CARBON CANYON ROAD
SHORING PLAN

REV #1

DESIGN CALCULATIONS
February 25, 2026

PREPARED BY:
SCOTT F CANNON, PE

MZB ENGINEERING, INC

TEL:949.254.4792 engineering@mzbinc.com www.mzbinc.com

1192 Athlone Lane Corona, CA 92882

Table of Contents

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1192 Athlone Lane Corona, CA 92882

PLANS FOR CONSTRUCTION ON

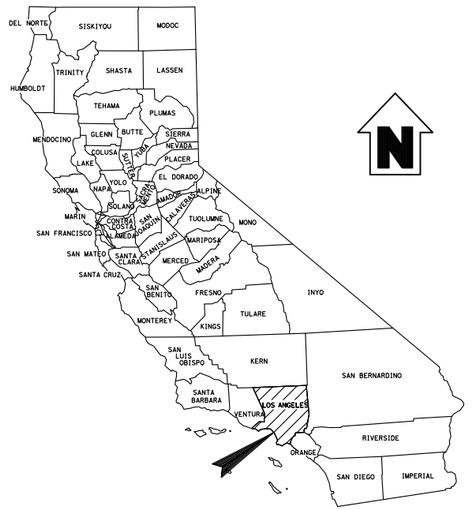
CARBON CANYON ROAD

IN LOS ANGELES COUNTY

8" & 12" WATERLINE
EXCAVATION / SHORING PLAN
REVISION 1

INDEX TO PLANS

LOCATION MAP



February 26, 2026

REGISTERED PROFESSIONAL ENGINEER
SCOTT F. CANNON
84327
Exp. 09-30-27
CIVIL
STATE OF CALIFORNIA

REV.	DATE	DESCRIPTION
0	1-31-26	INITIAL SUBMITTAL
1	2-24-26	PER COMMENTS DATED 2/23/26

DESIGN BY: S. CANNON
DRAWN BY: S. CANNON
SCALE: AS SHOWN

MZB
ENGINEERING INC.
1192 ATHLONE LANE
CORONA, CA 92882
(949) 254-4792

MZB ENGINEERING

WATER LINE EXCAVATION PLAN

COVER

PROJECT: CARBON CANYON ROAD

JOB NUMBER: -

CONTRACT NO.: -

SHEET NUMBER: 1 OF 11 SHEETS

GENERAL NOTES:
1. ALL EXCAVATIONS SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH OSHA CFR 29, PART 1926, SUBPART P, AND CAL/OSHA SAFETY ORDERS TITLE 8, SECTION 1504, AND 1539-1547.
2. THE DESIGN OF THIS EXCAVATION IS IN ACCORDANCE WITH LOS ANGELES PUBLIC WORKS STANDARD SPECIFICATIONS AND THE CALTRANS TRENCHING AND SHORING MANUAL 2025. 1

LOCATION AND PROTECTION OF EXISTING UTILITIES:
1. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES, OTHER OBSTACLES, DIMENSIONS, OFFSETS, ELEVATIONS AND CONDITIONS IN THE FIELD PRIOR TO STARTING ANY WORK. ALL EXISTING UTILITIES SHOWN ON THE CONTRACT PLANS WITHIN THE WORK ZONE SHALL BE POSITIVELY IDENTIFIED PRIOR TO STARTING WORK. THE CONTRACTOR IS RESPONSIBLE TO POTHOLE ALL UTILITIES (AS NEEDED) BEFORE SHORING WALL CONSTRUCTION IS TO BEGIN. THE ENGINEER SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES BEFORE PROCEEDING FURTHER WITH THE WORK.

SURVEYING AND GROUND ELEVATION INFORMATION:
1. EXISTING GROUND ELEVATIONS AND CONSEQUENTIAL ELEVATION HEIGHTS HAVE BEEN DETERMINED BASED ON TOPOGRAPHICAL INFORMATION PROVIDED BY THE PLANS AND OR ACTUAL FIELD DATA.

COMPETENT PERSONS:
1. A COMPETENT PERSON IS CAPABLE OF IDENTIFYING EXISTING AND PREDICTABLE HAZARDS IN THE SURROUNDINGS, OR WORKING CONDITIONS WHICH ARE UNSANITARY, HAZARDOUS, OR DANGEROUS TO EMPLOYEES AND WHO HAS AUTHORIZATION TO TAKE PROMPT CORRECTIVE MEASURES TO ELIMINATE THEM.

2. BEFORE COMMENCING ANY EXCAVATION, THE CONTRACTOR SHALL OBTAIN UNDERGROUND SERVICE ALERT (USA) INQUIRY I.D. NUMBER. A MINIMUM OF 3 DAYS SHALL BE ALLOWED AFTER THE I.D. NUMBER IS OBTAINED AND BEFORE THE EXCAVATION WORK IS STARTED TO NOTIFY UTILITY OWNERS. IF THE UTILITY OWNER IS THE CITY, A CONFIRMATION NUMBER INDICATING THE CITY HAS BEEN NOTIFIED SHALL BE OBTAINED BY USA AND/OR THE CONTRACTOR FROM THE APPROPRIATE CITY DEPARTMENT. THE I.D. NUMBER TOGETHER WITH THE DATE ACQUIRED SHALL BE REPORTED TO THE INSPECTOR WHEN CALLING FOR INSPECTION. USA I.D. NUMBERS WILL NOT BE GIVEN MORE THAN TEN (10) WORK DAYS BEFORE STARTING EXCAVATION WORK.

3. THE CONTRACTORS COMPETENT PERSON SHALL BE ON-SITE OBSERVING THE EXCAVATION PROCESS AND SHALL BE THE RESPONSIBLE PARTY IN THE DETERMINATION OF THE SOIL TYPE EXPOSED IN THE EXCAVATION WALLS. IF THE SOIL TYPE ENCOUNTERED IS DIFFERENT THAN THAT SPECIFIED ON THE PLANS, THE DESIGN ENGINEER MUST BE NOTIFIED.

4. THE COMPETENT PERSON SHALL INSPECT THE TRENCH OR EXCAVATION AT THE BEGINNING OF EACH SHIFT PRIOR TO WORKERS ENTERING THE TRENCH OR EXCAVATION AND/OR IF WEATHER HAS CHANGED OR EFFECTED THE WORK AREA.

ENVIRONMENTAL/SWPPP COMPLIANCE:
1. DESIGN OF EXCAVATIONS IS BASED ON ASSUMPTIONS THAT SOIL PROPERTIES AND GROUND CONDITIONS REMAIN CONSTANT THROUGH THE LIFE OF THE EXCAVATION. WATER CAN EFFECT THE STRENGTH OF SOILS AND GREAT CARE SHOULD BE TAKEN TO PREVENT CHANGES FROM EXISTING SOIL CONDITIONS. SLOPES MUST BE PROTECTED FROM EXCESSIVE SOIL SATURATION AND EROSION DURING CONSTRUCTION. WATER PONDING IN THE BASE OF EXCAVATIONS IS UNACCEPTABLE AND SHOULD BE DIVERTED OR REMOVED. PROPER SWPPP AND BMP MEASURES SHALL BE USED TO PREVENT ENVIRONMENTAL INDUCED SLOPE INSTABILITY.

2. THE ADL IMPACT MAP AND MANAGEMENT PLAN MUST BE REVIEWED PRIOR TO START OF EXCAVATIONS IN SOILS IDENTIFIED AS ADL IMPACTED WITHIN THE THE WORK AREA. WORK MUST BE IN COMPLIANCE WITH ADL MANAGEMENT PLAN WITHIN ADL IMPACTED WORK ZONES.

3. EXCAVATIONS THAT PENETRATE 5 FEET OR MORE INTO UNDISTURBED SEDIMENT MUST FOLLOW THE PALEONTOLOGICAL MITIGATION PLAN AND REQUIRE PALEONTOLOGICAL MITIGATION MONITORING ACTIVITIES.

4. NO CONSTRUCTION ACTIVITY MAY EFFECT THE ESA'S WITHOUT APPROVAL OF THE AUTHORITY AND THE APPROPRIATE GOVERNMENTAL ENTITIES.

CAL/OSHA REQUIREMENTS:
1. A CAL/OSHA EXCAVATION PERMIT MUST BE OBTAINED PRIOR TO ANY EXCAVATION.

2. A COPY OF THIS SHORING PLAN MUST BE AT THE JOB SITE DURING CONSTRUCTION.

3. INGRESS AND EGRESS TO THE EXCAVATION SHALL CONFORM TO ALL OSHA REQUIREMENTS INCLUDING: HANDRAILS, LADDER ACCESS AND FALL PROTECTION AS REQUIRED. IN ADDITION TO OSHA REQUIREMENTS, OPEN TRENCHES SHALL BE PROTECTED BY SECURITY FENCING OR PLATES IN ACCORDANCE WITH LACDPW STANDARD PLAN 6008. 1

4. CONTINGENCY PLANS FOR EMERGENCY SITUATIONS SHALL BE ADDRESSED IN JHA.

5. LADDERS TO BE PLACED EVERY 25 FEET 1 OF WORKING AREA PER OSHA REQUIREMENTS.

CONSTRUCTION REQUIREMENTS:
1. CONTACT THE DESIGN ENGINEER IF EXCAVATION SHOWS SIGNS OF SLOUGHING, SWELLING OR PUMPING.

2. CAUTION SHALL BE TAKEN WHEN EXCAVATIONS ARE ADJACENT TO TRAFFIC AND THE TRAVELING PUBLIC.

CONTROLLING FIELD DIMENSIONS
1. THE FIELD SUPERINTENDENT WILL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING, FABRICATING, OR INSTALLING SHORING. UPON APPROVAL BY THE DESIGN ENGINEER DIMENSIONS OF THE SHORING WILL BE ADJUSTED TO FIT THE ACTUAL DIMENSIONS.

2. IF AT ANY POINT THE EXCAVATION EXCEEDS THE DEPTH SHOWN ON THE PLANS BY MORE THAN 1 FT, NOTIFY THE DESIGN ENGINEER IMMEDIATELY.

SOIL LAYER DESCRIPTIONS:
1. THE FOLLOWING SOIL DESCRIPTIONS ARE ASSUMED TO BE PRESENT DURING EXCAVATION. IF SOILS DIFFER FROM THOSE DESCRIBED BELOW, STOP THE EXCAVATION AND CONSULT WITH THE DESIGN ENGINEER.

SOIL TYPES & DESCRIPTIONS:
SOIL TYPE – Af/Qc/Qal

DESIGN PARAMETERS:
1. EXCAVATION SLOPE DESIGN BASED ON BORING B-1 TO B-29 PROVIDED IN THE GEOTECHNICAL DESIGN REPORT DATED AUGUST 5, 2024, PREPARED BY LOS ANGELES COUNTY PUBLIC WORKS.

SOIL PARAMETERS:

γ = 125 PCF
Φ = 33°
Su = 100 PSF
Kw = 40 PCF 1

DESIGN SURCHARGE PARAMETERS:
1. IF K-RAIL IS LESS THAN 2 FT FROM TOP OF SLOPE IT MUST BE PINNED. SEE 2025 CALTRANS STANDARD PLAN T3B. 1

2. K-RAIL MAY NOT BE PLACED CLOSER THAN 3" FROM TOP OF SLOPE. (200PSF).

3. SLOPES WERE DESIGNED WITH A HS20-44 TRAFFIC SURCHARGE (300PSF) PLACED 2 FT FROM TOP OF SLOPE OR AS SHOWN IN THE SURCHARGE TABLE(S) IN THESE PLANS.

4. FOR SURCHARGE OFFSETS REFER TO "ASSUMED SURCHARGES & MIN. OFFSETS" TABLES ON SECTION VIEWS.

5. IF HIGHER GROUND PRESSURE IS ANTICIPATED, CONSULT WITH THE DESIGN ENGINEER.

6. THE MAXIMUM SLOPE FOR EXCAVATION IS 8 FT. 1

Underground Service Alert
Call: TOLL FREE 1-800-422-4133
TWO WORKING DAYS BEFORE YOU DIG

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MZB ENGINEERING

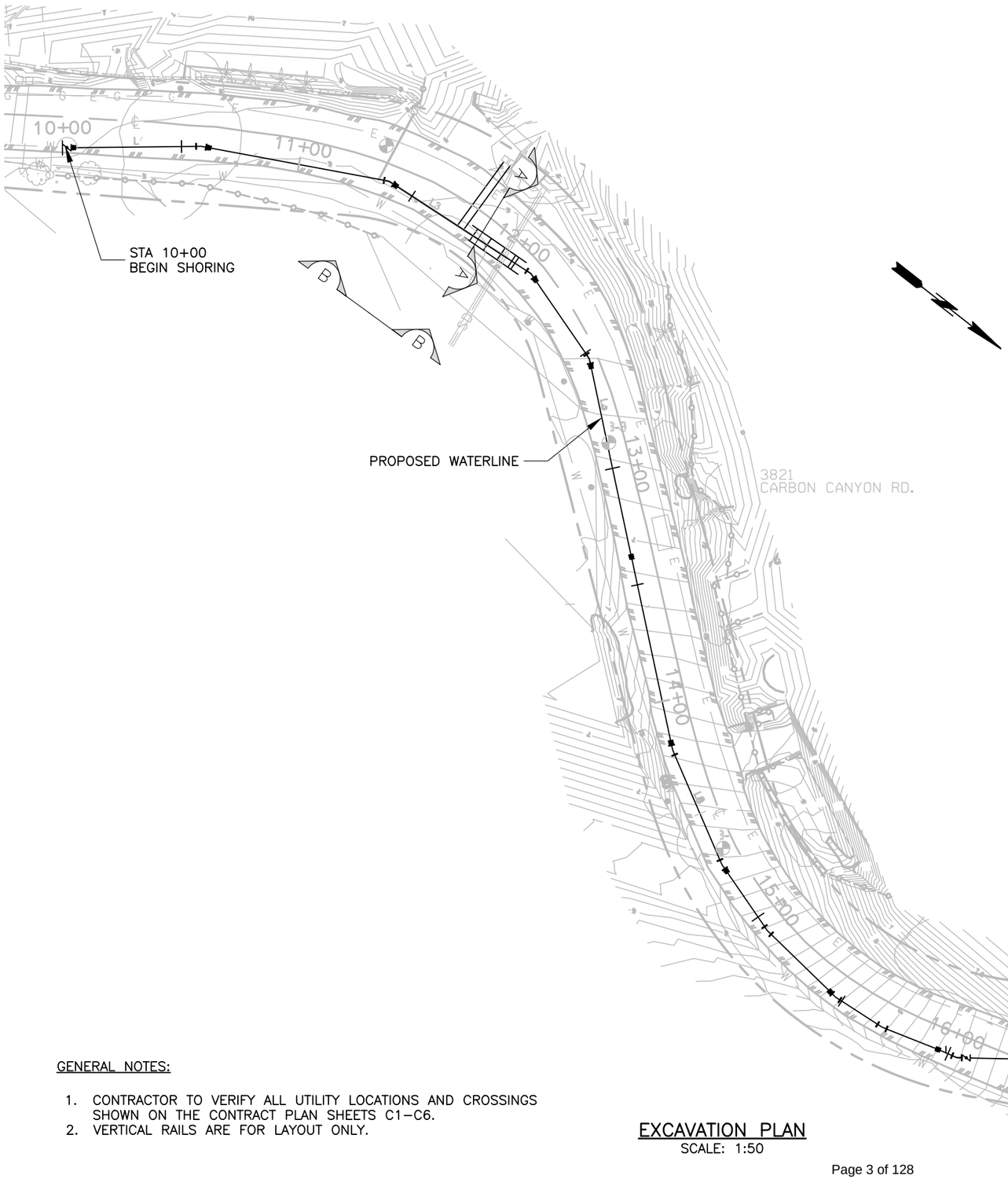
WATER LINE EXCAVATION PLAN

GENERAL & SHORING NOTES

PROJECT: CARBON CANYON ROAD
JOB NUMBER: -
CONTRACT NO.: -

SHEET NUMBER: 2
OF 11 SHEETS

D:\DROPBOX\KORPI_CANNON_ENGINEERING\PROJECTS\KC-0119 - MZB ENGINEERING\DESIGN\EXCAV - SHORING\13.0 CARBON CANYON RD\CARBON CANYON-RO VERT SHORING FILE.DWG



LEGEND:

VERTICAL SHORING

PROPOSED WATERLINE

BORING

RIGHT OF WAY

PROPERTY LINE

GENERAL NOTES:

1. CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS AND CROSSINGS SHOWN ON THE CONTRACT PLAN SHEETS C1–C6.
2. VERTICAL RAILS ARE FOR LAYOUT ONLY.

EXCAVATION PLAN
SCALE: 1:50

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WATER LINE EXCAVATION PLAN

PLAN VIEW

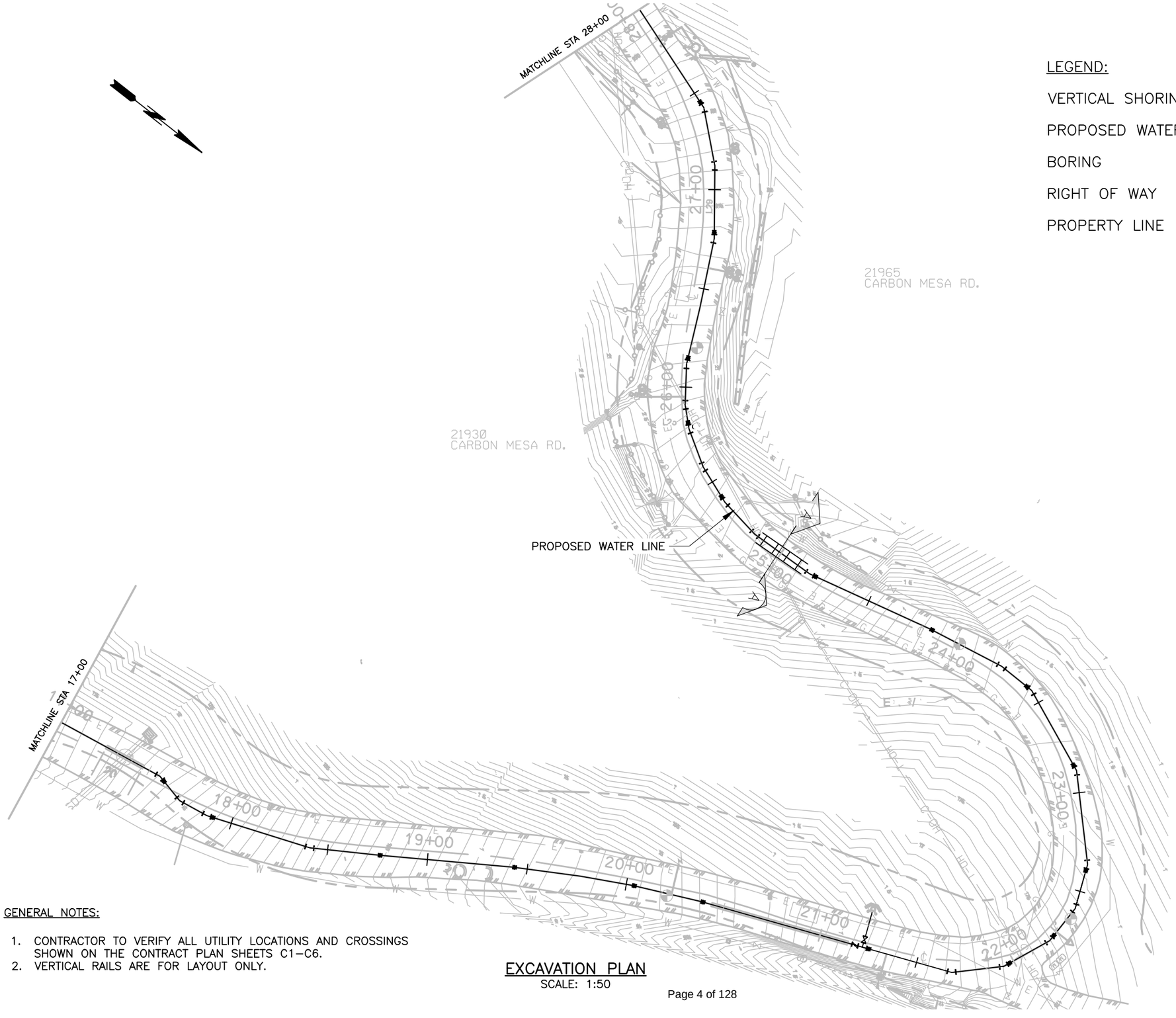
PROJECT: CARBON CANYON ROAD

JOB NUMBER: –

CONTRACT NO.: –

SHEET NUMBER: 3

OF 11 SHEETS



LEGEND:

- VERTICAL SHORING
- PROPOSED WATERLINE
- BORING
- RIGHT OF WAY
- PROPERTY LINE

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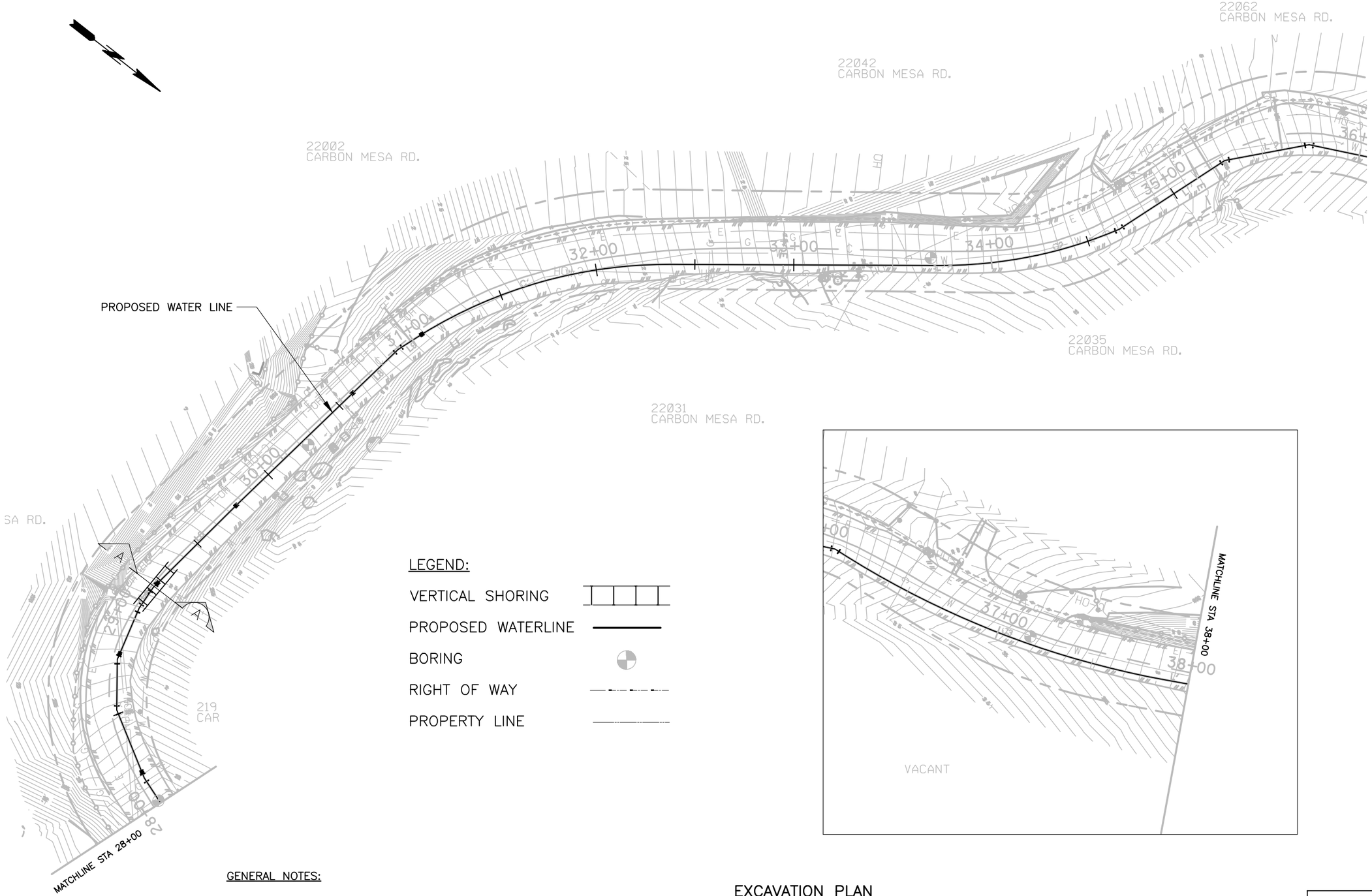
WATER LINE EXCAVATION PLAN

PLAN VIEW

PROJECT: CARBON CANYON ROAD
JOB NUMBER: -
CONTRACT NO.: -

SHEET NUMBER: 4
OF 11 SHEETS



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EXCAVATION PLAN
SCALE: 1:50

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WATER LINE EXCAVATION PLAN

PLAN VIEW

PROJECT: CARBON CANYON ROAD
JOB NUMBER: -
CONTRACT NO.: -

SHEET NUMBER: 5
OF 11 SHEETS

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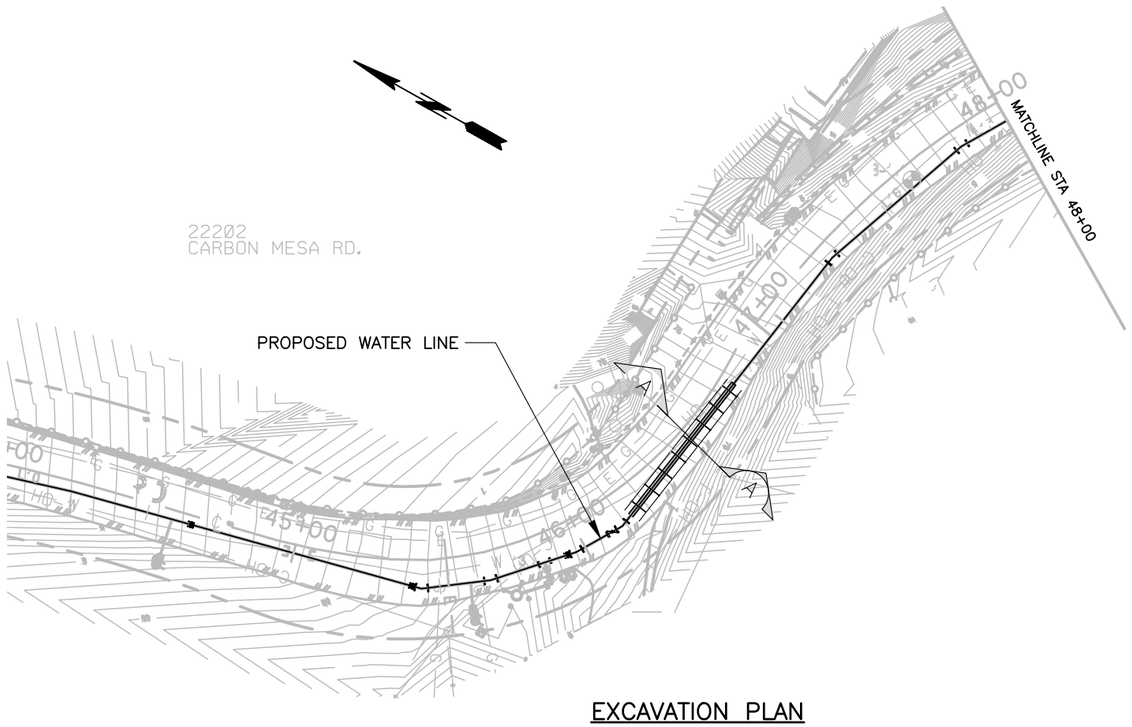
EXCAVATION PLAN
SCALE: 1:50



EXCAVATION PLAN
SCALE: 1:50

LEGEND:

VERTICAL SHORING

PROPOSED WATERLINE

BORING

RIGHT OF WAY

PROPERTY LINE

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MZB ENGINEERING

WATER LINE EXCAVATION PLAN

PLAN VIEW

PROJECT: CARBON CANYON ROAD
JOB NUMBER: -
CONTRACT NO.: -

SHEET NUMBER: 6
OF 11 SHEETS

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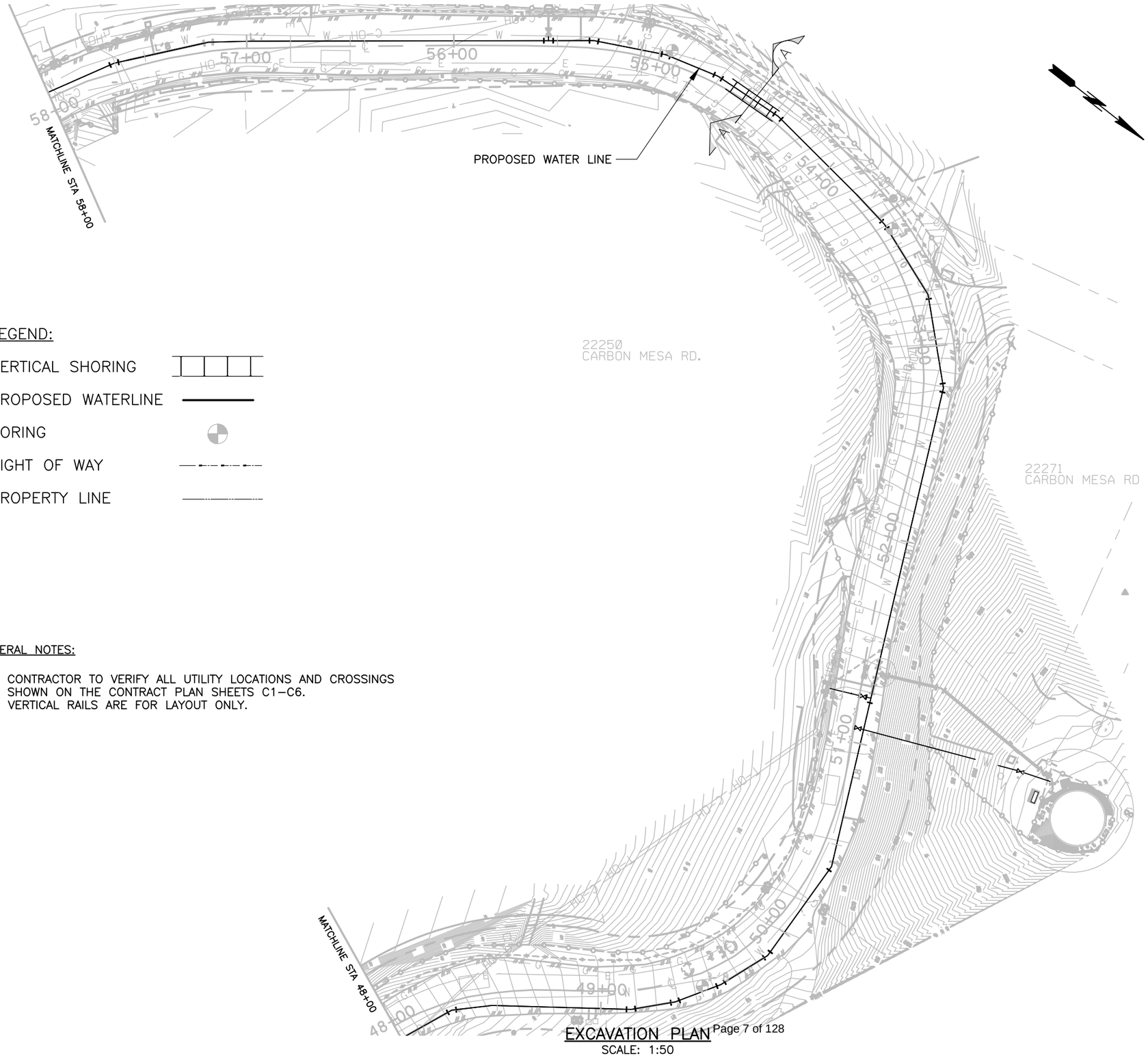

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PLAN VIEW

PROJECT: CARBON CANYON ROAD
JOB NUMBER: –
CONTRACT NO.: –

SHEET NUMBER: 7
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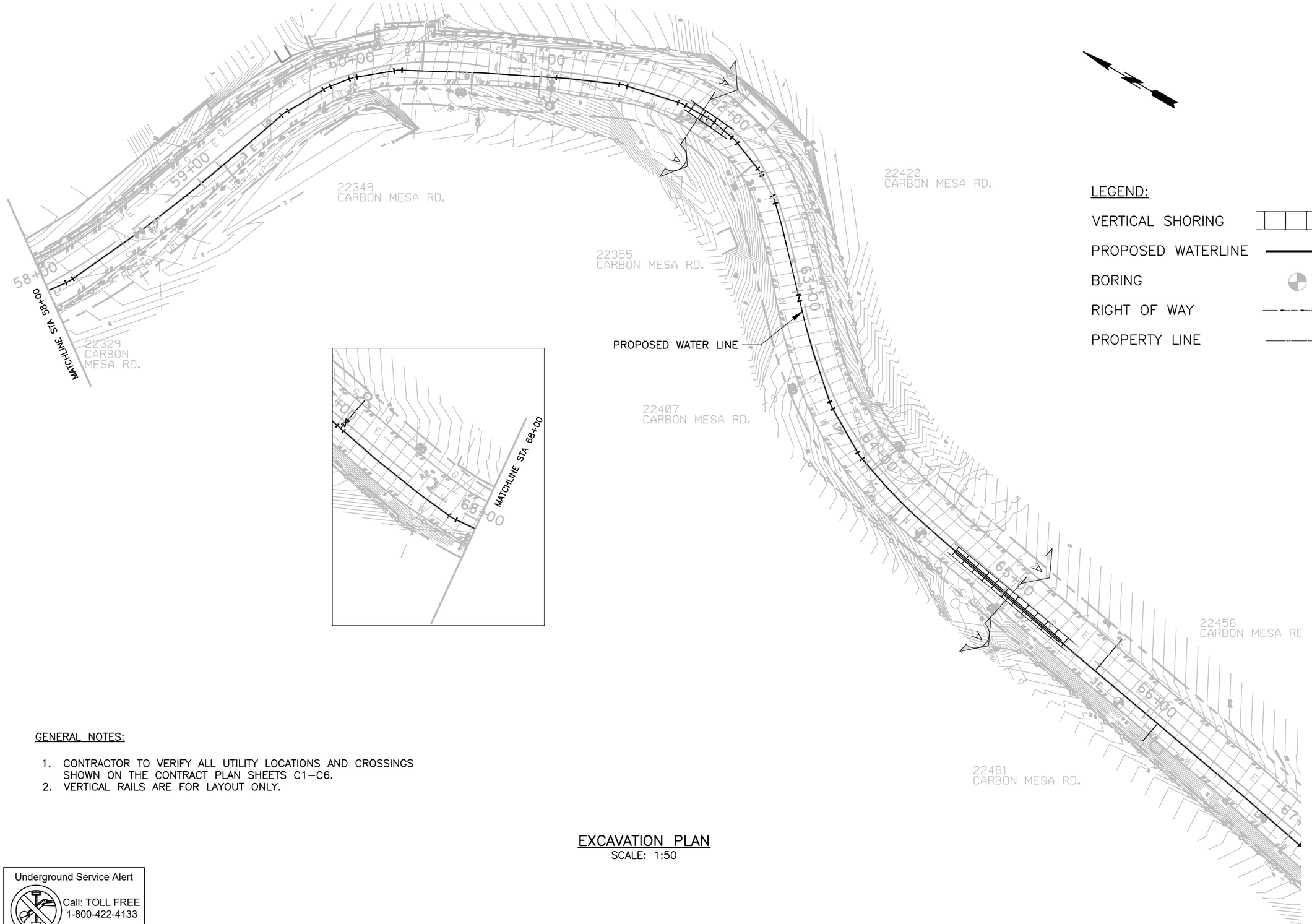

