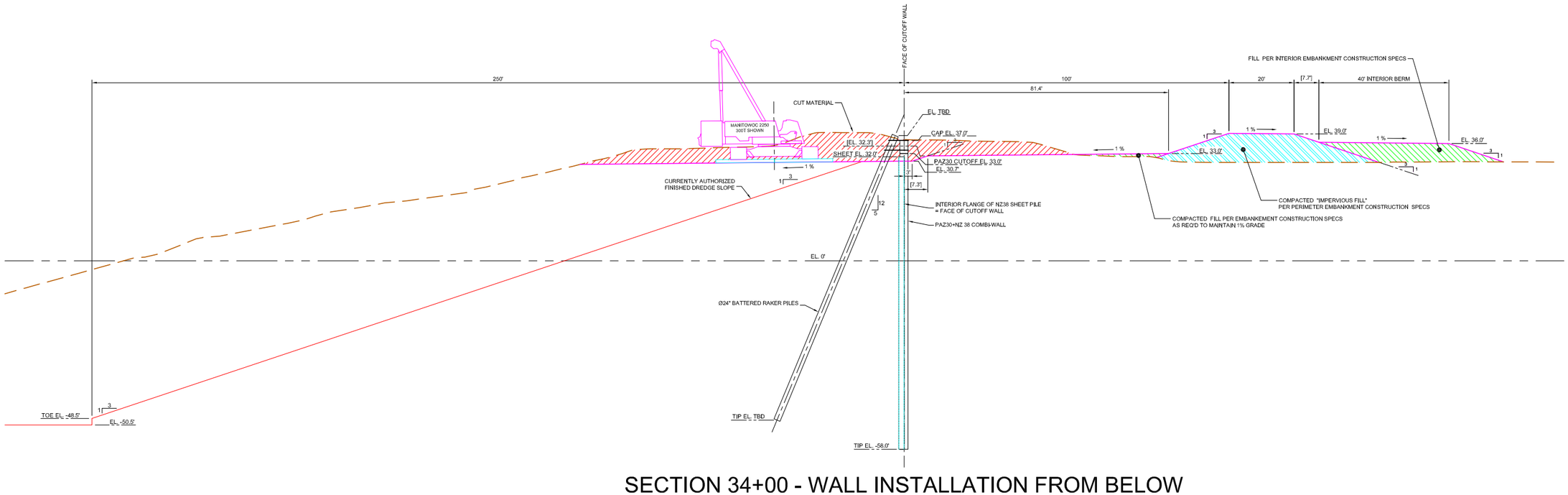
SECTION 34+00 - WALL INSTALLATION FROM ABOVE



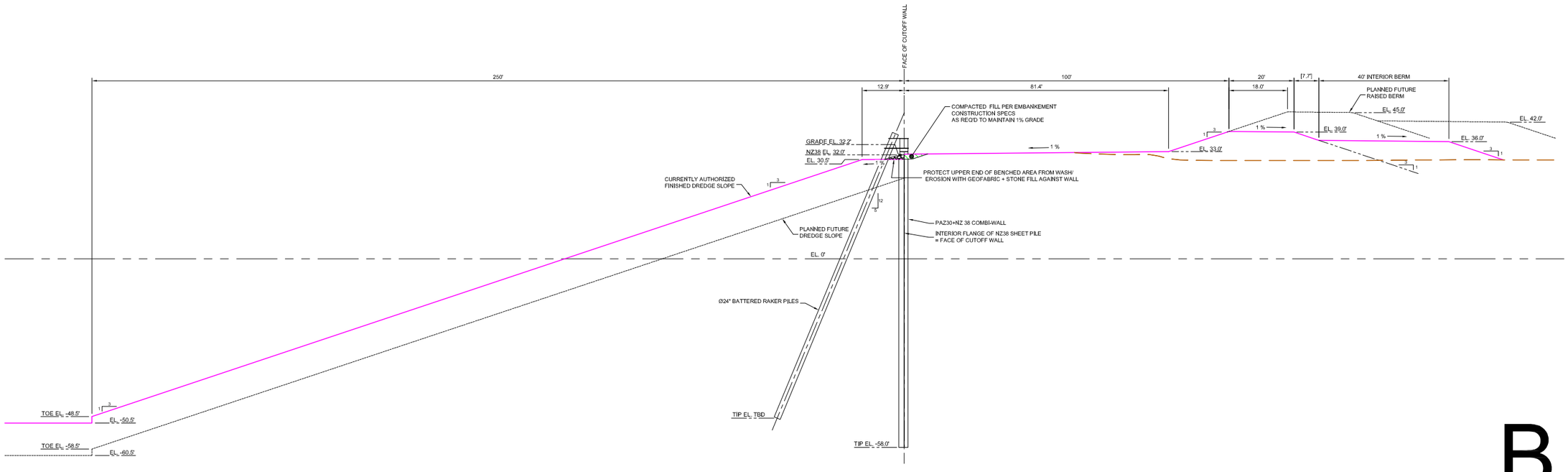
SECTION 34+00 - FINISHED GRADE

A

34+00



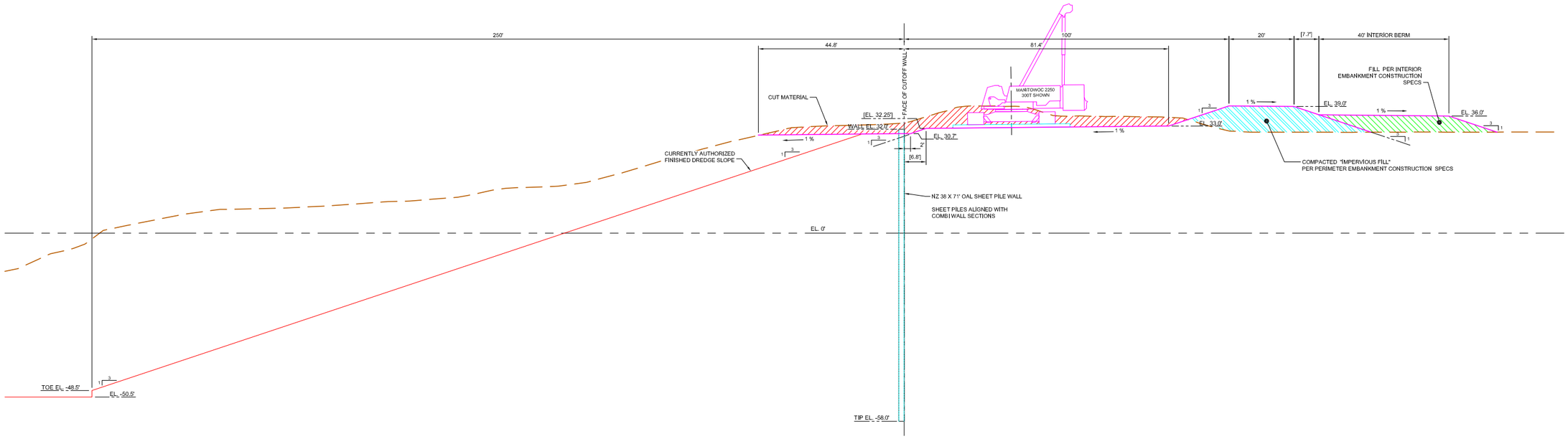
SECTION 34+00 - WALL INSTALLATION FROM BELOW



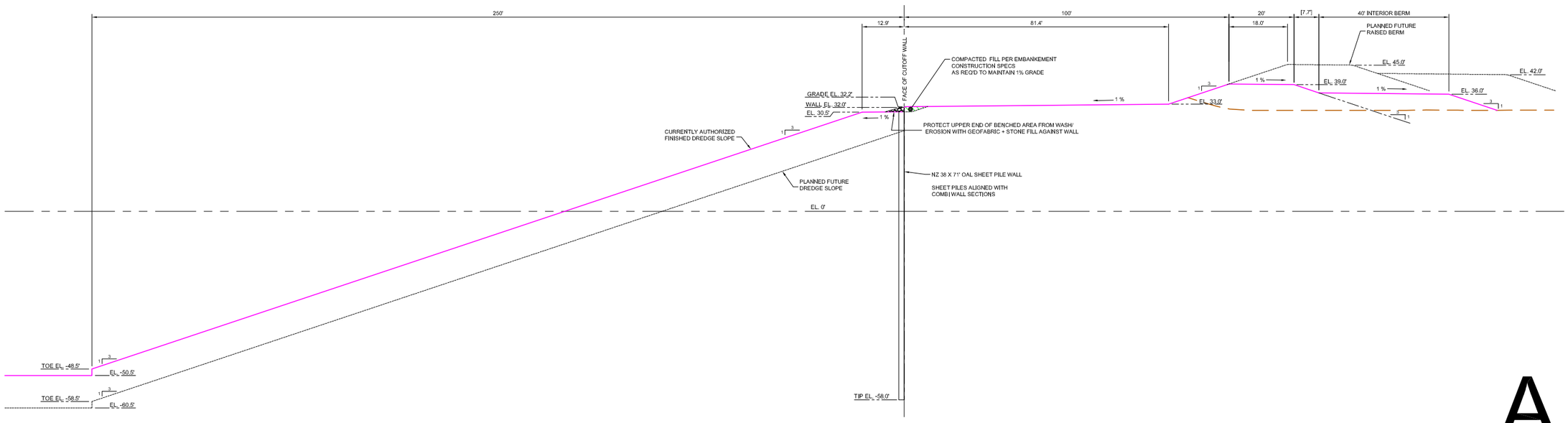
SECTION 34+00 - FINISHED GRADE

B

34+00



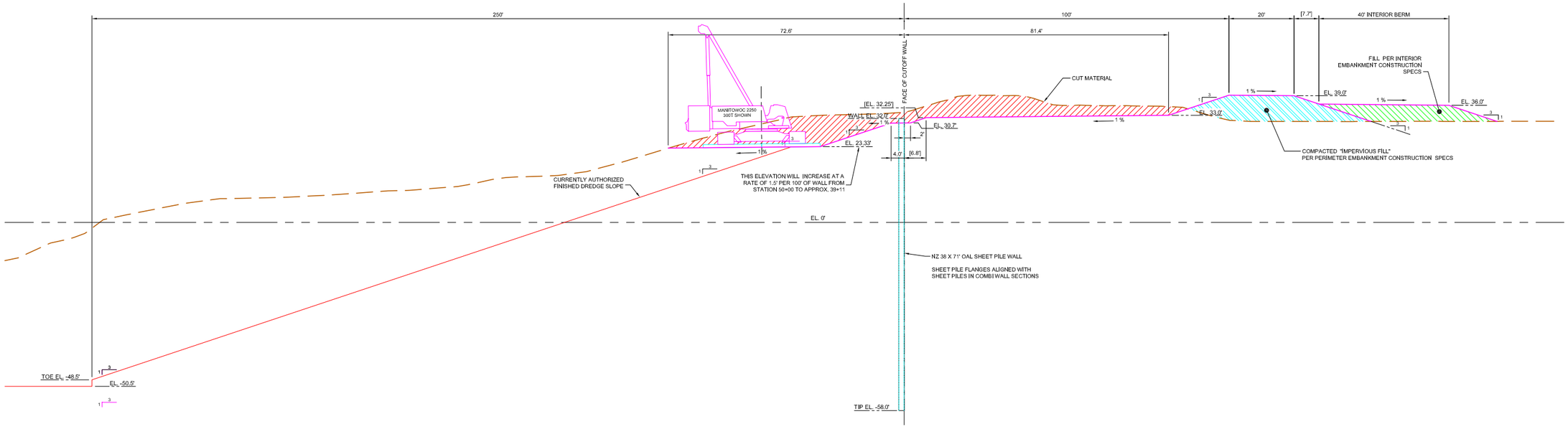
SECTION 44+00 - WALL INSTALLATION FROM ABOVE



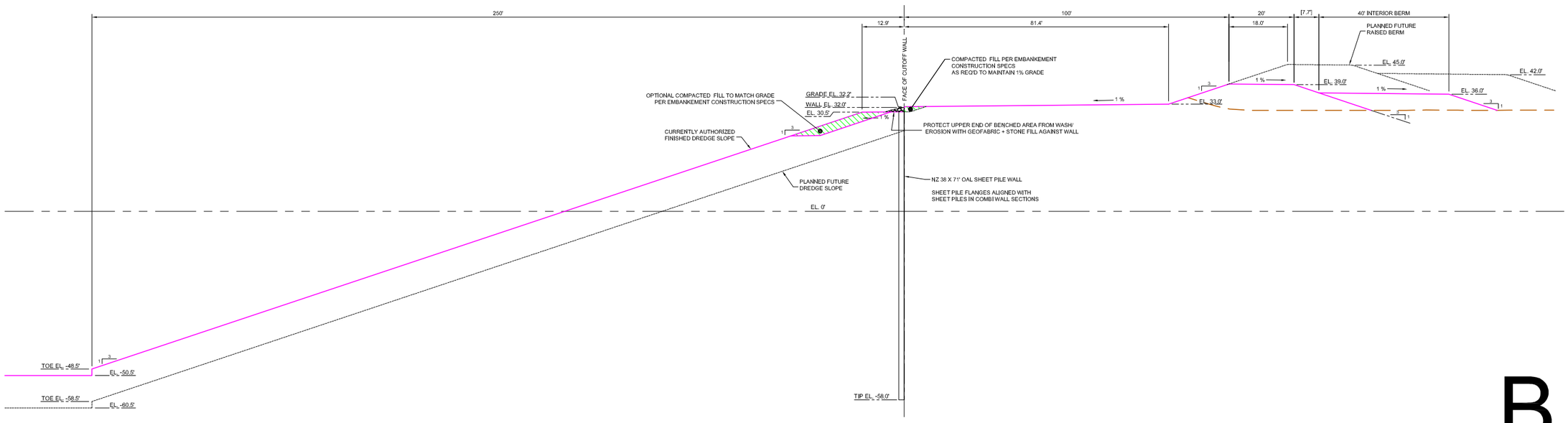
SECTION 44+00 - FINISHED GRADE

A

44+00



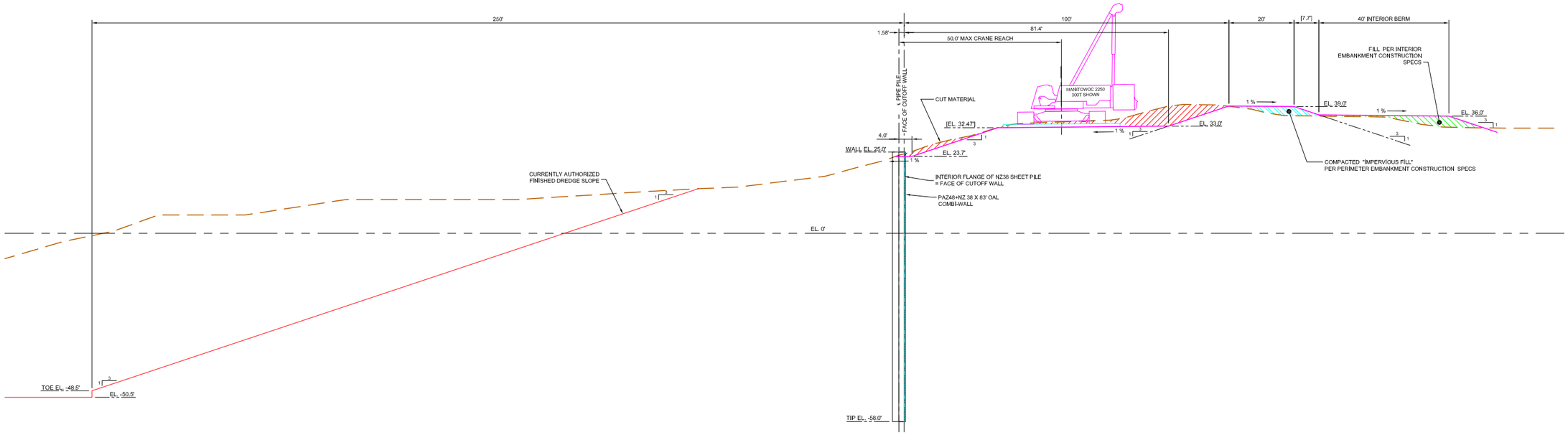
SECTION 44+00 - WALL INSTALLATION FROM BELOW



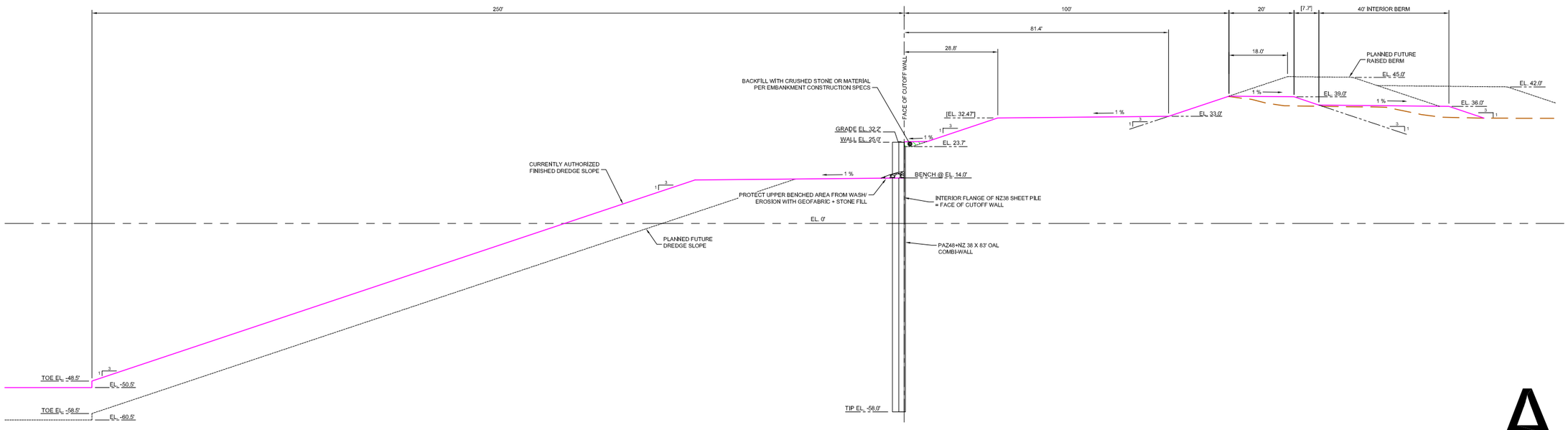
SECTION 44+00 - FINISHED GRADE

B

44+00



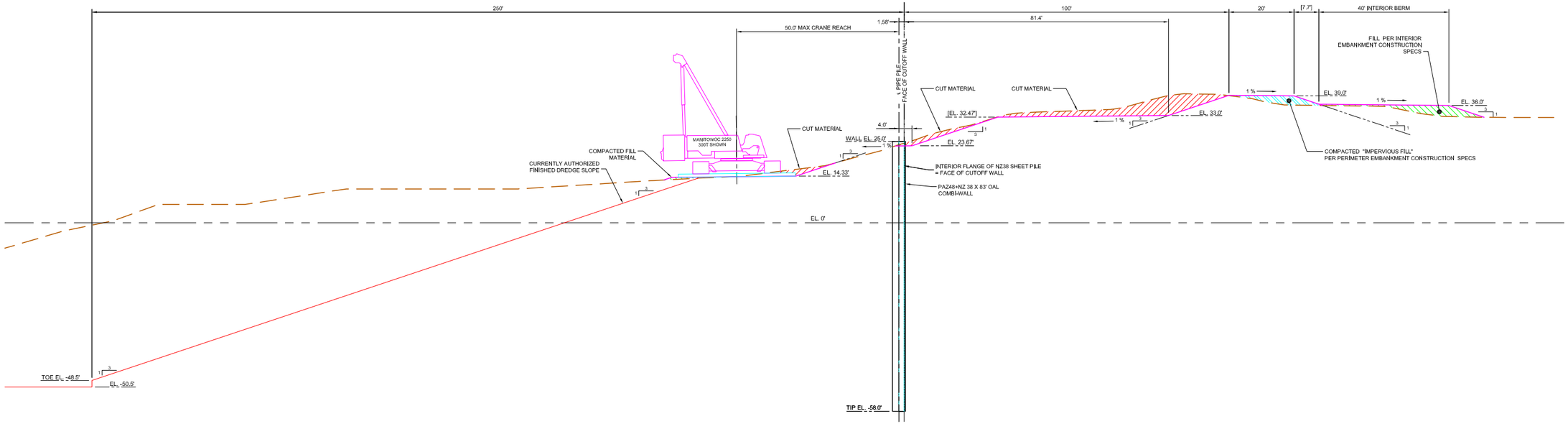
SECTION 55+00 - WALL INSTALLATION FROM ABOVE



