100% Remedial Design Basis of Design Report

Appendix H
Structural Calculations

STRUCTURAL CALCULATIONS

LOWER DUWAMISH WATERWAY
UPPER REACH ENGINEERING SERVICES AND SEDIMENTATION CLEAN UP

PREPARED FOR: ANCHOR QEA

DATE: NOVEMBER 20, 2023

BEI NO. 252.01

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

A - DESIGN CRITERIA AND GENERAL INFORMATION

Relevant Codes and Standards

ACI 318-19 Building Code Requirements for Structural Concrete and Commentary, 2019

AISC Steel Construction Manual, Fifteenth Edition, 2017

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

AWS D1.1/D1.1M: 2020 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, fy = 45ksi, or API 5Lx42 or API 5Lx52

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

Welding: 70XX Electrodes

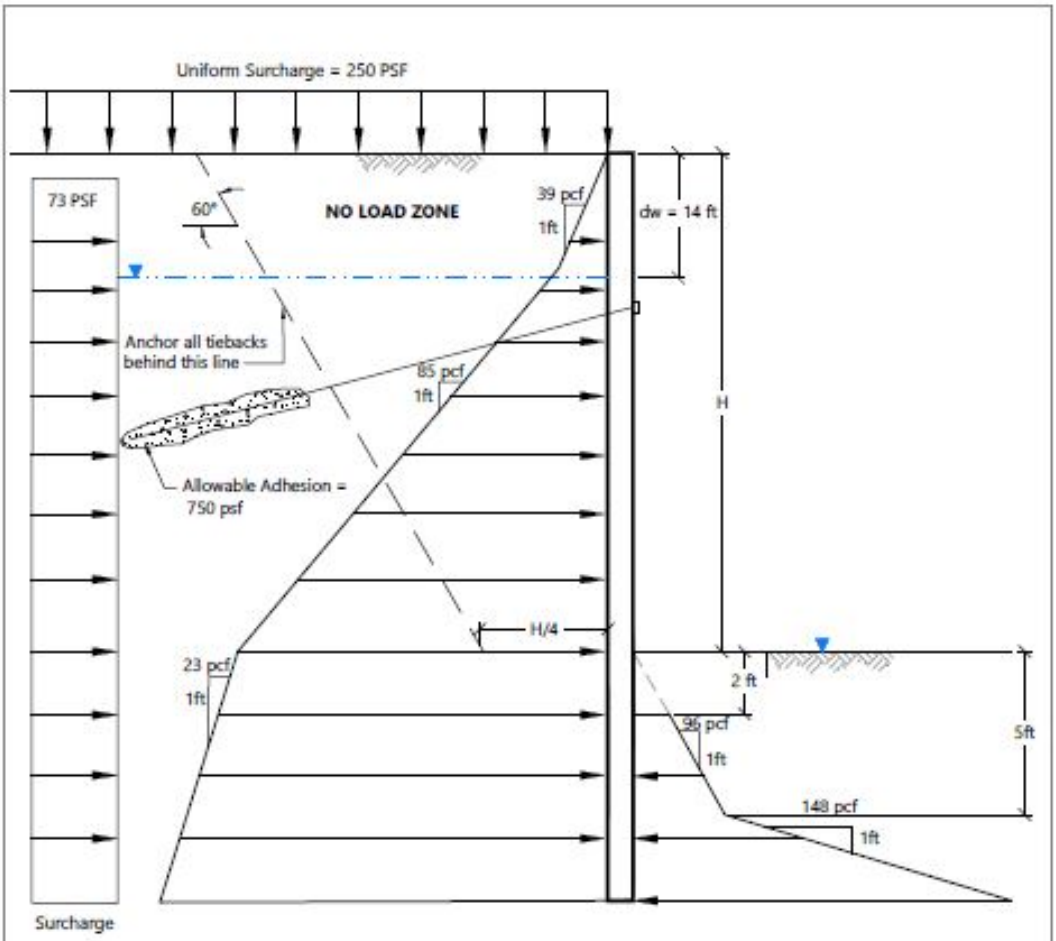
Date: December 2022 By: SL, AB BEI No. Sheet No. 2 of 9 Sheets