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WATER LINE EXCAVATION PLAN

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PROJECT: CARBON CANYON ROAD
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SHEET NUMBER: 8
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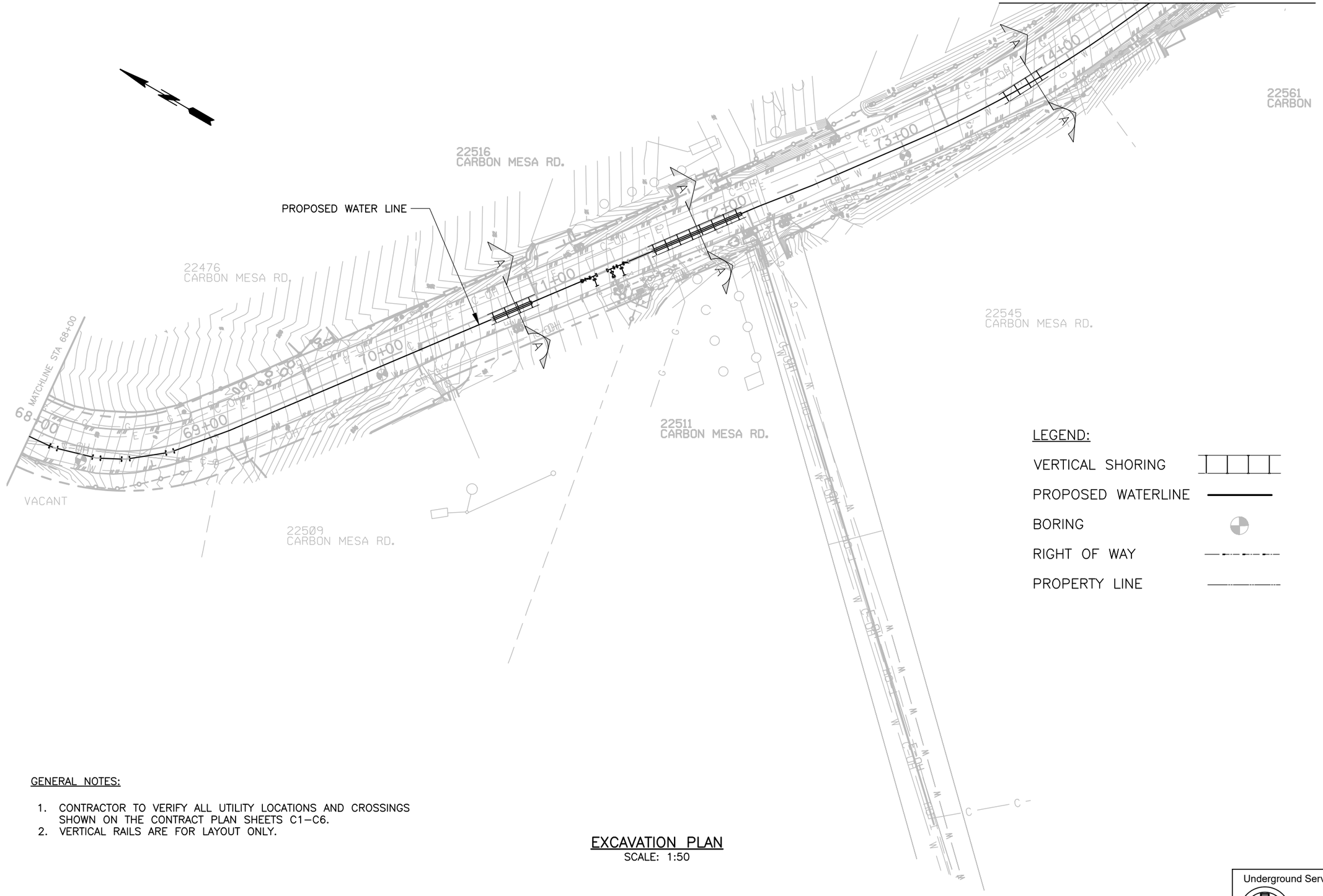

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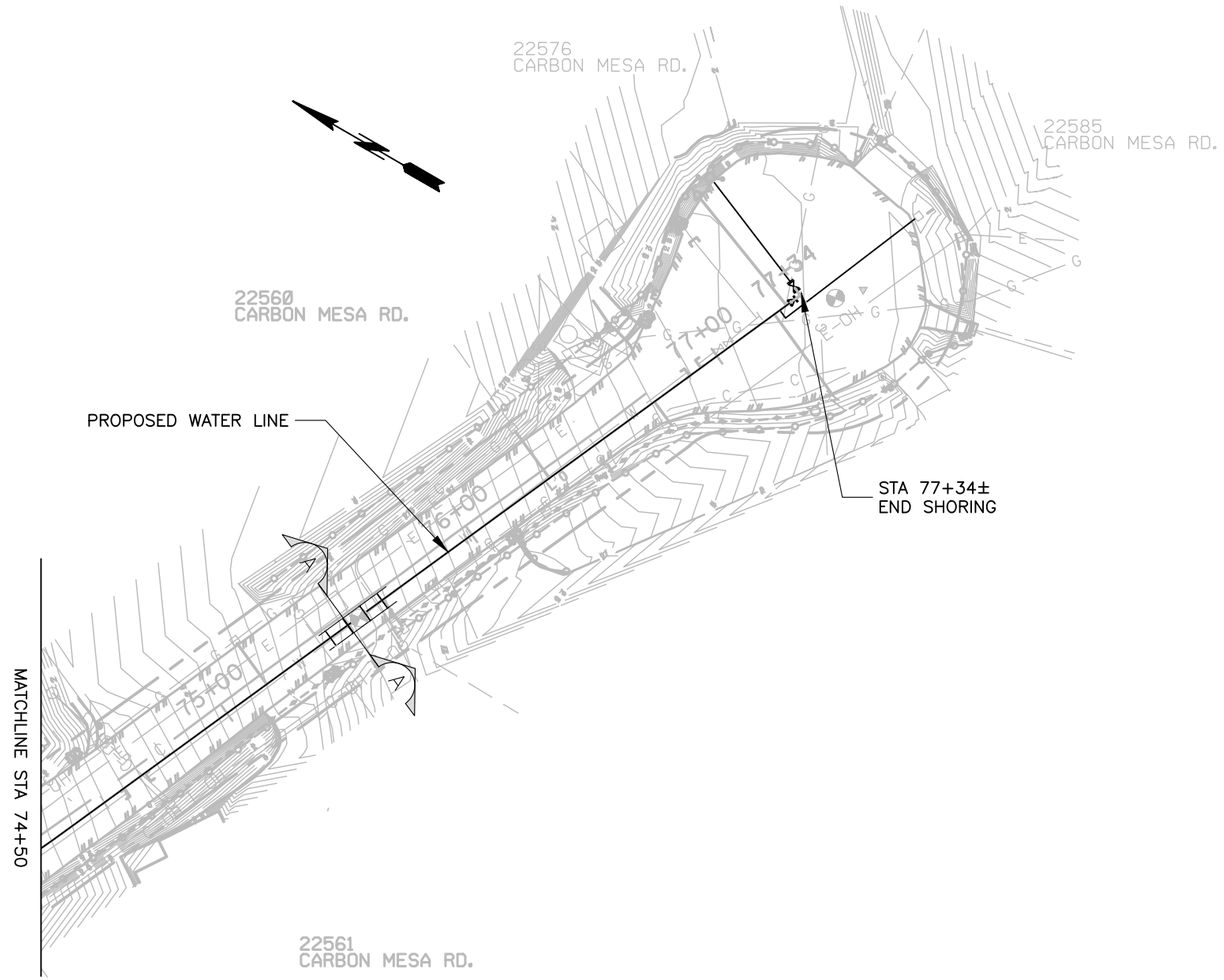

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VERTICAL SHORING

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BORING

RIGHT OF WAY

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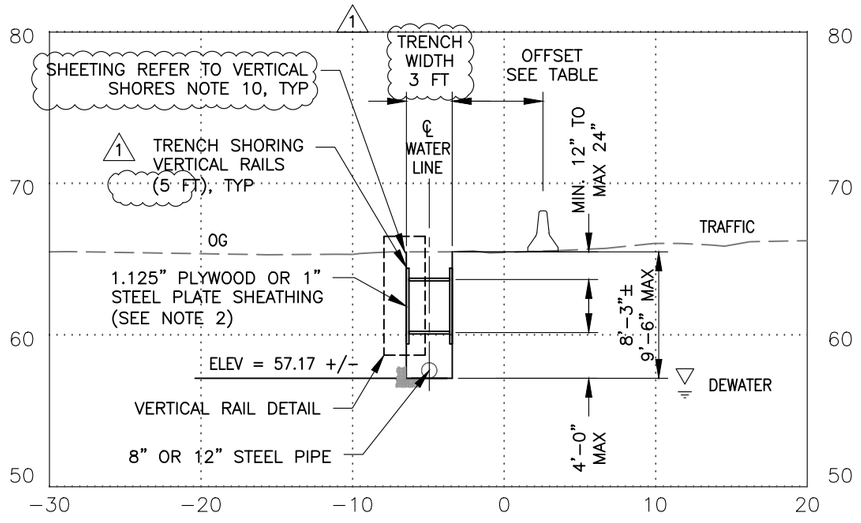
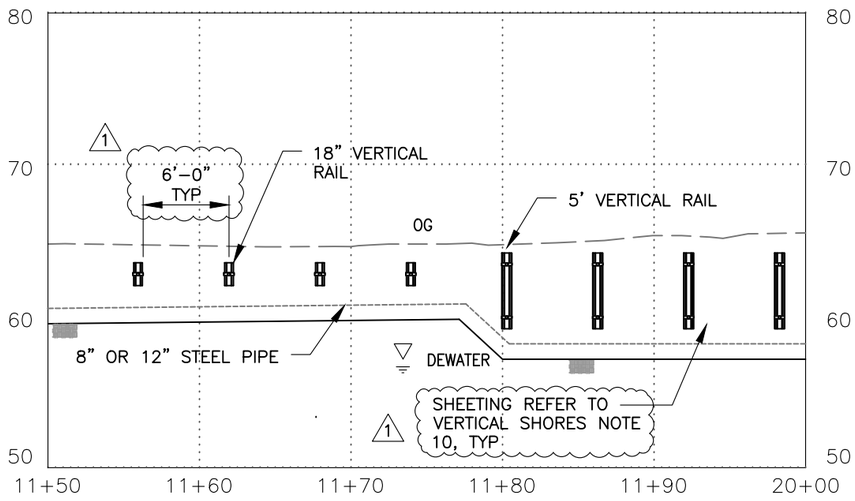
PROJECT: CARBON CANYON ROAD
JOB NUMBER: –
CONTRACT NO.: –

SHEET NUMBER: 10
OF 11 SHEETS



SECTION A–A
VERTICAL SHORES
SCALE: 1:10



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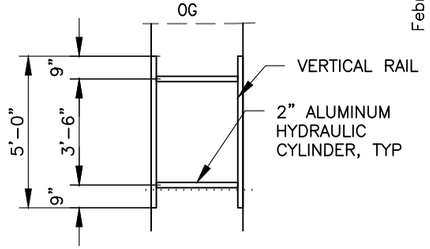
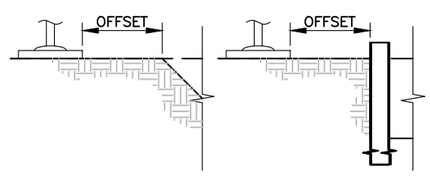


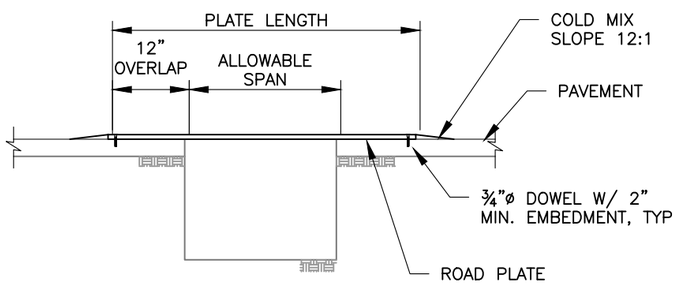
5' VERTICAL RAIL DETAIL
6 FT TO 9.5 FT HT
SCALE: 1:5



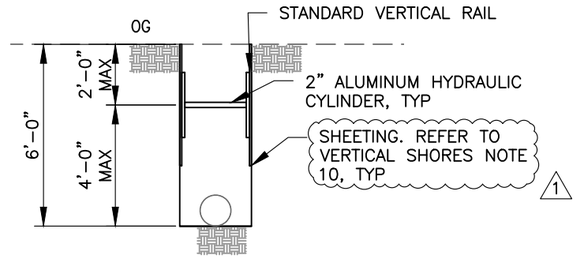
NOTES:

VERTICAL SHORES
1. THERE MUST BE A MINIMUM OF THREE COLUMNS OF SHORES SPACED EQUALLY IN THE TRENCH AT ALL TIMES.
2. MAY USE SHEETING FOR THE PREVENTION OF LOCAL RAVELING OR SLOUGHING. TYPES OF SHEETING ARE 2 EA 1⅛" CDX OR EQUIVALENT. MAY ALSO USE ½" A36 STEEL PLATE.
3. SHORING SYSTEM SHALL BE FULLY ASSEMBLED WITH ALL HYDRAULIC CYLINDERS IN PLACE PRIOR TO TO PLACING IT IN THE EXCAVATION. 1
4. DESIGNED FOR TYPE C SOIL.
5. SHEETING IS REQUIRED WHEN SLOUGHING OR RAVELING OCCURS AND IN C–60 OVER 8 FT.
6. MINIMUM OF THREE SHORES IN TRENCHES GREATER THAN 12 FT.
7. 140' MAX OPEN TRENCH WILL BE BACKFILLED AT THE END OF EACH SHIFT. IF NOT, USE EITHER STEEL PLATES OR FENCING TO PROTECT PEDESTRIANS AND TRAFFIC FROM THE TRENCH OPENING.
8. WORKERS SHALL ALWAYS ENTER, EXIT, & WORK INSIDE SHORED AREA OF THE TRENCH.
9. A COMPETENT PERSON MUST DECIDE WEATHER A TRENCH LESS THAN 5 FT DEEP ARE STABLE OR WILL REQUIRE SHORING.
10. PER MANUFACTURER DATA SHEETS, SHEETING IS REQUIRED FOR TYPE C SOIL WHEN EXCAVATION IS LARGER THAN 10 FT AND WHEN REVELING OR WHENEVER SLOUGHING OR RAVELING OCCUR.
11. THE LIMITS OF SHORING ARE FROM STA. 10+00 TO STA. 77+34.05
12. REFER TO TAB DATA.

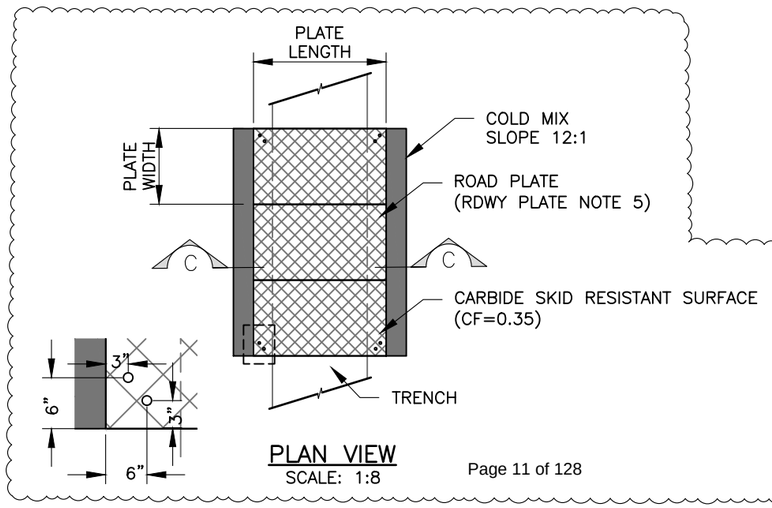
ROADWAY PLATES: 1
1. SPAN MEASUREMENT IS AC EDGE TO AC EDGE.
2. TRAFFIC MAY RUN IN ANY DIRECTION ON THE PLATES.
3. PLATE MAY BE PLACED IN EITHER DIRECTION OF THE TRENCH IN ACCORDANCE WITH THE CONDITIONS AND NOTES SPECIFIED HEREIN.
4. IT IS THE PLATE INSTALLERS RESPONSIBILITY TO INSTALL & MAINTAIN THE PLATES IN ACCORDANCE WITH THE TRENCH SHORING DATA SHEET AND LOCAL JURISDICTION REQUIREMENTS.
5. THE MAX ALLOWABLE SPAN IS 6 FT USING A 1.5" THICK STEEL ROAD PLATE BY TRENCH SHORING OR EQUIVALENT.
6. REFER TO TRENCH SHORING PRODUCT DATA.



SECTION C–C
SCALE: 1:5



18" VERTICAL RAIL DETAIL
MAX 6 FT HT
SCALE: 1:5



PLAN VIEW
SCALE: 1:8

ASSUMED SURCHARGES & MIN. OFFSETS		
SURCHARGE	OFFSET	LOAD
K–RAIL	2.5 FT	200 PSF
TRAFFIC	3.0 FT	300 PSF
CAT 420 BACKHOE	2 FT	3,580 PSF
CAT 315 EXCAVATOR	3 FT	900 PSF

PLATE SIZES		
PLATE THICKNESS	ALLOWABLE SPAN	PLATE SIZE
1"	4'	4x6, 4x8, 5x8, 5x10, 6x8, 6x10, 6x12, 8x10, 8x12, 8x15, 8x16, 8x20
1.25"	5'	8x10
1.5"	6'	8x12, 8x15, 8x16, 8x16

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84327
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STATE OF CALIFORNIA

REV.	DATE	DESCRIPTION
0	1-31-26	INITIAL SUBMITTAL
1	2-24-26	PER COMMENTS DATED 2/23/26

DESIGN BY: S. CANNON
DRAWN BY: S. CANNON
SCALE: AS SHOWN

MZB ENGINEERING INC.
1192 ATHLONE LANE
CORONA, CA 92882
(949) 254-4792

MZB ENGINEERING

WATER LINE EXCAVATION PLAN

SECTION VIEW

PROJECT: CARBON CANYON ROAD
JOB NUMBER: -
CONTRACT NO.: -

SHEET NUMBER: 11
OF 11 SHEETS

D:\DROPBOX\KORPI_CANNON_ENGINEERING\PROJECTS\KC-0119 - MZB ENGINEERING\DESIGN\EXCAV - SHORING\13.0 CARBON CANYON RD\CARBON CANYON-RO VERT SHORING FILE.DWG

Shoring Calculations

CAT 315 EXCAVATOR SURCHARGE LOADING ANALYSIS

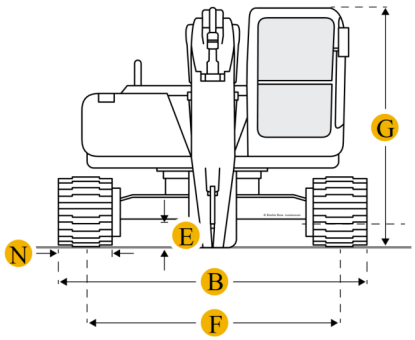
Total Equipment Weight $P := 36930 \cdot lb$ Per Richie Specs

Equipment Weight Per Track $P2 := \frac{P}{2} = 18465\ lb$ Number of Tracks = 2

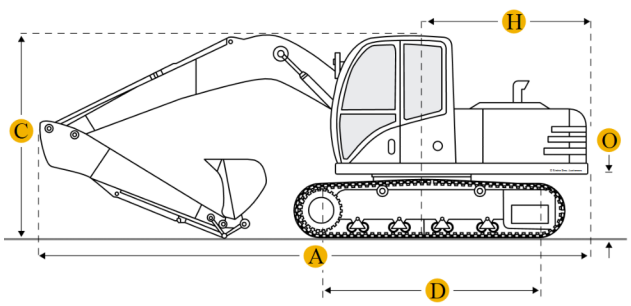
Width of Equipment Track (N2) $N2 := \frac{23.63 \cdot in}{12 \cdot \frac{in}{ft}} = 1.969\ ft$ $N := 24 \cdot in$

Length of Track (D) $D := 10.42 \cdot ft$

Excavator Surcharge Weight (wt) $wt := \frac{P2}{D \cdot N2} = 900\ \frac{lb}{ft^2}$ Per Track

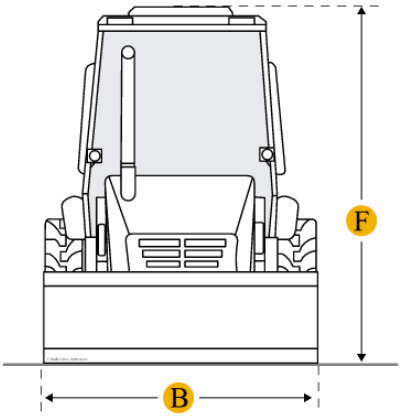


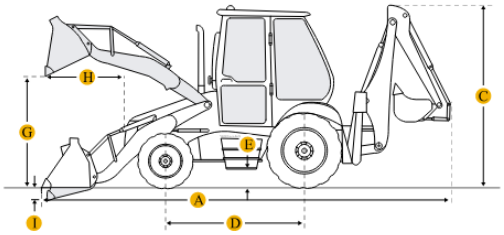
$F := 6.5 \cdot ft$

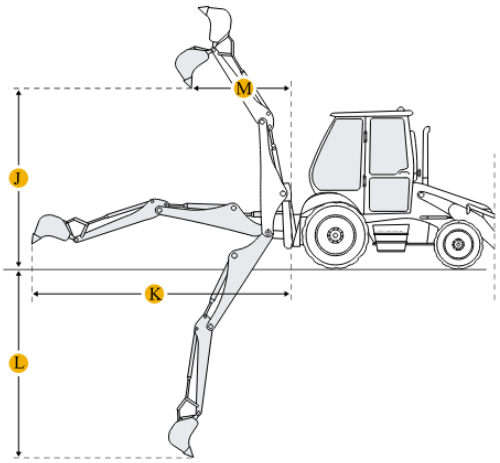


CAT 420 BACKHOE SURCHARGE LOADING ANALYSIS

Total Equipment Weight	$P := 16115.8 \cdot lb$	Per Richie Specs
Equipment Weight Per Track	$P2 := \frac{P}{4} = 4028.95\ lb$	Number of O.R. = 2
Width of Outrigger	$N2 := 0.75\ ft$	
Length of outrigger	$D := 1.5 \cdot ft$	
Excavator Surcharge Weight (wt)	$wt := \frac{P2}{D \cdot N2} = 3581\ \frac{lb}{ft^2}$	Per Outrigger

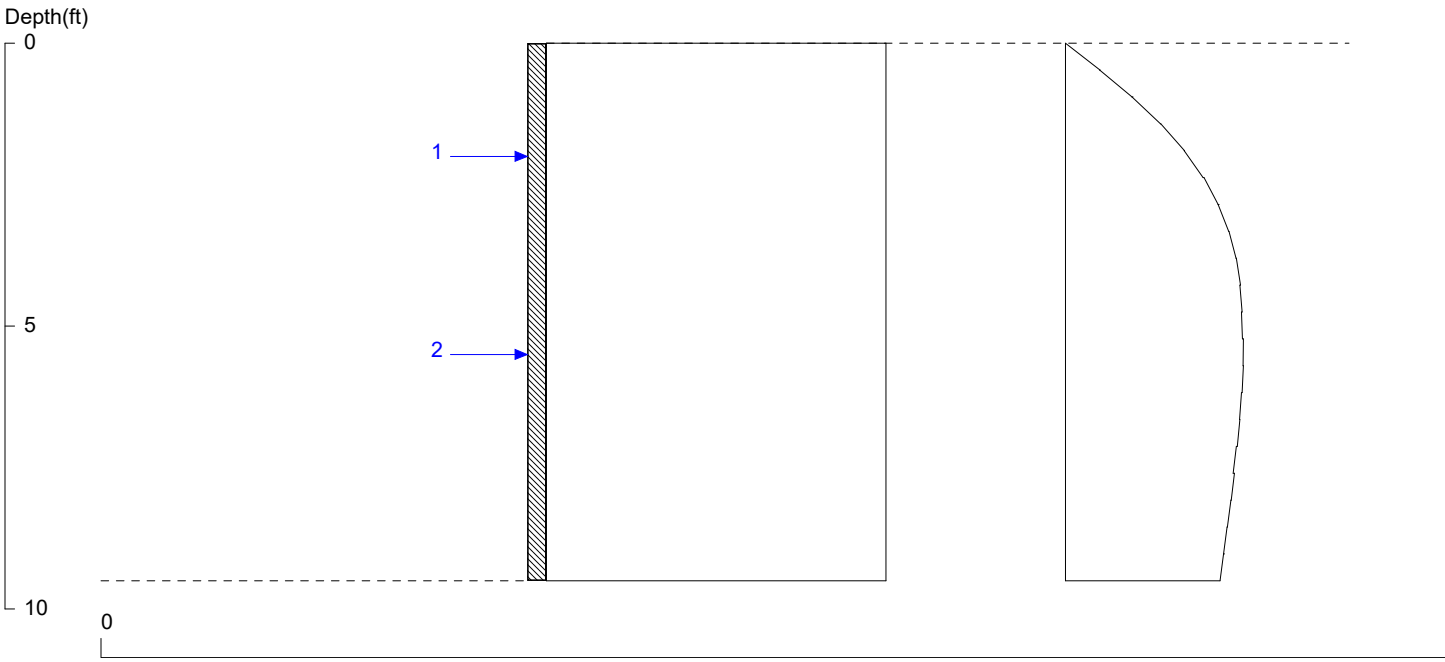






REV 1

Carbon Canyon Rd
Type C Soil



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File: D:\Dropbox\Korpi_Cannon_Engineering\Projects\KC-0119 - MZB Engineering\Design\Excav - Shoring\13.0 Carbon Can

Wall Height=9.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 6. Trench Box/Brace

MOMENT IN PILE: Max. Moment=2.24 per Pile Spacing=1.0 at Depth=5.50

PILE SELECTION:
Request Min. Section Modulus = 1.1 in3/pile=18.54 cm3/pile, Fy= 36 ksi = 248 MPa, Fb/Fy=0.66
User Input I (Moment of Inertia):
Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in4)/foot=140.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	N/A	N/A
1. Strut	2.0	0.0	6.0	2.9*	2.9	0.0	0.0	0.0
2. Strut	5.5	0.0	6.0	12.9	12.9	0.0	0.0	0.0

* Top Brace increased by 15% (DM7.2-103)
UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.189	9.500	0.189	0.000000
*	Below	Base		
9.500	0.341	85.500	3.552	0.042241
*	Sur-	charge		
0.000	0.000	0.475	0.019	0.040484
0.475	0.019	0.950	0.037	0.037960
0.950	0.037	1.425	0.053	0.033484
1.425	0.053	1.900	0.066	0.027935
1.900	0.066	2.375	0.077	0.022166
2.375	0.077	2.850	0.085	0.016789
2.850	0.085	3.325	0.091	0.012126

Allowable compressive load = 22 kips max per trench shoring

REV 1

3.325	0.091	3.800	0.095	0.008275
3.800	0.095	4.275	0.097	0.005197
4.275	0.097	4.750	0.098	0.002787
4.750	0.098	5.225	0.099	0.000926
5.225	0.099	5.700	0.099	-0.000499
5.700	0.099	6.175	0.098	-0.001583
6.175	0.098	6.650	0.097	-0.002403
6.650	0.097	7.125	0.095	-0.003021
7.125	0.095	7.600	0.094	-0.003482
7.600	0.094	8.075	0.092	-0.003823
8.075	0.092	8.550	0.090	-0.004070
8.550	0.090	9.025	0.088	-0.004244
9.025	0.088	9.500	0.086	-0.004360
9.500	0.086	10.450	0.082	-0.004450

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
9.500	0.166	85.500	24.796	0.324070

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	9.50	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

****

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
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****

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Title: Carbon Canyon Rd
Subtitle: Type C Soil

**********INPUT DATA**********

Wall Type: 6. Trench Box/Brace
Wall Height: 9.50
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.50
As Continuous Span Beam
Lateral Support Type (Braces): 2. Strut, Raker
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 2. No
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 36 ksi = 248 MPa
Allowable Fb/Fy: 0.66
Elastic Module, E: 29000.00

