90% Remedial Design Basis of Design Report

Appendix H
Structural Engineering Criteria

STRUCTURAL CALCULATIONS
90% SUBMITTAL

LOWER DUWAMISH WATERWAY
UPPER REACH ENGINEERING SERVICES AND SEDIMENTATION CLEAN UP

PREPARED FOR: ANCHOR QEA

DATE: JULY 20, 2023

BEI NO. 252.01

Bright Engineering Inc.
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LOWER DUWAMISH WATERWAY
UPPER REACH ENGINEERING SERVICES AND SEDIMENTATION CLEAN UP

TABLE OF CONTENTS

Date: December 2022 By: SL, AB BEI No. Sheet No. 1 of 10 Sheets

Subject: Engineering Services for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

A - DESIGN CRITERIA AND GENERAL INFORMATION

Relevant Codes and Standards

AISC Steel Construction Manual, Fifteenth Edition, 2017

ASCE/ SEI 7-16 Minimum Design Loads and Associated Criteria for Building and Other Structures

AWS D1.1/D1.1M: 2015 Structural Welding Code-Steel

IBC (International Building Code), 2018

SBC (Seattle Building Code), 2018

B - MATERIAL PROPERTIES

Structural steel

Wide flange shapes: ASTM A572 or ASTM A992, Grade 50, unless otherwise noted.

Tees, channels, angels, plates & bars: ASTM A36, unless otherwise noted.

Pipe Piles: ASTM A252, Grade 3 (Mod), fy = 50ksi, or API 5Lx42 or API 5Lx52

Sheet Piles: ASTM A572, Grade 50, fy = 50ksi (Type PZ)

Welding: 70XX Electrodes

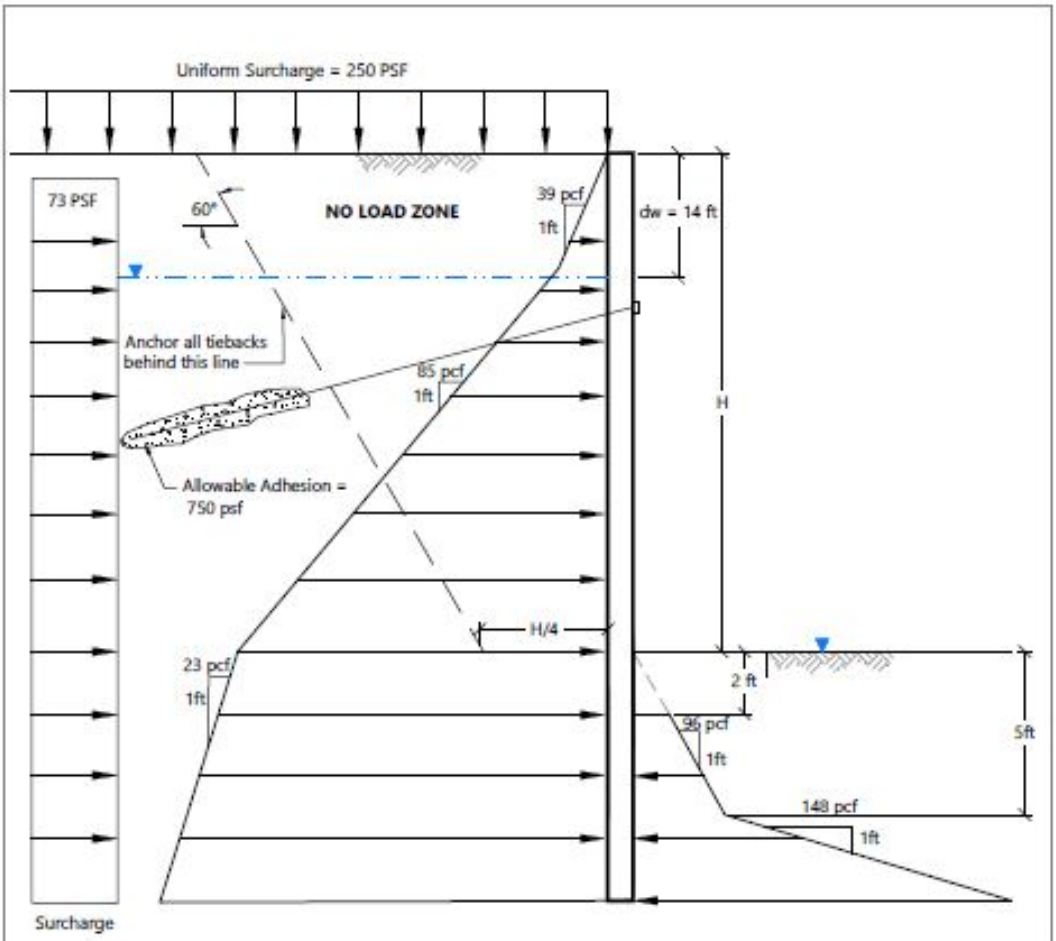
Date: December 2022 By: SL, AB BEI No. Sheet No. 2 of 10 Sheets

Subject: Engineering Services for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

C - FOUNDATION

1. Retaining Walls

Design Soil Lateral Pressures



NOTES:

1. Yielding walls are those walls that will deform at least 0.001 times the height of the wall.
2. Passive pressures are Ultimate values and do not include a factor of safety. We recommend applying a factor of safety of at least 1.5 when computing static passive pressures.
3. Ignore the contribution of the upper 2 feet of soil at the base of the wall when computing passive pressures.
4. Active and at-rest earth pressures are for cantilever walls or walls supported by a single row of tiebacks.
5. Anchor pull out resistance is based on non-pressure-grouted straight shaft anchors. These values should be considered tentative and for planning purposes only. Actual values will need to be determined on the basis of field testing prior to construction.
6. Passive Pressure acts over 2 pile diameters.

Not to Scale

Passive Earth Pressure Reduction Factors			
Offset Distance	Reduction Factor		
	2H:1V	1.5H:1V	1H:1V
0	0.75	0.56	0.38
2	0.85	0.66	0.48
4	0.95	0.76	0.58
3	0.90	0.71	0.53

Additional Design Soil Lateral Pressures Notes:

a) Diagram applies to drilled or driven soldier pile walls with lagging and sheet pile walls designed as a cantilevered wall or with a single row of tieback.
b) All pressures expressed as an equivalent fluid unit weight
c) Active earth and surcharge pressures act over the pile spacing within retained wall height and over pile width or shaft diameter below bottom of excavation, whichever is lesser.
d) Passive resistance are ultimate values. Divide with a safety factor of 1.5 for allowable values.
e) Passive earth pressure acts over 2 times shaft diameter or pile width; or pile spacing, whichever is lesser.
f) 50% of active surcharge pressure act on all lagging between soldier piles.

2. Single Piles

L-PILE Modeling Parameters

Layer	Effective Unit Weight γ' (pcf)	Friction Angle ϕ (°)	Undrained Shear Strength c_u (kip/ft^2)	P-Y Curve Model	Spring Constant; K (Es=Kx) k (pci)	Strain Factor; @50% max E ε_{50}
Recent sediment	36	27	0.08	Soft clay (Matlock)	--	0.020
Alluvium	61	32	--	Sand (Reese)	20	--

D - DESIGN ELEMENTS

1. Bulkheads (ST03)
   NOTE: Design of Wall 2 and Wall 3 have been deferred, therefore not included in this calculation set. Mention of Wall 2 and Wall 3 are for reference only.

   Evaluation Procedure and Assumptions:

   a) Apply Lateral Earth Pressure (LEP) to existing bulkhead assuming the original wall design was based on a similar apparent LEP
      Conservative Assumptions:
      i. Neglect live load surcharge pressures
      ii. Apply passive resistance on pile width (assuming no shaft [unknown] for soldier piles)
      iii. Base of wall at existing grade
   b) Resulting bending moment and displacement become the benchmark for existing wall capacity estimate
   c) Apply full LEP on existing wall with prescribed dredging depths and offsets. Compare bending moments allowing for 10% overstress for temporary and construction condition.
   d) Add temporary or permanent tiebacks, if necessary, to achieve no overstress condition. Consider using temporary tieback if the base of the pile is in good condition and permanent, if not in good condition, provide reinforcing as necessary.
   e) After dredging base of wall will be backfilled to original grade.
   f) Earthquake pressures will not be considered.

Date: December 2022 By: SL, AB BEI No. _____ Sheet No. 5 of 10 Sheets

Subject: Engineering Services for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall 3 - Soldier Pile and Lagging

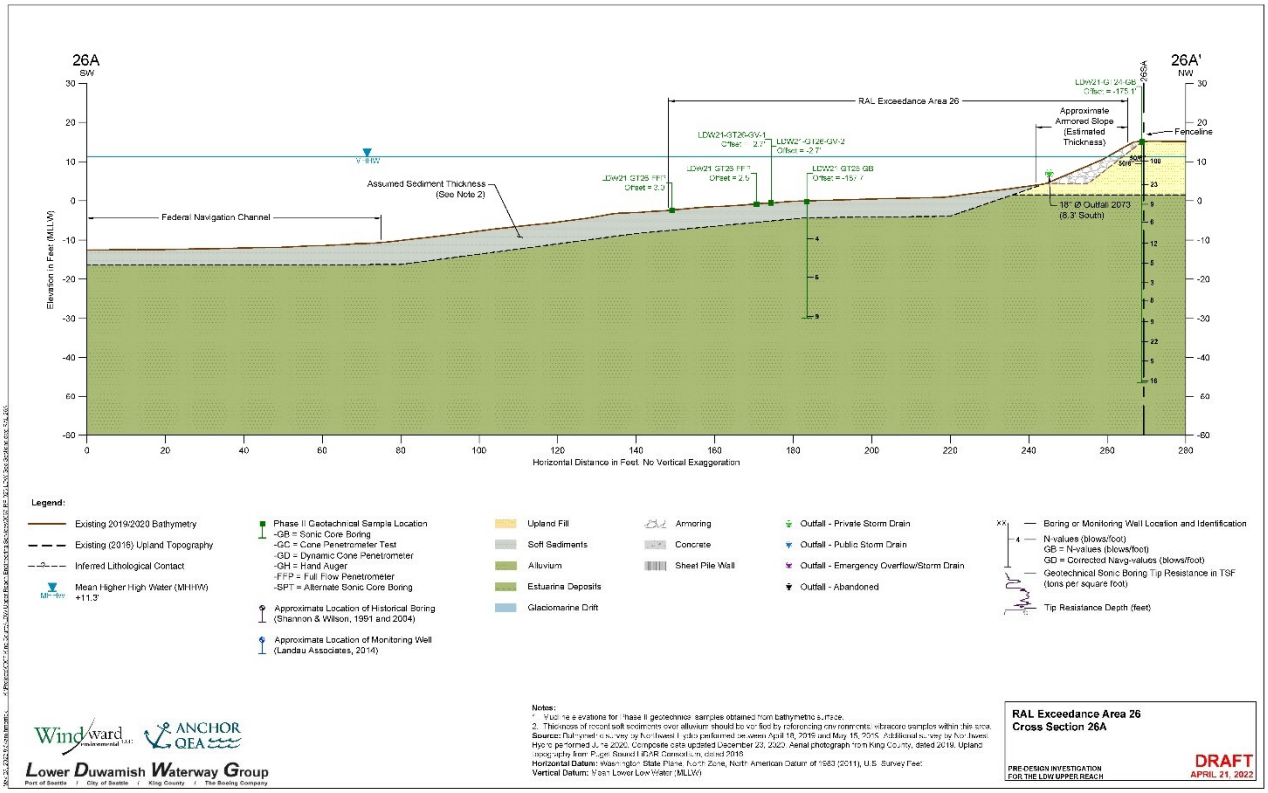
Wall 2 – Anchored Sheet Pile

Center Point (Insurance Auto Auction) – Wall 1

Sheet Piles – Wall 1

Design Parameters:

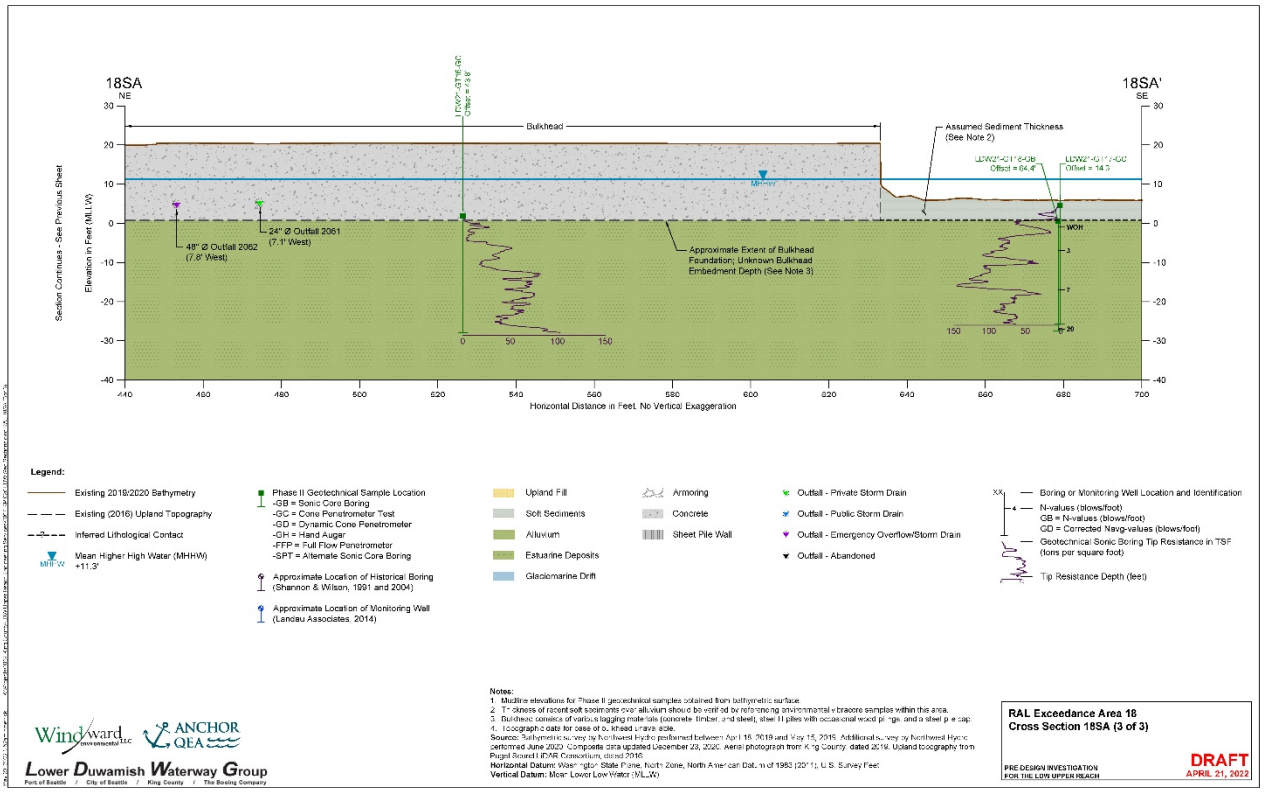
Retained Wall Height = 12’- 6”
Sheet Pile Size = Unknown
Physical and Material Properties = Unknown
Pile Embedment = Unknown
Observations/Condition – Appears to be older section profile; heavy corrosion and loss of section




Wall 1


Wall 1
Slag Debris Pile


Wall 1
Slag Debris

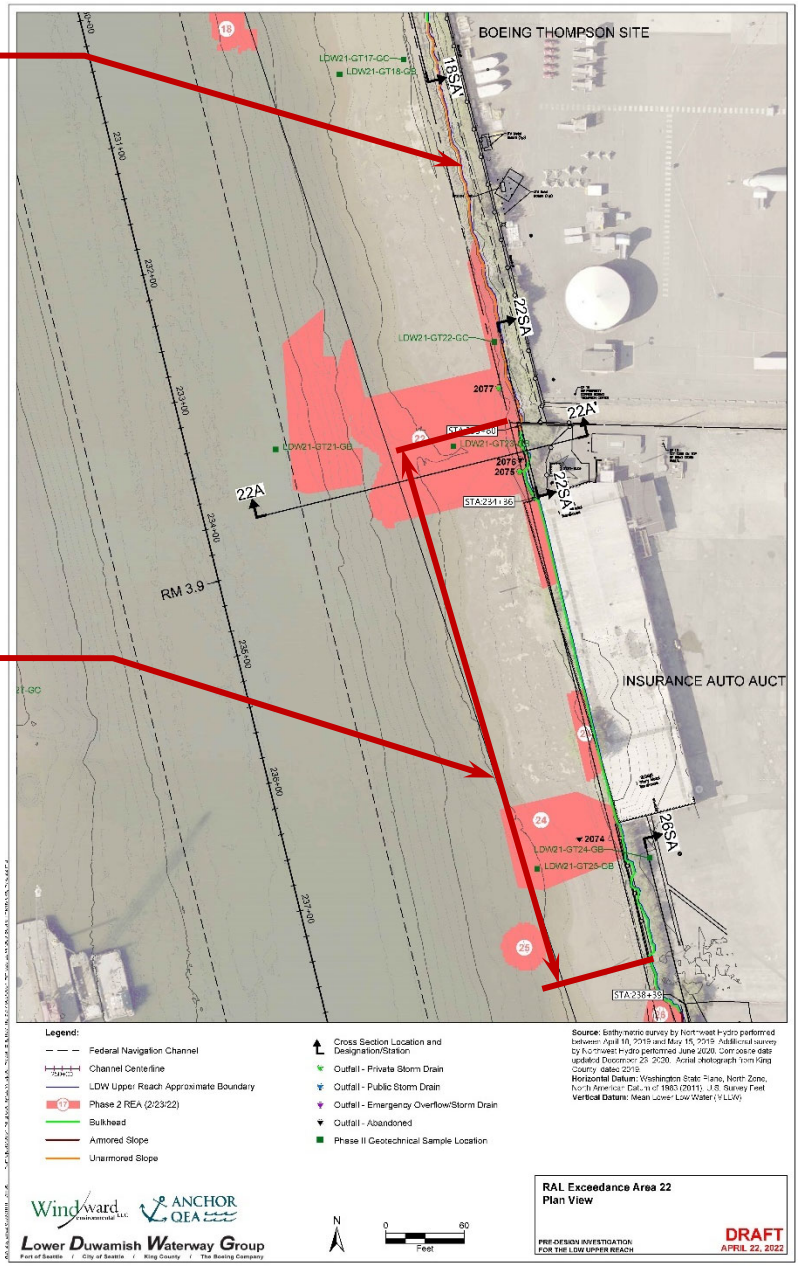

18SA
NE
18SA'
SE
Bulkhead
Assumed Sediment Thickness
(See Note 2)
MHHW
48" Ø Outfall 2062
(7.6' West)
24" Ø Outfall 2061
(7.1' West)
Approximate Extent of Bulkhead
Foundation; Unknown Bulkhead
Embedment Depth (See Note 3)
WOH
Section Continues - See Previous Sheet
Elevation in Feet (MLLW)
Horizontal Distance in Feet. No Vertical Exaggeration
Legend:
Existing 2019/2020 Bathymetry
Existing (2016) Upland Topography
Inferred Lithological Contact
Mean Higher High Water (MHHW)
+11.3'
Phase II Geotechnical Sample Location
-GB = Sonic Core Boring
-GC = Cone Penetrometer Test
-GD = Dynamic Cone Penetrometer
-GH = Hand Augar
-FFP = Full Flow Penetrometer
-SPT = Alternate Sonic Core Boring
Approximate Location of Historical Boring
(Shannon & Wilson, 1991 and 2004)
Approximate Location of Monitoring Well
(Landau Associates, 2014)
Upland Fill
Soft Sediments
Alluvium
Estuarine Deposits
Glaciomarine Drift
Armoring
Concrete
Sheet Pile Wall
Outfall - Private Storm Drain
Outfall - Public Storm Drain
Outfall - Emergency Overflow/Storm Drain
Outfall - Abandoned
Boring or Monitoring Well Location and Identification
N-values (blows/foot)
GB = N-values (blows/foot)
GD = Corrected Navg-values (blows/foot)
Geotechnical Sonic Boring Tip Resistance in TSF
(tons per square foot)
Tip Resistance Depth (feet)
Notes:
1. Mudline elevations for Phase II geotechnical samples obtained from bathymetric surface.
2. Thickness of recent soft sediments over alluvium should be verified by reforencing environmental vibracore samples within this area.
3. Bulkhead consists of various sagging materials (concrete, timber, and steel), steel H piles with occasional wood piles, and a steel pile cap.
4. Topographic data for base of bulkhead shown aside.
Sources: Bathymetric survey by Northwest Hydro performed between April 18, 2019 and May 15, 2019. Additional survey by Northwest Hydro performed June 2020. Composite data updated December 23, 2020. Aerial photograph from King County, dated 2019. Upland topography from Puget Sound LIDAR Consortium, dated 2016.
Horizontal Datum: Washington State Plane, North Zone, North American Datum of 1983 (2011), U.S. Survey Feet
Vertical Datum: Mean Lower Low Water (MLLW)
Windward Environmental LLC
ANCHOR QEA
Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company
RAL Exceedance Area 18
Cross Section 18SA (3 of 3)
PRE-DESIGN INVESTIGATION
FOR THE LOW UPPER REACH
DRAFT
APRIL 21, 2022

Date: December 2022 By: SL, AB BEI No. Sheet No. 9 of 10 Sheets

Subject: Engineering Services for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

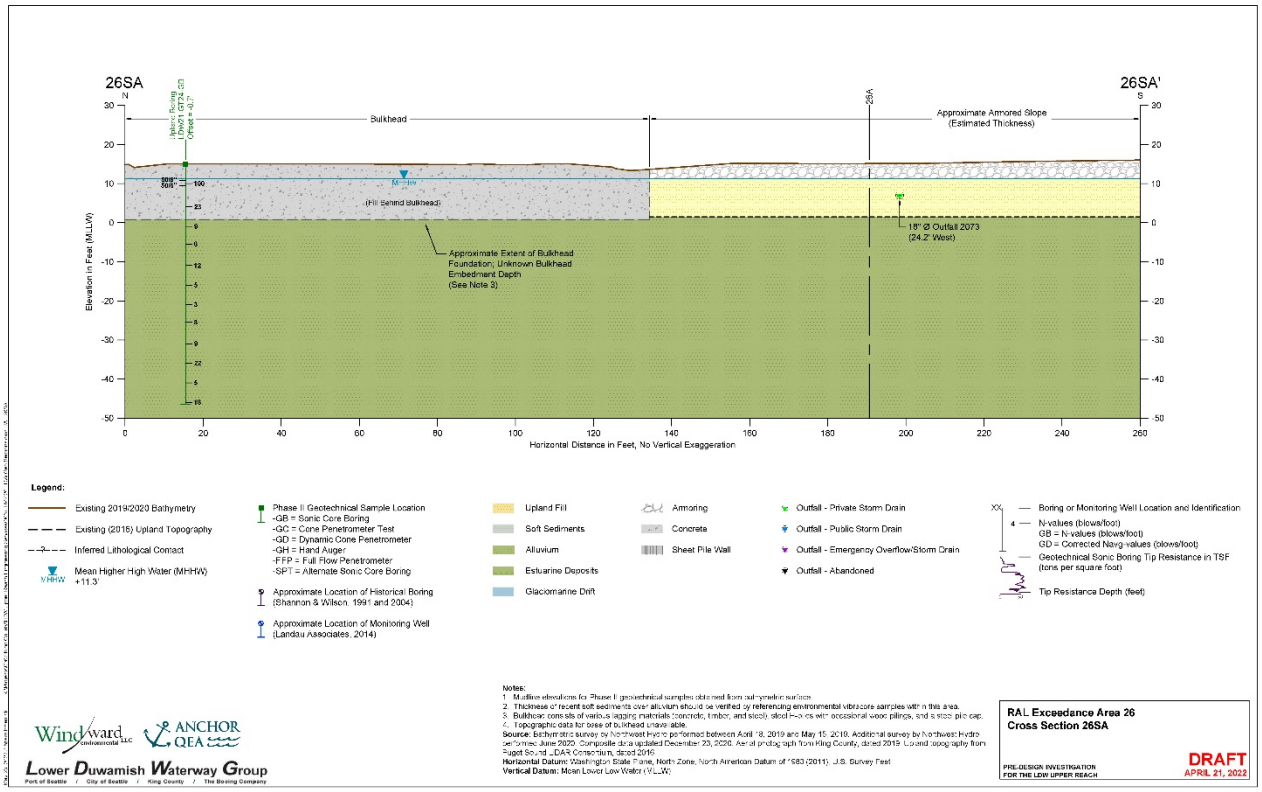
Stub Timber Piles

Wall 1 – Sheet Piles



Date: December 2022 By: SL, AB BEI No. _____ Sheet No. 10 of 10 Sheets

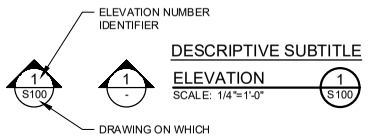
Subject: Engineering Services for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

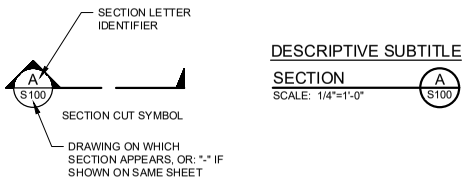


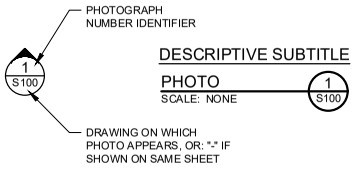
ABBREVIATIONS

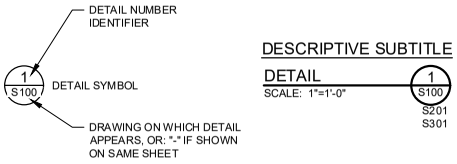
#	NUMBER, POUNDS
&	AND
@	AT
AB	ANCHOR BOLT
AP	ANGLE POINT
APPROX	APPROXIMATE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BLDG	BUILDING
BOT	BOTTOM
BTWN	BETWEEN
CDF	CONTROLLED DENSITY FILL
CIP	CAST-IN-PLACE
CJ	CONSTRUCTION JOINT
CL	CENTER LINE
CLR	CLEAR
CONC	CONCRETE
CONN	CONNECTION
CONT	CONTINUOUS
COORD	COORDINATE
COS	CITY OF SEATTLE
DI	DUCTILE IRON
DIA	DIAMETER
DICA	DRILLED IN CONCRETE ANCHOR
DIM	DIMENSION
DIP	DUCTILE IRON PIPE
DP	DEPTH, DEEP
DWG	DRAWING
E	EAST, EASTING
EA	EACH
EF	EACH FACE
EG	EXISTING GRADE
EJ	EXPANSION JOINT
EL	ELEVATION
EMBD	EMBEDDED
EQ	EQUAL
ES	EACH SIDE
EW	EACH WAY
EXIST	EXISTING
EXP	EXPANSION
FDN	FOUNDATION
FF	FAR FACE OR FINISHED FLOOR
FG	FINISHED GRADE
FIN	FINISHED
FT	FEET OR FOOT
FTG	FOOTING
GA	GAUGE, GAGE
GALV	GALVANIZED
HDPE	HIGH-DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
HP	HIGH POINT
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IN	INCH
INFO	INFORMATION
JT	JOINT
K	KIPS (1,000 POUNDS)
KC	KING COUNTY
KCDNR	KING COUNTY DEPARTMENT OF NATURAL RESOURCES
KIP(S)	THOUSAND POUNDS
KSF	KIPS PER SQUARE FOOT
KSI	KIPS PER SQUARE INCH
L	LENGTH OR ANGLE
LB	POUND
LF	LINEAR FEET
LOC	LOCATION
LONGIT	LONGITUDINAL
LP	LOW POINT
LVL	LEVEL
MAX	MAXIMUM
MHHW	MEAN HIGH HIGH WATER
MIN	MINIMUM
MISC	MISCELLANEOUS
MLLW	MEAN LOW LOW WATER
MLW	MEAN LOW WATER
MSL	MEAN SEA LEVEL
N	NEUTRAL, NORTH, NORTHING
N/A	NOT APPLICABLE
NF	NEAR FACE
NO	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER, CENTERS
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OH	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
PL	PROPERTY LINE OR PLATE
PSE	PUGET SOUND ENERGY
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT, POINT OF TANGENCY, PRESSURE TREATED
PVC	POLYVINYL CHLORIDE
R, RAD	RADIUS, RISER
RCP	REINFORCED CONCRETE PIPE
REBAR	REINFORCEMENT BAR
REF	REFER TO / REFERENCE
REINF	REINFORCEMENT OR REINFORCING
REQD	REQUIRED
ROW, R/W	RIGHT-OF-WAY
SCH	SCHEDULE
SCL	SEATTLE CITY LIGHT
SECT	SECTION
SF	SQUARE FOOT
SHT	SHEET
SIM	SIMILAR
SPCG	SPACING
SPEC(S)	SPECIFICATION(S)
SPU	SEATTLE PUBLIC UTILITIES
SS	STAINLESS STEEL
STA	STATION
STD	STANDARD
STL	STEEL
STRUC	STRUCTURAL
SUPT	SUPPORT
SYM	SYMMETRICAL
TEMP	TEMPORARY
T&B	TOP AND BOTTOM
TOC	TOP OF CONCRETE
TOF	TOP OF FOOTING
TOS	TOP OF STEEL
TOW	TOP OF WALL
TRANS	TRANSVERSE
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL
w/	WITH
w/o	WITHOUT
WP	WORK POINT

LEGEND









SITE PLAN
SCALE: 1/8"=1'-0"

GENERAL NOTES:

1. FIRST NOTE
2. SECOND NOTE

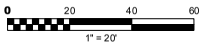
KEY NOTES:

1 FIRST NOTE

2 SECOND NOTE

KEY NOTE INDICATORS

NORTH ARROW



ENGINEERING GRAPHIC SCALE (FOR 20 SCALE)

SEDIMENT MANAGEMENT AREA NUMBER

STRUCTURAL LEGEND:

- CONCRETE
- EARTH
- BACKFILL
- EXISTING STRUCTURE TO BE REMOVED
- EXISTING STRUCTURE ABANDON IN PLACE
- STEEL

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company

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1809 7TH AVENUE
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PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
90% DRAFT
JULY 2023

STATE OF WASHINGTON — 19813 — REGISTERED PROFESSIONAL ENGINEER — STRUCTURAL

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA		
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED		
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18		
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX		

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

STRUCTURAL ABBREVIATIONS AND SYMBOLS

DATE: JULY 2023
DRAWING NO: **S001**
WP701-G-00001
SHT NO / TOTAL: 73 / 87
REV NO: 0

G-011

STRUCTURAL GENERAL NOTES

DESIGN CRITERIA
APPLICABLE BUILDING NOTES AND CODES
INTERNATIONAL BUILDING CODE, IBC 2018 EDITION, EXCEPT WHERE OTHER CODES ARE MORE RESTRICTIVE.

OUTFALLS AND STRUCTURE PROTECTION
ALL OUTFALLS OR STRUCTURES NEAR DREDGING OR EXCAVATION SHALL BE PROTECTED PRIOR TO START OF WORK.

FOUNDATION PILING
CONSULT SOILS REPORT BY ANCHOR QEA ENGINEERS, DATED AUGUST 2022 FOR FOUNDATION DREDGING AND BACKFILL INFORMATION

STRUCTURAL STEEL PILES
STEEL PIPE PILES - 14" DIA WITH ½" MINIMUM WALL THICKNESS PER ASTM A252, GRADE 3 (MOD), fy= 50 ksi OR API 5Lx42 OR API 5Lx52.

SHEET PILES
INTERLOCKING STEEL SHEET PILES SHALL BE NEW, CONFORMING TO ASTM A572, GRADE 50.
MINIMUM WEB OR FLANGE THICKNESS = 0.40 INCHES
MINIMUM ELASTIC SECTION MODULUS = 88.0 IN^3/FT
SHEET PILES SHALL BE SUPPLIED IN DOUBLE SECTIONS WHEREVER POSSIBLE.

WELDING
ALL WELDING SHALL CONFORM TO AWS D1.1 WELDING CODE. MINIMUM SIZE WELDS 3/16" CONTINUOUS FILLET. WELDING ELECTRODES SHALL BE 70XX SERIES CONFORMING TO ANSI/AWS D1.1 TABLE 3.1 AND ELECTRODE SPECIFICATION AWS A5. WELDING SHALL BE CONDUCTED BY WABO CERTIFIED WELDER.

PAINTING
STRUCTURAL STEEL SHALL BE COATED IN CONFORMANCE WITH SPECIFICATIONS

CONCRETE
ALL DETAILING, FABRICATION, AND ERECTION OF REINFORCING BARS, UNLESS OTHERWISE NOTED, SHALL BE IN ACCORDANCE WITH MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES ACI 315, LATEST EDITION. CONCRETE CONSTRUCTION SHALL CONFROM TO ACI 318 BUILDING CODE, LATEST EDITION.

DESIGN STRENGTH
UNDERWATER CEMENT GROUT SHALL CONFORM TO ASTM C1107 AND CRD-C-621
f'c= 5000 psi AT 28 DAYS

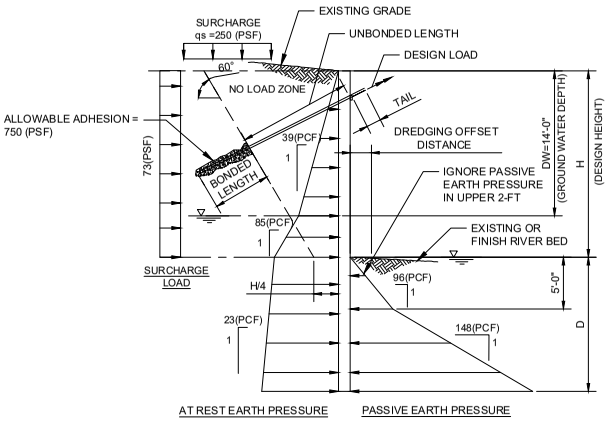
REINFORCING STEEL SHALL BE IN ACCORDANCE WITH ASTM A615, GRADE 60.

MISCELLANEOUS
SUBMIT ALL REQUIRED SHOP DRAWINGS AND RECEIVE THEIR SATISFACTORY REVIEW FROM THE PROJECT REPRESENTATIVE PRIOR TO FABRICATION.

COORDINATE AND VERIFY ALL DIMENSIONS WITH GENERAL AND CIVIL DRAWINGS AND CONDITIONS AT THE PROJECT SITE PRIOR TO STARTING WORK AND NOTIFY THE PROJECT REPRESENTATIVE IMMEDIATELY OF ANY DISCREPANCIES.

PROVIDE TEMPORARY ERECTION BRACING AND SHORING AS REQUIRED FOR STABILITY OF THE STRUCTURE AND ADJACENT STRUCTURES, DURING ALL PHASES OF CONSTRUCTION. REFER TO PROJECT SPECIFICATIONS FOR INFORMATION NOT CONTAINED IN THESE GENERAL NOTES.

SOIL PRESSURE DIAGRAM



PASSIVE EARTH PRESSURE REDUCTION FACTORS			
OFFSET DISTANCE	REDUCTION FACTOR		
	2H:1V	1.5H:1V	1H:1V
0	0.75	0.56	0.38
2	0.85	0.66	0.48
4	0.95	0.76	0.58

L-PILE MODELING PARAMETERS						
LAYERS	EFFECTIVE UNIT WEIGHT ɣ'(PCF)	FRICTION ANGLE Φ (DEG)	UNDRAINED SHEAR STRENGTH C_U (KSF)	P.Y CURVE MODEL	SPRING CONSTANT;K (Es=Kx) K (PCI)	STRAIN FACTOR; @50% MAX E ε_{50}
RECENT SEDIMENT	36	27	0.08	SOFT CLAY (MATLOCK)	-	0.020
ALLUVIUM	61	32	-	SAND (REESE)	20	-

NOTES:
1. DIAGRAM APPLIES TO DRILLED SOLDIER PILE WALLS WITH TIMBER LAGGING AND SHEET PILE WALLS DESIGNED AS A CANTILEVERED WALL OR WITH A SINGLE ROW OF TIEBACK.
2. ALL PRESSURES EXPRESSED AS AN EQUIVALENT FLUID UNIT WEIGHT.
3. ACTIVE EARTH AND SURCHARGE PRESSURES ACT OVER THE PILE SPACING WITHIN RETAINED WALL HEIGHT AND OVER PILE WIDTH OR SHAFT DIAMETER BELOW BOTTOM OF EXCAVATION, WHICHEVER IS LESSER.
4. PASSIVE EARTH PRESSURE ACTS OVER 2 TIMES SHAFT DIAMETER OR PILE WIDTH; OR PILE SPACING, WHICHEVER IS LESSER
5. 50% OF ACTIVE AND SURCHARGE PRESSURES ACT ON ALL LAGGING BETWEEN SOLDIER PILES.
6. PASSIVE RESISTANCE ARE ULTIMATE VALUES. DIVIDE WITH A SAFETY FACTOR OF 1.5 FOR ALLOWABLE VALUE.

CANTILEVER SOLDIER PILE OR SHEET PILE

PRESSURE DIAGRAM

SCALE: NTS

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company

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PRE-FINAL ISSUE DRAWING
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DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

STRUCTURAL GENERAL NOTES AND SOIL PRESSURE DIAGRAM

DATE: JULY 2023
DRAWING NO: **S002**
WP701-G-00001
SHT NO / TOTAL: 74 / 87
REV NO: 1

1-012

STATEMENT OF SPECIAL INSPECTIONS AND TESTING

TABLE 1
REQUIRED SPECIAL INSPECTIONS - STRUCTURAL SYSTEMS

SYSTEM OR MATERIAL	REQUIRED INSPECTION	FREQUENCY OF INSPECTION		REMARKS
		CONTINUOUS	PERIODIC	
SOILS	DREDGING AND IN-WATER WORK		X	31 09 00 (GEOTECHNICAL INSTRUMENTATION AND CONDITION INSPECTION)
	IDENTIFIED DEBRIS REMOVAL		X	31 09 00 (GEOTECHNICAL INSTRUMENTATION AND CONDITION INSPECTION)
CONCRETE	TREMIE CEMENT GROUT PLACEMENT		X	
STRUCTURAL STEEL	FABRICATION OF STRUCTURAL ELEMENTS		X	FABRICATOR SHALL BE APPROVED IN ACCORDANCE WITH IBC, CHAPTER 17 TO PERFORM WORK WITHOUT SPECIAL INSPECTION
	VERIFY MATERIAL FOR STRUCTURAL STEEL SHAPES, PLATES, BARS, ETC.		X	CONTRACTOR TO SUBMIT CERTIFIED MILL TEST REPORTS
	VERIFY MATERIALS FOR WELD FILLER MATERIALS		X	
	VERIFY WELDER QUALIFICATIONS		X	CONTRACTOR TO SUBMIT WELDERS CERTIFICATES
	VERIFY USE OF PROPER WELDING PROCEDURES		X	
	INSPECT COMPLETE AND PARTIAL-PENETRATION GROOVE WELDS, MULTI-PASS FILLET WELDS, AND SINGLE-PASS FILLET WELDS GREATER THAN 5/16"	X		

TABLE 2
REQUIRED TESTING FOR SPECIAL INSPECTIONS

SYSTEM OF MATERIAL	TESTING		REMARKS
	CODE OF STANDARD REFRENCE	FREQUENCY	
GEOTECHNICAL			
CONCRETE			
CONCRETE SLUMP	ASTM C143	WHENEVER CYLINDERS ARE CAST	
CEMENTITIOUS AND EPOXY GROUT COMPRESSIVE STRENGTH	ASTM C942 (CEMENTITIOUS) ASTM C579 (EPOXY)		TEST 2" CUBES FOR EACH GROUT SHIPMENT TO THE FIELD
STEEL			

QUALITY ASSURANCE NOTES

1. THE QUALITY OF WORKMANSHIP AND THE QUALITY OF THE MATERIALS OF CONSTRUCTION ARE GOVERNED BY THE SEATTLE BUILDING CODE, 2018 EDITION (SBC).
2. TO ASSURE THE QUALITY OF THE CONSTRUCTION OF THIS PROJECT, STRUCTURAL TESTS, SPECIAL INSPECTION AND STRUCTURAL OBSERVATION WILL BE PERFORMED IN ACCORDANCE WITH SBC, CHAPTER 17.
3. WHERE FREQUENCY OF INSPECTION IS SPECIFIED TO BE CONTINUOUS, THE SPECIAL INSPECTOR IS EXPECTED TO BE PRESENT IN THE AREA WHERE THE WORK IS BEING PERFORMED AND PROVIDING FULL-TIME OBSERVATION OF THE WORK REQUIRING SPECIAL INSPECTION.
4. WHERE FREQUENCY OF INSPECTION IS SPECIFIED TO BE PERIODIC, THE SPECIAL INSPECTOR IS EXPECTED TO BE PRESENT IN THE AREA WHERE THE WORK HAS BEEN OR IS BEING PERFORMED AND AT THE COMPLETION OF THE WORK(PRIOR TO THE NEXT CONSTRUCTION TASK).
5. SPECIAL INSPECTIONS ARE IN ADDITION TO INSPECTIONS BY THE BUILDING OFFICIALS. CONSTRUCTION IS SUBJECT TO INSPECTION BY THE BUILDING OFFICIAL. COORDINATE WITH BUILDING DEPARTMENT TO DETERMINE REQUIRED INSPECTIONS.
6. CONTRACTOR SHALL PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS. CONTRACTOR SHALL PROVIDE NOTIFICATION IN ADVANCE OF REQUIRED INSPECTIONS, TESTING AND STRUCTURAL OBSERVATIONS.