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

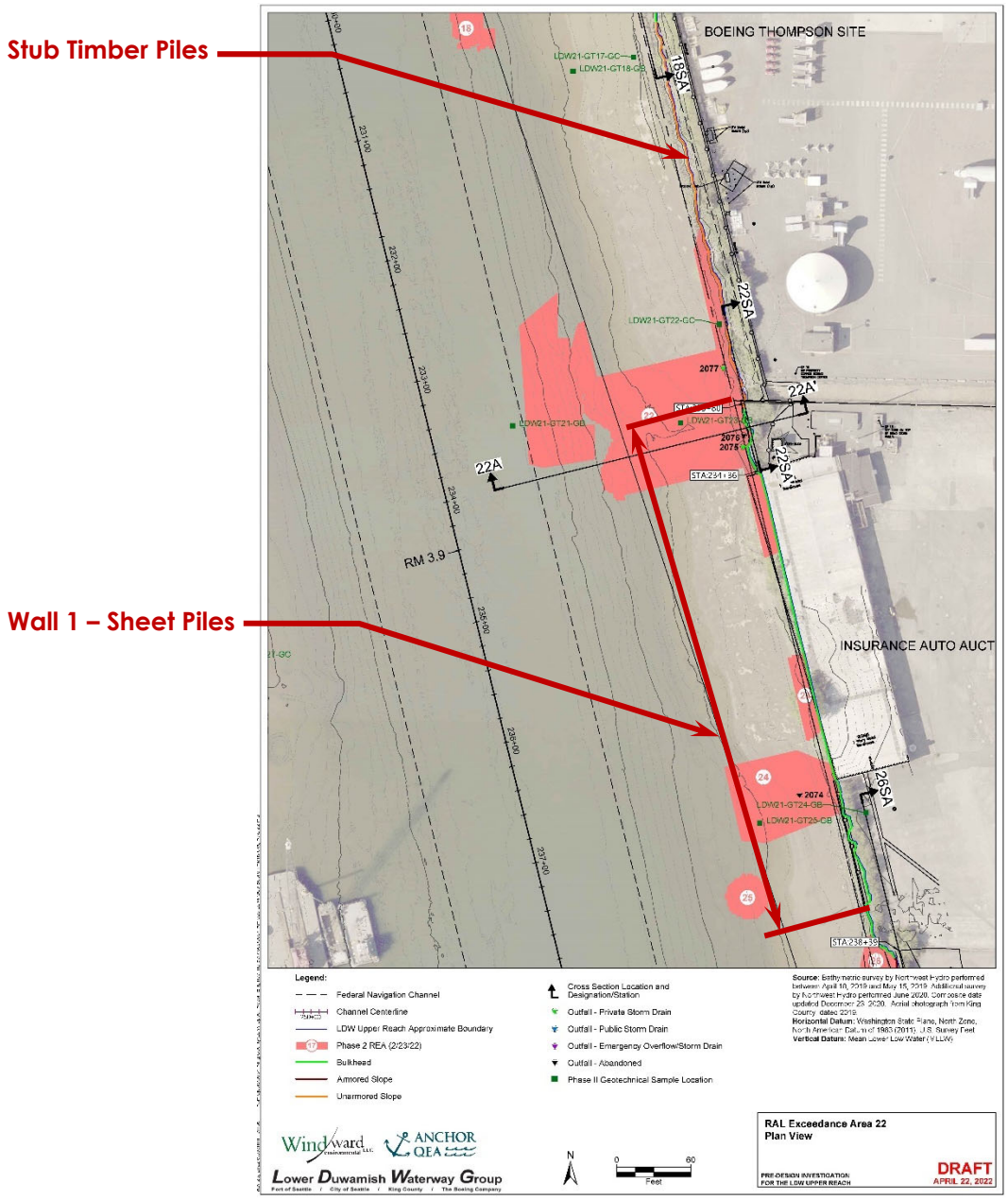
L-PILE Modeling Parameters

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

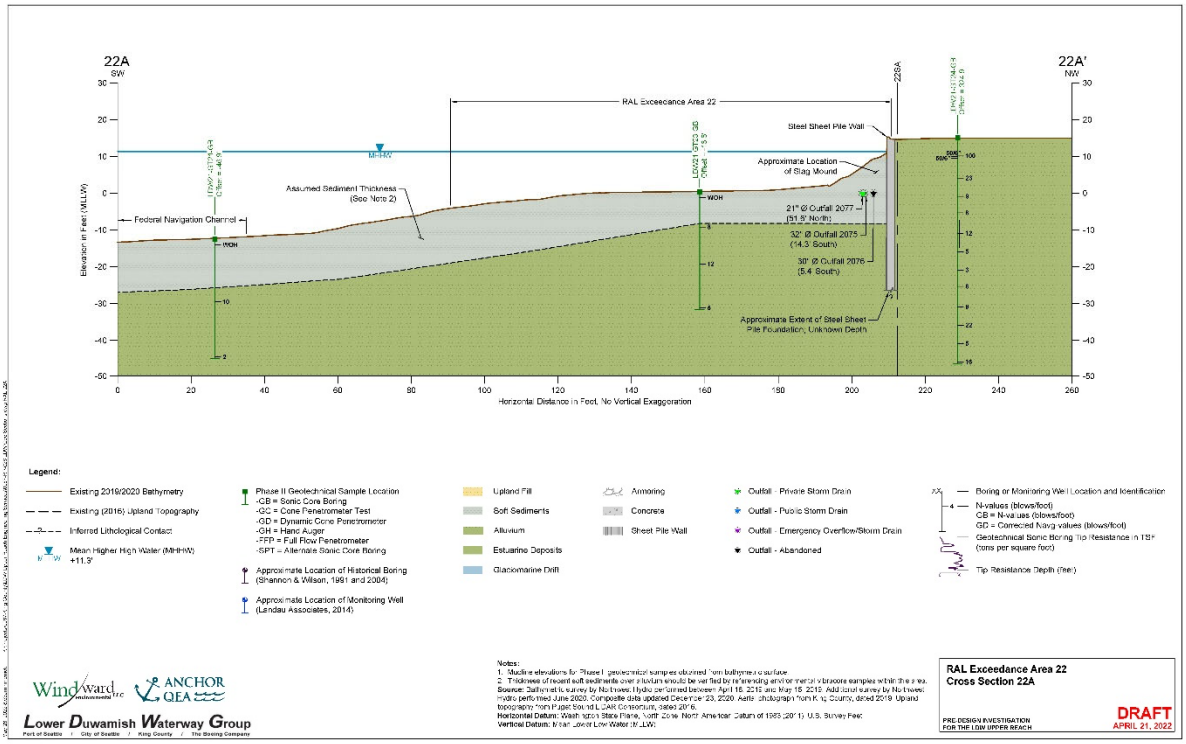
1. Bulkheads (ST03)

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.



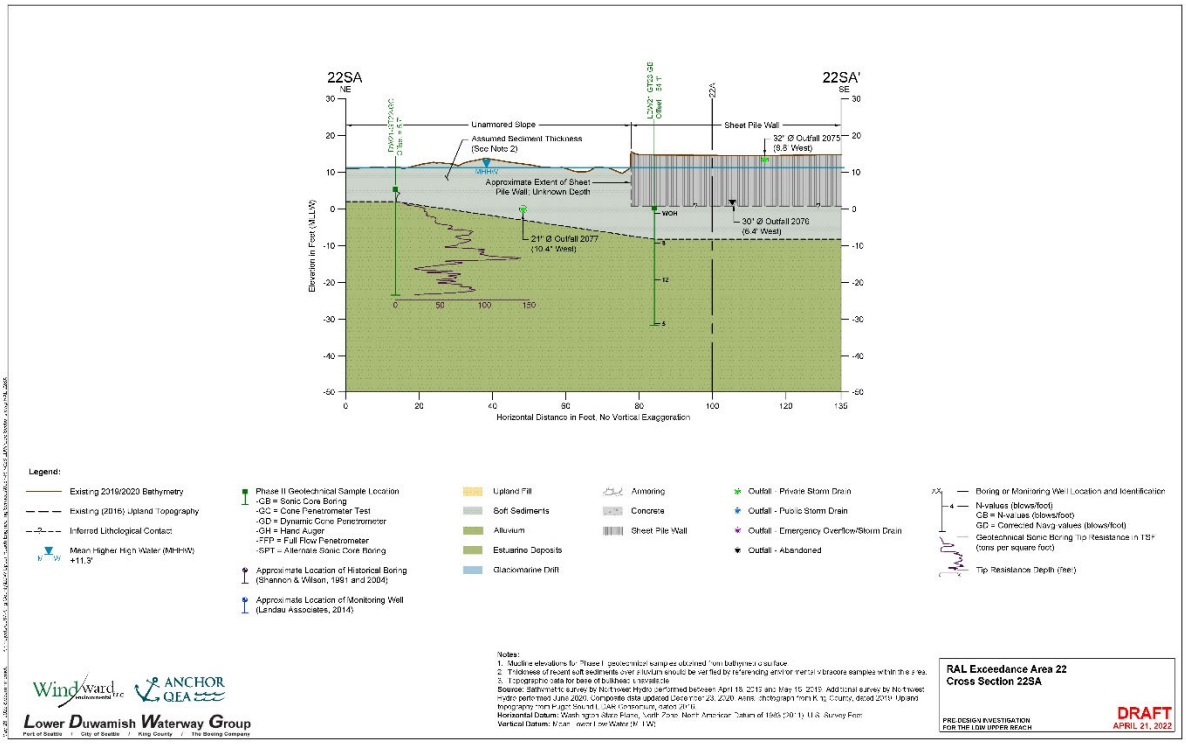
Date: December 2022 By: SL, AB BEI No. _____ Sheet No. 5 of 9 Sheets