Moment of Inertia, I: 140
User Input Pile: W14X82

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.189	9.500	0.189	0.000000
3	*	Below	Base		
4	9.500	0.341	85.500	3.552	0.042241
5	*	Sur-	charge		
6	0.000	0.000	0.475	0.019	0.040484
7	0.475	0.019	0.950	0.037	0.037960
8	0.950	0.037	1.425	0.053	0.033484
9	1.425	0.053	1.900	0.066	0.027935
10	1.900	0.066	2.375	0.077	0.022166
11	2.375	0.077	2.850	0.085	0.016789
12	2.850	0.085	3.325	0.091	0.012126
13	3.325	0.091	3.800	0.095	0.008275
14	3.800	0.095	4.275	0.097	0.005197
15	4.275	0.097	4.750	0.098	0.002787
16	4.750	0.098	5.225	0.099	0.000926
17	5.225	0.099	5.700	0.099	-0.000499
18	5.700	0.099	6.175	0.098	-0.001583
19	6.175	0.098	6.650	0.097	-0.002403
20	6.650	0.097	7.125	0.095	-0.003021
21	7.125	0.095	7.600	0.094	-0.003482
22	7.600	0.094	8.075	0.092	-0.003823
23	8.075	0.092	8.550	0.090	-0.004070
24	8.550	0.090	9.025	0.088	-0.004244
25	9.025	0.088	9.500	0.086	-0.004360
26	9.500	0.086	10.450	0.082	-0.004450
27	10.450	0.082	11.400	0.077	-0.004467
28	11.400	0.077	12.350	0.073	-0.004402
29	12.350	0.073	13.300	0.069	-0.004284
30	13.300	0.069	14.250	0.065	-0.004132
31	14.250	0.065	15.200	0.061	-0.003960
32	15.200	0.061	16.150	0.058	-0.003775
33	16.150	0.058	17.100	0.054	-0.003586
34	17.100	0.054	18.050	0.051	-0.003394
35	18.050	0.051	19.000	0.048	-0.003205
36	19.000	0.048	20.900	0.043	-0.002931
37	20.900	0.043	22.800	0.038	-0.002586
38	22.800	0.038	24.700	0.033	-0.002272
39	24.700	0.033	26.600	0.030	-0.001991
40	26.600	0.030	28.500	0.026	-0.001742
41	28.500	0.026	30.400	0.023	-0.001523
42	30.400	0.023	32.300	0.021	-0.001332
43	32.300	0.021	34.200	0.019	-0.001165
44	34.200	0.019	36.100	0.017	-0.001021

```
 45     36.100          0.017           38.000          0.000           -0.008771
-------------------------------------------------------------------------------

* PASSIVE PRESSURE *
 The pressures below will be divided by a Factor of Safety =1.5
 No.    Z1 top          Top Pres.       Z2 bottom       Bottom Pres.    Slope
-------------------------------------------------------------------------------
 1      *               Below           Base
 2      9.500           0.166           85.500          24.796          0.324070
-------------------------------------------------------------------------------

* ACTIVE SPACE *
 No.    Z depth         Spacing
-------------------------------------------------------------------------------
 1      0.00            1.00
 2      9.50            1.00
-------------------------------------------------------------------------------

* PASSIVE SPACE *
 No.    Z depth         Spacing
-------------------------------------------------------------------------------
 1      0.00            1.00
-------------------------------------------------------------------------------

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
 No.    Z brace         Angle           Spacing         Input1*         Input2*
Type
-------------------------------------------------------------------------------------------
---------------------
 1      2.00            0.0             6.00            1.00            1.00
Strut
 2      5.50            0.0             6.00            1.00            1.00
Strut
-------------------------------------------------------------------------------------------
---------------------
*For Tieback:  Input1 = Diameter;  Input2 = Bond Strength
*For Plate:  Input1 = Diameter;  Input2 = Allowable Pressure
*For Deadman:  Input1 = Horz. Width;  Input2 = Passive Pressure;
*For Sheet Pile Anchor:  Input1 = Horz. Width;  Input2 = Passive Slope;


*********************************CALCULATION*********************************

   The calculated moment and shear are per pile spacing.  Sheet piles are per one
foot or meter; Soldier piles are per pile.

   Top Pressures start at depth =  0.00

-------------------NO EMBEDMENT CASE (TWO OR MORE BRACES)------------------
```

```
   NUMBER OF BRACE LEVEL=  2


*  CANTILEVER SPAN, N0.0 *

        |      D1=0.00
        |
        |
        |<--   D2=2.00         R2=0.45, with Cantilever Moment=0.43

        D1 - TOP DEPTH
        D2 - BOTTOM DEPTH         R2 - BOTTOM REACTION

   TOTAL REACTION: R2 = 0.45
   TOTAL PRESSURES ACTING ON WALL = 0.45
      Total Reactions = Total Pressures,    OK!

   ____________________________________________________
   BRACE NO.1 AT DEPTH = 2.00
       R2 of Span No.0
                                } Sum of Reaction = Brace Load = 0.42
       R1 of Last Span
   ____________________________________________________

*  LAST SPAN  *

        |<--   D1=2.00         R1=-0.04
        |
        |
        |
        |<--   D2=5.50        R2=2.15
        |
        |
        |      D3=9.50

        D1 - TOP DEPTH          R1 - TOP REACTION
        D2 - LAST BRACE DEPTH   R2 - LAST BRACE REACTION
        D3 - BOTTOM DEPTH


   TOTAL REACTION: R1+R2 = 2.11
   TOTAL PRESSURES ACTING ON WALL = 2.11
      Total Reactions >= Total Pressures,    OK!

   ____________________________________________________
   BRACE NO.2 AT DEPTH = 5.50
       R2 of Last Span = Brace Load = 2.15
   ____________________________________________________

**********RESULTS**********
```

```
* EMBEDMENT *
MINIMUM EMBEDMENT = 0.00 (5~10ft recommended!!!),  TOTAL MINIMUM PILE LENGTH = 9.50

* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
 No.    Depth           M @ Brace       Mmax in Span    Depth of Mmax
-------------------------------------------------------------------------
 1      2.00            0.43            0.43            2.00
 2      5.50            2.24            0.00            9.49
-------------------------------------------------------------------------
Overall Maximum Moment = 2.24 at 5.50
Maximum Shear = 1.13
Moment and Shear are per pile spacing: 1.0 foot or meter

-> Top Brace Increase 15%. (Horizontal) From 0.42 to 0.48

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
The calculated brace force are per brace spacing.

 No.    DEPTH           Tangle          SPACING         HORIZONTAL      VERTICAL
TOTAL LOAD
-------------------------------------------------------------------------------
----------
 1      2.00            0.0             6.00            2.87            0.00
2.87
 2      5.50            0.0             6.00            12.88           0.00
12.88

 No.    DEPTH           Free length     Brace Type
-------------------------------------------------------------------------------
----------
 1      2.00            0.00            Strut
 2      5.50            0.00            Strut
-------------------------------------------------------------------------------
----------

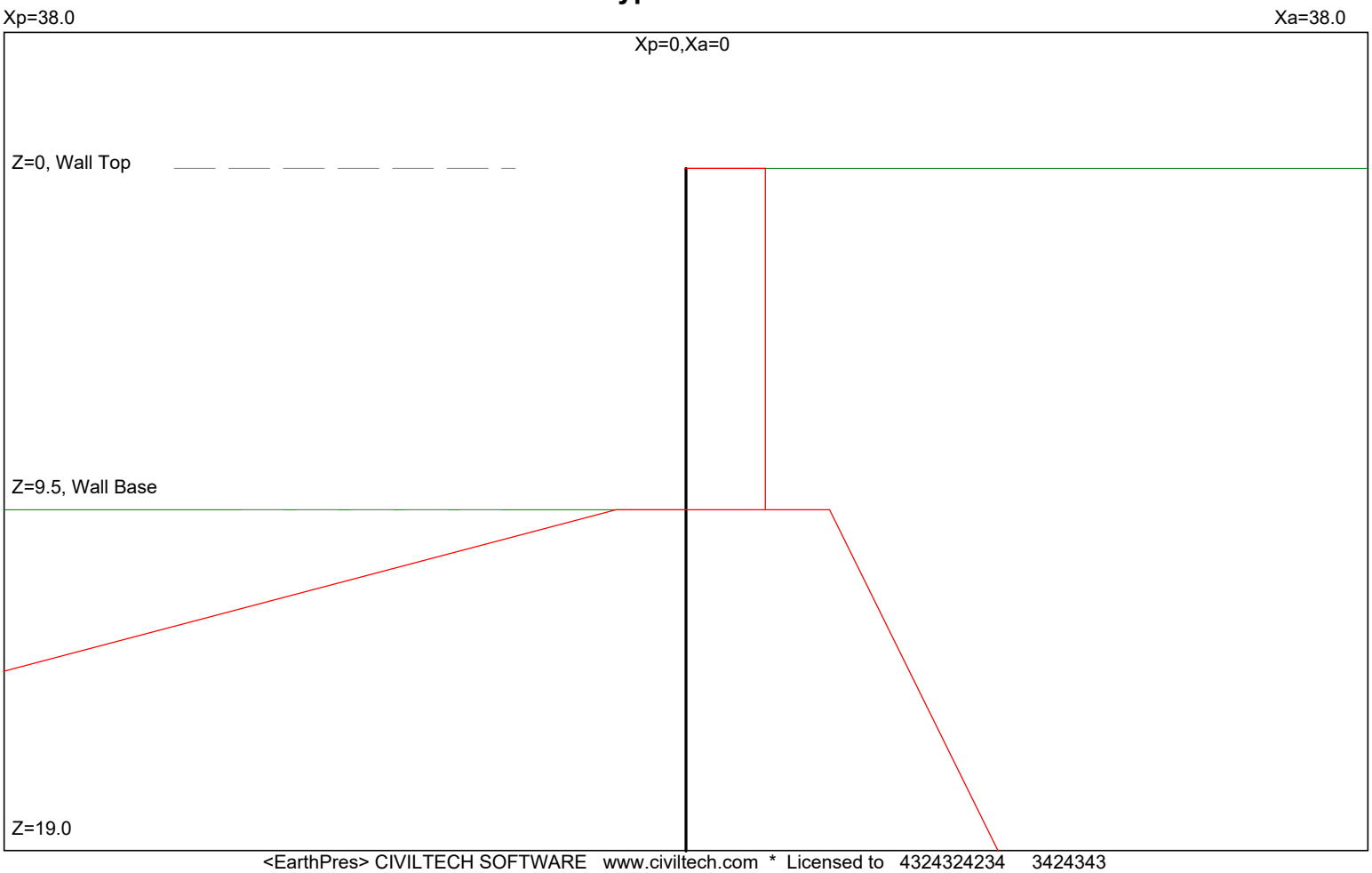
* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00



* DEFLECTION *
   I (in4)/foot=140.00
   Top deflection = 0.000(in)
   Max. deflection = 0.004(in)
```

REV 1

Carbon Canyon Rd
Type C Soil



UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=9.5 Total Soil Types= 1

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	117.0	128.0	28	.05	5	3	Silt

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Silt

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	9.5	0.0	9.5	800.0	1	Silt

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 1.38 per one linear foot (or meter) width along wall height
Total Static Force above Base= 1.38. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.19	9.50	0.19	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
9.50	0.34	19.00	0.74	0.0422	0.3610

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
9.50	0.17	19.00	3.25	0.324	2.7698

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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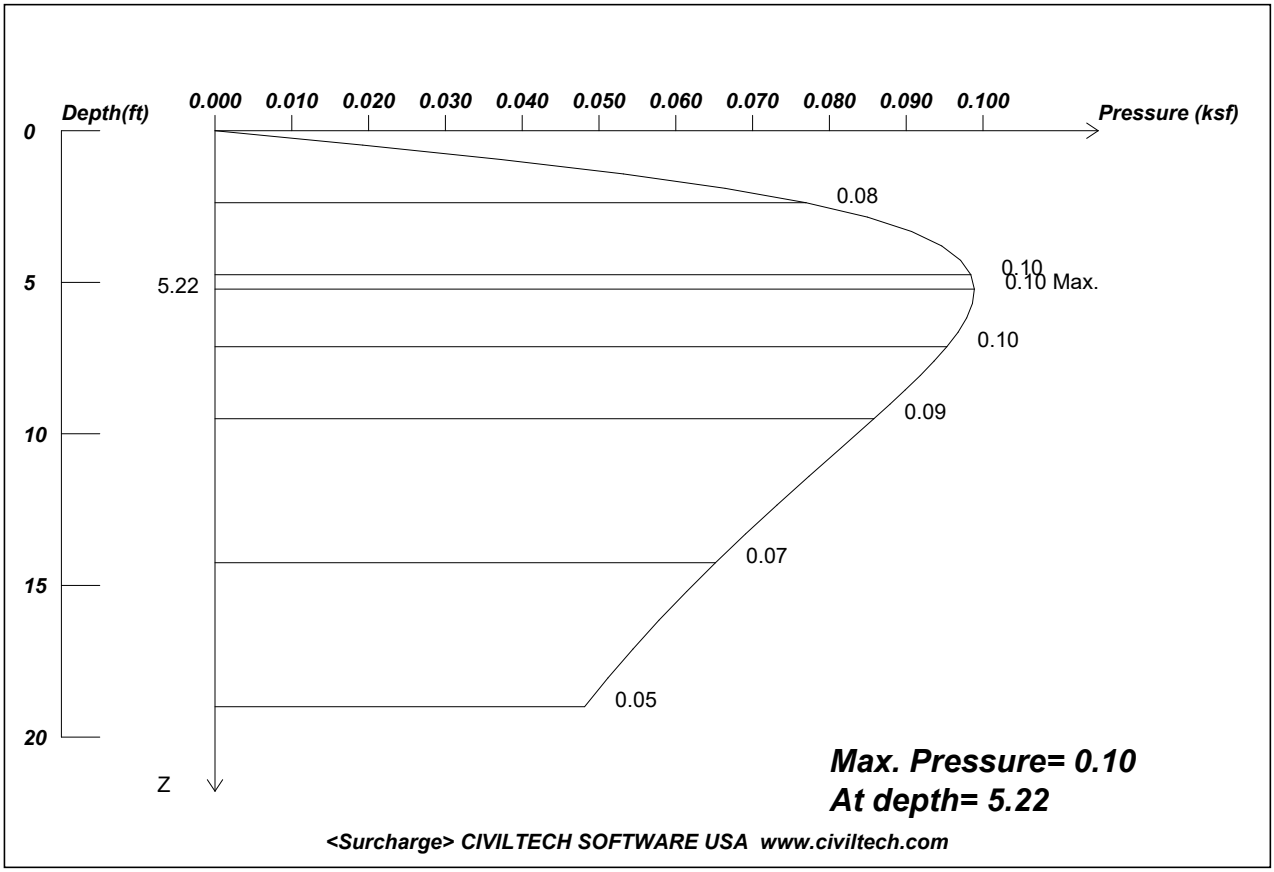

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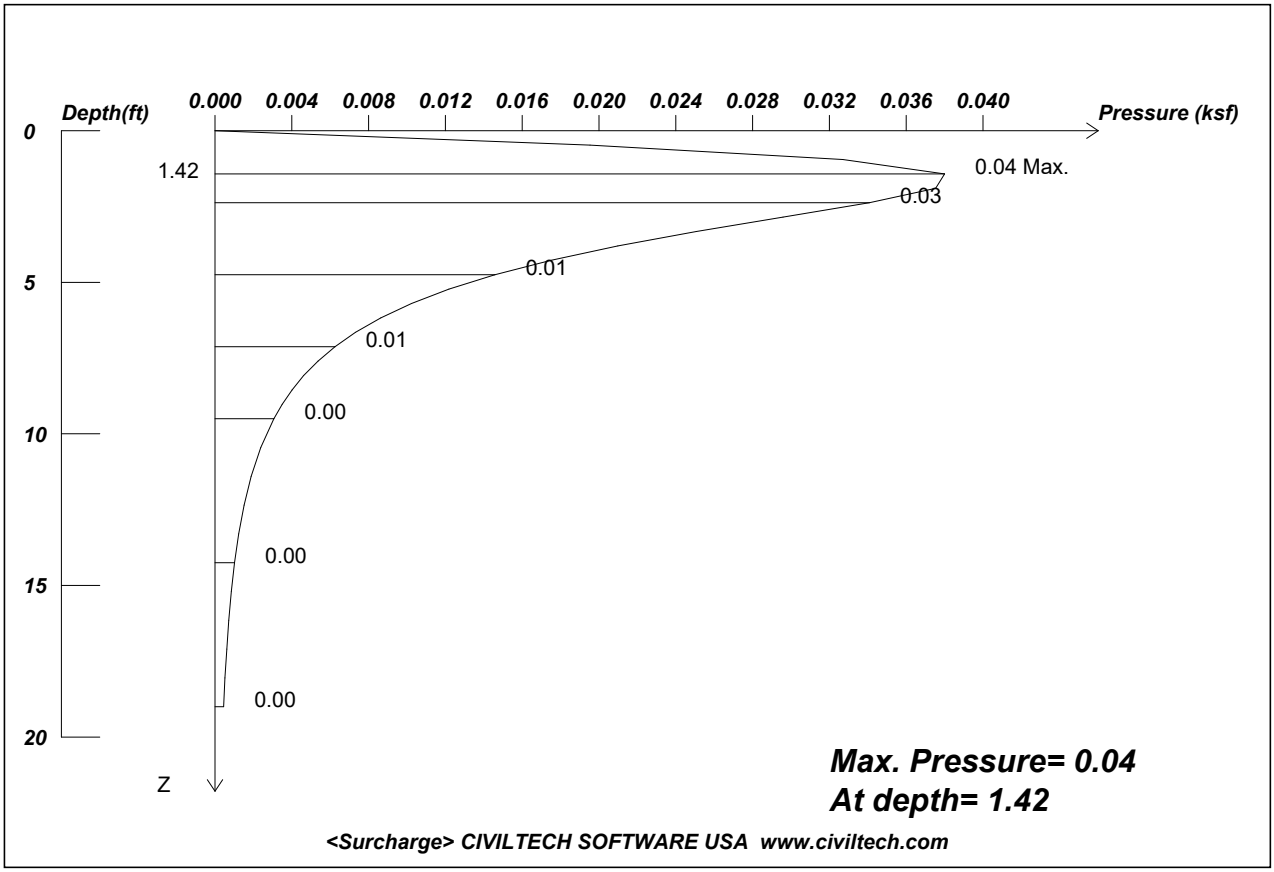
Wall Height, H= 9.5 Load Depth, D= 0
Load Factor of Surcharge Loading = 1
Flexible Wall Condition -- Movement or deflection are allowed.
Max. Pressure = 0.099 at depth = 5.22

X	Width	Strip Load
4.0	24.0	.30

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf



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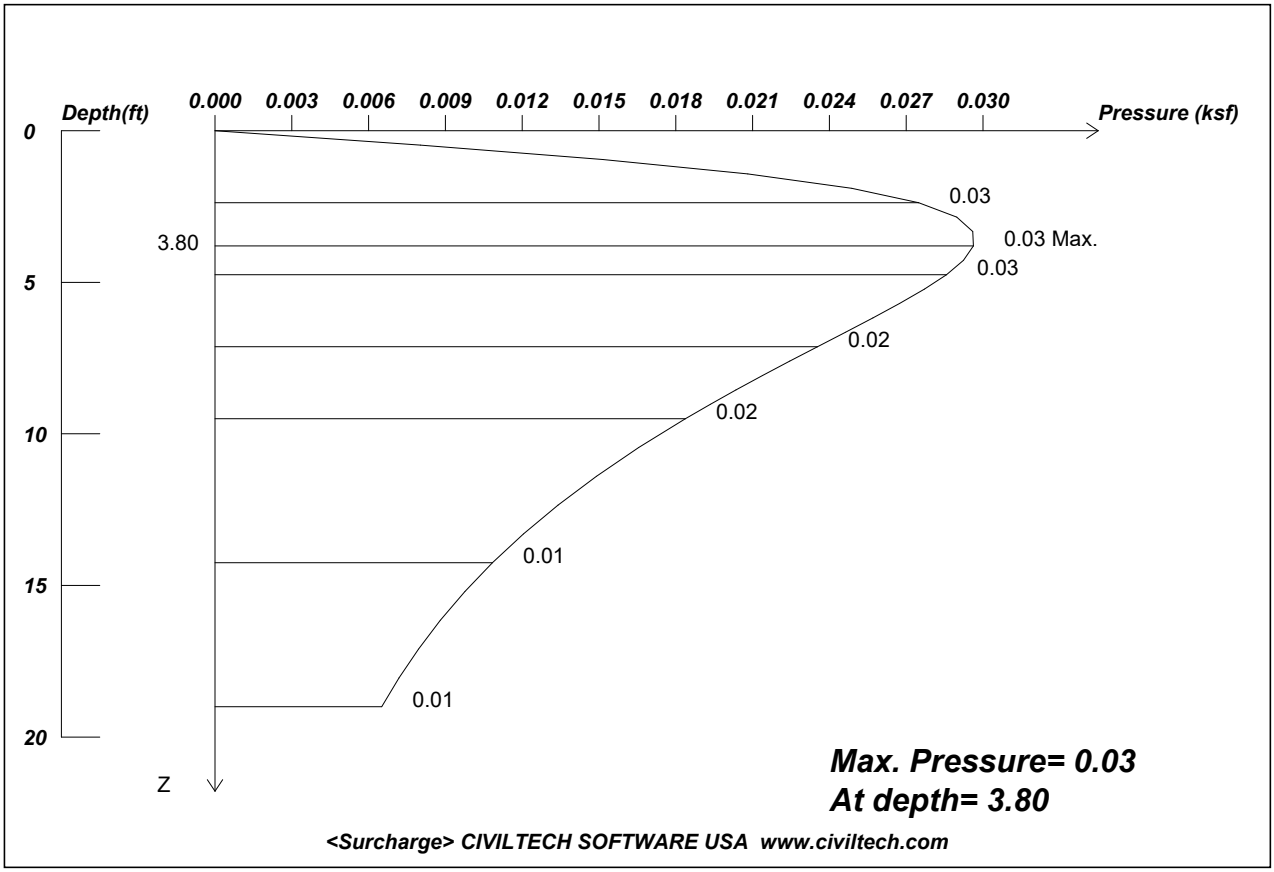
Date: 2/25/2026 File: UNTITLED

Wall Height, H= 9.5 Load Depth, D= 0
Load Factor of Surcharge Loading = 1
Flexible Wall Condition -- Movement or deflection are allowed.
Max. Pressure = 0.038 at depth = 1.42

X	Width	Length	Area Load
2.0	2.0	1.0	3.58

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf



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Date: 2/25/2026 File: UNTITLED

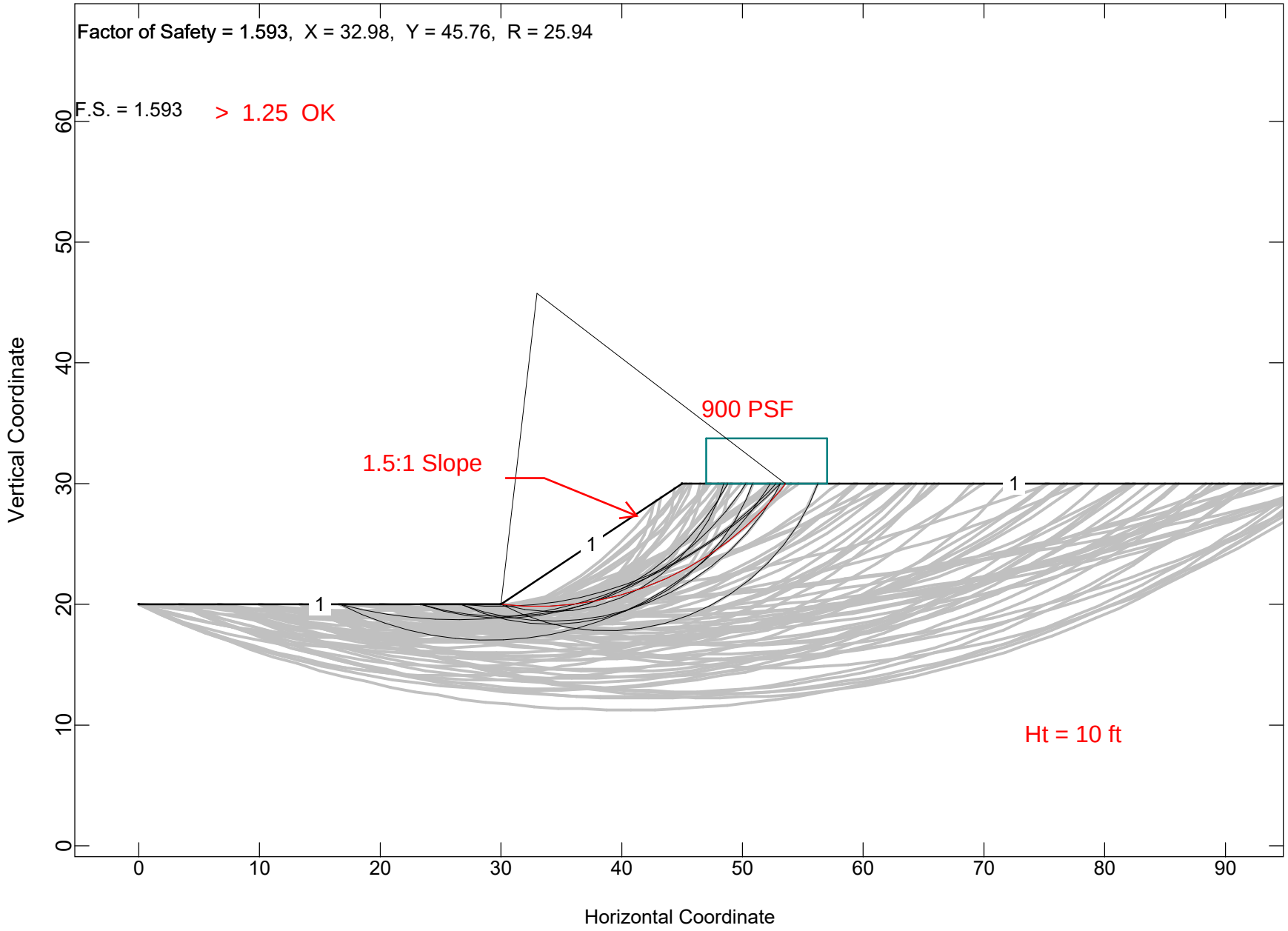
Wall Height, H= 9.5 Load Depth, D= 0
Load Factor of Surcharge Loading = 1
Flexible Wall Condition -- Movement or deflection are allowed.
Max. Pressure = 0.030 at depth = 3.80

X	Width	Length	Area Load
3.0	13.0	2.0	.90

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

REV 1

Excavator Surcharge Load



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                     STABLPro for Windows, Version 2015.4.5

                             Upgraded from:
                             FHWA-PCSTABLE

                      Serial Number :  357267753

                         --Slope Stability Analysis--
                       Simplified Janbu, Simplified Bishop
                         or Spencer Method of Slices

     ============================================================================


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- Shoring\13.0 Carbon Canyon Rd\R1\StablPro\
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     Name of plot output file    : 3.0 Excavator.sl4p

     ----------------------------------------------------------------------------
                           Time and Date of Analysis
     ----------------------------------------------------------------------------

               Date:  February 25, 2026     Time:  17:28:28




1
          PROBLEM DESCRIPTION   New Slope




          BOUNDARY COORDINATES

              3 Top   Boundaries
              3 Total Boundaries
```

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
1	0.00	20.00	30.00	20.00	1
2	30.00	20.00	45.00	30.00	1
3	45.00	30.00	100.00	30.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	117.0	117.0	150.0	29.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left ft.	X-Right ft.	Intensity psf	Deflection (deg)
1	47.00	57.00	900.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 42.00 ft.
and X = 100.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	20.00
2	31.99	19.85
3	33.99	19.85
4	35.99	20.00
5	37.96	20.31
6	39.91	20.77
7	41.82	21.38
8	43.67	22.14
9	45.46	23.03
10	47.17	24.06
11	48.80	25.22
12	50.34	26.50
13	51.77	27.89
14	53.09	29.39
15	53.55	30.00

Circle Center At X = 33.0 ; Y = 45.8 and Radius, 25.9

*** 1.593 ***

Individual data on the 16 slices

Slice No.	Width Ft	Weight Lbs	Water Force Top Lbs	Water Force Bot Lbs	Tie Force Norm Lbs	Tie Force Tan Lbs	Earthquake Force Hor Lbs	Earthquake Force Ver Lbs	Surcharge Load Lbs
1	2.0	0.17E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	2.0	0.50E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	2.0	0.79E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	2.0	0.10E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.9	0.12E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	1.9	0.14E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	1.9	0.15E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	1.3	0.11E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	0.5	0.38E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.5	0.12E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.2	0.12E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.16E+03
12	1.6	0.10E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.15E+04
13	1.5	0.74E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.14E+04
14	1.4	0.47E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.13E+04
15	1.3	0.21E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.12E+04
16	0.5	0.16E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.41E+03

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	20.00
2	28.66	19.86
3	30.66	19.85
4	32.66	19.96
5	34.64	20.21
6	36.61	20.58
7	38.55	21.08
8	40.45	21.70
9	42.30	22.45
10	44.11	23.31

11	45.85	24.29
12	47.53	25.38
13	49.13	26.57
14	50.65	27.87
15	52.09	29.26
16	52.76	30.00

Circle Center At X = 29.9 ; Y = 50.8 and Radius, 30.9

*** 1.672 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	20.00
2	28.57	19.38
3	30.52	18.94
4	32.50	18.68
5	34.50	18.61
6	36.50	18.73
7	38.48	19.03
8	40.42	19.52
9	42.30	20.18
10	44.12	21.02
11	45.85	22.02
12	47.48	23.18
13	48.99	24.49
14	50.38	25.93
15	51.62	27.50
16	52.71	29.17
17	53.15	30.00

Circle Center At X = 34.3 ; Y = 40.0 and Radius, 21.4

*** 1.675 ***

Failure Surface Specified By 16 Coordinate Points

Point	X-Surf	Y-Surf

No.	ft.	ft.
1	26.67	20.00
2	28.53	19.26
3	30.46	18.73
4	32.43	18.43
5	34.43	18.35
6	36.42	18.49
7	38.39	18.86
8	40.30	19.44
9	42.14	20.24
10	43.87	21.23
11	45.48	22.42
12	46.95	23.78
13	48.26	25.29
14	49.39	26.94
15	50.32	28.71
16	50.83	30.00

Circle Center At X = 34.2 ; Y = 36.1 and Radius, 17.8

*** 1.758 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	20.00
2	25.27	19.51
3	27.25	19.18
4	29.24	19.02
5	31.24	19.02
6	33.23	19.20
7	35.20	19.53
8	37.14	20.04
9	39.03	20.70
10	40.85	21.51
11	42.60	22.48
12	44.27	23.59
13	45.83	24.84
14	47.29	26.21
15	48.62	27.69
16	49.83	29.29
17	50.28	30.00

Circle Center At X = 30.2 ; Y = 42.9 and Radius, 23.9

*** 1.817 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	20.00
2	31.81	19.16
3	33.71	18.51
4	35.66	18.07
5	37.64	17.84
6	39.64	17.83
7	41.63	18.03
8	43.59	18.44
9	45.49	19.06
10	47.32	19.88
11	49.04	20.89
12	50.65	22.08
13	52.12	23.44
14	53.44	24.95
15	54.58	26.58
16	55.55	28.33
17	56.25	30.00

Circle Center At X = 38.8 ; Y = 36.4 and Radius, 18.6

*** 1.846 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	20.00
2	31.95	19.57
3	33.95	19.40
4	35.94	19.50

5	37.91	19.86
6	39.81	20.49
7	41.61	21.36
8	43.27	22.47
9	44.77	23.79
10	46.09	25.30
11	47.18	26.97
12	48.05	28.78
13	48.44	30.00

Circle Center At X = 34.2 ; Y = 34.3 and Radius, 14.9

*** 1.876 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	16.67	20.00
2	18.61	19.53
3	20.58	19.17
4	22.56	18.92
5	24.56	18.77
6	26.56	18.73
7	28.56	18.79
8	30.55	18.96
9	32.53	19.24
10	34.49	19.62
11	36.43	20.11
12	38.34	20.70
13	40.22	21.39
14	42.06	22.18
15	43.85	23.06
16	45.59	24.04
17	47.28	25.12
18	48.91	26.28
19	50.47	27.52
20	51.97	28.85
21	53.13	30.00

Circle Center At X = 26.4 ; Y = 56.2 and Radius, 37.5

*** 1.973 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	20.00
2	25.25	19.44
3	27.22	19.07
4	29.21	18.88
5	31.21	18.88
6	33.20	19.08
7	35.16	19.46
8	37.08	20.02
9	38.94	20.76
10	40.72	21.68
11	42.40	22.76
12	43.98	23.99
13	45.43	25.37
14	46.74	26.87
15	47.91	28.50
16	48.78	30.00

Circle Center At X = 30.2 ; Y = 40.0 and Radius, 21.1

*** 1.990 ***

Failure Surface Specified By 22 Coordinate Points

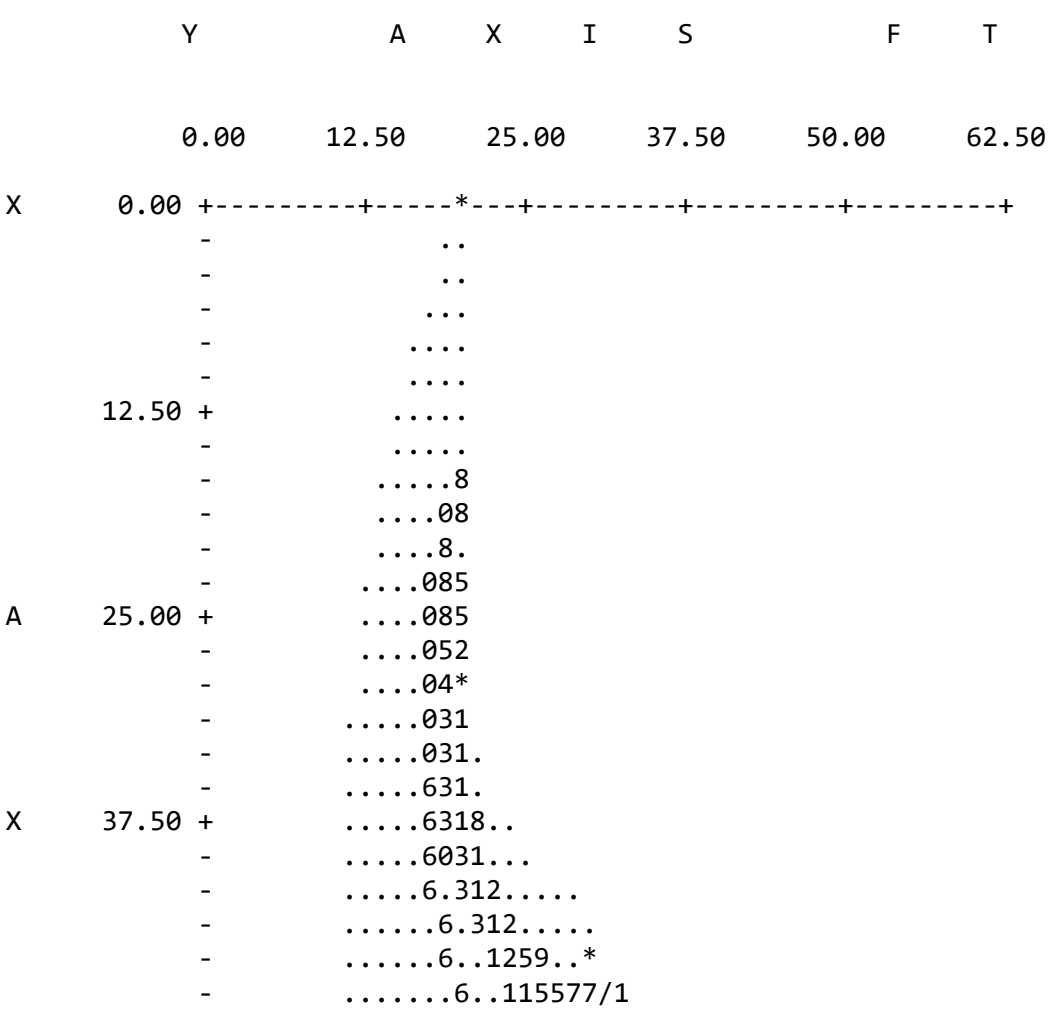
Point No.	X-Surf ft.	Y-Surf ft.
1	16.67	20.00
2	18.48	19.16
3	20.35	18.45
4	22.27	17.89
5	24.22	17.46
6	26.20	17.18
7	28.20	17.04
8	30.20	17.05
9	32.19	17.21
10	34.17	17.51
11	36.12	17.96

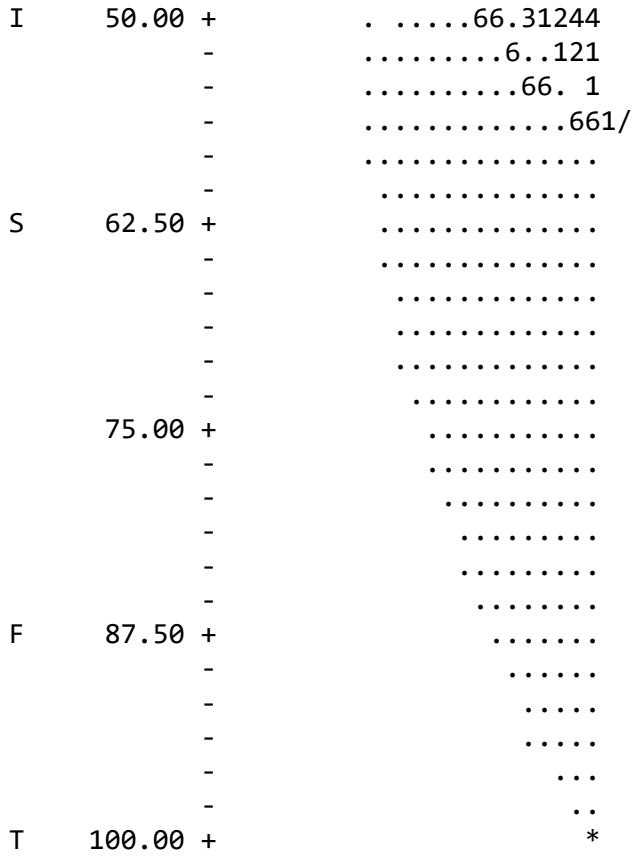
12	38.03	18.55
13	39.90	19.27
14	41.70	20.13
15	43.44	21.12
16	45.10	22.24
17	46.68	23.47
18	48.16	24.81
19	49.53	26.26
20	50.80	27.81
21	51.95	29.44
22	52.29	30.00

Circle Center At X = 29.1 ; Y = 44.3 and Radius, 27.3

*** 1.999 ***

1

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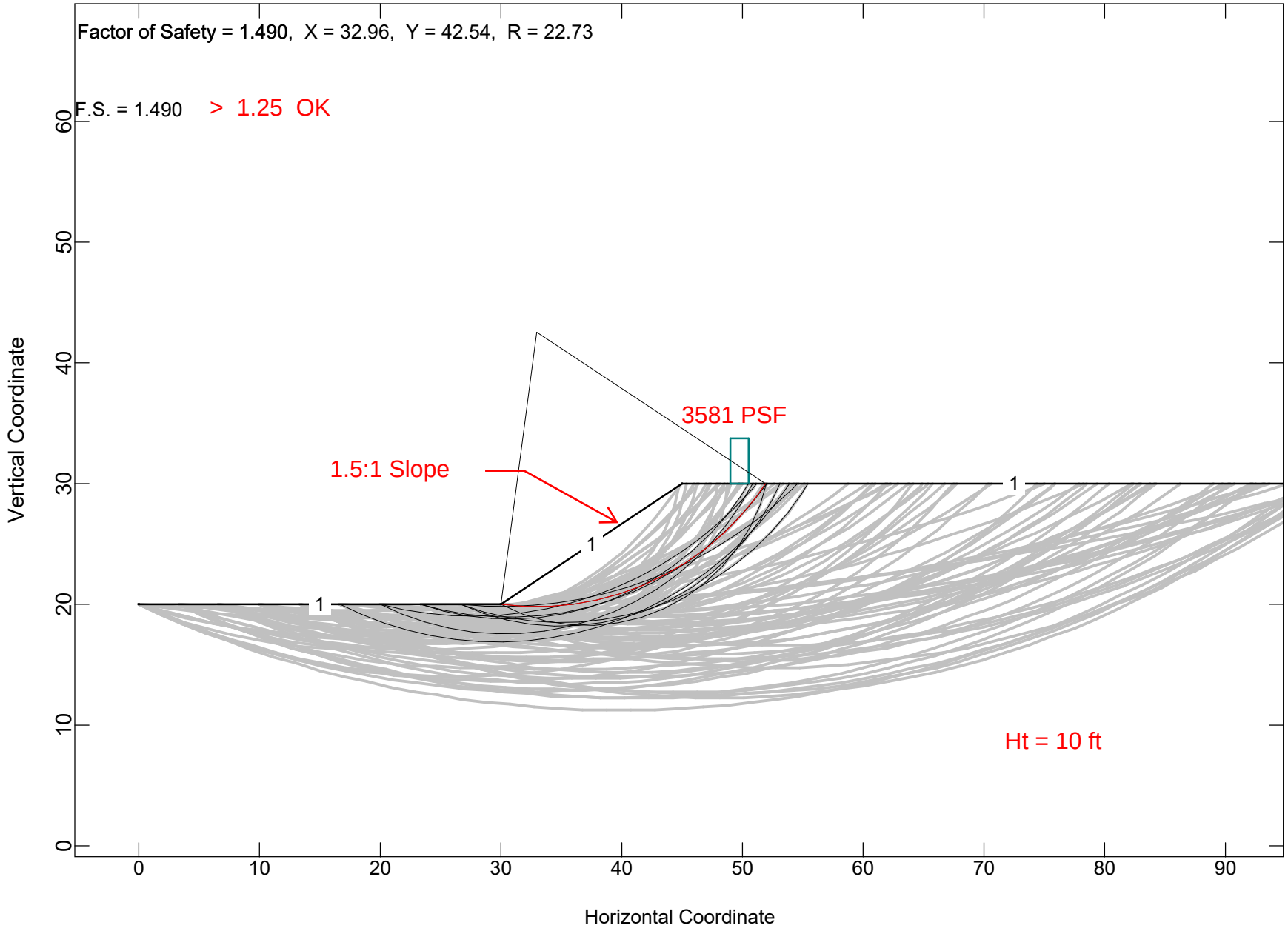
REV 1

Backhoe Surcharge Load



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                     STABLPro for Windows, Version 2015.4.5

                            Upgraded from:
                            FHWA-PCSTABLE

                      Serial Number :  357267753

                         --Slope Stability Analysis--
                       Simplified Janbu, Simplified Bishop
                         or Spencer Method of Slices

     ========================================================================


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               Date:  February 25, 2026     Time:  17:35:51




1
          PROBLEM DESCRIPTION   New Slope




          BOUNDARY COORDINATES

              3 Top   Boundaries
              3 Total Boundaries
```