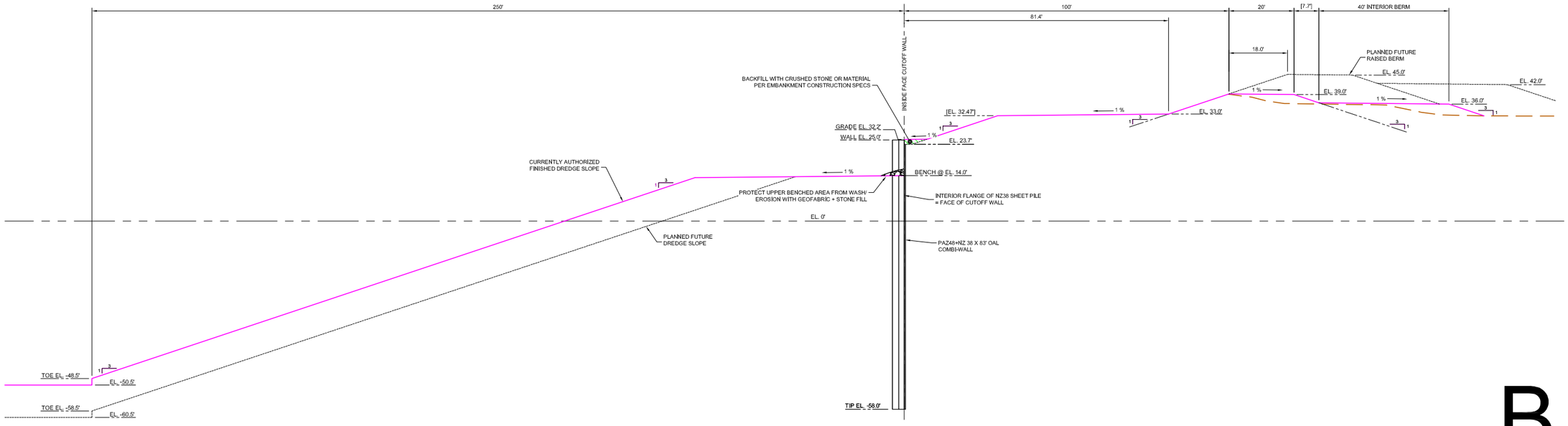
SECTION 55+00 - FINISHED GRADE

A

55+00



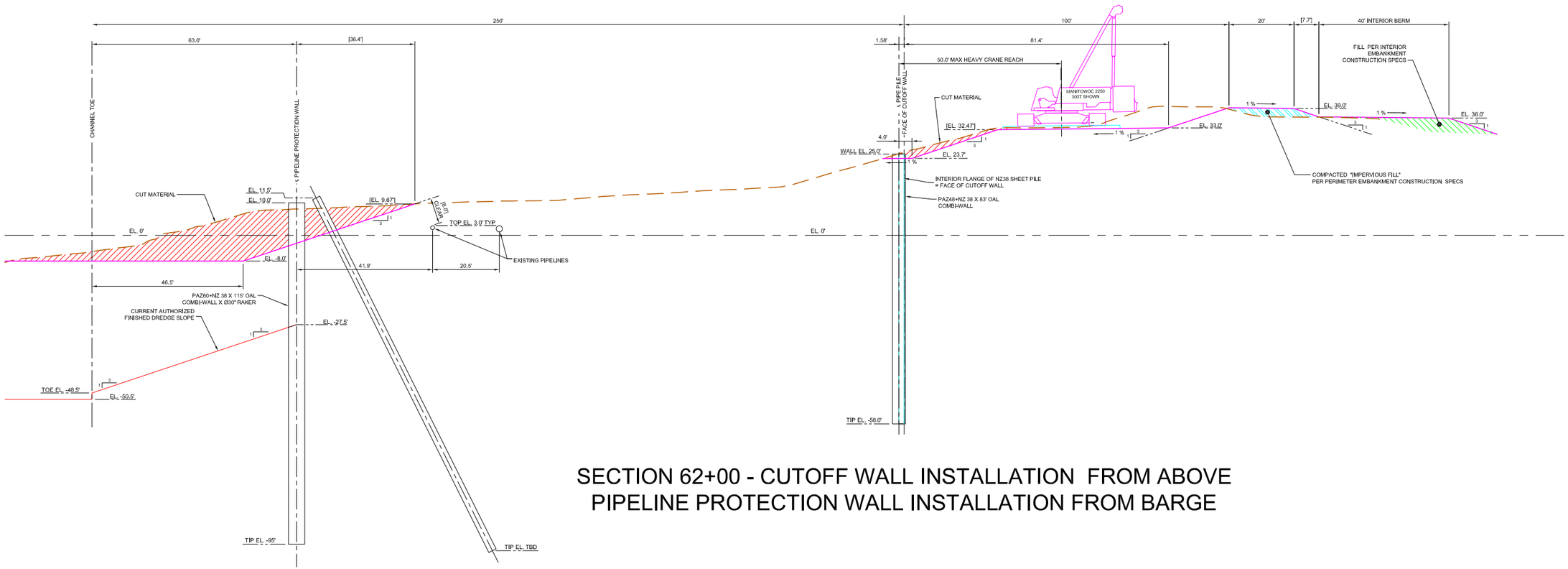
SECTION 55+00 - WALL INSTALLATION FROM BELOW



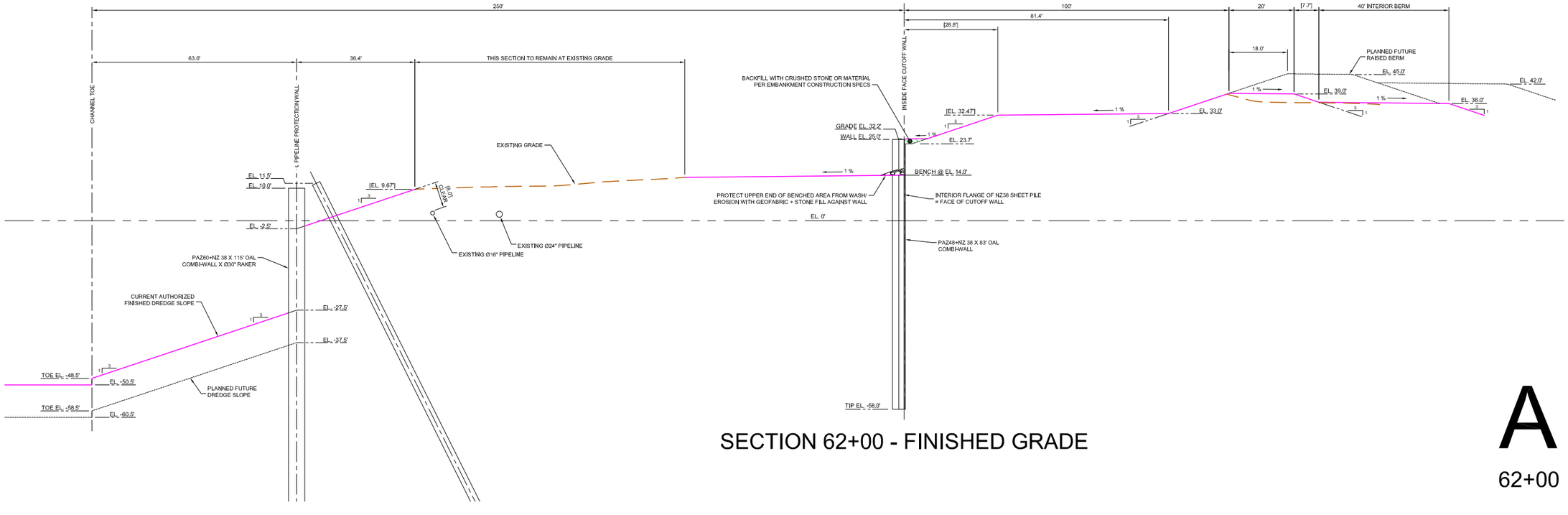
SECTION 55+00 - FINISHED GRADE

B

55+00



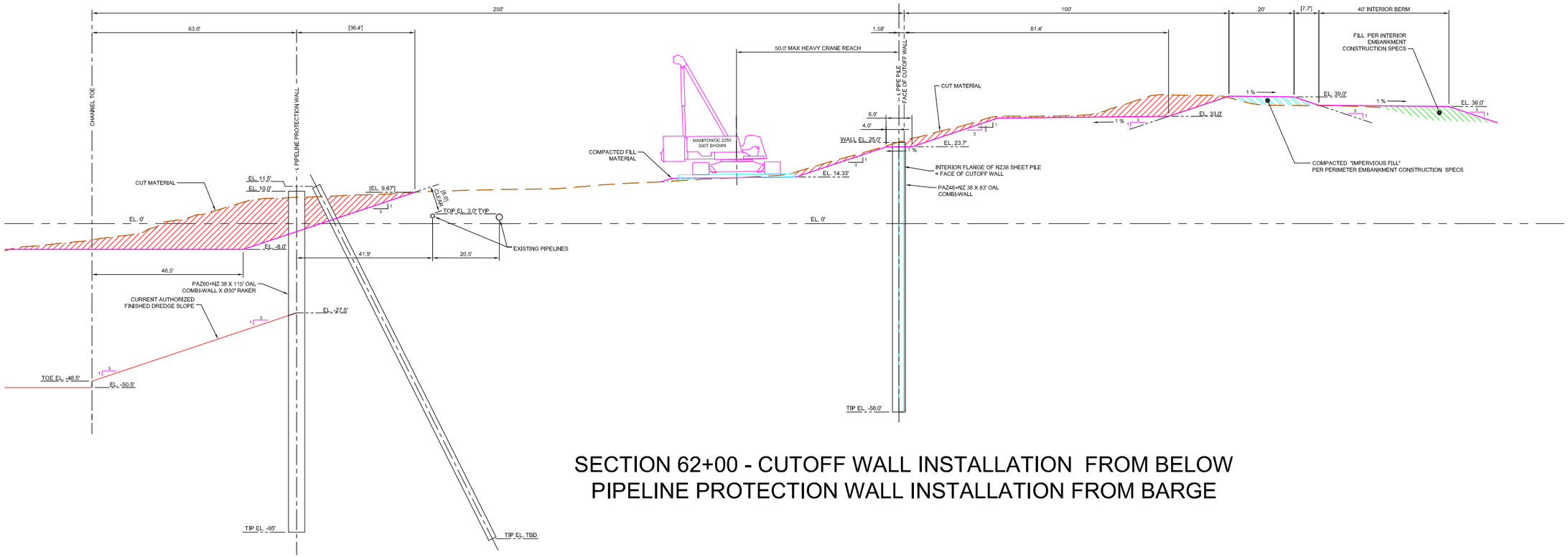
SECTION 62+00 - CUTOFF WALL INSTALLATION FROM ABOVE PIPELINE PROTECTION WALL INSTALLATION FROM BARGE



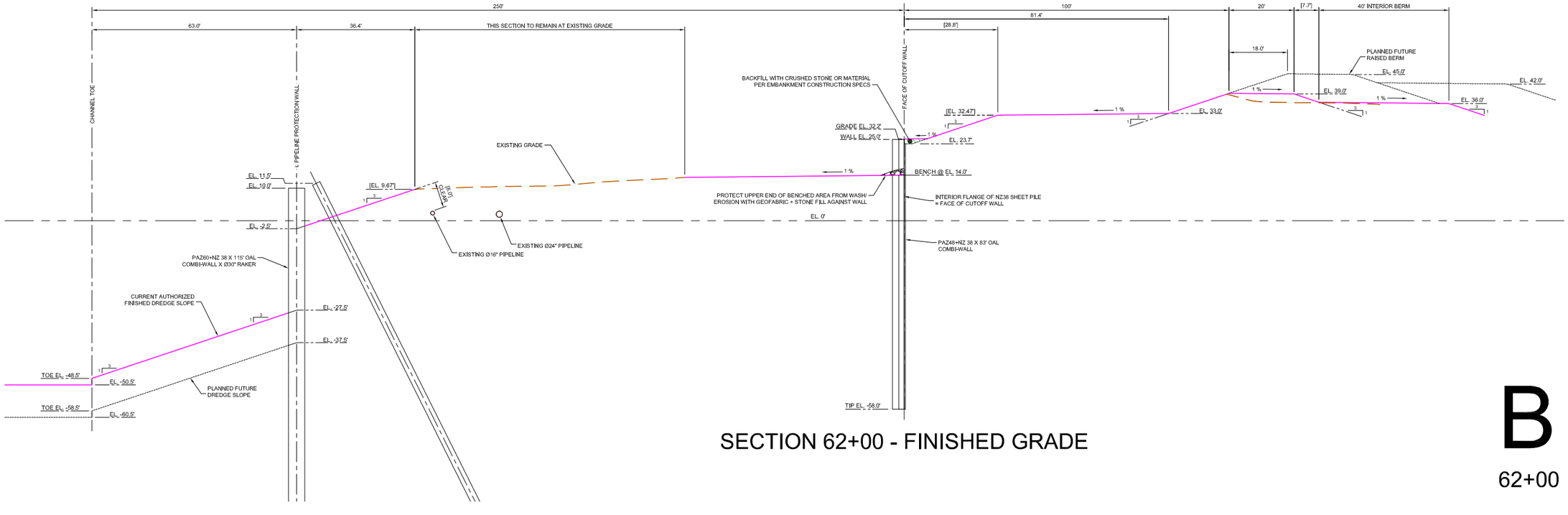
SECTION 62+00 - FINISHED GRADE

A

62+00



SECTION 62+00 - CUTOFF WALL INSTALLATION FROM BELOW PIPELINE PROTECTION WALL INSTALLATION FROM BARGE

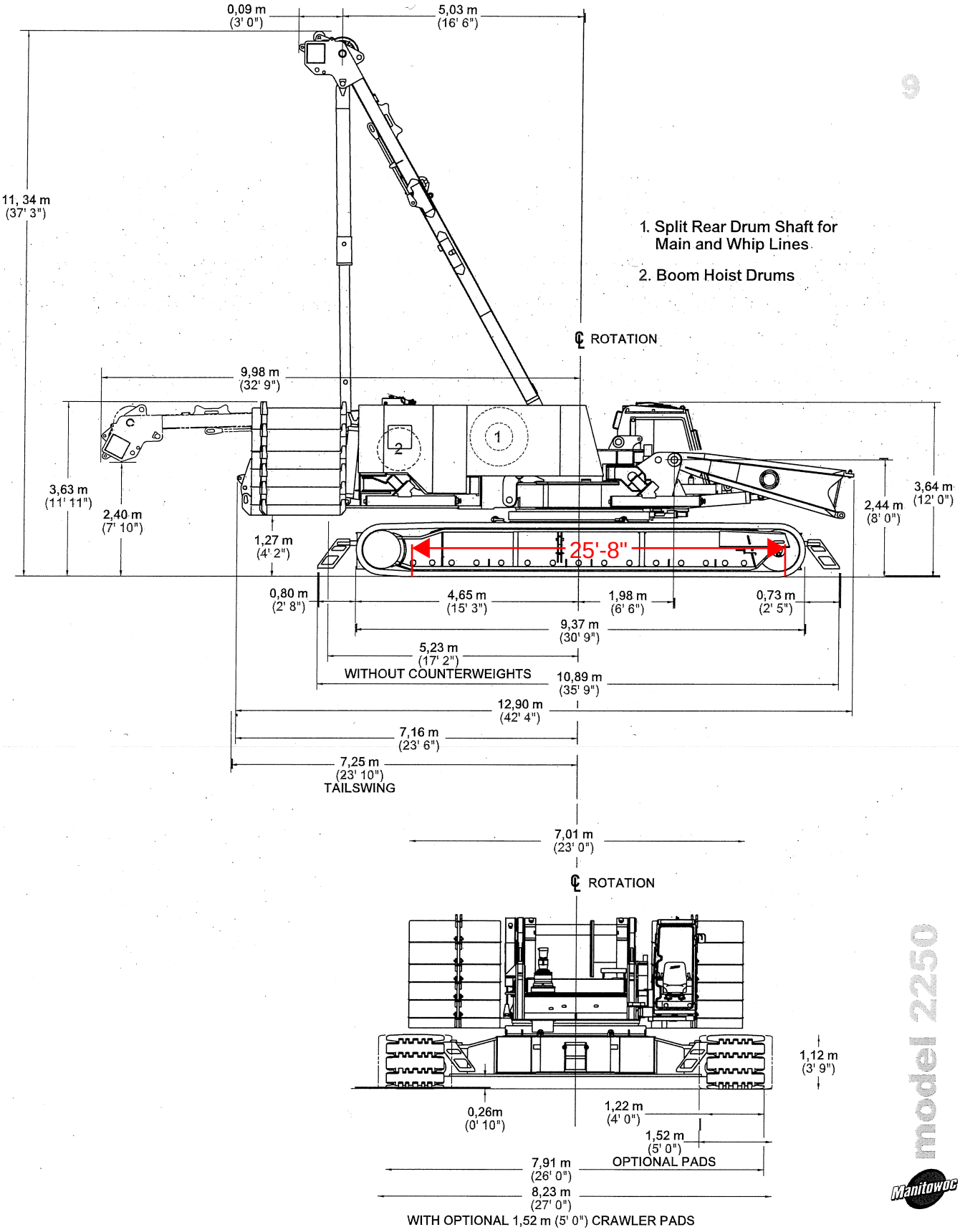


SECTION 62+00 - FINISHED GRADE

B

62+00

outline dimensions



model 2250

Manitowoc

heavy-lift load charts

Liftcrane Boom Capacities - 2250 Series 3
Boom No. 44 with Heavy Lift Top

113 040 kg (249,200 lb) Crane Counterweight 54 430 kg (120,000 lb) Carbody Counterweight

360° Rating **kg (lb) x 1 000**

Boom m (ft)	21,3 (70)	27,4 (90)	33,5 (110)	39,6 (130)	45,7 (150)	51,8 (170)	57,9 (190)	67,1 (220)	73,2 (240)	79,2 (260)	85,3 (280)	91,4 (300)
Radius												
5,5 (18)	272,1 (600.0)											
7,0 (22)	239,3 (541.5)	223,4 (495.6)	169,8 –									
8,0 (26)	210,8 (469.1)	210,4 (468.1)	166,2 (367.0)	158,8 (350.7)								
9,0 (30)	188,2 (408.7)	187,8 (407.7)	162,9 (358.2)	155,9 (343.0)	135,8 (298.6)	– (284.1)						
11,0 (36)	154,1 (340.9)	154,2 (340.9)	153,8 (339.8)	150,9 (333.2)	130,7 (288.3)	124,9 (275.6)	108,2 (238.8)					
12,0 (40)	135,9 (293.0)	140,7 (304.2)	140,4 (303.9)	138,0 (298.3)	128,4 (282.3)	123,1 (270.7)	106,5 (234.2)	97,7 (214.8)	– (185.8)			
14,0 (46)	109,0 (239.8)	113,0 (248.7)	112,8 (248.3)	112,6 (247.9)	110,9 (244.2)	107,4 (236.4)	103,1 (227.2)	90,8 (200.2)	80,9 (178.4)	73,8 (162.8)	64,4 (142.0)	55,9 (123.3)
15,0 (50)	98,6 (212.6)	102,5 (221.2)	102,3 (220.8)	102,2 (220.4)	101,9 (219.6)	99,1 (214.7)	96,1 (207.8)	87,5 (191.2)	78,3 (171.3)	71,5 (156.5)	63,4 (138.6)	55,6 (122.6)
18,0 (60)	74,7 (160.4)	79,8 (172.4)	79,5 (171.8)	79,4 (171.4)	78,9 (170.5)	78,8 (169.8)	77,7 (168.3)	74,4 (160.5)	70,5 (153.9)	64,4 (140.7)	58,5 (129.1)	53,0 (116.0)
22,0 (70)	– (110.2)	59,4 (137.4)	60,7 (139.5)	60,4 (139.0)	60,0 (138.1)	59,7 (137.4)	59,2 (136.4)	58,4 (133.8)	56,5 (129.5)	55,4 (125.9)	55,0 (125.0)	48,4 (108.3)
24,0 (80)		51,6 (110.7)	54,0 (116.6)	53,8 (116.1)	53,3 (115.1)	53,0 (114.5)	52,5 (113.4)	51,9 (112.0)	50,9 (110.2)	50,1 (108.3)	48,9 (105.8)	46,4 (101.7)
28,0 (90)			42,8 (97.6)	43,6 (99.0)	43,2 (98.0)	42,8 (97.3)	42,3 (96.2)	41,7 (94.8)	41,2 (93.7)	41,3 (93.6)	40,2 (91.1)	38,8 (88.0)
30,0 (100)			37,8 (80.9)	39,6 (85.6)	39,2 (84.7)	38,9 (84.0)	38,4 (82.9)	37,8 (81.5)	37,2 (80.3)	37,3 (80.5)	36,7 (79.5)	35,4 (76.6)
34,0 (110)				32,1 (72.7)	32,9 (74.1)	32,6 (73.4)	32,1 (72.3)	31,4 (70.8)	30,9 (69.6)	30,9 (69.8)	30,7 (69.2)	29,8 (67.2)
36,0 (120)				28,7 (61.1)	29,9 (64.1)	30,0 (64.7)	29,5 (63.6)	28,8 (62.1)	28,3 (60.9)	28,4 (61.1)	28,1 (60.5)	27,5 (59.4)
42,0 (140)					21,9 (46.3)	22,9 (49.1)	23,2 (49.5)	22,6 (48.8)	22,1 (47.6)	22,2 (47.8)	21,9 (47.1)	21,3 (45.4)
50,0 (160)						– (35.5)	15,8 (37.1)	16,0 (37.4)	15,8 (37.0)	16,3 (38.0)	15,2 (35.8)	13,9 (32.8)
56,0 (180)								11,8 (27.8)	11,7 (27.4)	12,2 (28.6)	11,2 (26.4)	9,8 (23.3)
62,0 (200)								8,5 (20.0)	8,4 (19.7)	8,9 (21.0)	8,1 (19.0)	6,8 (16.1)
68,0 (220)									5,6 (13.3)	6,2 (14.7)	5,5 (13.0)	4,3 (10.4)
72,0 (235)										4,7 (10.8)	4,0 (9.2)	3,0 (7.0)
74,0 (245)											3,3 (6.9)	2,4 (5.0)
76,0 (255)											2,6 (4.7)	1,9 –

RECOMMENDED MAX HEAVY LIFT PER DESIGN

MAXED OUT @ R60' FOR 170kip LOAD (& NO WIND LOAD)

Fixed Jib No. 132 on Boom No. 44

Jib Length m (ft)	Deduct from Capacity when fixed jib is attached kg (lb)
12,2 (40)	2 900 (6,400)
18,3 (60)	3 720 (8,200)
24,4 (80)	4 670 (10,300)
30,5 (100)	5 810 (12,800)
36,6 (120)	6 940 (15,300)

Meets ANSI B30.5 Requirements - Capacities do not exceed 75% of static tipping load.
NOTICE: This capacity chart is for reference only and must not be used for lifting purposes.