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



Date: December 2022 By: SL, AB BEI No. _____ Sheet No. 6 of 9 Sheets

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



Date: December 2022 By: SL, AB BEI No. Sheet No. 7 of 9 Sheets

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

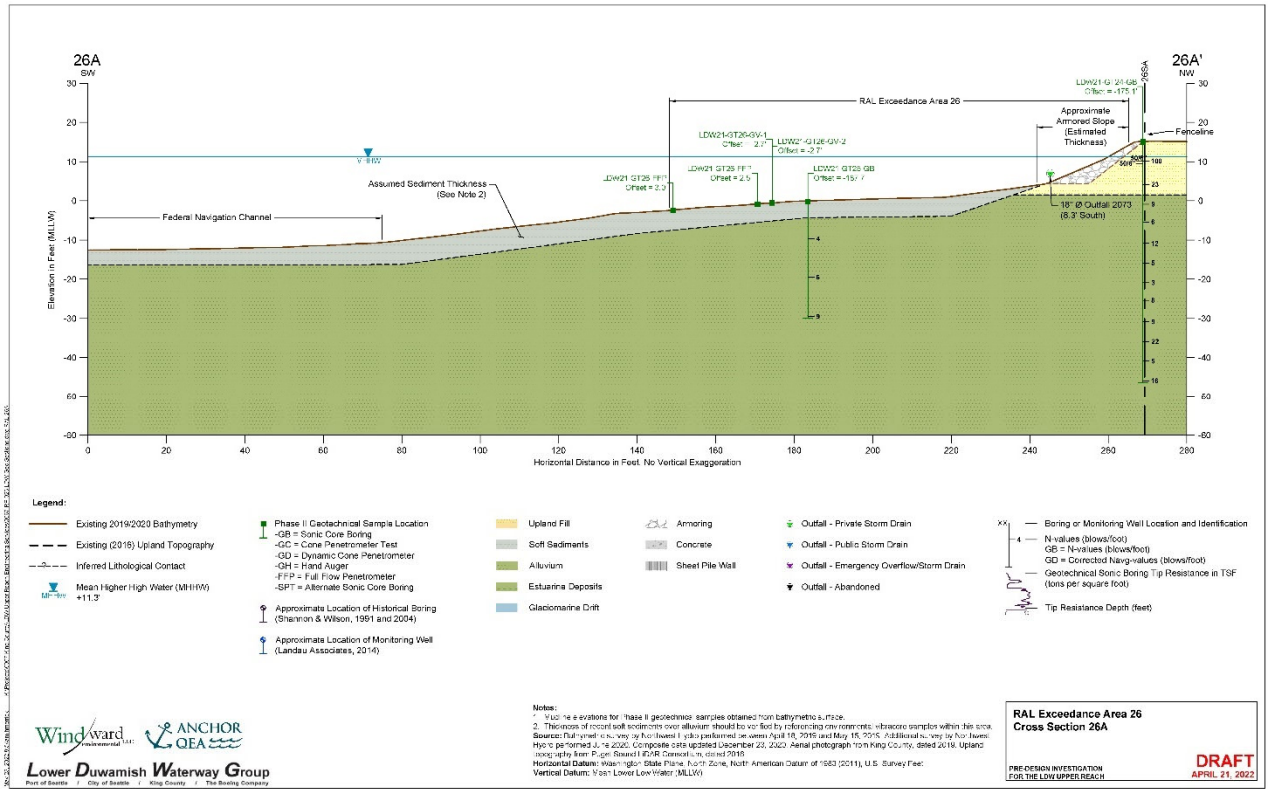
Center Point (Insurance Auto Auction) – Wall 1

Sheet Piles – Wall 1

Design Parameters:

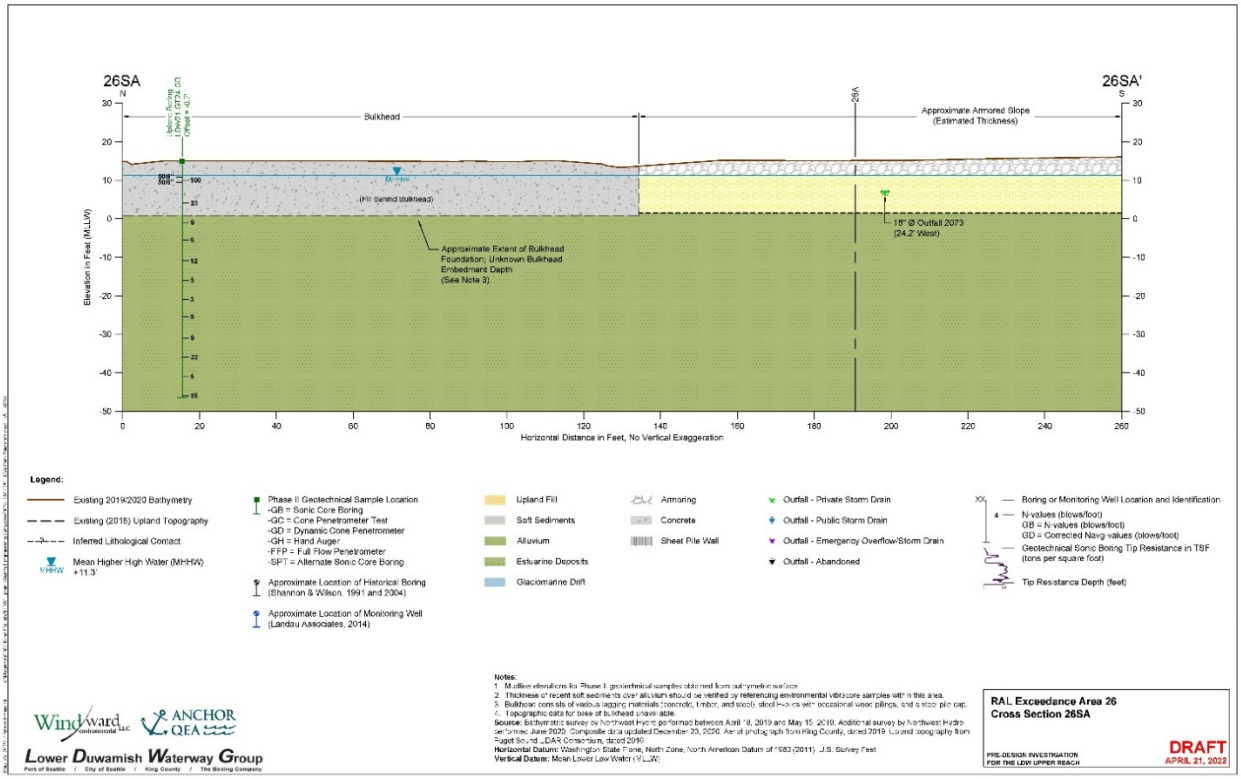
Retained Wall Height	= 12’- 6”
Sheet Pile Size	= Unknown
Physical and Material Properties	= Unknown
Pile Embedment	= Unknown

Observations/Condition – Appears to be older section profile; heavy corrosion and loss of section