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company

BRIGHT ENGINEERING, INC.
STRUCTURAL & CIVIL ENGINEERING
1809 7TH AVENUE
SUITE 1100
SEATTLE, WA 98101
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F: (206) 625-1851

PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
90% DRAFT
JULY 2023

STATE OF WASHINGTON 19813 STRUCTURAL ENGINEER PROFESSIONAL ENGINEER

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

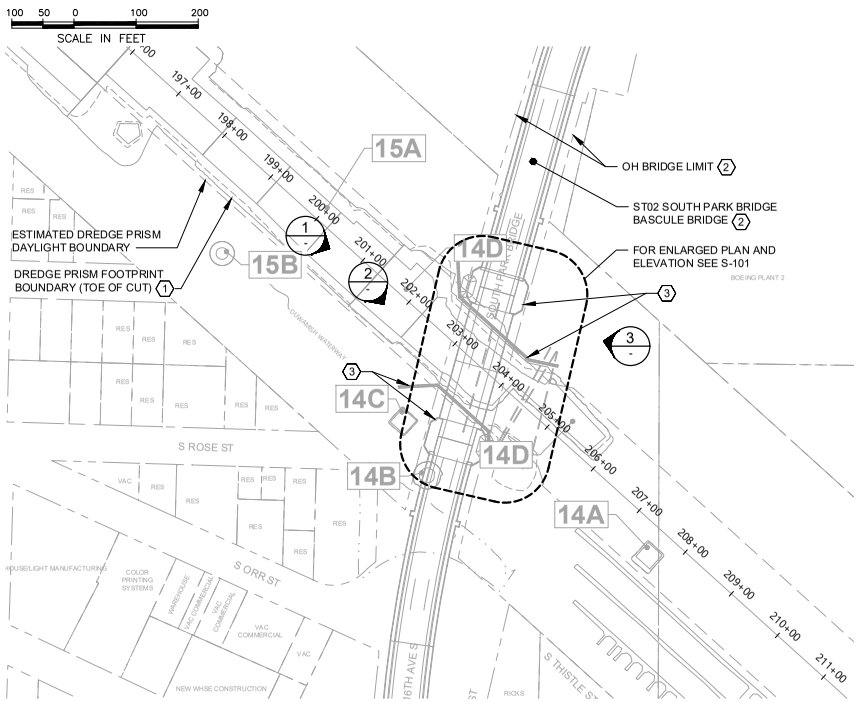
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

STATEMENT OF SPECIAL INSPECTIONS AND TESTING

DATE: JULY 2023
DRAWING NO: **S003**
WP701-G-00001
SHT NO / TOTAL: 75 / 87
REV NO: 1

1-013



PARTIAL SITE PLAN
SCALE: 1 : 100

GENERAL NOTES:

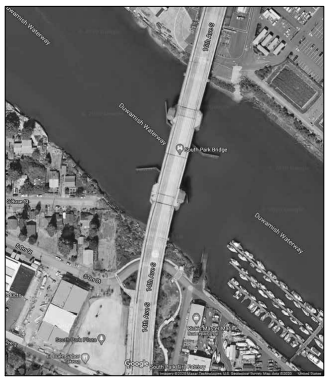
1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.

KEY NOTES:

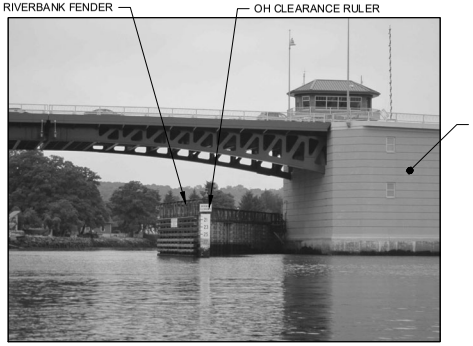
1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS TO KING COUNTY STRUCTURES.
3. MAINTAIN THE MINIMUM OFFSETS FROM BRIDGE PIERS AND FENDERING PILE SYSTEM INDICATED ON THE PLANS. PROTECT-IN-PLACE BRIDGE FENDERING SYSTEM.

BASCULE BRIDGE (LOOKING UPSTREAM)
PHOTO 1 -
SCALE: NONE

FENDERS (LOOKING UPSTREAM)
PHOTO 2 -
SCALE: NONE



GOOGLE MAP VIEW
SCALE: NONE



FENDER (LOOKING DOWNSTREAM)
PHOTO 3 -
SCALE: NONE

COLOR IMAGE
THIS DRAWING IS COMPOSED USING COLOR IMAGES OR PHOTOGRAPHS AND MUST BE PLOTTED, PRINTED, AND REPRODUCED IN COLOR TO BE VIEWED ACCURATELY.

NO	REVISION DESCRIPTION	BY	APVD	DATE

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Port of Seattle / City of Seattle / King County / The Boeing Company

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PRE-FINAL ISSUE DRAWING
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JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED:		
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED		
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18		
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX		

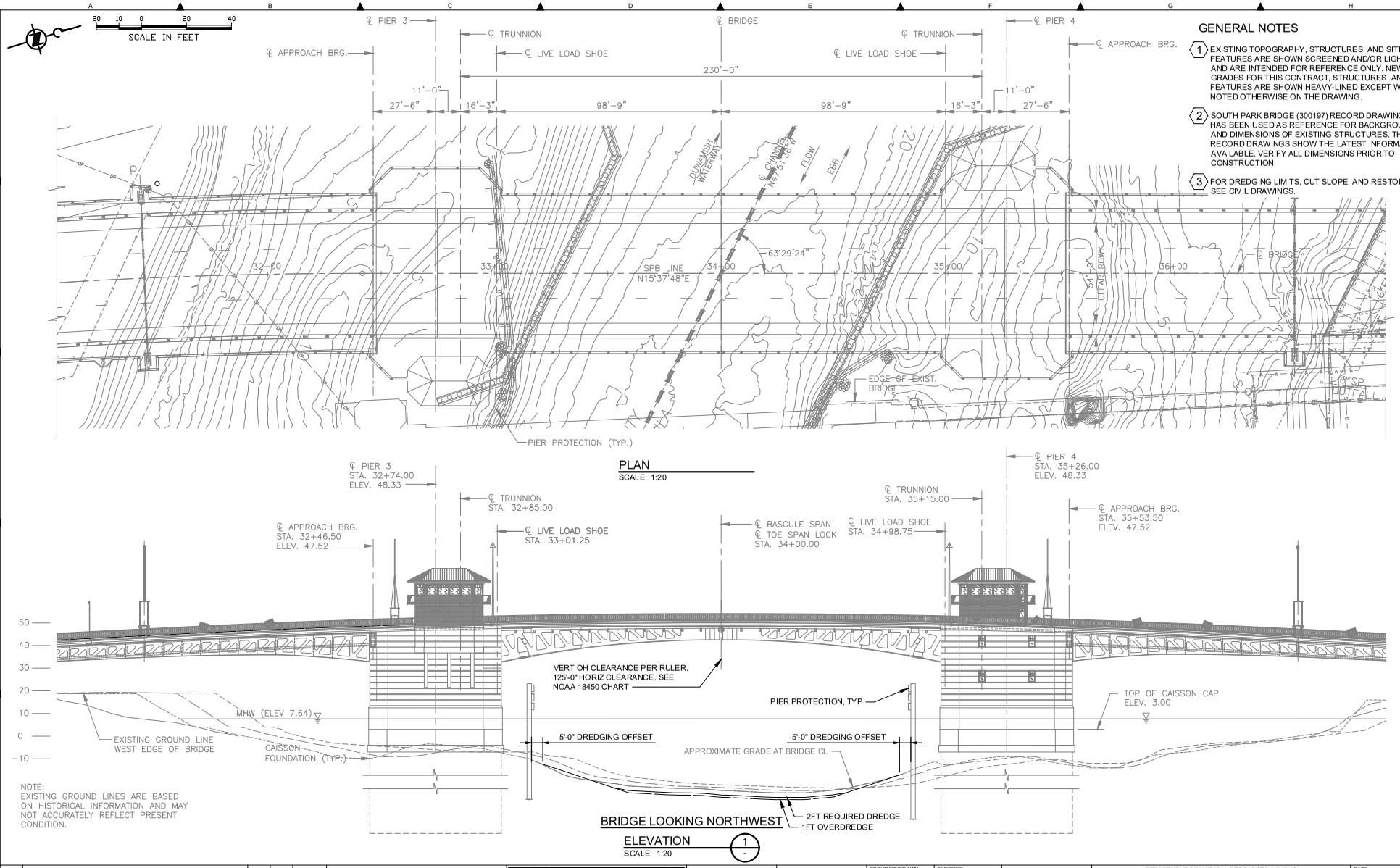
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

SOUTH PARK BRIDGE PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: **S100**
WP701-G-00001
SHT NO / TOTAL: 76 / 87
REV NO: 1

1-014



GENERAL NOTES

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.
2. SOUTH PARK BRIDGE (300197) RECORD DRAWING BG04 HAS BEEN USED AS REFERENCE FOR BACKGROUNDS AND DIMENSIONS OF EXISTING STRUCTURES. THESE RECORD DRAWINGS SHOW THE LATEST INFORMATION AVAILABLE. VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION.
3. FOR DREDGING LIMITS, CUT SLOPE, AND RESTORATION, SEE CIVIL DRAWINGS.

NO	REVISION DESCRIPTION	BY	APVD	DATE

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PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
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JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

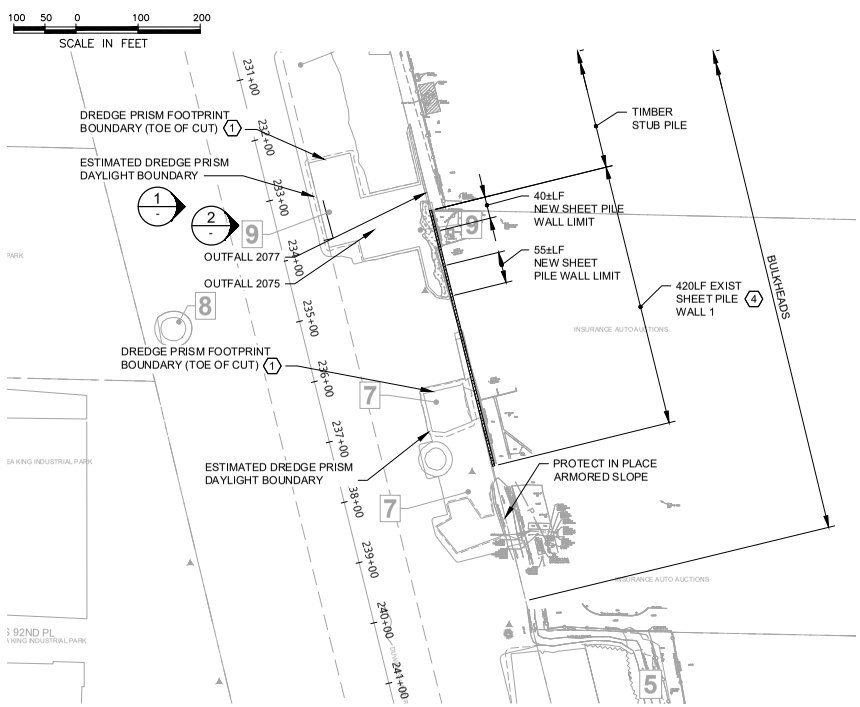
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH SEDIMENT CLEANUP

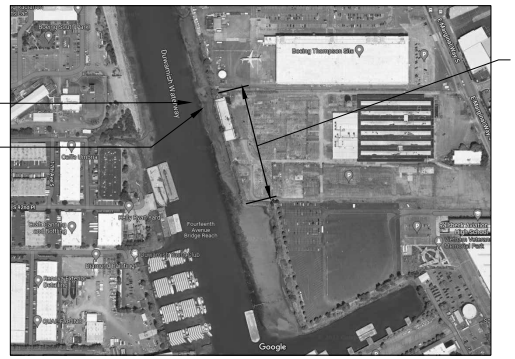
SOUTH PARK BRIDGE PLAN AND PROFILE

DATE: JULY 2023
DRAWING NO: **S101**
WP701-G-00001
SHT NO / TOTAL: 77 / 87
REV NO:

C-015



PARTIAL SITE PLAN
SCALE: 1 : 100



GOOGLE MAP VIEW
SCALE: NONE

PHOTO 1
SCALE: NONE

PHOTO 2
SCALE: NONE

GENERAL NOTES:

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.

KEY NOTES:

1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE, AND RESTORATION, SEE CIVIL DRAWINGS.
2. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS ON THE BULKHEADS.
3. NO WALL DESIGN INFORMATION OR PILE EMBEDMENT DEPTH IS AVAILABLE THEREFORE MAINTAIN THE MINIMUM OFFSETS INDICATED ON THE PLANS.
4. HANDLE AND DISPOSE CREOSOTE TIMBER PILES IN CONFORMANCE TO THE SPECIFICATIONS AND PERMITS.
5. PROTECT OUTFALL AND DUCKBILL VALVE FROM DAMAGE AS REQUIRED. MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS - 2214, 2075, 2077, 2073, AND 2093.
6. PRIOR TO DREDGING, NOTIFY PROJECT REPRESENTATIVE TO OBSERVE AND ASSESS THE CONDITION OF THE SHEET PILE AT MUDLINE FOR POSSIBLE REPAIRS.

REFERENCE DRAWINGS:

S122 TO S126	WALL 1: PLANS AND PROFILES
S129 TO S131	WALL 1: LOADING RESTRICTIONS AND REPAIRS CONTINGENCIES, SECTIONS AND DETAILS
S200 AND S201	OUTFALLS: PLANS AND PHOTOS
S202 AND S203	OUTFALLS: ENERGY DISSIPATION - PLANS, ELEVATIONS, AND SECTIONS
V201 TO V205	LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

COLOR IMAGE
THIS DRAWING IS COMPOSED USING COLOR IMAGES OR PHOTOGRAPHS AND MUST BE PLOTTED, PRINTED, AND REPRODUCED IN COLOR TO BE VIEWED ACCURATELY.

NO	REVISION DESCRIPTION	BY	APVD	DATE

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JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED:
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

BULKHEADS WALL 1 PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: **S121**
WP701-G-00001
SHT NO / TOTAL: 78 / 87
REV NO:

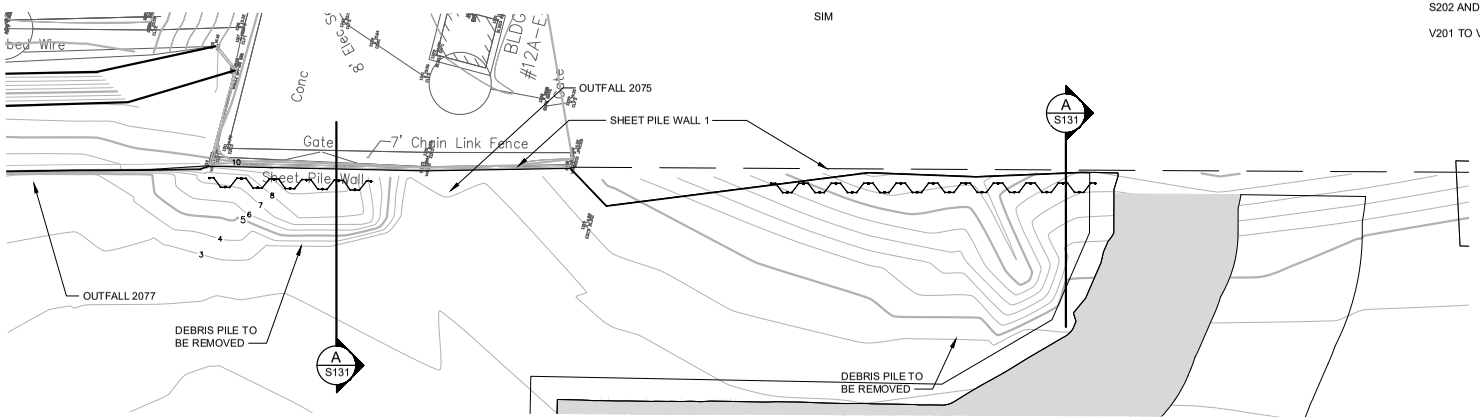
1-016

BORDER FILE EDITION: xKCWTD-Dsize-TB-Border_AQByLayer
T:\2552 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00559E18\Drawings\Structural\SCAD-LDWUR_S-121.dwg | Layout: S121
PLOTTED: Jul 20, 2023-02:09:20pm By: SLor

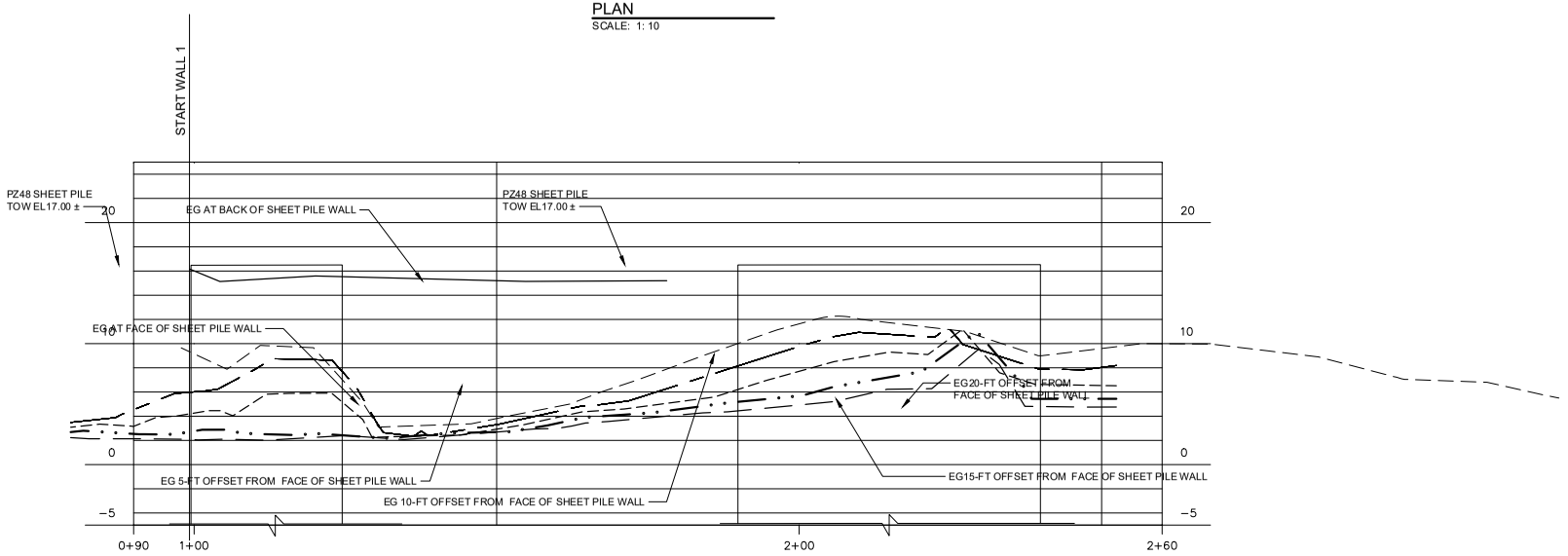
REFERENCE DRAWINGS:

S200 AND S201	OUTFALLS: PLANS AND PHOTOS
S202 AND S203	OUTFALLS: ENERGY DISSIPATION - PLANS, ELEVATIONS, AND SECTIONS
V201 TO V205	LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

SCALE IN FEET



PLAN
SCALE: 1: 10



PROFILE
SCALE: 1:5 VERT, 1:10 HOR

NO	REVISION DESCRIPTION	BY	APVD	DATE

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PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
90% DRAFT
JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA		
PROJECT ENGINEER: A. BRIGHT	SCALE:		
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18		
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX		

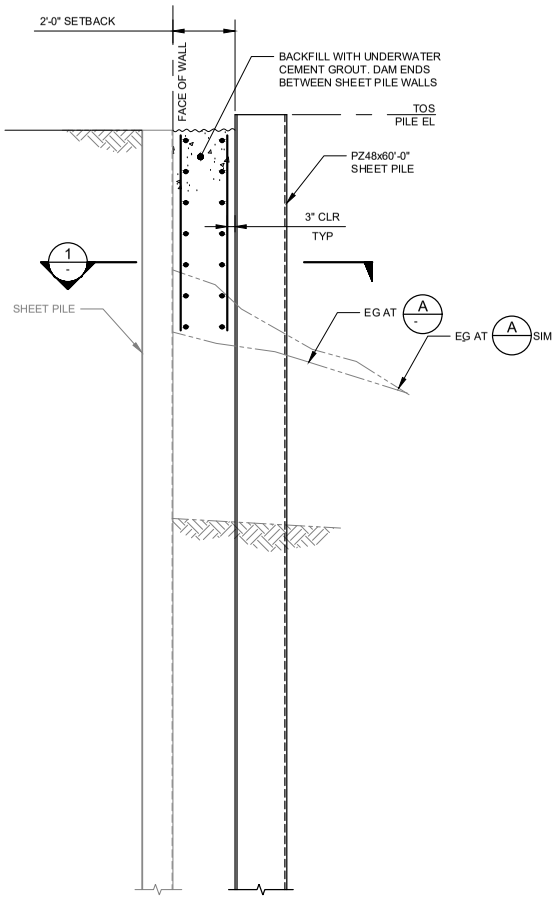
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

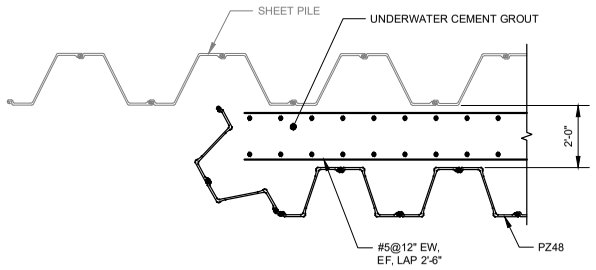
BULKHEADS WALL 1 PLAN AND PROFILE

DATE: JULY 2023
DRAWING NO: S125
WP701-G-00001
SHT NO / TOTAL: 79 / 87
REV NO:

T-017



WALL 1
SECTION
SCALE: 1/2" = 1'-0"
A
S125



DETAIL
SCALE: 1/2" = 1'-0"
1

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company

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SEATTLE, WA 98101
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PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
90% DRAFT
JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

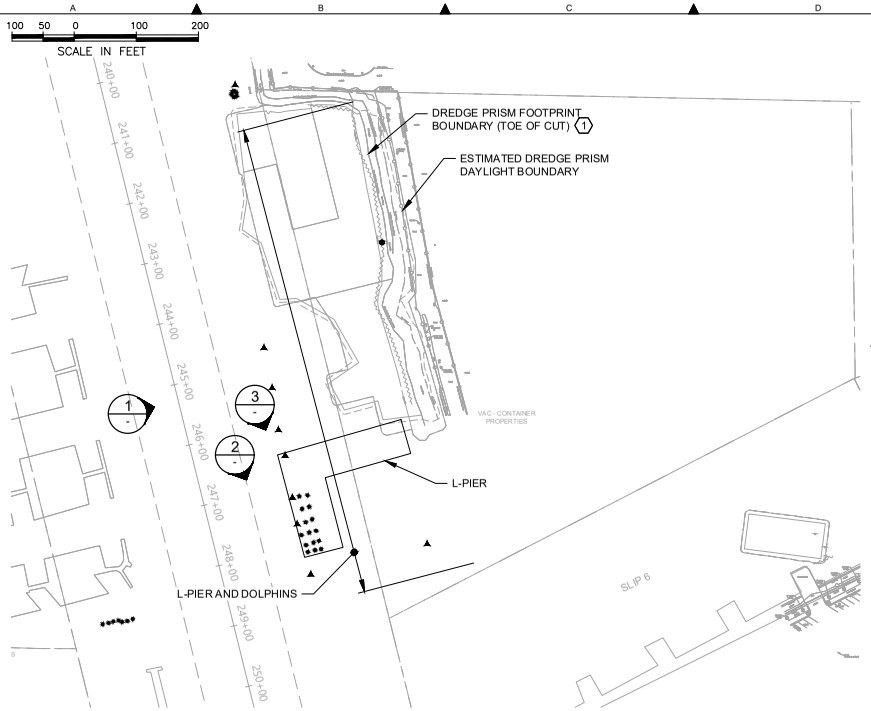
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

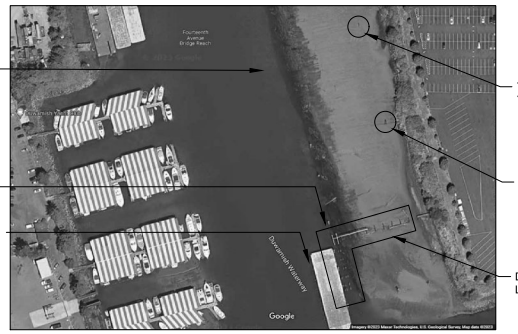
BULKHEADS WALL 1 SECTIONS AND DETAILS

DATE: JULY 2023
DRAWING NO: **S131**
WP701-G-00001
SHT NO 80 / TOTAL 87
REV NO: 1

0-018



PARTIAL SITE PLAN
SCALE: 1 : 100

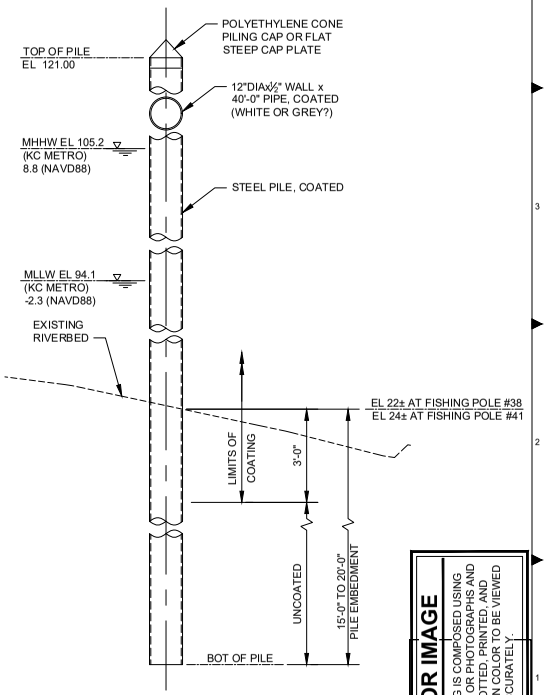


AERIAL VIEW
SCALE: NONE

TIMBER PILE
PHOTO 1
SCALE: NONE

DOLPHINS
PHOTO 2
SCALE: NONE

DILAPIDATED L-SHAPED PIER BENT
PHOTO 3
SCALE: NONE



FISHING POLE PILE SECTION
DETAIL 4
SCALE: 1/4" = 1'-0"

GENERAL NOTES:

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY.. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.

KEY NOTES:

1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. REMOVE AND REPLACE (1) TIMBER PILE WITH COATED STEEL PIPE PILE.
3. HANDLE AND DISPOSE CREOSOTE TIMBER PILES IN CONFORMANCE TO THE SPECIFICATIONS AND PERMITS.

REFERENCE DRAWINGS:

V201 TO V205 LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

COLOR IMAGE
THIS DRAWING IS COMPOSED USING COLOR IMAGES OR PHOTOGRAPHS AND MUST BE PLOTTED, PRINTED, AND REPRODUCED IN COLOR TO BE VIEWED ACCURATELY.

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
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PRE-FINAL ISSUE DRAWING
INFORMATION ONLY
90% DRAFT
JULY 2023

STATE OF WASHINGTON 19813 STRUCTURAL ENGINEER PROFESSIONAL ENGINEER

DESIGNED/DRAWN: S. LOR	CHECKED:
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

King County

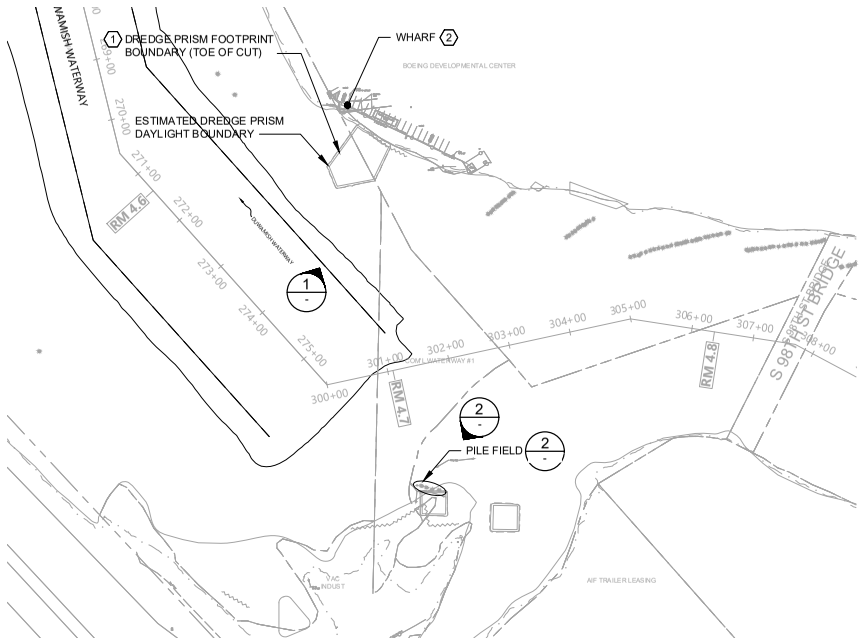
DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

L-SHAPE PIER & DOLPHINS PLAN, PHOTOS, AND PILE DETAILS

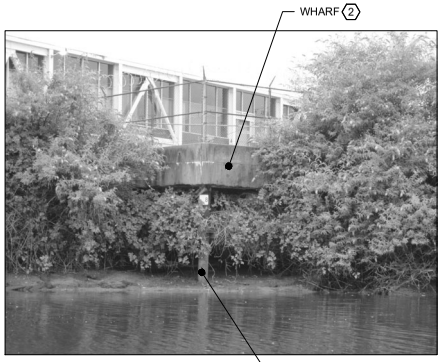
DATE: JULY 2023
DRAWING NO: S140
WP701-G-00001
SHT NO / TOTAL: 81 / 87
REV NO:

J-019

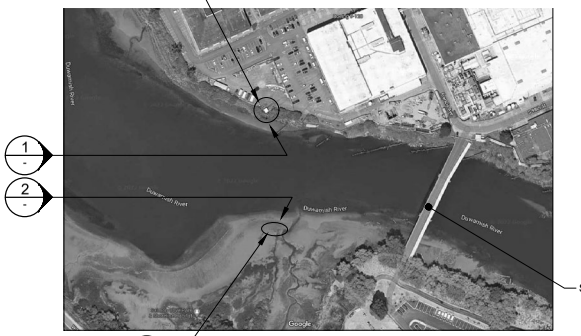
BORDER FILE EDITION: xKCWTD-Dsize-TB-Border_AQByLayer
T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00559E18\Drawings\Structural\SCAD-LDWUR_S-140.dwg | Layout: S140
PLOTTED: Jul 20, 2023-02:25:12pm By SLor



PARTIAL SITE PLAN
SCALE: 1 : 100



WHARF
PHOTO 1
SCALE: NONE



AERIAL VIEW
SCALE: NONE

PILE FIELD
PHOTO 2
SCALE: NONE

GENERAL NOTES:

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KEY NOTES:

1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. PROTECT AND DO NOT MOOR ON OR OTHERWISE IMPOSE LATERAL LOADS ON THE WHARF STRUCTURE.
3. NO PILE DESIGN INFORMATION OR PILE EMBEDMENT DEPTH IS AVAILABLE THEREFORE MAINTAIN THE MINIMUM OFFSETS INDICATED ON THE PLANS.
4. ESTIMATED BRIDGE VERTICAL CLEARANCE NEAR MID SPAN: APPROXIMATELY 12'-0" ABOVE TIDE AT 1:55PM, JULY 17, 2020.

REFERENCE DRAWINGS:

V201 TO V205 LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

COLOR IMAGE
THIS DRAWING IS COMPOSED USING COLOR IMAGES OR PHOTOGRAPHS AND MUST BE PLOTTED, PRINTED, AND REPRODUCED IN COLOR TO BE VIEWED ACCURATELY.

NO	REVISION DESCRIPTION	BY	APVD	DATE

Lower Duwamish Waterway Group
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PRE-FINAL ISSUE DRAWING
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JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED:
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

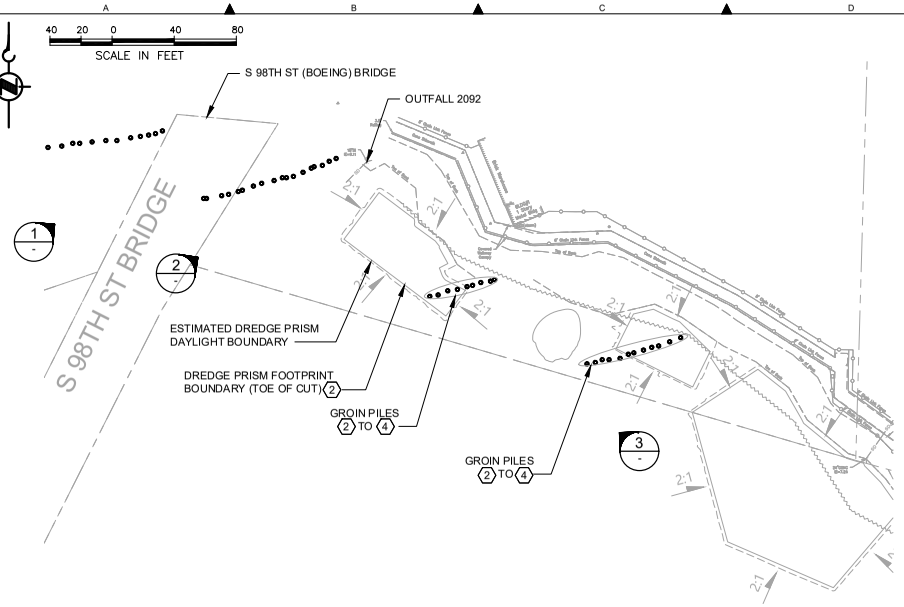
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

WHARF & PILE FIELD PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: S150
WP701-G-00001
SHT NO 82 / TOTAL 87
REV NO:

T-020



PARTIAL SITE PLAN
SCALE: 1 : 40

GENERAL NOTES:

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.

KEY NOTES:

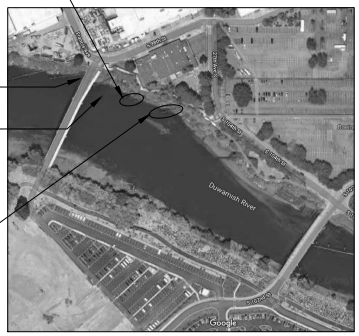
1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS ON THE PILE STRUCTURES.
3. NO PILE DESIGN INFORMATION OR PILE EMBEDMENT DEPTH IS AVAILABLE THEREFORE A MAXIMUM OF 1FT DIFFERENTIAL DREDGING DEPTH SHALL MAINTAIN BETWEEN BOTH (NORTH AND SOUTH) SIDES OF THE GROIN PILE ROW.
4. CONTRACTOR IS RESPONSIBLE FOR PROTECTING AND PREVENTING ANY DAMAGE TO EXISTING PILE STRUCTURES.

REFERENCE DRAWINGS:

V201 TO V205 LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

GROIN PILES
PHOTO 1 -
SCALE: NONE

GROIN PILES
PHOTO 2 -
SCALE: NONE



AERIAL VIEW
SCALE: NONE

GROIN PILES (LOOKING EAST)
PHOTO 3 -
SCALE: NONE

COLOR IMAGE
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NO	REVISION DESCRIPTION	BY	APVD	DATE

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Port of Seattle / City of Seattle / King County / The Boeing Company

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DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

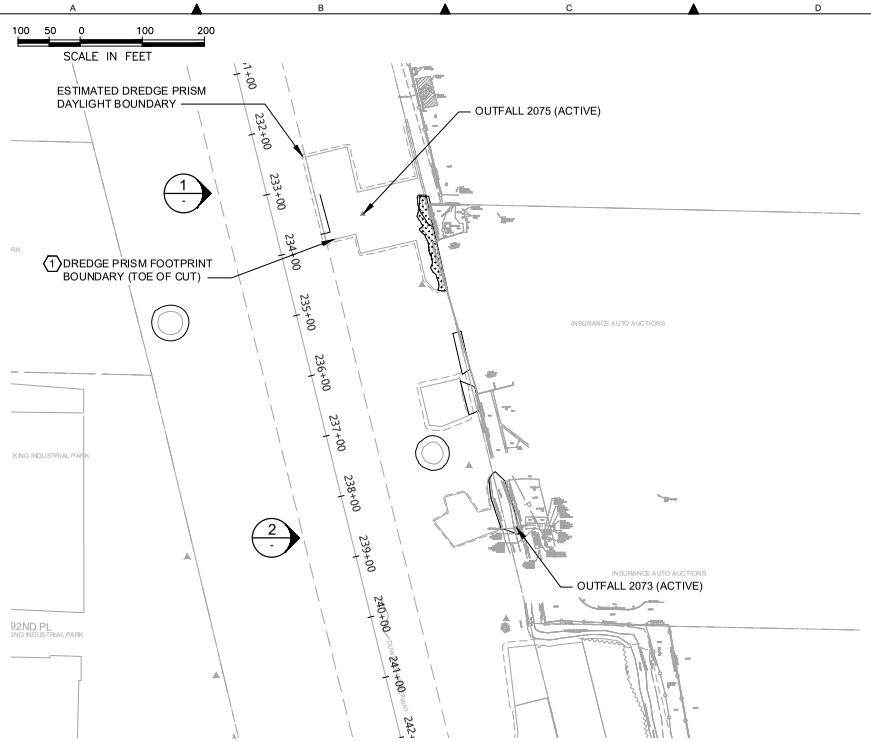
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

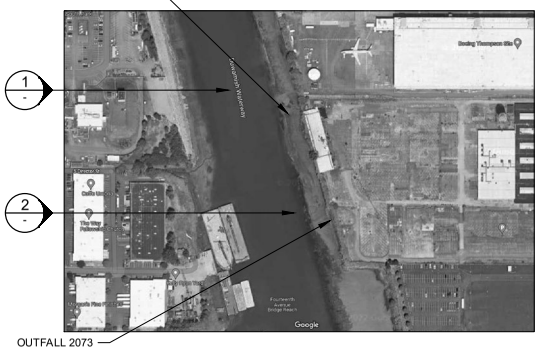
GROIN PILES PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: S151
WP701-G-00001
SHT NO 83 / TOTAL 87 REV NO:

21-021

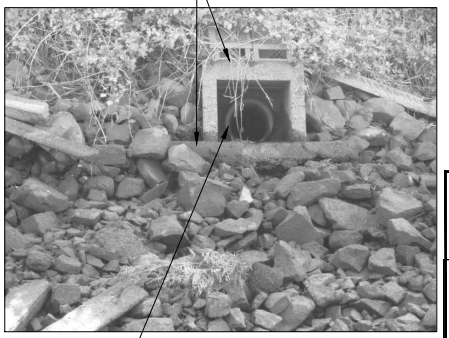


PARTIAL SITE PLAN
SCALE: 1 : 100



AERIAL VIEW
SCALE: NONE

OUTFALL 2075
PHOTO 1
SCALE: NONE



OUTFALL 2073
PHOTO 2
SCALE: NONE

GENERAL NOTES:

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.
2. MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS - 2214, 2075, 2077, 2073 AND 2093.
3. WORK AROUND OR DEMOLISH INACTIVE OUTFALLS - 2076, 2074, 2092, 2097, DC16, 2096 AND 2094 WHERE ENCOUNTERED.