Manitowoc

Manitowoc 2250 Lattice Boom Crawler Crane

Item	QTY	Weight	
Upperworks module	1	85,020	85,020
Carbody+rotating module+lower boom butt	1	64,350	64,350
Crawlers	2	53,820	107,640
Upper center counterweight	1	37,000	37,000
Counterweight tray	1	39,115	39,115
Side Counterweight Series 1,2,3	6	15,500	93,000
Side Counterweight Series 2,3	6	20,000	120,000
Carbody center Cweight series 2,3	2	30,000	60,000
Carbody side Counterweight Series 3	4	15,000	60,000
No. 44 Upper boom butt 40'	1	11,450	11,450
No. 44 boom top 30'	1	12,475	12,475
No. 44 Boom insert 40'	2	3,805	7,610
No. 44 Boom insert 20'	1	6,500	6,500
Hook block 28mm	1	9,410	9,410
Weight ball	1	1,310	1,310

Crane Subtotal	714,880	lbs
Full Load - 85' PAZ48 + Pileco 180-32	168,385	lbs

TOTAL LOAD **883,265 lbs**

Crane Track Dimensions

Total Standard Track Width (2x4')	8	ft
Total Track Length*	30.75	ft
Est. Effective Track Length	25.67	ft
sq ft effective track outline	205.33	sq ft

Weight distribution, unloaded	3482	psf
Average Weight distribution, fully loaded**	4302	psf

Proposed Crane Pad Dimensions

Qty (12) 4'x18'x12" =28'x36'	1008	sq ft

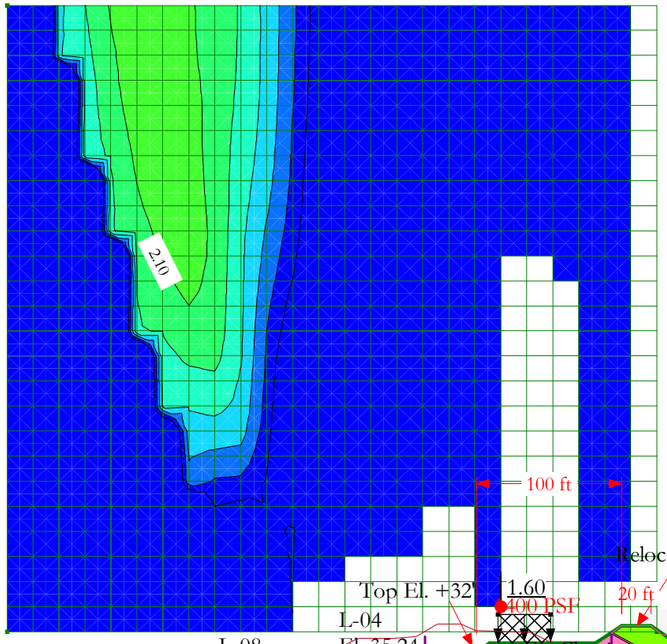
Average Weight distribution, unloaded	709	psf
Average Weight distribution, fully loaded**	876	psf
Estimated weight on loadside track, fully loaded**	705	kips
Estimated weight on offside track, fully loaded	178	kips
Average distributed pressure on loadside mats***	**1400**	psf

* Radii do not make ground contact
** Fully loaded with PAZ48 along west wall
*** Bearing on Qty (6) 4' wide x 18' long mats on load side, assumed evenly distributed, 1.0 factor of safety

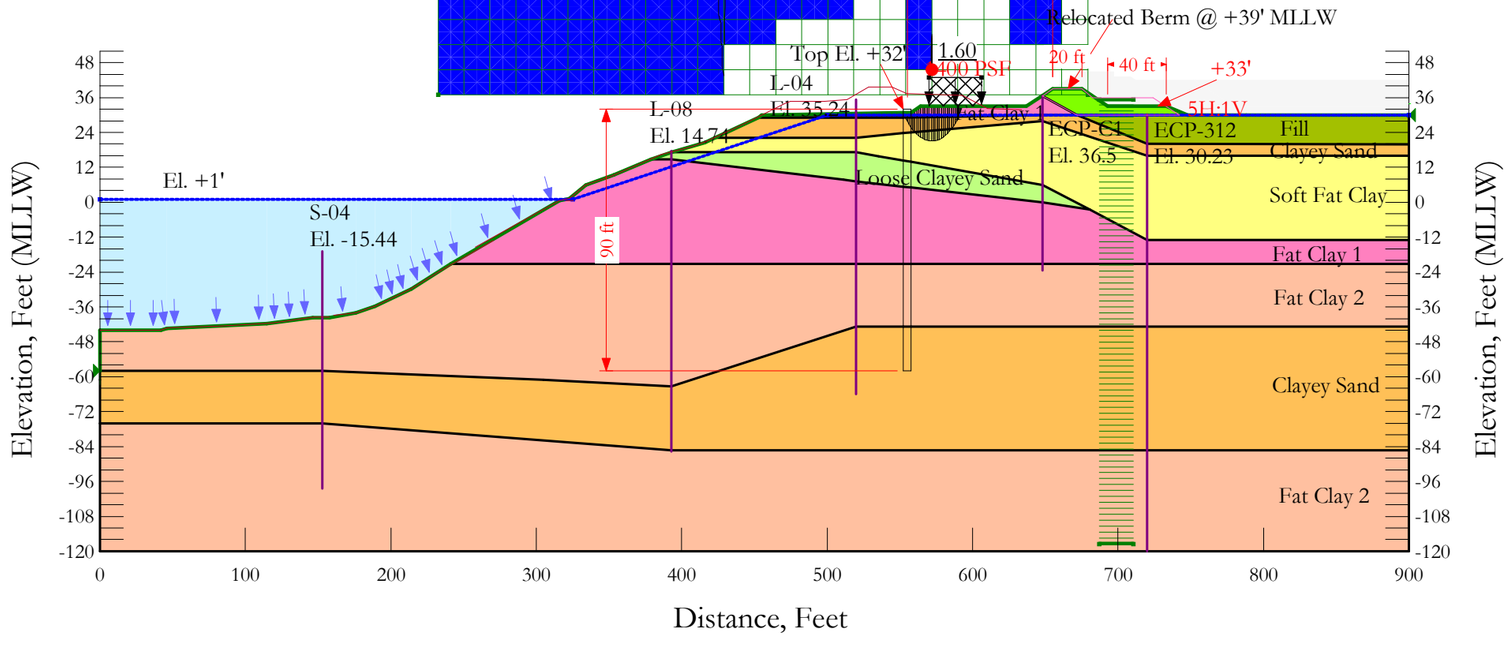
SLOPE STABILITY ANALYSIS:
1,400 PSF CONSTRUCTION SURCHARGE

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term
Slip Surface: Circular



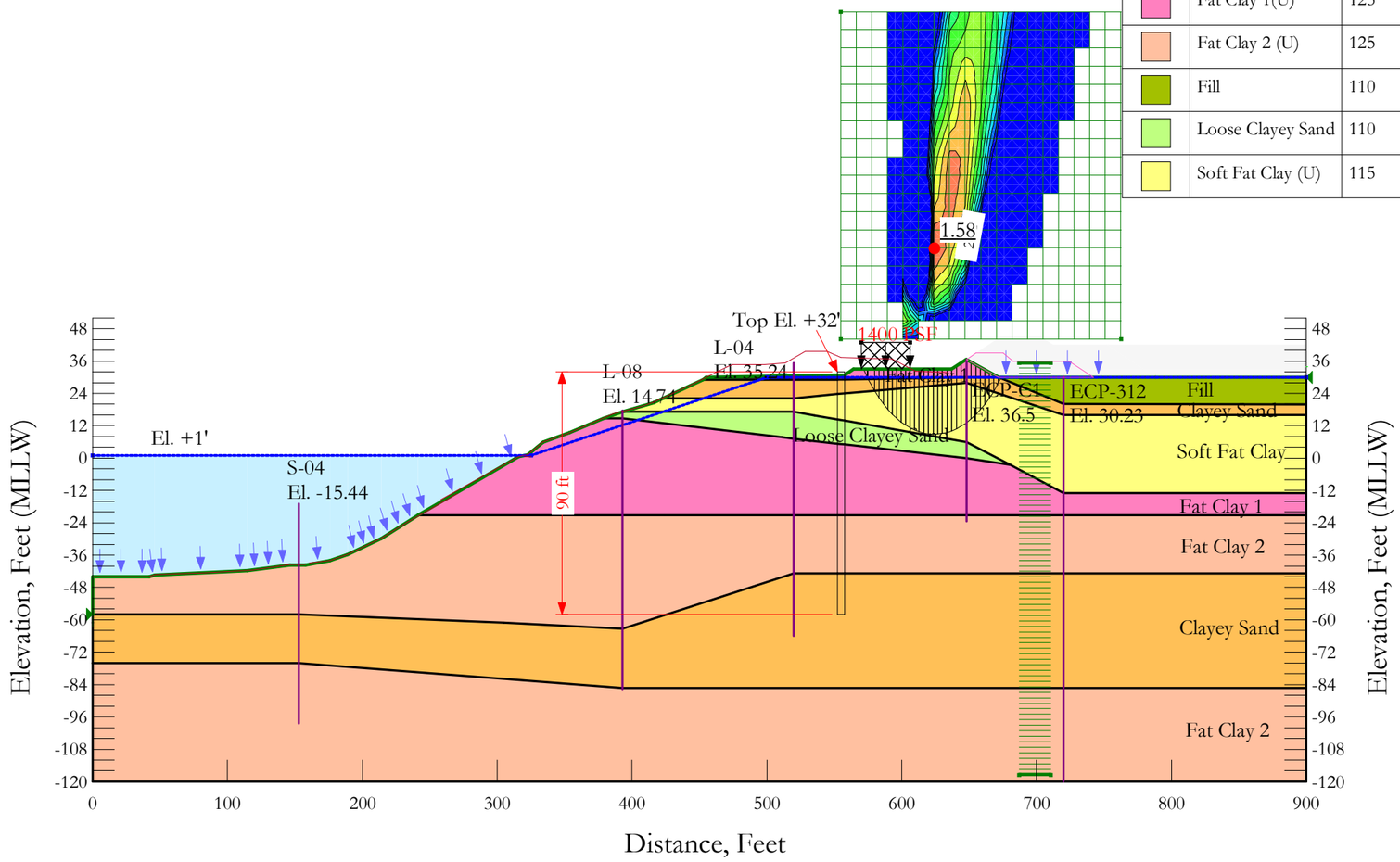
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term - Interior
Slip Surface: Circular

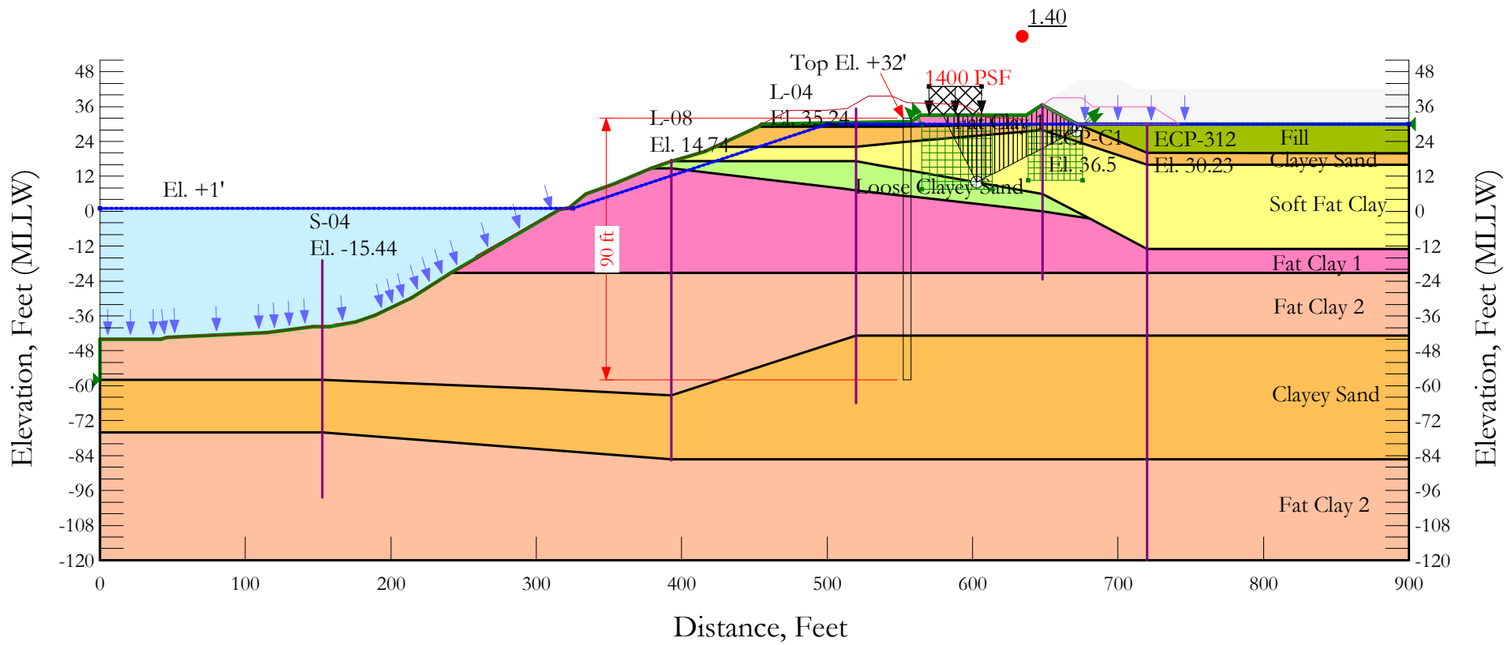
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



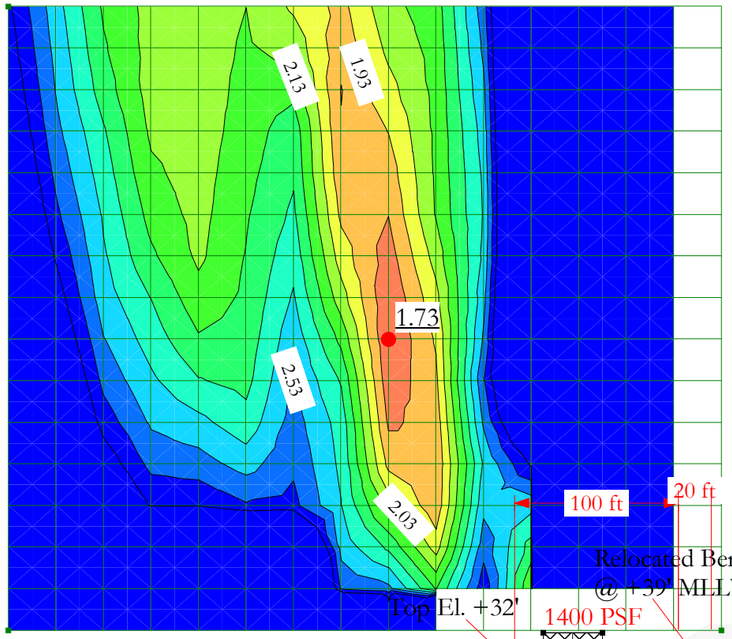
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term - Interior
Slip Surface: Block

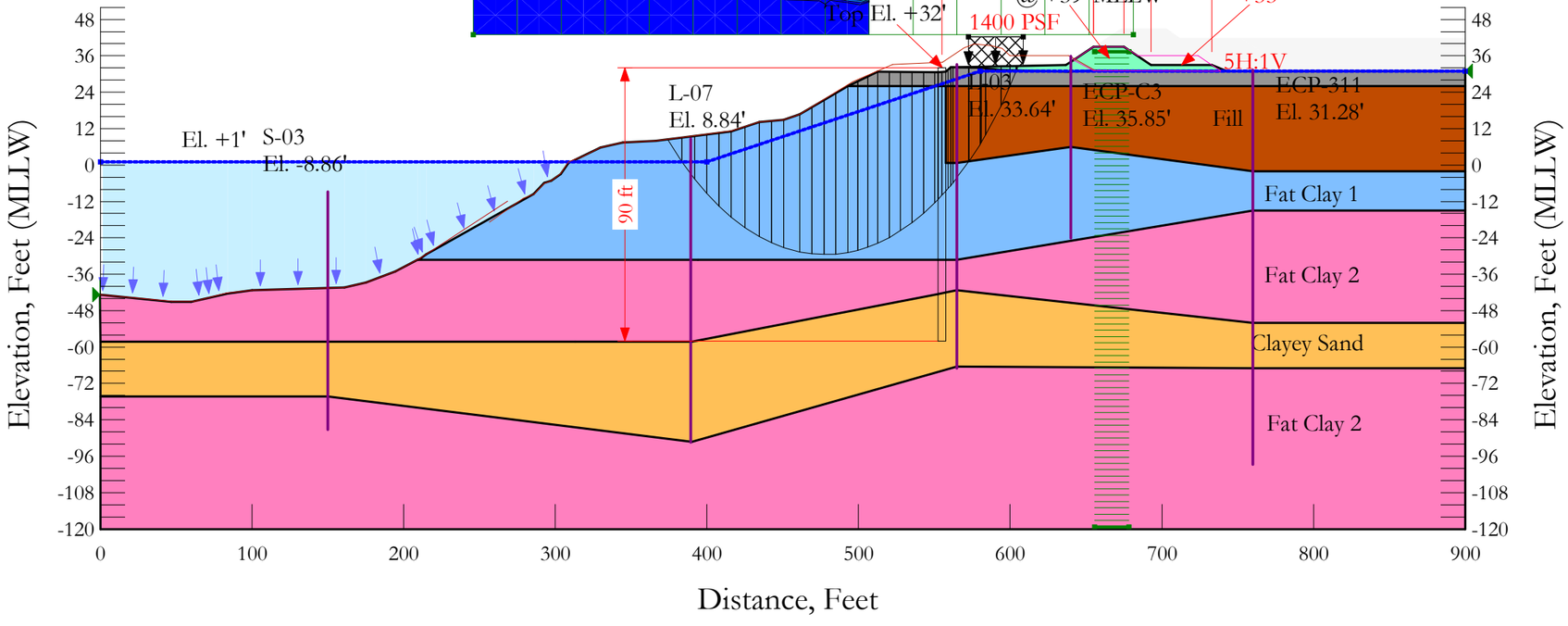
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term
Slip Surface: Circular