Date: December 2022 By: SL, AB BEI No. _____ Sheet No. 8 of 9 Sheets

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




Wall 1

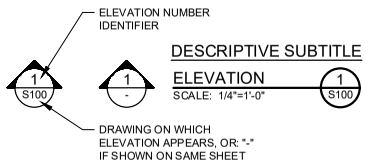

Wall 1
Slag Debris Pile

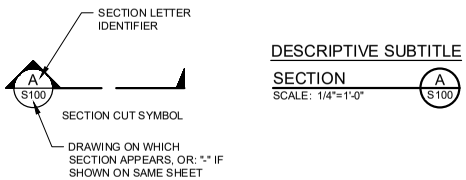

Wall 1
Slag Debris

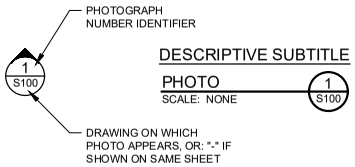
ABBREVIATIONS

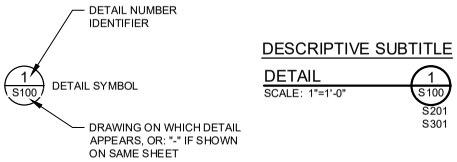
#	NUMBER, POUNDS
&	AND
@	AT
AB	ANCHOR BOLT
AP	ANGLE POINT
APPROX	APPROXIMATE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BLDG	BUILDING
BOT	BOTTOM
BTWN	BETWEEN
CDF	CONTROLLED DENSITY FILL
CIP	CAST-IN-PLACE
CJ	CONSTRUCTION JOINT
CL	CENTER LINE
CLR	CLEAR
CONC	CONCRETE
CONN	CONNECTION
CONT	CONTINUOUS
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"

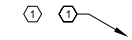
GENERAL NOTES:

1. FIRST NOTE
2. SECOND NOTE

KEY NOTES:

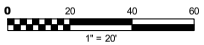
1 FIRST NOTE

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
- GABION

NO	REVISION DESCRIPTION	BY	APVD	DATE

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

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FINAL ISSUE DRAWING
INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 1953 — 11/02/2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL: J. ABDALKHANI	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: G. STEINER	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: DECEMBER 2023
DRAWING NO: **S001**
SHT NO / TOTAL: 78 / 91
REV NO:

1-010

STRUCTURAL GENERAL NOTES

DESIGN CRITERIA
APPLICABLE BUILDING NOTES AND CODES
CITY OF SEATTLE BUILDING CODE, SBC 2018 EDITION
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, DATED AUGUST 2022 FOR FOUNDATION DREDGING AND BACKFILL INFORMATION

STRUCTURAL STEEL PILES
STEEL PIPE PILES - 12" DIA WITH ½" MINIMUM WALL THICKNESS PER ASTM A252, GRADE 3, fy= 45 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 = 0.50 INCHES
MINIMUM ELASTIC SECTION MODULUS = 88.0 IN^3/FT

STRUCTURAL STEEL
PLATES AND BARS SHALL BE NEW AND CONFORM TO ASTM A572, GRADE 50.

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

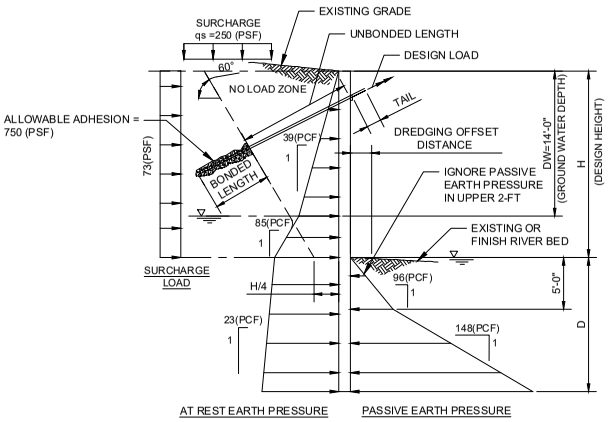
REINFORCING STEEL SHALL BE IN ACCORDANCE WITH ASTM A615, GRADE 60.

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.

SOLDIER PILE OR SHEET PILE
CANTILEVERED OR WITH A SINGLE ROW TIEBACK

PRESSURE DIAGRAM
SCALE: NTS

NO	REVISION DESCRIPTION	BY	APVD	DATE

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STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 1984 — 11/02/2023

DESIGNED/DRAWN:	CHECKED:
S. LOR	I. IKEDA
PROJECT ENGINEER:	SCALE:
A. BRIGHT	AS NOTED
DESIGN APPROVAL:	PROJECT FILE NO:
J. ABDALKHANI	E00559E18
PROJECT ACCEPTANCE:	CONTRACT NO:
G. STEINER	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: DECEMBER 2023
DRAWING NO: **S002**
SHT NO / TOTAL: 79 / 91
REV NO:

C-011

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

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STATE OF WASHINGTON — JOSEPH A. BRIGHT — 21052 — REGISTERED PROFESSIONAL ENGINEER
11/02/2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL: J. ABDALKHANI	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: G. STEINER	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: DECEMBER 2023
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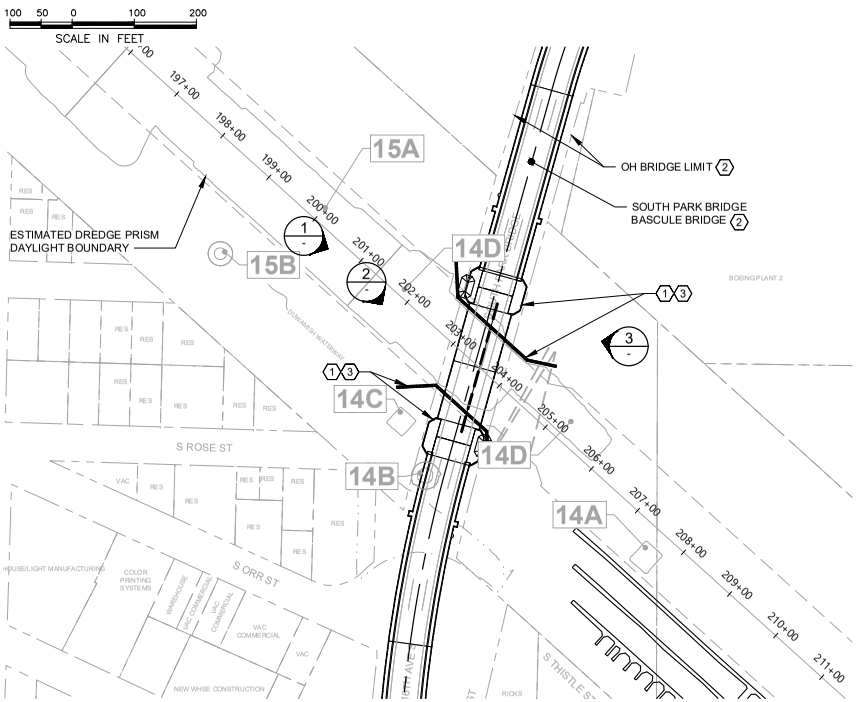
REV NO:

1-012



PARTIAL SITE PLAN
SCALE: 1 : 100

GENERAL NOTES:

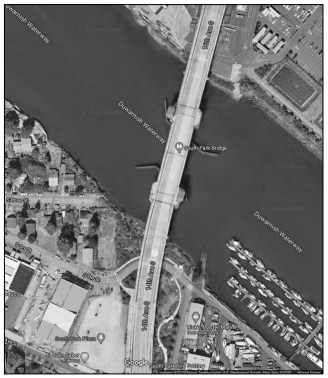
1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.
2. FOR BRIDGE DIMENSIONS AND LATEST AVAILABLE INFORMATION, SEE:
   SOUTH PARK BRIDGE 300197
   REFERENCE RECORD DRAWING BG04

KEY NOTES:

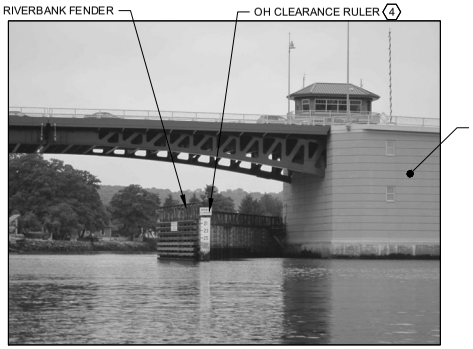
1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS TO KING COUNTY STRUCTURES.
3. PROTECT-IN-PLACE BRIDGE FENDERING SYSTEM.
4. VERTICAL OH CLEARANCE PER RULER. 125'-0" HORIZONTAL CLEARANCE. SEE NOAA 18450 CHART.