KEY NOTES:

1. FOR CUT DREDGING OFFSET AND SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. NO WALL DESIGN INFORMATION OR PILE EMBEDMENT DEPTH IS AVAILABLE, THEREFORE MAINTAIN THE MINIMUM OFFSETS INDICATED ON THE PLANS.
3. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS THE BULKHEADS.
4. PROTECT STORMWATER RISER PIPE IN PLACE.
5. PROTECT OUTFALL PIPE IN PLACE.
6. CONSTRUCT ENERGY DISSIPATION STRUCTURE CONSISTING OF GABION MATTRESS FOUNDATION AND RIPRAP.

REFERENCE DRAWINGS:

S202 AND S203	OUTFALLS: ENERGY DISSIPATION - PLANS, ELEVATIONS, AND SECTIONS
V201 TO V205	LOCATION OF IDENTIFIED DEBRIS AND PILING FOR REMOVAL

COLOR IMAGE
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PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

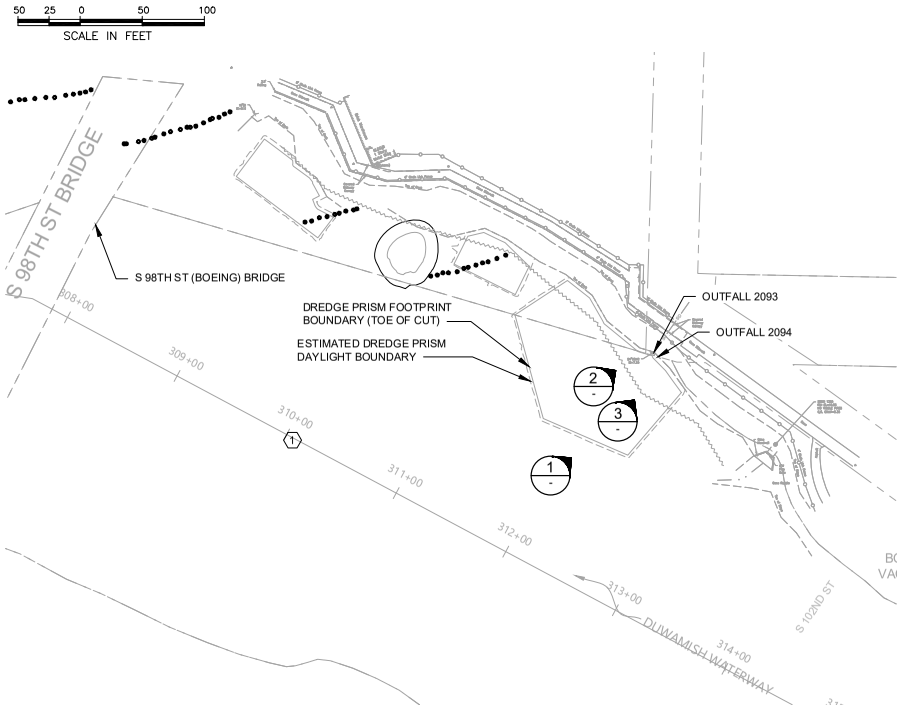
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

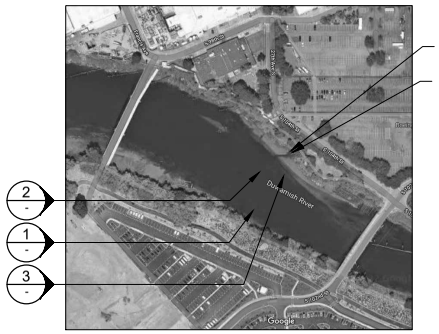
OUTFALLS 2075 & 2073 PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: **S200**
WP701-G-00001
SHT NO 84 / TOTAL 87
REV NO: 1

1-022



PARTIAL SITE PLAN
SCALE: 1 : 50



GOOGLE MAP VIEW
SCALE: NONE

GENERAL NOTES:

1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.
2. WORK AROUND OR DEMOLISH INACTIVE OUTFALLS - 2076, 2074, 2092, 2097, DC16, 2096 AND 2094 WHERE ENCOUNTERED.

KEY NOTES:

1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. PROTECT OUTFALL PIPE IN PLACE. CONSTRUCT ENERGY DISSIPATION STRUCTURE CONSISTING OF GABION MATTRESS FOUNDATION AND RIPRAP. SEE DRAWING S202.
3. MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS - 2214, 2075, 2077, 2073 AND 2093.

REFERENCE DRAWINGS:

S202 AND S203 OUTFALLS: ENERGY DISSIPATION - PLANS, ELEVATIONS, AND SECTIONS

OUTFALLS
PHOTO 1 S-108
SCALE: NONE

OUTFALL 2093
PHOTO 2 S-108
SCALE: NONE

OUTFALL 2094
PHOTO 3 S-108
SCALE: NONE

COLOR IMAGE
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PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

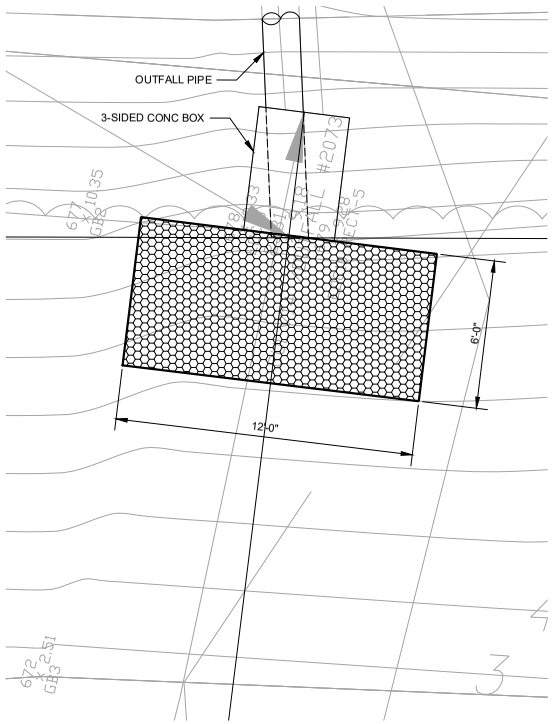
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH SEDIMENT CLEANUP

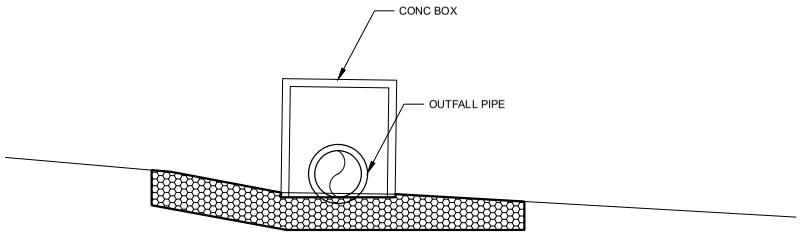
OUTFALLS 2094 & 2093 PLAN AND PHOTOS

DATE: JULY 2023
DRAWING NO: S201
WP701-G-00001
SHT NO 85 / TOTAL 87
REV NO: 1

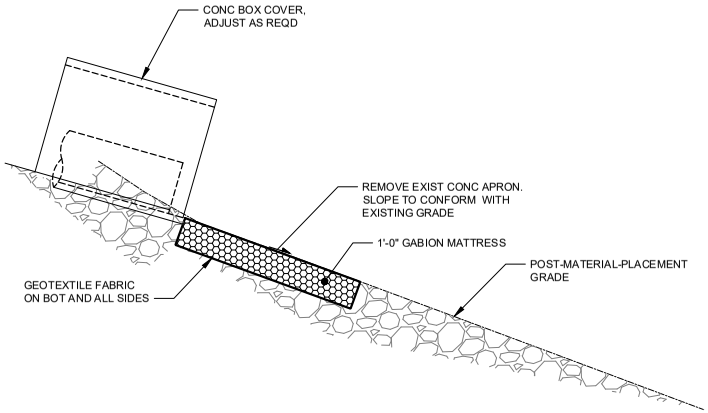
1-0-023



OUTFALL 2073
PARTIAL PLAN
SCALE: 1/2" = 1'-0"



ELEVATION 1
SCALE: 1/2" = 1'-0"



SECTION A
SCALE: 1/2" = 1'-0"

NO	REVISION DESCRIPTION	BY	APVD	DATE

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JULY 2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE:
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

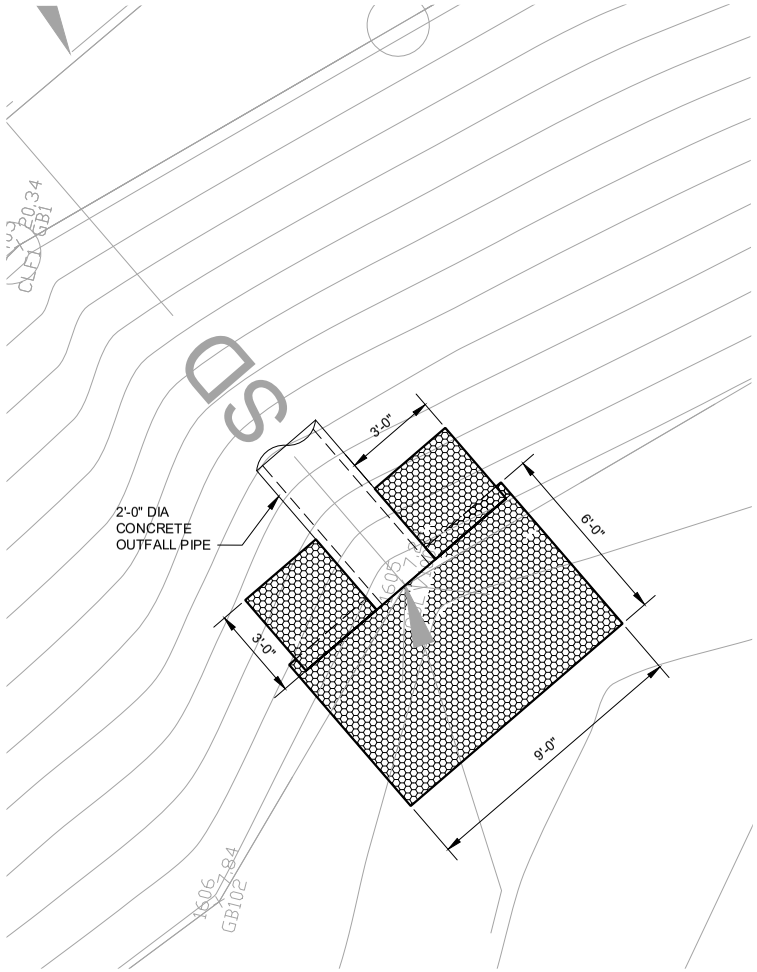
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

OUTFALLS ENERGY DISSIPATION PLANS, ELEVATIONS AND SECTION 1 OF 2

DATE:	JULY 2023
DRAWING NO:	S202
	WP701-G-00001
SHT NO / TOTAL	86 / 87
REV NO:	1

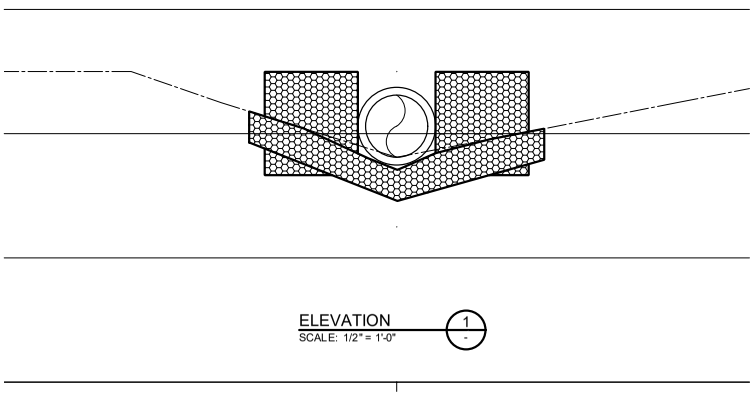
1-024



OUTFALL 2093

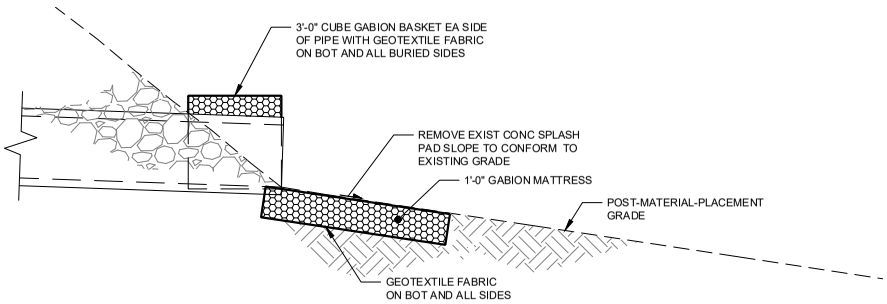
PARTIAL PLAN

SCALE: 1/2" = 1'-0"



ELEVATION 1

SCALE: 1/2" = 1'-0"



SECTION A

SCALE: 1/2" = 1'-0"

NO	REVISION DESCRIPTION	BY	APVD	DATE

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PROJECT ENGINEER: A. BRIGHT	SCALE:
DESIGN APPROVAL:	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: PRJCT MNGR	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
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LOWER DUWAMISH WATERWAY UPPER REACH
SEDIMENT CLEANUP

OUTFALLS ENERGY DISSIPATION PLANS, ELEVATIONS AND SECTIONS 2 OF 2

DATE: JULY 2023

DRAWING NO: S203

WP701-G-00001

SHT NO 87 \ TOTAL 87

REV NO: P1-025

BORDER FILE EDITION: xKCWTD-Dsize-TB-Border_AQByLayer
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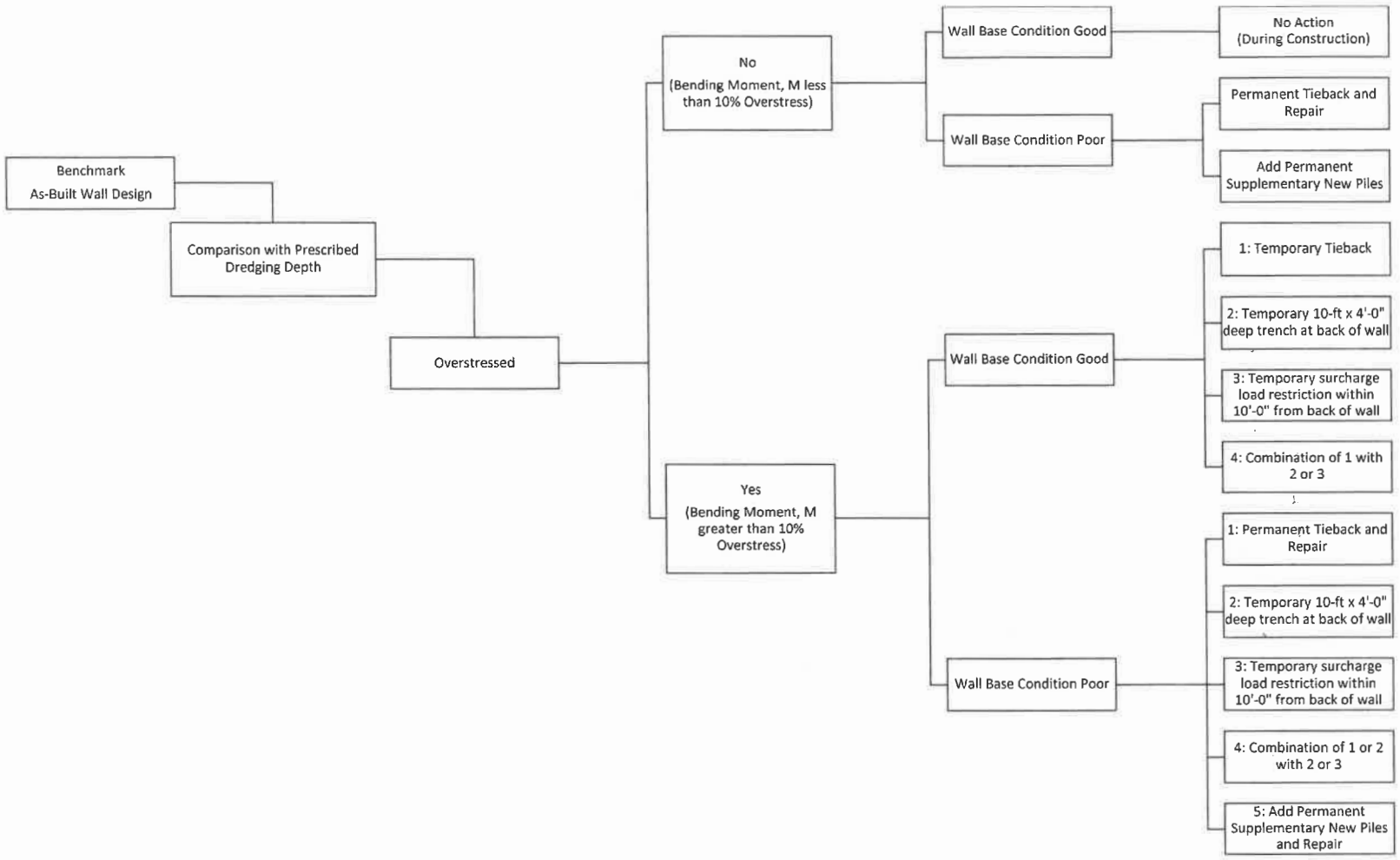
PLOTTED: Jul 20, 2023-03:05:03pm By: SLor

CONTINGENCIES DURING CONSTRUCTION, LOAD RESTRICTION, AND REPAIR - EVALUATION PROCEDURE AND ASSUMPTIONS



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Date: 4-2023 By: AB BEI No._____ Sheet No.____ of ____ Sheets

Subject: LDW Upper Reach

Summary of Loading and Dredging Options

A - Baseline (As-is condition)
1. Condition 1 As-is
   (a) without surcharge S=0
   (b) with surcharge S=73
2. Condition 2 (Ø dredging offset)
   (a) without surcharge S=0
   (b) with surcharge S=73
3. Condition 3 (3Ft dredging offset)
   (a) without surcharge S=0
   (b) with surcharge S=73

B - Case A (With Teback or deadman anchor)
1. condition 2 - (Ø dredging offset)
   (a) without surcharge S=0
   (b) with surcharge S=73
2. Condition 3 - (3Ft dredging offset)
   (a) without surcharge (S=0)
   (b) with surcharge (S=73)

C - Case B (No surcharge loading within 10ft from back of wall)
1. condition 2 - (Ø dredging offset)
   ~~(a) without surcharge loading (S=0)~~ N/A
   (b) with surcharge loading (S=73)
2. condition 3 - (3Ft dredging offset)
   ~~(a) without surcharge (S=0)~~ N/A
   (b) with surcharge (S=73)

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Consulting Structural and Civil Engineering

Date: 4-2023 By: AB BEI No. _____ Sheet No. _____ of _____ Sheets

Subject: LDW Upper Reach

D- case C (4Ft x 10Ft Wide trench behind back of wall)
1. condition 2 (0 dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)
2. condition 3 (3Ft dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)

E - Case C. 1 (2Ft 0 x 10Ft wide trench behind back of wall)
1. condition 2 (0 dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)

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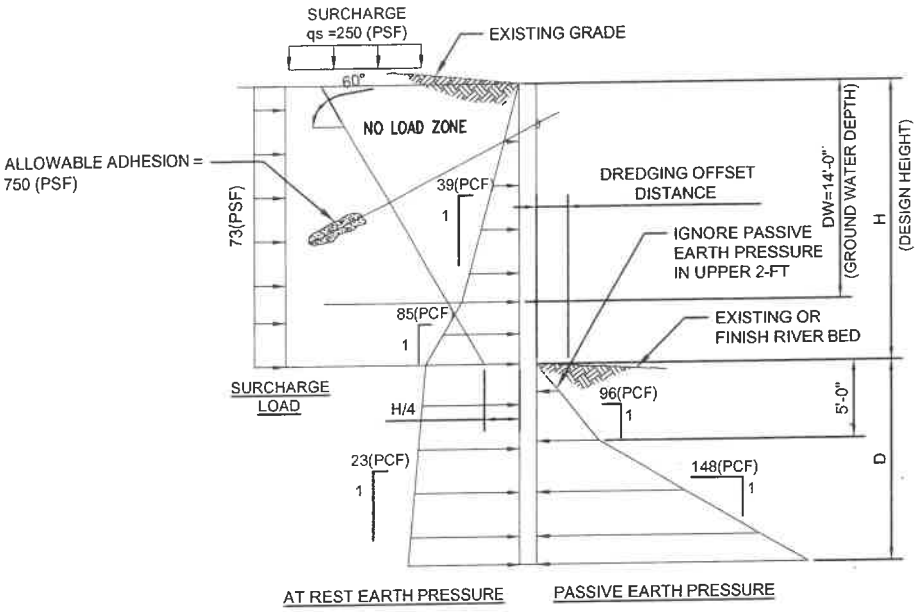
Date: 2-2023 By: AB BEI No. _____ Sheet No. _____ of _____ Sheets

Subject: LDW - Upper Reach



PASSIVE EARTH PRESSURE REDUCTION FACTORS			
OFFSET DISTANCE	REDUCTION FACTOR		
	2H:1V	1.5H:1V	1H:1V
0	0.75	0.56	0.38
2	0.85	0.66	0.48
4	0.95	0.76	0.58

L-PILE MODELING PARAMETERS						
LAYERS	EFFECTIVE UNIT WEIGHT γ'(PCF)	FRICTION ANGLE Φ (DEG)	UNDRAINED SHEAR STRENGTH C_u (KSF)	P.Y CURVE MODEL	SPRING CONSTANT;K (Es=Kx) K (PCI)	STRAIN FACTOR; @50% MAX E ε_{50}
RECENT SEDIMENT	36	27	0.08	SOFT CLAY (MATLOCK)	-	0.020
ALLUVIUM	61	32	-	SAND (REESE)	20	-

NOTES:

1. DIAGRAM APPLIES TO DRILLED SOLDIER PILE WALLS WITH TIMBER LAGGING AND SHEET PILE WALLS DESIGNED AS A CANTILEVERED WALL OR WITH A SINGLE ROW OF TIEBACK.
2. ALL PRESSURES EXPRESSED AS AN EQUIVALENT FLUID UNIT WEIGHT.
3. ACTIVE EARTH AND SURCHARGE PRESSURES ACT OVER THE PILE SPACING WITHIN RETAINED WALL HEIGHT AND OVER PILE WIDTH OR SHAFT DIAMETER BELOW BOTTOM OF EXCAVATION, WHICHEVER IS LESSER.
4. PASSIVE EARTH PRESSURE ACTS OVER 2 TIMES SHAFT DIAMETER OR PILE WIDTH; OR PILE SPACING, WHICHEVER IS LESSER
5. 50% OF ACTIVE AND SURCHARGE PRESSURES ACT ON ALL LAGGING BETWEEN SOLDIER PILES.
6. PASSIVE RESISTANCE ARE ULTIMATE VALUES. DIVIDE WITH A SAFETY FACTOR OF 1.5 FOR ALLOWABLE VALUE.

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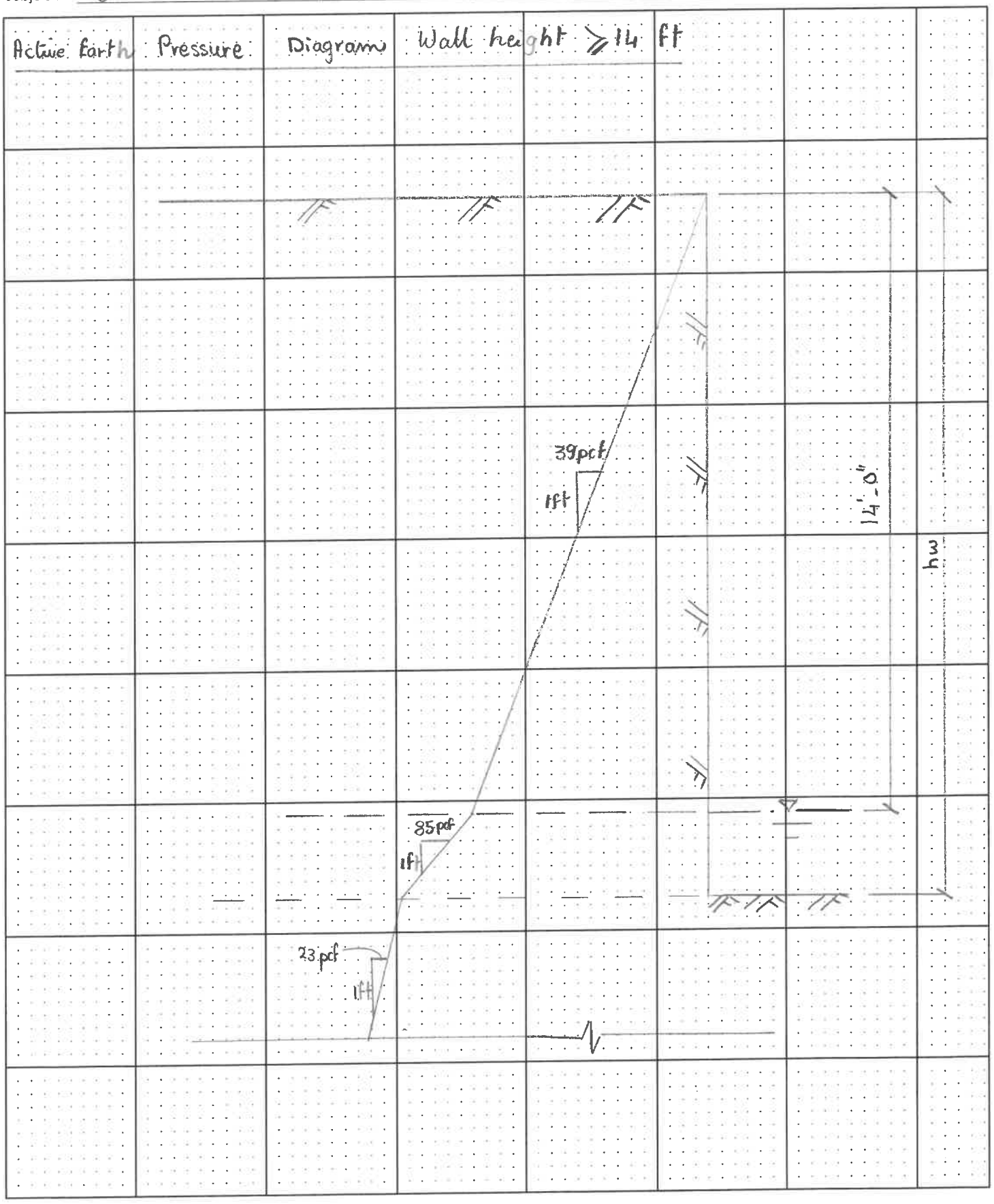
Date: April 2023 By: MS BEI No. 252.01 Sheet No. 1 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Active Earth Pressure Diagrams Wall height ≥ 14 ft



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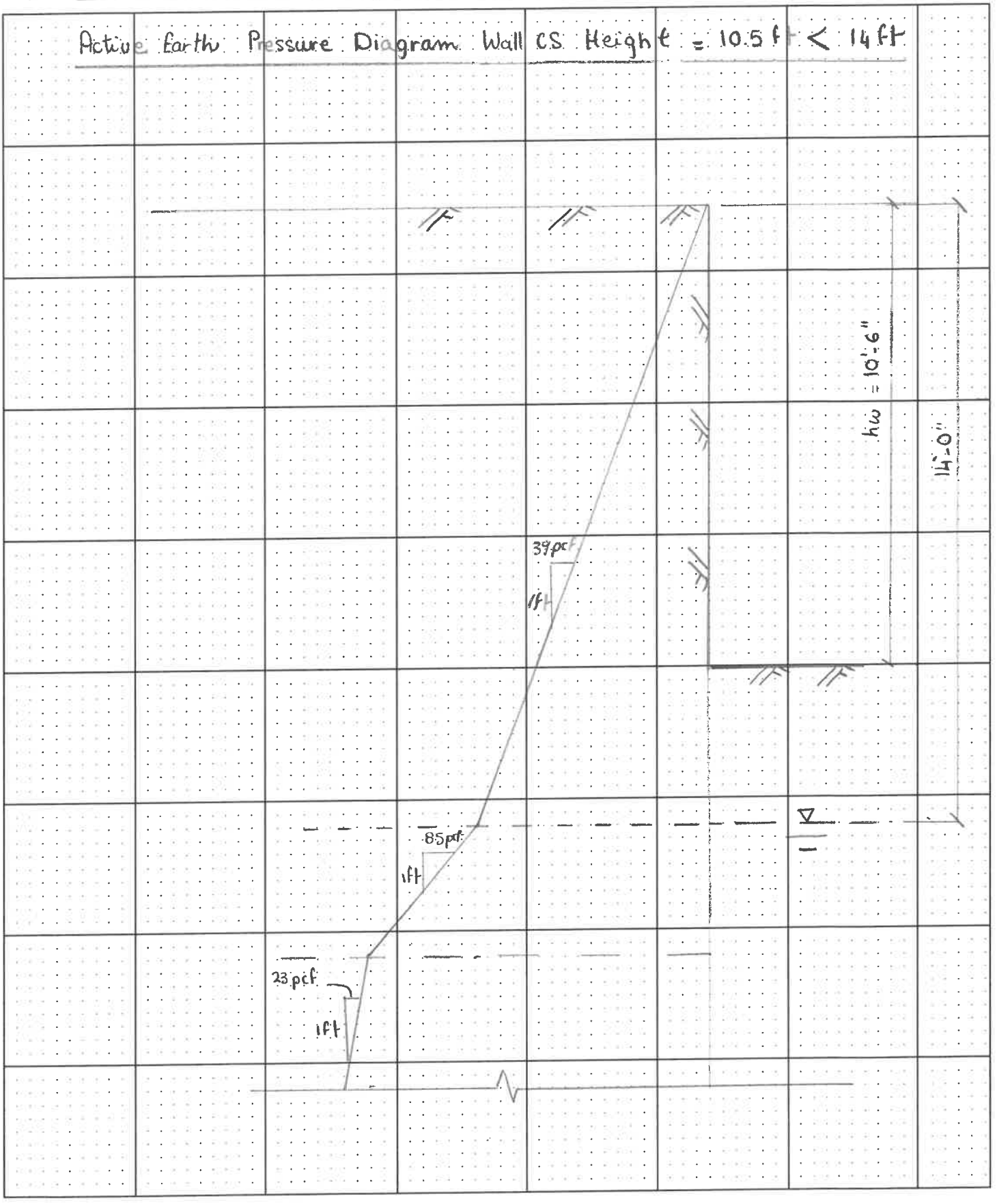
Date: April 2023 By: MS BEI No. 252.01 Sheet No. 2 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Active Earth Pressure Diagram Wall CS Height = 10.5 ft < 14 ft



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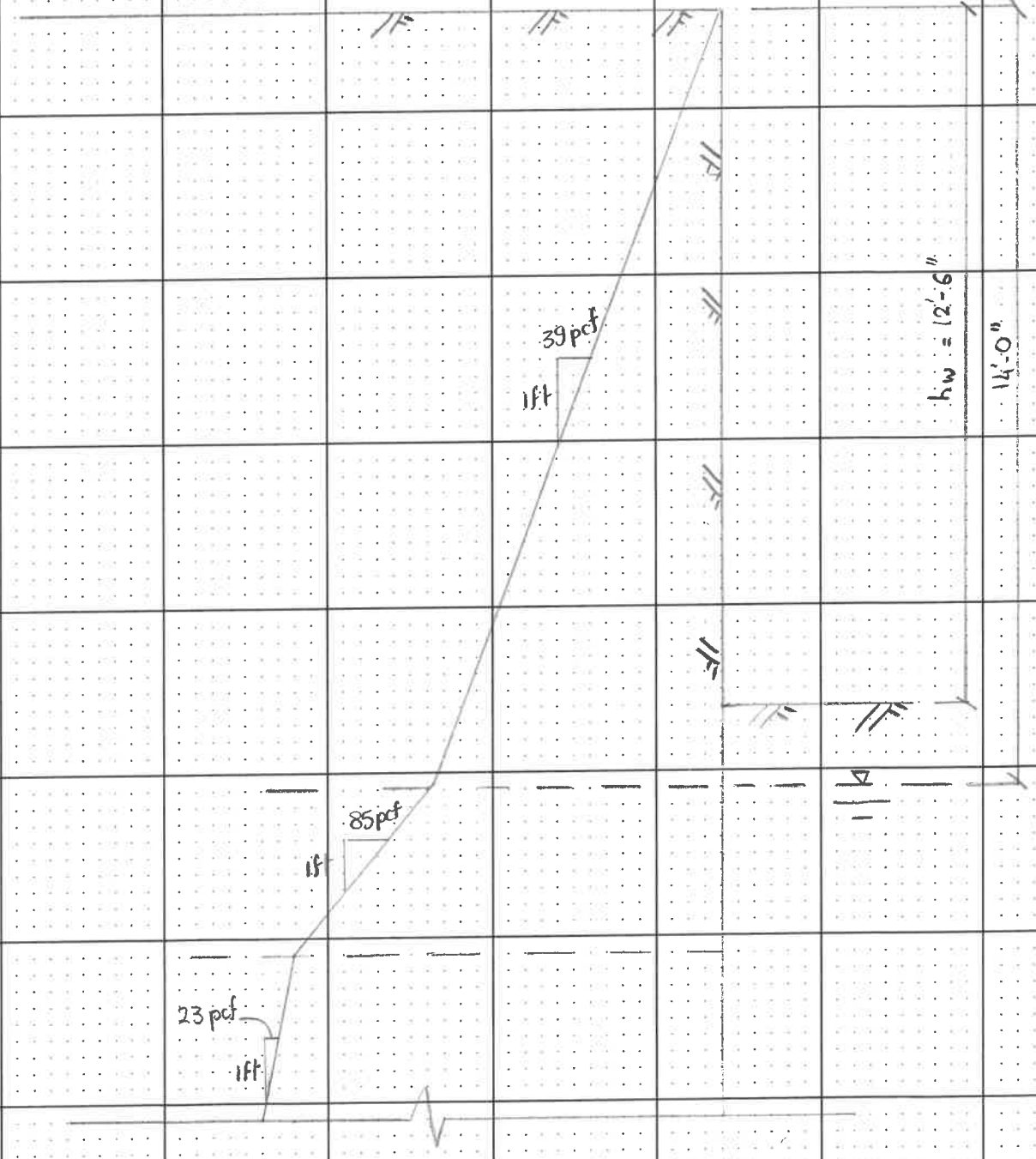
Date: April 2023 By: MS BEI No. 252.01 Sheet No. 3 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Active Earth Pressure Diagram Wall Height = 12.5ft < 14ft



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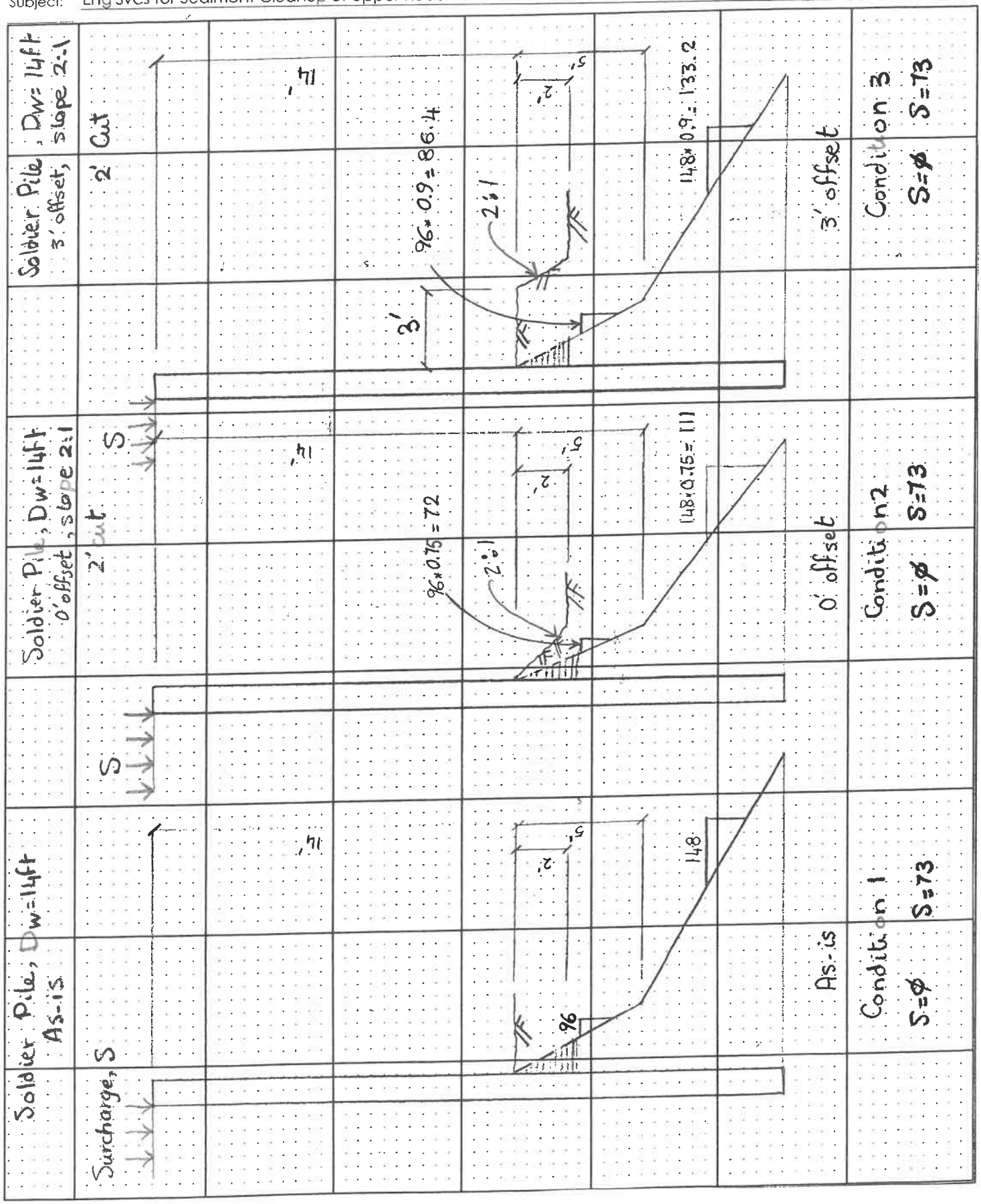
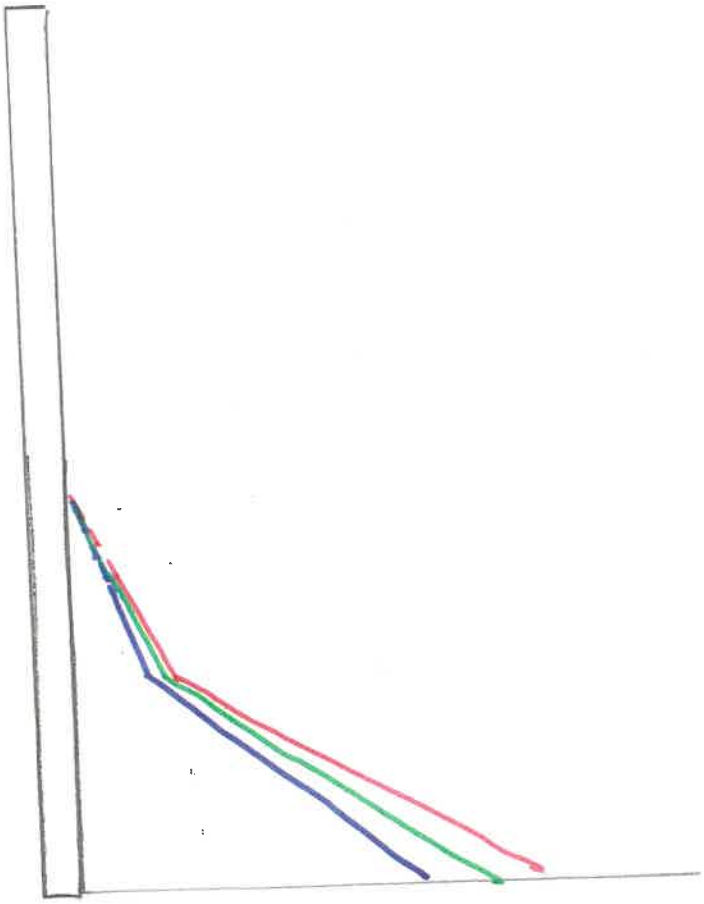
Date: _____ By: MS BEI No. 252.01 Sheet No. ____ of ____ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway — As-is Condition



Passive Earth Pressure Reduction Factor Diagram for Condition 1 (As-is), Condition 2 (0' off) and Condition 3 (3' off)



Comparison between
- Condition 1 (As-is)
- Condition 2 (0'off)
- Condition 3 (3'off)

Conclusion:

Condition 3 (3'off) results lay between Condition 1 (As-is) and Condition 2 (0'off) based of slope factors.