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
1	0.00	20.00	30.00	20.00	1
2	30.00	20.00	45.00	30.00	1
3	45.00	30.00	100.00	30.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	117.0	117.0	150.0	29.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left ft.	X-Right ft.	Intensity psf	Deflection (deg)
1	49.00	50.50	3581.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 44.00 ft.
and X = 100.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	20.00
2	31.99	19.83
3	33.99	19.83
4	35.99	20.01
5	37.95	20.36
6	39.88	20.89
7	41.76	21.58
8	43.57	22.43
9	45.29	23.44
10	46.93	24.60
11	48.45	25.90
12	49.85	27.32
13	51.12	28.87
14	51.90	30.00

Circle Center At X = 33.0 ; Y = 42.5 and Radius, 22.7

*** 1.490 ***

Individual data on the 16 slices

Slice No.	Width Ft	Weight Lbs	Water Force Top Lbs	Water Force Bot Lbs	Tie Force Norm Lbs	Tie Force Tan Lbs	Earthquake Force Hor Lbs	Earthquake Force Ver Lbs	Surcharge Load Lbs
1	2.0	0.18E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	2.0	0.51E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	2.0	0.79E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	2.0	0.10E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.9	0.12E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	1.9	0.13E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	1.8	0.14E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	1.4	0.11E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	0.3	0.23E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.6	0.11E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	1.5	0.85E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.6	0.25E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.9	0.31E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.30E+04
14	0.6	0.17E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.23E+04
15	0.6	0.11E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.8	0.52E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	20.00
2	25.25	19.44
3	27.22	19.05
4	29.20	18.83
5	31.20	18.79
6	33.20	18.92
7	35.18	19.22
8	37.12	19.69
9	39.02	20.32
10	40.85	21.12
11	42.61	22.08

12	44.28	23.18
13	45.84	24.42
14	47.30	25.80
15	48.62	27.29
16	49.82	28.90
17	50.50	30.00

Circle Center At X = 30.7 ; Y = 41.9 and Radius, 23.1

*** 1.542 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	20.00
2	25.27	19.51
3	27.24	19.17
4	29.23	18.98
5	31.23	18.94
6	33.23	19.06
7	35.21	19.33
8	37.17	19.75
9	39.08	20.32
10	40.95	21.04
11	42.76	21.89
12	44.49	22.89
13	46.15	24.01
14	47.71	25.26
15	49.18	26.62
16	50.53	28.09
17	51.77	29.66
18	51.99	30.00

Circle Center At X = 30.7 ; Y = 45.0 and Radius, 26.0

*** 1.649 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	20.00
2	31.83	19.19
3	33.75	18.62
4	35.72	18.31
5	37.72	18.26
6	39.71	18.47
7	41.65	18.94
8	43.52	19.65
9	45.28	20.61
10	46.90	21.79
11	48.35	23.16
12	49.61	24.72
13	50.65	26.42
14	51.46	28.25
15	51.98	30.00

Circle Center At X = 37.1 ; Y = 33.5 and Radius, 15.3

*** 1.689 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	20.00	20.00
2	21.95	19.56
3	23.93	19.25
4	25.92	19.07
5	27.92	19.02
6	29.92	19.10
7	31.91	19.31
8	33.88	19.65
9	35.82	20.12
10	37.73	20.71
11	39.60	21.43
12	41.42	22.27
13	43.17	23.22
14	44.86	24.29
15	46.48	25.46
16	48.02	26.74
17	49.47	28.12

18	50.83	29.58
19	51.17	30.00

Circle Center At X = 27.7 ; Y = 49.7 and Radius, 30.6

*** 1.712 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	20.00	20.00
2	21.83	19.18
3	23.72	18.53
4	25.65	18.04
5	27.63	17.71
6	29.62	17.57
7	31.62	17.59
8	33.61	17.79
9	35.58	18.15
10	37.51	18.69
11	39.38	19.39
12	41.18	20.25
13	42.91	21.27
14	44.54	22.42
15	46.06	23.72
16	47.47	25.14
17	48.75	26.68
18	49.89	28.32
19	50.85	30.00

Circle Center At X = 30.3 ; Y = 40.7 and Radius, 23.1

*** 1.717 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.

1	26.67	20.00
2	28.53	19.26
3	30.45	18.71
4	32.42	18.36
5	34.41	18.20
6	36.41	18.25
7	38.40	18.50
8	40.35	18.94
9	42.24	19.58
10	44.06	20.41
11	45.79	21.41
12	47.41	22.58
13	48.91	23.91
14	50.26	25.38
15	51.46	26.98
16	52.49	28.70
17	53.11	30.00

Circle Center At X = 34.9 ; Y = 38.1 and Radius, 19.9

*** 1.718 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	20.00
2	28.66	19.86
3	30.66	19.83
4	32.66	19.92
5	34.65	20.13
6	36.62	20.45
7	38.58	20.88
8	40.50	21.43
9	42.39	22.09
10	44.24	22.85
11	46.04	23.72
12	47.78	24.70
13	49.47	25.77
14	51.09	26.94
15	52.65	28.20
16	54.12	29.55
17	54.56	30.00

Circle Center At X = 30.1 ; Y = 54.3 and Radius, 34.5

*** 1.834 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	20.00
2	28.57	19.38
3	30.52	18.92
4	32.49	18.63
5	34.49	18.50
6	36.49	18.54
7	38.48	18.74
8	40.44	19.12
9	42.37	19.65
10	44.24	20.35
11	46.06	21.20
12	47.79	22.20
13	49.43	23.34
14	50.97	24.61
15	52.40	26.01
16	53.71	27.52
17	54.89	29.14
18	55.41	30.00

Circle Center At X = 35.0 ; Y = 42.4 and Radius, 23.9

*** 1.905 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	16.67	20.00
2	18.48	19.16
3	20.35	18.45
4	22.26	17.86
5	24.21	17.41

6	26.19	17.10
7	28.18	16.93
8	30.18	16.89
9	32.18	16.99
10	34.16	17.23
11	36.13	17.61
12	38.06	18.12
13	39.95	18.77
14	41.80	19.54
15	43.58	20.44
16	45.30	21.46
17	46.95	22.60
18	48.51	23.85
19	49.98	25.21
20	51.35	26.66
21	52.62	28.21
22	53.78	29.84
23	53.88	30.00