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

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

BRIGHT ENGINEERING, INC.
STRUCTURAL & CIVIL ENGINEERING
1809 7TH AVENUE
SUITE 1100
SEATTLE, WA 98101
P: (206) 625-3777
F: (206) 625-1851

FINAL ISSUE DRAWING
INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — 19854 — REGISTERED PROFESSIONAL ENGINEER — 11/02/2023

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

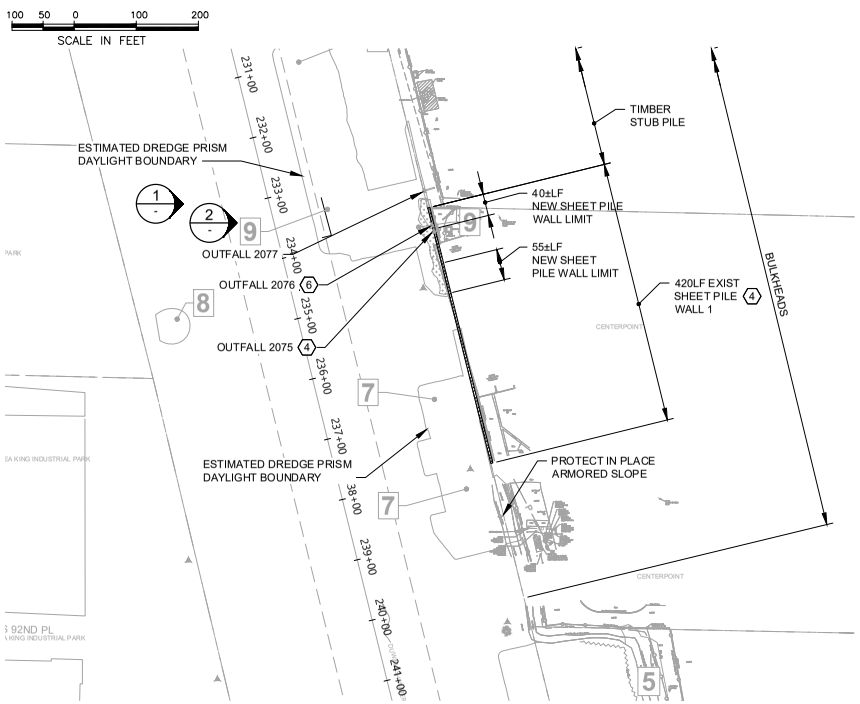
King County

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

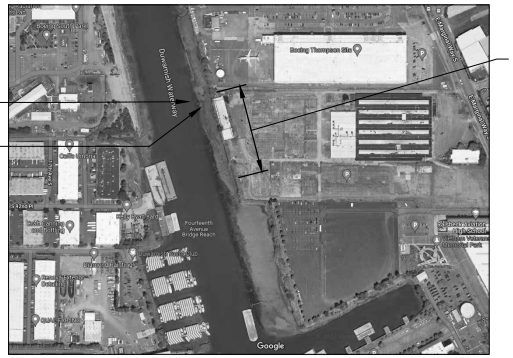
SOUTH PARK BRIDGE PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S100**
SHT NO / TOTAL: 81 / 91
REV NO:

G-013



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. PRIOR TO STARTING WORK LOCATE DEPTH, HORIZONTAL POSITION, AND ALIGNMENT OF OUTFALL 2075. CLEARLY MARK THE ALIGNMENT RELATIVE TO THE OUTFALL RISER ON THE EXISTING SHEET PILE WALL.
5. PROTECT OUTFALL AND DUCKBILL VALVE FROM DAMAGE AS REQUIRED. MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS.
6. IF ABANDONED OUTFALL 2076 IS ENCOUNTERED DURING REMOVAL OF DEBRIS OR DREDGING, THE PIPE SHALL BE CUT AT THE FACE OF THE WALL AND PLUGGED WITH 2FT OF UNDERWATER CEMENT GROUT.

REFERENCE DRAWINGS:

S125	WALL 1: PLAN AND PROFILE
S131	WALL 1: 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

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

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FINAL ISSUE DRAWING
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DECEMBER 2023