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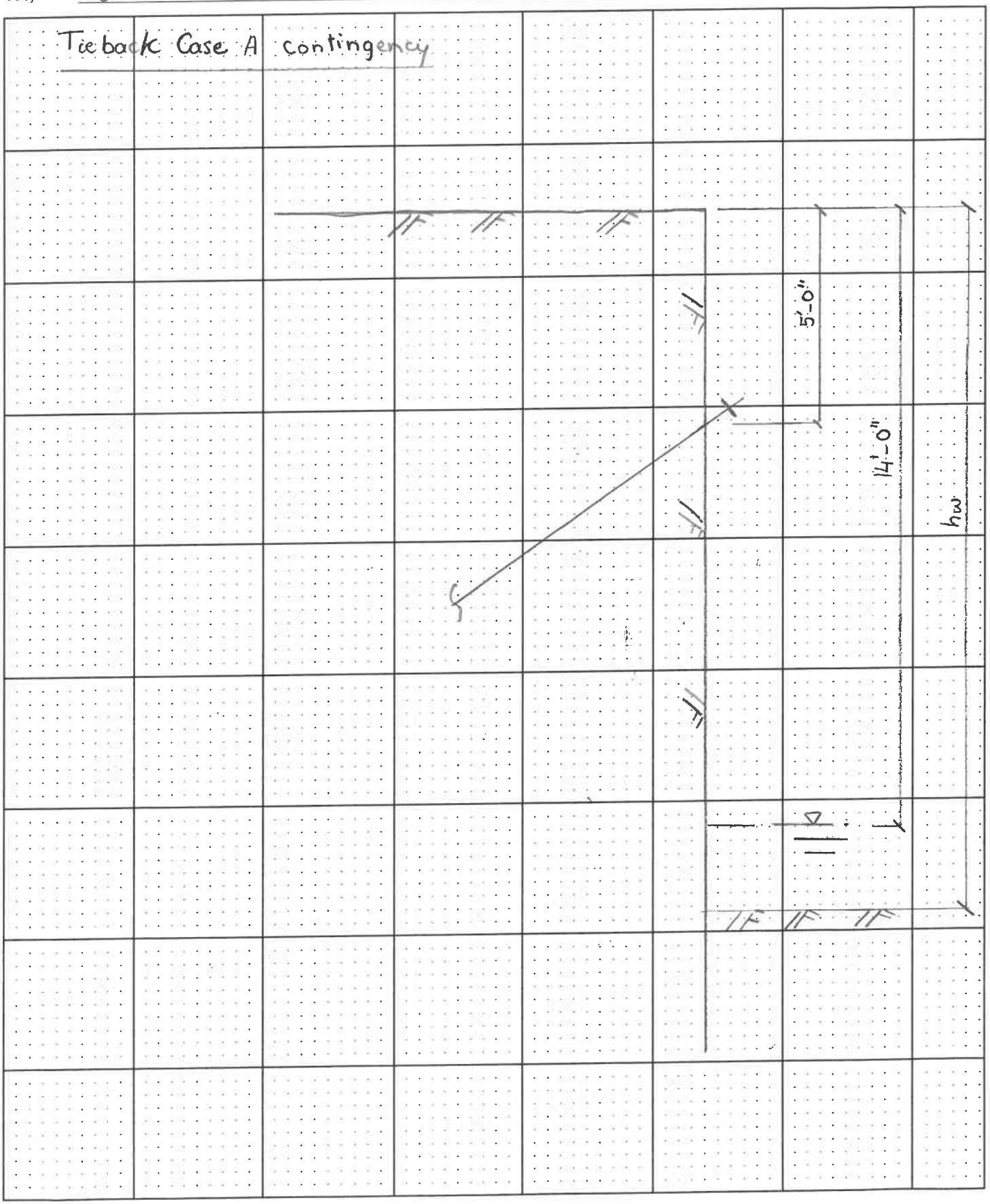
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 1 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Tieback Case A contingency



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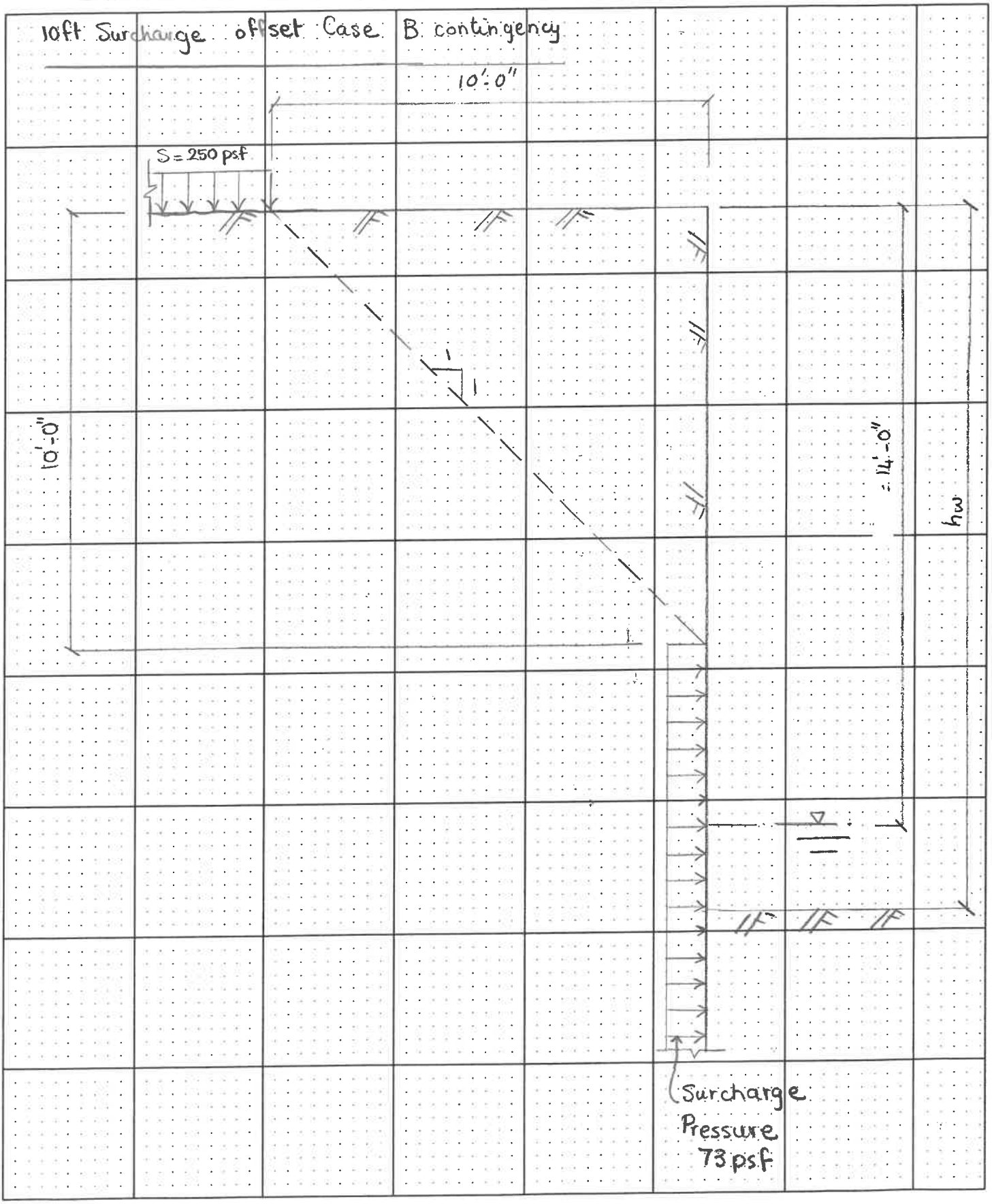
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 2 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

10ft Surcharge offset Case B contingency



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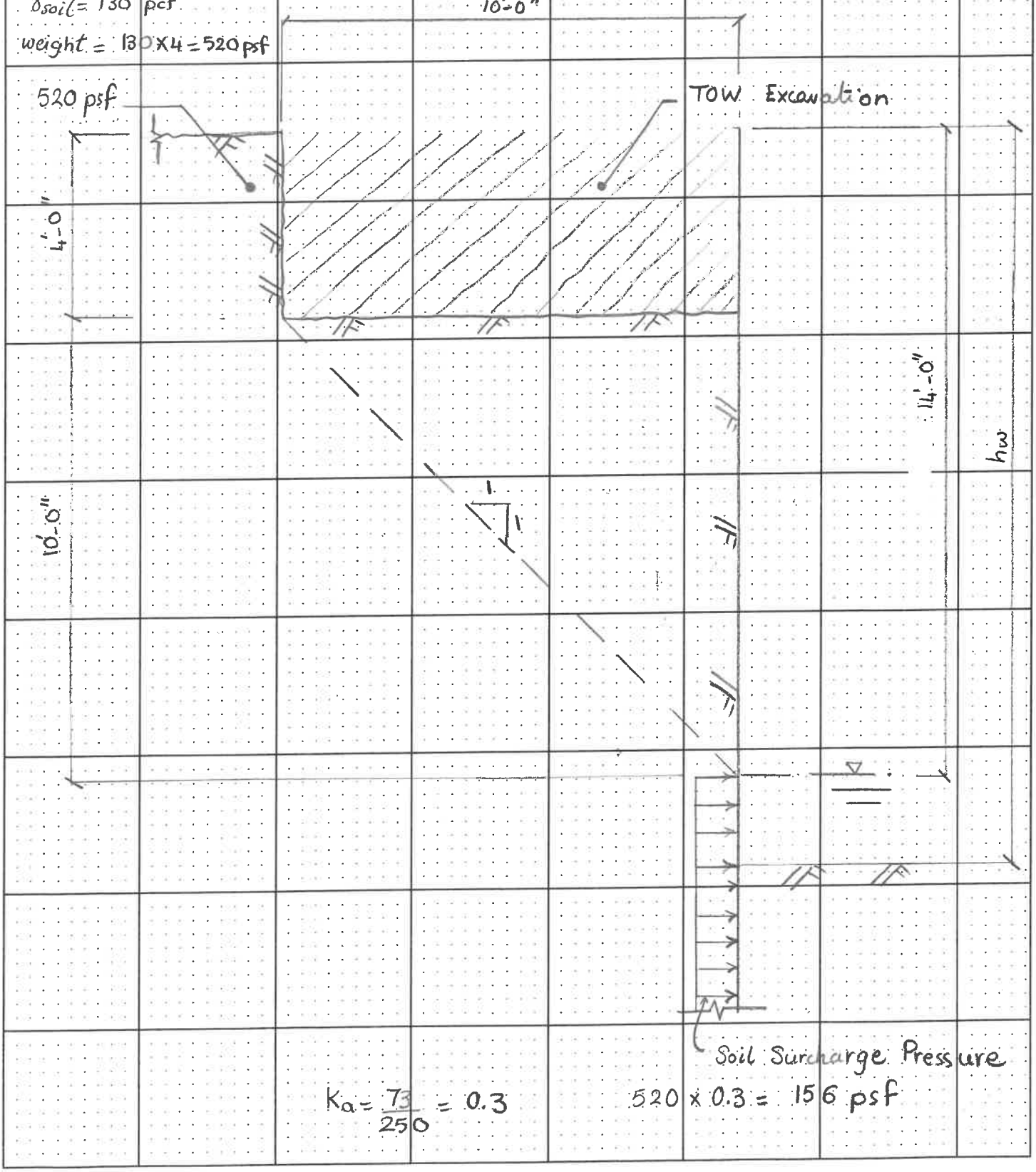
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 3 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

10ft wide x 4ft deep Trench Excavation at TOW Case C contingency

γ_{soil} = 130 pcf

weight = 130 x 4 = 520 psf



$K_a = \frac{73}{250} = 0.3$

520 x 0.3 = 156 psf

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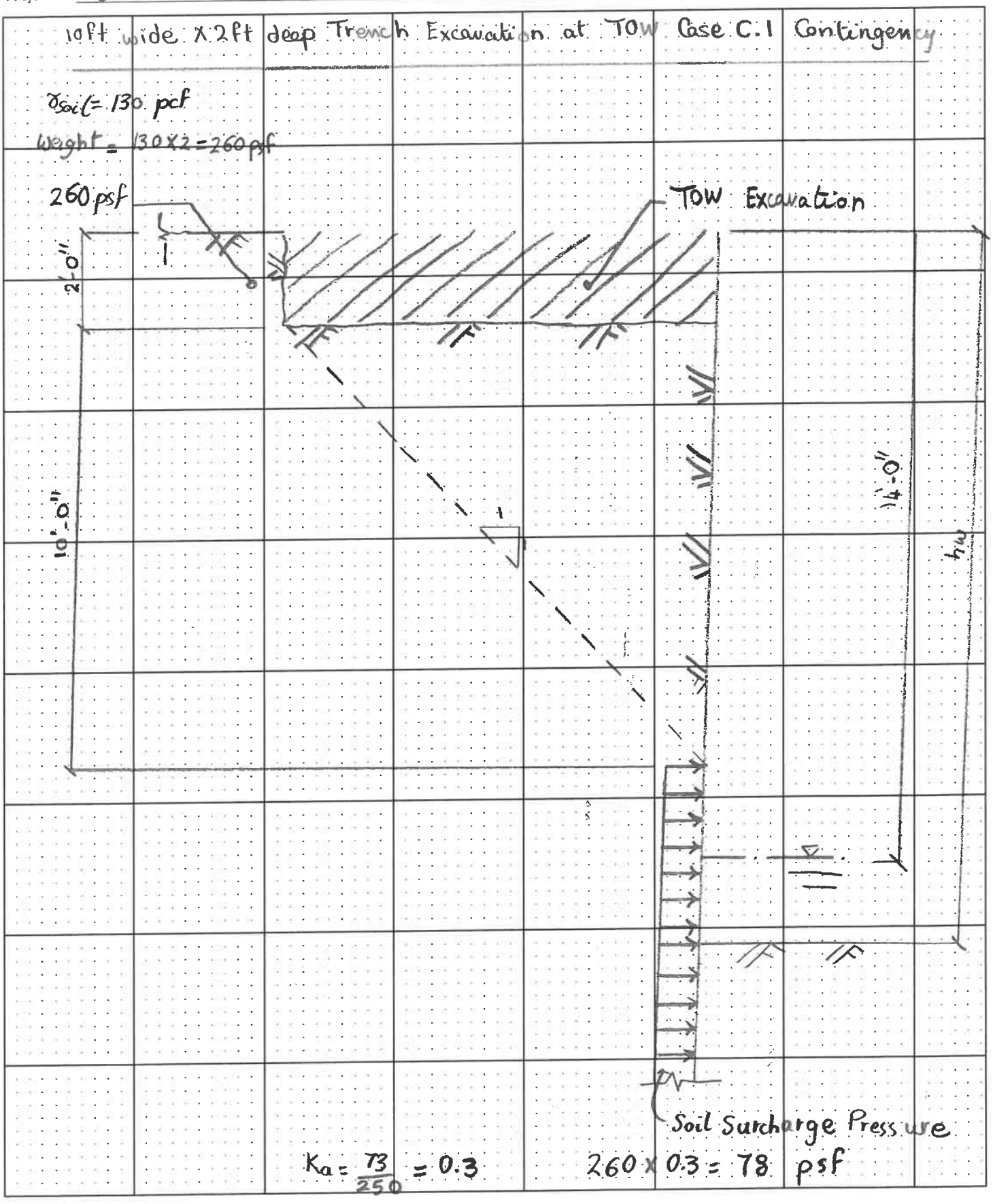
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. ____ of ____ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

10ft wide x 2ft deep Trench Excavation at TOW Case C.1 Contingency

γ_{soil} = 130 pcf

Weight = 130 x 2 = 260 psf



$K_a = \frac{73}{250} = 0.3$

260 x 0.3 = 78 psf

Bright Engineering, Inc
Consulting Structural and Civil Engineering

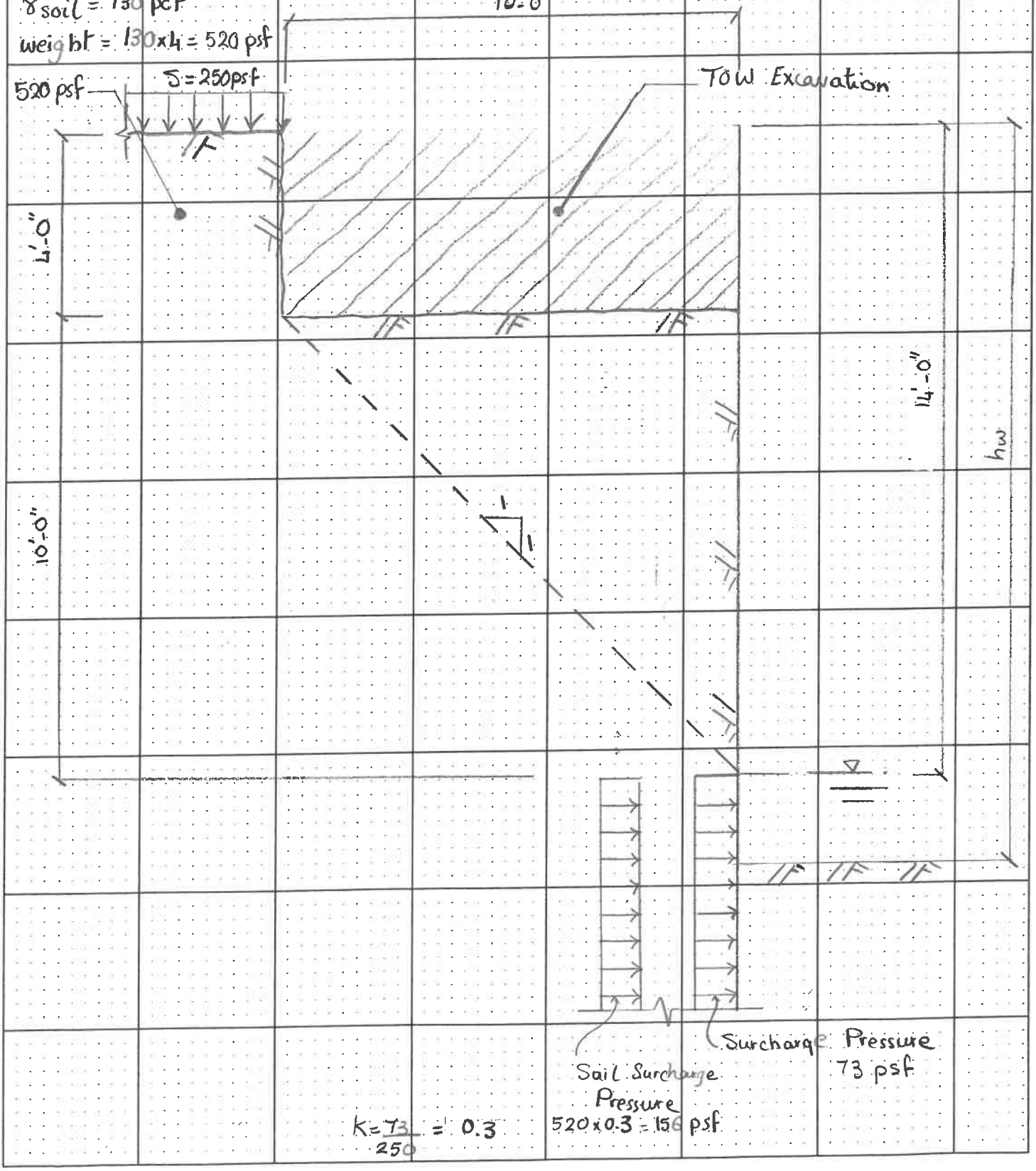
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 4 of ___ Sheets

Subject: Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

10ft wide x 4ft deep Trench Excavation at TOW w/ Surcharge combination of B+C

γ_{soil} = 130 pcf

weight = 130 x 4 = 520 psf



$K = \frac{73}{250} = 0.3$

WALL 1

CONTINGENCIES DURING CONSTRUCTION AND PRIOR TO DREDGING:

A. LOADING RESTRICTION CONTINGENCY OPTIONS:
   1. ZERO DREDGING OFFSET. CONSTRUCT 4'-0" DPx10'-0" WIDE TEMPORARY TRENCH AT BACK OF WALL. 250PSF MAXIMUM SURCHARGE LOADING PERMITTED WITHIN 10'-0" FROM BACK OF WALL. TRENCH SHALL BE BACKFILLED AND COMPACTED AFTER BACKFILL OF DREDGED MATERIAL HAS BEEN COMPLETED.
   2. MAINTAIN 3'-0" DREDGING OFFSET. CONSTRUCT 4'-0" DPx10'-0" WIDE TEMPORARY TRENCH AT BACK OF WALL. TRENCH SHALL BE BACKFILLED AND COMPACTED AFTER BACKFILL OF DREDGED MATERIAL HAS BEEN COMPLETED.
   3. ZERO DREDGING OFFSET. INSTALL TEMPORARY TIEBACK ANCHORS AS INDICATED. 250PSF MAXIMUM SURCHARGE LOADING PERMITED WITHIN 10'-0" FROM BACK OF WALL. TIEBACK ANCHORS, IF NOT REQUIRED, SHALL BE DESTRESSED AFTER BACKFILL OF DREDGED MATERIAL HAS BEEN COMPLETED.

B. REPAIR CONTINGENCY OPTIONS:
   1. INSTALL PERMANENT TIEBACK ANCHORS AS INDICATED (OR MAINTAIN TEMPORARY TIEBACK ANCHORS IN PLACE, IF INSTALLED).
   2. INSTALL NEW STEEL SHEET PILES IN FRONT OF EXISTING SHEET PILES AS INDICATED. FILL VOID SPACE BETWEEN SHEETS WITH UNDERWATER GROUT.

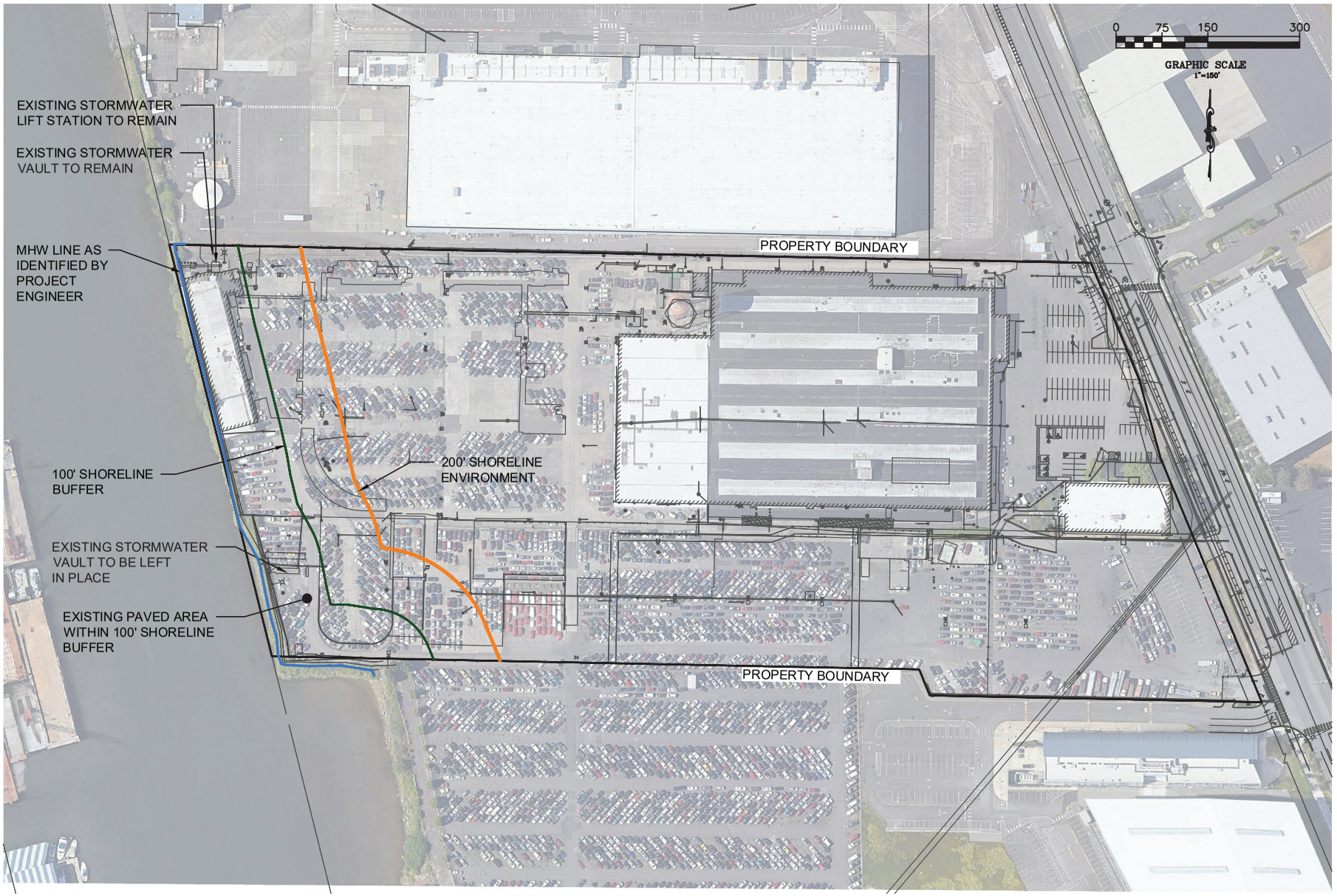
FINAL ANALYSIS

RECENT REMEDIATION LANDSCAPING AND DEVELOPMENTS OF THIS SITE NEGATES USE OF ANY OF THE OPTIONS ABOVE. THEREFORE WALL 1 WILL:

A. BE REINFORCED/STRENGTHENED WITHIN THE TWO DEBRIS PILE AREAS WITH A SHEETPILE WALL, OFFSET 2'-0" IN FRONT OF THE EXISTING. THE VOID SPACE WILL BE FILLED WITH REINFORCED UNDERWATER CEMENT GROUT.

B. HAVE A 5'-0" DREDGING OFFSET APPLIED IN OTHER SMA (SEDIMENT MANAGEMENT AREA) ZONES.

CENTERPOINT TUKWILA - EXISTING CONDITIONS



SOURCES:

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425)251-6222
(425)251-8782 FAX
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE, SUITE D
GIG HARBOR, WASHINGTON 98335
P. 253.514.8952
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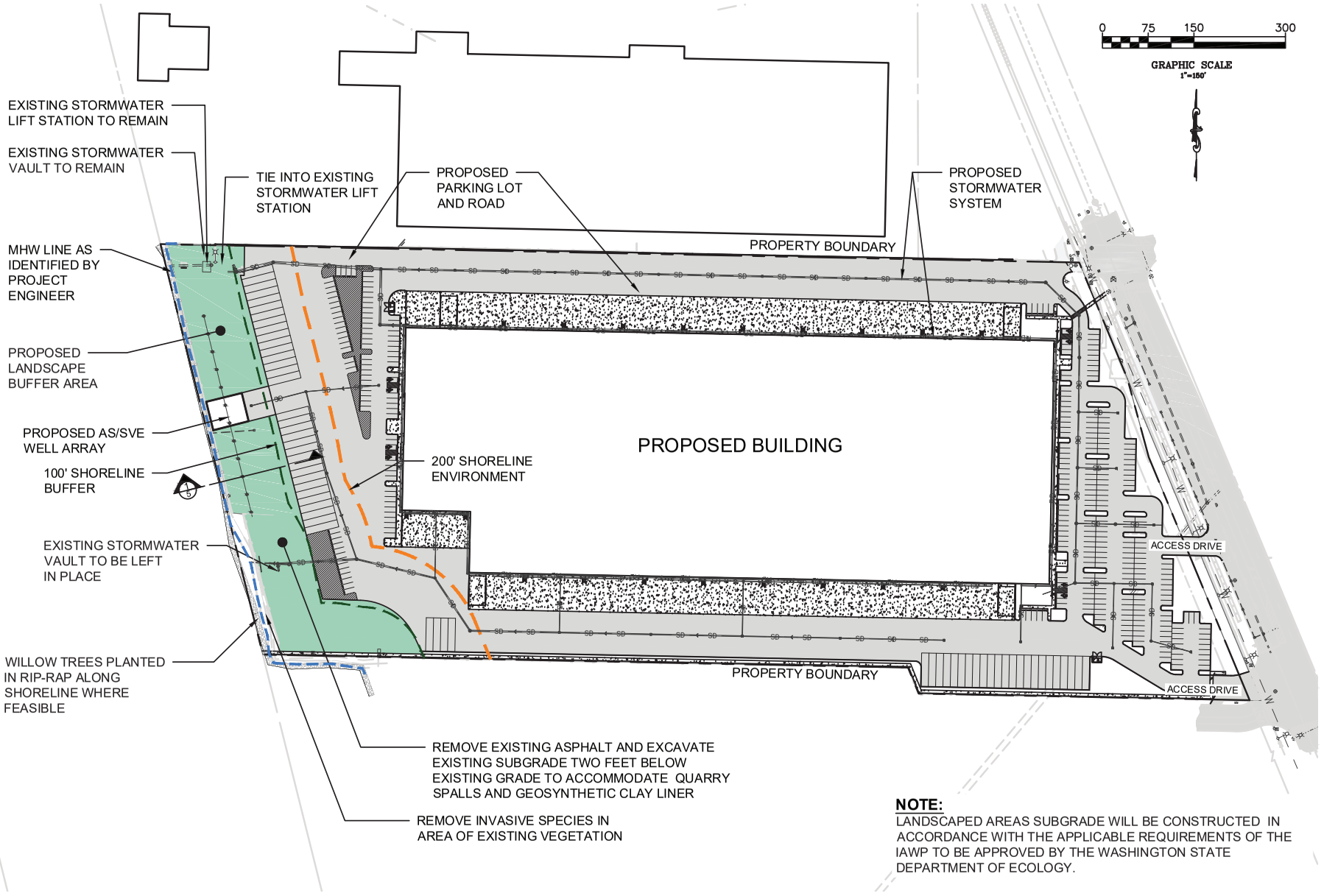
CENTERPOINT TUKWILA
8801 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108

THE SE¼ OF SECTION 33, TOWNSHIP 24N, RANGE 04E, W.M.

DATE:	10/21/2020
JOB:	1853.0001
BY:	MW
SCALE:	AS SHOWN
SHEET	1 OF 7

CENTERPOINT TUKWILA - PROPOSED PROJECT



NOTE:
LANDSCAPED AREAS SUBGRADE WILL BE CONSTRUCTED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE IAWP TO BE APPROVED BY THE WASHINGTON STATE DEPARTMENT OF ECOLOGY.

SOURCES: BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
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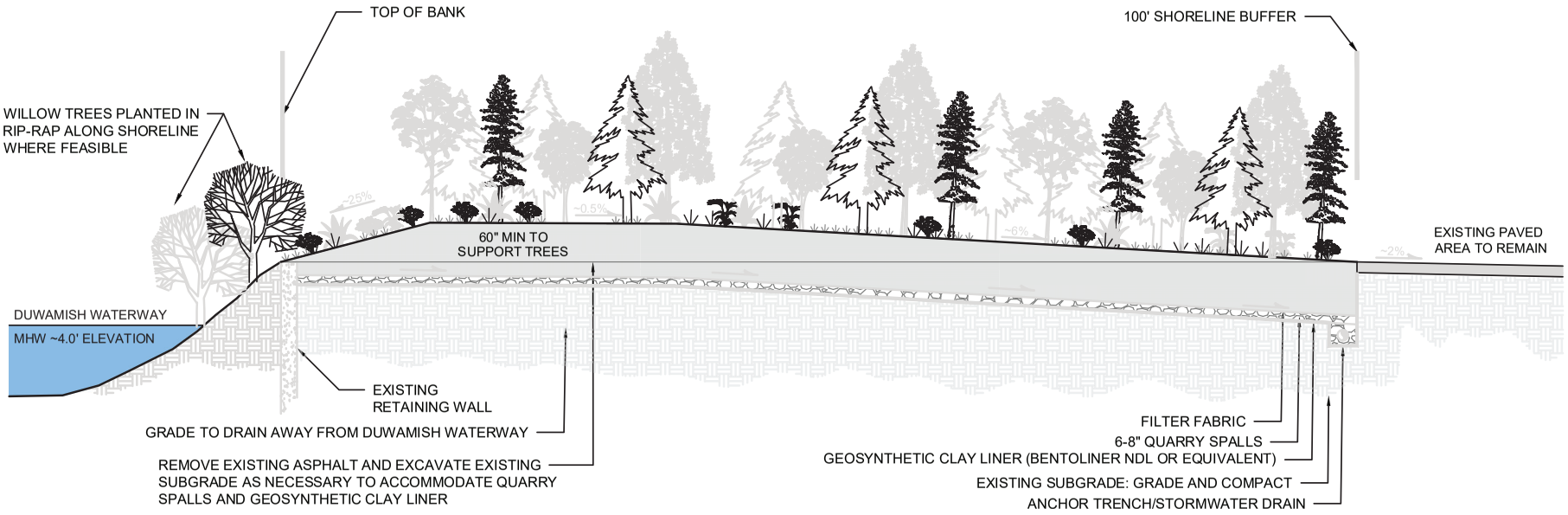
CENTERPOINT TUKWILA
8801 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108
THE SE¼ OF SECTION 33, TOWNSHIP 24N, RANGE 04E, W.M.

DATE:	10/21/2020
JOB:	1853.0001
BY:	MW
SCALE:	AS SHOWN
SHEET	2 OF 7

CENTERPOINT TUKWILA - PROPOSED SHORELINE CROSS-SECTION



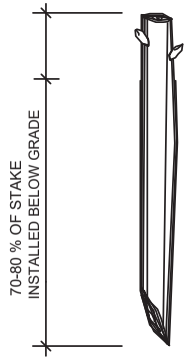
PROPOSED SHORELINE CROSS-SECTION

10 0 10

SCALE IN FEET

LIVE STAKE PLANTING DETAIL

NOT TO SCALE



STORAGE OF LIVE STAKES

ALL WOODY PLANT CUTTINGS COLLECTED MORE THAN 12 HR PRIOR TO INSTALLATION, MUST BE CAREFULLY BOUND, SECURED, AND STORED OUT OF DIRECT SUNLIGHT AND SUBMERGED IN CLEAN FRESH WATER FOR A PERIOD OF UP TO TWO WEEKS.

OUTDOOR TEMPERATURES MUST BE LESS THAN 50 DEGREES F AND TEMPERATURE INDOORS AND IN STORAGE CONTAINERS MUST BE BETWEEN 34 AND 50 DEGREES F.

IF THE LIVE STAKES CANNOT BE INSTALLED DURING THE DORMANT SEASON, CUT DURING THE DORMANT SEASON AND HOLD IN COLD STORAGE AT TEMPERATURES BETWEEN 33 AND 39 DEGREES F FOR UP TO 2 MONTHS.

NOTES:

1. LIVE STAKES TO BE 1 TO 2 INCH DIAMETER 24 TO 32 INCHES LENGTH.
2. USE 1/2 INCH DIAMETER REBAR OR ROCK BAR TO MAKE PILOT HOLE.
3. INSTALL LIVE STAKES TAPER END DOWN WITH BUDS POINTED UP.
4. MINIMUM TWO BUDS ABOVE GRADE.
5. SET LIVE STAKES WITH DEAD-BLOW HAMMER.
6. WATER IMMEDIATELY AFTER INSTALLATION.

SOURCES:
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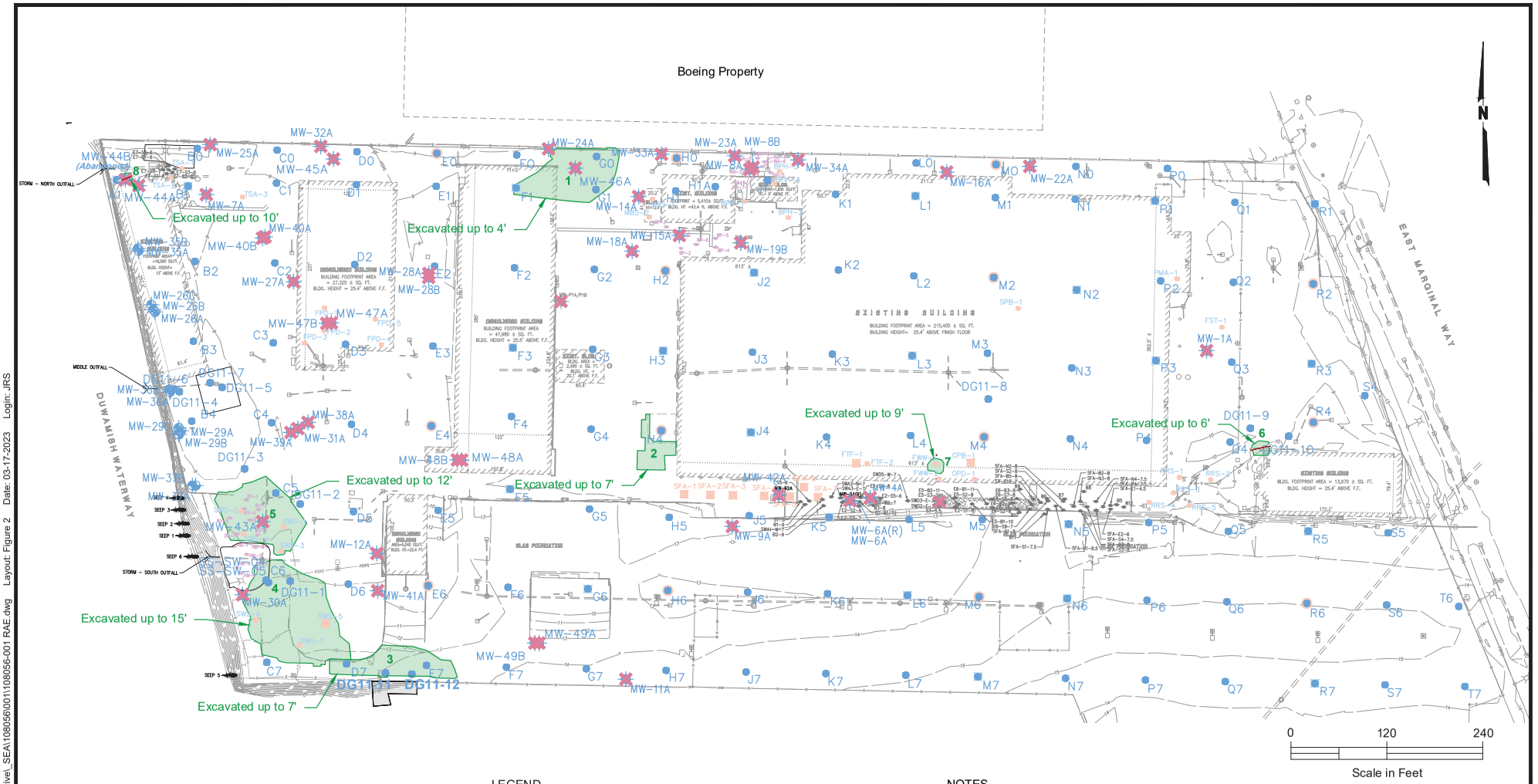
SEATTLE, WASHINGTON 98108

THE SE¼ OF SECTION 33, TOWNSHIP 24N, RANGE 04E, W.M.

DATE:	10/21/2020
JOB:	1853.0001
BY:	MW
SCALE:	AS SHOWN
SHEET	7 OF 7



LEGEND

- 3 — Estimated Excavation Extents with Area Number Designation
- Historical Soil Sample
- MW-36B — Groundwater Monitoring Well
- Monitoring Wells (Decommissioned)
- Fenceline
- Feet

NOTES

1. Exploration locations are approximate.
2. Base map and historic exploration points are from Kennedy-Jenks Figures 2 and 3, 046001.00/Report/Po4SK003.
3. Excavation Limits are based from the files J1743,07 09-14-22.dwg, received September 14, 2022, and J1743.07 12-23-21.dwg, received January 31, 2022.