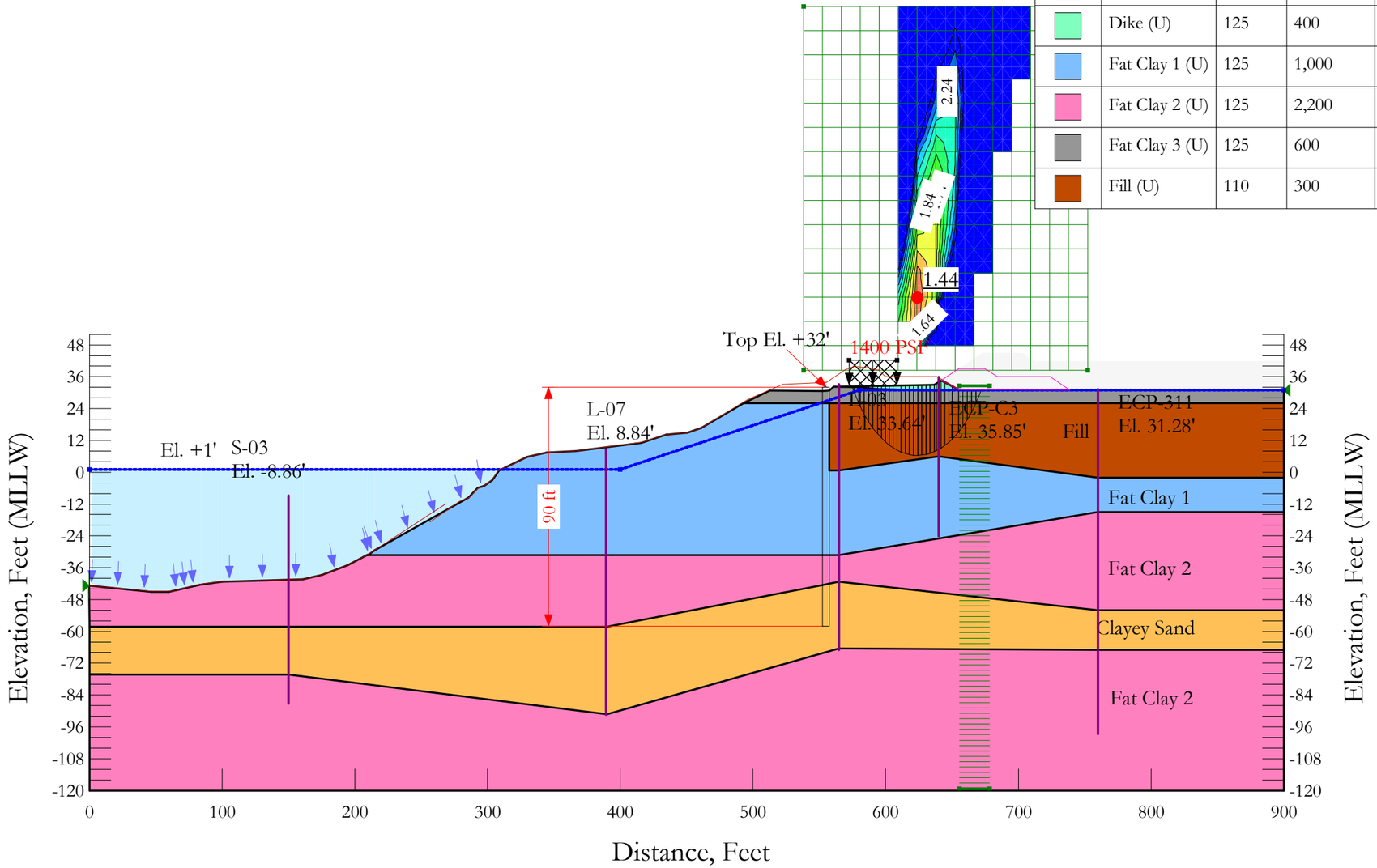


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



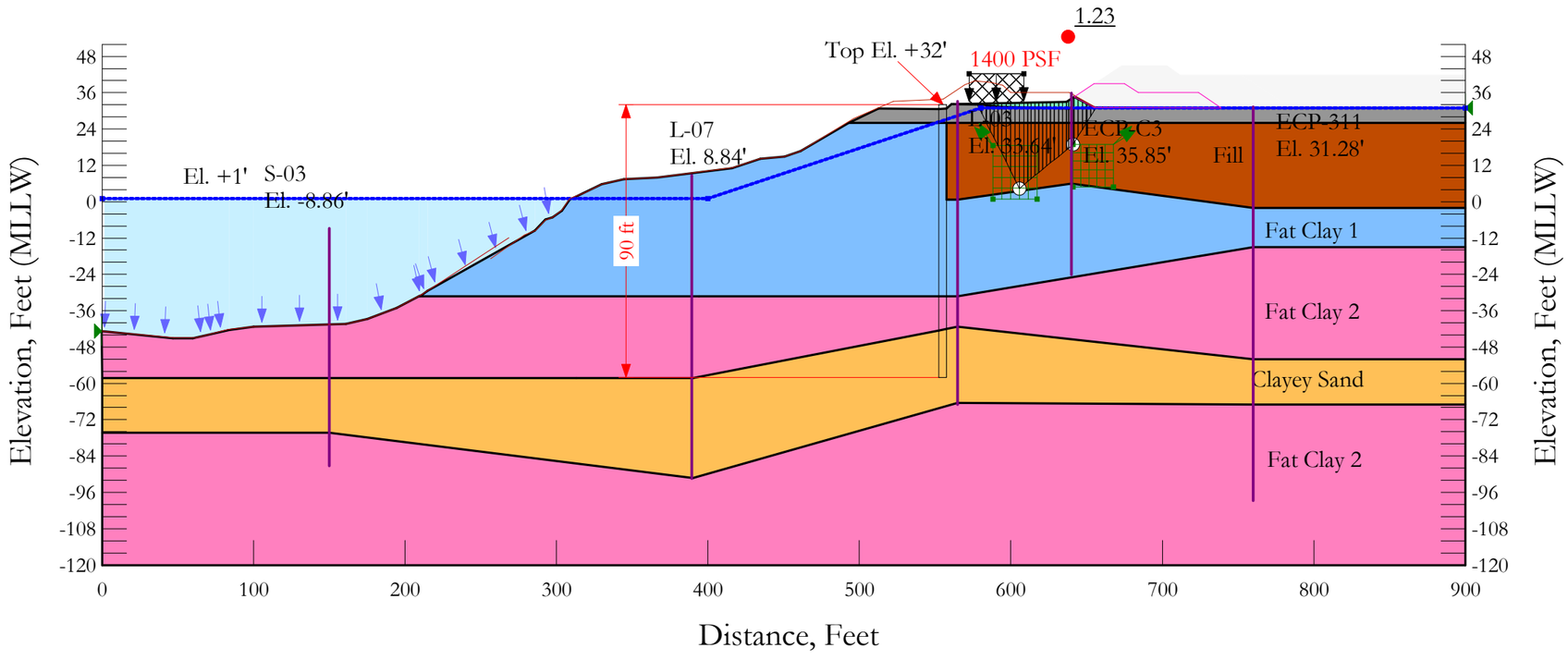
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		

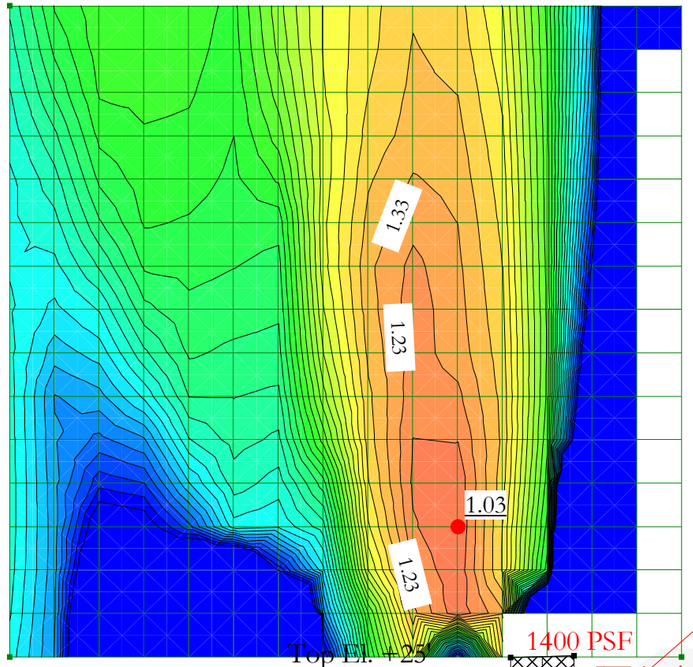


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Block

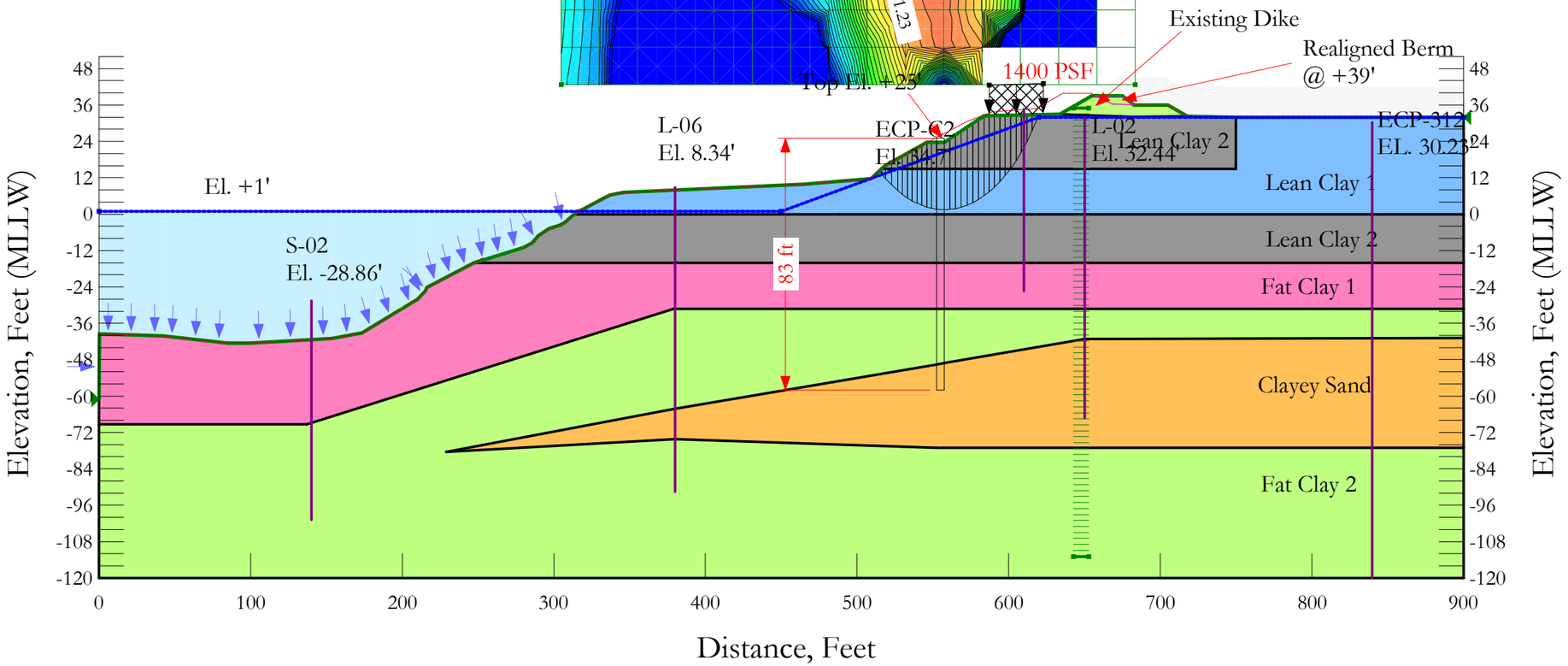
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term
Slip Surface: Circular

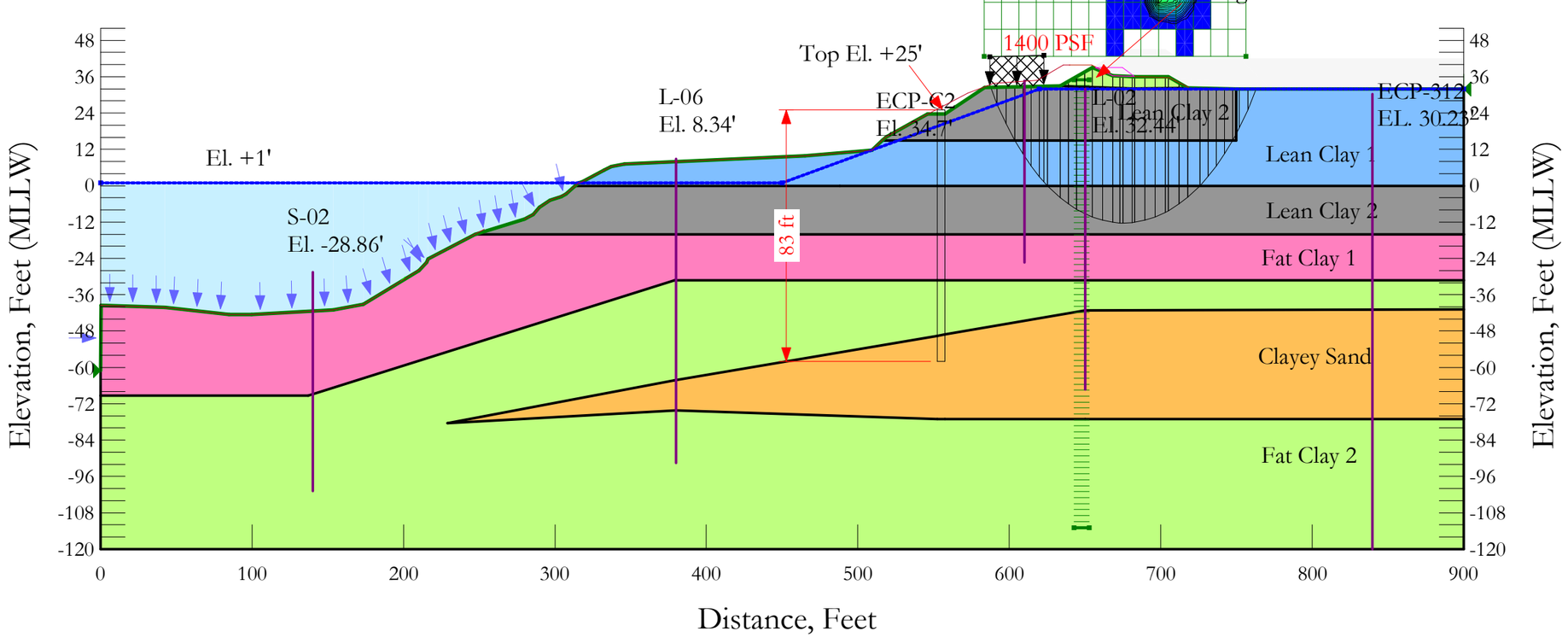


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



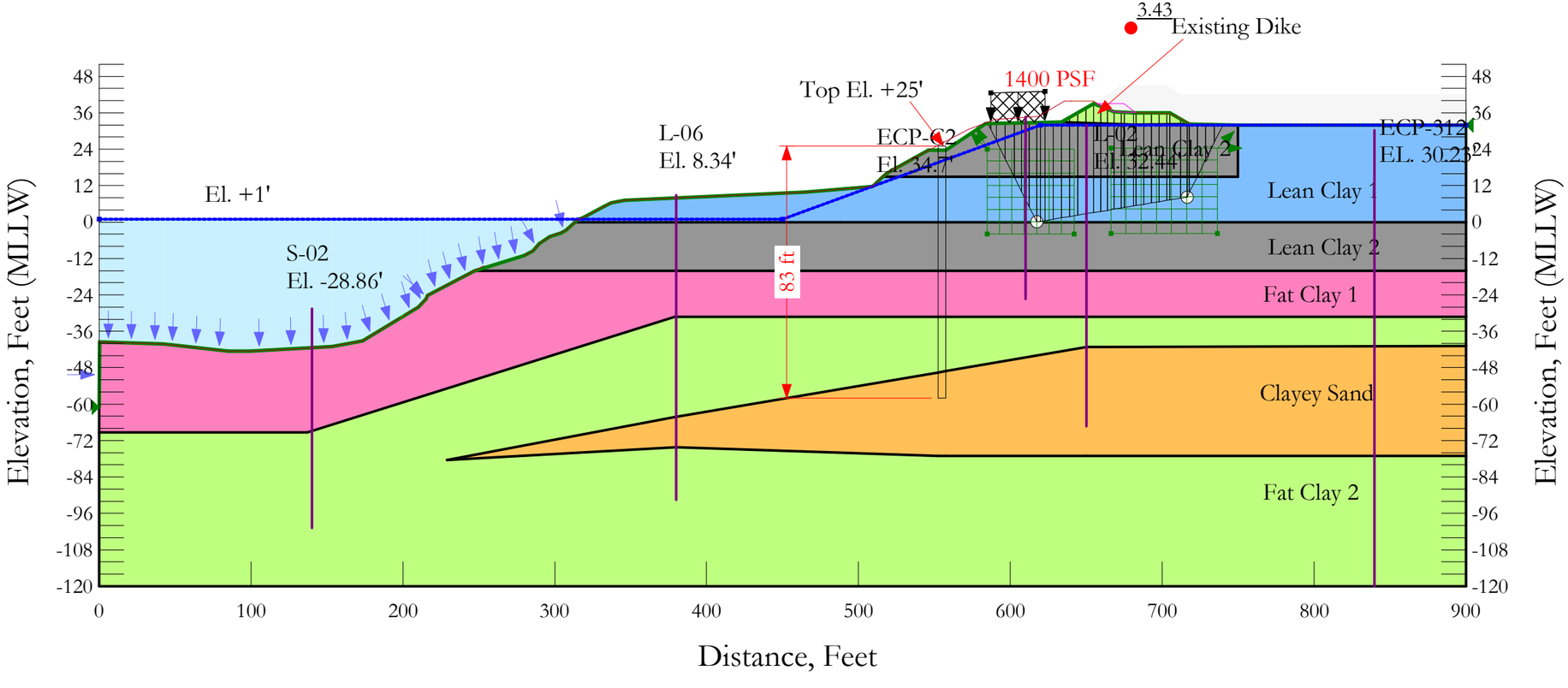
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		

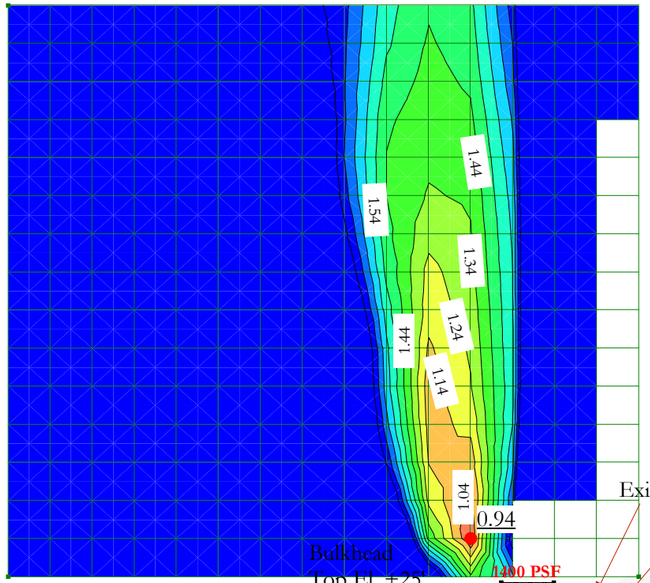


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Block

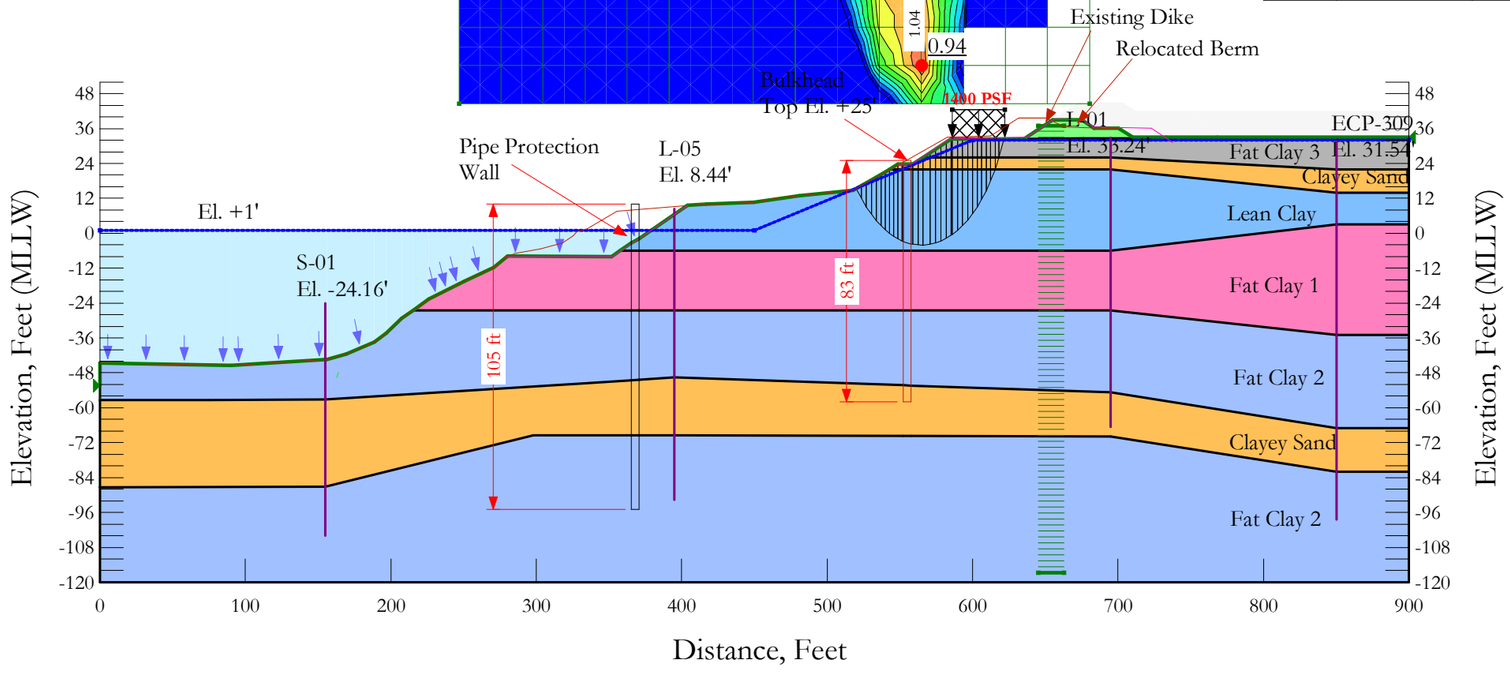
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term
Slip Surface: Circular