STATE OF WASHINGTON — JOSEPH A. BRIGHT — 21851 — REGISTERED PROFESSIONAL ENGINEER — 11/02/2023

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

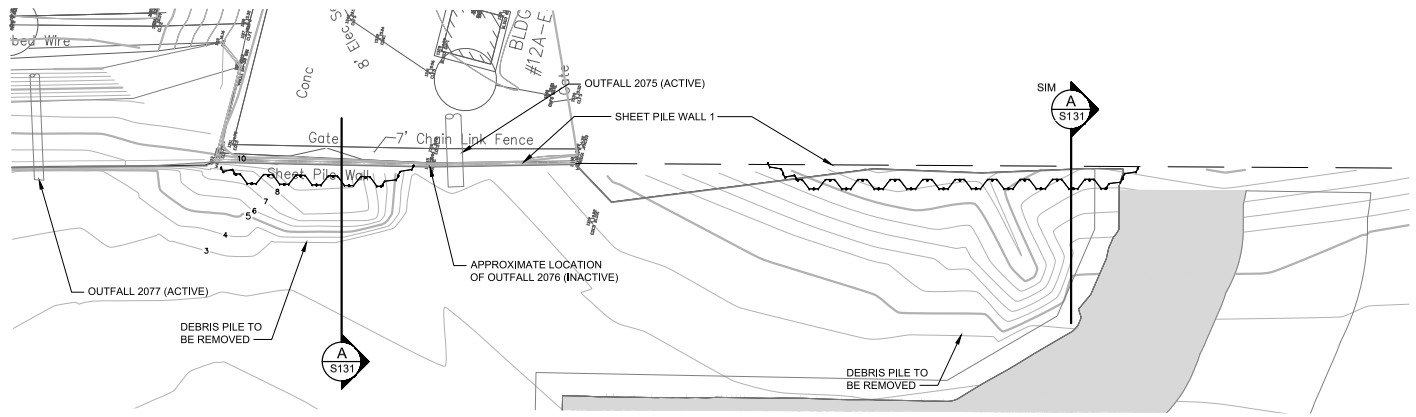
King County

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

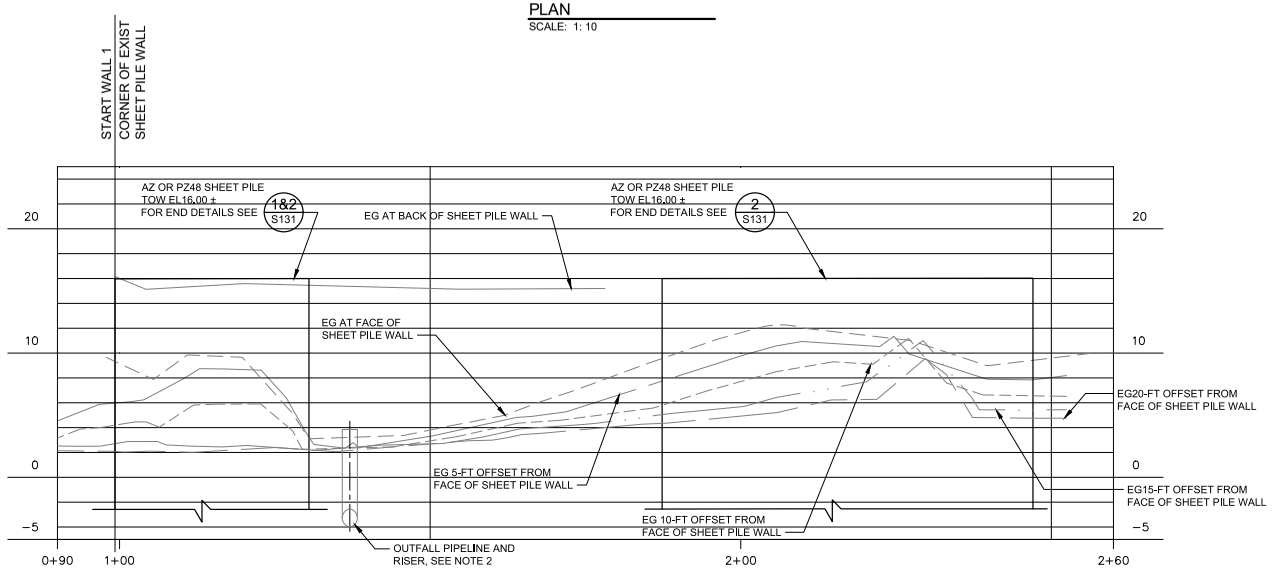
BULKHEAD WALL 1 PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S121**
SHT NO 82 / TOTAL 91
REV NO:

C-014



PLAN
SCALE: 1: 10



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

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. PRIOR TO STARTING WORK LOCATE DEPTH, HORIZONTAL POSITION, AND ALIGNMENT OF OUTFALL 2075. CLEARLY MARK THE ALIGNMENT RELATIVE TO THE OUTFALL RISER ON THE EXISTING SHEET PILE WALL.
3. PROTECT STORMWATER RISER PIPE IN PILE.
4. IF ABANDONED OUTFALL 2076 IS ENCOUNTERED DURING REMOVAL OF DEBRIS OR DREDGING, THE PIPE SHALL BE CUT AT THE FACE OF THE WALL AND PLUGGED WITH 2FT OF UNDERWATER CEMENT GROUT.

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

NO	REVISION DESCRIPTION	BY	APVD	DATE

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

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INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — ANDREW BRIGHT — 1983 — PROFESSIONAL ENGINEER
11/02/2023

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

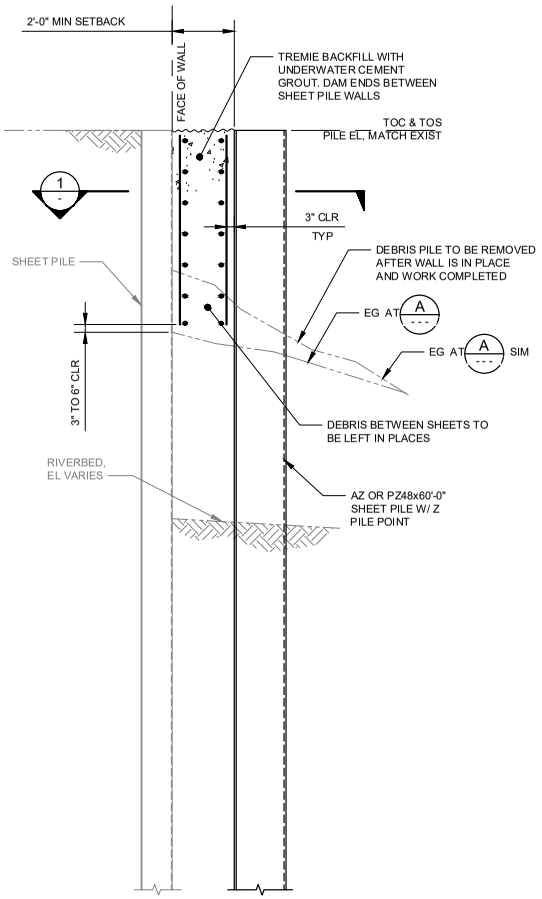
King County

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

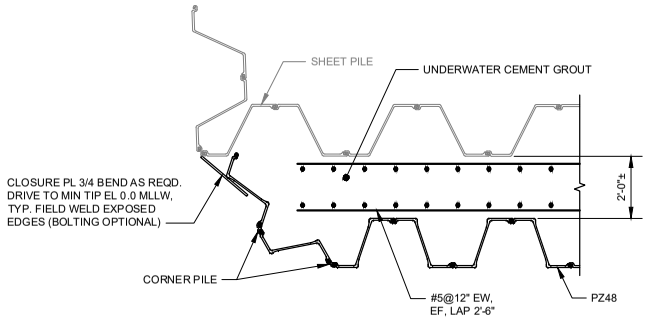
BULKHEAD WALL 1
PLAN AND PROFILE

DATE: DECEMBER 2023
DRAWING NO: **S125**
SHT NO / TOTAL: 83 / 91
REV NO:

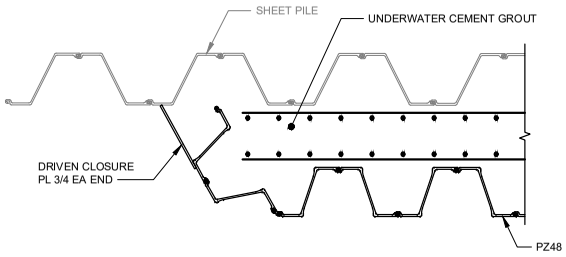
G-015



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



AT NORTH END
DETAIL 1
SCALE: 1/2" = 1'-0"



TYPICAL WALL END
DETAIL 2
SCALE: 1/2" = 1'-0"

NO	REVISION DESCRIPTION	BY	APVD	DATE

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

BRIGHT ENGINEERING, INC.
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FINAL ISSUE DRAWING
INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — BRIGHT — 19814 — PROFESSIONAL ENGINEER
11/02/2023