DRAFT Compliance Monitoring Report
Remedial Excavations
8801 East Marginal Way S.
Tukwila, Washington

REMEDIAL ACTION EXCAVATIONS

April 2023 | 108056-001

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS | FIG. 2

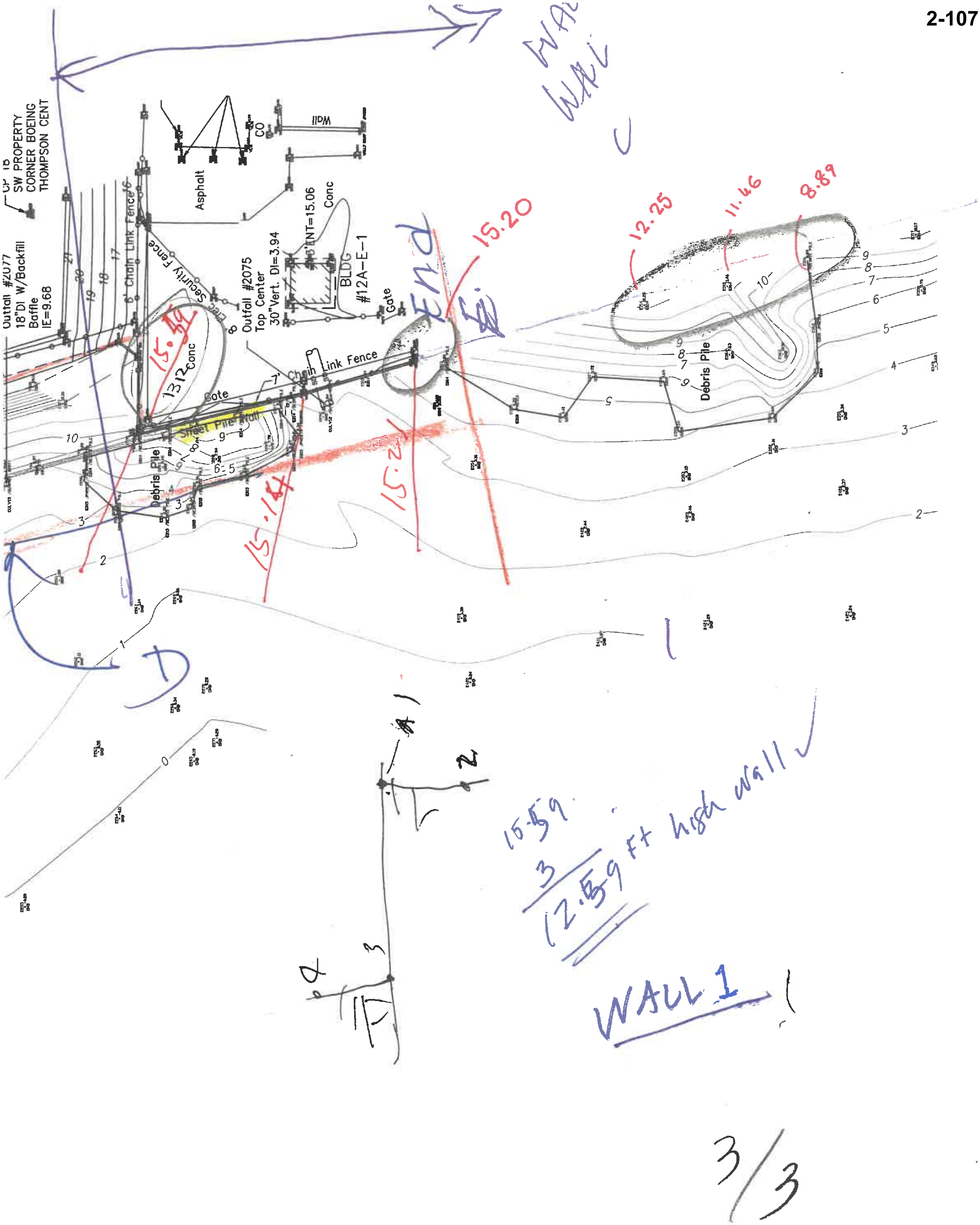
Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\108056\001\108056-001 RAE.dwg Layout: Figure 2 Date: 03-17-2023 Login: JRS

SHANNON & WILSON

108056

Locations of AS/SVE and Monitoring Wells
8801 Property
Tukwila, WA

June 2023
Site Map
Figure 2

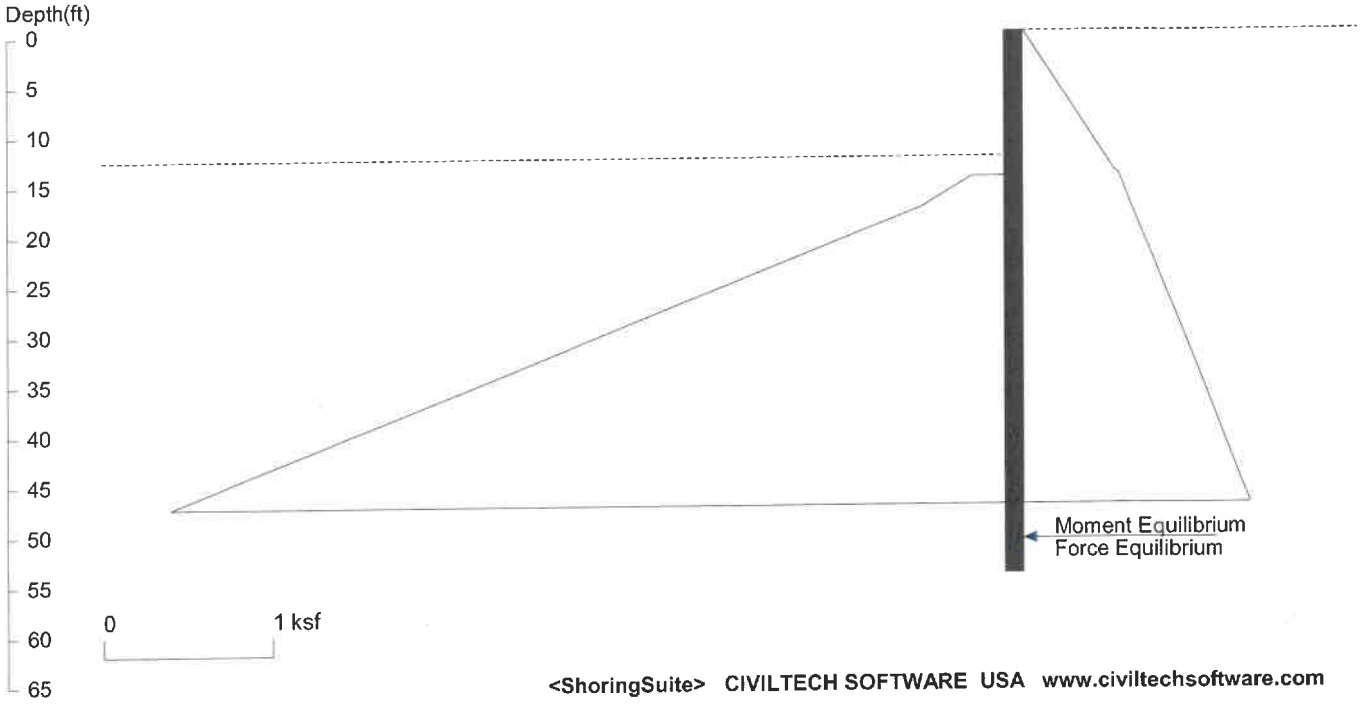

SW PROPERTY
CORNER BOEING
THOMPSON CENT
Outfall #2077
18"DI W/Backfill
Baffle
IE=9.68
Asphalt
CO
Wall
Security Fence
6' Chain Link Fence
Conc
Outfall #2075
Top Center
30"Vert. DI=3.94
ENT=15.06
Conc
BLDG
#12A-E-1
Gate
Chain Link Fence
Gate
Sheet Pile Wall
Debris Pile
Debris Pile
15.20
12.25
11.46
8.89
End
15.59
3
12.59 ft high wall
WALL 1
3/3

Sheet Pile - Wall 1

			Embedment	Deflection
As-is Baseline Condition 1	S = ϕ	AZ48	41.74	1.09
	S = 73		46.78	1.68
Case B (No Surcharge for 10' behind wall)				
			Embedment	Deflection
Condition 2 0' off	S = ϕ	AZ48	55.81	2.18
	S = 73		60.68	2.86
Condition 3 3' off	S = ϕ	AZ48	46.11	1.37
	S = 73		49.89	1.75
Case C (4' Deep x 10' wide Trench)				
			Embedment	Deflection
Condition 2 0' off	S = ϕ	AZ48	49.97	1.68
	S = 73		54.47	2.04
Condition 3 3' off	S = ϕ	AZ48	40.61	0.99
	S = 73		44.00	1.21
Case A (Tieback)			Embedment	Force
Condition 2 0' off	S = 73		24.77	7.1
Condition 3 3' off	S = 73		19.53	6.8
Case A+B (Tieback + No Surcharge for 10' behind wall)				
Condition 2 0' off	S = 73		24.73	6.3
Condition 3 3' off	S = 73		19.59	5.9

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, S=0



Licensed to 4324324234 3424343 Date: 4/13/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=41.74 Min. Pile Length=54.24

MOMENT IN PILE: Max. Moment=107.81 per Pile Spacing=1.0 at Depth=34.31

PILE SELECTION:

Request Min. Section Modulus = 39.2 in3/ft=2107.57 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

CZ148 (3.37) 4N (3.16) AZ25 (2.41) FSPZ25 (3.30) PZ38 (3.29)
BZ26 (2.78) H175 (2.85) AZ26 (2.27) PZ35 (2.55) AZ28 (2.14)
H215 (2.35) BZ32 (2.24) FSPZ32 (2.29) PZ40 (1.88)

AZ48(1.09)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023

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

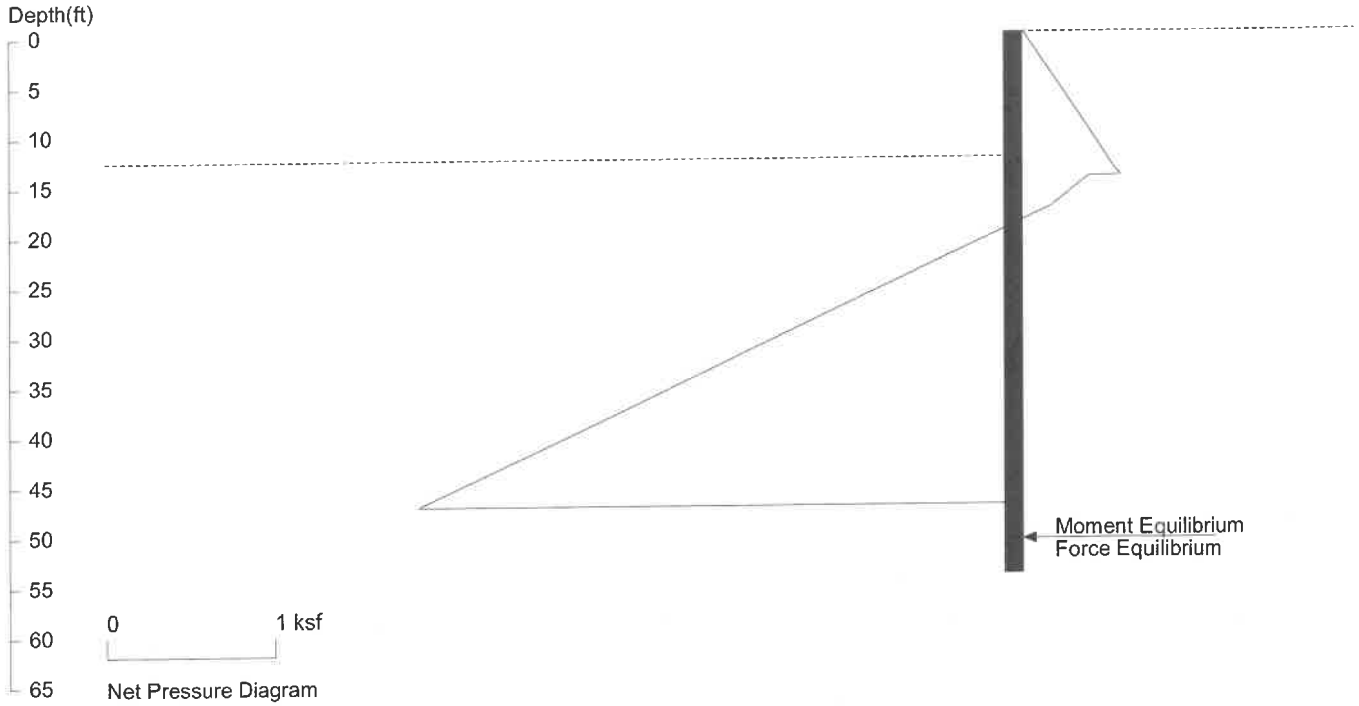
Z1	P1	Z2	P2	Slope
14.5	0.19	17.5	0.48	0.096
17.5	0.48	99.0	12.54	0.148

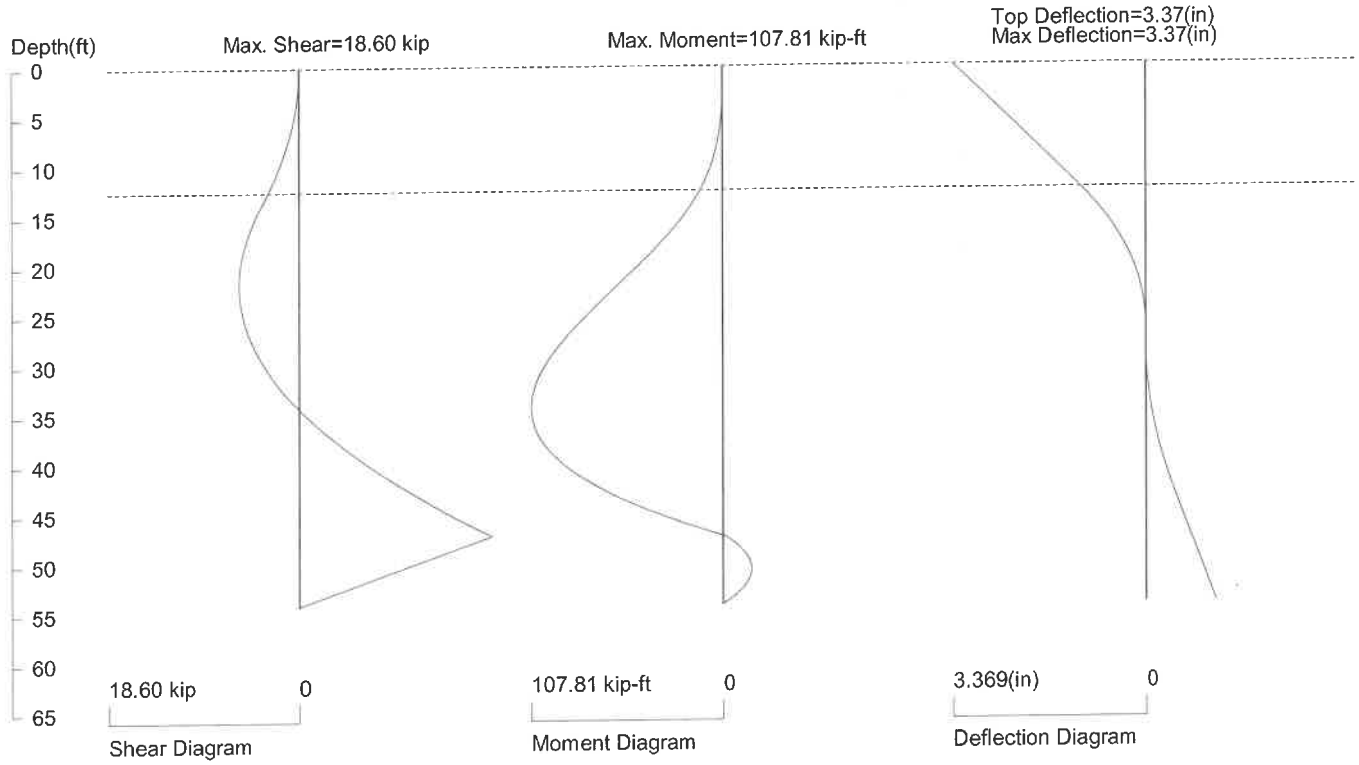
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, S=0





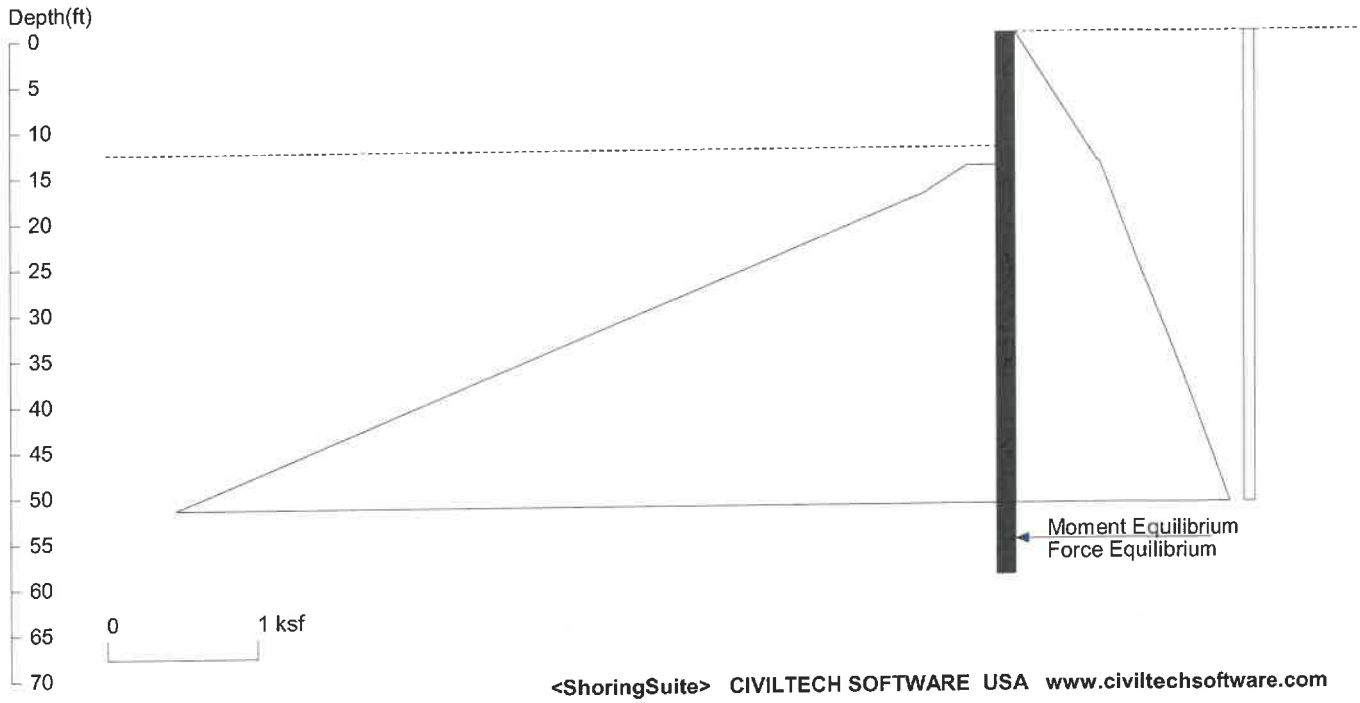
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: CZ148: E (ksi)=29000.0, I (in4)/foot=273.9

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, S=73



Licensed to 4324324234 3424343 Date: 4/13/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=46.78 Min. Pile Length=59.28

MOMENT IN PILE: Max. Moment=154.03 per Pile Spacing=1.0 at Depth=36.87

PILE SELECTION:

Request Min. Section Modulus = 56.0 in3/ft=3011.11 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

H215 (3.62) BZ32 (3.45) FSPZ32 (3.53) PZ40 (2.90) 5RU3 (3.79)
AZ34 (2.47) AZ36700 (2.16) AZ36 (2.34) BZ37 (3.04) AZ38 (2.23)
FSPZ38 (2.80) AZ38700 (2.05) AZ40700 (1.94) BZ42 (2.61)

AZ48(1.68)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023
0	0.073	99	0.073	0

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

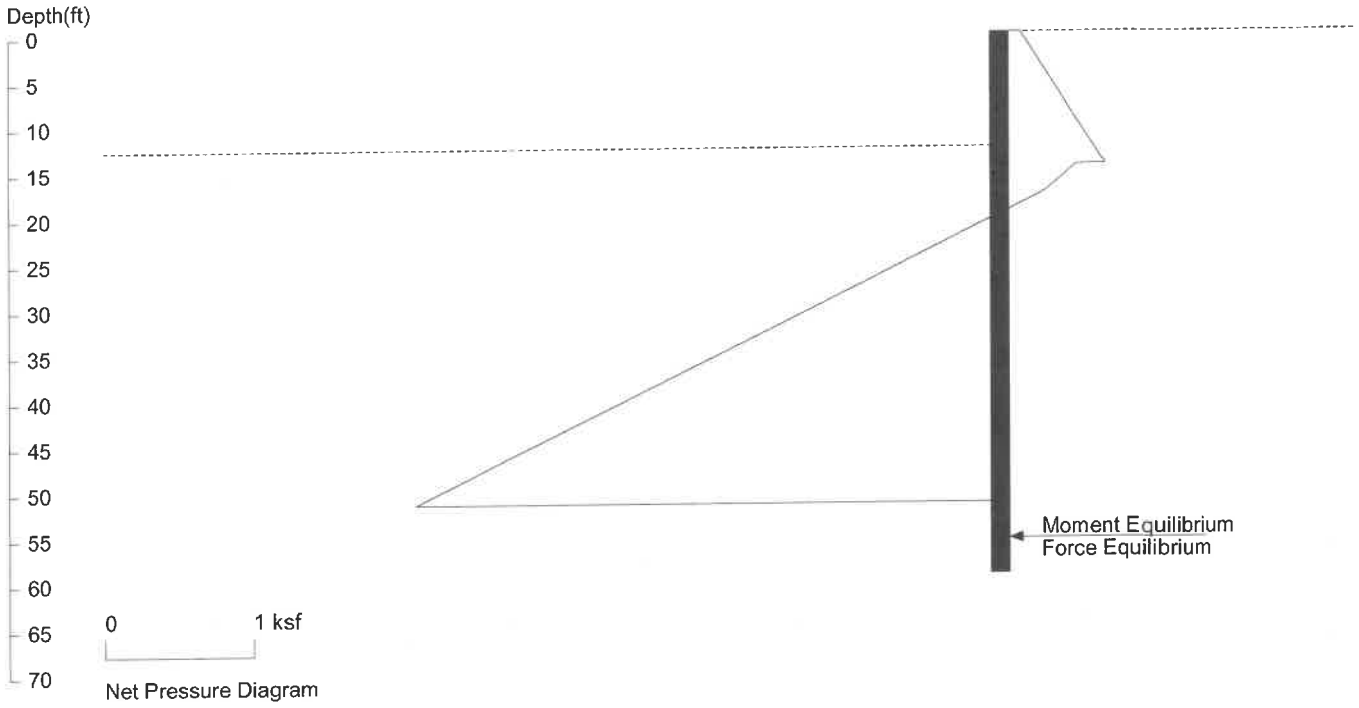
Z1	P1	Z2	P2	Slope
14.5	0.19	17.5	0.48	0.096
17.5	0.48	99.0	12.32	0.148

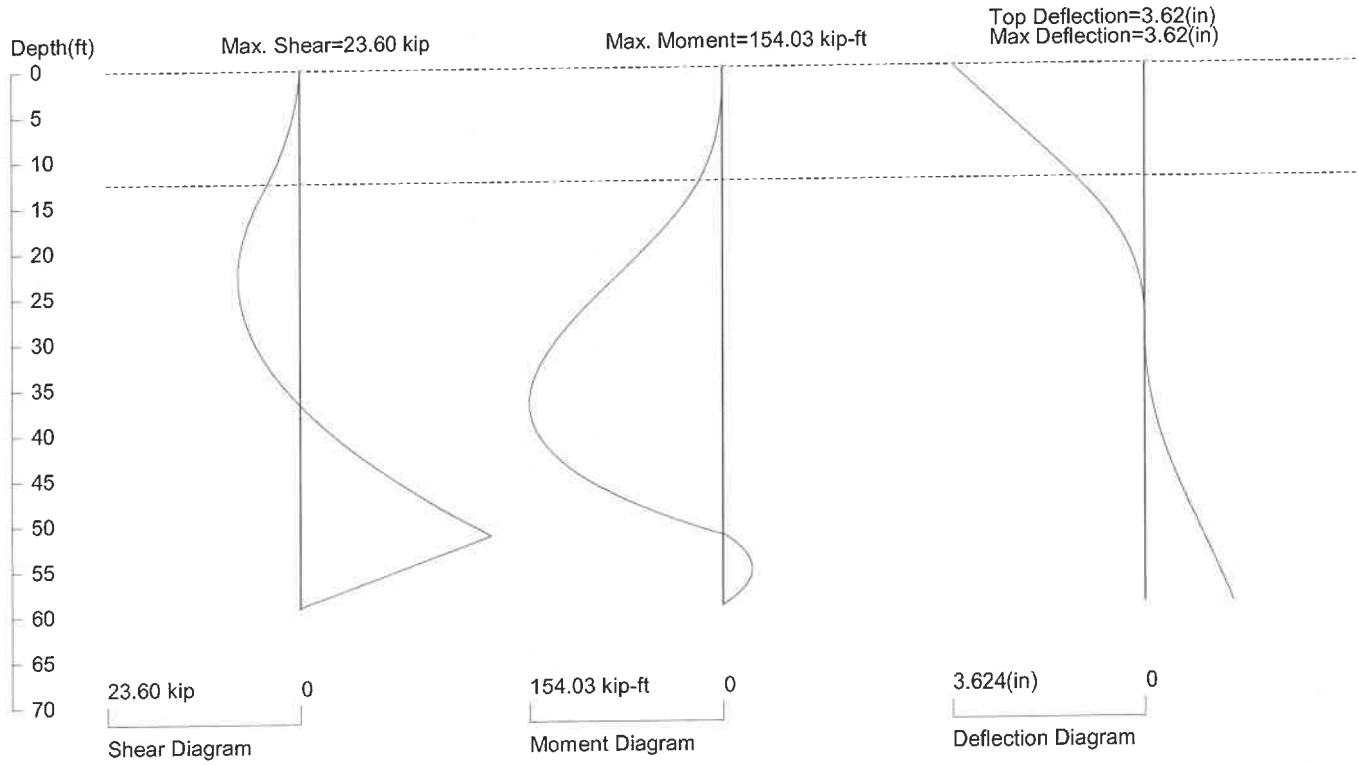
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, S=73





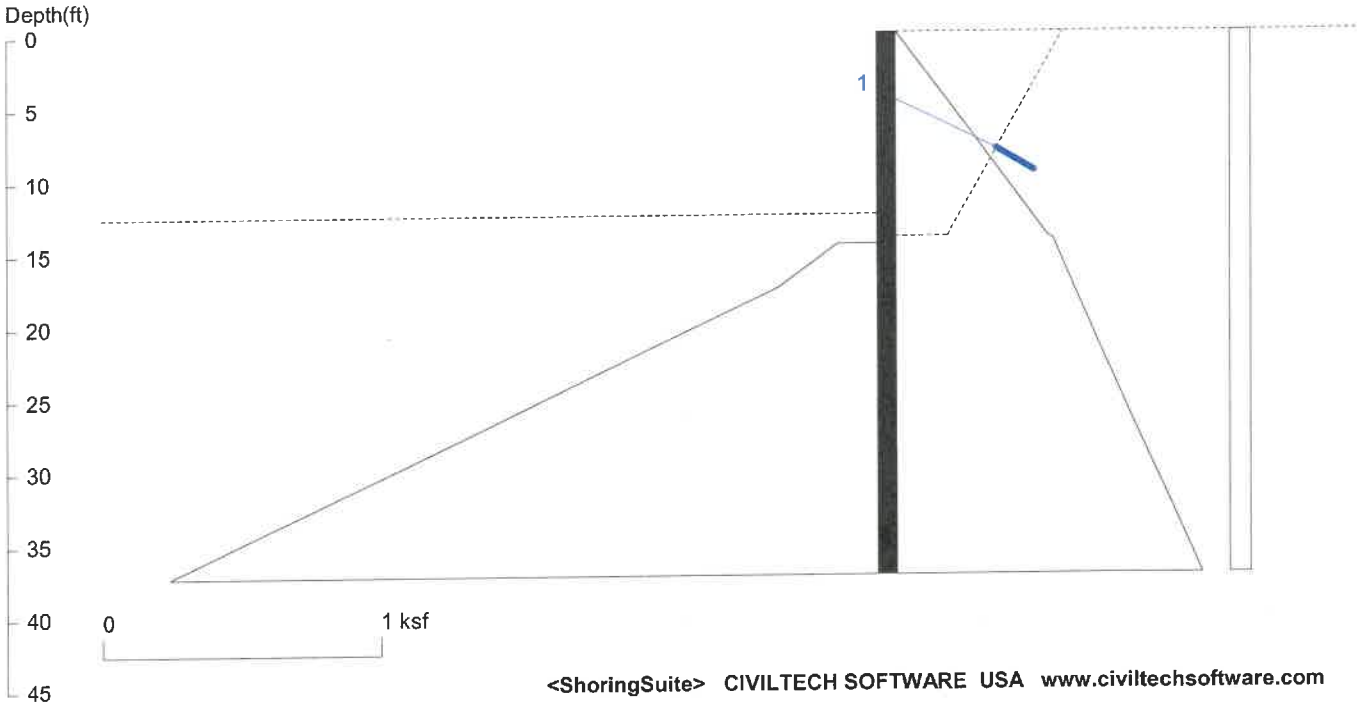
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: H215: E (ksi)=29000.0, I (in4)/foot=392.2

12.5ft High Sheet Pile, Dw=14ft

Case A, Condition 2, S=73



Licensed to 4324324234 3424343 Date: 4/19/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=24.77 Min. Pile Length=37.27

MOMENT IN PILE: Max. Moment=38.35 per Pile Spacing=1.0 at Depth=16.42

K 107.81 OK

PILE SELECTION:

Request Min. Section Modulus = 13.9 in3/ft=749.67 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

BZ7 (-1.65) H95 (-1.66) SZ145U (-1.00) CZ14 (-1.20) Z70 (-1.48)
CZ95RD (-1.45) CZ95 (-1.41) Z75 (-1.35) CZ16 (-1.10) BZ8.6 (-1.42)
SZ18 (-1.09) CZ101 (-1.33) SPZ19-5 (-1.24) SZ250 (-0.97)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	30.0	1.0	7.1	6.2	3.6	8.0	3.0

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
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023
0	0.073	99	0.073	0

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

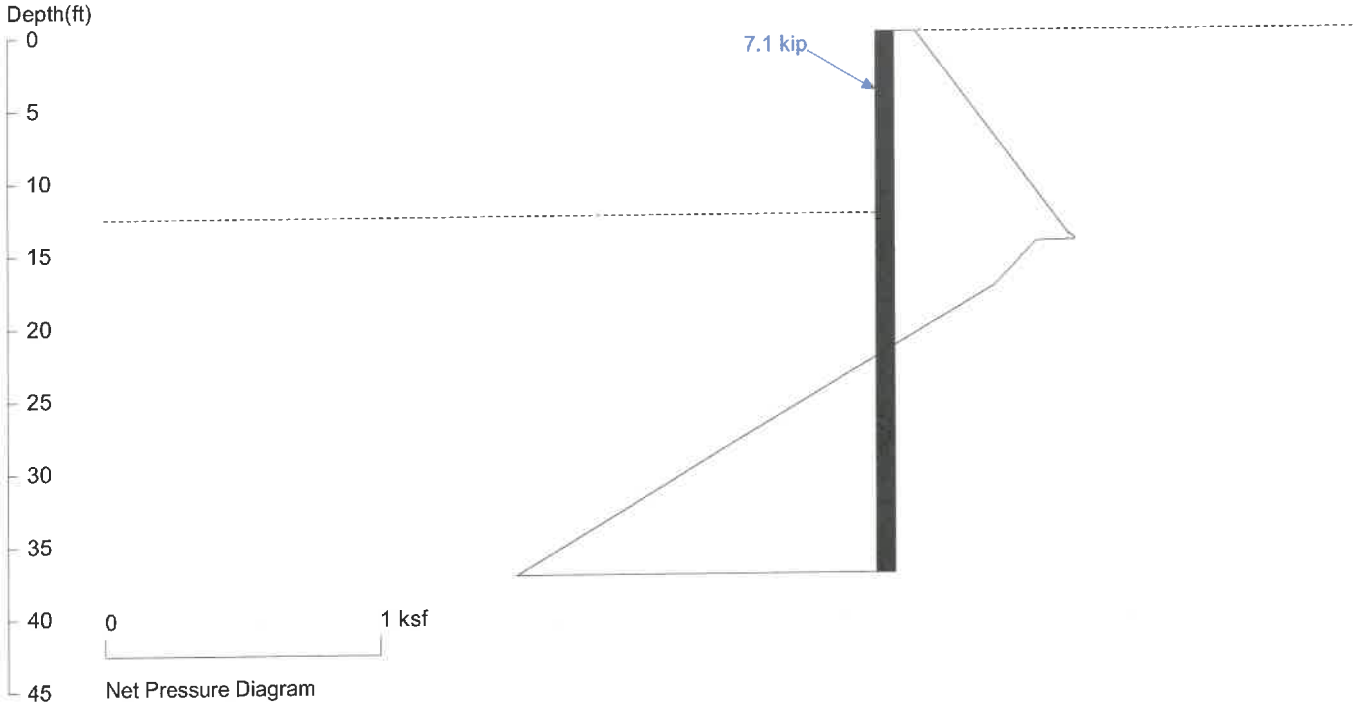
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.40	0.111

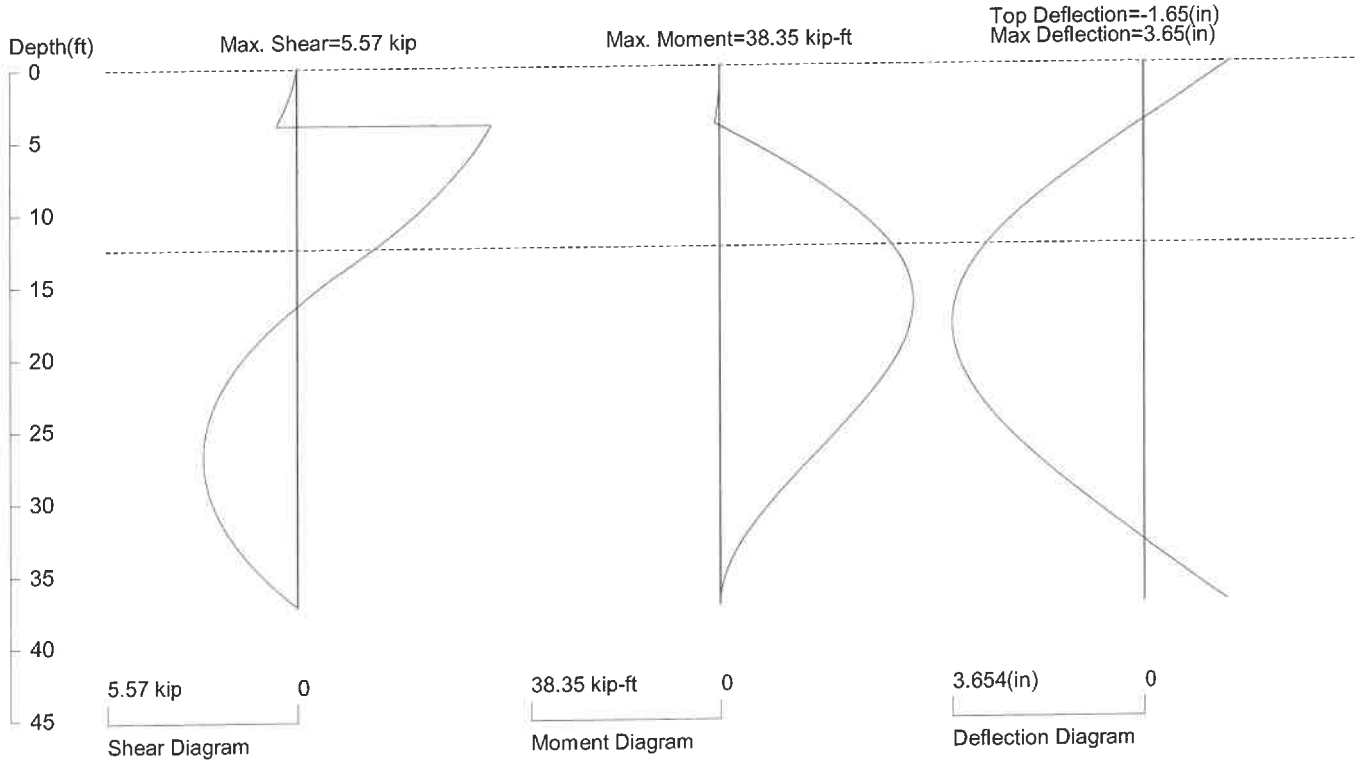
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00

12.5ft High Sheet Pile, Dw=14ft

Case A, Condition 2, S=73





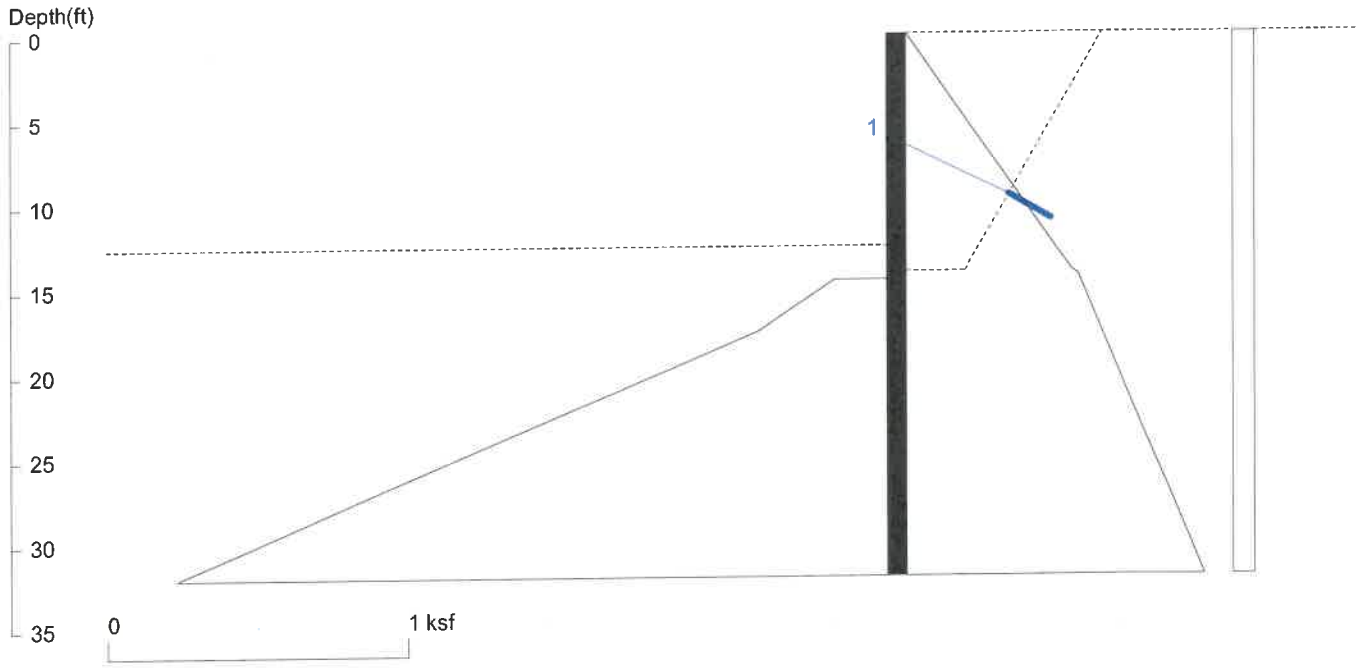
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: BZ7: E (ksi)=29000.0, I (in4)/foot=52.5

12.5ft High Sheet Pile, Dw=14ft

Case A, Condition 3, S=73



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltechsoftware.com

Licensed to 4324324234 3424343 Date: 4/19/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=19.53 Min. Pile Length=32.03

MOMENT IN PILE: Max. Moment=22.81 per Pile Spacing=1.0 at Depth=15.88

OK

PILE SELECTION:

Request Min. Section Modulus = 11.5 in3/ft=619.30 cm3/m, Fy= 36 ksi = 248 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