Circle Center At X = 29.7 ; Y = 45.7 and Radius, 28.9

*** 2.036 ***

1

```
          Y           A     X     I     S           F     T

          0.00     12.50     25.00     37.50     50.00     62.50

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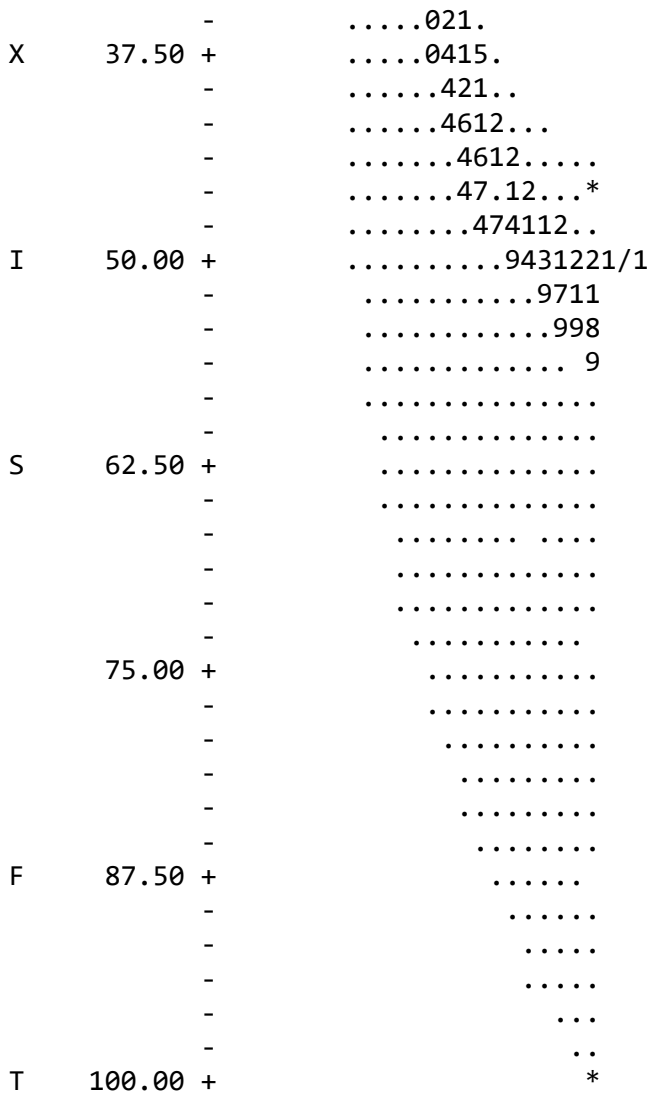
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Shoring - Rev 1

Check Vertical Shoring

Type C Soil

$Depth := 9.5\ ft$

$Spacing := 6\ ft$ Per Tab Data

$Width := 4\ ft$ Per Tab Data

$Vert.Shore := 5\ ft$ Per Tab Data Trench Depth = 6 ft to 9.5 ft

$Vert.Shore := 1.5\ ft$ Per Tab Data Trench Depth = 6 ft max

Check Veretical Shoring

Check Surcharge Loading

$HS20_{front} := 8000\ lb \cdot 0.1 = 800\ lb$ < 20,000 lb per axle AASHTO

$HS20_{center} := 32000\ lb \cdot 0.4 = 12800\ lb$ < 20,000 lb per axle AASHTO

Refer to Surcharge Spreadsheet Calculations

1. Traffic Surcharge = 300 psf per Caltrans Trench & Shoring Manual

2. CAT 315 Excavator = 900 psf

3. Construction Traffic = 100 psf

4. Backhoe = 3,580 psf

K-Rail = 8,000 lb per 20 ft

1. Determine Length, Width, Depth of Shoring Requirement

Length = 12 ft
Width = 8 ft
Depth = 9.5 ft

2. Check Soil Type

Type C Soil per Geotechnical Report and Slope Stability Analysis

3. Determine Horizontal Shore Spacing

6 ft (Over 5 ft to 10 ft)

4. Determine Vertical Cylinder Spacing

Spacing = 3.5 ft (5' Vertical Rail) & 2 ft from top

5. Determine Cylinder Size & Oversize Requirement

2" ID for 8' Wide Trench for 10' or less depth

6. Determine Sheeting Requirement

Not Required for 10 ft or less

7. Stacked Configuration

Shores will not be stacked

May Stagger shores as long as allowable spacing in not exceeded

8. Combined Sloping and Shoring Configuration

No back slopes

9. Single Hydraulic Shore

Use 18" vertical rail, Cylinder Block, 2" Hydraulic Cylinder

Ht = 6 ft Max
From Top: 1 ft min, 2 ft max
From Bottom: 4 ft max from center of rail to BOE
Shore Spacing: 8 ft
Sheeting: Not required in Type C soil when less than 10 ft depth

Hydraulic Vertical Shores

Check Sheeting Placed Parallel to Vertical Rail

$D_1 := 2\ ft$ Depth to Top Strut

$D_2 := 5.5\ ft$ Depth to Mid Strut

$P_1 := 500\ \frac{lb}{ft^2}$ Loading at D1

$P_2 := 500\ \frac{lb}{ft^2}$ Loading at D2

$W := P_1 = 500\ \frac{lb}{ft^2}$ Avg loading on panel, used for end plate loading

$a := 0.6$ Soil Arching factor for sheeting or lagging per Caltrans Shoring Manual

$W_d := P_1 \cdot a = 300\ \frac{lb}{ft^2}$ Design Soil Load on Shoring

$w_S := 4\ ft$ Sheeting Width

$w_R := 0.67\ ft$ Rail Width

$Arch := 2$ Rail Width Arch Factor

$L := 1.33\ ft$ Span of end panel sheeting

$M_u := \frac{W \cdot L^2 \cdot a \cdot 1\ ft}{2} = 265.335\ lb \cdot ft$ Sheeting max Moment

$V_u := \frac{W \cdot a \cdot L \cdot ft}{2} = 199.5\ lb$ Sheeting max Shear

Check Plywood Sheeting

$Ldf := 1.25$ Load Duration Factor

Per NDS Specification Table 1A

$F_b := 1545\ \frac{lb}{in^2}$ Bending Stress

$F_v := 57\ \frac{lb}{in^2}$ Rolling Shear

$E := 1500000\ \frac{lb}{in^2}$ Modulus of Elasticity

$F'_b := F_b \cdot Ldf = 1931\ \frac{lb}{in^2}$ Allowable Bending Stress

$F'_v := F_v \cdot Ldf = 71.25\ \frac{lb}{in^2}$ Allowable Bending Stress

$t := 1.125\ in$ Sheeting Thickness

$n := 2$ Number of Sheets

Section Properties

$KS := 0.955\ in^3$ $I := 0.623\ in^3$

$lb.Q := 8.841\ in^2$

$f_b := \frac{M_u}{KS \cdot n} = 1667\ \frac{lb}{in^2}$ < F'b OK

$f_v := \frac{V_u}{lb.Q \cdot n} = 11\ \frac{lb}{in^2}$ < F'v OK

$\Delta := \frac{W \cdot L^4}{8 \cdot E \cdot I} = 0.03\ in$ < 1 in OK

Check Steel Plate Sheeting

$Ov := 1.33$ Temporary Loading Overstress Factor

$\Omega := 1.67$ ASD bending/shear reduction factor

$F_y := 36000\ \frac{lb}{in^2}$

Bending Stress

$S_{req} := \frac{\Omega \cdot M_u}{Ov \cdot F_y} = 0.111\ in^3$

Shear Stress

$$A_{req} := \frac{\Omega \cdot V_u}{0.6 \cdot Ov \cdot F_y} = 0.012\ in^2$$

1/2" Steel Plate

$$w_{plate} := 12\ in$$

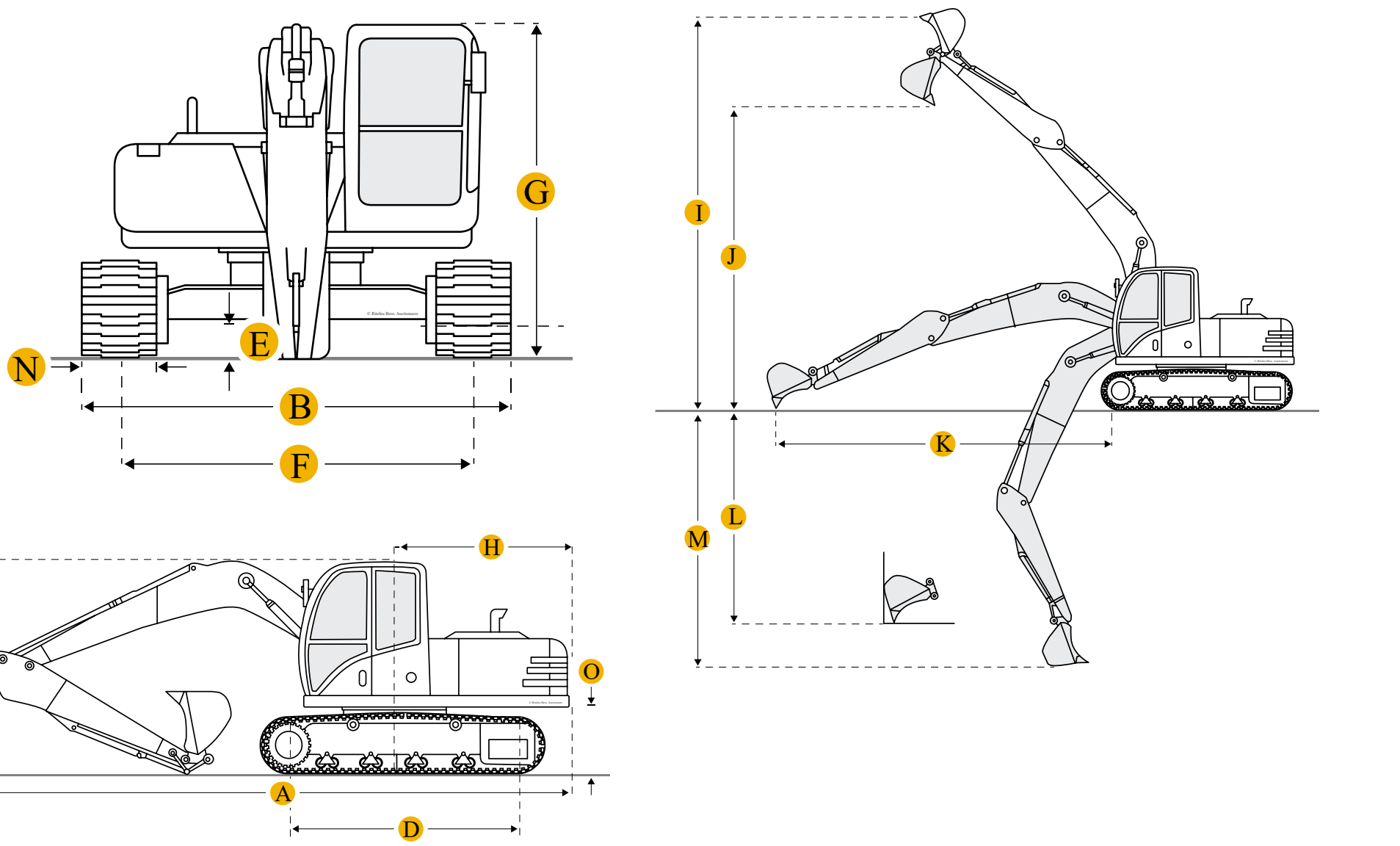
$$ht_{plate} := 0.5\ in$$

$$S_{plate} := \frac{w_{plate} \cdot ht_{plate}^{\ 2}}{6} = 0.5\ in^3 \qquad > \text{ Sreq OK}$$

$$S_{plate} := w_{plate} \cdot ht_{plate} = 6\ in^2 \qquad > \text{ Areq OK}$$

Reference Documents

Caterpillar 315C L Hydraulic Excavator



Units Imperial Metric

Dimensions

Boom/Stick Option (Hex) 1

A	**Shipping Length Of Unit**	27.83 ft in
C	**Shipping Height Of Unit**	9.42 ft in
I	**Max Cutting Height**	28.67 ft in
J	**Max Loading Height**	20.18 ft in
K	**Max Reach Along Ground**	27.58 ft in
L	**Max Vertical Wall Digging Depth**	16.18 ft in
M	**Max Digging Depth**	18.75 ft in

	Boom/Stick Option (Hex) 1	Boom 16'9" (5100mm) / Stick Length - 7' 5" (2250mm)

Boom/Stick Option (Hex) 2

A	**Shipping Length Of Unit**	27.92 ft in
I	**Max Cutting Height**	29.25 ft in
C	**Shipping Height Of Unit**	9.42 ft in
J	**Max Loading Height**	20.75 ft in
K	**Max Reach Along Ground**	28.67 ft in
L	**Max Vertical Wall Digging Depth**	17.5 ft in
M	**Max Digging Depth**	19.83 ft in
	Boom/Stick Option (Hex) 2	Boom 16'9" (5100mm) / Stick Length - 8' 6" (2600mm)

Boom/Stick Option (Hex) 3

A	**Shipping Length Of Unit**	28 ft in
I	**Max Cutting Height**	29.42 ft in
J	**Max Loading Height**	21 ft in
C	**Shipping Height Of Unit**	9.83 ft in
K	**Max Reach Along Ground**	30 ft in
L	**Max Vertical Wall Digging Depth**	18.25 ft in
M	**Max Digging Depth**	21.5 ft in
	Boom/Stick Option (Hex) 3	Boom 16'9" (5100mm) / Stick Length - 10' 2" (3100mm)

Dimensions

E	**Ground Clearance**	1.5 ft in
G	**Height To Top Of Cab**	9.42 ft in
B	**Width To Outside Of Tracks**	8.5 ft in
D	**Length Of Track On Ground**	10.42 ft in
H	**Tail Swing Radius**	8 ft in

Undercarriage

N	**Shoe Size**	24 in

Drawbar Pull	34620 lb
Max Travel Speed	3.4 mph
Ground Pressure	5.66 psi

Specifications

Engine

Number Of Cylinders	4
Engine Make	2236
Engine Model	3046T
Net Power	110 hp
Gross Power	115 hp
Power Measured @	1800 rpm
Displacement	305 cu in

Operational

Operating Weight	36930 lb
Fuel Capacity	75 gal
Cooling System Fluid Capacity	5.8 gal
Hydraulic System Fluid Capacity	50.2 gal
Engine Oil Capacity	5 gal
Operating Voltage	24 V
Swing Drive Fluid Capacity	0.8 gal
Alternator Supplied Amperage	50 amps
Hydraulic System Relief Valve Pressure	4980 psi
Hydraulic Pump Flow Capacity	39.6 gal/min

Swing Mechanism

Swing Torque	31700 lb ft
Swing Speed	10.2 rpm

Buckets

Reference Bucket Capacity	0.8 yd3
Minimum Bucket Capacity	0.5 yd3
Maximum Bucket Capacity	1.2 yd3

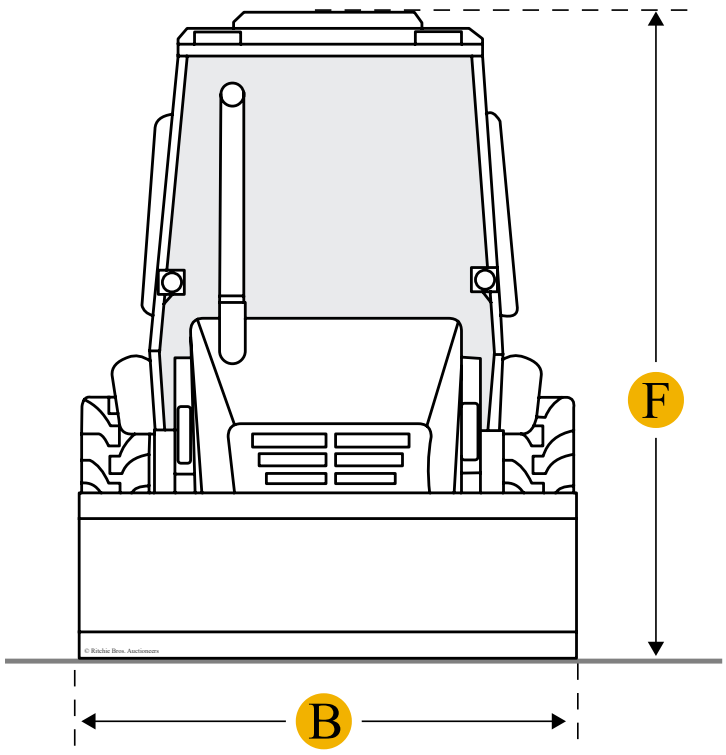
Compare similar models

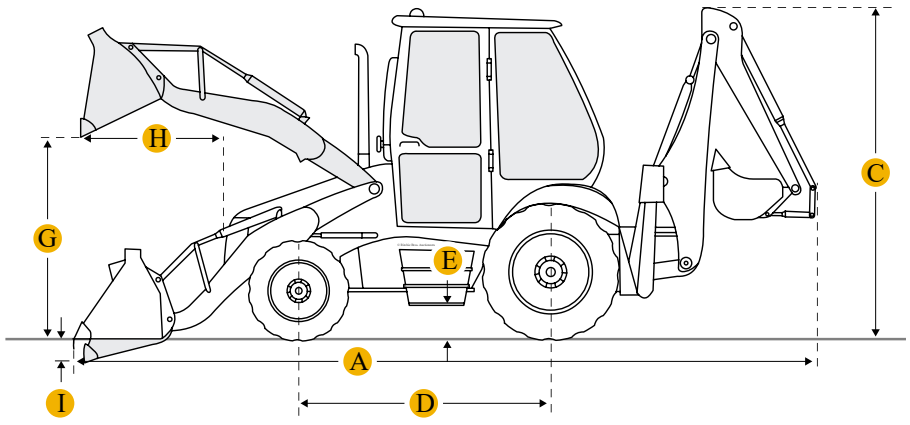
	Volvo EC140LCM	John Deere 135C RTS	Terex TXC180LC-2
Net Power	98.6 hp	88 hp	118 hp
Operating Weight	31812.8 lb	30441.5 lb	38933 lb
Reference Bucket Capacity	0.7 yd3	0.9 yd3	1 yd3

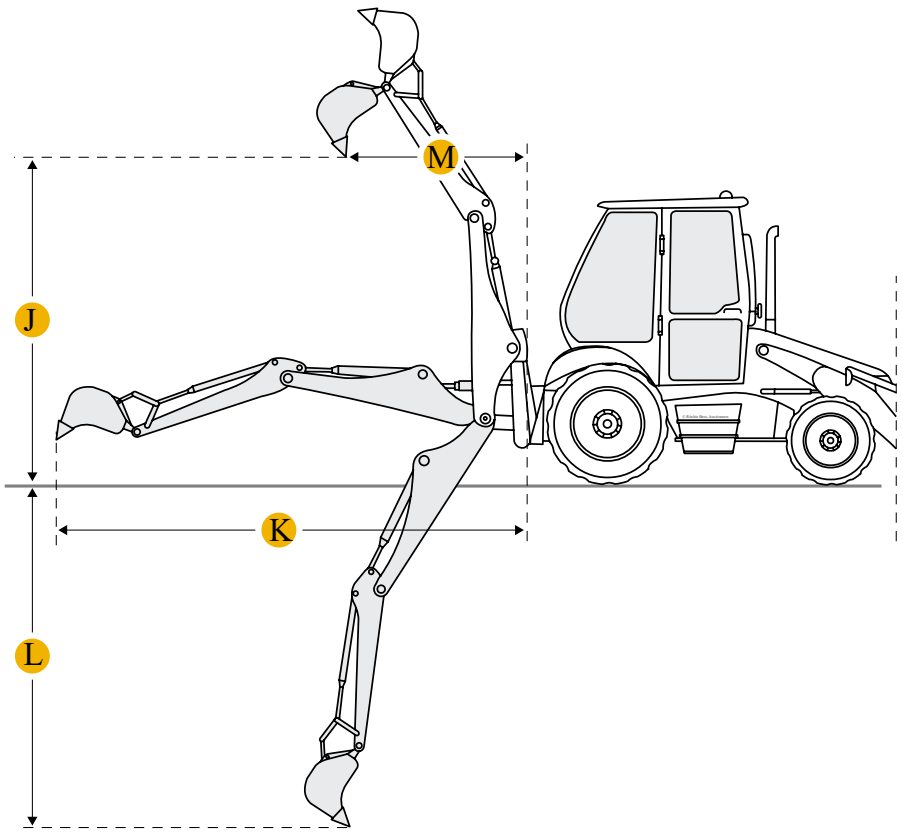
Compare

Find Caterpillar 315C L Hydraulic Excavator for Sale

Caterpillar 420E Loader Backhoe







Units Imperial Metric

Dimensions

Backhoe

J	**Load Height - Std**	11.92 ft in
K	**Reach From Swivel - Std**	18.42 ft in
L	**Dig Depth - Std**	14.34 ft in
M	**Reach At Load Height - Std**	5.84 ft in
	Load Height - Ext	13.59 ft in
	Bucket Dig Force - Ext	13863 lb

Bucket Dig Force - Std	13875 lb
Dig Depth - Ext	17.92 ft in
Reach At Load Height - Ext	9.09 ft in
Load At Max Lift - Ext	2288 lb
Load At Max Lift - Std	3511 lb
Reach From Swivel - Ext	21.84 ft in

Dimensions

A	**Transport Length**	24.1 ft in
B	**Transport Width**	8 ft in
C	**Transport Height**	11.75 ft in
D	**Wheelbase**	7.25 ft in
E	**Ground Clearance**	1.05 ft in
	Height To Top Of Suspended Cab	9.25 ft in

Loader

G	**Clearance At Max Dump Height**	8.42 ft in
H	**Reach At Max Dump Height**	2.84 ft in
I	**Dig Depth**	4 in
	Bucket Breakout Force	10242 lb
	Bucket Width	7.42 in
	Bucket Capacity	1.25 yd3
	Lift Capacity At Full Height	6457 lb

Specifications

Engine

Engine Make	2236
Engine Model	C4.4 DIT
Gross Power	101 hp
Net Power	93 hp

Power Measured @	2200 rpm
Torque Measured @	1400 rpm
Net Torque Rise	36 %
Net Max Torque	301 lb ft
Displacement	268 cu in

Operational

Fuel Capacity	38 gal
Operating Weight 4wd	16115.8 lb
Max Weight	24250.9 lb
Hydraulic System Fluid Capacity	20.9 gal
Oil System Fluid Capacity	2 gal
Cooling System Fluid Capacity	4.4 gal
Transmission Fluid Capacity	5 gal
Front Axle Fluid Capacity	2.9 gal
Rear Axle Fluid Capacity	4.4 gal
Turning Radius	17.8 ft in
Tire Size Front - 2wd / 4wd	11L-16 F-3/12.5/80-18 (10ply) 1-3 Super Traction
Rear Tires Size 2wd/4wd	19.5L-24 (12 ply) R4 ATU/ 19.5L-24 (12 ply) IT 525
Operating Voltage	12 V

Transmission

Number Of Forward Gears	4
Number Of Reverse Gears	4
Max Speed - Forward	24.9 mph
Max Speed Reverse	24.9 mph

Hydraulic

Pump Type	variable-flow, axial piston
Pump Flow Capacity	43 gal/min
Relief Valve Pressure	3611 psi

TABULATED DATA

VERTICAL ALUMINUM HYDRAULIC SHORING

2025

REGISTERED PROFESSIONAL ENGINEER
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NO. 85366
CIVIL
STATE OF CALIFORNIA

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SCOTT@OCSTRUCTURAL.COM

EFFECTIVE DATE: JANUARY 1, 2025

Corporate Office

Trench Shoring Company
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TRENCH SHORING COMPANY™

"Commitment To Safety & Service"
Since 1973

Contents

About Trench Shoring Safety Vertical Aluminum Hydraulic Shore Tabulated Data

Vertical Aluminum Hydraulic Shores are built by several major manufacturers all with similar parts and their own version of manufacturer's tabulated data. Some parts are also interchangeable. Due to the interchangeability and variety of tabulated data available, Trench Shoring Company has developed this set of universal tabulated data under;

> Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches
>
> 1926.652(c)(3)-**Option (3)** - Designs Using other Tabulated Data.
>
> 1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

Note that **manufacturer's** tabulated data is developed under;

> 1926.652(c)(3)-**Option (2)** - Designs Using Manufacturers Tabulated Data.

Use of this Trench Shoring Universal Vertical Aluminum Hydraulic Shore tabulated data will result in selection of a system that, at a minimum, conforms to manufacturers tabulated data developed by;

- Allied Tren-Shore
- Cerda
- Efficiency Corporation
- GME Corporation
- Kundle Tren-Shore
- Pacific Shoring, LLC
- Quick Shore
- Safety Shore
- Speed Shore Corporation

In some cases, this tabulated data will be more restrictive than the manufacturers version; however it is always less restrictive than the OSHA Appendix D version. The competent person utilizing this tabulated data should have a clear understanding that he is selecting a shoring system under Option 3, Designs Using other Tabulated Data.

Vertical Aluminum Hydraulic Shores Description

Vertical Aluminum Hydraulic Shores are constructed from standard duty or heavy-duty vertical rails attached to 2" hydraulic cylinders. The rail lengths vary from 18" to 20 ft long. The cylinders can extend from 17" to 88". Cylinder extensions can be added to obtain lengths to 15'. The hydraulic cylinder consists of a 2" OD piston, a 2" ID x 3/16" barrel, and a 3" OD x 3/16" oversleeve. The cylinders provide a 23,000 lb safe working load for cylinder bulging at a 1.5 factor of safety. At lengths 8 ft to 12 ft an additional 3" round aluminum over sleeve is required and at 12 ft to 15 ft a 3.5" x 3.5" x 3/16" wall square steel oversleeve over the 3" round aluminum or a 3" x 3/16" round steel oversleeve only is required to prevent buckling. Based on the principal of soil arching Vertical Aluminum Hydraulic Shores can be spaced horizontally as much as 8 ft apart without sheeting on the trench walls. Plywood sheeting is used either attached or separate behind the rails to prevent the trench walls from sloughing or raveling.

Vertical Aluminum Hydraulic Shores are installed from outside the excavation. The shores are hinged so that they can be folded when lowered into the trench and then opened up and pressurized with a hydraulic hand pump. The hydraulic fluid is water soluble, environmentally safe, and biodegradable. Rails 5 ft long and less can typically be moved, set, and removed by a two man crew. Larger shores are typically handled by backhoe, loader or boom truck.

Vertical Aluminum Hydraulic Shores are typically used in linear trench applications in OSHA Type A, Type B, and Type C-60 soils at depths to 23 ft and trench widths to 15 ft. Constraints such as the requirement that the bottom cylinder be set a maximum of 4 ft from the bottom of the excavation , bedding requirements, and pipe wall thicknesses limits the pipe diameter or duct height to approximately 36" maximum. The 8 ft maximum horizontal spacing limits large pipe lengths to approximately 8 ft, while smaller diameters with longer lengths to 20 ft such as PVC sewer and water lines can be maneuvered between the cylinders to fit into the trench.

General Information for Use of Vertical Aluminum Hydraulic Shores

1. The vertical aluminum hydraulic shoring system tabulated here is based on requirements of Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches

   1926.652(c)(3)-Option (3) - Designs Using other Tabulated Data.

   1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

   All provisions of Subpart P apply when utilizing this tabulated data. The contractor's competent person shall use this data to select:

   - allowable trench depth
   - vertical and horizontal shore spacing
   - proper oversleeve requirement based on trench width
   - plywood use requirements

2. The competent person utilizing this tabulated data shall be experienced and knowledgeable of all requirements of Subpart P, and trained in the use and safety procedures for aluminum vertical hydraulic shores.

3. For specific Subpart P requirements regarding aluminum hydraulic shoring that is in addition to the tabulated data requirements, see OSHA Subpart P additional requirements related to aluminum hydraulic shoring. Some of these requirements are listed at the end of this document, See **Header Pg. C-3.**

4. Use of this tabulated data is dependent on first classifying the soil in accordance with OSHA Appendix A, Soil Classification. Classification shall be just prior to installing Vertical Hydraulic Shoring. Soil conditions may change at a later date and require Vertical Hydraulic Shoring to be reset at a different spacing.

5. Hydraulic vertical shores are tabulated based on the effect of a 20,000 lb surcharge load, or an imposed load of a 2 ft spoil pile, set back 2 ft from the edge of the trench and the equivalent weight effect of the OSHA soil type. See classification of soil types, note 2.

6. The depth and spacing given in **Table 1** governs the use of Vertical Hydraulic Shores and not tabulations given in OSHA Appendix C

7. Faces of excavations shall be strait and near vertical. Sides of the hydraulic shore shall bear continuously and firmly against firm soil or solid filler, **Figure 1**.

8. Shores shall be set near vertical; however, they may be set as much as 30 degrees from vertical provided that vertical and horizontal spacing is maintained.

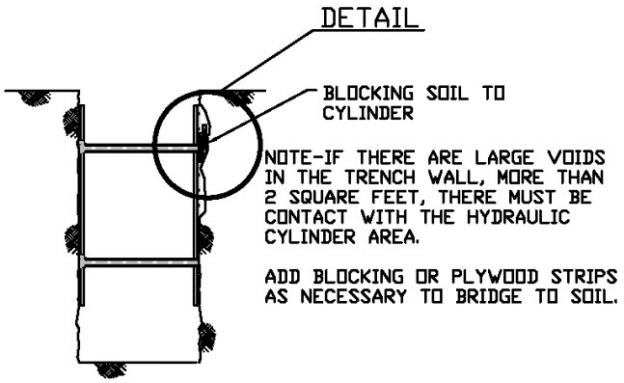


Figure 1. - See note 7

9. Vertical Hydraulic Shores may be stacked or longitudinally lapped, **Figure 2**, provided shore spacing is maintained. **DO NOT** butt rails back to back to span a wider excavation.

10. Shores shall be installed and removed from outside the trench, see installation and removal procedure.

11. Single cylinder shores may be used in place of multiple cylinder shores provided that horizontal and vertical spacing is maintained.

12. The competent person shall continually monitor the shored excavation for changed conditions such as water seepage, soil movement cracks at the surface, sloughing or raveling, proper surcharge load weight less than 20,000 lbs with proper set back and for damaged shores.

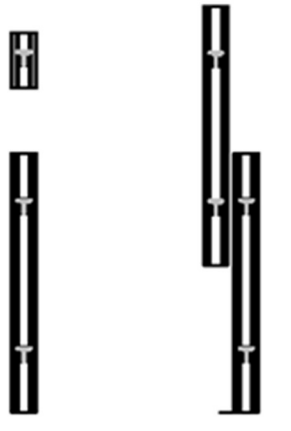


Figure 2. - See note 9

13. The excavation shall be free of water when using hydraulic shores. Surface water shall be diverted away from the excavation and any water must be pumped out of the base of excavation.

14. Workers shall always enter, exit, and work inside the shored area of the trench.

15. When shores are used for a trench at the base of a benched or sloped grade steeper than three horizontal to one vertical (3H:1V), the overall height from the top of slope to the base of excavation shall be used to determine the excavation height per Table 1. Full length roll off protection shall be provided at the top of excavation.

16. Trenches maximum 12 ft long or horizontal spacing 4 ft or less shall have a minimum of 2 shores set in accordance with spacing requirements. Longer trenches shall have a minimum of 3 shores set at required spacing. See **Figure 3.**

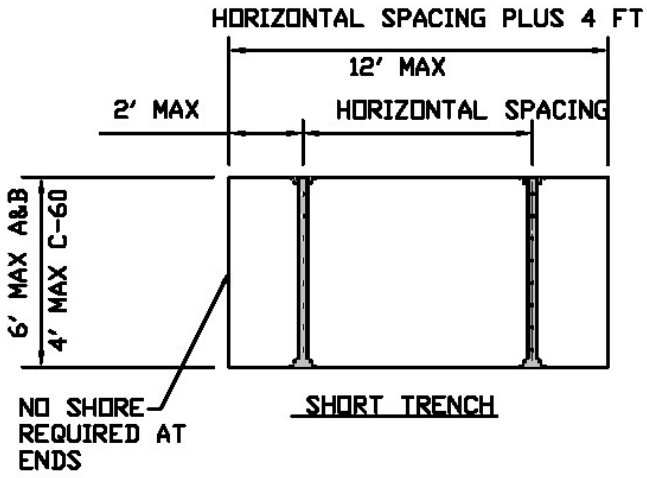


Figure 3. – Short Trench, **See Note 16**

17. Trenches less than or equal to 6 ft deep require only one hydraulic cylinder per vertical spacing increment. The cylinder shall be placed no more than 4ft from the bottom of excavation, and no more than 2 ft below the top of excavation per **Figure 4**. Horizontal spacing remains unchanged from **Table 1.** Competent person to review **Table 1, Note 2** for sheeting requirements.

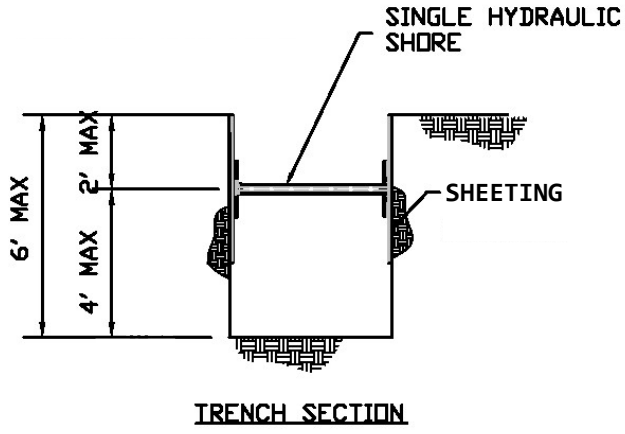


Figure 4. – Single Shore Set-up, **See Note 17**

Classification of Soil Types

1. Soil classification shall be in accordance with OSHA Appendix A and classified just prior to installing hydraulic vertical shores. Soil conditions may change at a later date and require hydraulic vertical shores to be reset at a different spacing.

2. The equivalent weight of OSHA soil types* is assumed to be as follows:

   - OSHA Type "A" Soil 25 PSF per ft of depth
   - OSHA Type "B" Soil 45 PSF per ft of depth
   - Type "C-60" Soil 60 PSF per ft of depth**
   - OSHA Type "C" Soil 80 PSF per ft of depth

   * These equivalent weights were adapted from OSHA 1926 Subpart P App C, Timber Shoring for Trenches, Tables C-1.1, C-1.2, and C-1.3

   ** Type C-60 soil is not identified or classified in OSHA Appendix A

3. Type C-60 soil is;
   - soil that does not qualify as OSHA Type A, or Type B, can be cut with vertical walls and will stand up long enough to safely insert and pressurize the hydraulic shore,
   - the water table must be at or below the bottom of the excavation with no visible water seeping from the sides of the excavation

4. Hydraulic shores shall not be used in OSHA Type C-80 Soil

Vertical Aluminum Hydraulic Shore Selection Guide

Table 1. Vertical Hydraulic Shore Selection Guide[1]

Depth of Trench (ft)	Hydraulic Cylinder Requirements[5]					Sheeting[2]
	Max Horizontal Cylinder Spacing (ft)	Max Vertical Cylinder Spacing (ft)	Cylinder Type per Width of Excavation (ft)			
			to 8'	8' to 12'	12' to 15'	
TYPE "A" Soil						
to 10'	8'	4'	2" ID	2" ID	2" ID[6]	(2)
10' to 15'	8'	4'	2" ID	2" ID	2" ID[6]	(2)
15' to 20'	8'	4'	2" ID	2" ID[6]	2" ID[6]	(2)
20' to 25'	8'	4'	2" ID	2" ID[6]	2" ID[6]	(2)
TYPE "B" Soil						
to 10'	8'	4'	2" ID	2" ID	2" ID[6]	(2)
10' to 15'	7'	4'	2" ID	2" ID	2" ID[6]	(2)
15' to 20'	6'	4'	2" ID	2" ID[6]	2" ID[6]	(2)
20' to 25'	5'	4'	2" ID	2" ID[6]	2" ID[6]	(4)
TYPE "C-60" Soil						
to 10'	6'	4'	2" ID	2" ID	2" ID[6]	(2)
10' to 15'	5'	4'	2" ID	2" ID	2" ID[6]	(3)
15' to 20'	4'	4'	2" ID	2" ID[6]	2" ID[6]	(3)
20' to 25'	3'	4'	2" ID	2" ID[6]	2" ID[6]	(4)

Table 1 Notes

1. Soil shall first be classified in accordance with OSHA Appendix A Soil Classification for use with this selection guide. Type C-60 soil is OSHA Appendix A Type C soil that will stand up long enough to install the hydraulic shores.

2. Sheeting is required at any depth whenever sloughing or raveling occur. If sloughing or raveling occurs between sheeting, decrease spacing until it is prevented. See **Table 2** for allowable sheeting types. Sheeting may be attached to jack or set into trench separately.

Table 2. Allowable Sheeting(2)

Plywood	Other Materials
3/4" Finn Form	Steel plate 1/2" min thickness (Grade A36)
3/4" Omni Form	Steel sheet piles panels
3/4" Plywood, Class 1 Exterior	Aluminum sheet pile panels
3/4" HDO, High Density Overlay	Buildable box panels
3/4" 14 Ply Artic White Birch	**4" Timber Lagging Set Horizontal**
1-1/8" CDX	Spacing : Type A - 8ft, Type B - 6ft, Type C - 4ft
2ea sheets of 3/4" CDX (back to back)	Grade : Douglas Fir #2 or Oak

3. Sheeting is required at this depth and shall extend to within 2ft of the base of excavation.

4. Sheeting is required at this depth and shall extend to the bottom of the excavation.

5. This tabulation includes lateral loading from equipment weighing 20,000 lbs or less and a maximum 2 ft high spoil pile set back a minimum of 2 ft. The competent person shall determine the effect of all other surcharge loads and reduce hydraulic shore spacing as required to resist those loads.

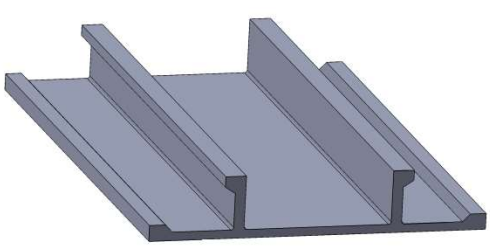
6. Use 2-inch inside diameter cylinders with 3-inch aluminum oversleeves and standard extension units as required for trench width (8 ft to 12 ft width). Oversleeves for models larger than 88-56 (12 ft to 15 ft width) are aluminum or steel 3.5 in. x 3.5 in. x 3/16 in. wall over 3 in. round standard aluminum pipe or a steel 3 in. x 3 in. x 3/16 in. full length. Round oversleeve members with an equivalent diameter and wall thickness may be used as a substitute to the square sections previously noted.

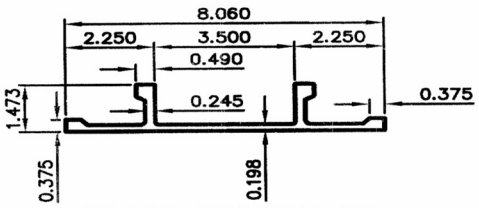
7. Not included in Table 1 is: GME hydraulic vertical shore Model EXT 180 - 216 which may be used for trench widths 15 ft to 18 ft. This aluminum shore length extension must include a A35 Steel 3 in diameter Sch 80 Pipe Oversleeve. The maximum vertical cylinder and sheeting requirements per depths shown on Table 1 apply to this shore. The following maximum horizontal cylinder spacing shall be used:
   - Type “A” Soils – 8 ft maximum horizontal spacing
   - Type “B” Soils – 6 ft maximum horizontal spacing
   - Type “C-60” Soils – 4 ft maximum horizontal spacing

Vertical Aluminum Rail Specification

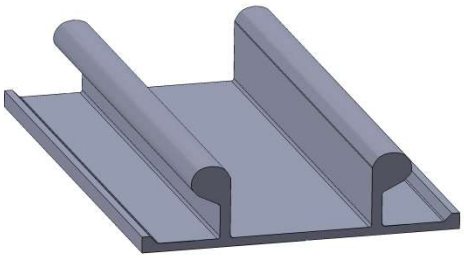
VERTICAL RAIL SPECIFICATION SHEET

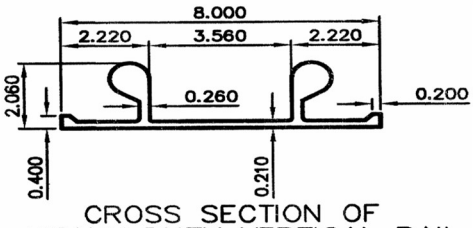
SECTION PROPERTIES	STANDARD RAIL	HEAVY DUTY RAIL
MATERIAL	ALUMINUM	ALUMINUM
ALLOY	6061–T6	6061–T6
AREA	2.45 in^2	3.47 in^2
WEIGHT	2.94 plf	4.17 plf
SECTION–MODULUS – TOP (LEG SIDE)	0.44 in^3	1.25 in^3
SECTION–MODULUS – BOTTOM (BLADE SIDE)	1.29 in^3	2.38 in^3
EQUIVALENT TIMBER SIZE * (#2 DOULAS FIR)	3x10 (FLAT)	4x10 (FLAT)



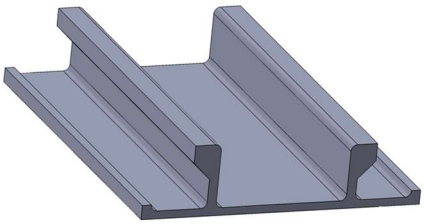


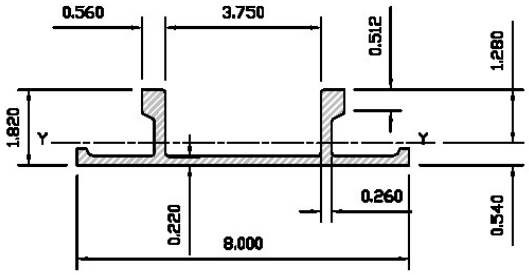
CROSS SECTION OF
STANDARD VERTICAL RAIL





CROSS SECTION OF
HEAVY DUTY VERTICAL RAIL





ALLIED HEAVY DUTY
TRENCH JACK RAIL

AREA	=3.08 IN^2
WEIGHT	=3.52 PLF
MOMENT OF INERTIA	=0.52 IN^4
SECTION MODULUS TENSION	=0.99 IN^3
SECTION MODULUS,COMPRESSION	=2.37 IN^3

Typical Vertical Aluminum Hydraulic Rail Dimensions

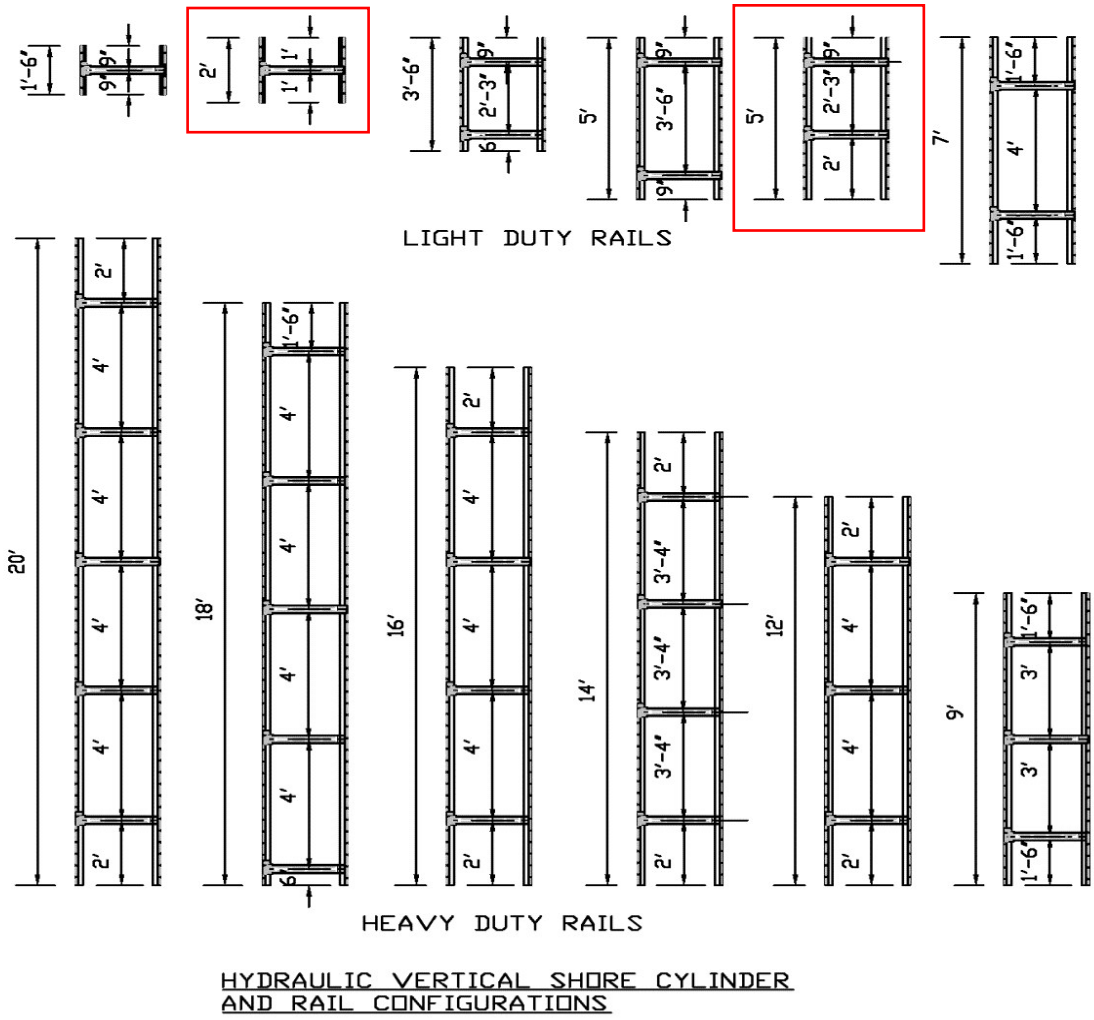


Figure 5. – Rail Dimensions

Note - Custom rail and cylinder spacing available upon request, however when using them with this tabulated data all spacing requirements of the data shall be met.

Hydraulic Cylinder Specifications

To configure for trench width, the proper cylinder range, extension if necessary, and oversleeve must be determined. **Table 3** lists some of the available cylinder ranges and some of the ranges with extensions.

Table 3. Hydraulic Cylinder Range

Extension	Range		Extension	Range	
	Cylinder	w/ Extension		Cylinder	w/ Extension
(in)	(in)	(in)	(in)	(in)	(in)
11	17 - 27	28 - 38	21	40 - 64	61 - 85
22		39 - 49	42		82 - 106
33		50 - 60	56		96 - 120