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

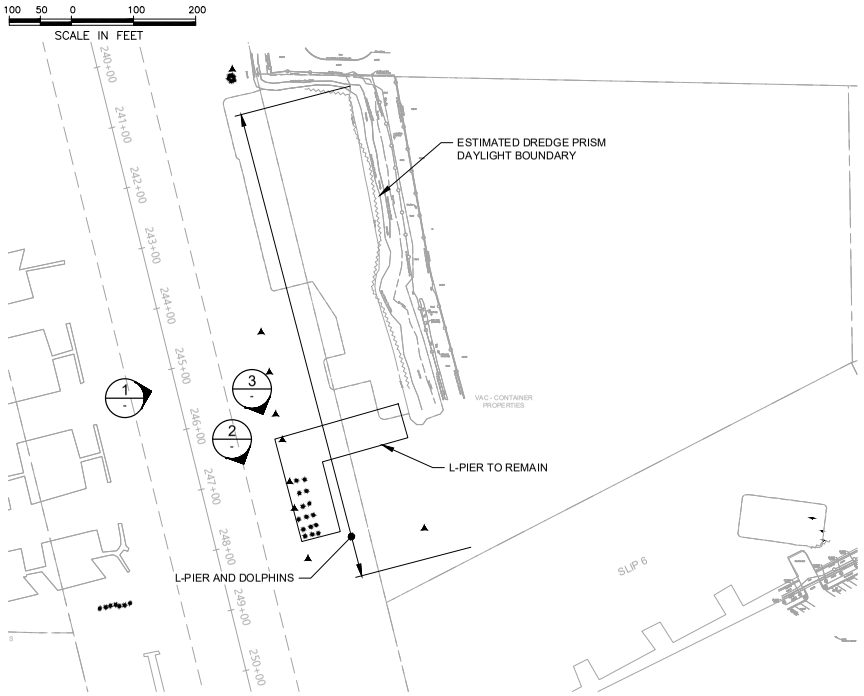
King County

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

BULKHEAD WALL 1 SECTIONS AND DETAILS

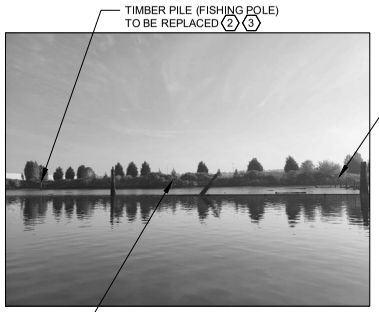
DATE: DECEMBER 2023
DRAWING NO: **S131**
SHT NO / TOTAL: 84 / 91
REV NO:

1-016



PARTIAL SITE PLAN
SCALE: 1 : 100

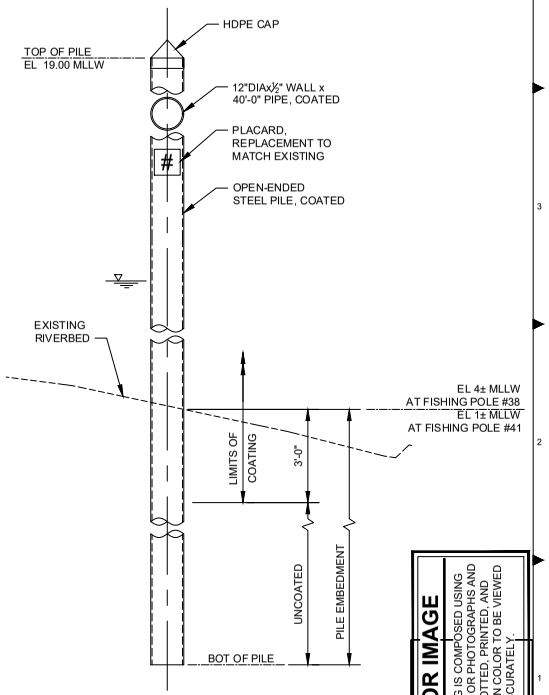
AERIAL VIEW
SCALE: NONE



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
City of Seattle / King County / The Boeing Company

Bright Engineering, Inc.
Structural & Civil Engineering
1809 7th Avenue
Suite 1100
Seattle, WA 98101
P: (206) 625-3777
F: (206) 625-1851

FINAL ISSUE DRAWING
INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — 19854 — REGISTERED PROFESSIONAL ENGINEER
11/02/2023

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

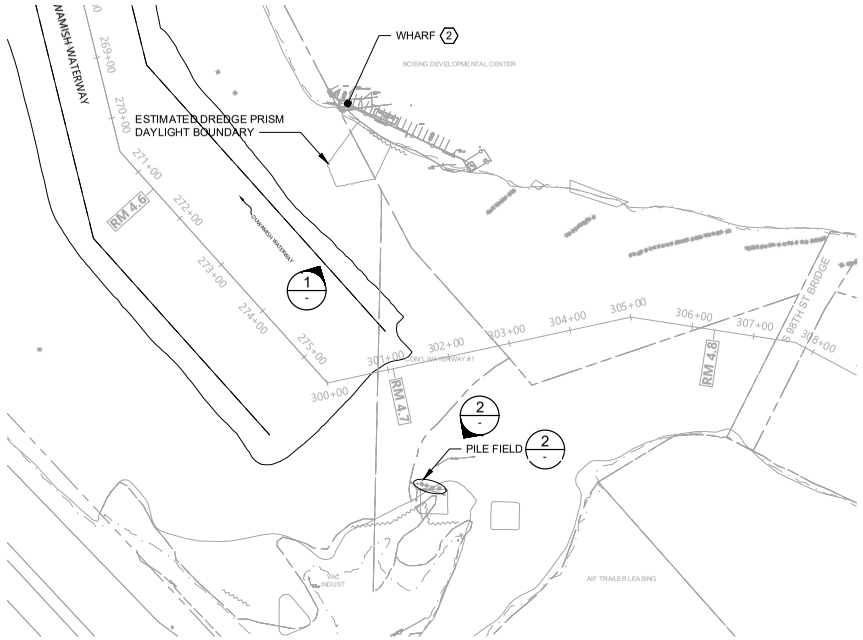
King County

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

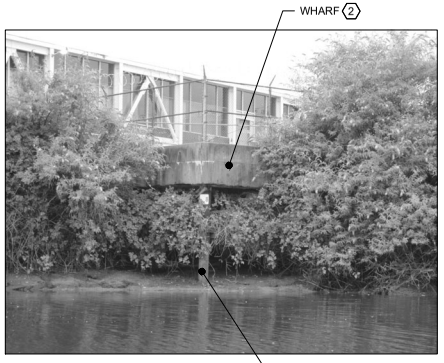
L-SHAPE PIER & DOLPHINS PLAN, PHOTOS, AND PILE DETAILS

DATE: DECEMBER 2023
DRAWING NO: S140
SHT NO / TOTAL: 85 / 91
REV NO:

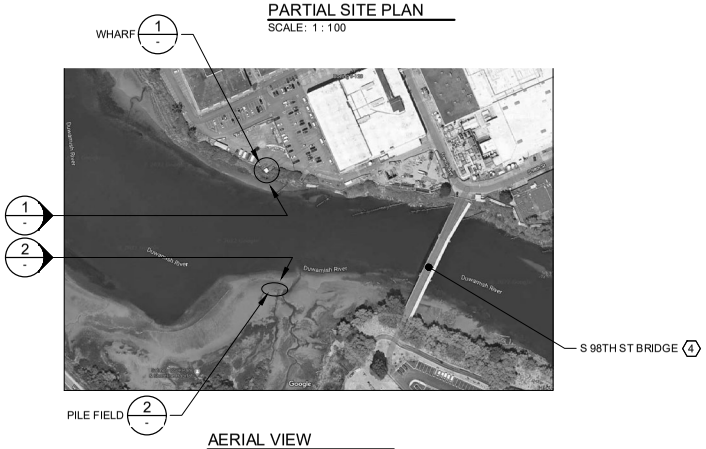
G-017



PARTIAL SITE PLAN
SCALE: 1 : 100



WHARF
PHOTO 1
SCALE: NONE



AERIAL VIEW
SCALE: NONE

PILE FIELD
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. 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. CONTRACTOR TO VERIFY CLEARANCES.