CZ72 (-1.25) 1BXN (-1.60) SZ14.5 (-0.94) 1N (-1.30) Z65 (-1.06)
CZ84 (-1.07) BZ7 (-1.09) H95 (-1.10) SZ145U (-0.67) CZ14 (-0.80)
Z70 (-0.98) CZ95RD (-0.96) CZ95 (-0.94) Z75 (-0.90)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	30.0	1.0	6.8	5.9	3.4	7.0	2.9

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
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023
0	0.073	99	0.073	0

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

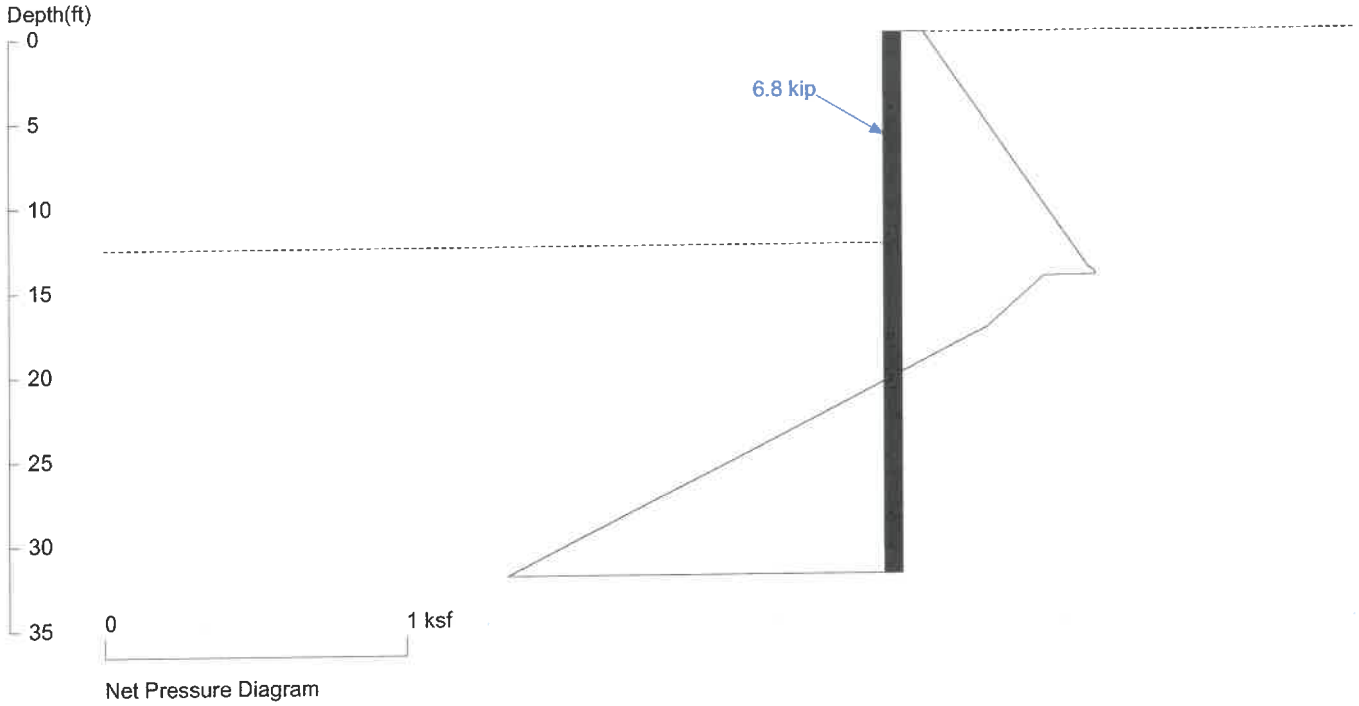
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.29	0.133

ACTIVE SPACING:

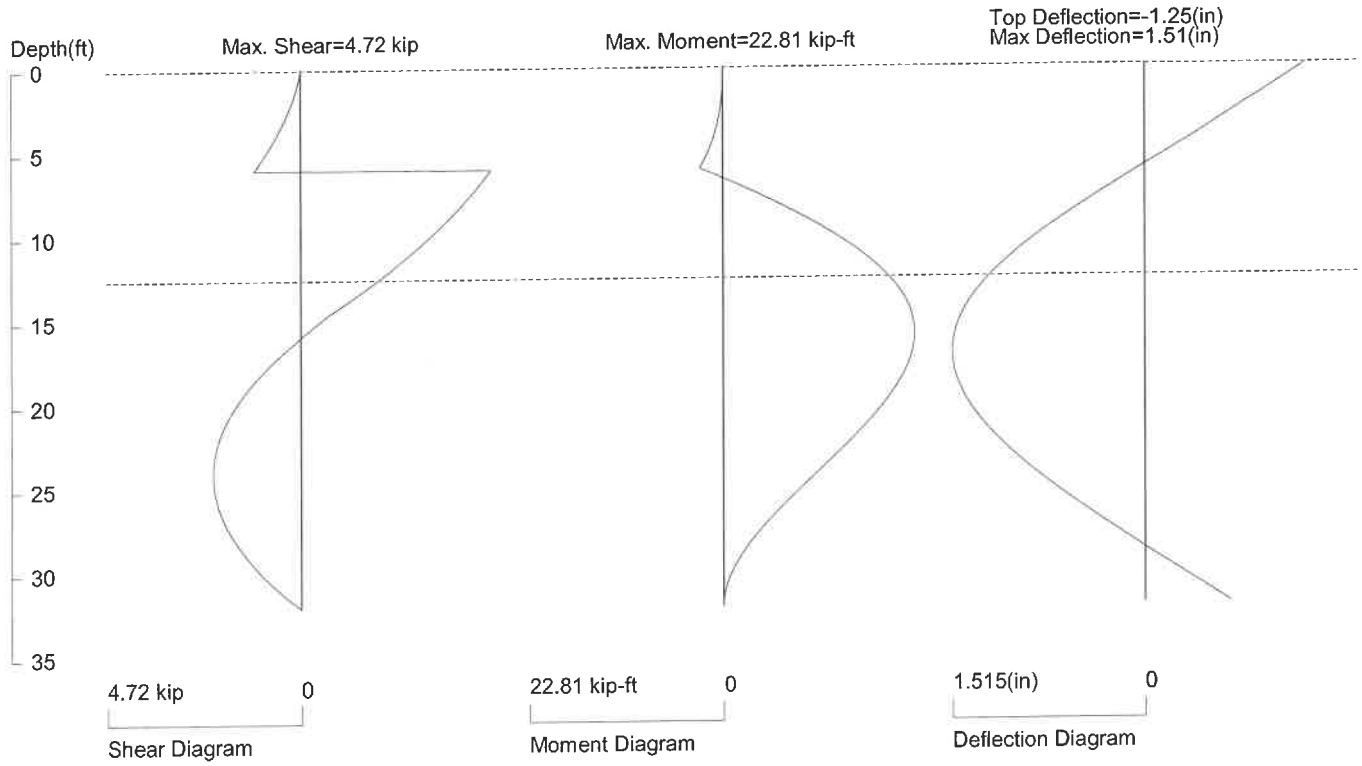
No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00

12.5ft High Sheet Pile, Dw=14ft

Case A, Condition 3, S=73



Net Pressure Diagram



Shear Diagram

Moment Diagram

Deflection Diagram

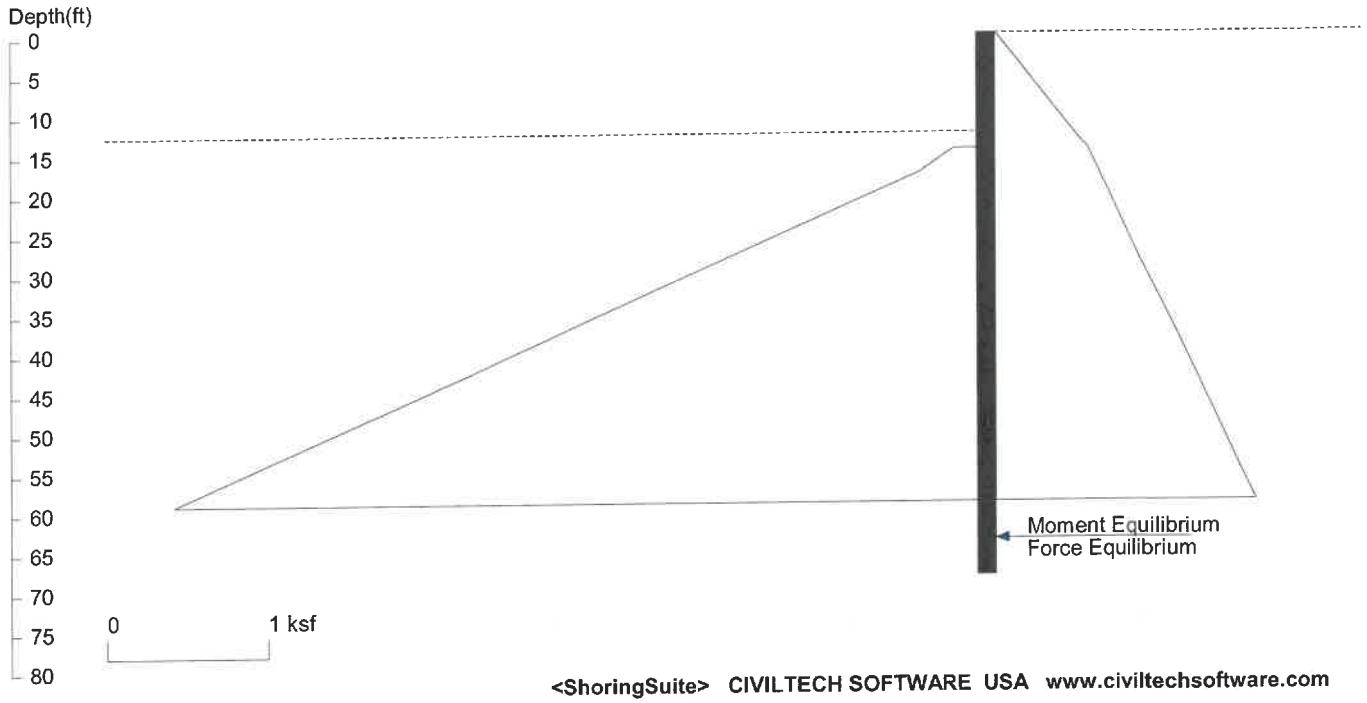
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: CZ72: E (ksi)=29000.0, I (in4)/foot=46.0

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 2, S=0



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=55.81 Min. Pile Length=68.31

MOMENT IN PILE: Max. Moment=163.57 per Pile Spacing=1.0 at Depth=41.99

PILE SELECTION:

Request Min. Section Modulus = 59.5 in3/ft=3197.56 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

FSPZ32 (4.58) PZ40 (3.76) 5RU3 (4.92) AZ34 (3.20) AZ36700 (2.81)
AZ36 (3.04) BZ37 (3.94) AZ38 (2.89) FSPZ38 (3.64) AZ38700 (2.66)
AZ40700 (2.52) BZ42 (3.39) FSPZ45 (3.02) AZ46 (2.28)

>10% over

AZ48 (2.18)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023

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

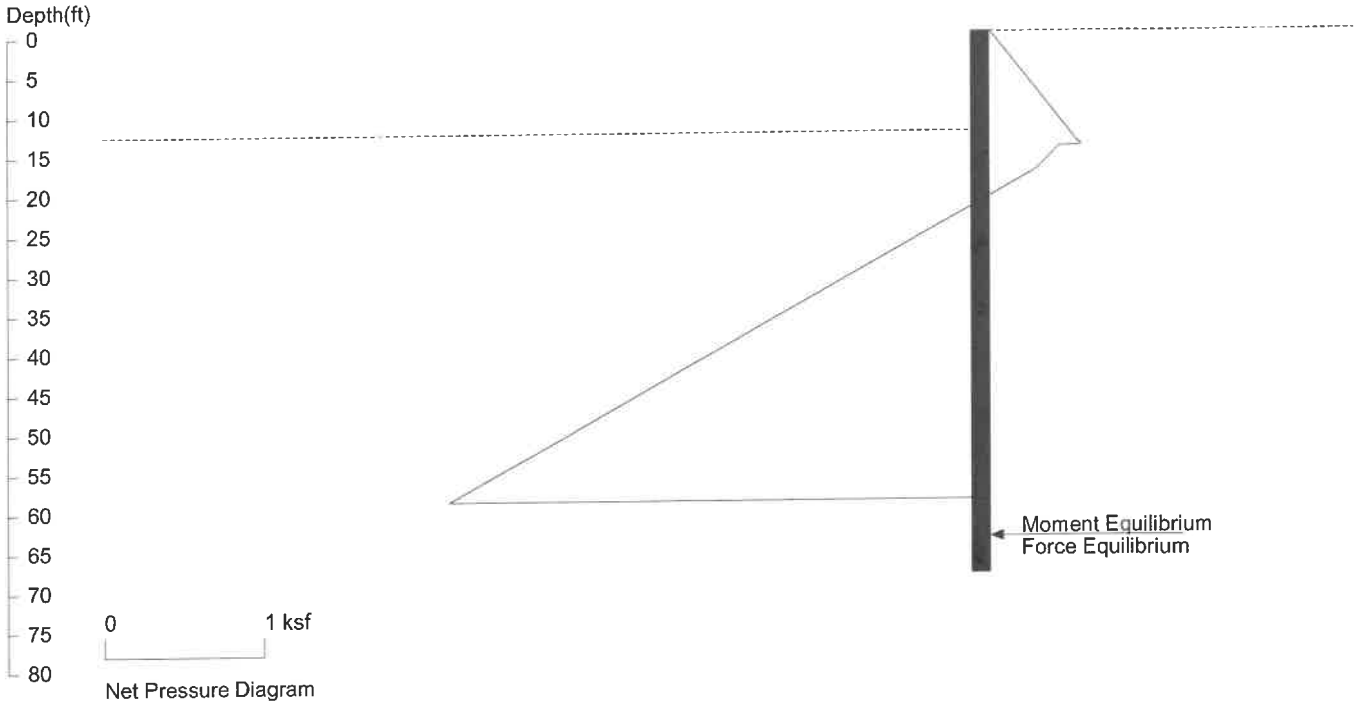
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.24	0.111

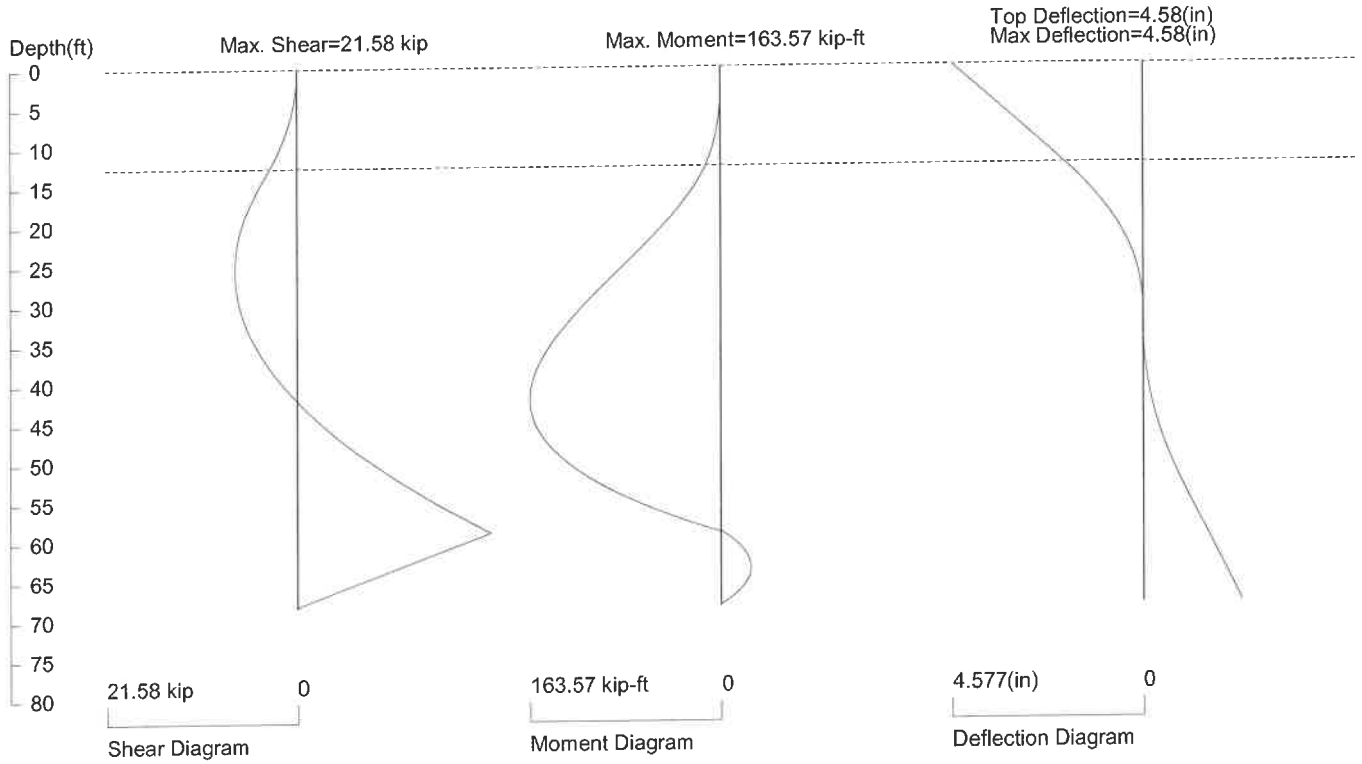
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 2, S=0





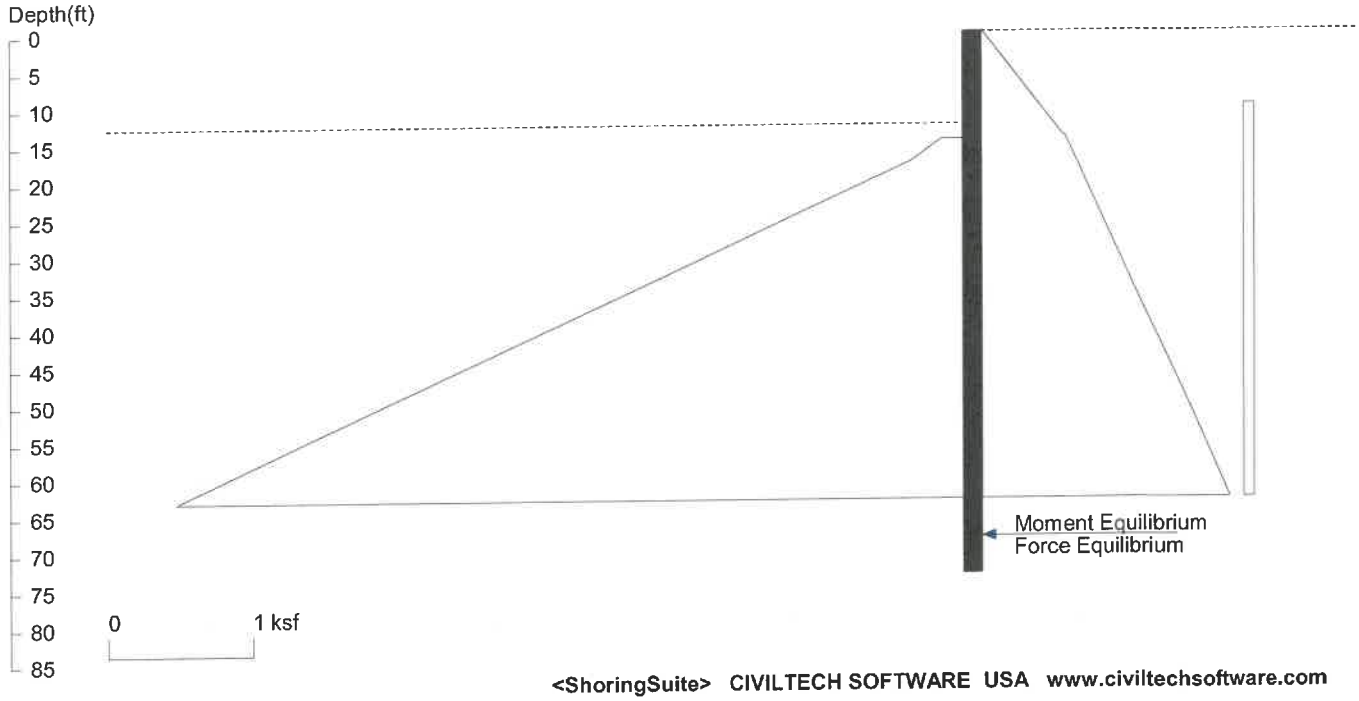
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: FSPZ32: E (ksi)=29000.0, I (in4)/foot=403.0

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 2, S=73



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=60.68 Min. Pile Length=73.18

MOMENT IN PILE: Max. Moment=204.36 per Pile Spacing=1.0 at Depth=44.83

> 10% over

PILE SELECTION:

Request Min. Section Modulus = 74.3 in3/ft=3994.98 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

AZ40700 (3.32) BZ42 (4.46) FSPZ45 (3.97) AZ46 (3.00) AZ48 (2.86)

AZ50 (2.74)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	0.546	14.25	0.567	0.085
14.25	0.567	99	2.516	0.023
10	0.073	99	0.073	0

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

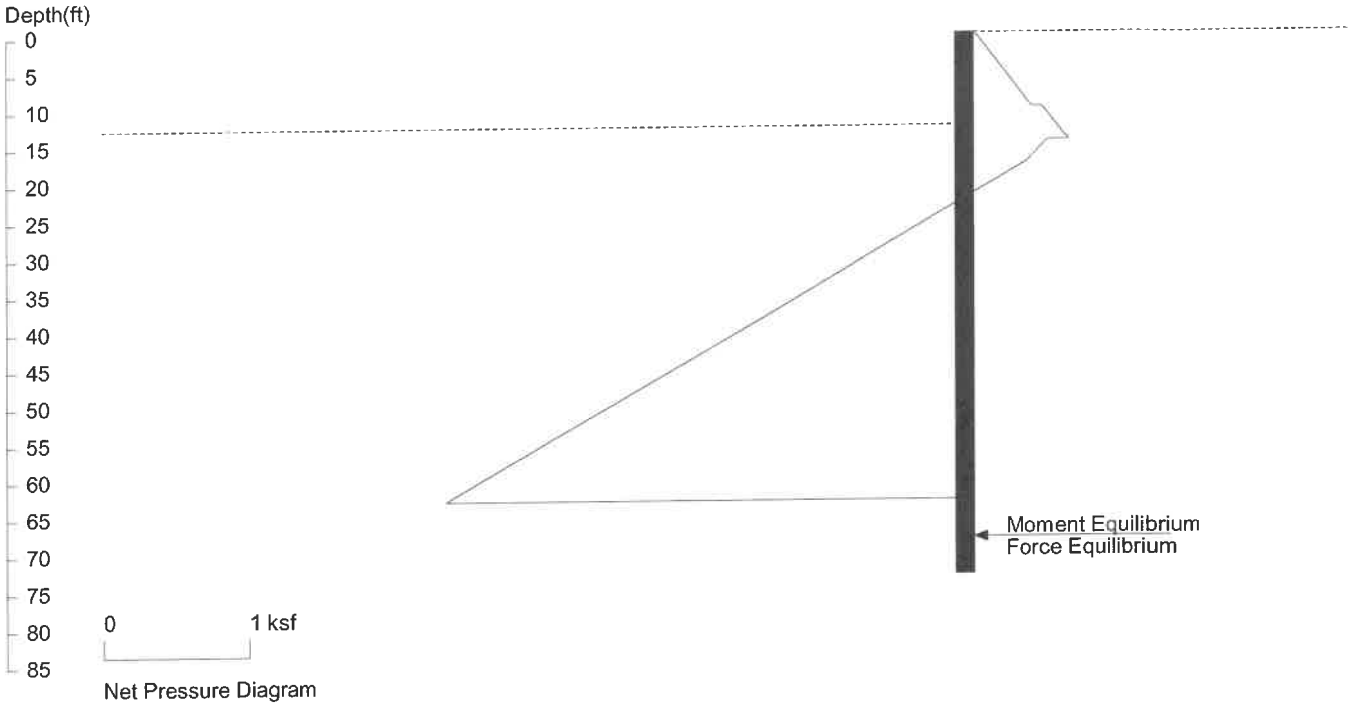
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.40	0.111

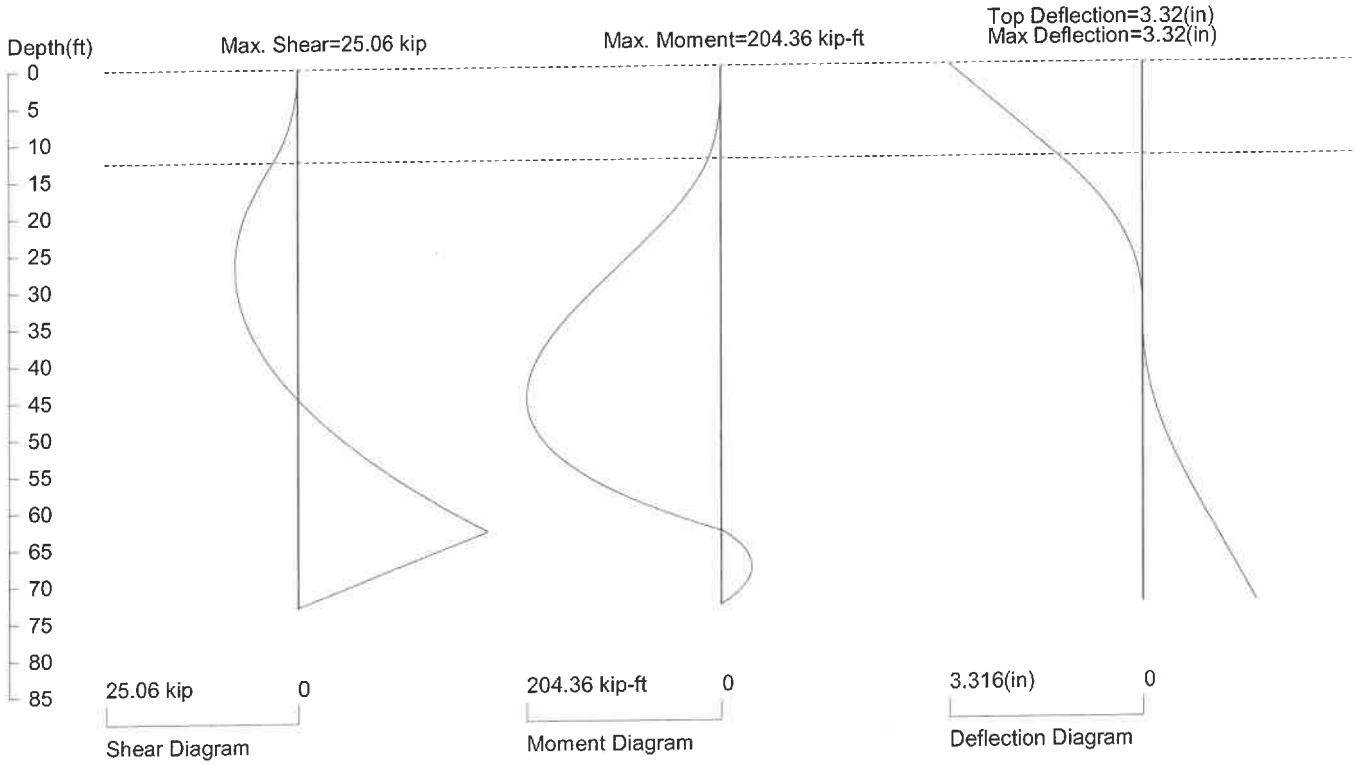
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 2, S=73





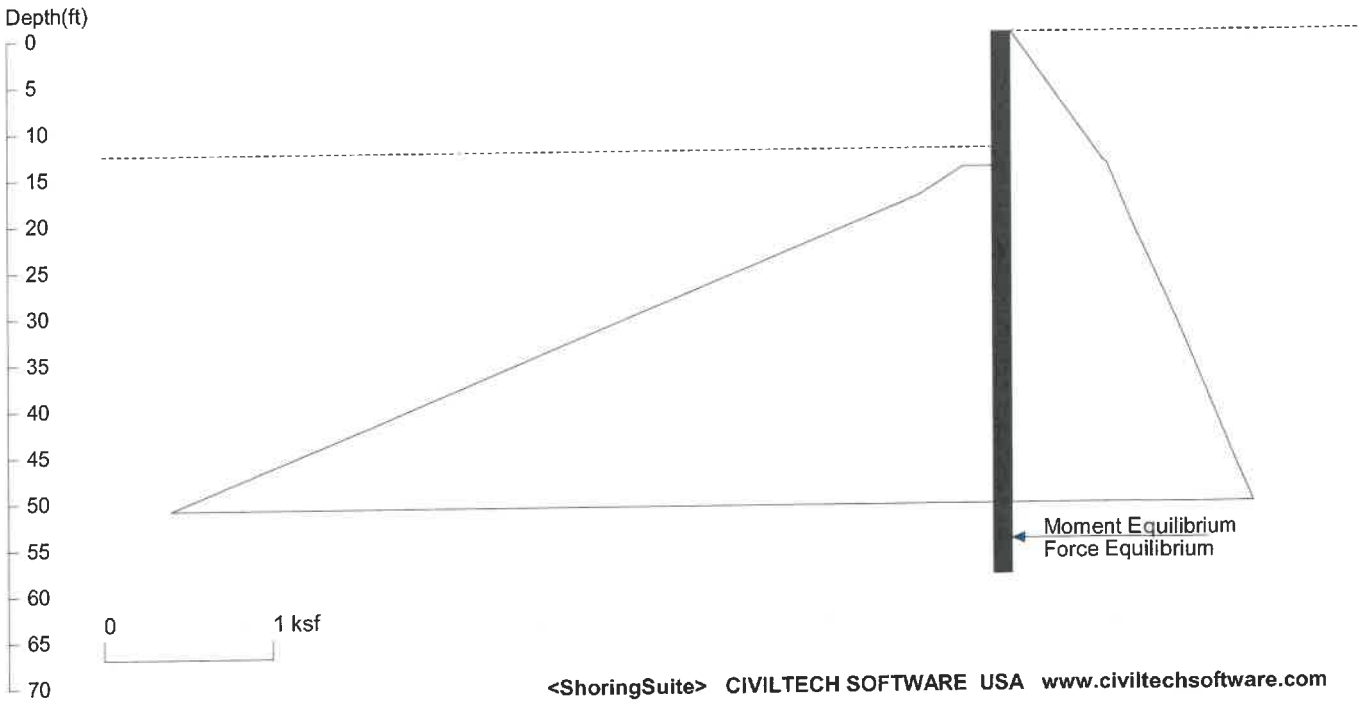
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: AZ40700: E (ksi)=29000.0, I (in4)/foot=731.8

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 3, S=0



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=46.11 Min. Pile Length=58.61

MOMENT IN PILE: Max. Moment=123.80 per Pile Spacing=1.0 at Depth=36.69

15% over

PILE SELECTION:

Request Min. Section Modulus = 45.0 in3/ft=2420.21 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

AZ25 (3.03) FSPZ25 (4.14) PZ38 (4.13) BZ26 (3.49) H175 (3.58)
AZ26 (2.85) PZ35 (3.21) AZ28 (2.69) H215 (2.96) BZ32 (2.82)
FSPZ32 (2.88) PZ40 (2.36) 5RU3 (3.09) AZ34 (2.01)

AZ48 (1.37)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023

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

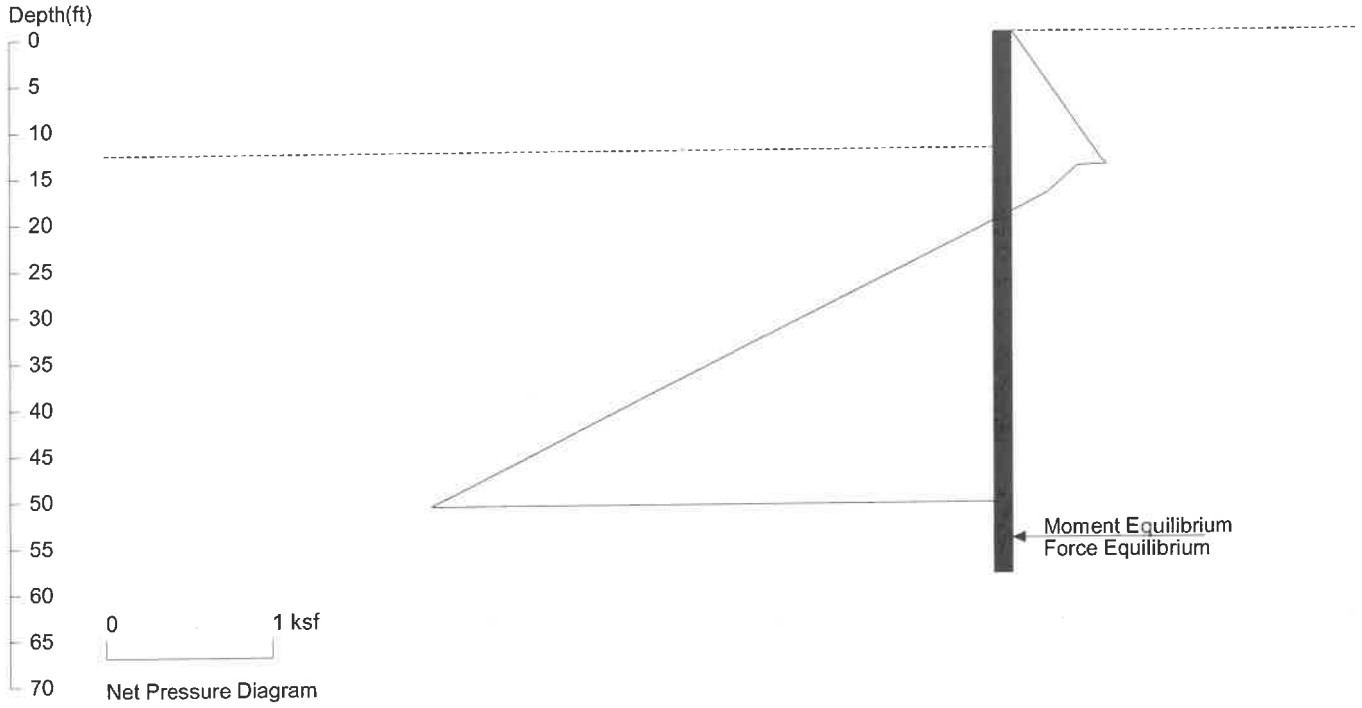
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.28	0.133

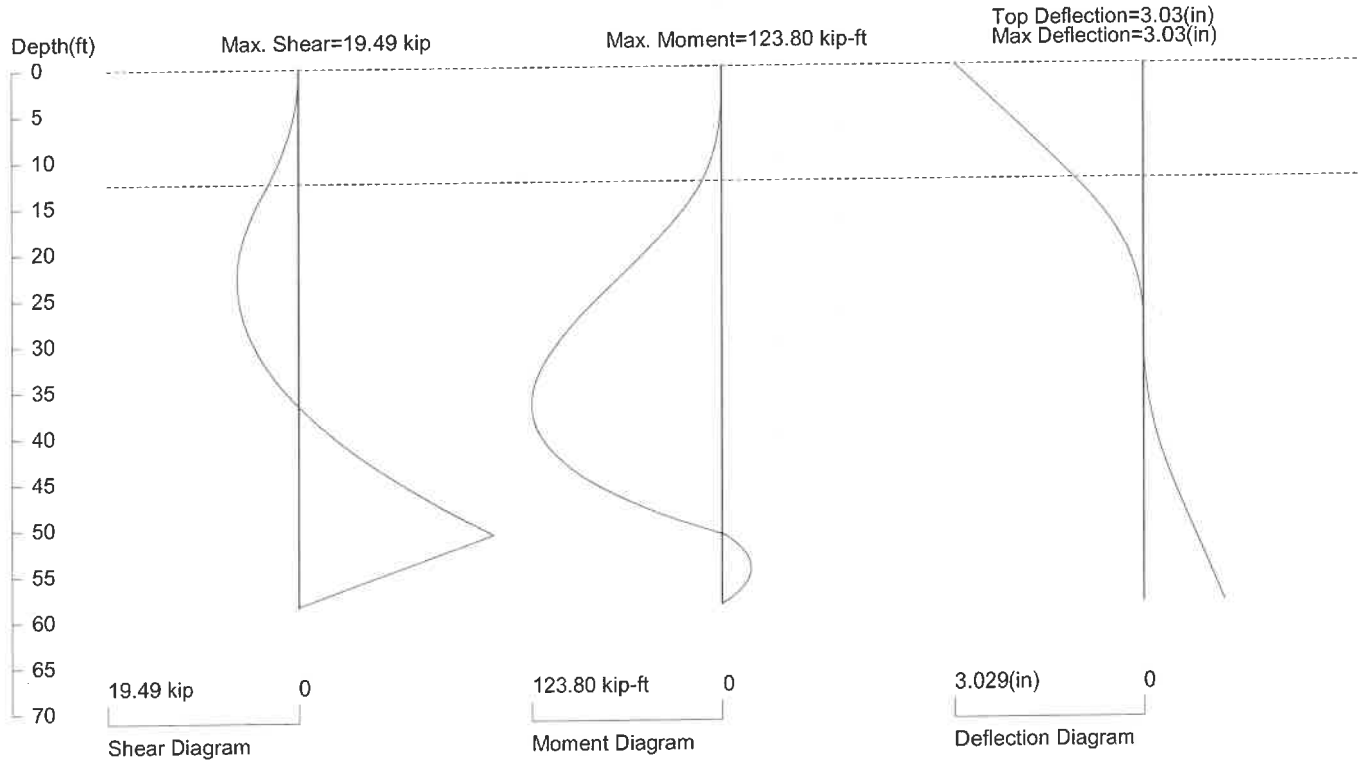
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case B, Condition 3, S=0





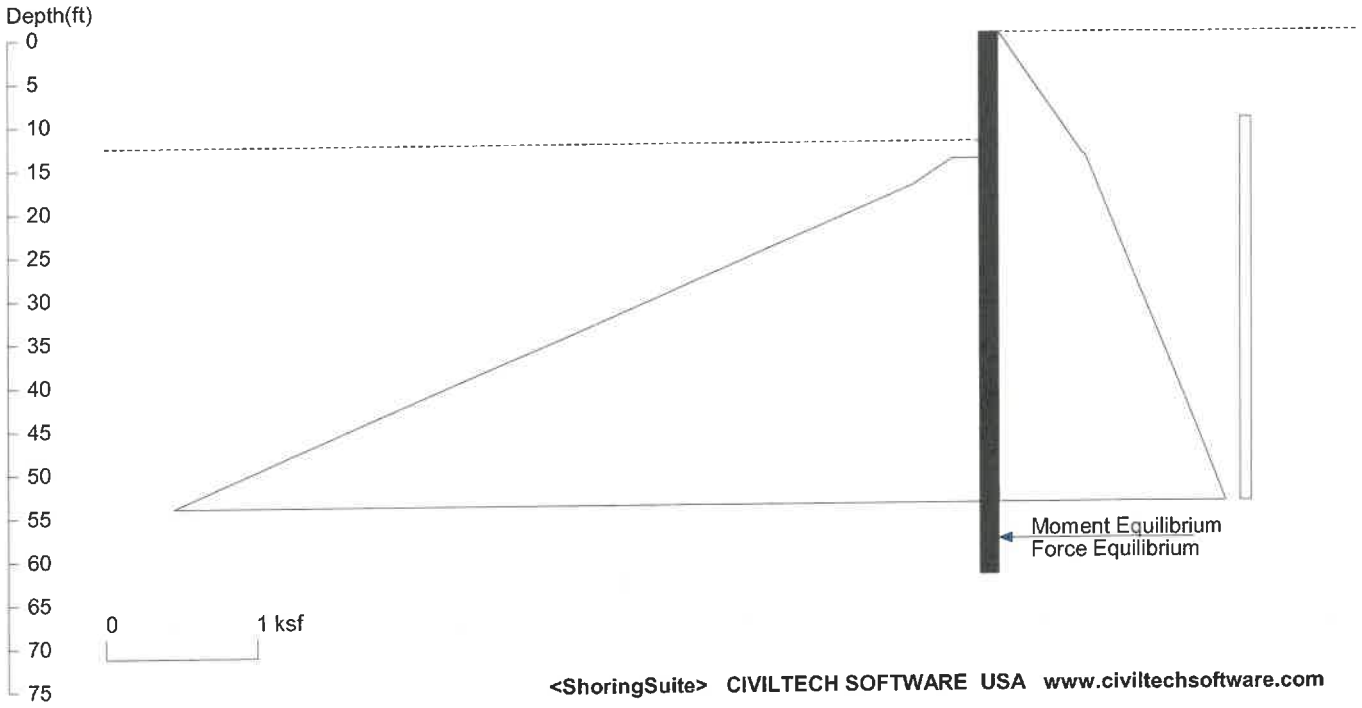
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: AZ25: E (ksi)=29000.0, I (in4)/foot=382.6