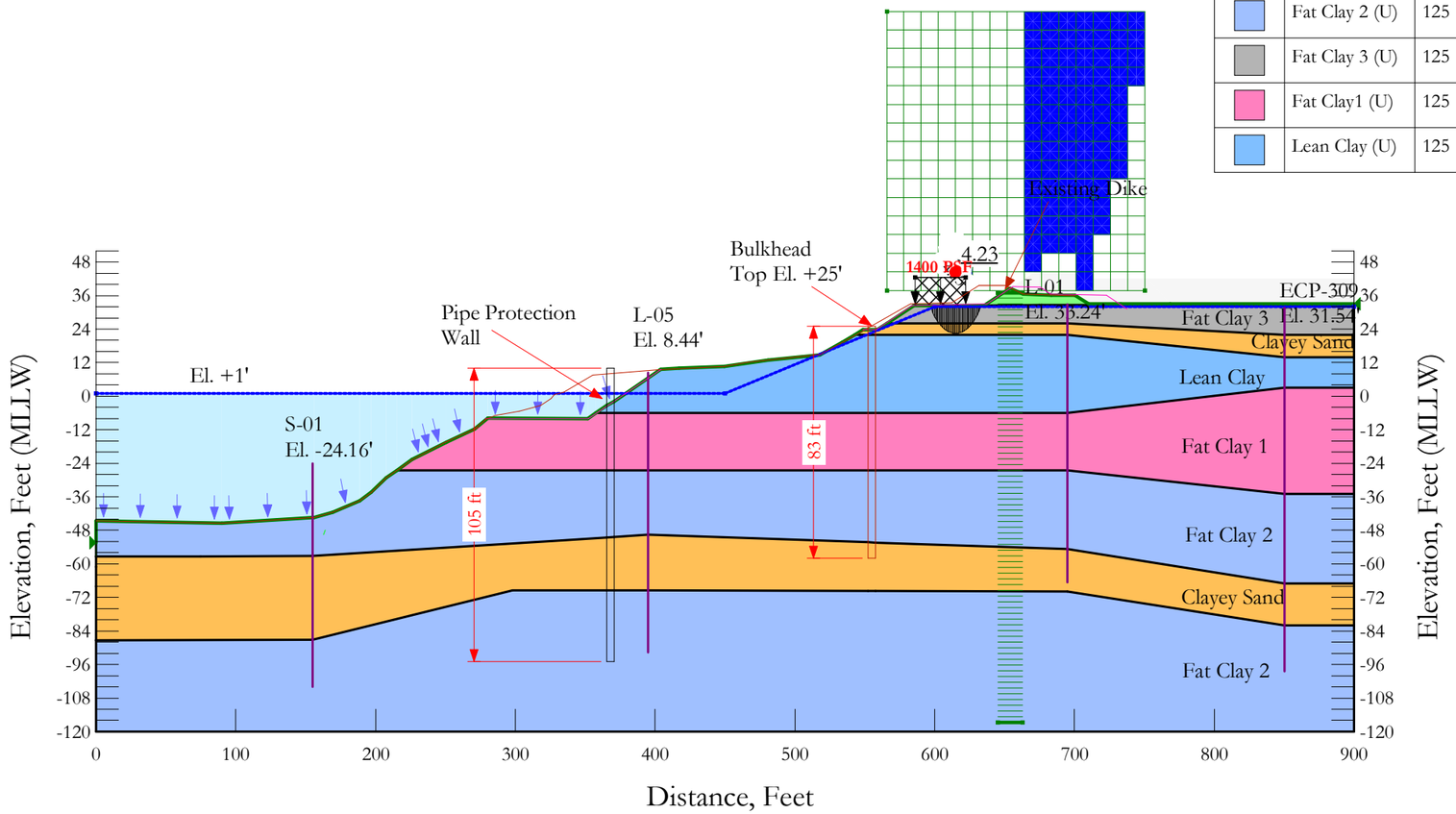


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



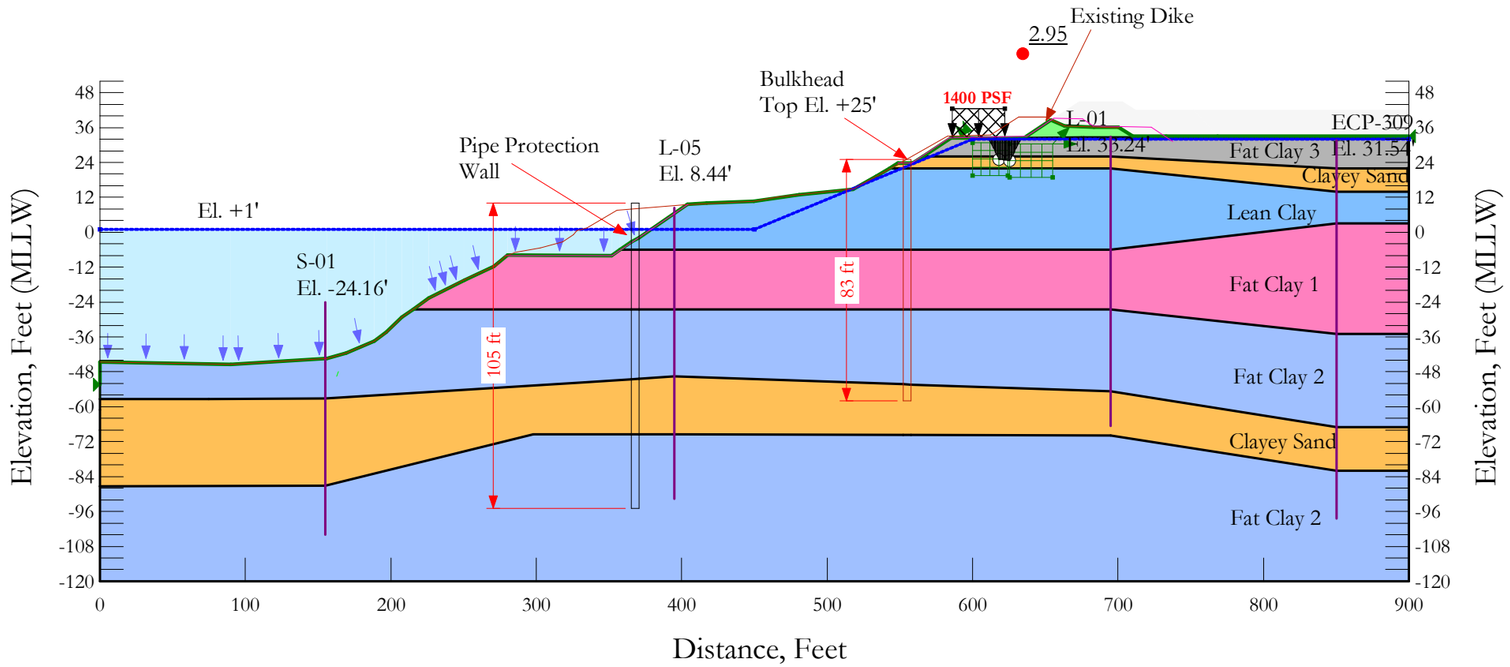
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



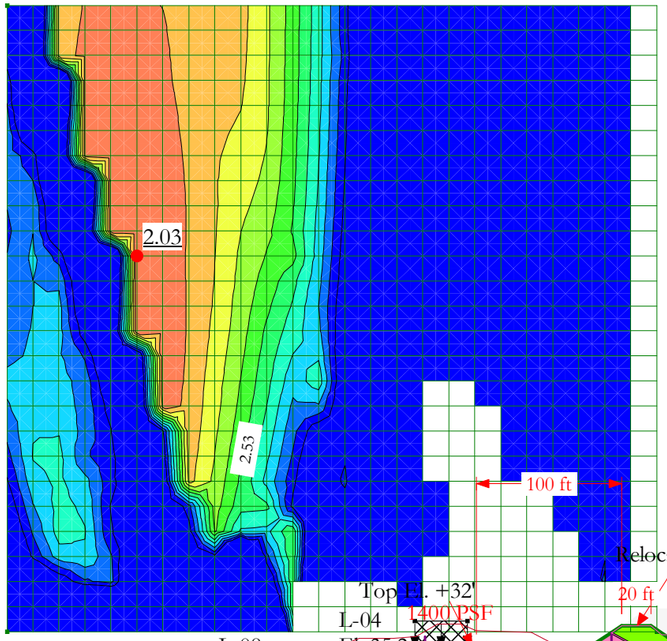
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term - Interior
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

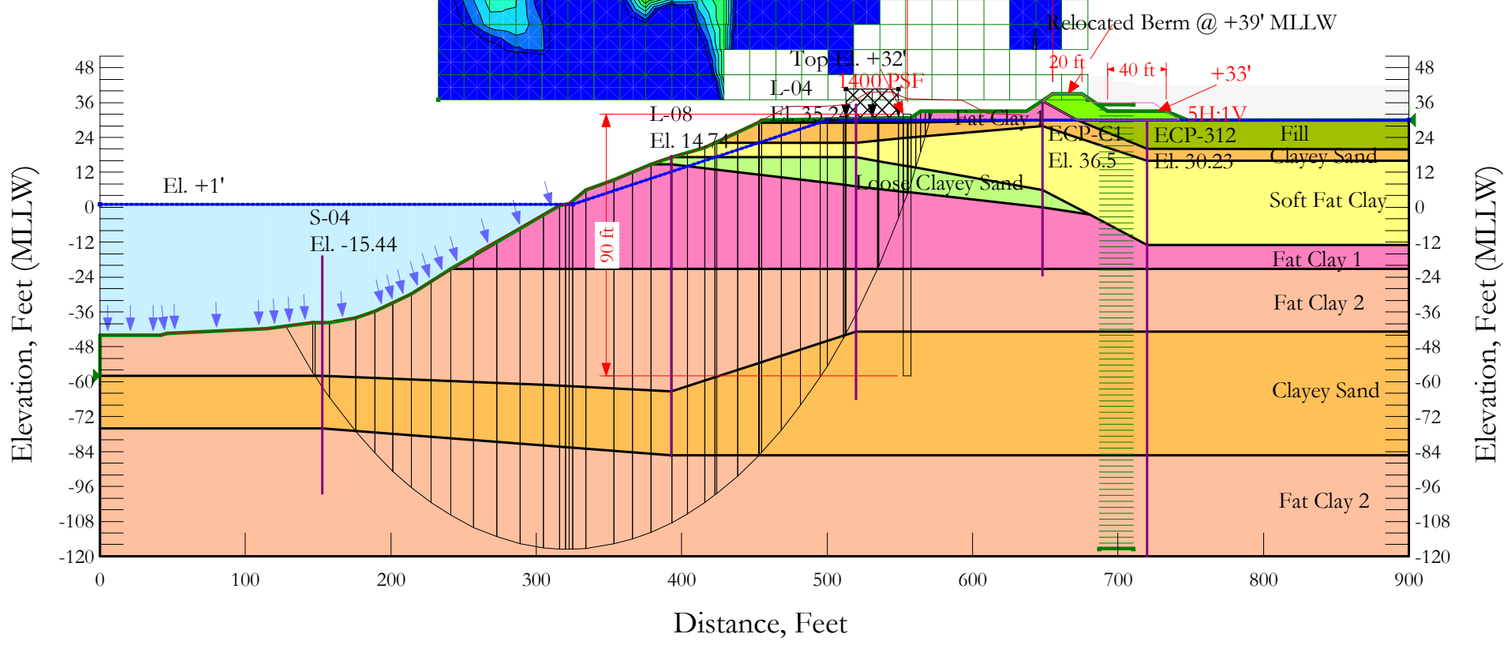


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Below

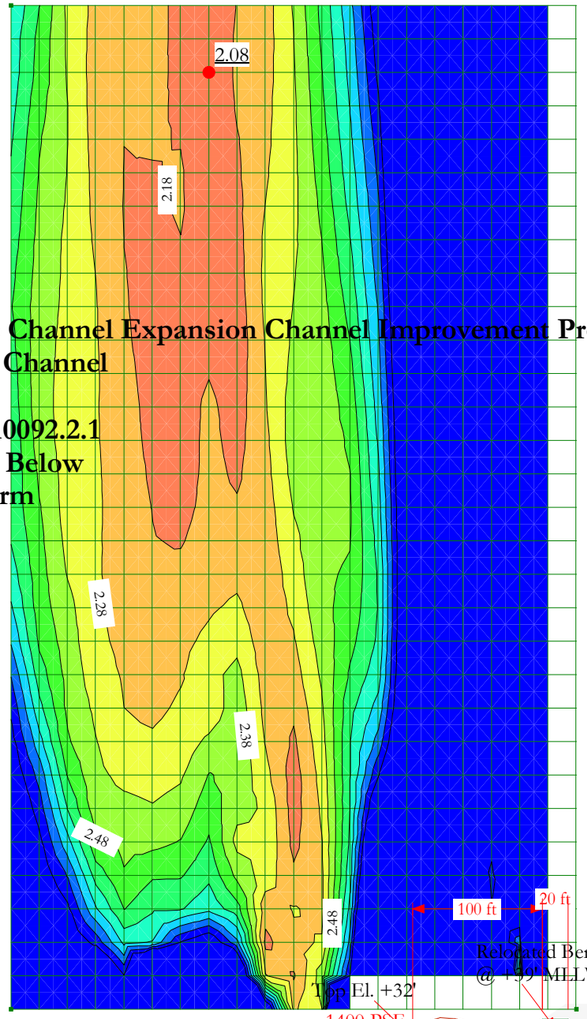
Loading Condition: Short Term
Slip Surface: Circular



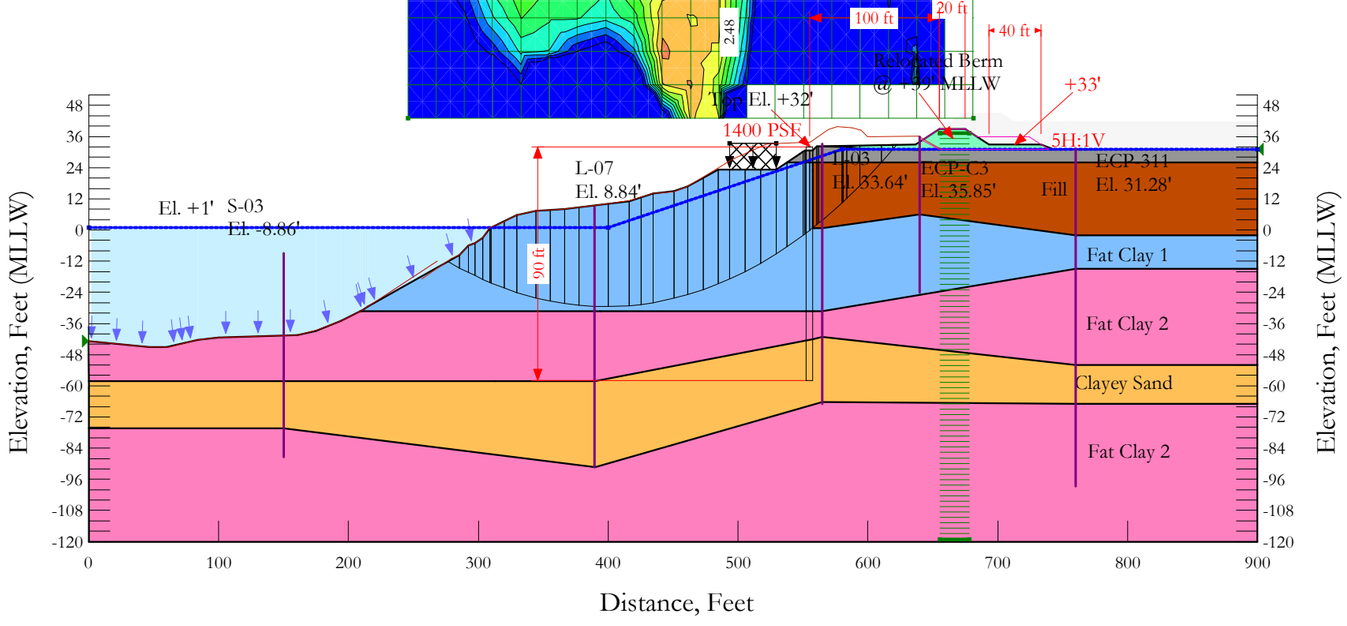
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



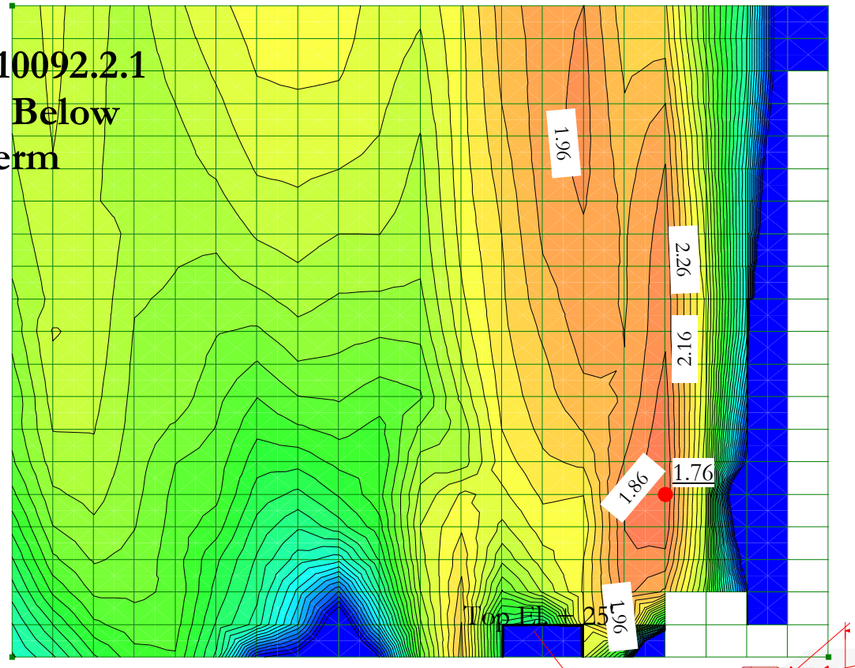
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Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Below
Loading Condition: Short Term
Slip Surface: Circular



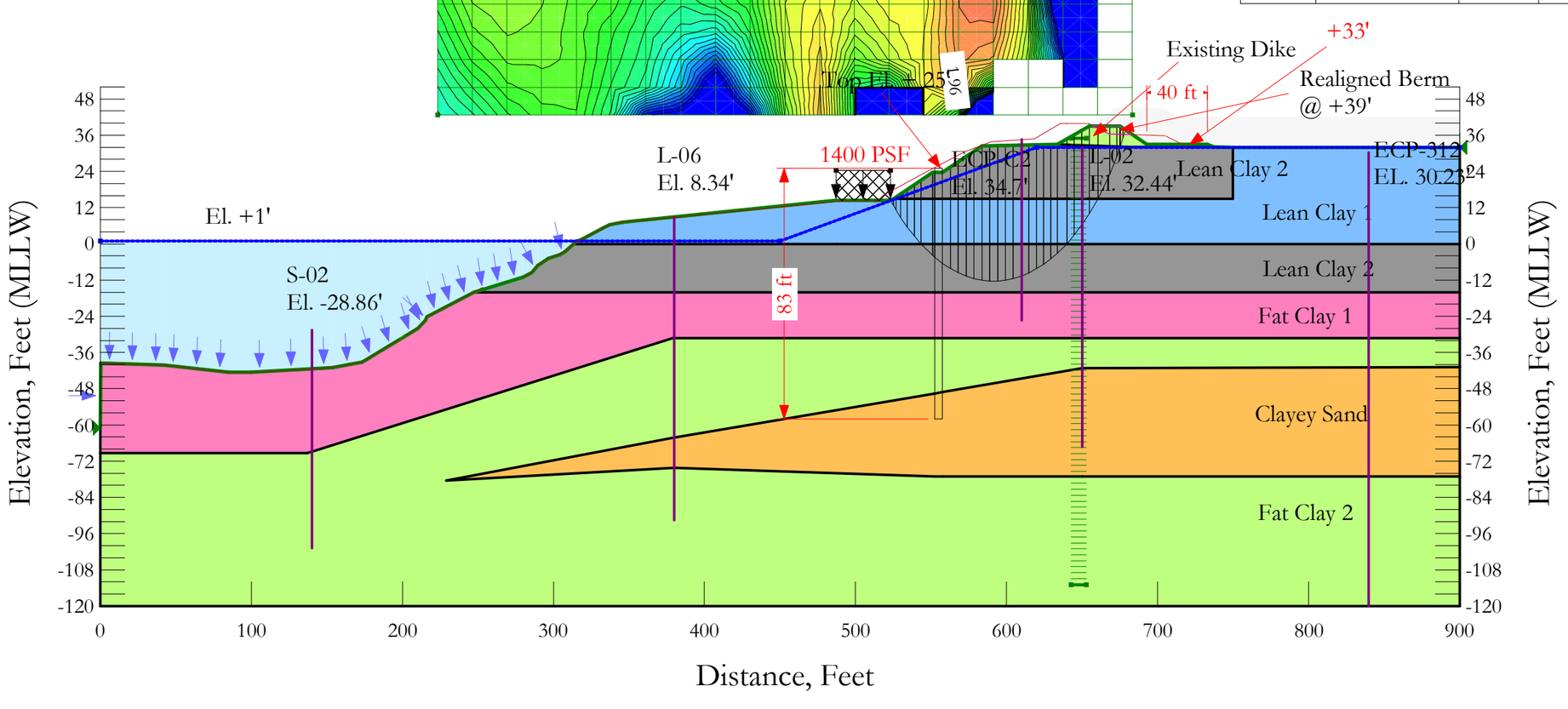
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



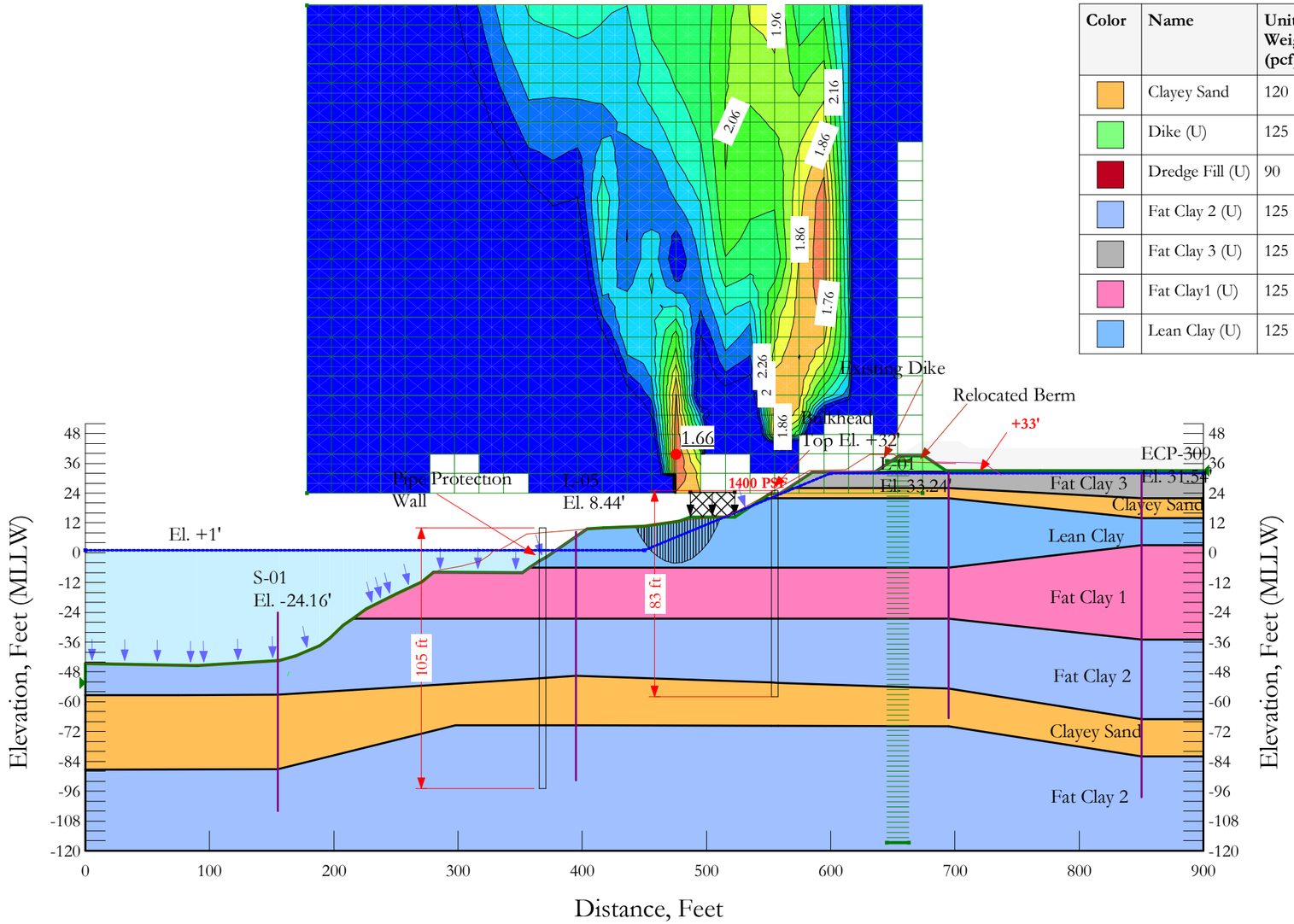
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Below
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Below
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term
Slip Surface: Circular