11	22 - 36	33 - 47	24	52 - 88	76 - 112
22		44 - 58	42		94 - 130
33		55 - 69	56		108 - 144
15	28 - 46	43 - 61	72	52 - 88	124 - 160
30		58 - 76	82		132 - 168
45		73 - 91	92		144 - 180
18	34 - 55	52 - 73	128		180 - 216
36		70 - 91			
54		88 - 109			

Oversleeve requirements are given in **Table 4** and shown in **Figures 6, 7, 8.**

Table 4. Oversleeve Requirements

Trench Width	Oversleeve Required
to 8 ft	No oversleeve required
8 ft to 12 ft	3 in. x 3/16 in. round aluminum oversleeve
12 ft to 15 ft	Steel or aluminum 3.5 in. x 3.5 in. x 3/16 in. wall over 3 in. round standard aluminum pipe or a steel 3 in. x 3 in. x 3/16 in. full length
15 ft to 18 ft	3 in. Sch 80 steel pipe (Grade A35)

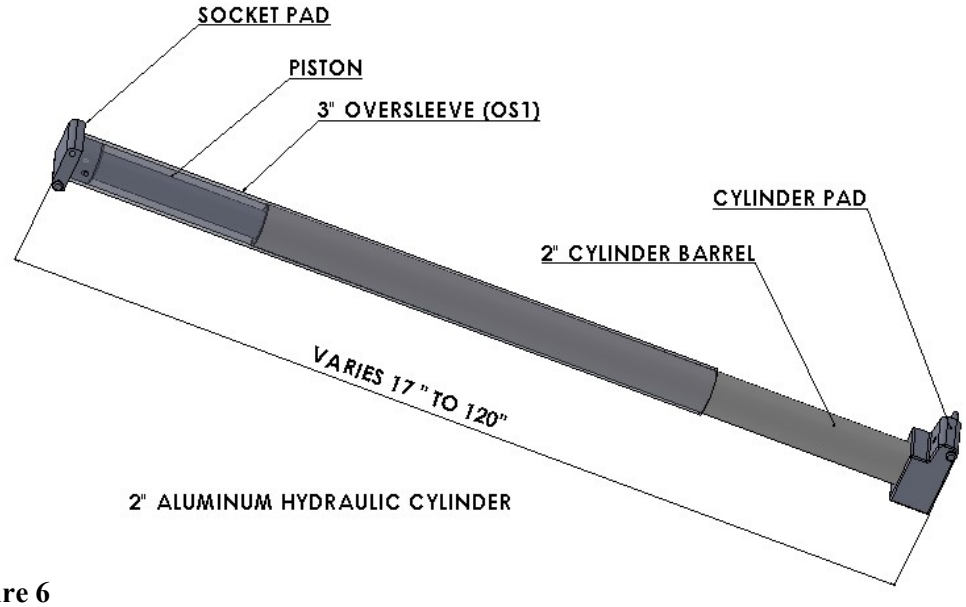


Figure 6

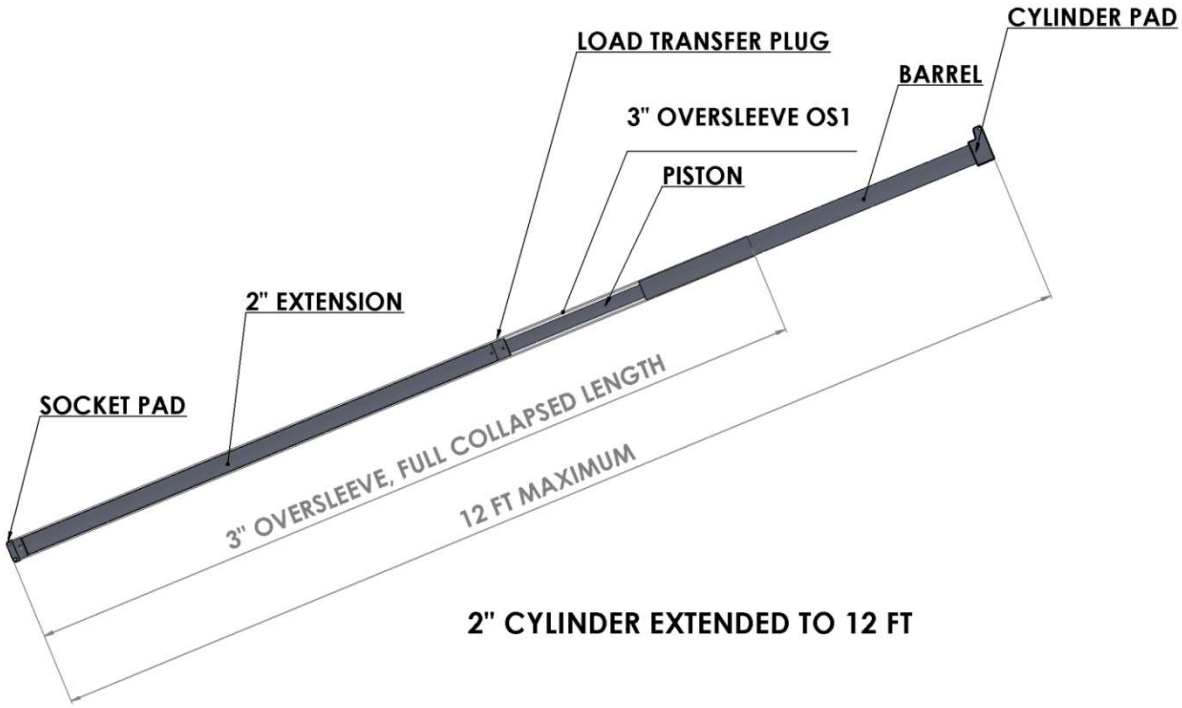


Figure 7

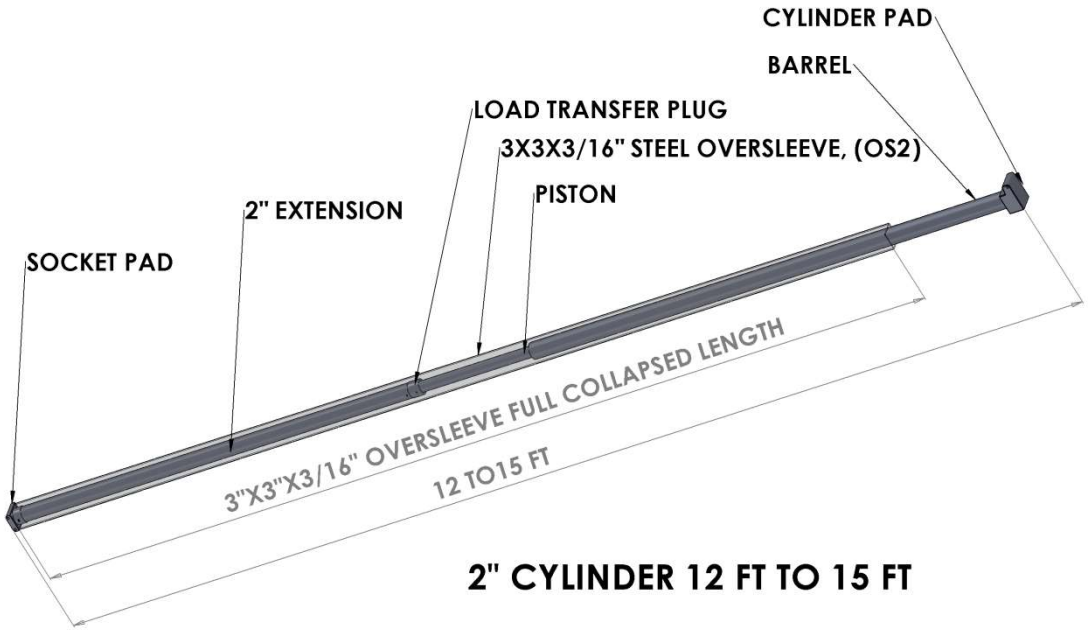


Figure 8

Aluminum Hydraulic Shore Installation and Removal Procedure

Required for installation

- Vertical Hydraulic Jack
- Pump with fluid and operating pressure gauge
- Release tool

Installation Procedure

Step 1 Attach hydraulic hose to hydraulic fitting on shore. Open the valve on the pump can so that the shore cannot be pressurized. Set plywood, if required, into trench if not attached to the shore.

Step 2 Lower shore into trench with folded up blade toward opposite trench wall and hydraulic fitting toward adjacent wall. After the shore is set to elevation, hold adjacent blade in place with release tool and let go of opposite blade allowing it to completely unfold and lock into position. In order for the shore to lock into position, the cylinder must be 90 degrees from the blade. Heavy or wide shores that cannot be safely lifted by one person should be set in with lifting equipment such as backhoe, boom truck or crane.

Step 3 Close the valve on the pump can and pressurize the hydraulic shore to between 750 and 1500 psi. Pressure gauge should hold at pressure and not indicate any loss of pressure.

Step 4 Remove the hydraulic hose by prying off with release tool. Clip hose to top of pump to prevent contamination by dragging it in the dirt. Move to next shore location and repeat process.

While trench shores are in place

- Check, at a minimum, at start of shift for loose shores. This can be done by tapping the top of the shore with a metal rod; it will sound loose, sort of like kicking a tire to see if it is flat. Remove and replace loose shores.
- Check for sloughing or raveling. If it is occurring, sheeting must be used.
- Confirm that soil classification has not changed.

Required for Removal

- Vertical Hydraulic shore
- Release tool
- Removal tool or lifting equipment

Removal Procedure

Step 1 Place release tool over hydraulic fitting and removal hook in handle on opposite blade.

Step 2 Push release tool away to release fluid and pressure. Pull up on the removal hook to fold the shore up and then lift it out of trench.

Note - Depending on the length of the shore and width of the trench different installation procedures may be used. It is the responsibility of the contractor and his competent person to establish a safe installation and removal procedure for each application. All trench shore installers shall be instructed in the procedure prior to installing the shores.

Pulling Hydraulic Shores without releasing pressure first will damage the shore.

Hydraulic Shore Safety Issues

Hydraulic shores provide a relatively fast way to support an unshored trench making it an optimal equipment to assist in overall excavation safety. Utilizing trench jacks for excavation support still has safety hazards that users should understand and protect workers from. Although rare, it is important for workers to be informed of all the risks of utilizing hydraulic shores as a method of protection. The following are hazards and safety procedures associated with the use of Vertical Aluminum Shores:

- Heavy lifting of hydraulic shore equipment – An 8 ft long 52-88 trench jack weighs approximately 120 lbs. A two-man team can safely lift, set, and remove this jack from a trench. Workers shall properly asses the weight of the equipment and use machinery like a backhoe to set larger shores.
- Overhead lifting hazard – Hydraulic jacks that are hoisted by machinery and slings present an overhead fall hazard. Tag lines can be used to assist in a safe hoist while workers should avoid standing under or directly adjacent to the hoisted load.
- Finger and hand protection – Trench jacks have multiple pinch points between the cylinder and the rail as shown in Figure 9. Fingers can be crushed or severed under the cylinder block and rail leg when jacks are opened or closed. Workers shall be properly trained to handle the proper installation and removal of hydraulic jacks. Lift handles shall be used when moving shores by hand and if hand placement on the rail is necessary a minimum of 12 in. offset from the block is recommended.

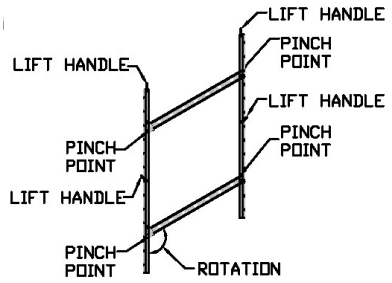


Figure 9 – Pinch Points

- Soil arch removal – Prior to setting the jacks in place, soil arching has not been achieved and the excavation side wall is not yet stable. Additional weight from installation activity can cause a partial bank collapse and trench jack installation should closely follow the excavation activity. As shown in Figure 10, removal of intermediate jacks during work production removes the arch column and soil failure will follow. Workers shall never be located within the trench if proper jack spacing and installation cannot be maintained. During backfill operations, jacks should be removed only in areas adjacent to compacted soil. Remote backfill equipment such as remote operated compactors must be used outside of shored area. Workers and equipment shall maintain a safe distance away from any unshored edges.

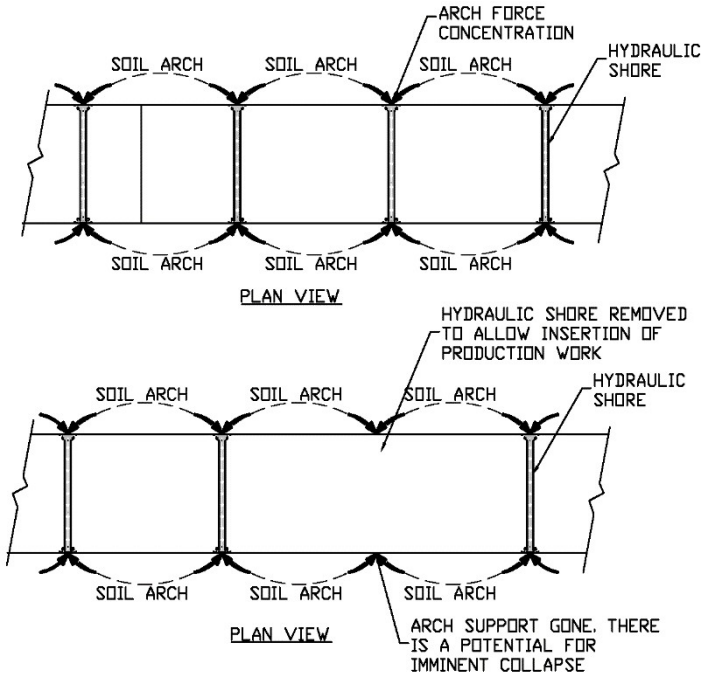
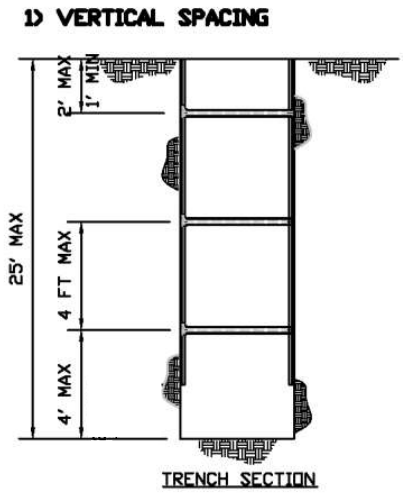


Figure 10 – Soil Arching Principal

- Surcharge loading – It is the competent persons responsibility to ensure equipment over 20,000 lbs and large spoils over 2 ft high are not overloading the upper trench jacks. As stated in soil arch removal above, one intermediate cylinder failure can cause a progressive failure to the bottom of the trench. Keep additional surcharge loads away from the trench walls and spread loads using timber pads or steel plates. Adjust the horizontal jack spacing as needed and closely monitor any locations where surcharge loading is present.

APPENDIX A - Vertical Aluminum Hydraulic Shoring Quick Use Guide

This quick use guide provides a step-by-step methodology for determining the proper configuration of a vertical aluminum hydraulic shoring system. Proper use of this process will result in a system constructed in accordance with the tabulated data presented here. To be in conformance with this tabulated data, all of the information presented in this document shall be read and understood by the person utilizing this data.



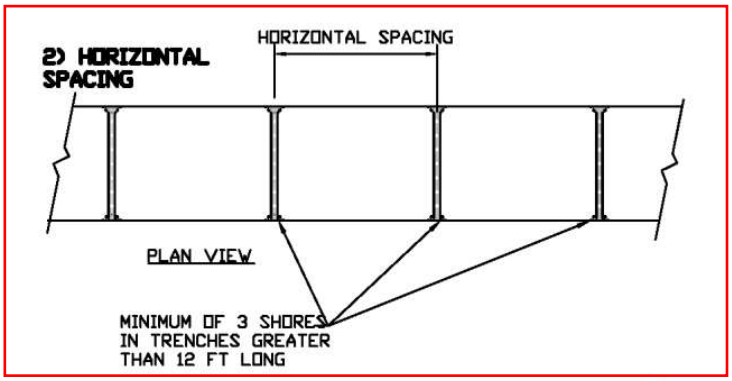
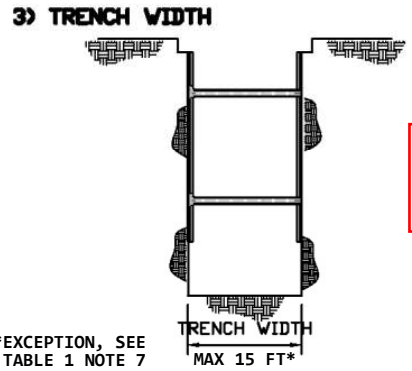


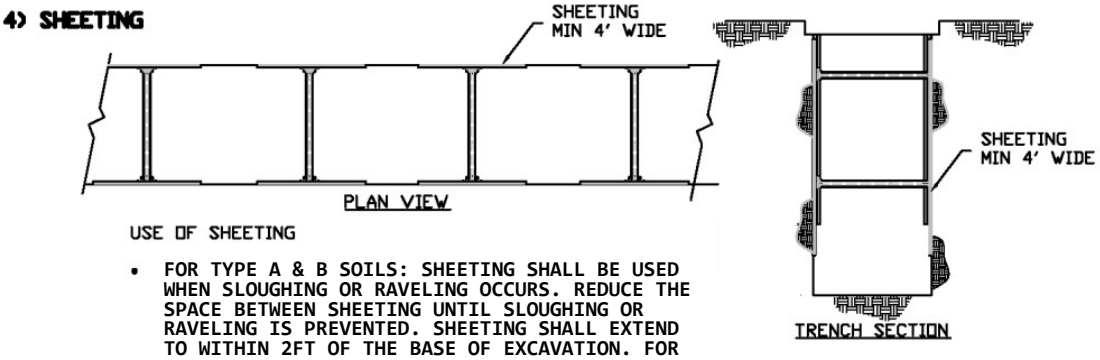
Table 5. Horizontal Shore Spacing

Depth	OSHA Soil Type		
(ft)	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	7	5
over 15 to 20	8	6	4
over 20 to 25	8	5	3



TRENCH WIDTH OVERSLEEVE REQUIREMENTS:

- 0 TO 8 FT WIDE — NO OVERSLEEVE REQUIRED TYPE A & B SOIL
- 8 TO 12 FT WIDE — 3"x3/16" ROUND ALUMINUM OR STEEL OVERSLEEVE
- 12 TO 15 FT WIDE — STEEL OR ALUMINUM 3.5"x3.5"x3/16" WALL OVER 3" ROUND STANDARD OVERSLEEVE OR A STEEL 3"x3"x3/16" FULL LENGTH OR AN A35 STEEL 3" SCH 80 PIPE OVERSLEEVE FULL LENGTH

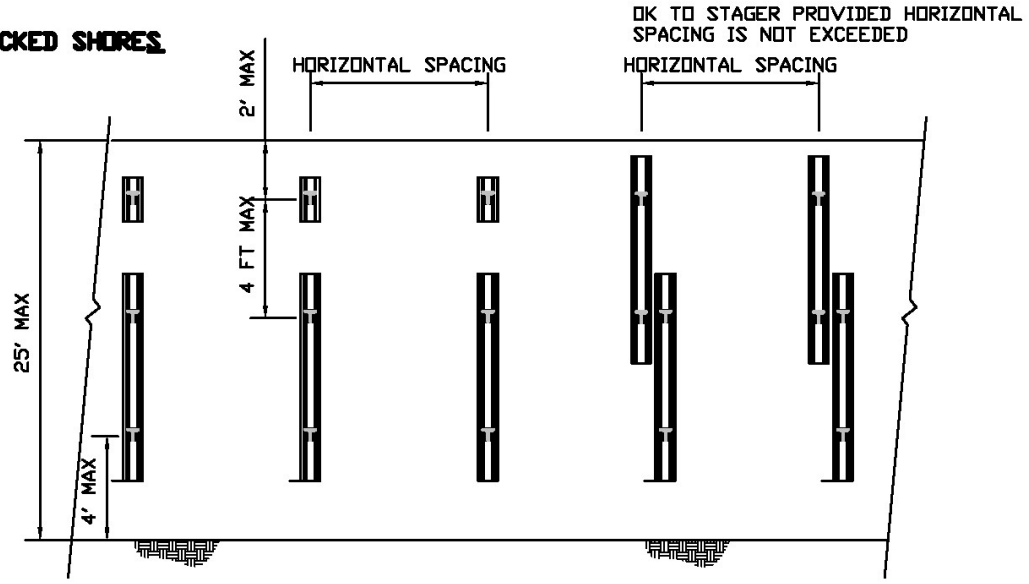


USE OF SHEETING

- FOR TYPE A & B SOILS: SHEETING SHALL BE USED WHEN SLOUGHING OR RAVELING OCCURS. REDUCE THE SPACE BETWEEN SHEETING UNTIL SLOUGHING OR RAVELING IS PREVENTED. SHEETING SHALL EXTEND TO WITHIN 2FT OF THE BASE OF EXCAVATION. FOR EXCAVATION DEPTHS GREATER THAN 20FT, SHEETING IS REQUIRED TO EXTEND TO BASE OF EXCAVATION.

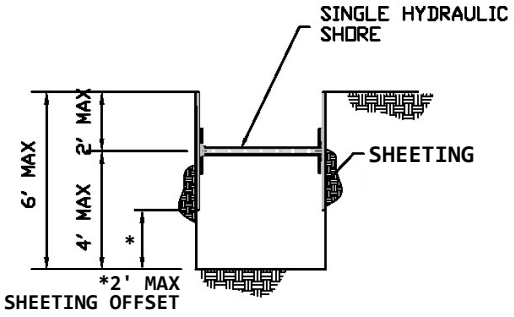
- FOR TYPE C-60 SOILS: SHEETING IS REQUIRED FOR ALL EXCAVATION DEPTHS GREATER THAN 10FT. SHEETING SHALL EXTEND TO WITHIN 2FT OF THE BASE OF EXCAVATION. FOR EXCAVATION DEPTHS GREATER THAN 20FT, SHEETING IS REQUIRED TO EXTEND TO BASE OF EXCAVATION.

5) STACKED SHORES



TRENCH ELEVATION

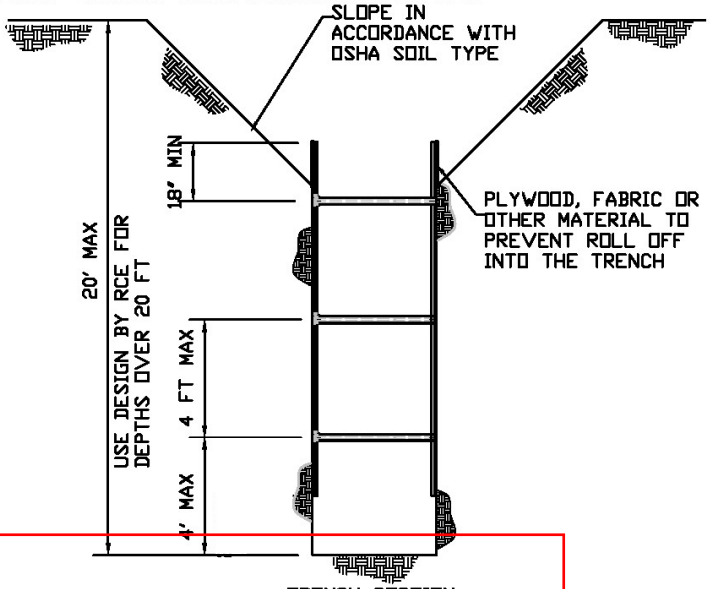
6) SINGLE SHORE IN 6 FT TRENCH



TRENCH SECTION

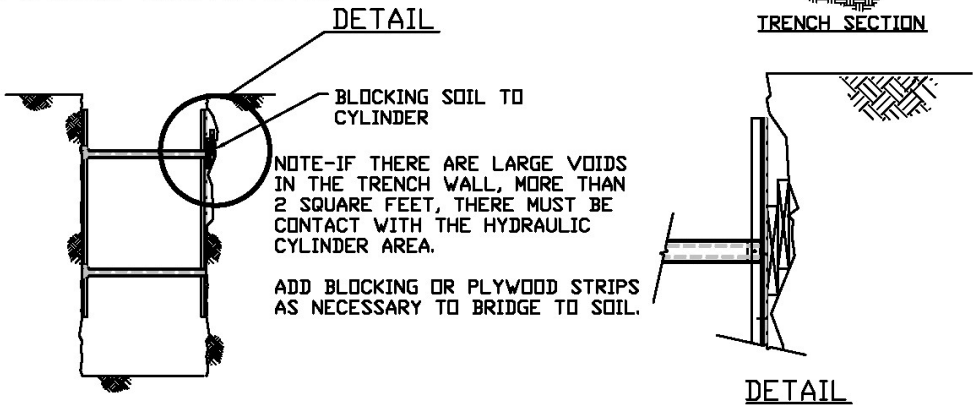
- SEE TABLE 1 NOTE 2 FOR SHEETING REQUIREMENTS.

7) SLOPED TRENCH WITH HYDRAULIC SHORES



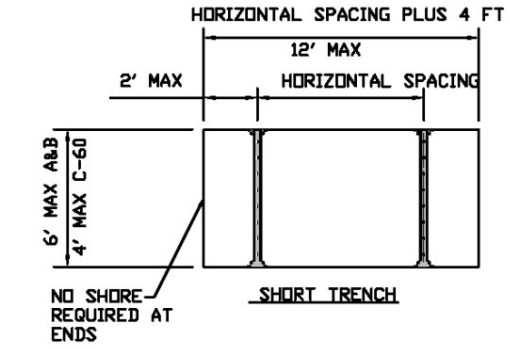
TRENCH SECTION

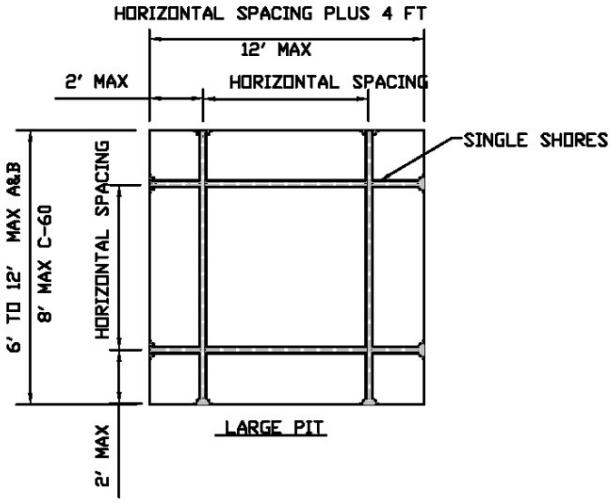
8) SOIL CONTACT WITH CYLINDERS



DETAIL

9) NON LINEAR TRENCH CONFIGURATIONS





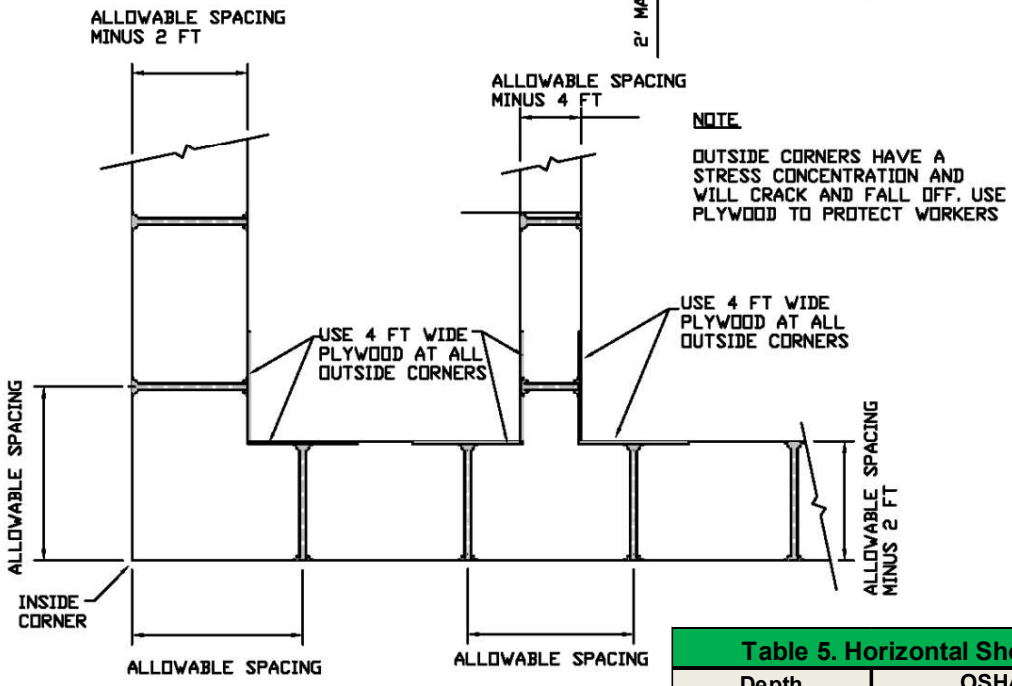
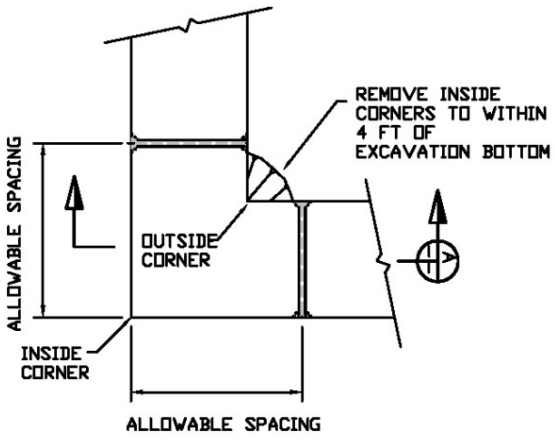
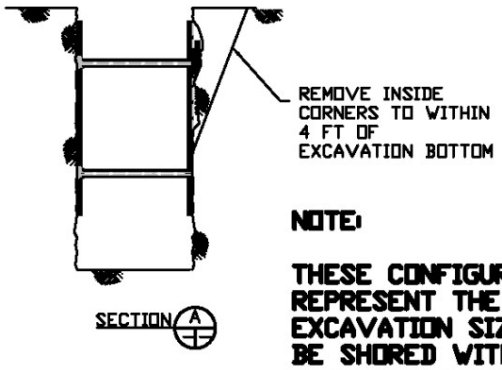


Table 5. Horizontal Shore Spacing			
Depth	OSHA Soil Type		
(ft)	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	7	5
over 15 to 20	8	6	4
over 20 to 25	8	5	3



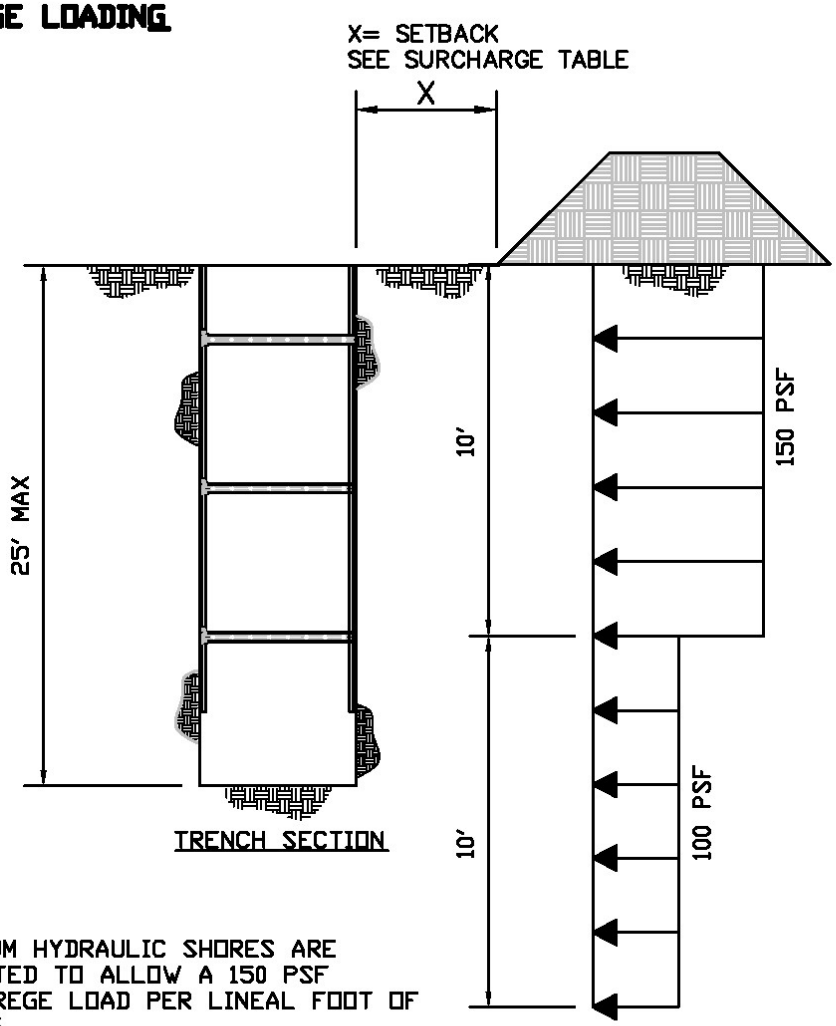


NOTE:

THESE CONFIGURATIONS REPRESENT THE LIMITS OF EXCAVATION SIZES THAT CAN BE SHORED WITH 2' VERTICAL HYDRAULIC SHORES

CORNER AND T TRENCH ALTERNATIVE TO USING PLYWOOD AT OUTSIDE CORNERS

10) SURCHARGE LOADING



NOTE

ALUMINUM HYDRAULIC SHORES ARE TABULATED TO ALLOW A 150 PSF SURCHAREGE LOAD PER LINEAL FOOT OF SPACING

SURCHARGE LOADING DIAGRAM

SURCHARGE AFTER 20 FT DEEP IS 50 PSF OR LESS

Table 6. Surcharge Setback Table

Surcharge	Setback Distance "x"		Surcharge	Setback Distance "x"	
K-Rail	1	ft	3 CY Loader	2	ft
HS20-44 Traffic	4	ft	5 CY Loader	3	ft
Spoil Pile 3 ft high	2	ft	225 Excavator	2	ft
Backhoe	2	ft	325 Excavator	3	ft
Equipment < 20,000 lb	2	ft	Dump Truck	3	ft
Equipment > 20,000 lb	4	ft	10 CY Concrete Truck	4	ft
			Boom Truck Pad	6	ft

Table Notes:

1. These setbacks limit horizontal shoring loads to 72psf for 0 to 10 ft and 50psf 10 to 20 ft.
2. Provide separate surcharge analysis for all cranes and structures within 15 ft of the excavation.
3. Table setbacks are for open trenches. For trench widths 4 ft or less, when traffic covers are in place, HS20-44 traffic can pass over the covered excavation.

APPENDIX B - Installation steps for use of Vertical Aluminum Hydraulic Trench Shores

Step 1 - Determine trench shoring requirements (Figure 11)

- Trench Depth
- Trench Width
- Trench Length

Note - Dewatering must be to the bottom of the excavation

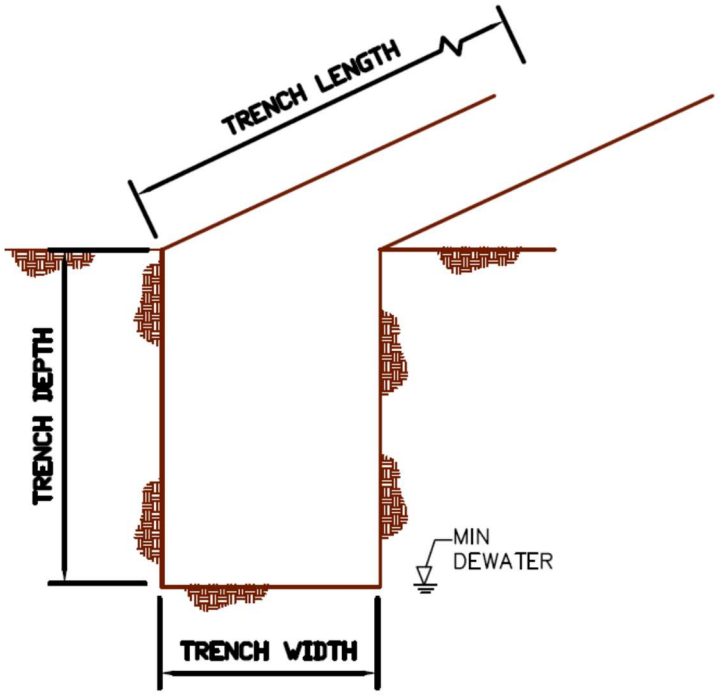


Figure 11 - Trench Parameters

Step 2 - Determine soil type in conformance with OSHA Appendix A

- **Type A-25 Sloping ¾ :1**
- **Type B-45 Sloping 1:1**
- **Type C-60 Sloping 1-1 ½ :1**

Hydraulic Shores cannot be used in Type C-80 soil

Step 3 - Determine horizontal shore spacing (Figure 12)

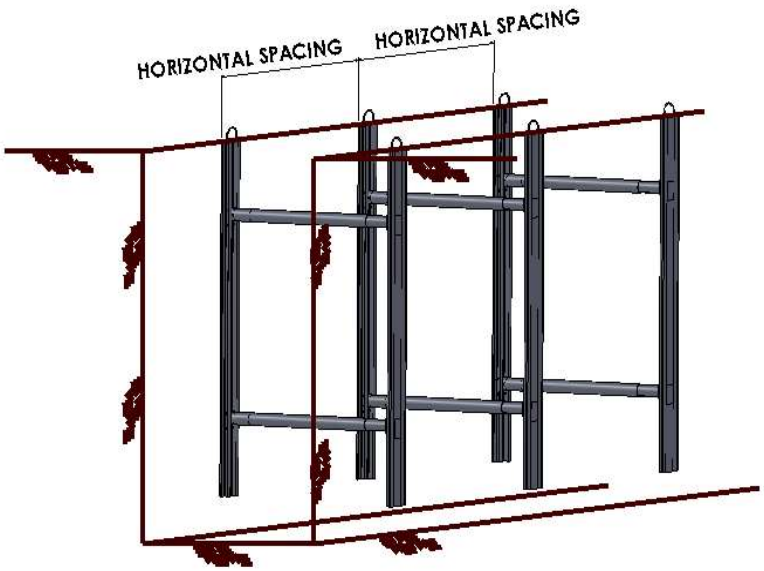


Figure 12 - Horizontal Spacing

Table 5 Notes

1. A competent person must decide whether trenches under 5 ft deep are stable or will require shoring.
2. Aluminum hydraulic shores are not allowed at any spacing in C-80 soil.

Table 5. Horizontal Shore Spacing			
Depth	OSHA Soil Type		
(ft)	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	7	5
over 15 to 20	8	6	4
over 20 to 25	8	5	3

Step 4 - Determine vertical cylinder spacing (Figure 13)

Table 7. Vertical Cylinder Spacing		
Between	Maximum (ft)	Minimum (ft)
Top cylinder and surface	2	1
Between cylinders (note 3)	4	—
Bottom to first cylinder	4	—

Table 7 Notes

1. — Indicates no limitation.
2. When stacking hydraulic shores do not set hydraulic cylinders more than 4 ft apart.

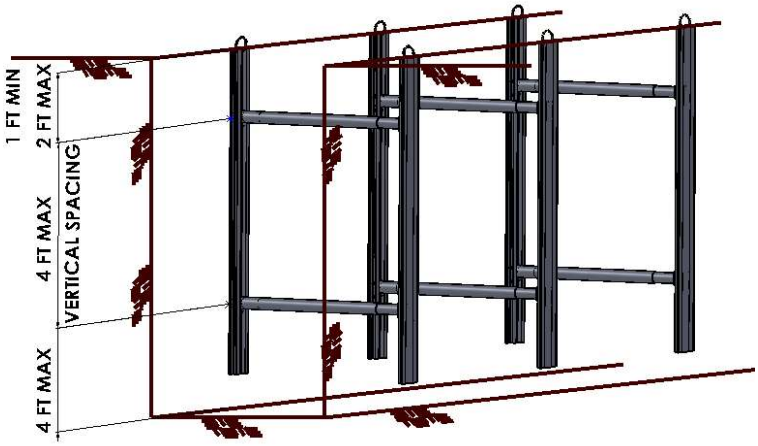


Figure 13 - Vertical Spacing

Step 5 - Determine Cylinder size and Oversleeve Requirement for trench width

Table 8. Allowable Trench Width			
Depth of Trench (ft)	Cylinder Type per Width of Excavation (ft)		
	to 8'	8' to 12'	12' to 15'
TYPE "A" Soil			
to 10'	2" ID	2" ID	2" ID(1)
over 10' to 15'	2" ID	2" ID	2" ID(1)
over 15' to 20'	2" ID	2" ID(1)	2" ID(1)
over 20' to 25'	2" ID	2" ID(1)	2" ID(1)
TYPE "B" Soil			
to 10'	2" ID	2" ID	2" ID(1)
over 10' to 15'	2" ID	2" ID	2" ID(1)
over 15' to 20'	2" ID	2" ID(1)	2" ID(1)
over 20' to 25'	2" ID	2" ID(1)	2" ID(1)
TYPE "C-60" Soil			
to 10'	2" ID	2" ID	2" ID(1)
over 10' to 15'	2" ID	2" ID	2" ID(1)
over 15' to 20'	2" ID	2" ID(1)	2" ID(1)
over 20' to 25'	2" ID	2" ID(1)	2" ID(1)

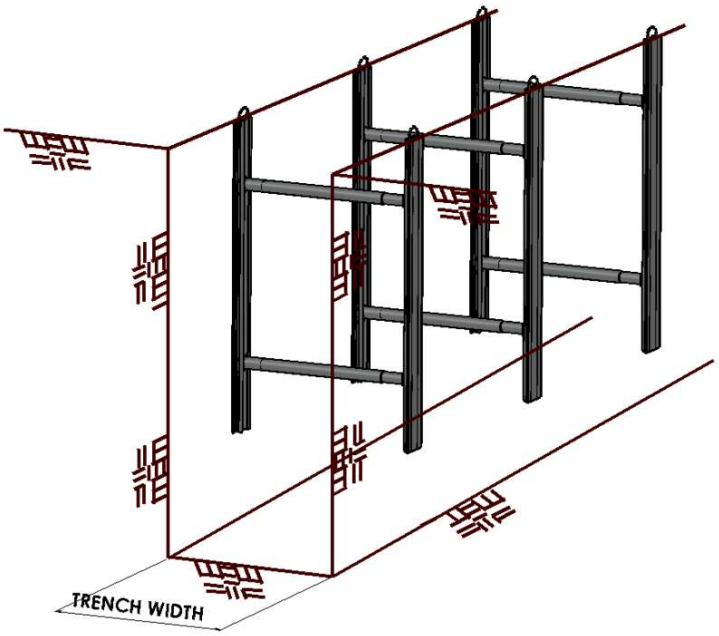


Figure 14 - Trench Width

Table 8 Notes:

1. Use 2-inch inside diameter cylinders with 3-inch aluminum oversleeves and standard extension units as required for trench width (8 ft to 12 ft width). Oversleeves for models larger than 88-56 (12 ft to 15 ft width) are aluminum or steel 3.5 in. x 3.5 in. x 3/16 in. wall over 3 in. round standard aluminum pipe or a steel 3 in. x 3 in. x 3/16 in. full length. Round oversleeve members with an equivalent diameter and wall thickness may be used as a substitute to the square sections previously noted.
2. See **Table 4** for oversleeve types.

Table 4. Oversleeve Requirements	
Trench Width	Oversleeve Required
to 8 ft	No oversleeve required
8 ft to 12 ft	3 in. x 3/16 in. round aluminum oversleeve
12 ft to 15 ft	Steel or aluminum 3.5 in. x 3.5 in. x 3/16 in. wall over 3 in. round standard aluminum pipe or a steel 3 in. x 3 in. x 3/16 in. full length
15 ft to 18 ft	3 in. Sch 80 steel pipe (Grade A35)

Step 6 - Determine sheeting requirements (Figure 15)

Table 9. Sheeting Requirements			
Depth	OSHA Soil Type		
(ft)	A	B	C-60
to 10	Not Required	Not Required	Not Required
over 10 to 15	↓	↓	Required
over 15 to 20	↓	↓	↓
over 20 to 25	↓	Required	↓

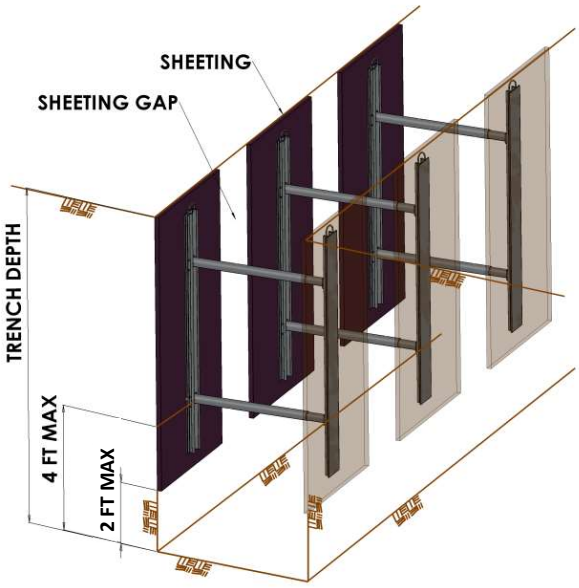


Figure 15 - Sheeting Requirements

Table 9 Notes:

1. Sheeting is always required when sloughing or raveling occurs and in C-60 soil for depths greater than 10 ft.
2. If there is a sheeting gap due to allowable shore spacing, the gap must be reduced until sloughing or raveling is prevented.
3. Sloughing is associated with soft cohesive soil that squeezes around the rail or sheeting. Raveling is associated with non-cohesive soil, sands and gravels that fall off the face of the trench wall. Trench wall face exposure over time can create raveling as moisture cohesion weakens due to drying.
4. Sheeting is not considered a structural part of the shore. Sheeting material requirements are strictly to meet minimum durability and handling requirements.
5. Sheeting may be set separately or connected to the shore.
6. Some soils may require that the sheeting be extended to the full depth of the excavation, this shall be determined by the competent person. Sheeting is required to extend to the base of excavation in depths greater than 20 ft in Type B & C soils, see **Table 1**.
7. See **Table 2** for allowable sheeting material.

Table 2. Allowable Sheeting[2]	
Plywood	Other Materials
3/4" Finn Form	Steel plate 1/2" min thickness (Grade A36)
3/4" Omni Form	Steel sheet piles panels
3/4" Plywood, Class 1 Exterior	Aluminum sheet pile panels
3/4" HDO, High Density Overlay	Buildable box panels
3/4" 14 Ply Artic White Birch	**4" Timber Lagging Set Horizontal**
1-1/8" CDX	Spacing : Type A - 8ft, Type B - 6ft, Type C - 4ft
2ea sheets of 3/4" CDX (back to back)	Grade : Douglas Fir #2 or Oak

Step 7 - Stacked Configurations (Figure 16)

- Shores may be stacked vertically as long as the hydraulic cylinders are no more than 4 ft apart
- Shores may be staggered as long as allowable shore spacing is not exceeded

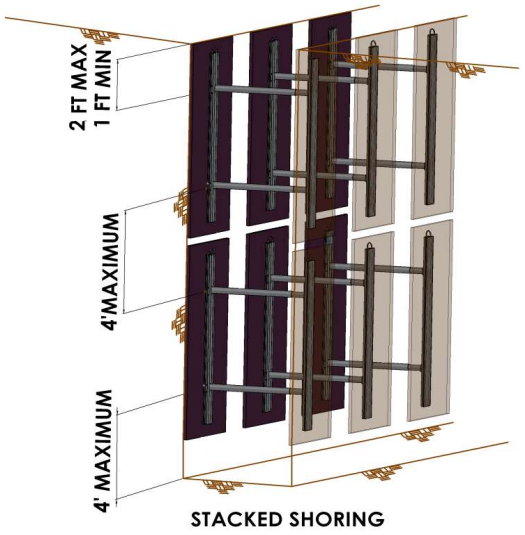


Figure 16

Step 8 - Combined sloping and shoring configurations (Figure 17)

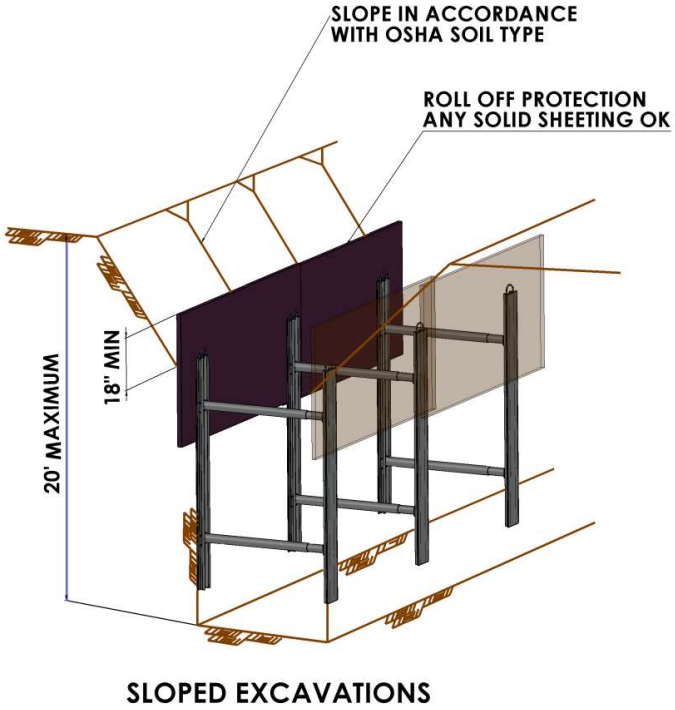
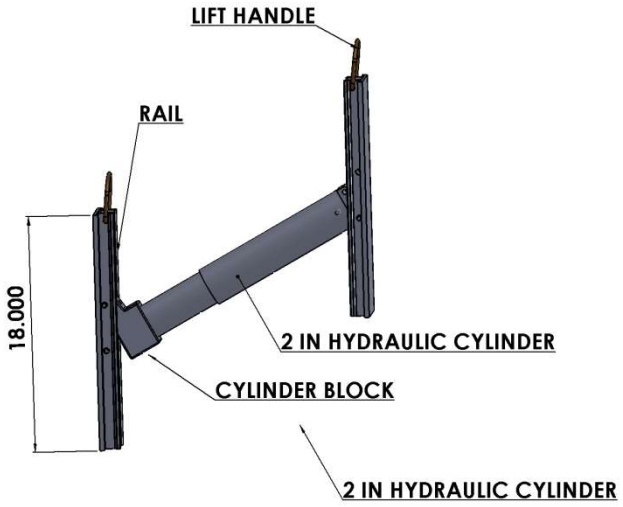
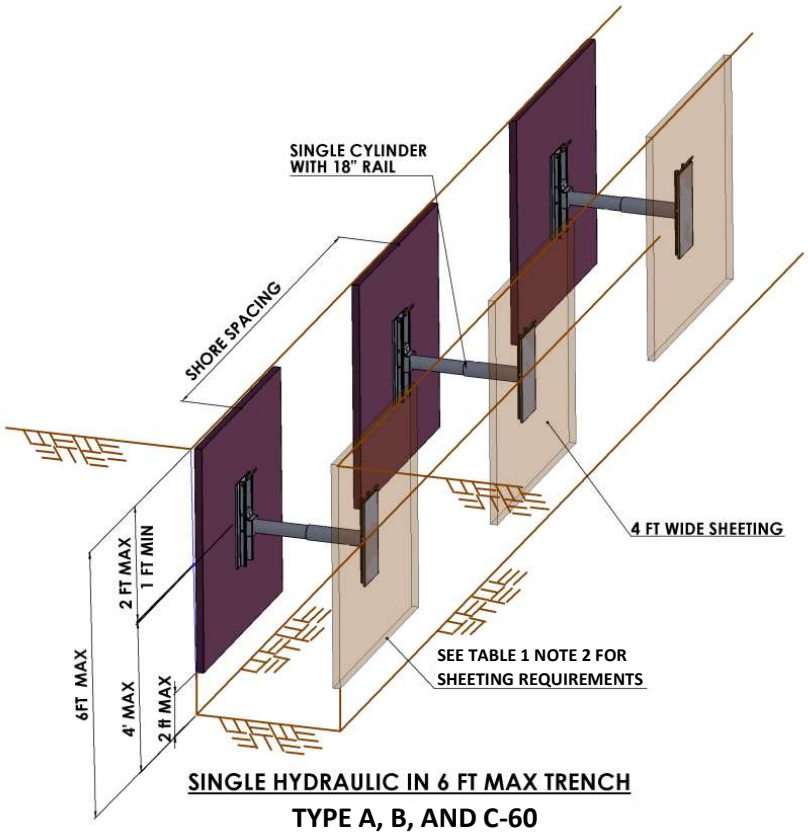


Figure 17

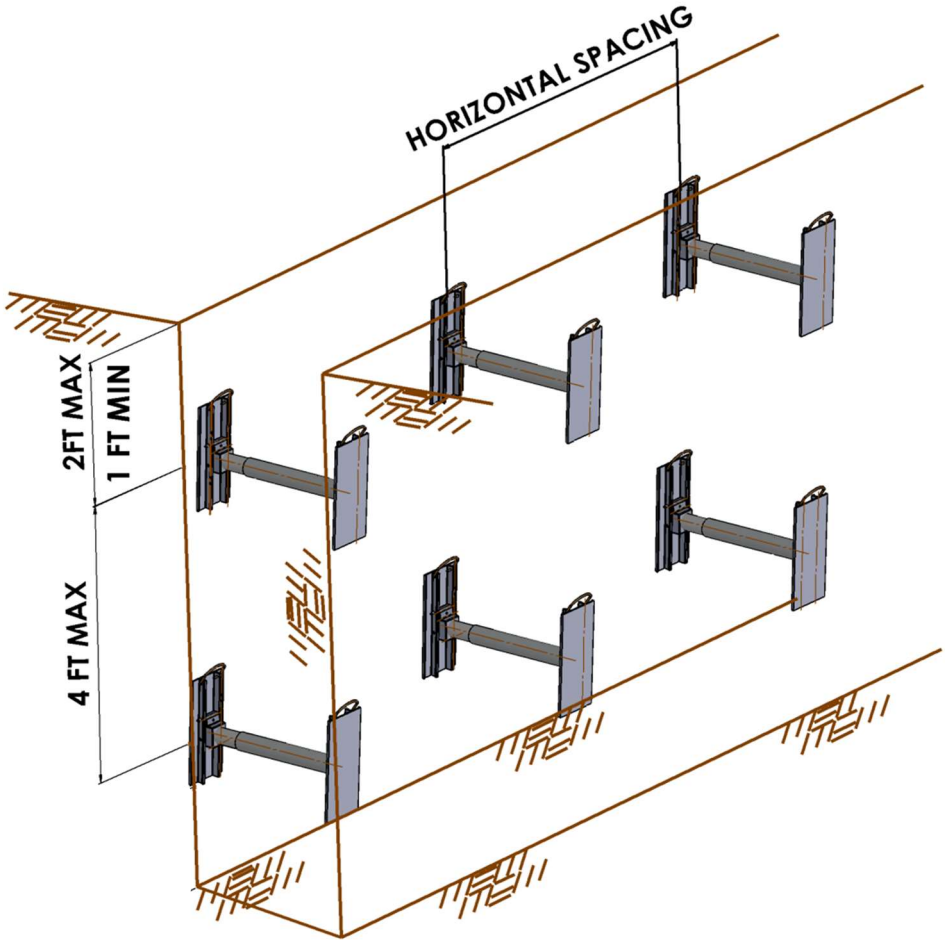
Step 9 - Single Hydraulic Shore



SINGLE HYDRAULIC SHORE



SINGLE HYDRAULIC IN 6 FT MAX TRENCH
TYPE A, B, AND C-60



SINGLE HYDRAULIC SHORES

APPENDIX C - Safe Handling and Use of Trench Shores

Hydraulic shores provide a relatively fast way to support an unshored trench making it an optimal equipment to assist in overall excavation safety. Utilizing trench jacks for excavation support still has safety hazards that users should understand and protect workers from. Although rare, it is important for workers to be informed of all the risks of utilizing hydraulic shores as a method of protection. The following are hazards and safety procedures associated with the use of Vertical Aluminum Shores:

- Injury to back and muscles from lifting heavy objects - An 8 ft long 52x88 extension trench jack weighs approximately 120 lbs. A two-man crew can safely lift, set and remove it from the trench. Anything longer or heavier should be lifted and set with equipment such as a backhoe or boom truck.

- Overhead lifting hazard - When jacks are being hoisted by sling from a tractor bucket or boom truck, the swinging jack presents a hazard to workers guiding it. Loose plywood and rocks can also fall off onto workers. Workers should stand clear and guide with a lead rope.

- Finger and hand protection - Trench jacks have moving parts at the connection between the cylinder and the rail. When the jack swings open fingers can be crushed under the cylinder block and when it is swung closed fingers can easily be sheared off if they are between the block and the rail leg. When the hydraulic hose is being connected to the block, fitting and when the jack is being lifted by hand shearing and crushing is most likely to happen. Awareness through safety instruction and hand placement a safe distance, 12", from the blocks is safe practice. Trench jacks may have optional finger guards however, it is still possible to get fingers under the block and wrists cut and banged when the jack folds or unfolds. See **Figure 15.**

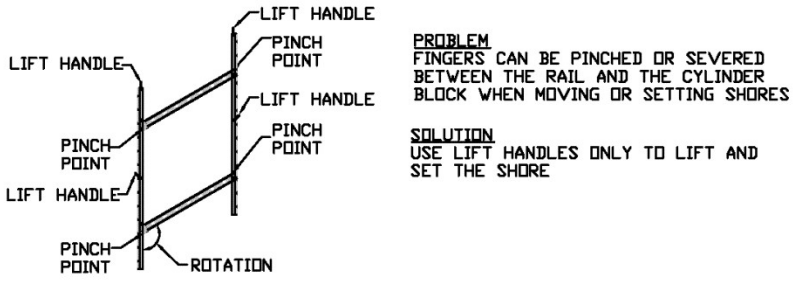


Figure 15. Trench Safety issues

- Bank collapse with worker standing on it - When the jack is being set it is still possible for the trench wall to collapse from the additional weight and activity going on around it. Trench jack installation should closely follow the excavation activity.

  During jack removal, the arch column is being literally removed with the load still on it. Pipe bedding and initial backfill cut the trench depth adding some stability prior to removing the jack. If backfill operations are closely following jack removal, the length of unshored collapsible trench wall becomes short. Soil arching back to the backfilled area is likely and trench wall failure becomes less likely. Remote backfill operation such as excavator wheel or vibraplate, or remote operated compactors must always be used for compaction outside the shored area. When trench jacks are being removed to allow pipe installation and then reset there is a greater likelihood of trench wall collapse. Equipment and personnel in close proximity are at risk of losing the ground under their feet. Keep equipment and personnel except those needed to remove the jack a safe distance away. This type of operation is not uncommon and most often works safely, however if there is any evidence of trench wall collapse the operation should be discontinued and a different method of getting production materials into the trench or a different shoring system should be used. Several bad accidents have occurred in conjunction with this type of operation.

- Get the surcharge loads right - Equipment over 20,000 lbs and large spoil piles over 2 ft high quickly add additional surcharges, especially in the top 10 ft, that can easily overload the trench jack. If one cylinder fails, a progressive failure to the bottom of the trench and then down the length of the trench is possible. A boom truck or backhoe outrigger placed next to a trench jack can trigger this. The way to adjust for additional surcharge load is to move the load away from the trench, spread the load with timber pad or steel plate, or decrease the trench jack spacing. Centering the load on the jack, places most of the load on that jack. The alternative, centering the load between the jacks distributes the load evenly between the jacks, however it increases the possibility of the arch void to fall out or arch shear failure at the jack. One alternative may not be any better than the other.

- Loose trench jacks in the trench - Jacks that are not pressurized in the trench are not setting up arching and preventing trench collapse. In this condition the jacks can also fall down on workers below them. Jacks should not leak at all. Pressure can change slightly up or down due to temperature changes or increase due to loading however it should never loosen up in the ditch. If jacks are left overnight they should be checked before entering the trench in the morning. Simply tap them with a hammer or bar of metal, they will sound loose if they are. Remove and replace jacks that bleed off.
  If the trench wall has voids where the cylinder hits the wall, use wood blocking to extend the connection to the soil.

- Non-vertical trench walls - Trench walls that are not vertical, an inverted A shape, the trench jack is not stable. Assuming a coefficient of friction of 0.1 between the soil and the aluminum rail and applying a factor of safety of 1.5 calculations indicate that the slope of the trench wall should not exceed 3 degrees or the jack will lift up and fail to provide an arching point.

- In trenches that are sloped above, extending the jack 18" above the hinge point does not provide roll off protection for workers below due to the fact that the jack is spaced. Place fabric or boards behind the jack rail to stop objects at the surface and bank ravel from falling on workers, See **Figure 16**.

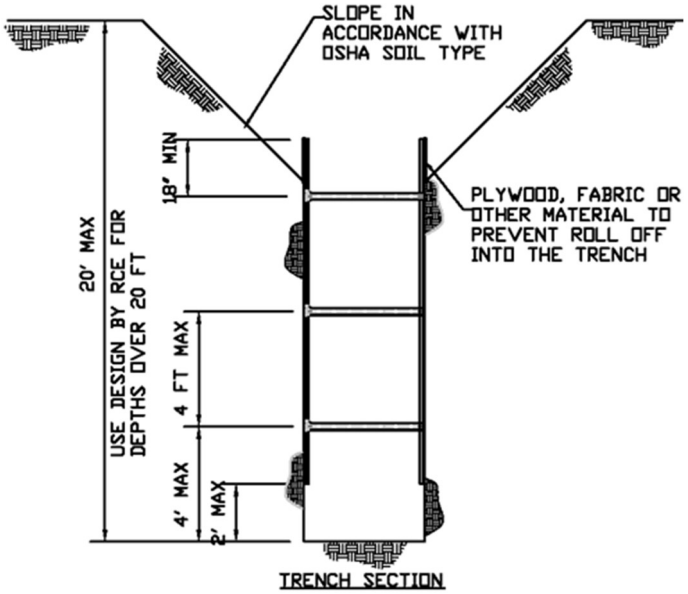


Figure 16. Trench Safety issues

Subpart P Additional Requirements Related to Hydraulic Shoring with Commentary

The following are excerpts from Subpart P that are relative to hydraulic shoring use.

1926.652(e)(1)(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

1926.652(e)(2)(ii)
Installation of a support system shall be closely coordinated with the excavation of trenches.

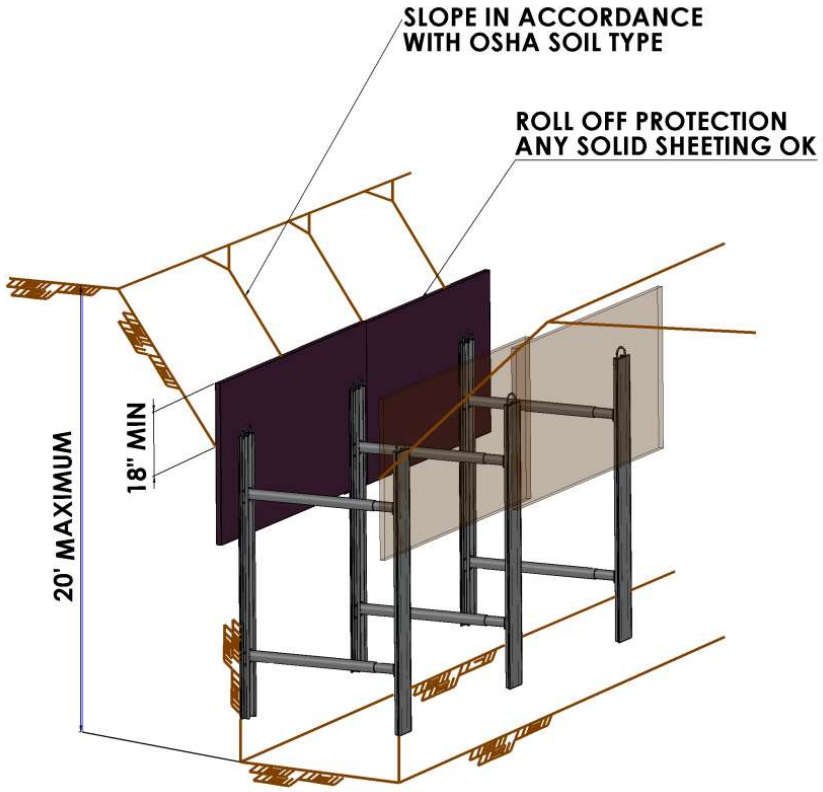
Commentary - Hydraulic shores were developed so that they could be installed and removed from outside the excavation. Cave-in from the surface is still a hazard while installing and removing the shore. Hydraulic shores should be installed as soon as possible after the trench is excavated. This means that if the shores are being installed horizontally at 6 ft on center there should be no more than 6 to 10 ft of trench unshored at any time. It is not acceptable to open a length of trench and then go back and install the shores later.

When hydraulic shores are being removed use caution, stand away from the trench edge and backfill as close to the shore removal location as possible.

It is not allowed to remove and replace a hydraulic shore in order to install production work that will not fit within the shore spacing. If a hydraulic shore is being removed and replaced in order to set pipe into the excavation the soil arching support that was originally set up is being removed similar to removing a column from under an arch. Collapse is imminent and can occur immediately or at the time of resetting the shore.

1926.652(f) Sloping and benching systems. Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

Commentary - When hydraulic shores are used in sloped excavations without sheeting some form of roll off protection must be provided.



SLOPED EXCAVATIONS

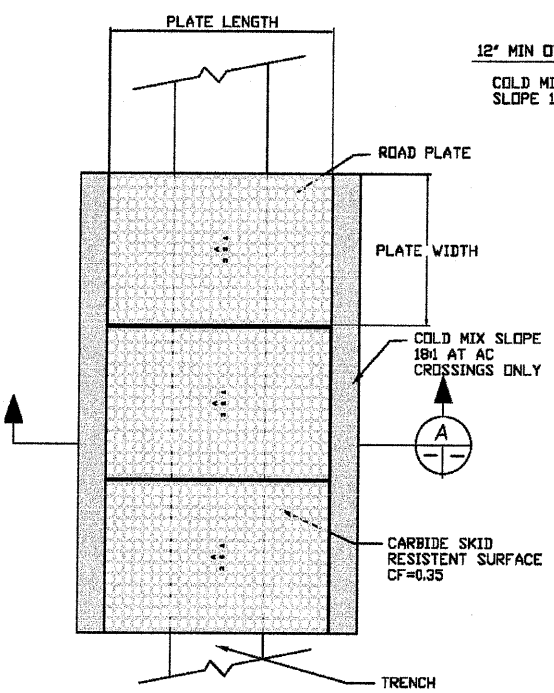
1926.652(e)(2)(i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