12.5ft High Sheet Pile,Dw=14ft

Case B, Condition 3, S=73



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=49.89 Min. Pile Length=62.39

MOMENT IN PILE: Max. Moment=152.09 per Pile Spacing=1.0 at Depth=38.84

PILE SELECTION:

Request Min. Section Modulus = 55.3 in3/ft=2973.25 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

H215 (3.79) BZ32 (3.61) FSPZ32 (3.69) PZ40 (3.03) 5RU3 (3.96)

AZ34 (2.58) AZ36700 (2.26) AZ36 (2.45) BZ37 (3.18) AZ38 (2.33)

FSPZ38 (2.93) AZ38700 (2.14) AZ40700 (2.03) BZ42 (2.73)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	14	0.546	.039
14	0.546	14.25	0.567	0.085
14.25	0.567	99	2.516	0.023
10	0.073	99	0.073	0

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

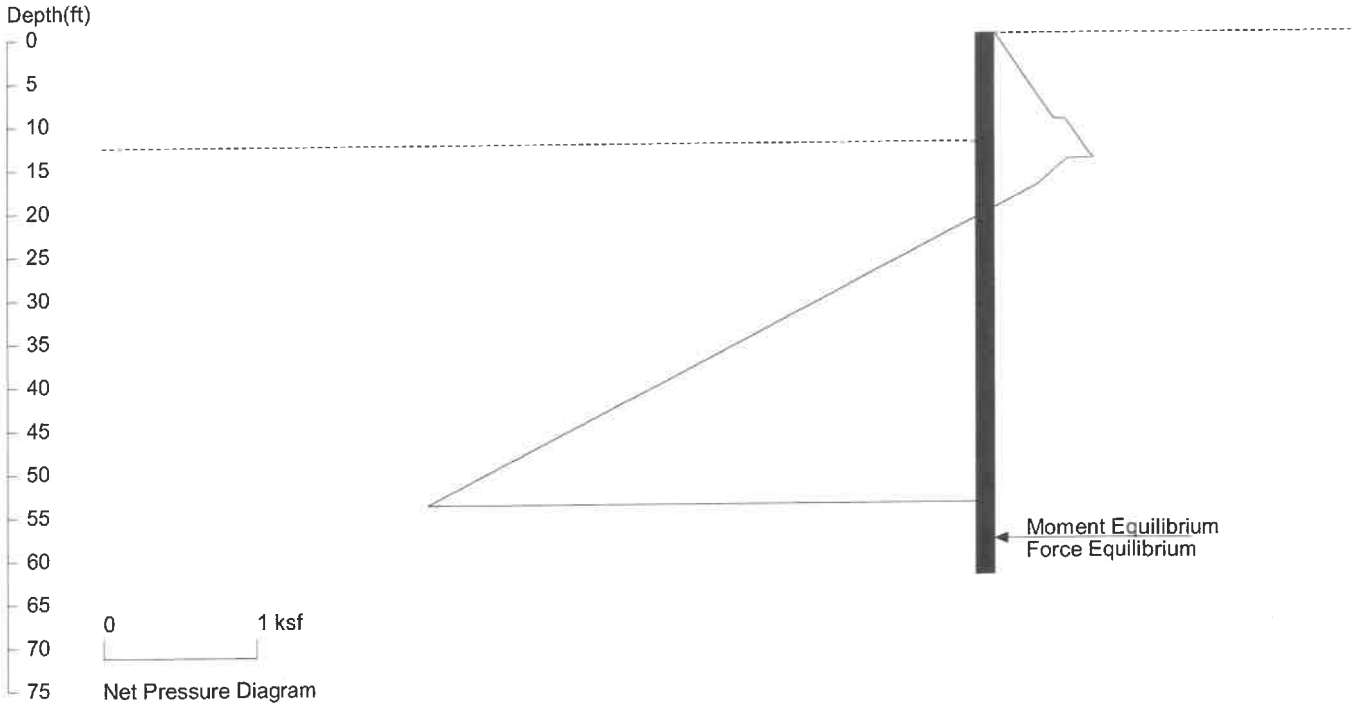
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.28	0.133

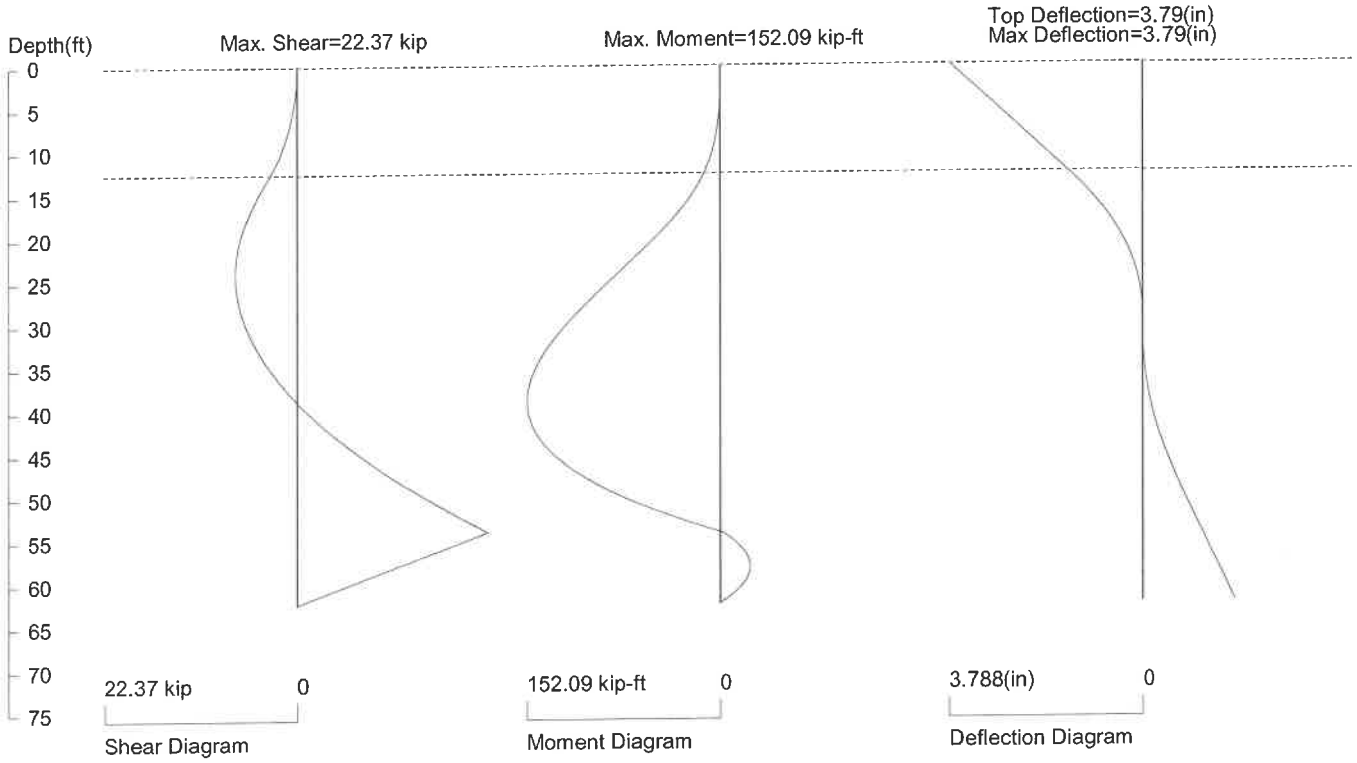
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile,Dw=14ft

Case B, Condition 3, S=73





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

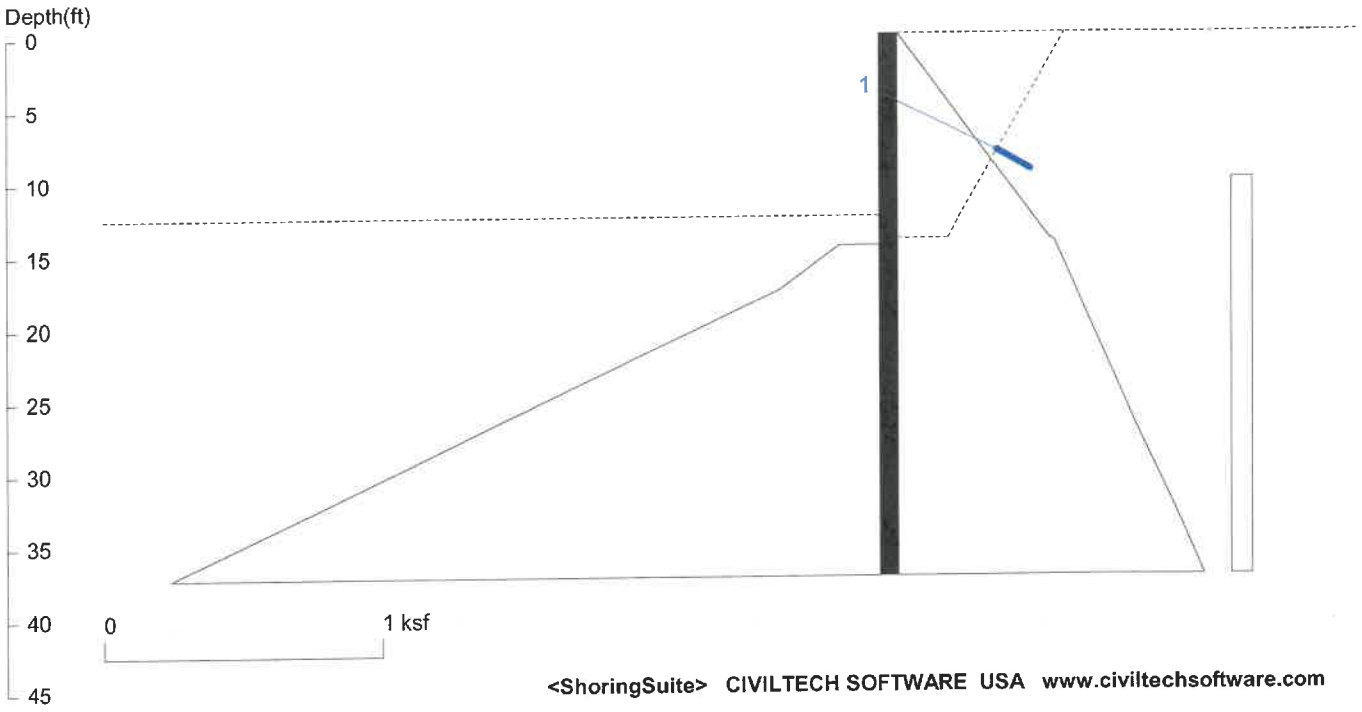
Based on pile spacing: 1.0 foot or meter

First Suitable Pile: H215: E (ksi)=29000.0, I (in4)/foot=392.2

252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00559E18\Calculations\MS\new\Sheet Pile-Cases\Wall 1-CN\CASE I

12.5ft High Sheet Pile, Dw=14ft

Case A+B, Condition 2, S=73



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=24.73 Min. Pile Length=37.23

MOMENT IN PILE: Max. Moment=37.89 per Pile Spacing=1.0 at Depth=16.45

OIL

PILE SELECTION:

Request Min. Section Modulus = 13.8 in3/ft=740.74 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

BZ7 (-1.62) H95 (-1.63) SZ145U (-0.99) CZ14 (-1.19) Z70 (-1.45)
CZ95RD (-1.43) CZ95 (-1.39) Z75 (-1.33) CZ16 (-1.08) BZ8.6 (-1.40)
SZ18 (-1.07) CZ101 (-1.31) SPZ19-5 (-1.23) SZ250 (-0.95)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	30.0	1.0	6.3	5.5	3.2	8.0	2.7

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
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023
10	0.073	99	0.073	0

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

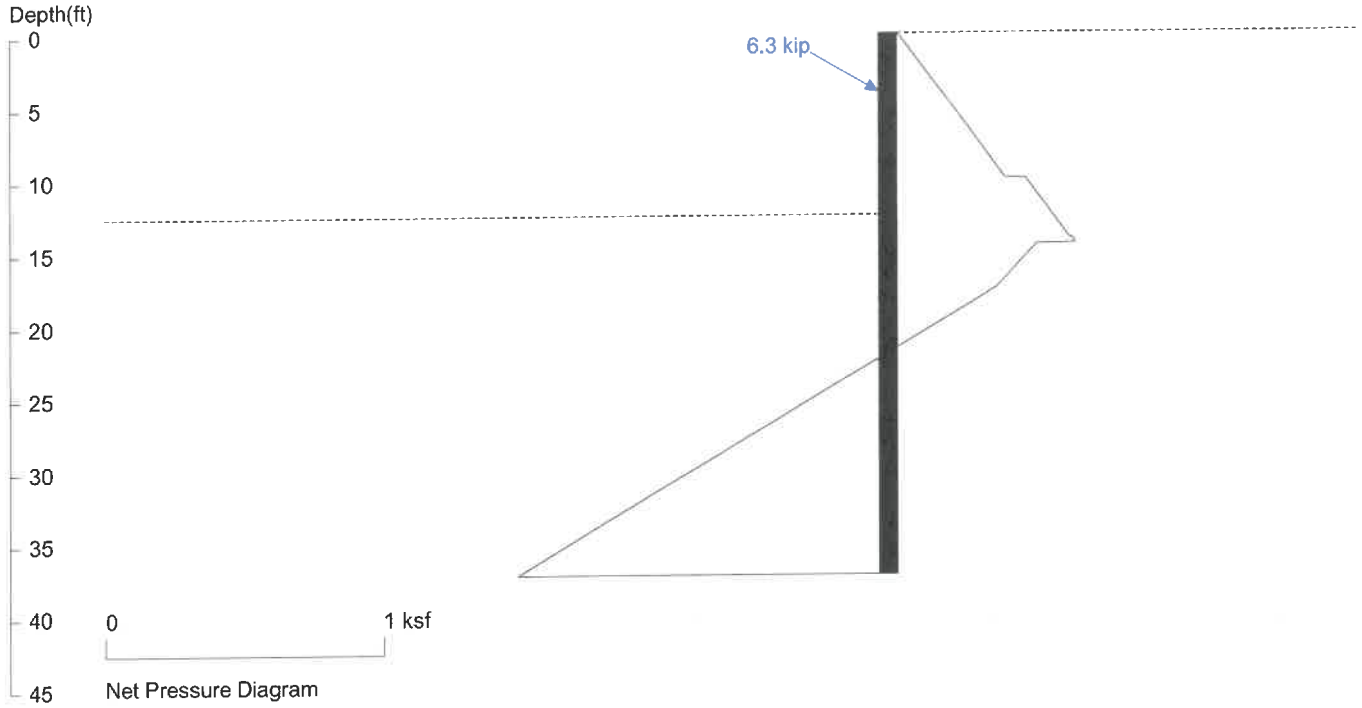
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.40	0.111

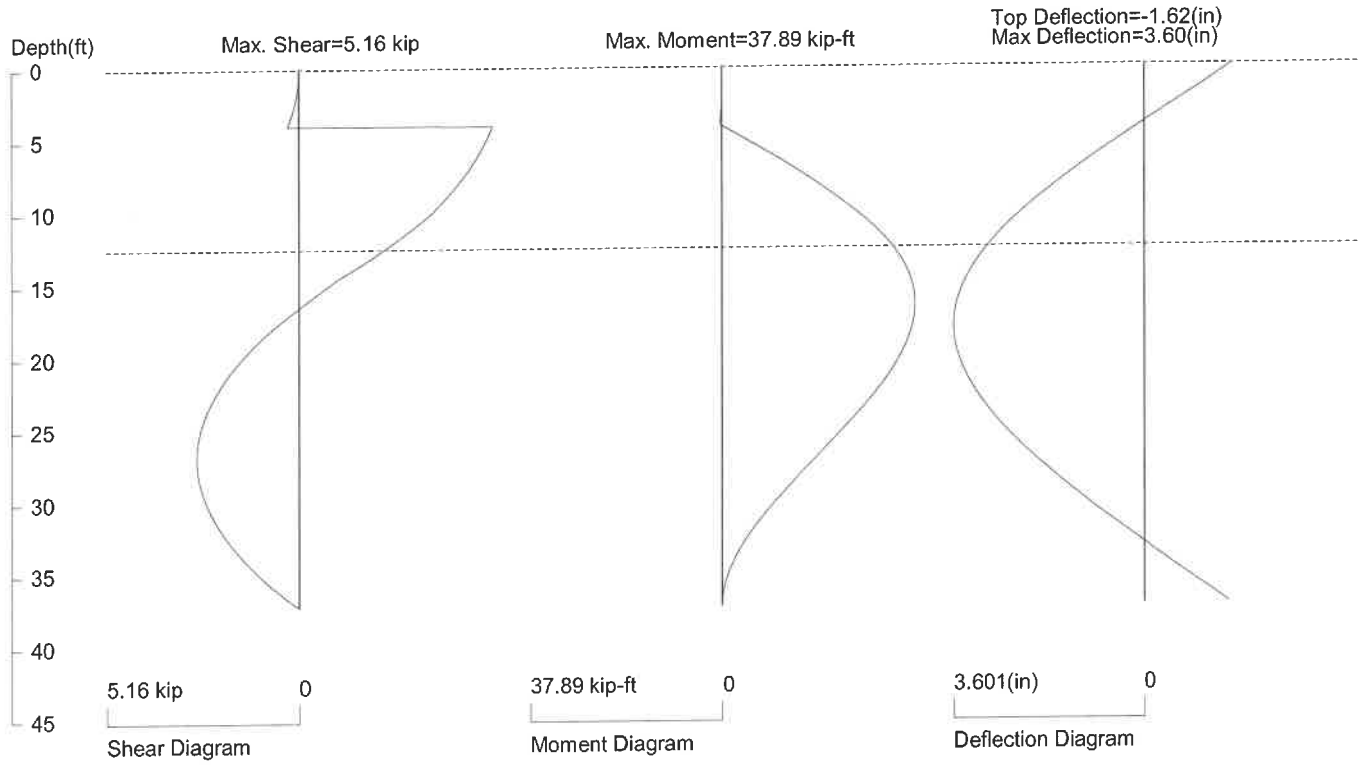
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00

12.5ft High Sheet Pile, Dw=14ft

Case A+B, Condition 2, S=73





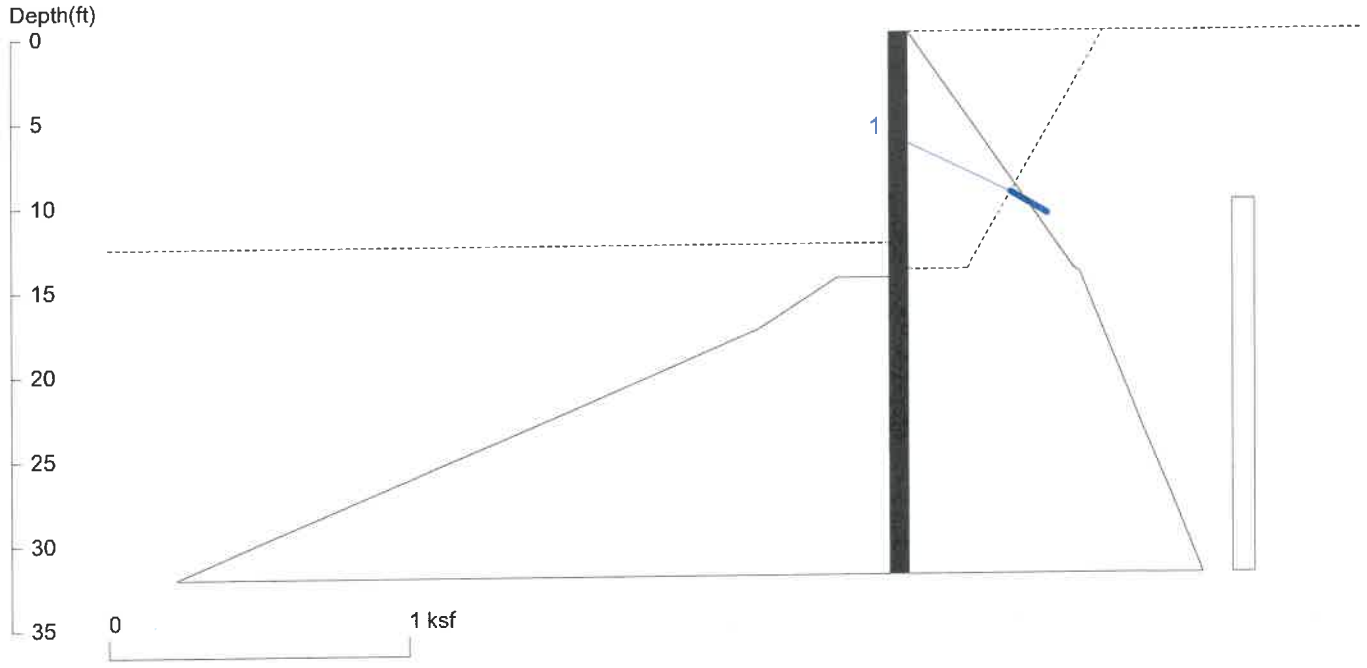
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: BZ7: E (ksi)=29000.0, I (in4)/foot=52.5

12.5ft High Sheet Pile, Dw=14ft

Case A+B, Condition 3, S=73



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=19.59 Min. Pile Length=32.09

MOMENT IN PILE: Max. Moment=23.26 per Pile Spacing=1.0 at Depth=15.83

OK

PILE SELECTION:

Request Min. Section Modulus = 11.7 in3/ft=631.63 cm3/m, Fy= 36 ksi = 248 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

1BXN (-1.67) SZ14.5 (-0.98) 1N (-1.36) Z65 (-1.11) CZ84 (-1.12)
BZ7 (-1.15) H95 (-1.15) SZ145U (-0.70) CZ14 (-0.84) Z70 (-1.03)
CZ95RD (-1.01) CZ95 (-0.99) Z75 (-0.94) CZ16 (-0.77)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	30.0	1.0	5.9	5.1	2.9	7.0	2.5

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
0	0	14	0.546	.039
14	.546	14.25	0.567	0.085
14.25	0.567	99	2.522	0.023
10	0.073	99	0.073	0

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

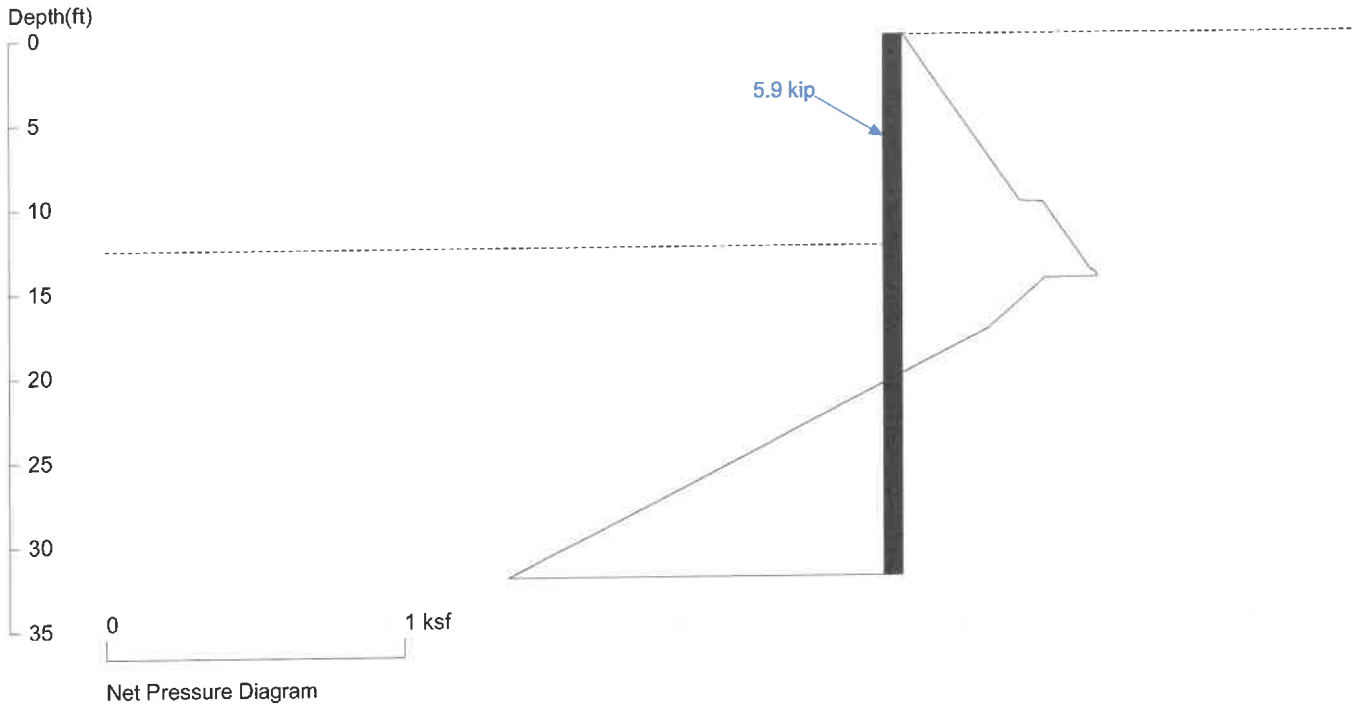
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.28	0.133

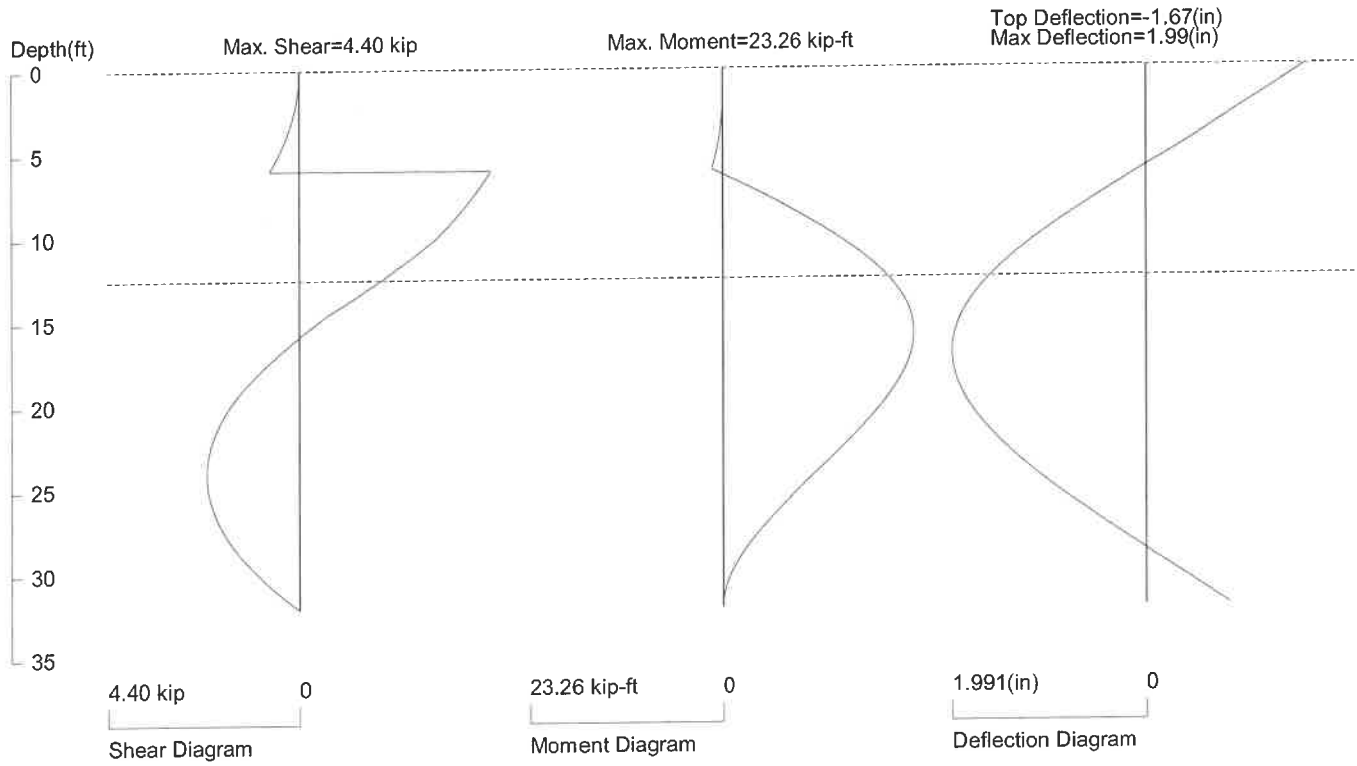
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00

12.5ft High Sheet Pile, Dw=14ft

Case A+B, Condition 3, S=73





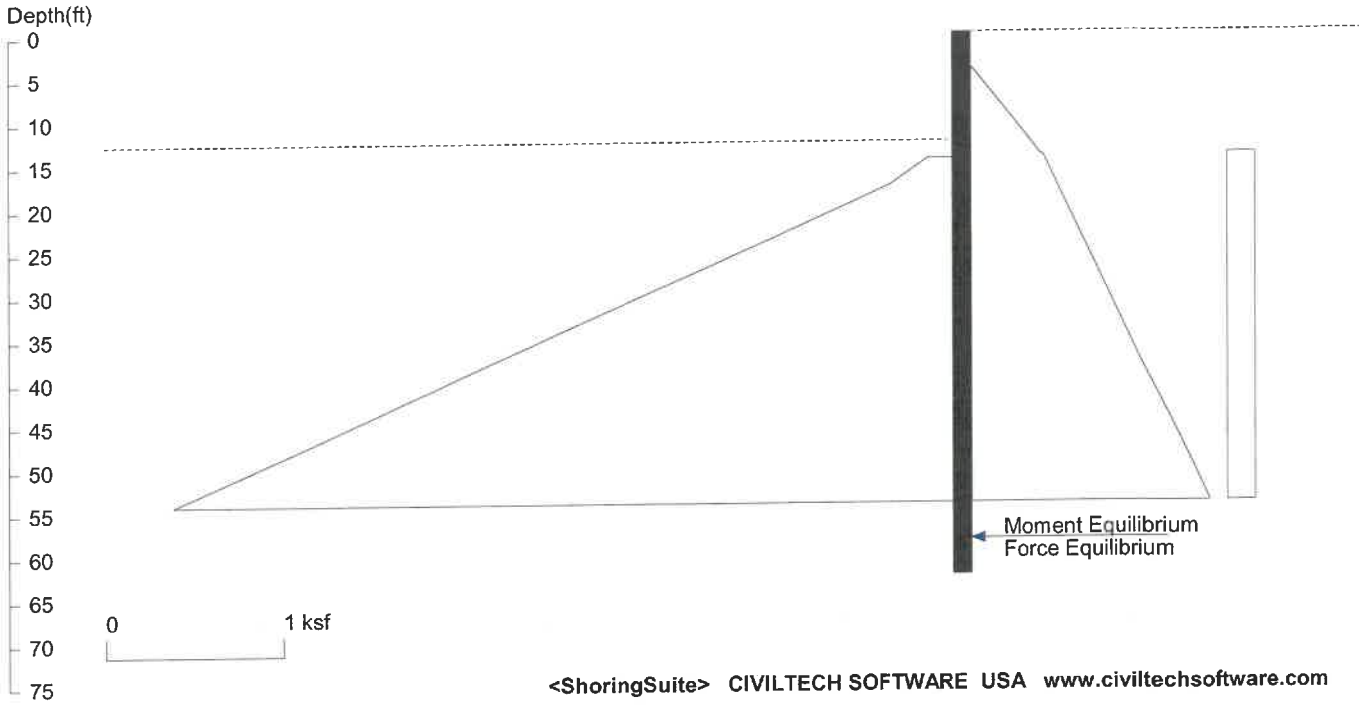
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: 1BXN: E (ksi)=29000.0, I (in4)/foot=36.0

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 2, S=0



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=49.97 Min. Pile Length=62.47

MOMENT IN PILE: Max. Moment=101.92 per Pile Spacing=1.0 at Depth=39.67

OK

PILE SELECTION:

Request Min. Section Modulus = 37.1 in3/ft=1992.37 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

H155 (6.25) RZ11 (6.19) PZ32 (6.23) BZ20.7L (5.59) CZ141 (5.25)
CZ148 (5.01) 4N (4.71) AZ25 (3.59) FSPZ25 (4.91) PZ38 (4.89)
BZ26 (4.14) H175 (4.24) AZ26 (3.38) PZ35 (3.80)

AZ 48 (1.62)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
4	0	14	0.390	.039
14	0.390	14.25	0.411	0.085
14.25	0.411	99	2.360	0.023
14	0.156	99	0.156	0

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

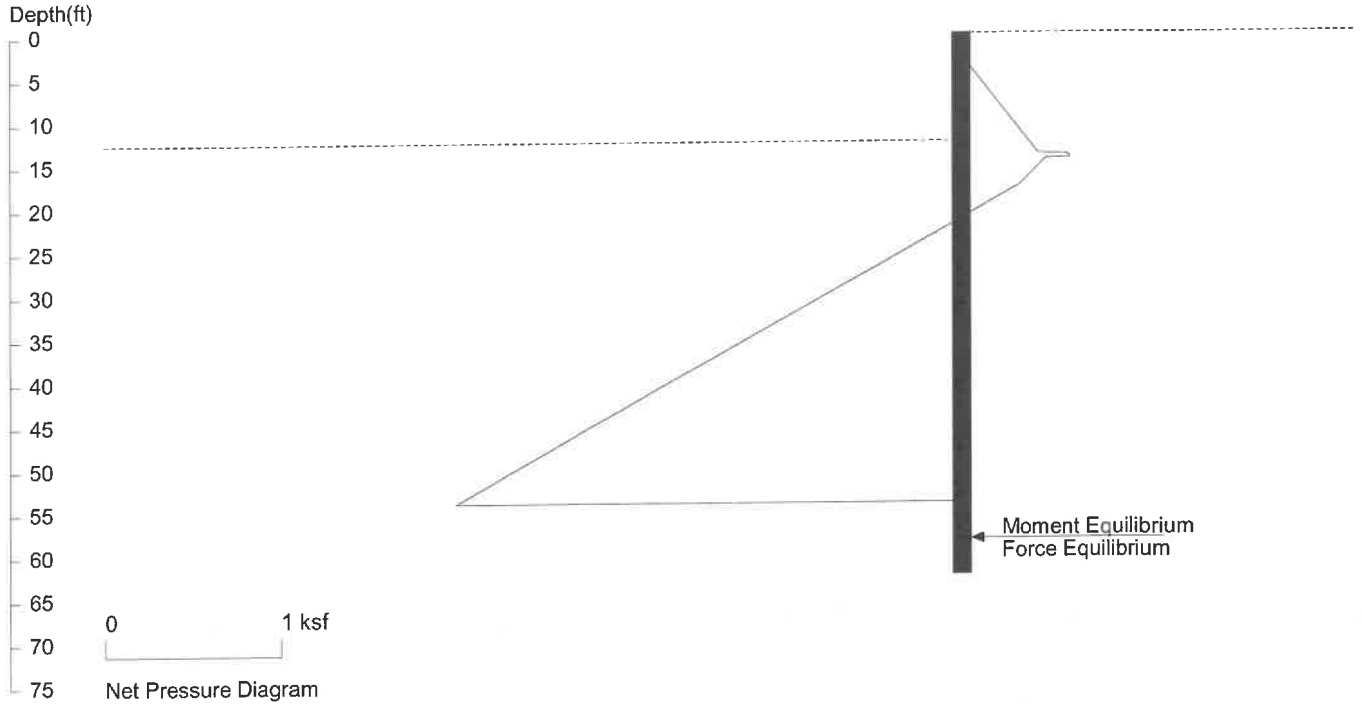
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.40	0.111

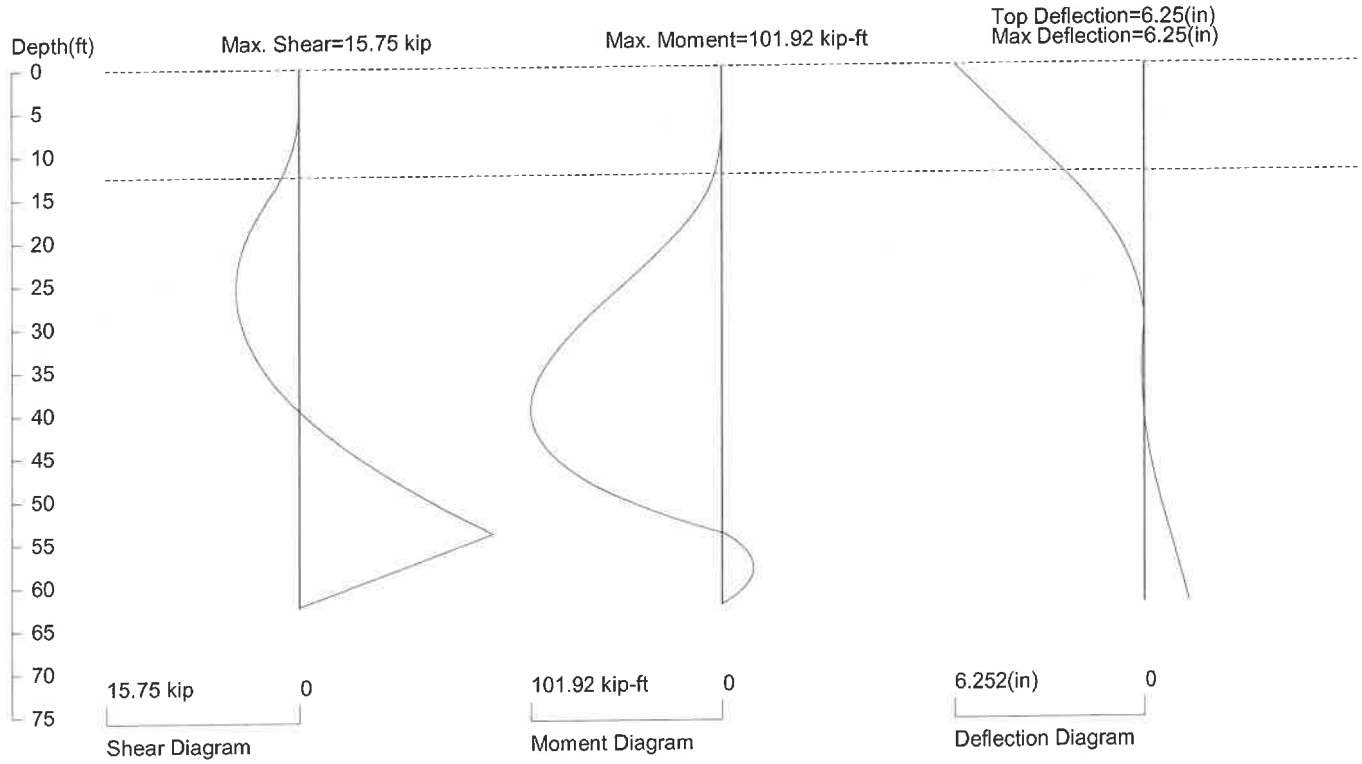
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 2, S=0