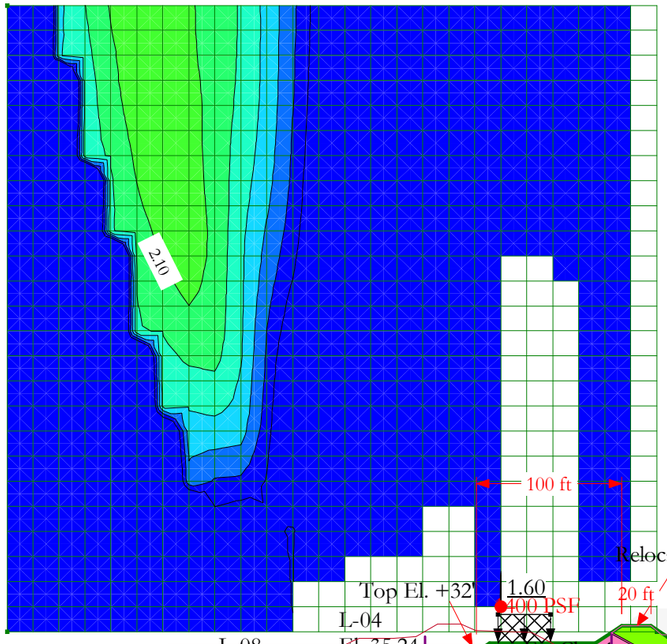


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

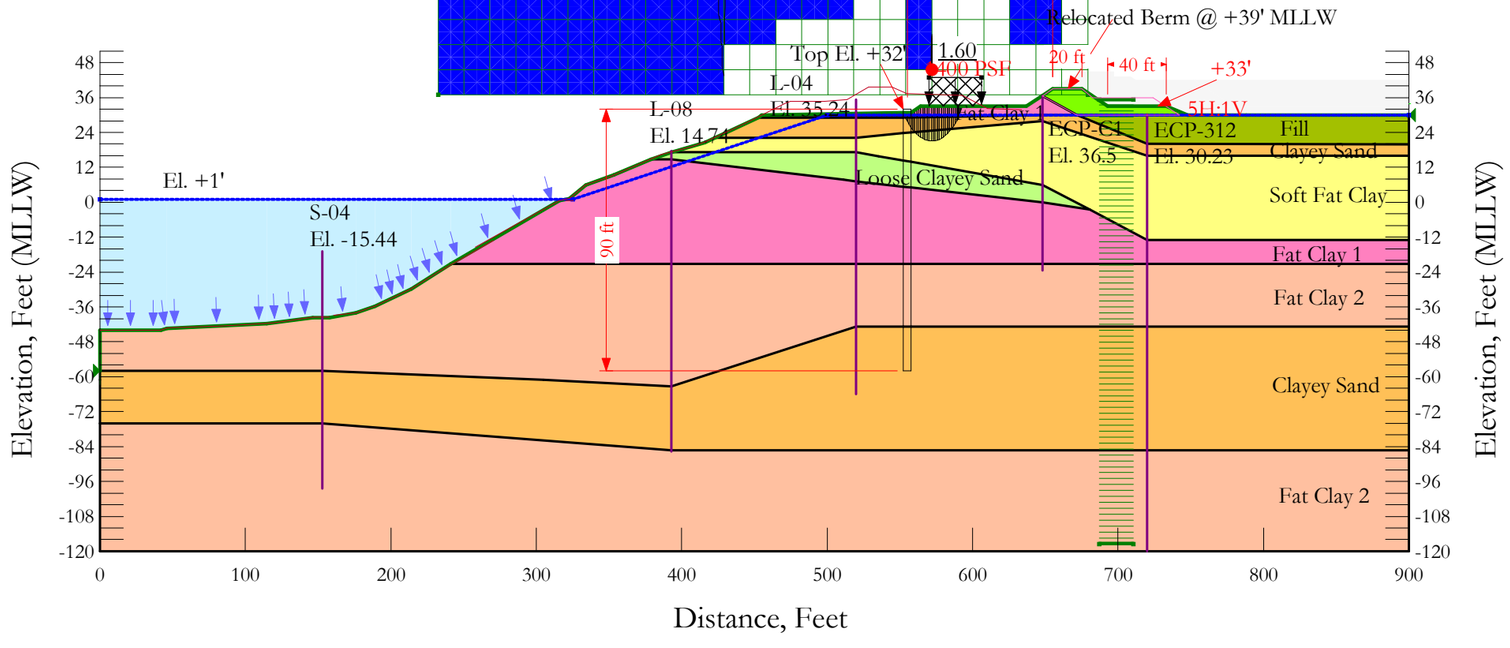
SLOPE STABILITY ANALYSIS:
ALLOWABLE CONSTRUCTION SURCHARGE

Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term
Slip Surface: Circular



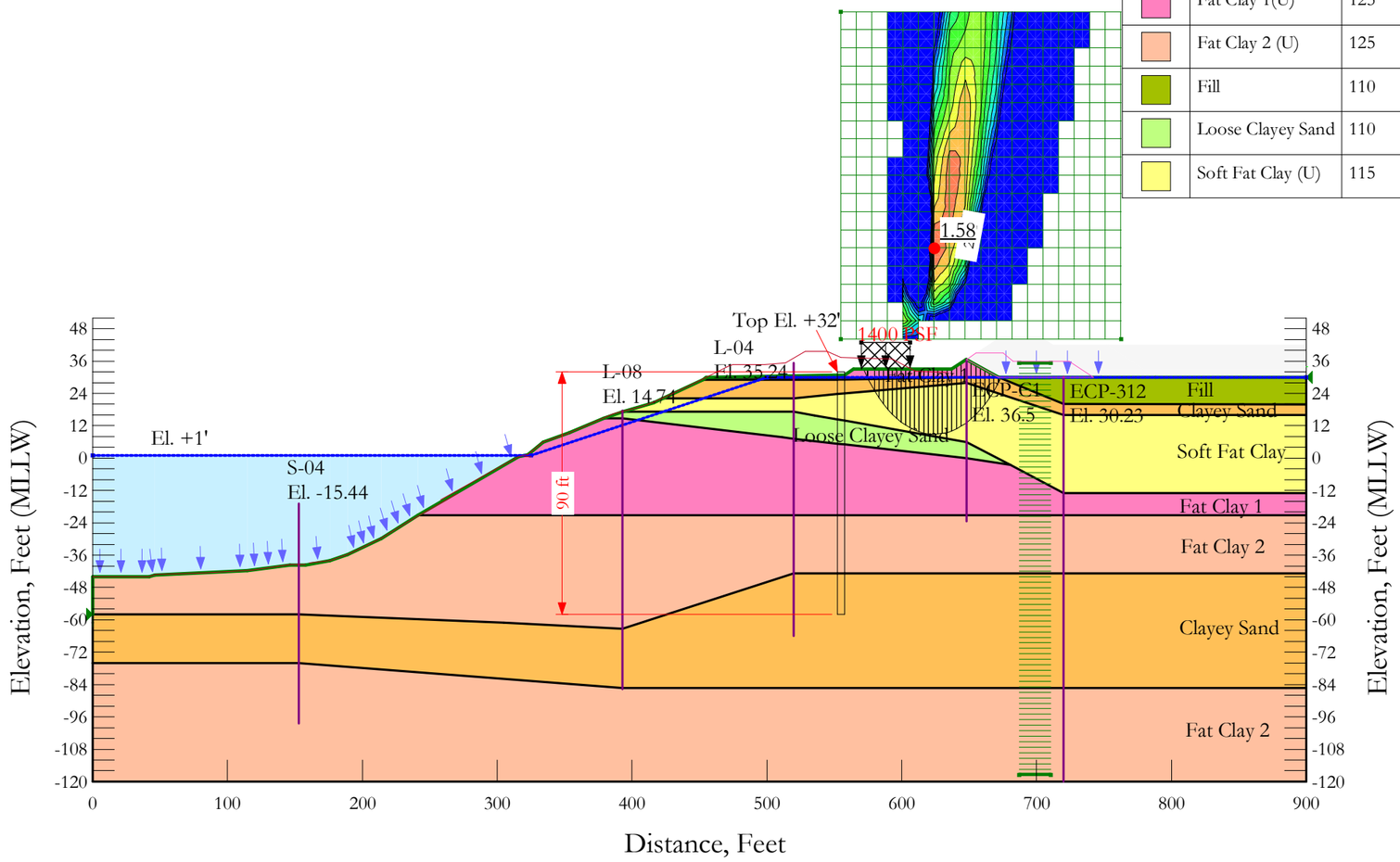
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Dike (U)	125				400		
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term - Interior
Slip Surface: Circular

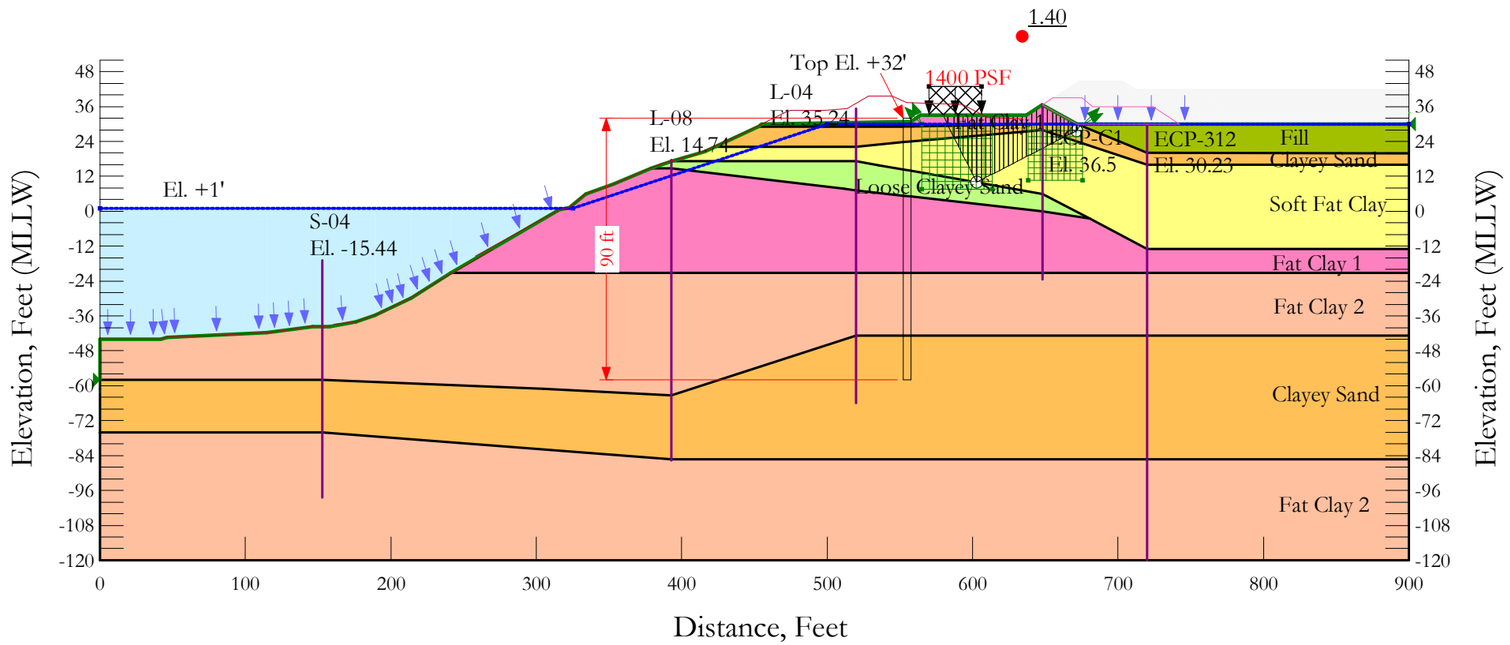
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



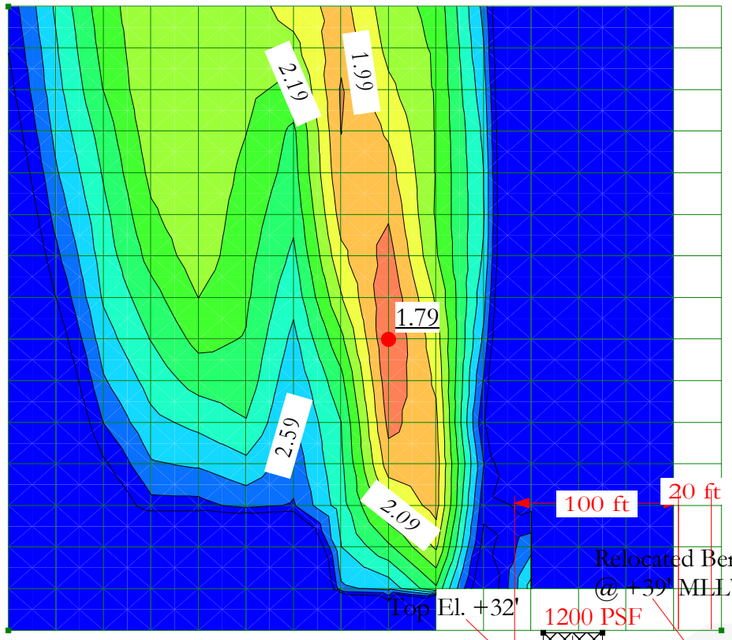
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
HVJ Project Number: HG1910092.2.1
BCC CL Sta. 34+00
Cutoff Wall Installation from Above

Loading Condition: Short Term - Interior
Slip Surface: Block

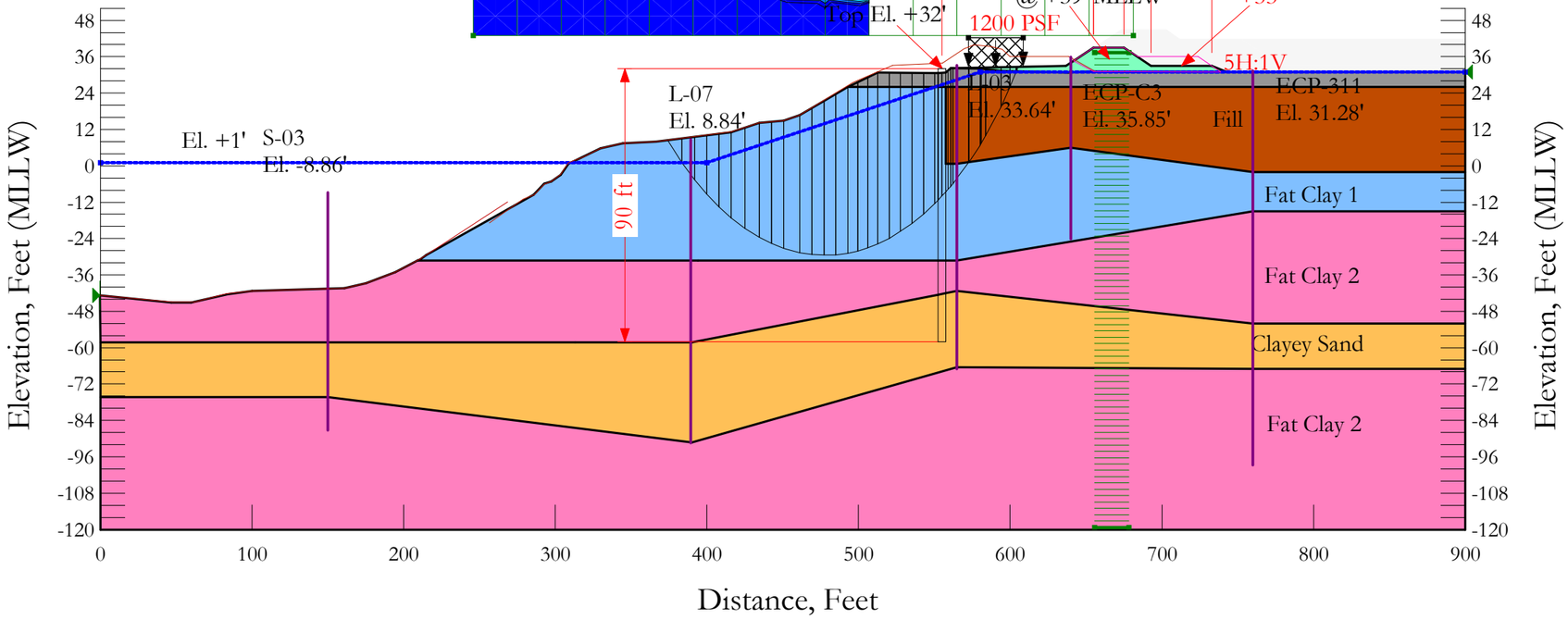
Color	Name	Unit Weight (pcf)	C-Top of Layer (psf)	C-Rate of Change ((lbf/ft²)/ft)	C-Maximum (psf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
	Clayey Sand	120					0	30
	Fat Clay 1(U)	125				1,200		
	Fat Clay 2 (U)	125				2,200		
	Fill	110	50	10	150			
	Loose Clayey Sand	110					0	28
	Soft Fat Clay (U)	115				280		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term
Slip Surface: Circular