Commentary - Either the rail or the plywood must be within 2 ft of the bottom of the excavation.

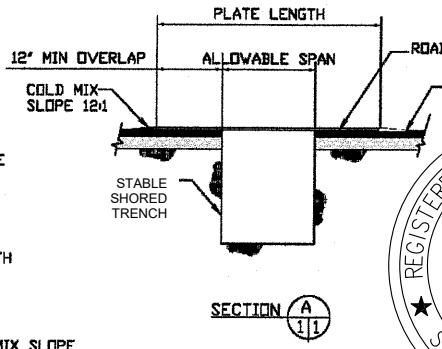
1926.652(d)(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

Commentary - Daily inspections are required to check for equipment malfunctions.

ROAD PLATE with CARBIDE SKID RESISTANT SURFACE TABULATED DATA



PLAN VIEW



REGISTERED PROFESSIONAL ENGINEER
JASPER B. CALCARA
No. 62941
CIVIL
STATE OF CALIFORNIA
1/21/21

TABLE NOTES:

1. SPAN MEASUREMENT IS AC EDGE TO AC EDGE.
2. TRAFFIC MAY RUN IN ANY DIRECTION ON THE PLATES.
3. PLATES MAY BE PLACED IN EITHER DIRECTION OF THE TRENCH IN ACCORDANCE WITH CONDITIONS AND NOTES SPECIFIED HERIN.
4. IT IS THE PLATE INSTALLERS RESPONSIBILITY TO INSTALL AND MAINTAIN THE PLATES IN ACCORDANCE WITH THIS DATA SHEET AND LOCAAL JURISDICTION REQUIREMENTS INCLUDEING ANY NECESSARY TRAFFIC CONTROL OPERATIONS.

Table 1-ALLOWABLE SPANS AND WEIGHTS FOR STEEL ROAD PLATES

Plate Thickness	Allowable Span	Plate Size / Weight					
	2.5'	Size	4'x5' *				
		Weight (lbs)	816				
1"	4'	Size	4'x6' *	4'x8' *			
		Weight (lbs)	979	1306			
		Size	5'x8' *	5'x10' *			
		Weight (lbs)	1632	2040			
		Size	6'x8'	6'x10'	6'x12'		
		Weight (lbs)	1958	2448	2938		
		Size	8'x10'	8'x12'	8'x15'	8'x16'	8'x20'
		Weight (lbs)	3264	3917	4896	5222	6528
1.25"	5'	Size	8'x10'				
		Weight (lbs)	4080				
1.5"	6'	Size	8'x12'	8'x15'	8'x16'	8'x20'	
		Weight (lbs)	5875	7344	7834	9792	

* The long size of steel road plates must be placed perpendicular to the trench direction unless the plate is used for trench width less than the specified allowable span and with minimum 12" overlap on each end

TRENCH SHORING COMPANY
206 N.Central Ave, Compton, CA 90220 - (310) 327-5554

ROAD PLATE with CARBIDE SKID RESISTANT SURFACE TABULATED DATA

General Conditions

1. Plates are allowed in street pavement only, excluding any cross walk, driveway, and sidewalk
2. Plates are minimum ASTM A36 Min Fy= 36 ksi
3. Trench plate installations including cold mix ramping within the City of Los Angeles and all pavement repairs shall be in accordance Los Angeles Public Works Standard S-601-3, WATCH Manual and all other jurisdiction requirements.
4. Plates are designed for HS20-44 and HL-93 axel loading with 1.33 impact factor
5. Design is based on allowable bending strength and maximum deflection of ½".
6. Minimum overlap is 12"
7. There shall be no paint on the surface of the road plates.
8. The non-skid surface shall have a dynamic coefficient of friction of 0.35 per California Test Method No. 325 or equivalent skid number of 0.35 as tested per ASTM E274. Any trench plate with non-skid surface less than specified frictional resistance shall be removed and replaced.
9. All pick holes and pin holes in the plates where there is backing underneath the plate shall be filled with temporary paving material.
10. All road plates with carbide skid resistant surface are manufactured in Trench Shoring Company **Plant at 325 N. Cota Street, Corona, CA**
11. All tops of the road plates must be flush.

D.H. Charles Engineering, Inc.
135 Liverpool Drive, Suite C
Cardiff, CA 92007
(760) 436-9756

REVISED GEOTECHNICAL INVESTIGATION

CARBON CANYON ROAD
WATERLINE IMPROVEMENTS
MALIBU, CALIFORNIA

Prepared for

Los Angeles County Public Works
Project Management Division III

Prepared by

Los Angeles County Public Works
Geotechnical and Materials Engineering Division
Geotechnical and Geology Investigation Sections

August 5, 2024

- The following geotechnical and design parameters in Table 2 can be used for cohesion, friction angle, and lateral earth pressure coefficients:

TABLE 2 – DESIGN PARAMETERS FOR ACTIVE AND LATERAL EARTH PRESSURES

Material Types	Unit Weight (pcf)	C (psf)	Φ (°)	K_a	K_p
Af, Qc, Qal	117	400	29	0.35	2.88

- Excavations greater than 20 feet deep, based on Cal/OSHA Title 8, Article 6, Section 154.1, require sloping or benching designed by a registered professional engineer.

- Stockpiling of excavated materials near an excavation shall have a minimum clearance equal to the depth of the excavation. All trench excavations shall be made in accordance with Cal/OSHA requirements.

- Per Cal/OSHA, construction work within 2 feet of excavation edge shall be performed by hand-operated equipment.

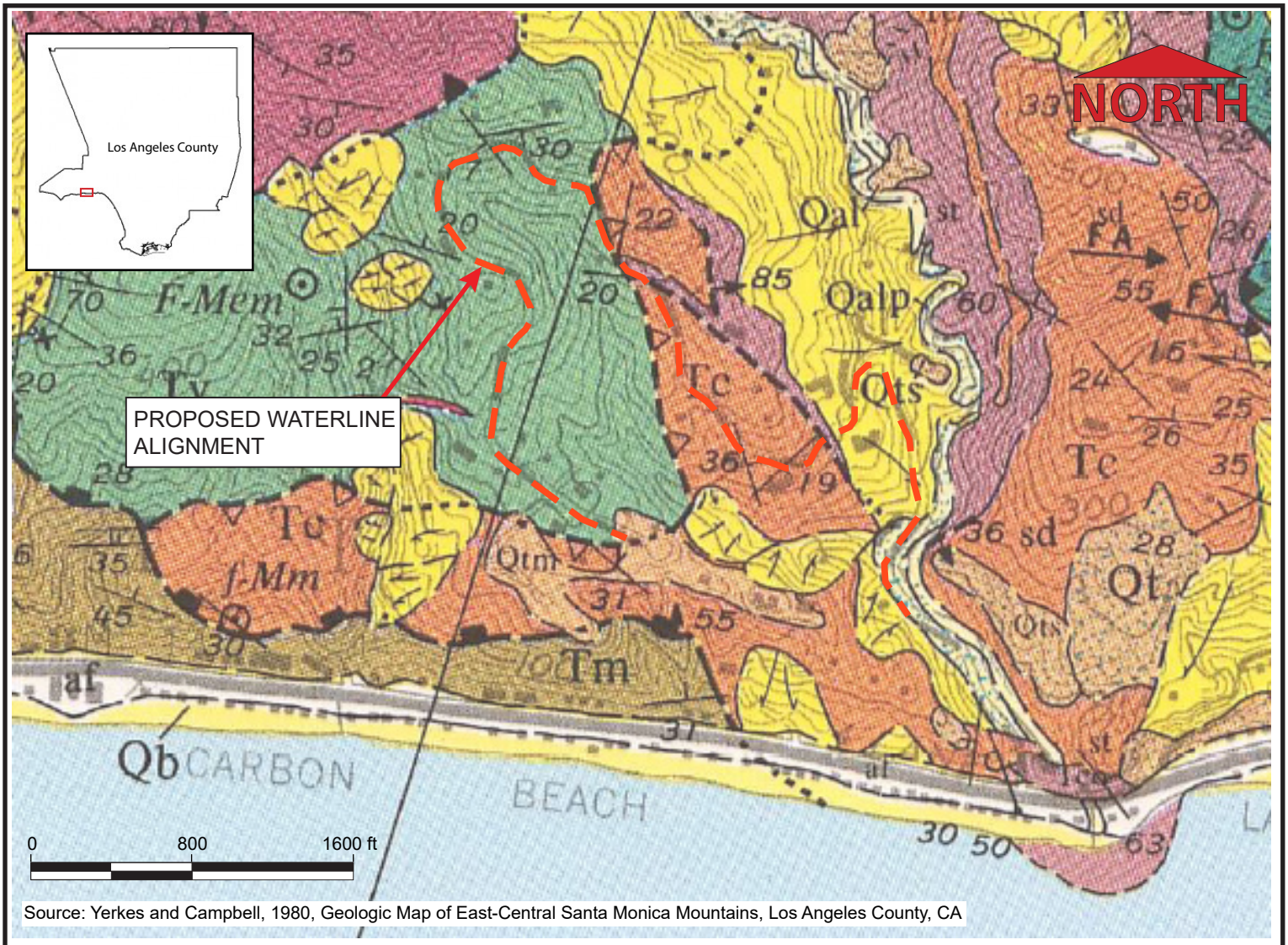
- Amendments to Specifications are provided in Appendix E.

The design parameters above are based on the assumptions that there are no hydrostatic pressures and the backfill is level.

Lateral surcharge loads developed from adjacent traffic within a 1:1 plane drawn upward from the base of the excavation shall be added to the lateral earth pressures. As a minimum, a 2-foot equivalent uniform soil surcharge (240 pounds per square foot) is recommended to account for traffic and nominal construction loads.

CONSTRUCTION CONSIDERATIONS

The contractor shall be solely responsible for choosing the appropriate construction means, methods, and monitoring so that no one is injured. The construction installation method selection shall consider proximity to improvements, utility lines, existing nearby structures, environmental concerns, subsurface soil composition, acceptable degree of invasiveness to the roadway, and any other concerns from owners or agencies involved.



Source: Yerkes and Campbell, 1980, Geologic Map of East-Central Santa Monica Mountains, Los Angeles County, CA

30	Bedrock Bedding Orientations
	Las Flores Thrust Fault with Teeth on Upper Plate (dotted where concealed)
	Malibu Coast Fault with Boxes on Upper Plate (dotted where concealed)
af	Artificial Fill
Qal	Alluvium (Quaternary)
Qalp	Alluvial Floodplain Deposits (Quaternary)
Qb	Beach Deposits (Quaternary)
Qls	Landslide Deposits (Quaternary)
Qts	Fluvial Terrace Deposits (Quaternary)
Qtm	Marine Terrace Deposits (Quaternary)
Tm	Monterey Shale (middle and upper Miocene)
Ti	Diabase Dikes and Sills (middle and upper Miocene)
Tc	Calabasas Formation (middle Miocene)
Tco	Conejo Volcanics (middle Miocene)
Tv	Vaqueros Formation (lower Miocene)
Tv	Sespe Formation (Upper Oligocene)

Public Works
LOS ANGELES COUNTY

LOS ANGELES COUNTY PUBLIC WORKS

GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

REGIONAL GEOLOGIC MAP
Carbon Canyon Road and Carbon Mesa Road
Waterline Replacement
Malibu, California

Date: Nov. 2021	Drafted by: MC	Scale: 1": 800'	**FIGURE 3**

Los Angeles County Public Works
Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-1

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**31.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.040294 -118.65161**	Approxiate Surface Elevation:	**64** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**20** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**3/2/2022** to **3/2/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-4" Surface is sandy gravel, dry, loose, approximately 4" thick				Start drilling @ 8:00						
		4" - 15' SILTY SAND to SANDY SILT (Artificial Fill), light reddish brown, slightly moist, loose to soft, angular to subangular mudstone fragments (<2"), caliche nodules <2"										
5				B1-1R	3-3-3 (6)							37
				B1-2B								
10				B1-3R	7-9-14 (23)							
		@ 13' gravel layer				Rig chatter from 13-15'						
15												
		15-20' CLAYEY SAND to SILTY SAND (Alluvium), with fine-grained sand in sampler tip, reddish to light brown, slightly moist, loose, subrounded sandstone fragments common (<2")		B1-4R	5-4-3 (7)							
20		▽										
		20-25' SILTY SAND to WELL-GRADED SAND, reddish brown, saturated, loose, fine to medium-grained, subrounded mudstone and volcanic fragments (<3")		*	5-5-7 (12)	Perched water @20'; SPT taken @ 20' for reference						
		@ 22' gravel layer				Rig chatter from 22-24'						
25												
		25-31.5' BEDROCK (Mudstone), dark brown, slightly moist, moderately hard, highly weathered		*	7-11-31 (42)	SPT taken at 25' for reference						
30												
		30-31.5' BEDROCK (Interbedded Claystone), dark reddish brown, slightly moist to wet, low hardness, moderately weathered, faint bedding planes on mudstone ~30-degrees, organic odor		*	6-11-16 (27)	SPT taken at 30' for reference						
		TD @ 31.5' Groundwater @ 20' Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:05 Finish Backfilling @ 10:20						

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Los Angeles County Public Works
Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-2

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**31.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.040712 -118.652052**	Approxiate Surface Elevation:	**65** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**3/1/2022** to **3/1/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-7" Asphalt				Start drilling @ 13:30						
		7"-5' SILTY SAND (Artificial Fill), light reddish brown, dry, loose, gravel and asphalt fragments (<2")				Hand auger to 5'						
5		**5-10' SANDY CLAY (Artificial Fill)**, reddish-orangish brown to dark brown, dry, stiff, low plasticity, subrounded to subangular fragments of volcanic rock		B2-1R	7-10-12 (22)	Rig chatter from 5-14'	109.8	5.4				
10				B2-2B								
		10-15' SANDY CLAYEY SILT (Alluvium), reddish brown, slightly moist, very firm, subrounded andesite (<3")		B2-3R	28-14-42 (56)		118.4	8.8	29	16	13	
15		**15-31.5' BEDROCK (Mudstone)**, dark brown, slightly moist, hard, moderately weathered, siltstone and claystone layers (<1"), bedding planes steeper than ~60-degrees		B2-4R	13-26-40 (66)							
20		**20-30' BEDROCK (Interbedded Mudstone and Sandstone)**, dark brown to grayish brown, dry to slightly moist, moderately hard to hard, moderately weathered, sandstone layers (<0.5"), fine-grained, bedding is near vertical		*	19-21-50/3"	SPT taken at 20' for reference						
25		@ 25' organic odor		*	8-6-12 (18)	SPT taken at 25' for reference						
30		**30-31.5' BEDROCK (Sandy Mudstone)**, dark brown, dry, hard, sand is fine-grained, pyrite mineralization throughout		*	17-21-26 (47)	SPT taken at 30' for reference						
		TD @ 31.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:45 Finish Backfilling @ 16:00						

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Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-3

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**30.25** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.041404 -118.651656**	Approxiate Surface Elevation:	**77** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**3/1/2022** to **3/1/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-7" Asphalt				Start drilling @ 10:08 Hand auger to 5'						
		7"-10.5' SILTY SAND (Artificial Fill), reddish brown, dry, medium dense, subrounded gravel and asphalt fragments (<2") @ 3' color change to dark reddish brown										
5				B3-1R	7-8-10 (18)	Rig chatter from 5-10'	103.7	4.8				24
				B3-2B								
10		@ 9' asphalt fragments		B3-3R	10-21-50/2"	@ 10' Driller on top of rock. Decides to drill through and sample at 10.5'						
15		**10.5-15' SILTY SAND to WELL-GRADED SAND (Landslide Deposit)**, light brown to reddish brown, dry, dense, subangular andesite, siltstone, and sandstone fragments (<3")										
		15-30.3' BEDROCK (Interbedded Mudstone and Siltstone), grayish brown to black with orangish-yellowish oxidation streaks, dry, hard, moderately weathered, trace well-graded medium to coarse-grained sand, bedding dips ~ 60-degrees		B3-4R	13-16-41 (57)							
20		**20-30' BEDROCK (Claystone)**, bluish gray to dark gray, dry to slightly moist, hard, highly weathered, bedding dips ~70-degrees, pyrite mineralization		*	27-25-22 (47)	SPT taken at 20' for reference						
25		@ 25' rounded fragments of dark brown mudstone (<1"), organic odor, pyrite mineralization		*	6-9-10 (19)	SPT taken at 25' for reference						
30		**30-30.25' BEDROCK (Claystone)**, bluish gray, slightly moist to moist, hard, highly weathered		*	50/3"	SPT taken at 30' for reference						
		TD @ 30.25' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 11:20 Finish Backfilling @ 12:10						

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Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-4

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**30.25** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.041526 -118.651564**	Approxiate Surface Elevation:	**82** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**3/1/2022** to **3/1/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-12" Asphalt				Start drilling @ 7:55						
		1-15' GRAVELLY SILTY SAND (Artificial Fill), light reddish brown, dry, loose, subangular andesite (<4")										
5				B4-1R	6-4-10 (14)	@ 5' No recovery						
						Rig chatter from 7-10'						
				B4-2B								
10		@10' weathered sandstone fragment in sampler tip (<4")		B4-3R	10-7-12 (19)	@ 10' Partial recovery; sample very disturbed						
15		**15-20' WELL-GRADED SAND (Landslide Deposit)**, light reddish brown, dry, medium dense, subrounded to subangular sandstone, mudstone, and andesite fragments (<2"), trace silt		B4-4R	12-9-15 (24)	@ 15' No recovery						
						Rig chatter from 18-20'						
20		**20-30' SANDY WELL-GRADED GRAVEL (Landslide Deposit)**, reddish-orangish brown, dry to slightly moist, medium dense to dense, sandstone, andesite, and siltstone fragments (<5")		*	8-24-17 (41)	SPT taken at 20' for reference; no recovery						
25				*	27-50/2"	SPT taken at 25' for reference; no recovery						
30				*	50/3"	SPT taken at 30' for reference; poor recovery						
		30-30.25' CLAYEY SILT (Landslide Deposit), bluish gray, dry to slightly moist, hard, angular claystone fragments (<2")										
		TD @ 30.25' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:05 Finish Backfilling @ 10:40						

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Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-5

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**31.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04198 -118.65157**	Approxiate Surface Elevation:	**104** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**25** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/28/2022** to **2/28/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-15" Asphalt				Start drilling @ 13:20						
		15"-5' SILTY GRAVELLY SAND (Artificial Fill), grayish brown, dry, loose, angular andesite fragments (<4")										
5		@3' becomes light reddish brown										
		5-10' SANDY SILTY GRAVEL (Landslide Deposit), reddish brown to light brown with gray-black mottling and yellowish streaks, dry, medium dense, angular andesite fragments (<5")		B5-1R	6-8-7 (15)							
10				B5-2B								
		10-15' SANDY SILT (Landslide Deposit), grayish green, dry, stiff, poorly consolidated, angular andesite fragments (<5")		B5-3R	6-9-9 (18)		102.9	5.9				12
15		**15-20' BEDROCK (Interbedded Mudstone and Siltstone)**, medium to dark brown, slightly moist to moist, low hardness, highly weathered, high angle contact between sitlstone and mudstone, <1 mm thick bluish-green high plasticity clay in mudstone, <2 mm quartz vein in mudstone		B5-4R	7-8-10 (18)							
20		**20-25' INTERBEDDED CLAYEY SILT**, bluish green, slightly moist, medium stiff, rock fragments (<1")		*	3-3-4 (7)	SPT taken at 20' for reference						
25	▽	**25-31.5' BEDROCK (Interbedded Claystone and Mudstone)**, claystone is grayish brown, saturated, soft, high plasticity, mudstone is dark brown, slightly moist, low hardness, organic odor, fissile		*	3-8-11 (19)	@ 25' Groundwater; SPT taken at 25' for reference						
30				*	6-8-11 (19)	SPT taken at 30' for reference						
		TD @ 31.5' Groundwater @ 25' Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:24 Finish Backfilling @ 15:15						

Los Angeles County Public Works
Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-6

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Canyon Road, Malibu**	Drilled Total Depth:	**51.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042919 -118.651937**	Approxiate Surface Elevation:	**149** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/28/2022** to **2/28/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-9" Asphalt 9-17" Silty Gravelly Sand (Base) 17-24" Asphalt				Start drilling @ 8:20 Hand auger to 5'						
		2-20' SANDY WELL SORTED GRAVEL (Landslide Deposit), light brown, dry, loose to medium dense, subangular andesite (<6")										
5				B6-1R	3-3-3 (6)	@ 5' No recovery						
				B6-2B								
10		@10' color change to reddish brown		B6-3R	5-5-11 (16)		89.8	7.1				11
15		@15' organic odor		B6-4R	19-20-19 (39)	@ 15' Sampler stuck in hole during sampling. After 20 minutes of trying to fish it out, driller decides to resume drilling.						
20		**20-30' GRAVELLY SILTY SAND (Landslide Deposit)**, dark brown, dry, dense, angular mudstone fragments (<3"), trace low plasticity clay, organic odor.		*	17-17-27 (44)	No recovery Rig chatter from 18-20' due to sampler being destroyed. Metal pieces returned to surface at 20-22' depth.						
25						@ 25' No sample taken						
30		**30-35' BEDROCK (Interbedded Sandstone and Mudstone)**, dark brown to grayish brown, dry, medium hard, highly weathered, organic odor		*	13-12-11 (23)	SPT taken at 30' for reference						
35												

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Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-6

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
35		**30-35' BEDROCK (Interbedded Sandstone and Mudstone)**, dark brown to grayish brown, dry, medium hard, highly weathered, organic odor *(continued)* **35-50' BEDROCK (Interbedded Mudstone and Siltstone)**, dark brown, stiff, highly weathered, slightly moist, subangular mudstone fragments (<3"), organic odor		*	3-4-5 (9)	SPT taken at 30' for reference *(continued)* SPT taken at 35' for reference @ 39' Rig chatter						
40				*	16-7-9 (16)	SPT taken at 40' for reference						
45				*	5-5-8 (13)	SPT taken at 45' for reference						
50		**50-51.5' BEDROCK (Mudstone)**, dark brown, slightly moist, hard, grayish brown sandstone fragments (<2"), fine-grained, organic odor		*	21-16-24 (40)	SPT taken at 50' for reference						
		TD @ 51.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 10:40 Finish Backfilling @ 12:00						

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Geotechnical and Materials Engineering Division
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BORING NUMBER B-7

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**41.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.043461 -118.652263**	Approxiate Surface Elevation:	**180** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/25/2022** to **2/25/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 8:05						
		10"-5' SILTY SAND (Artificial Fill), brown, slightly moist, loose, asphalt fragments				Hand auger to 5'						
5		**5-25' SILTY SAND GRAVEL (Landslide Deposit)**, dark brown, dry, dense, siltstone and mudstone fragments, common gypsum veins, silt and sand as matrix between bedrock blocks, trace clay		B7-1R	37-40-33 (73)		114.4	11.6				42
				B7-2B								
10				B7-3R	21-43-50/5"							
15				B7-4R	9-16-22 (38)							
20		@ 20' becomes moderately hard, decreasing bedrock fragments		*	8-11-13 (24)	SPT taken at 20' for reference						
25		**25-35' GRAVELLY SANDY SILT (Landslide Deposit)**, dark brown, dry, very stiff, mudstone and sandstone fragments (<4"), trace low plasticity clay		*	7-11-12 (23)	SPT taken at 25' for reference						
30				*	5-8-15 (23)	SPT taken at 30' for reference						
35												

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BORING NUMBER B-7

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
35		**35-41.5' BEDROCK (Mudstone)**, dark brown, dry, moderately hard, moderately weathered, fissile, trace gypsum veins		*	19-17-20 (37)	SPT taken at 35' for reference; Driller adds water to hole before driving sample. Drilling is getting harder						
40				*	7-18-25 (43)	SPT taken at 40' for reference						
		TD @ 41.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:40 Finish Backfilling @ 10:40						

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Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-8

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**51.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04305 -118.65247**	Approxiate Surface Elevation:	**190** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/24/2022** to **2/24/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-11" Asphalt				Start drilling @ 12:05						
		11"-5' GRAVELLY SAND (Artificial Fill), tan to reddish brown, slightly moist, loose to dense, asphalt fragments				Hand auger to 3'						
		@ 3' Asphalt, approximately 2" thick										
5		**5-10' SILTY SAND (Artificial Fill)**, tan to reddish brown, slightly moist, loose		B8-1R	6-5-6 (11)		94	9.3				22
10				B8-2B								
		10-51.5' GRAVELLY SILTY SAND (Landslide Deposit), tan to light brown, dry, medium dense to dense, angular andesite fragment (<2")		B8-3R	5-7-8 (15)							
15				B8-4R	16-16-18 (34)							
20				*	18-26-21 (47)	SPT taken at 20' for reference						
25		@ 25' manganese alteration on faces of andesite fragments, trace reddish brown low plasticity clay		*	15-23-50/2"	SPT taken at 25' for reference						
30		@ 30' roots in sandy matrix; trace gypsum veins		*	10-18-7 (25)	SPT taken at 30' for reference						
35												

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BORING NUMBER B-8

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
35		**10-51.5' GRAVELLY SILTY SAND (Landslide Deposit)**, tan to light brown, dry, medium dense to dense, angular andesite fragment (<2") *(continued)*		*	6-3-6 (9)	SPT taken at 35' for reference						
40				*	13-12-19 (31)	SPT taken at 40' for reference						
45		**45-50' SILTY CLAY TO CLAYEY SILT (Landslide Deposit)**, light gray, dry, very stiff		*	5-5-10 (15)	SPT taken at 45' for reference						
50		**50-51.5' CLAYEY SAND (Landslide Deposit)**, greenish blue, slightly moist, medium dense, altered andesite fragments (<2"), pyrite mineralization		*	19-16-11 (27)	SPT taken at 50' for reference						
		TD @ 51.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:30 Finish Backfilling @ 15:40						

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BORING NUMBER B-9

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**26.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042604 -118.652807**	Approxiate Surface Elevation:	**211** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/25/2022** to **2/25/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 11:45						
		10"-5' SILTY SAND (Artificial Fill), reddish brown, slightly moist, loose, asphalt fragments				Hand auger to 5'						
5		**5-10' SANDY SILT (Colluvium)**, reddish brown, dry, very stiff, angular mudstone fragments (<0.25"), abundant roots, possible landslide debris based on geomorphology		B9-1R	8-12-12 (24)				33	24	9	
10				B9-2B								
		10-26.5' BEDROCK (Interbedded Siltstone and Claystone), dark reddish brown to light reddish brown with orangish oxidation streaks, dry, hard, highly weathered, gypsum veins <0.25"), poorly consolidated, possible landslide debris based on geomorphology		B9-3R	10-26-50/5"							
15				B9-4R	22-32-43 (75)							
20				*	20-32-36 (68)	SPT taken at 20' for reference						
25				*	12-26-44 (70)	SPT taken at 25' for reference						
		TD @ 26.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 12:45 Finish Backfilling @ 13:40						

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BORING NUMBER B-10

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**31.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042375 -118.653143**	Approxiate Surface Elevation:	**227** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/24/2022** to **2/24/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-6" Asphalt **6"-5' CLAYEY SAND (Artificial Fill)**, light reddish brown, slightly moist, medium dense, asphalt fragments				Start drilling @ 8:15 Hand auger to 5'						