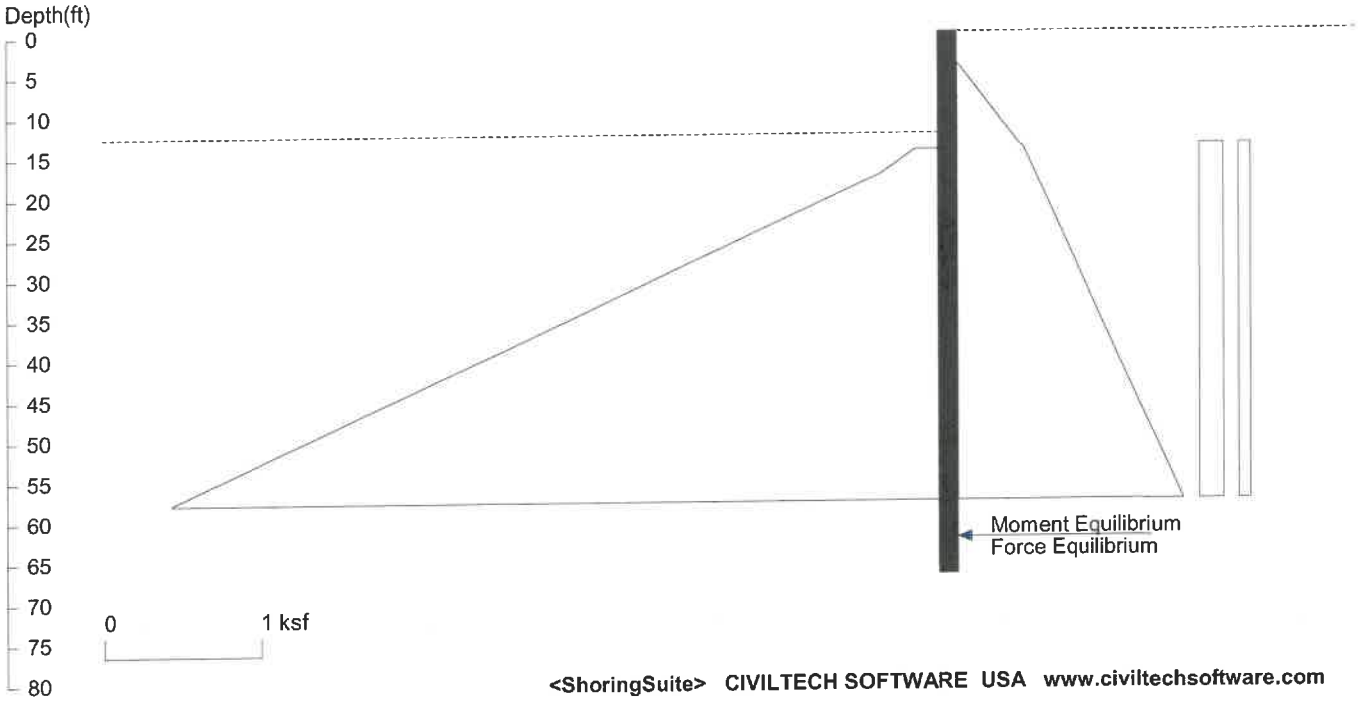
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: H155: E (ksi)=29000.0, I (in4)/foot=219.7

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 2, S=73



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File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=54.47 Min. Pile Length=66.97

MOMENT IN PILE: Max. Moment=128.46 per Pile Spacing=1.0 at Depth=42.23

19% over

PILE SELECTION:

Request Min. Section Modulus = 46.7 in3/ft=2511.20 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

PZ38 (6.15) BZ26 (5.20) H175 (5.34) AZ26 (4.25) PZ35 (4.78)
AZ28 (4.00) H215 (4.40) BZ32 (4.20) FSPZ32 (4.29) PZ40 (3.52)
5RU3 (4.60) AZ34 (3.00) AZ36700 (2.63) AZ36 (2.85)

AZ 48 (2.04)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
4	0	14	0.390	.039
14	0.390	14.25	0.411	0.085
14.25	0.411	99	2.360	0.023
14	0.156	99	0.156	0
14	0.073	99	0.073	0

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

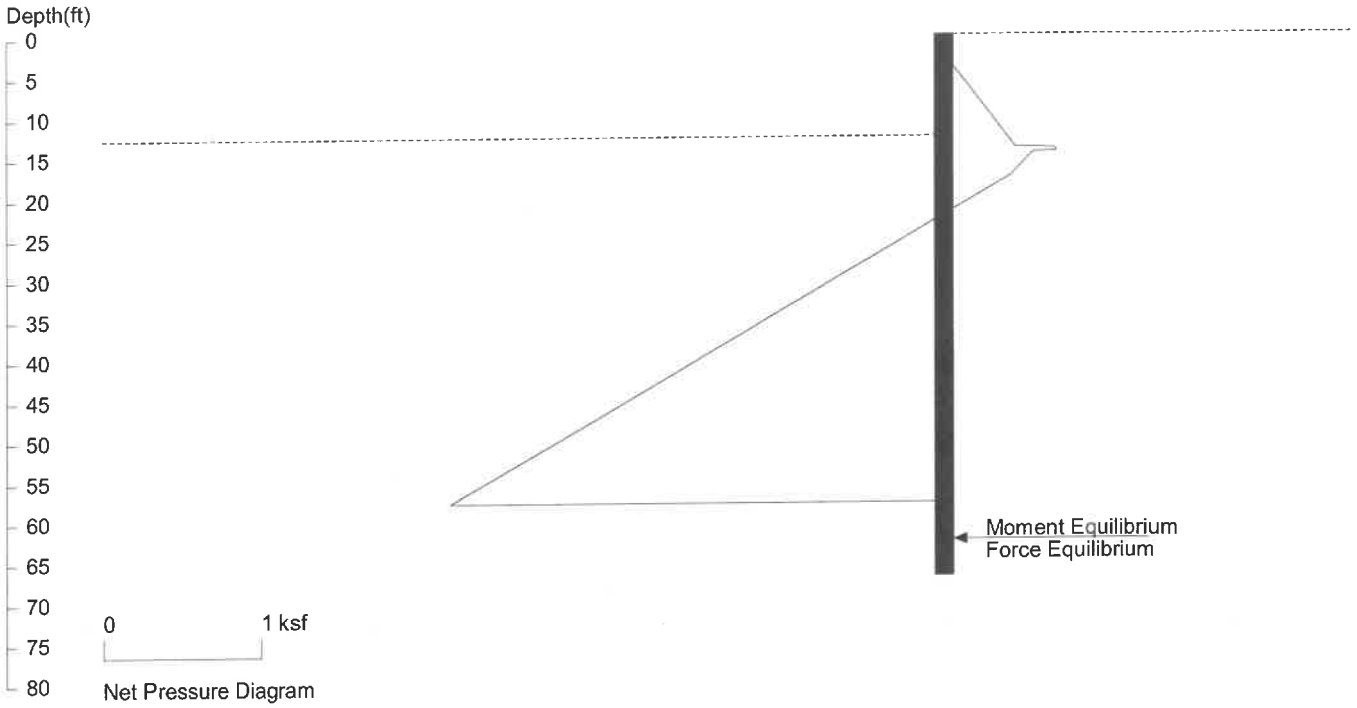
Z1	P1	Z2	P2	Slope
14.5	0.14	17.5	0.36	0.072
17.5	0.36	99.0	9.40	0.111

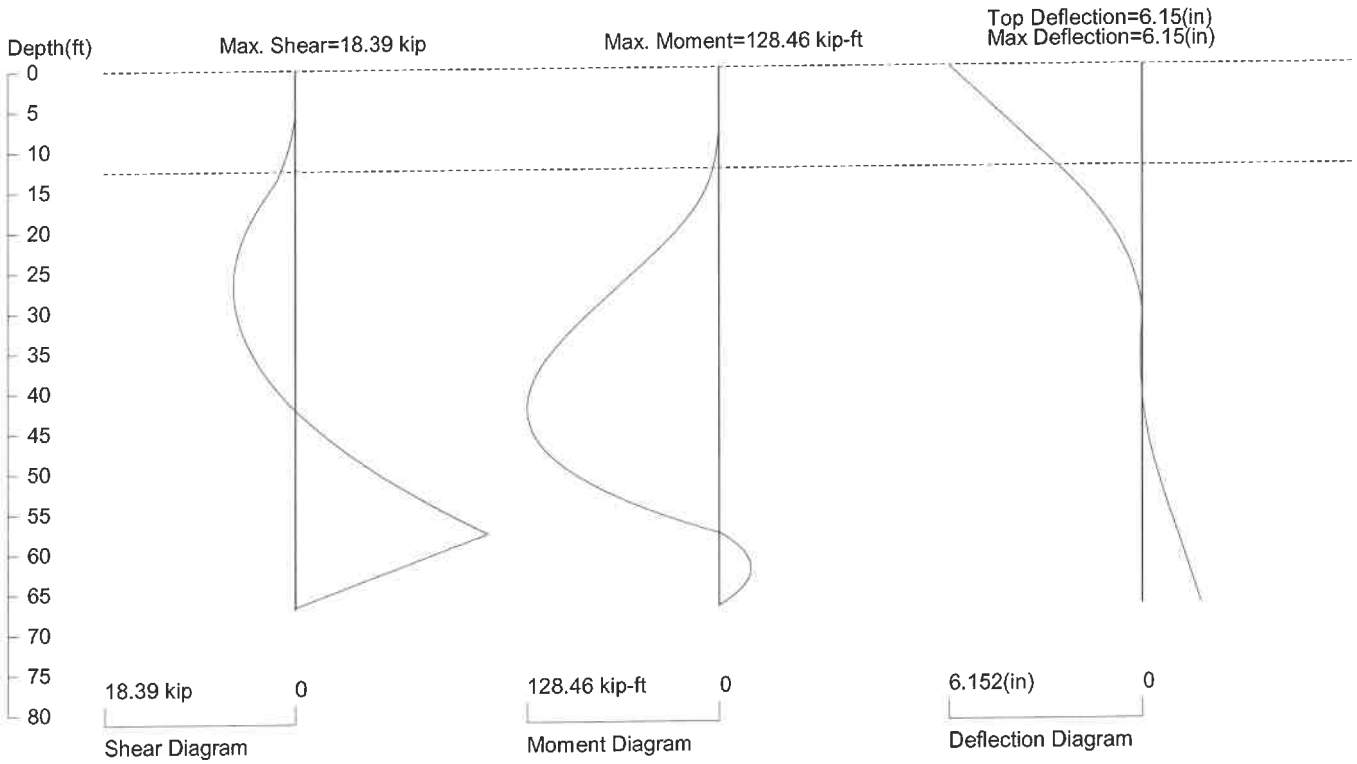
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 2, S=73





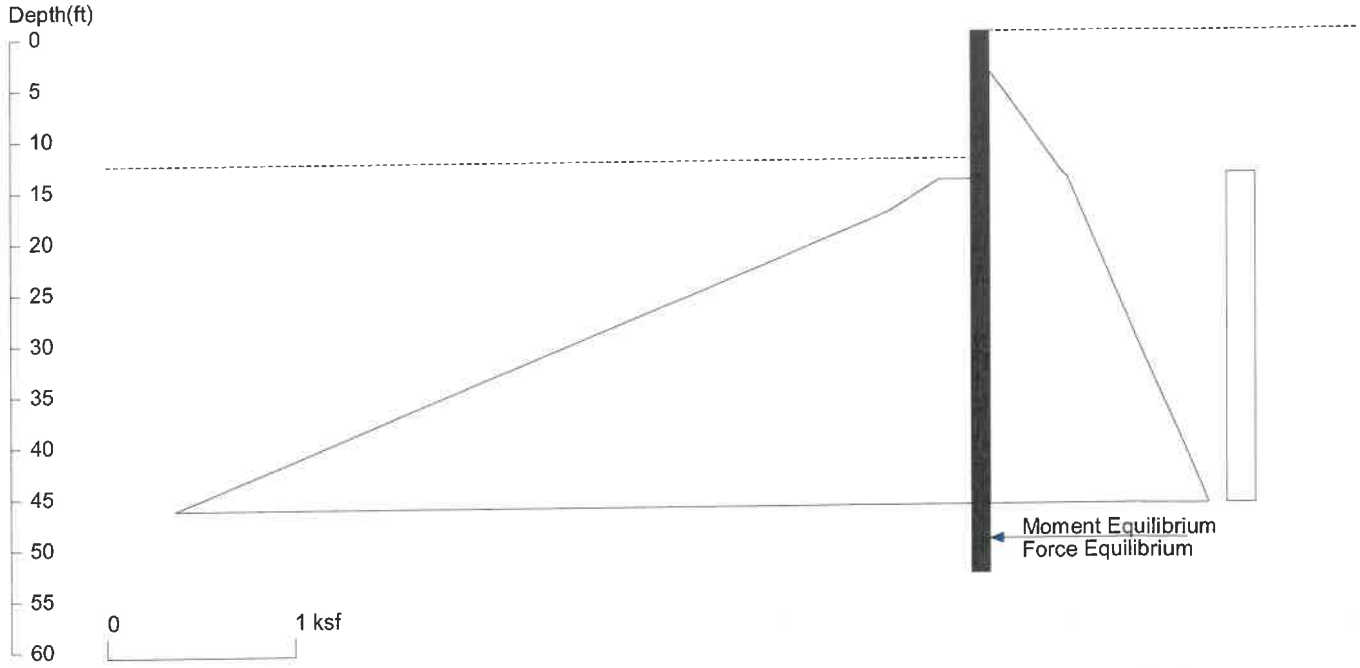
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: PZ38: E (ksi)=29000.0, I (in4)/foot=280.8

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 3, S=0



Licensed to 4324324234 3424343 Date: 4/13/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=40.61 Min. Pile Length=53.11

MOMENT IN PILE: Max. Moment=72.13 per Pile Spacing=1.0 at Depth=34.44

ok

PILE SELECTION:

Request Min. Section Modulus = 26.2 in3/ft=1410.13 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

SZ222 (4.94) SZ24 (4.51) SZ24A (4.51) SZ25 (4.62) CZ114D (4.22)
3N(M) (5.00) PLZ23 (4.13) PZ27 (4.56) BZ16.4 (4.67) RZ10 (4.89)
134N (4.64) AZ17 (3.64) BZ17 (4.58) SPZ23 (4.03)

AZ 48 (0.99)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
4	0	14	0.390	.039
14	0.390	14.25	0.411	0.085
14.25	0.411	99	2.360	0.023
14	0.156	99	0.156	0

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

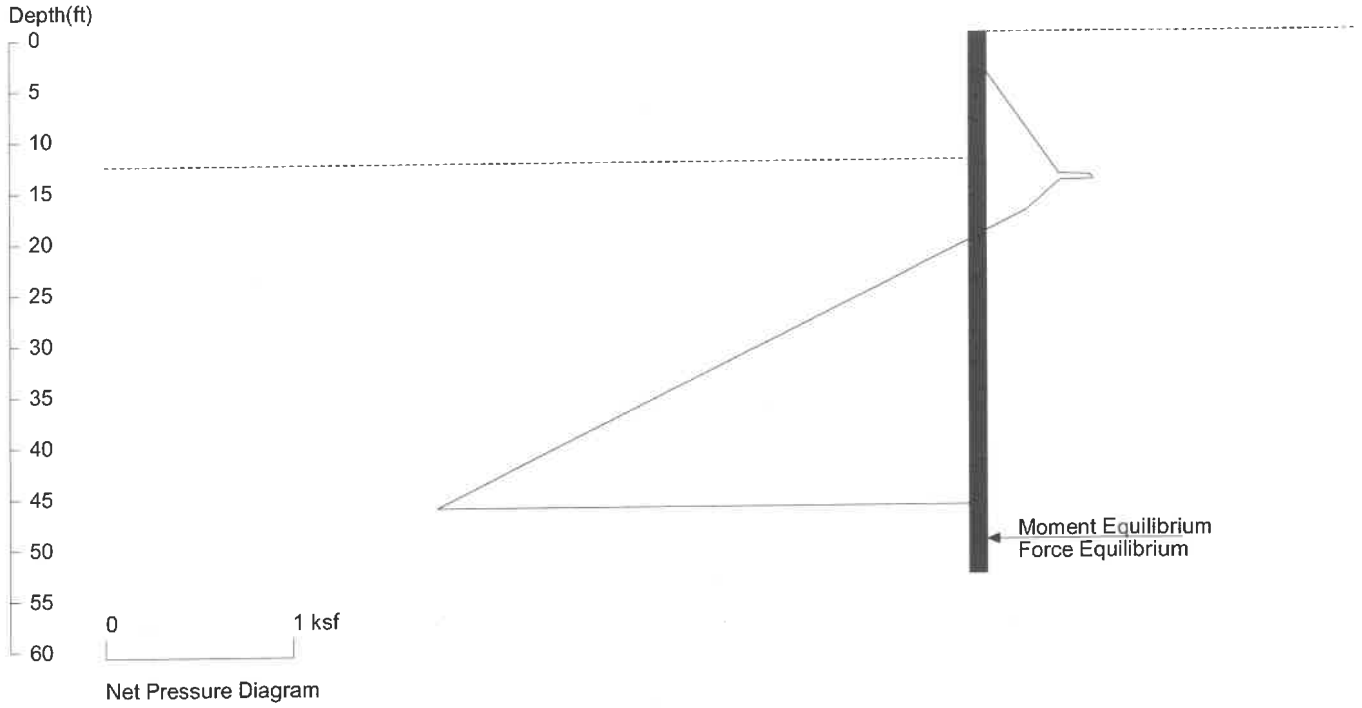
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.29	0.133

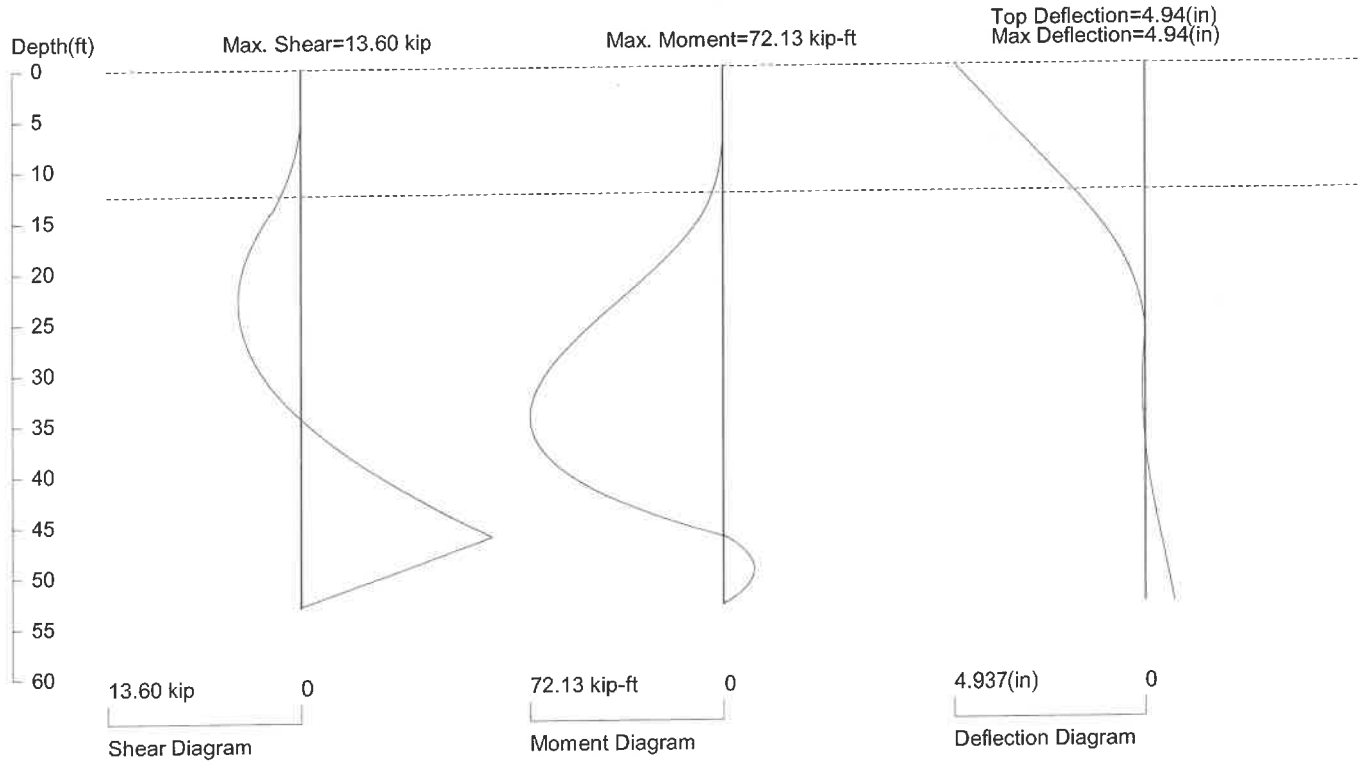
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 3, S=0





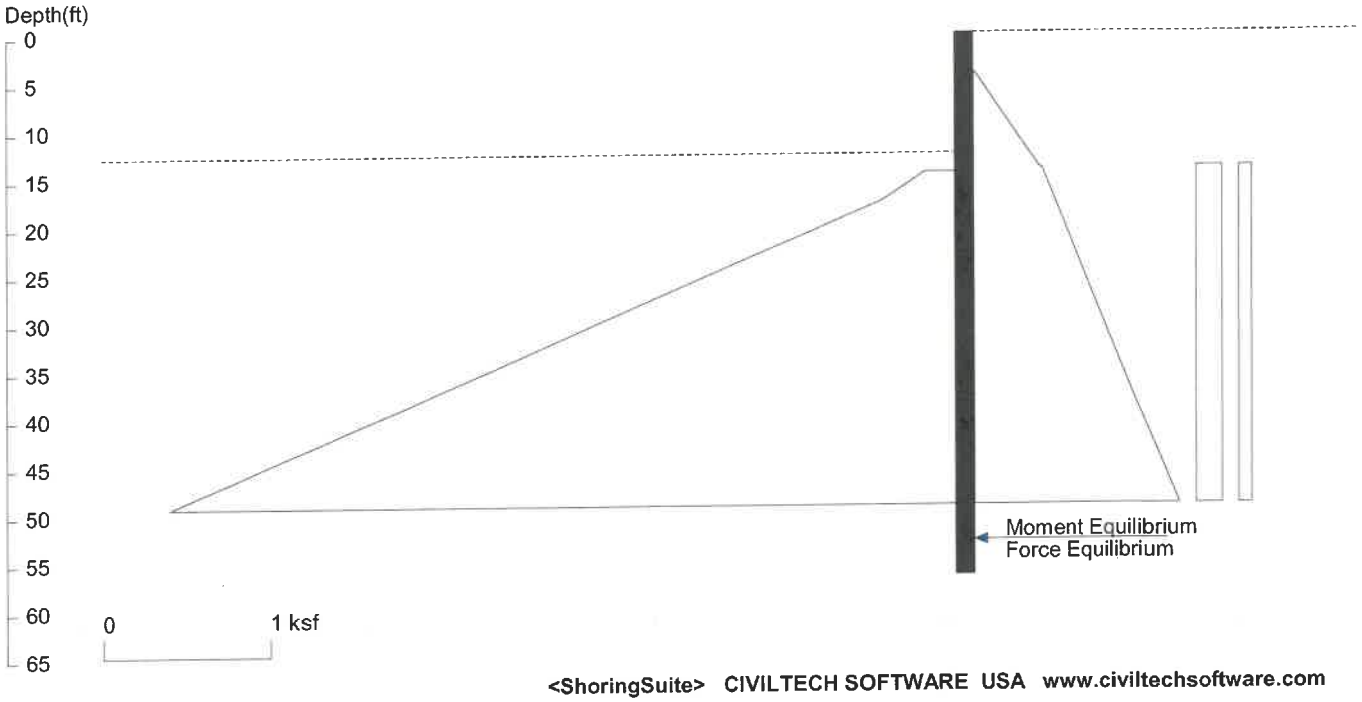
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: SZ222: E (ksi)=29000.0, I (in4)/foot=170.3

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 3, S=73



Licensed to 4324324234 3424343 Date: 4/13/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway

Wall Height=12.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=44.00 Min. Pile Length=56.50

MOMENT IN PILE: Max. Moment=88.93 per Pile Spacing=1.0 at Depth=36.44

ok

PILE SELECTION:

Request Min. Section Modulus = 32.3 in3/ft=1738.50 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

SZ27 (4.97) PLZ25 (4.60) 6L (1.52) CZ121 (4.58) AZ18700 (3.71)
AZ18 (4.10) L6 (1.52) SPZ26 (4.41) AZ19700 (3.56) 6M (1.36)
CZ128 (4.34) 6H (1.26) AZ19 (3.79) AZ20700 (3.42)

AZ48 (1.21)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
4	0	14	0.390	.039
14	0.390	14.25	0.411	0.085
14.25	0.411	99	2.360	0.023
14	0.156	99	0.156	0
14	0.073	99	0.073	0

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

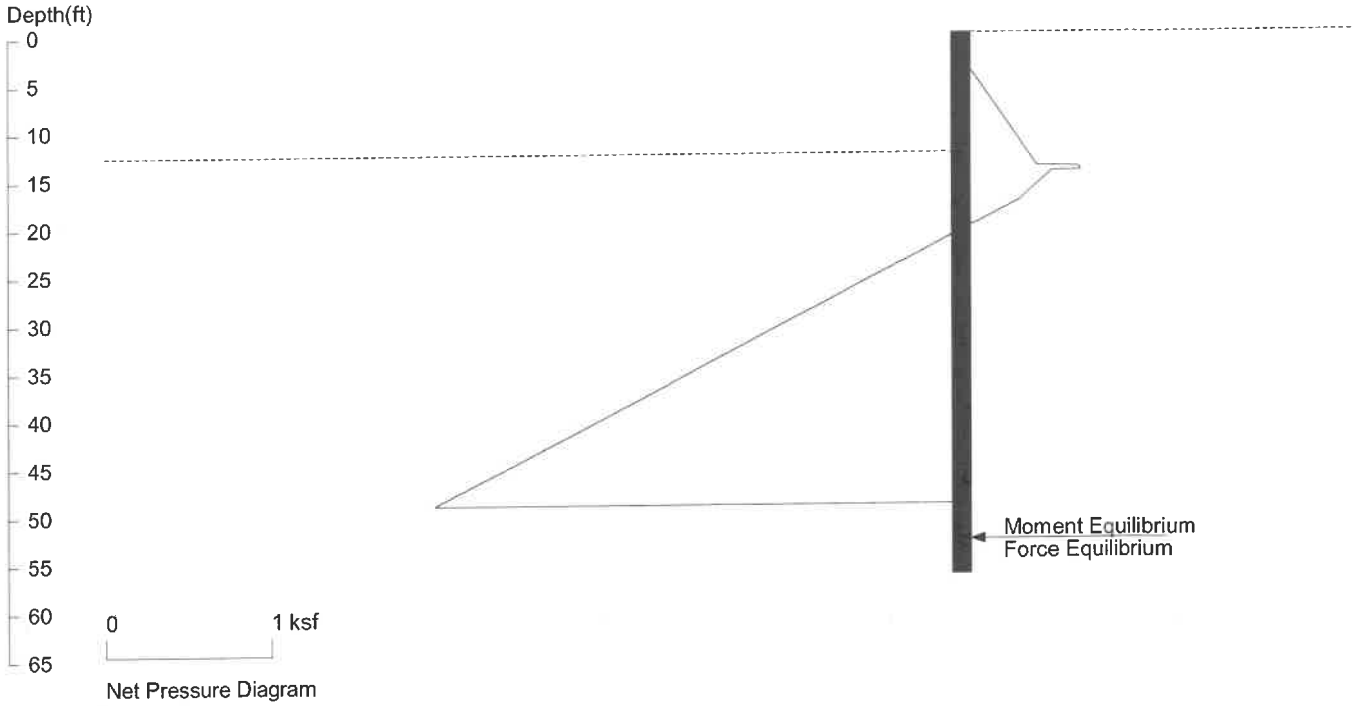
Z1	P1	Z2	P2	Slope
14.5	0.17	17.5	0.43	0.086
17.5	0.43	99.0	11.28	0.133

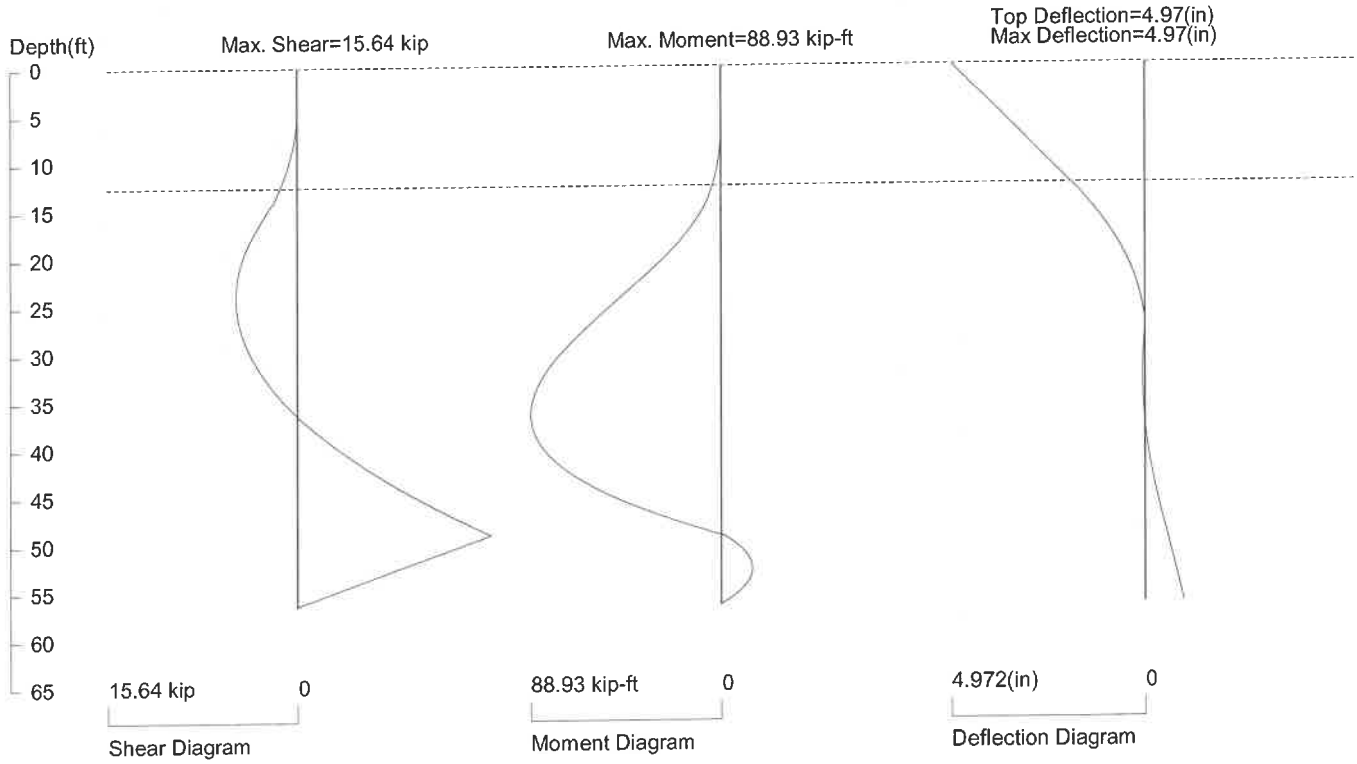
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00
3	14.01	1.00
4	99.00	1.00

12.5ft High Sheet Pile, Dw=14ft

Case C, Condition 3, S=73



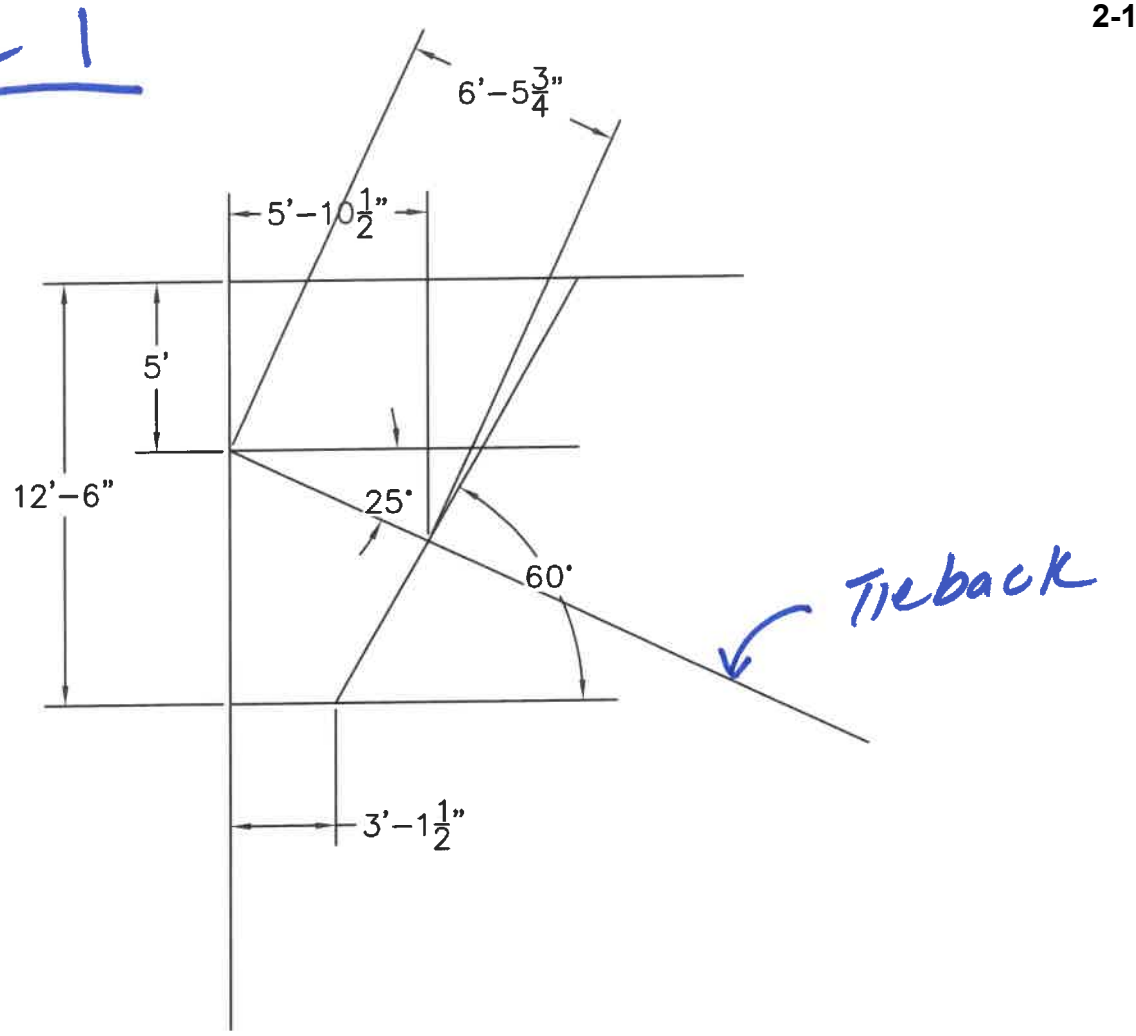


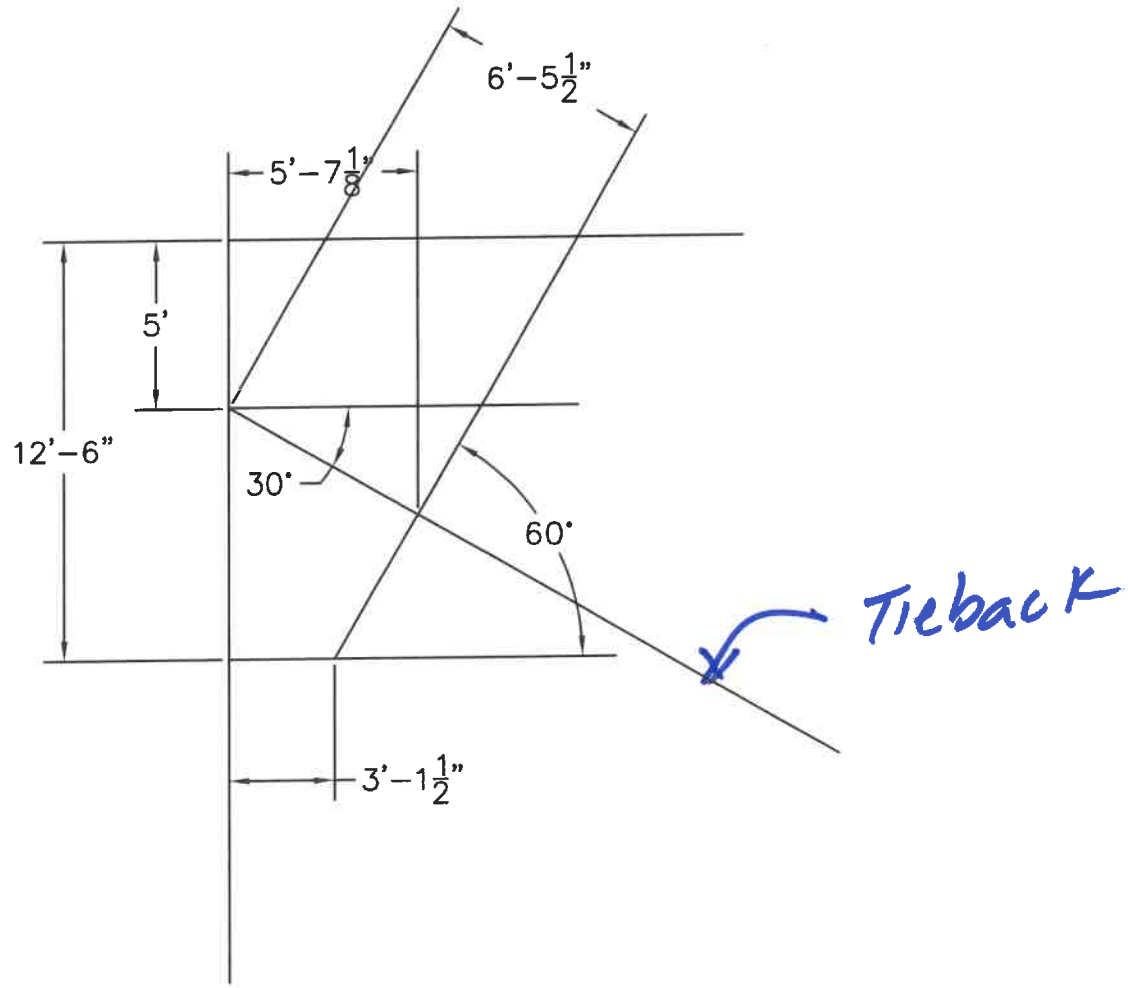
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: SZ27: E (ksi)=29000.0, I (in4)/foot=206.6

WALL 1


6'-5 3/4"
5'-10 1/2"
5'
12'-6"
25°
60°
Tieback
3'-1 1/2"


6'-5 1/2"
5'-7 1/8"
5'
12'-6"
30°
60°
Tieback
3'-1 1/2"

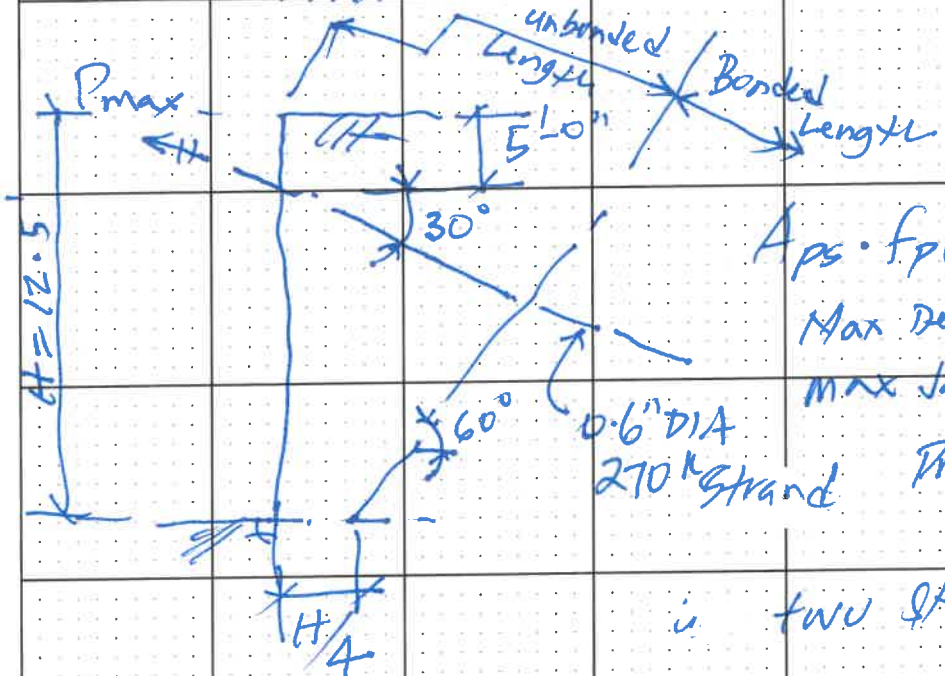
Bright Engineering, Inc. Consulting Structural and Civil Engineering

Date: 1/2023 By: AB BEI No. _____ Sheet No. _____ of _____ Sheets

Subject: LDW - Pile Wall

Wall 1

P_{max} = 7.1 K/ft (max Design Load) per pile



$A_{ps} \cdot f_{pu} = 0.217 \times 270 = 58.59^K$

Max Design LL = $0.6 \times 58.59 = 35.2^K$

Max Jacking LL = $0.8 \times 58.59 = 46.9^K$

Proof LL = $1.5 \times 7.1^K/ft$
$= 10.7^K/ft$

use two 0.6" strands @ 8'-0" O/C
or 6'-0" OC