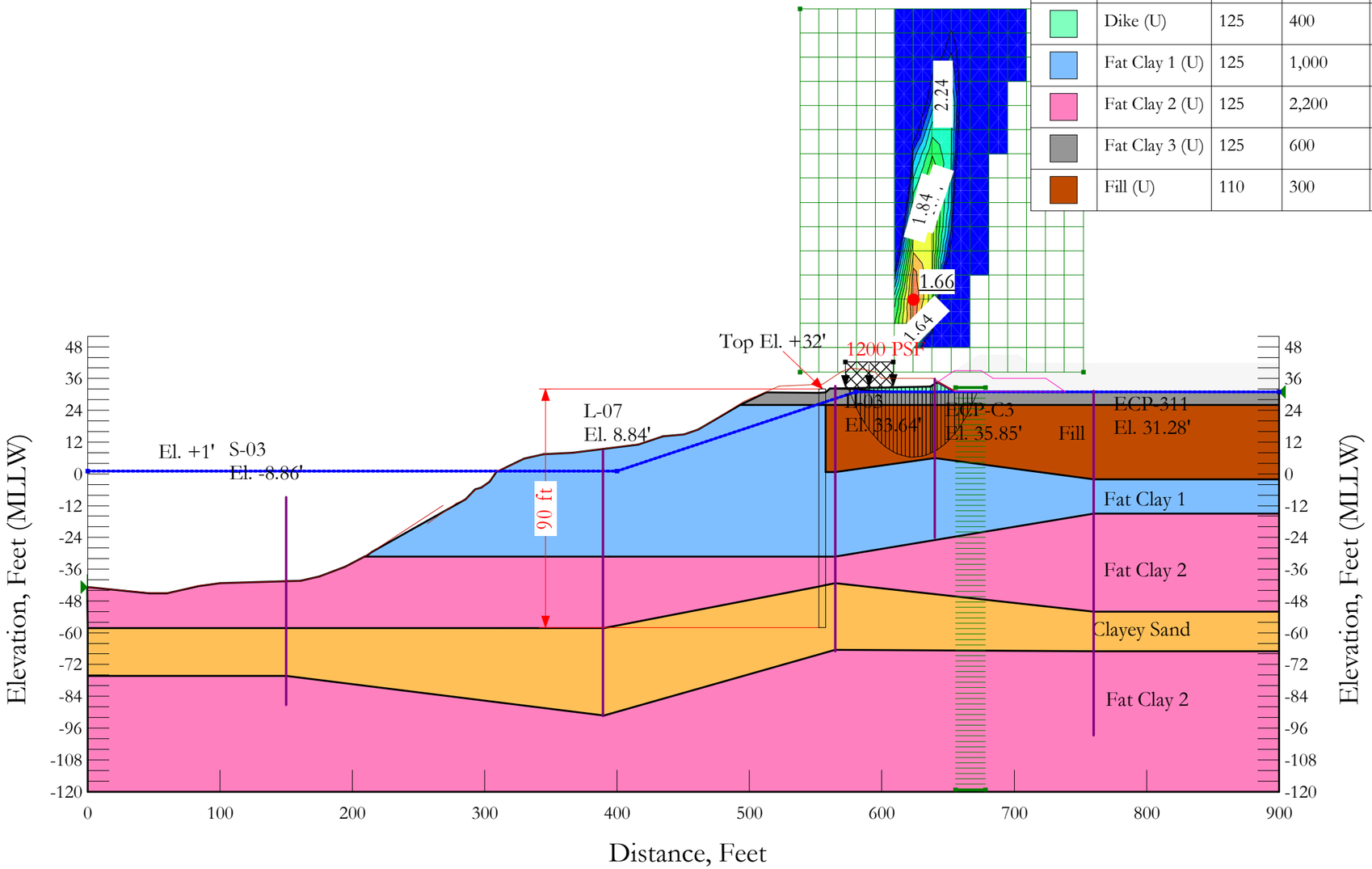


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



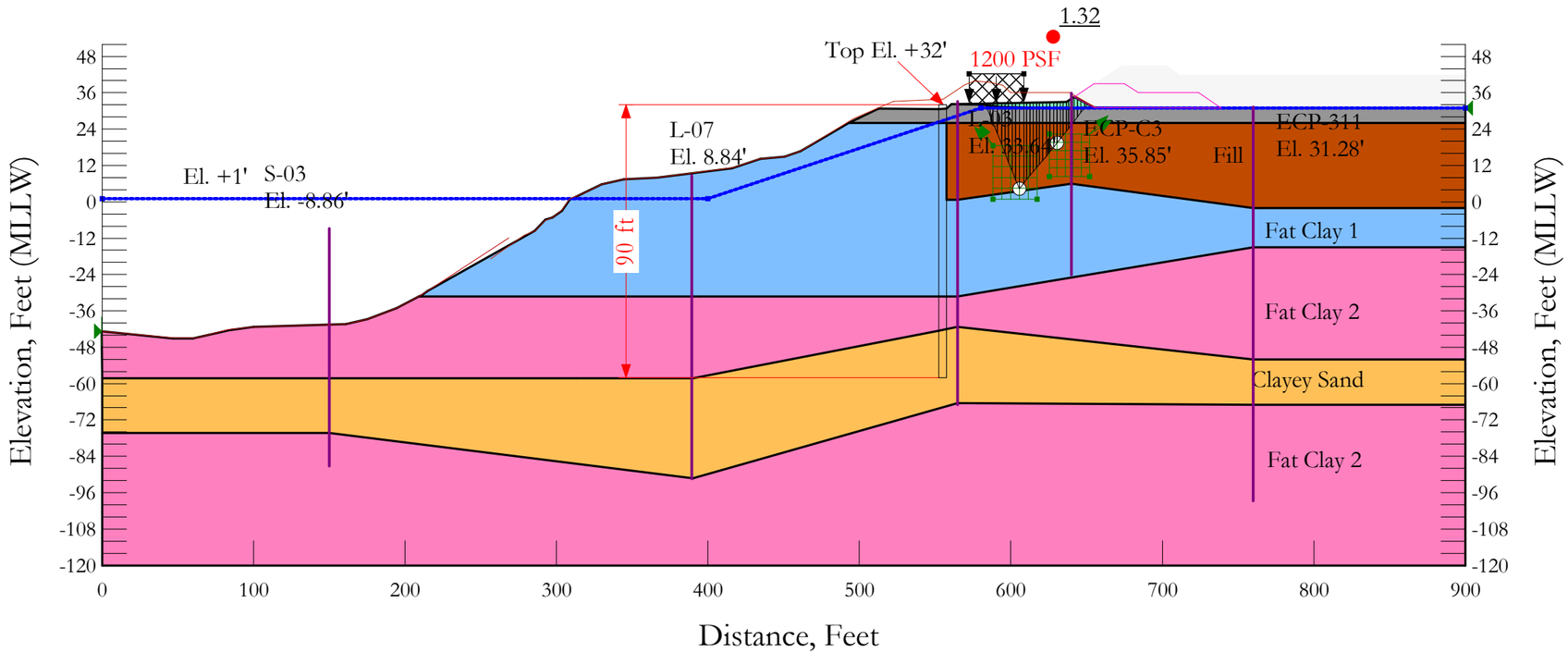
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		

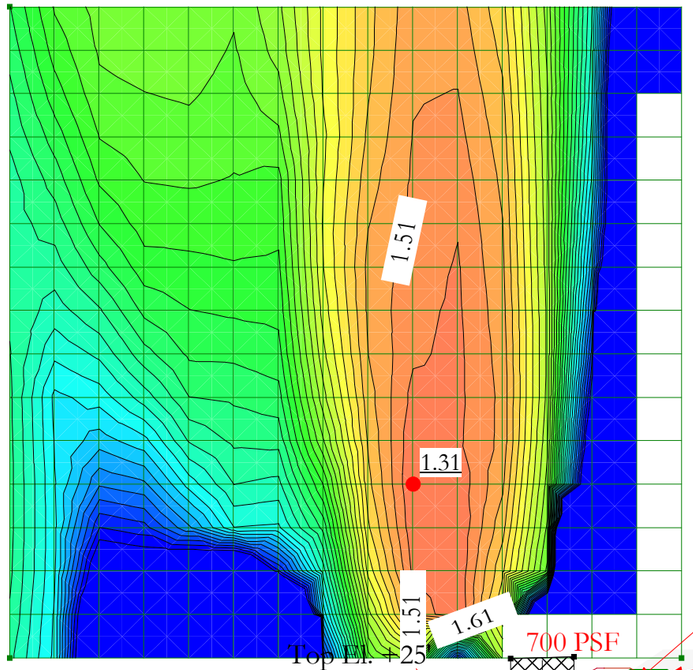


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Block

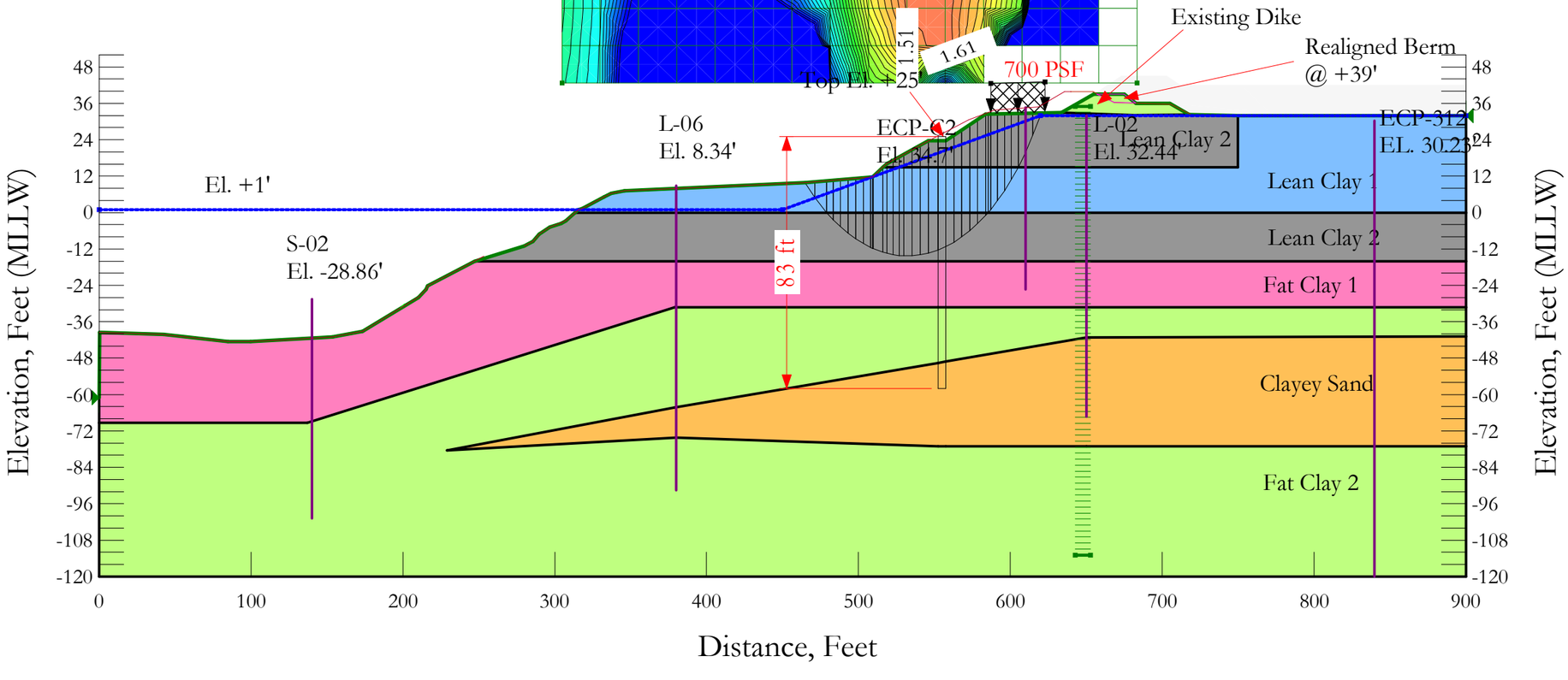
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1 (U)	125	1,000		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	600		
	Fill (U)	110	300		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term
Slip Surface: Circular

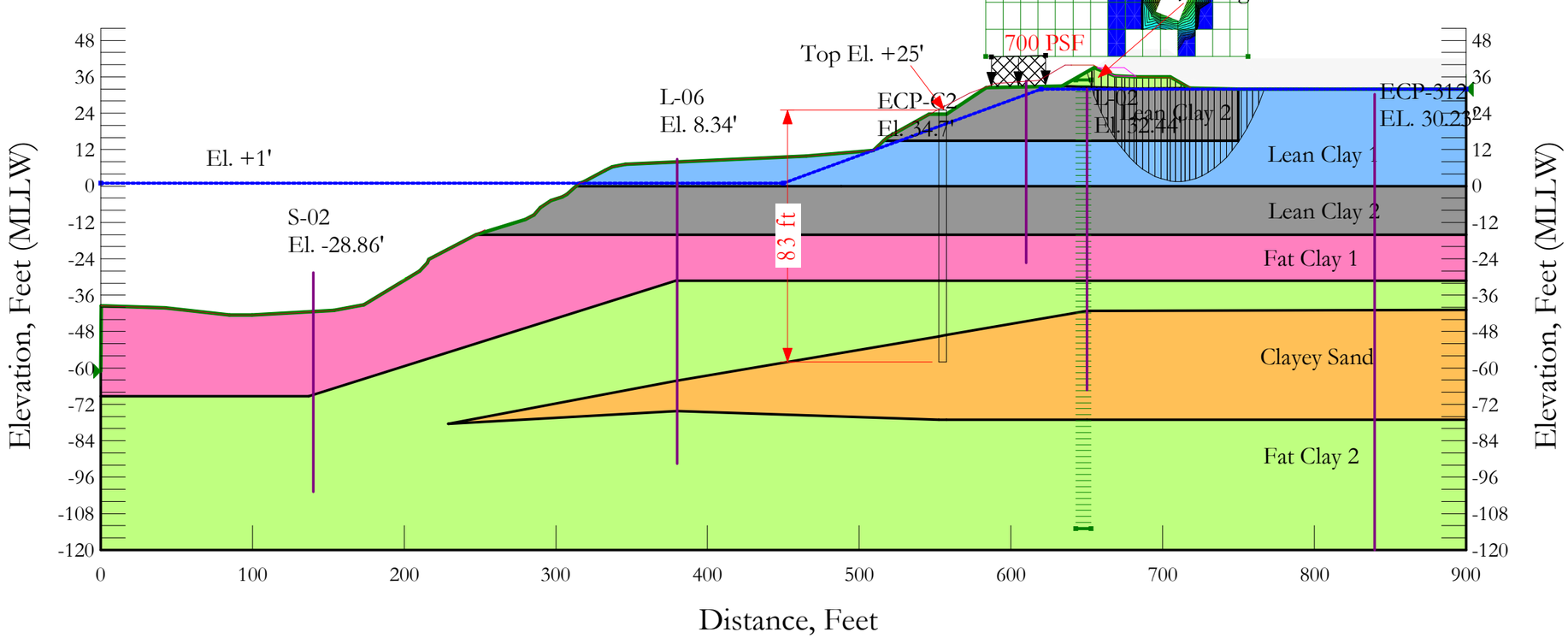


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



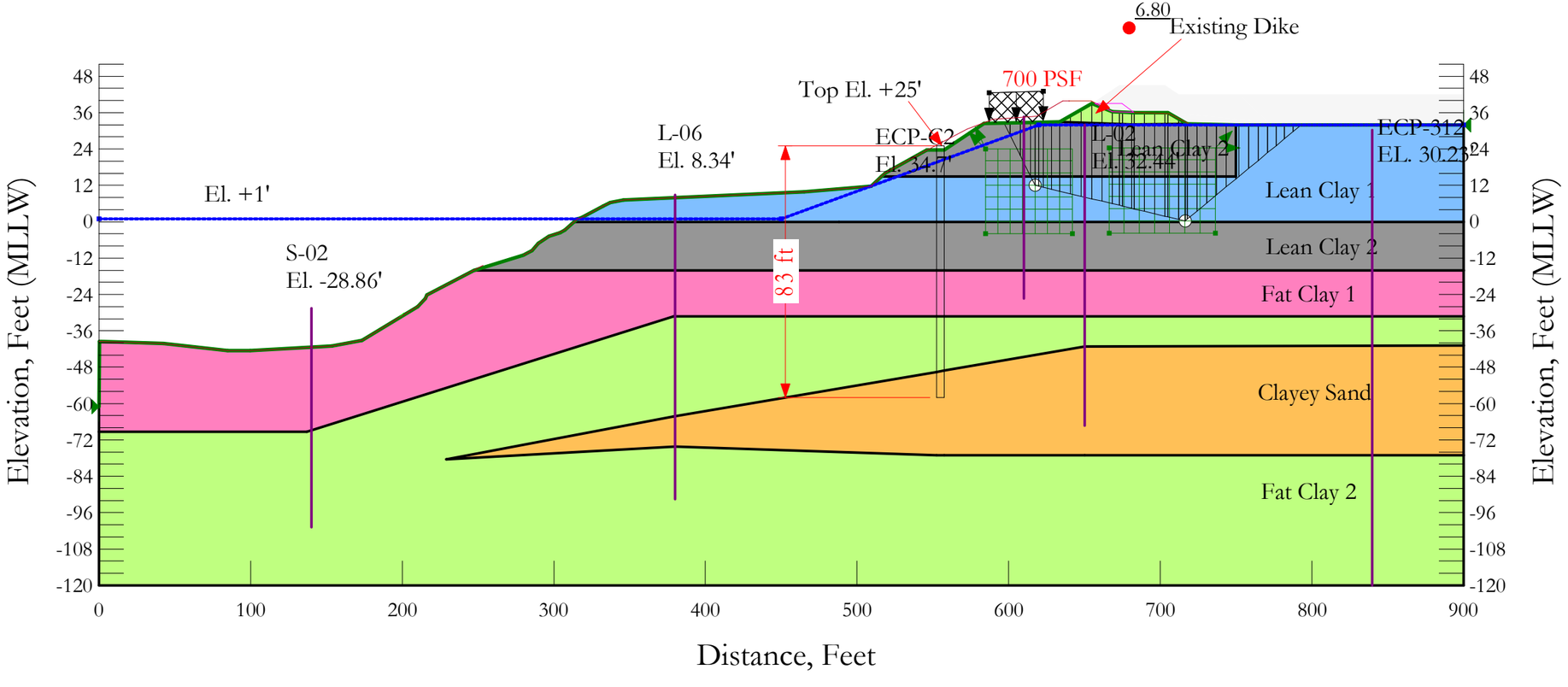
Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
	Fat Clay 2(U)	125	2,200		
	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		

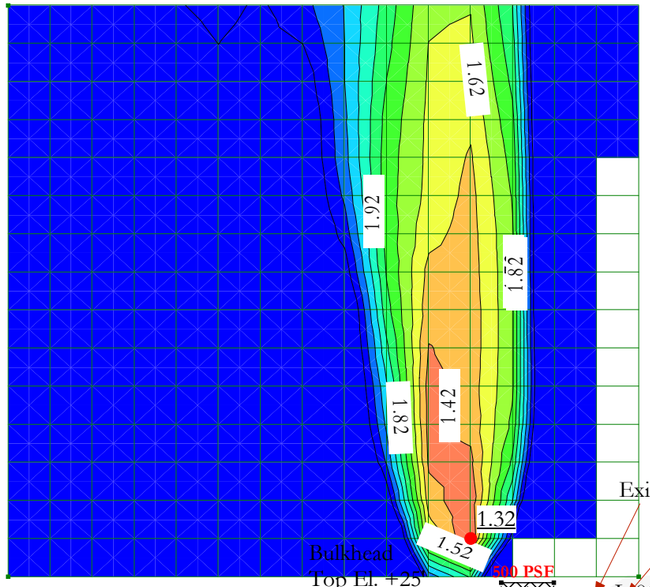


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 55+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Loading Condition: Short Term - Interior
Slip Surface: Block

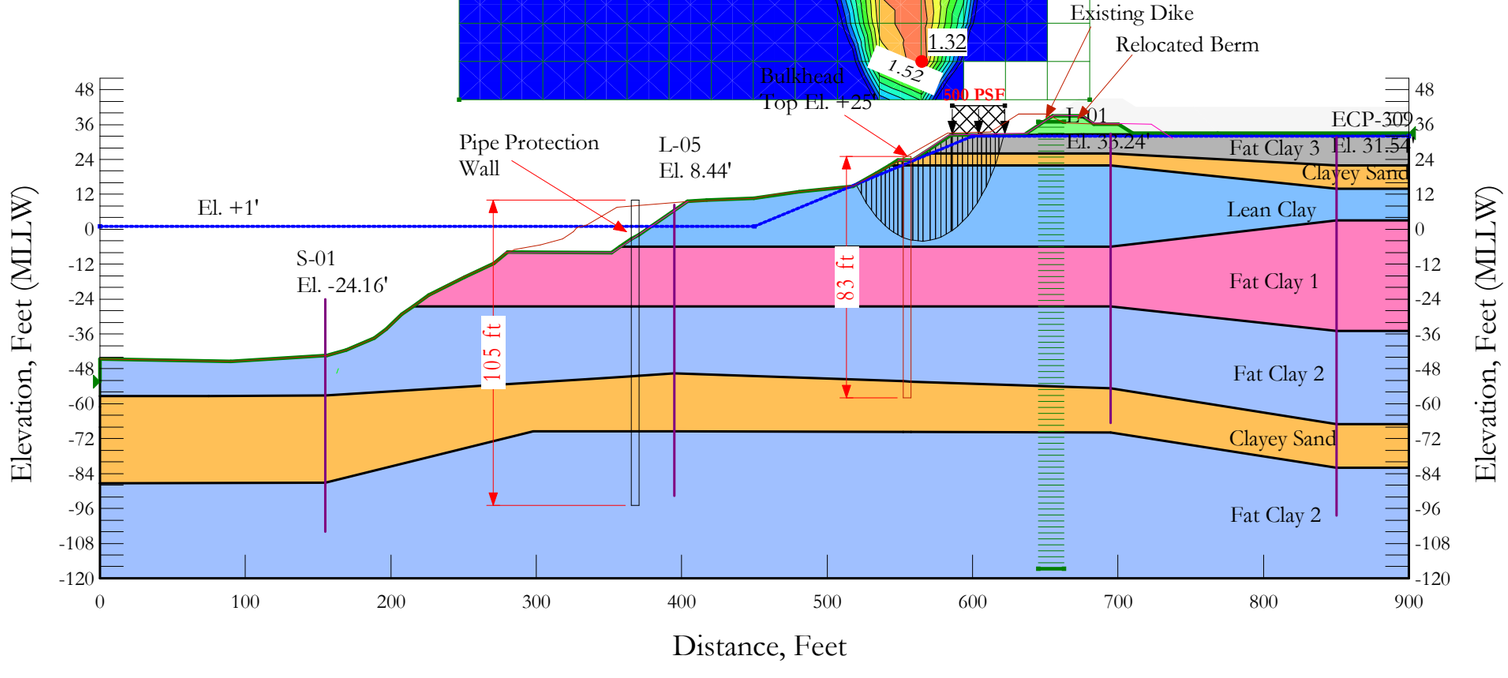
Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Fat Clay 1(U)	125	1,000		
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	Lean Clay 1 (U)	125	500		
	Lean Clay 2 (U)	125	700		



Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term
Slip Surface: Circular

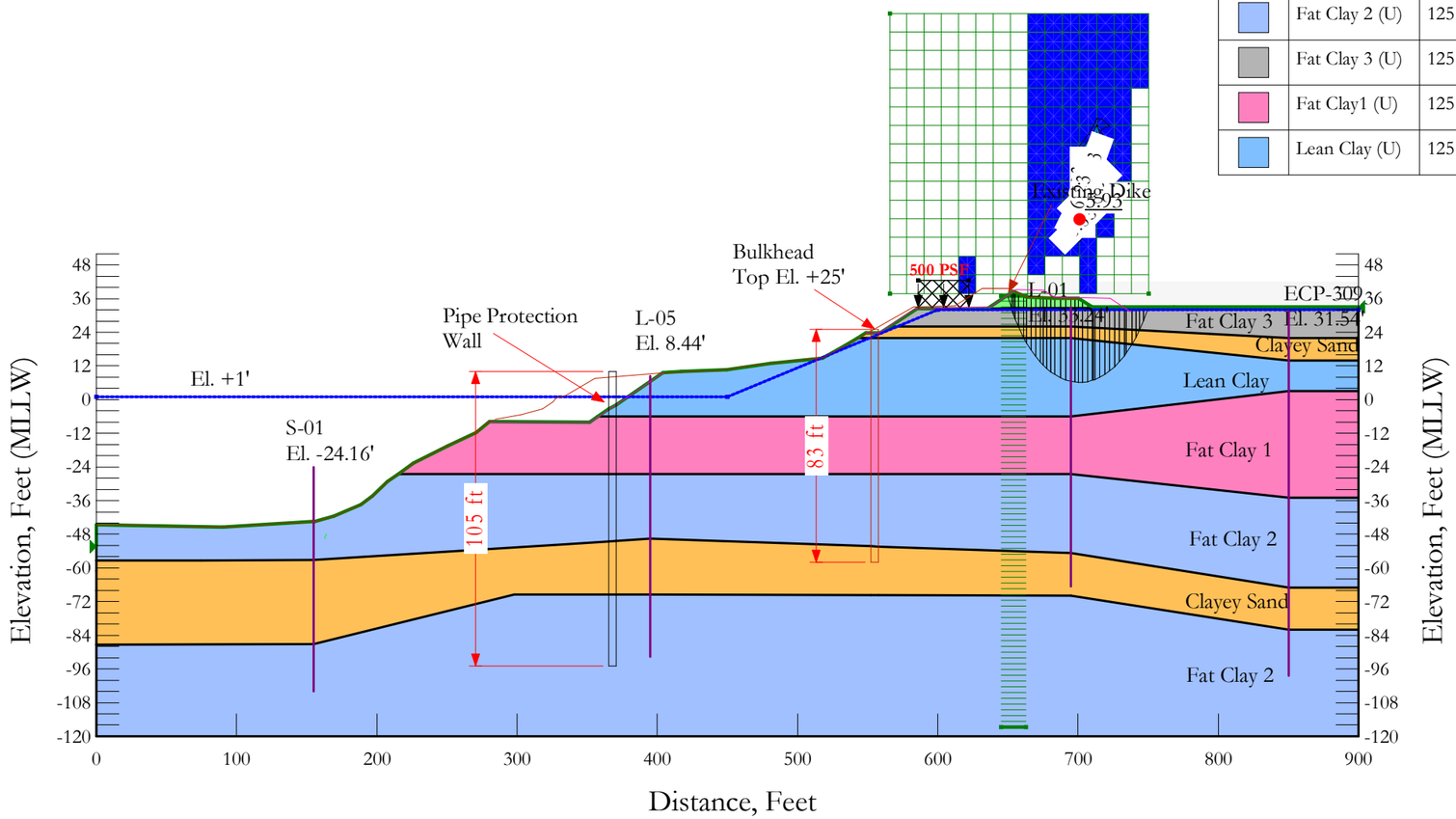


Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		



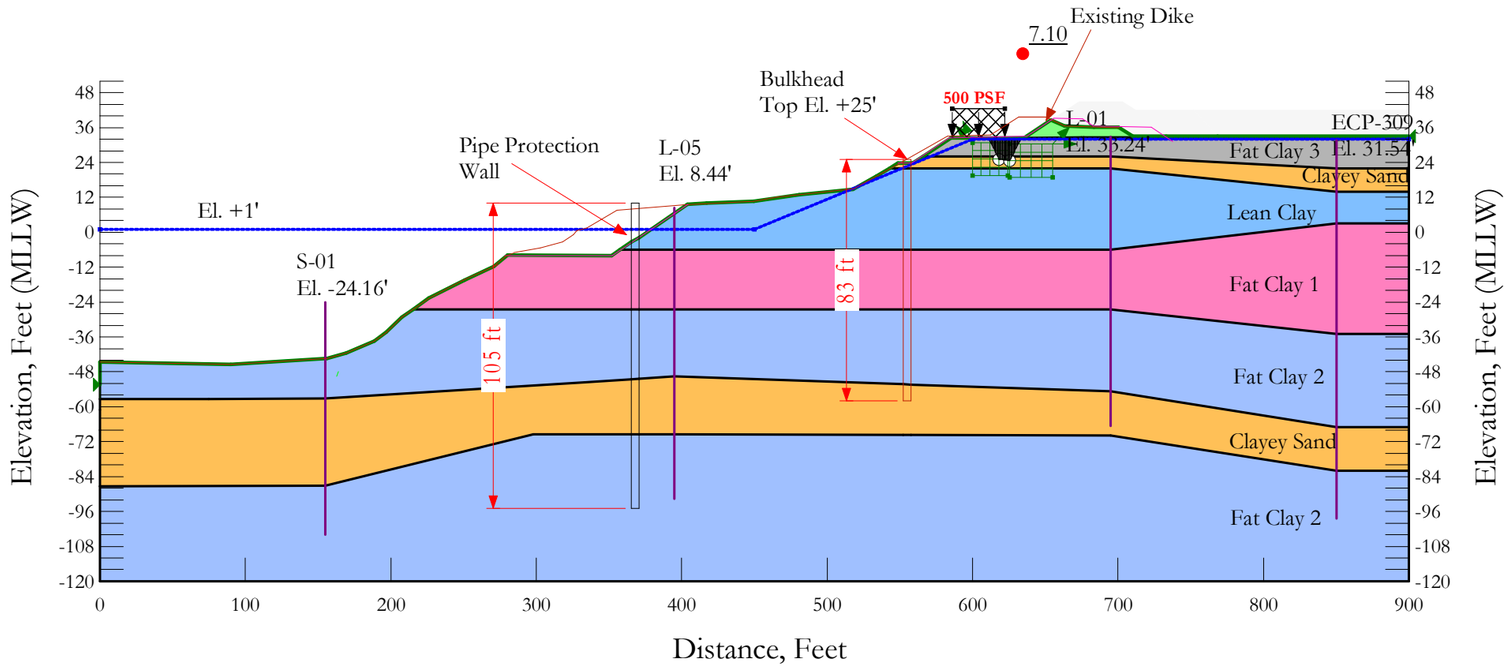
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Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
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Loading Condition: Short Term - Interior
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Color	Name	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	120		0	30
	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

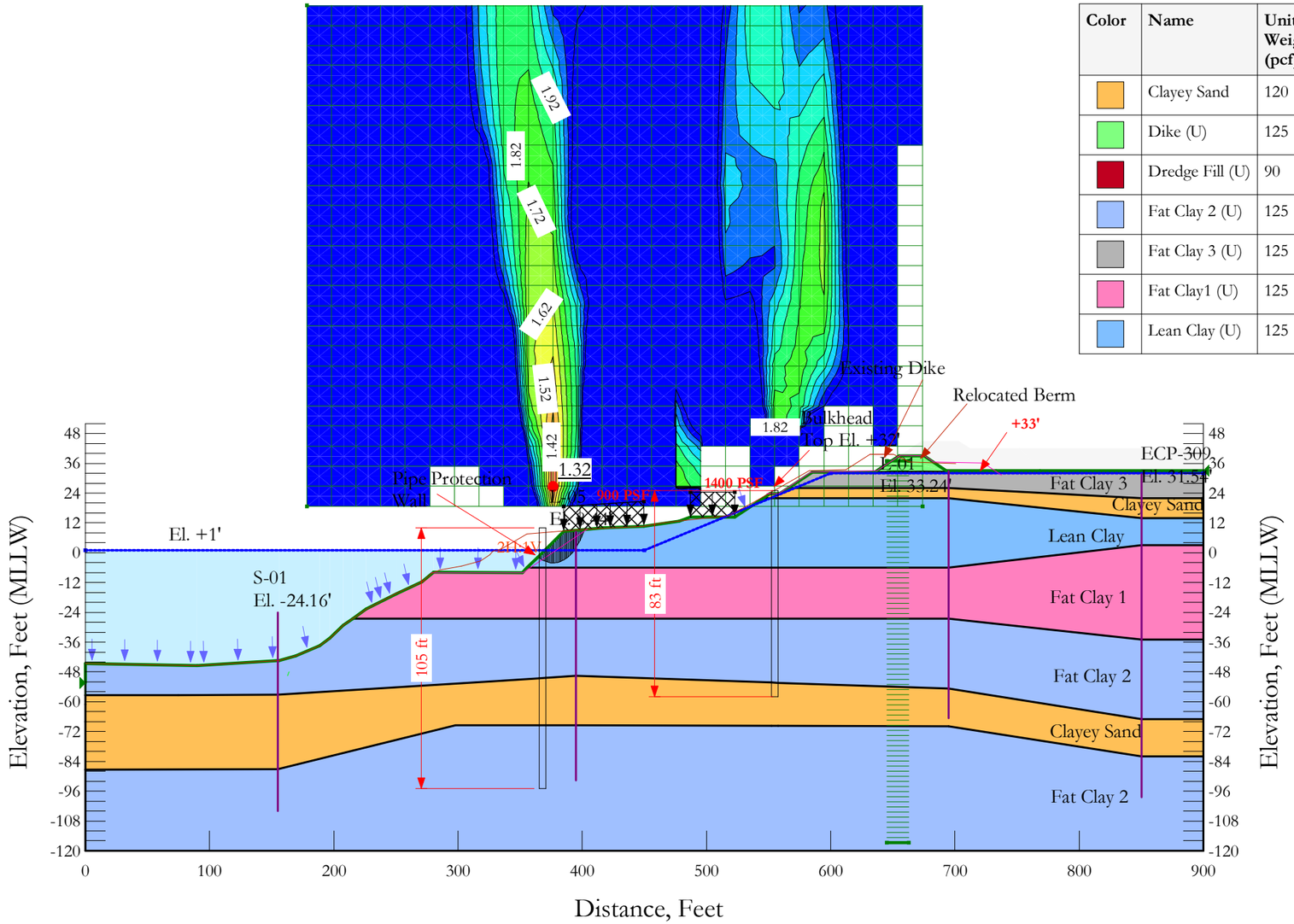


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Above
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term - Interior
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	Fat Clay 3 (U)	125	800		
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	Lean Clay (U)	125	500		

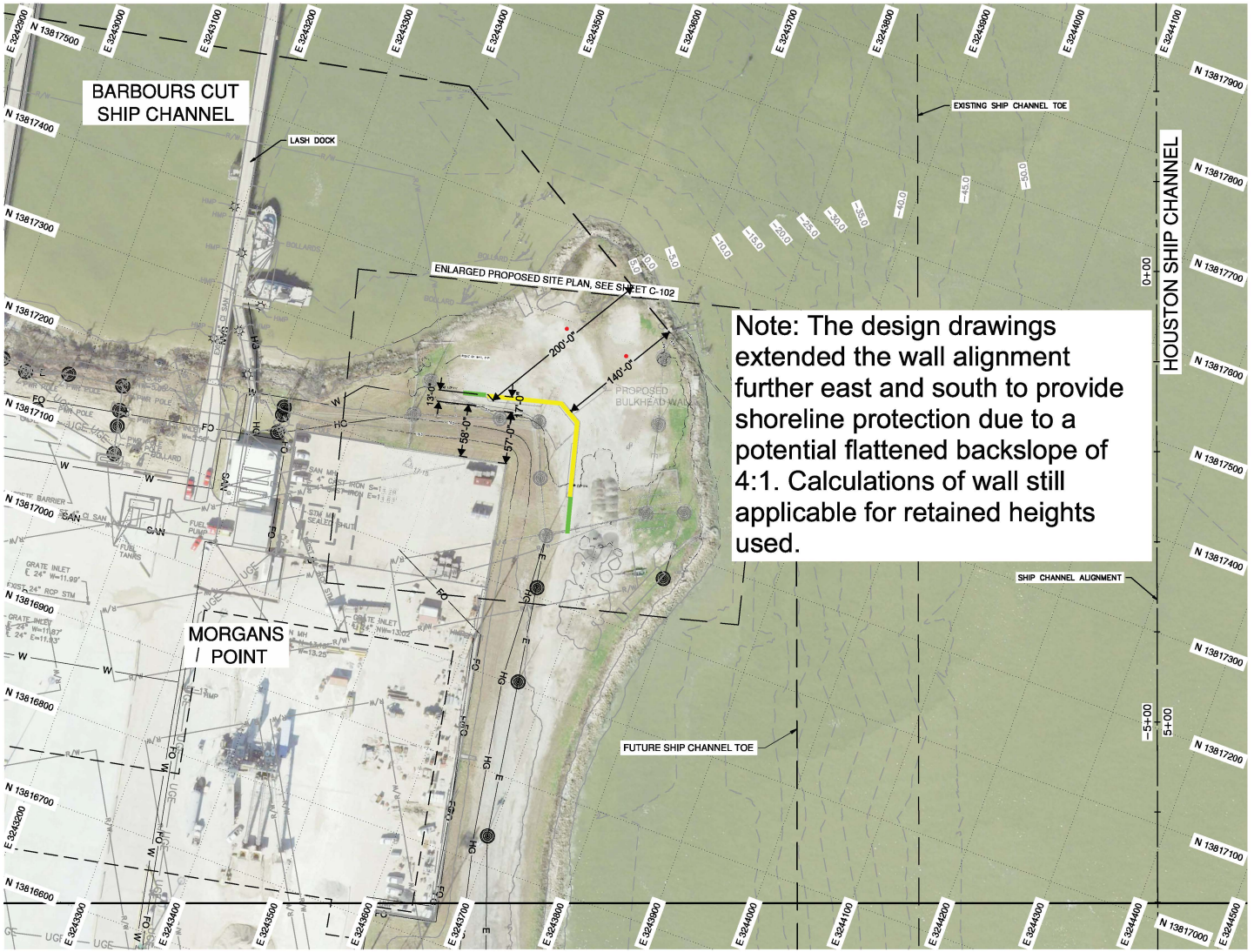


Project Name: Houston Ship Channel Expansion Channel Improvement Project
Location: Barbours Cut Ship Channel
Station Analyzed: 62+00
HVJ Project Number: HG1910092.2.1
Cutoff Wall Installation from Below
Pipeline Protection Wall Installation from Barge
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion (psf)	Cohesion' (psf)	Phi' (°)
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	Dike (U)	125	400		
	Dredge Fill (U)	90	50		
	Fat Clay 2 (U)	125	2,200		
	Fat Clay 3 (U)	125	800		
	Fat Clay1 (U)	125	1,000		
	Lean Clay (U)	125	500		

BARBOURS CUT SHIP CHANNEL – SITE 1



Note: The design drawings extended the wall alignment further east and south to provide shoreline protection due to a potential flattened backslope of 4:1. Calculations of wall still applicable for retained heights used.

GENERAL NOTES

1. REFER TO GENERAL NOTES ON SHEET G-002.

NZ 26 SSP Bulkhead Wall

NZ 38 Bulkhead Wall

A PROPOSED SITE PLAN
SCALE: 1"=60'

120'-0"
60 30 0 60 120

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PORT OF HOUSTON AUTHORITY

CONSULTANT:
DESIGN PREPARED BY:
HDR
HDR Engineering, Inc.
Texas P.E. Firm
Registration No. F-754

SEAL:

65% REVIEW

APPROVED: DATE

PORT CONTRACT REPRESENTATIVE
MANAGING DIRECTOR – ENGINEERING DESIGN & SUPPORT

PROJECT TITLE:
HOUSTON SHIP CHANNEL (HSC)

EXPANSION CHANNEL IMPROVEMENT PROJECT (ECIP)

SHEET TITLE:
SEGMENT 3 - BARBOURS CUT CHANNEL, MORGANS POINT BULKHEAD

PROPOSED SITE PLAN

REV	DATE	DESCRIPTION
A	7/31/20	65% SUBMITTAL

DESIGNER:	D. BROYLES
CADD:	J. THORPE
CHECKER:	S. MCCOY
DATE:	8/15/20
SCALE:	1"=60'

DRAWING NO.
C90-D13-P11-007

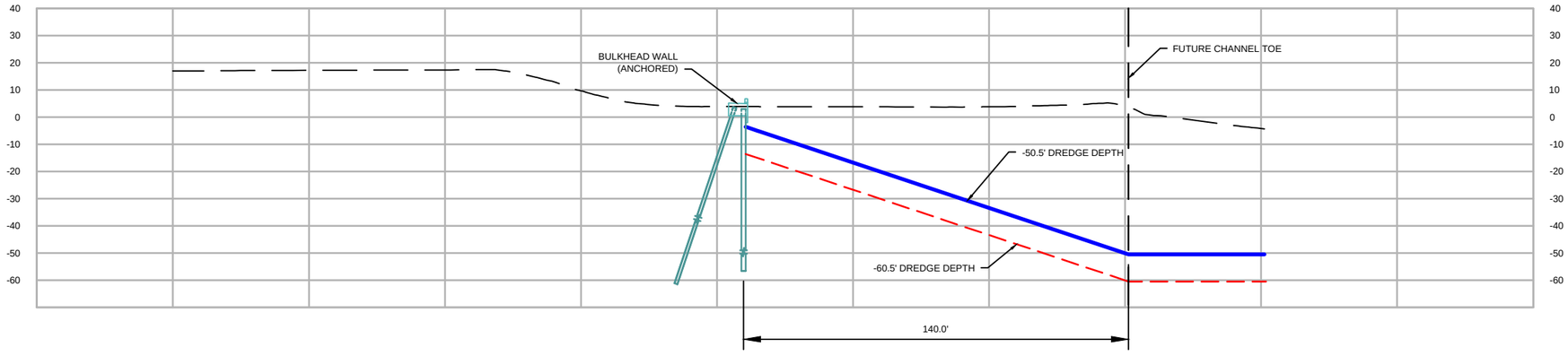
SHEET NO. C-101

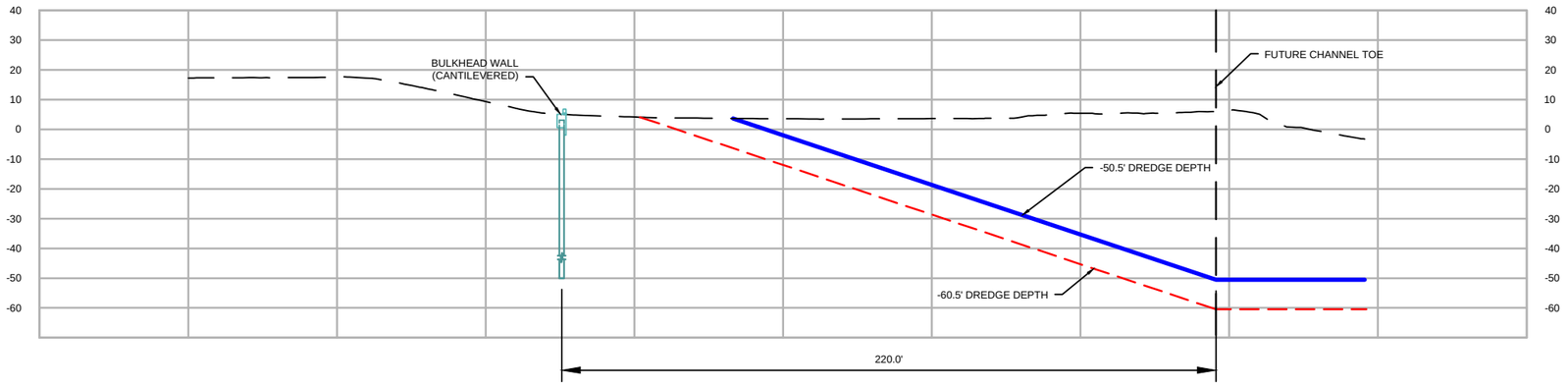
REV. NO. A

65% REVIEW

TIME: 7-09-20 – 7:27am User: GESPANTO DWG: C:\pwworking\central01\d1766239\C90-D13-P11-007-C-101.dwg

SCALE:
HORIZONTAL 1"=50'
VERTICAL 1"=50'





Soil Parameters for Slope Stability Analyses – Barbours Cut Channel, Site 1									
Boring Numbers	**Soil Description**	**Elevation, Feet**		**Total Unit Weight (γ), pcf**	**Short Term**	**Long Term**		**Rapid Drawdown**	
		Top	**Bottom**		**Undrained Shear Strength, psf**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**	**Cohesion, psf**	**Friction Angle (ϕ'), degrees**
ECP-317 & ECP-307A	Lean Clay	4.5	-7.5	115		180	26	310	16
	Sand	-7.5	-11.5	110	0	0	32	0	32
	Sand	-11.5	-18.5	110	0	0	26	0	26
	Fat Clay	-18.5	-35.5	130	950	160	22	160	22
	Lean Clay	-35.5	-43.5	130	2,300	180	26	310	16
	Lean Clay	-43.5	-53.5	130	1,500	180	26	310	16
	Lean Clay	-53.5	-95.5	130	3,700	180	26	310	16
	Fat Clay	-95.5	-115.5	120	1,400	160	22	160	22
	Silt	-115.5	-120.5	120	0	0	30	0	30
	Lean Clay	-120.5	-133.5	115	2,100	180	26	310	16
ECP-318& ECP-307A	Fill: Sand	+10	-7	110	0	0	30	0	30
	Lean Clay	-7	-11	110	340	180	26	310	16
	Sand	-11	-23	110	0	0	27	0	27
	Fat Clay	-23	-33	120	1,700	160	22	160	22
	Silty Clay	-33	-38	120	450	180	26	310	16
	Lean Clay	-38	-53	120	1,100	180	26	310	16
	Sand	-53	-58	120	0	0	34	0	34
	Lean Clay	-58	-88	125	3,600	180	26	310	16
	Fat Clay	-88	-95	125	3,000	160	22	160	22
	Lean Clay	-95	-105	125	2,400	180	26	310	16
	Fat Clay	-105	-115	125	1,600	160	22	160	22
	Silt	-115	-120	120	0	0	30	0	30
	Lean Clay	-120	-135	110	2,000	180	26	310	16
	Fat Clay	-135	-145	125	2,600	160	22	160	22