5		**5-10' SANDY CLAY (Colluvium)**, light reddish brown, dry, hard, high plasticity, possible landslide debris based on geomorphology		B10-1R	8-22-30 (52)		106.1	16	54	20	34	
10				B10-2B								
		10-31.5' BEDROCK (Interbedded Siltstone and Mudstone), dark brown, dry, hard, highly weathered, caliche pockets and veins, sandstone and siltstone fragments (<0.5"), gypsum/caliche? veins (<1 mm), possible landslide debris based on geomorphology		B10-3R	16-19-29 (48)							
15				B10-4R	12-23-36 (59)							
20		@ 20' color change to reddish brown, mudstone fragments, becomes very stiff		*	8-10-12 (22)	SPT taken at 20' for reference						
25				*	9-11-14 (25)	SPT taken at 25' for reference						
30		**30-31.5' BEDROCK (Mudstone)**, dark brown, dry, low hardness to moderately hard, moderately weathered, fissile, gypsum veins, possible landslide debris based on geomorphology		*	9-12-16 (28)	SPT taken at 30' for reference						
		TD @ 31.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:40 Finish Backfilling @ 10:40						

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BORING NUMBER B-11

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042232 -118.65368**	Approxiate Surface Elevation:	**255** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/23/2022** to **2/23/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-12" Asphalt				Start drilling @ 13:20						
		1-5' CLAYEY SAND (Colluvium), reddish brown, slightly moist, medium dense, abundant roots				Hand auger to 5'						
5		**5-21.5' BEDROCK (Interbedded Siltstone and Mudstone)**, reddish to dark brown, dry, moderately hard to hard, highly weathered, abundant gypsum veins (<4 mm)		B11-1R	4-9-23 (32)	@ 5' Sample disturbed	105.6	18.2	39	18	21	
				B11-2B								
10		@ 10' becomes moderately weathered		B11-3R	26-35-40 (75)							
15				B11-4R	23-50/5"							
20		@ 20' Decreasing gypsum veins; becomes dark reddish brown		*	15-22-28 (50)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:00 Finish Backfilling @ 14:40						

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BORING NUMBER B-12

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042907 -118.654603**	Approxiate Surface Elevation:	**307** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/23/2022** to **2/23/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-8" Asphalt				Start drilling @ 10:35						
		8"-5' SILTY SAND (Colluvium), light brown, dry, loose, abundant roots, subangular andesite fragments (<2")				Hand auger to 5'						
5		**5-20' BEDROCK (Andesite Breccia)**, tan to dark brown to yellowish brown, dry, hard, moderately weathered, caliche veins common (<0.5")		B12-1R	15-42-50/5"				41	29	12	
				B12-2B								
10				B12-3R	18-30-50 (80)							
15				B12-4R	17-37-50/4"							
20		**20-21.5' BEDROCK (Interbedded Siltstone and Claystone)**, dark reddish brown with orangish-brown oxidation streaks, dry, hard, highly weathered, caliche veins common (<0.5")		*	14-14-27 (41)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 11:15 Finish Backfilling @ 12:00						

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BORING NUMBER B-13

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04357 -118.65512**	Approxiate Surface Elevation:	**350** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/23/2022** to **2/23/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-8" Asphalt				Start drilling @ 8:25						
		8"-5' CLAYEY SAND (Artificial Fill), reddish brown, slightly moist, loose to medium dense, fine to medium-grained, asphalt fragments				Hand auger to 5'						
5		**5-21.5' BEDROCK (Silty Sandstone)**, light grayish brown with orange oxidation streaks, slightly moist, moderately hard, highly weathered		B13-1R	10-12-25 (37)		115.4	14.7	39	16	23	
				B13-2B								
10				B13-3R	18-24-33 (57)							
15				B13-4R	18-28-36 (64)							
20		**20-21.5' BEDROCK (Claystone)**, greenish gray, dry, moderately hard, low plasticity, silstone layer <2" thick		*	12-16-20 (36)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:30 Finish Backfilling @ 10:15						

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BORING NUMBER B-14

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**26.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.044262 -118.655465**	Approxiate Surface Elevation:	**384** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/22/2022** to **2/22/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-7" Asphalt **7"-5' SILTY SAND (Artificial Fill)**, light brown, dry, loose, angular mudstone fragments (<1"), abundant roots				Start drilling @ 12:50 Hand auger to 5'						
5		**5-26.5' BEDROCK (Andesite Breccia)**, excavates to silty sand, reddish to yellowish brown with white-black mottling, slightly moist, moderately hard, highly weathered, angular andesite fragments (<0.5")		B14-1R	11-14-19 (33)							32
				B14-2B								
10		@ 10' andesite fragments increase to 1" in length		B14-3R	12-15-20 (35)							
15		@ 15' decreasing andesite fragments		B14-4R	22-24-22 (46)							
20		@ 20' becomes softer		*	10-8-9 (17)	SPT taken at 20' for reference						
25		@ 25' caliche nodules and gypsum veins		*	10-9-12 (21)	SPT taken at 25' for reference						
		TD @ 26.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:05 Finish Backfilling @ 15:00						

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BORING NUMBER B-15

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**26.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.044508 -118.65575**	Approxiate Surface Elevation:	**401** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/22/2022** to **2/22/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-7" Asphalt **7"-5' SILTY SAND (Artificial Fill)**, light brown, dry, loose, subrounded silstone fragments (<3")				Start drilling @ 8:30 Hand auger to 5'						
5		**5-15' BEDROCK (Siltstone)**, olive to grayish brown to dark brown, dry, moderately hard, highly weathered, caliche veins		B15-1R	17-25-32 (57)		118.8	9.7	28	17	11	
				B15-2B								
10		@ 10' becomes yellowish brown, sandstone fragments		B15-3R	17-29-39 (68)							
15		**15-20' BEDROCK (Andesite Breccia)**, dark gray to yellowish brown, dry, moderately hard, moderately weathered		B15-4R	9-23-24 (47)							
20		**20-25' BEDROCK (Interbedded Siltstone and Mudstone)**, reddish brown, dry, low hardness, highly weathered, subangular andesite fragments (<1"), grayish brown silty sandstone layer (<4")		*	11-12-16 (28)	@ 18' Driller notes that it feels like he's drilling through gravel layer SPT taken at 20' for reference						
25		**25-26.5' BEDROCK (Andesite Breccia)**, yellowish brown, dry, moderately hard, highly weathered		*	22-26-27 (53)	SPT taken at 25' for reference						
		TD @ 26.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:50 Finish Backfilling @ 10:40						

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BORING NUMBER B-16

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**31.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.044973 -118.656194**	Approxiate Surface Elevation:	**431** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/18/2022** to **2/18/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 8:00						
		10"-5' SILTY SAND (Artificial Fill), brown, slightly moist, loose				Hand auger to 5'						
5		**5-14.5' SANDY CLAY (Landslide Deposit) with andesite breccia and mudstone fragments**, dark brown, dry to slightly moist, very stiff to hard, caliche veins		B16-1R	8-10-22 (32)		108.6	12.5	32	21	11	
				B16-2B								
10				B16-3R	18-34-50/4"							
				*	21-23-23-25 (46)	SPT taken at 12.5' for reference; 2' sampler used						
				*	16-15-16 (31)	SPT taken at 14.5' for reference						
15		@ 14.5' clay layer with caliche veining 1.5-2" thick (slide plane)		B16-4R	20-19-29 (48)							
		14.5-20' BEDROCK (Interbedded Sandstone and Mudstone), yellowish to reddish brown, slightly moist, moderately hard, highly weathered, caliche nodules and veins, some clay infilling within joints		*	16-68/5"	SPT taken at 16.5' for reference; 2' sampler used						
20		**20-25' BEDROCK (Andesite Breccia)**, dark brown to black with reddish brown oxidation streaks, dry, moderately hard, highly weathered, clay infilling in fractures		*	16-27-27 (54)	SPT taken at 20' for reference						
25		**25-31.5' BEDROCK (Mudstone)**, dark brown to black, dry, hard, moderately weathered, somewhat fissile, gypsum veins (<2 mm)		*	21-43-50/3"	SPT taken at 25' for reference						
30												
		TD @ 31.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 10:15 Finish Backfilling @ 11:15						

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BORING NUMBER B-17

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**26.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.045715 -118.65709**	Approxiate Surface Elevation:	**486** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/18/2022** to **2/18/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-8" Asphalt				Start drilling @ 12:20						
		8"-5' SILTY SAND to SANDY SILT (Artificial Fill), reddish brown, dry, loose				Hand auger to 5'						
5		**5-15' SILTY CLAY to SANDY SILT (Colluvium)**, mottled green to reddish brown to light brown, dry, medium stiff, caliche veins		B17-1R	7-10-12 (22)				32	18	14	
				B17-2B								
10				B17-3R	9-7-6 (13)							
15		**15-26.5' BEDROCK (Sandstone)**, greenish gray, slightly moist, friable to moderately hard, highly weathered, fine-grained		B17-4R	11-11-16 (27)							
20		@ 20' interbedded greenish gray claystone and black medium to coarse-grained sandstone (<1")		*	12-16-15 (31)	SPT taken at 20' for reference						
25				*	7-12-23 (35)	SPT taken at 25' for reference						
		TD @ 26.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 13:20 Finish Backfilling @ 14:00						

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BORING NUMBER B-18

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.046127 -118.657516**	Approxiate Surface Elevation:	**513** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/17/2022** to **2/17/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-11" Asphalt				Start drilling @ 12:45						
		11"-5' CLAYEY SAND (Artificial Fill), light reddish brown, slightly moist, loose, asphalt fragments (<3")				Hand auger to 5'						
5		**5-21.5' BEDROCK (Interbedded Claystone and Siltstone)**, yellowish orange-brown, dry, hard, moderately weathered, jointed with manganese on joint faces, steeply dipping bedding planes		B18-1R	14-14-20 (34)							
				B18-2B								
10				B18-3R	15-45-50/3"		106.5	13.9				
15				B18-4R	41-50/5"							
20		@ 20' clay layers dipping ~20-30 degrees (<4 mm) and quartz vein (<0.5")		*	14-31-40 (71)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 13:46 Finish Backfilling @ 14:30						

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BORING NUMBER B-19

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.045824 -118.658638**	Approxiate Surface Elevation:	**486** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/17/2022** to **2/17/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-6" Asphalt				Start drilling @ 9:45						
		6"-5' SILTY SAND (Colluvium), yellowish-orangish brown, dry, loose, abundant roots				Hand auger to 3'						
5		**5-21.5' BEDROCK (Sandstone)**, yellowish brown, dry, moderately hard to hard, moderately weathered, subrounded to subangular volcanic and chert(?) fragments (<1"), caliche cementation		B19-1R	16-32-50/3"		120.8	5.5				
				B19-2B								
10				B19-3R	38-50/2"							
15		@ 15' becomes greenish gray		B19-4R	23-39-50/5"							
20				*	11-22-29 (51)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 10:35 Finish Backfilling @ 11:10						

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BORING NUMBER B-20

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**20.8** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.045425 -118.658706**	Approxiate Surface Elevation:	**467** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/17/2022** to **2/17/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-8" Asphalt				Start drilling @ 7:50						
		8"-5' SILTY SAND (Artificial Fill), reddish brown, slightly moist, loose, sandstone fragments (<0.25"), trace clay				Hand auger to 5'						
5		**5-10' SILTY CLAY (Colluvium)**, reddish brown, dry, stiff, low plasticity		B20-1R	6-7-13 (20)				39	21	18	
				B20-2B								
10		**10-15' BEDROCK (Sandstone)**, yellowish brown, dry, hard, highly weathered, fine-grained, steeply dipping clay filled joints up to 4 mm thick		B20-3R	30-50/5"							
15		**15-21.5' BEDROCK (Siltstone)**, grayish brown, dry, hard, moderately weathered, fine-grained, caliche veins, micaceous		B20-4R	36-50/5"							
20		@ 20' light greenish gray claystone layers (<1")		*	21-50/4"	SPT taken at 20' for reference						
		TD @ 20.8' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 8:30 Finish Backfilling @ 9:30						

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BORING NUMBER B-21

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.044739 -118.658081**	Approxiate Surface Elevation:	**466** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/16/2022** to **2/16/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 14:00						
		10"-5' SILTY SAND (Artificial Fill), reddish brown, slightly moist, loose, asphalt fragments				Hand auger to 5'						
5		**5-15' CLAY (Colluvium)**, brown, very stiff, dry, low to high plasticity, sandstone fragments (<1")		B21-1R	3-8-17 (25)	@ 5' Sample disturbed	108.7	15.2	54	16	38	
				B21-2B								
10				B21-3R	13-24-28 (52)							
15		**15-21.5' BEDROCK (Interbedded Sandstone and Siltstone)**, yellowish to grayish brown, dry, moderately hard to hard, moderately weathered, jointed, manganese on joint faces, gypsum and calcite crystals in matrix		B21-4R	43-50/4"							
20				*	11-14-21 (35)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:50 Finish Backfilling @ 15:20						

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BORING NUMBER B-22

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04413 -118.65734**	Approxiate Surface Elevation:	**443** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/16/2022** to **2/16/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 10:10						
		10"-5' SILTY SAND (Artificial Fill), reddish brown, dry, loose, trace clay				Hand auger to 5'						
5		**5-21.5' BEDROCK (Sandstone)**, reddish to yellowish brown, dry, hard, highly weathered, fine to medium-grained, jointed, caliche veins, gypsum veins (<2 mm)		B22-1R	19-34-50/5"				33	12	21	
				B22-2B								
10		@ 10' reddish brown claystone layers (<2")		B22-3R	19-47-47 (94)		121.8	3.8				
15		@ 15' quartz veins (<4 mm)		B22-4R	40-50/2"							
20				*	20-30-29 (59)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 11:00 Finish Backfilling @ 12:10						

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BORING NUMBER B-23

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.0434 -118.657753**	Approxiate Surface Elevation:	**398** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/16/2022** to **2/16/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 8:00						
		10"-5' CLAYEY SAND (Artificial Fill), reddish brown, slightly moist, loose, asphalt and gravel fragments (<0.5")				Hand auger to 5'						
5		**5-10' SANDY CLAY (Colluvium)**, reddish brown, slightly moist, stiff, low plasticity, trace roots		B23-1R	3-5-9 (14)				29	14	15	
				B23-2B								
10		**10-21.5' BEDROCK (Sandstone)**, yellowish to reddish brown, dry, hard, moderately weathered, fine to medium-grained, micaceous, silt layers (<2 mm)		B23-3R	42-50/5"							
15		@ 15' reddish brown claystone layers (<0.1")		B23-4R	28-40-50/3"							
20		@ 20' quartz veins (<5 mm), dipping ~35-degrees		*	15-31-41 (72)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 8:55 Finish Backfilling @ 9:30						

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BORING NUMBER B-24

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**15.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04298 -118.65784**	Approxiate Surface Elevation:	**379** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/15/2022** to **2/15/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 13:05						
		10"-5' CLAYEY SAND (Artificial Fill), brown, dry, loose, asphalt fragments				Hand auger to 5'						
5		**5-15' BEDROCK (Sandstone)**, yellowish brown, dry, moderately hard, highly weathered, caliche veins; upper 5' very weathered		B24-1R	6-8-11 (19)		87.6	18	45	30	15	
				B24-2B								
10				B24-3R	11-50							
						@ 12-15' Tough drilling. Driller said it felt gravelly.						
15		@ ~14' subrounded silicified diabase (?) fragments (<4" in length)										
		15-15.5' BEDROCK (Diabase), gray-black-white mottled, dry, very hard, moderately weathered, coarse-grained with plagioclase (<2 mm), minor calcite infilling in voids and inbetween phenocrysts		B24-4R	50	@ 15' Sample very disturbed; attempted to continue advancing, but hit refusal						
		TD @ 15.5' due to Refusal Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:00 Finish Backfilling @ 14:40						

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BORING NUMBER B-25

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04262 -118.657915**	Approxiate Surface Elevation:	**361** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/15/2022** to **2/15/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-11" Asphalt				Start drilling @ 10:05						
		11"-5' CLAYEY SAND (Artificial Fill), reddish brown, slightly moist, loose, abundant roots				Hand auger to 5'						
5		**5-10' SANDY CLAY (Colluvium)**, reddish brown, dry, medium dense, low plasticity, rootlets, tan silt layers (<0.5"); could be weathered bedrock		B25-1R	4-5-18 (23)				39	18	21	84
				B25-2B								
10		**10-21.5' BEDROCK (Sandstone)**, yellowish brown, dry, hard, moderately weathered, fine-grained		B25-3R	13-45-50/2"							
15		**15-20' BEDROCK (Claystone)**, reddish brown, dry, hard, moderately weathered, gray medium-grained sandstone fragments (<0.25"), micaceous		B25-4R	17-50/4"	@ 15-20' Hard drilling per driller						
20		**20-21.5' BEDROCK (Sandstone)**, yellowish brown, dry, hard, moderately weathered, fine-grained		*	19-23-31 (54)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 10:55 Finish Backfilling @ 11:30						

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BORING NUMBER B-26

CLIENT PMD III (Waterworks Division)
PROJECT NAME Carbon Canyon/Mesa Waterline Replacement
PROJECT NUMBER Y5292322
PROJECT LOCATION Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**20.8** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.042146 -118.657533**	Approxiate Surface Elevation:	**329** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/15/2022** to **2/15/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-11" Asphalt				Start drilling @ 8:00						
		11"-5' SILTY SAND (Artificial Fill), brown, slightly moist, loose to medium dense, asphalt fragments				Hand auger to 5'						
5		**5-21' BEDROCK (Sandstone)**, light yellowish brown, dry, hard, highly weathered, silt/clay filled joints (<2 mm), fine-grained		B26-1R	10-22-23 (45)		116.9	6.9	28	13	15	
				B26-2B								
10		@ 10' manganese staining on joint surfaces		B26-3R	20-30-50/5"							
15		@ 15' trace coarse-grained sand		B26-4R	38-50/3"							
20				*	29-50/4"	SPT taken at 20' for reference						
		TD @ 21' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:00 Finish Backfilling @ 9:30						

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BORING NUMBER B-27

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04161 -118.65666**	Approxiate Surface Elevation:	**303** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/14/2022** to **2/14/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-8" Asphalt				Start drilling @ 13:40						
		8"-5' SILTY SAND (Artificial Fill), light yellowish brown, dry, loose, clumps of tan silt (<0.5")				Hand auger to 5'						
5		**5-10' BEDROCK (Interbedded Siltstone and Sandstone)**, light brown to yellowish brown to reddish brown, dry, moderately hard, highly weathered, sandstone is fine- to medium-grained		B27-1R	6-21-30 (51)		94.5	17.4	41	21	20	
				B27-2B								
10		**10-21.5' BEDROCK (Sandstone)**, yellowish brown, dry, friable to moderately hard, moderately weathered, fine-grained, joints with manganese staining on joint faces, micaceous, caliche veins		B27-3R	11-19-26 (45)							
15				B27-4R	9-10-17 (27)							
20		@ 20' becomes softer, more friable		*	7-5-8 (13)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 14:22 Finish Backfilling @ 15:05						

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BORING NUMBER B-28

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**21.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.041332 -118.655993**	Approxiate Surface Elevation:	**278** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/14/2022** to **2/14/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-9" Asphalt				Start drilling @ 10:35						
		9"-5' CLAYEY SILT (Artificial Fill), dark brown, slightly moist, stiff				Hand auger to 5'						
5		**5-20' SANDY SILT (Marine Terrace Deposits)**, light to dark brown, dry, very stiff		B28-1R	5-11-15 (26)							
				B28-2B								
10		@ 10' shale fragment in sampler tip (<1")		B28-3R	9-16-21 (37)							
15				B28-4R	9-14-20 (34)							
20		**20-21.5' BEDROCK (Sandstone)**, reddish to dark brown, dry, friable to low hardness, highly weathered, fine to medium-grained, quartz veins (<2 mm)		*	8-11-22 (33)	SPT taken at 20' for reference						
		TD @ 21.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 11:15 Finish Backfilling @ 12:15						

Los Angeles County Public Works
Geotechnical and Materials Engineering Division
900 South Fremont Avenue, Alhambra, CA 91803

BORING NUMBER B-29

CLIENT PMD III (Waterworks Division) **PROJECT NAME** Carbon Canyon/Mesa Waterline Replacement

PROJECT NUMBER Y5292322 **PROJECT LOCATION** Malibu

Drilling Contractor:	**Gregg Drilling**	Boring Location:	**Carbon Mesa Road, Malibu**	Drilled Total Depth:	**26.5** ft.	Logged By:	**MC**
Drilling Method:	**Hollow Stem Auger**	Lat. and Long. Coordinates:	**34.04108 -118.65542**	Approxiate Surface Elevation:	**257** ft.	Checked By:	**KB**
Drill Rig Type:	**Truck-mounted CME-95**	Drill Bit Diameter:	**8** in.	Depth to Groundwater:	**NA** ft.	Inclination/ Bearing (°):	**90**
Hammer Description:	**140-Pound Autohammer**	Finished Diameter:	**8** in.	Dates(s) Drilled:	**2/14/2022** to **2/14/2022**		

Notes:

DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	COMMENTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0-10" Asphalt				Start drilling @ 8:00						
		10"-10' CLAYEY SAND (Artificial Fill), dark brown, slightly moist, loose to medium dense, asphalt fragments				Hand auger to 5'						
5				B29-1R	4-9-19 (28)							
10				B29-2B								
		10-20' SILTY SAND (Marine Terrace Deposits), reddish brown, slightly moist, medium dense, sandstone fragments (<1"), trace reddish clay		B29-3R	8-18-21 (39)							
15				B29-4R	8-10-8 (18)							
20		**20-26.5' SILTY SAND to SANDY SILT (Marine Terrace Deposits)**, light brown, dry, medium dense/stiff		*	8-8-9 (17)	SPT taken at 20' for reference						
25				*	4-6-9 (15)	SPT taken at 25' for reference						
		TD @ 26.5' Groundwater or Seepage Not Encountered Backfilled with Portland Cement Surface Completed with Dyed Concrete				TD @ 9:15 Finish Backfilling @ 10:05						