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
City of Seattle / King County / The Boeing Company

BRIGHT ENGINEERING, INC.
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FINAL ISSUE DRAWING
INFORMATION ONLY
BID DOCUMENTS
DECEMBER 2023

STATE OF WASHINGTON — 19854 — REGISTERED PROFESSIONAL ENGINEER
11/02/2023

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

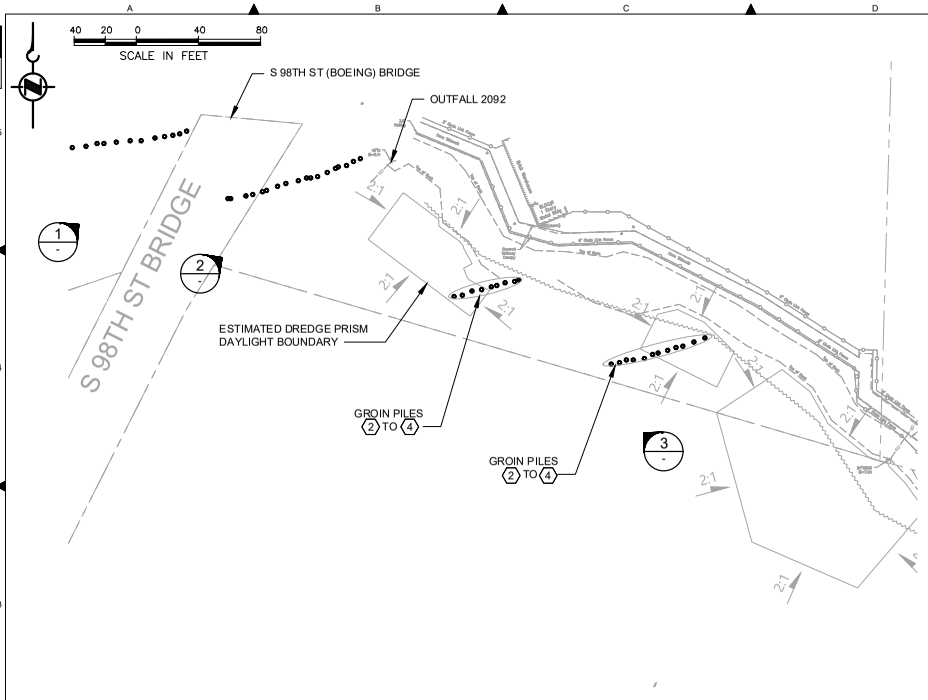
King County

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

WHARF & PILE FIELD PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S150**
SHT NO / TOTAL: 86 / 91
REV NO:

C-018



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:

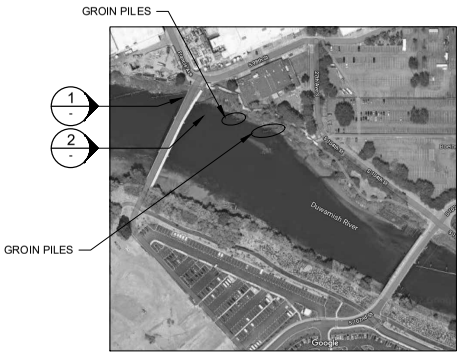
1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS ON THE PILE STRUCTURES.
3. NO PILE DESIGN INFORMATION OR PILE EMBEDMENT DEPTH IS AVAILABLE THEREFORE MAINTAIN THE MINIMUM OFFSETS INDICATED ON THE PLANS.
4. CONTRACTOR IS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

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
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
City of Seattle / King County / The Boeing Company

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FINAL ISSUE DRAWING
INFORMATION ONLY
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DECEMBER 2023

STATE OF WASHINGTON — 19854 — REGISTERED PROFESSIONAL ENGINEER
11/02/2023

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

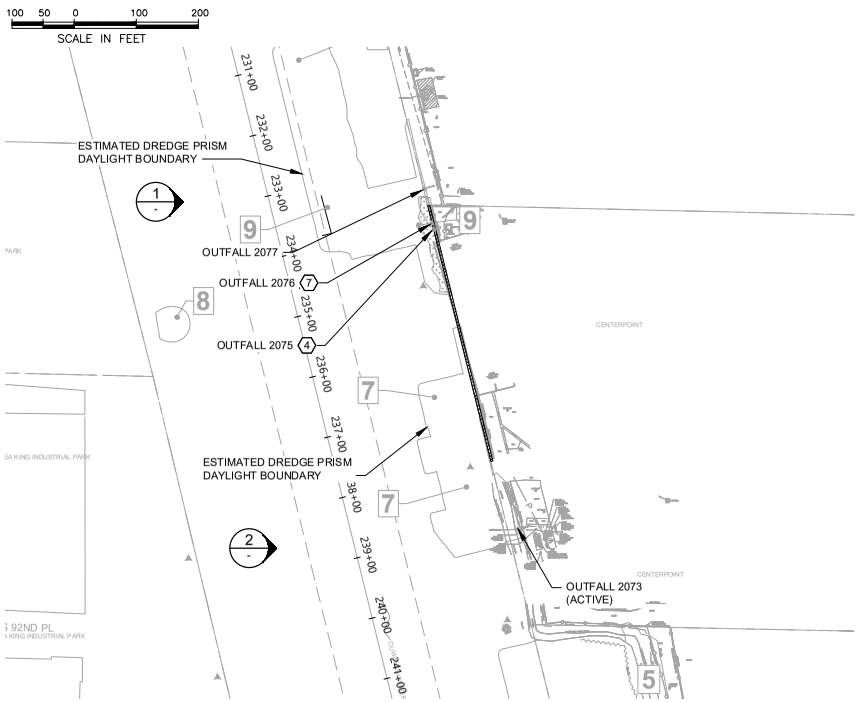
King County

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

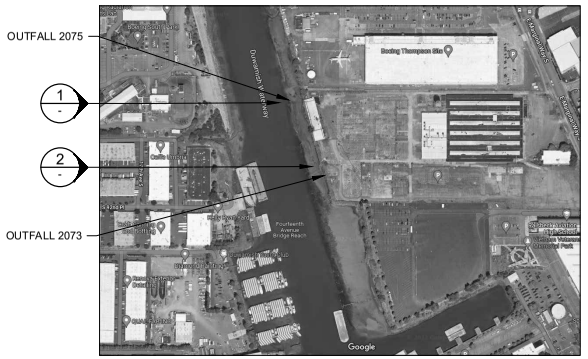
GROIN PILES PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S151**
SHT NO 87 / TOTAL 91
REV NO:

G-019



PARTIAL SITE PLAN
SCALE: 1 : 100



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. PROTECT AND MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS, UNLESS INDICATED OTHERWISE.
3. WORK AROUND OR DEMOLISH INACTIVE OUTFALLS THAT MAY BE 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. PRIOR TO STARTING WORK LOCATE DEPTH, HORIZONTAL POSITION, AND ALIGNMENT OF OUTFALL 2075. CLEARLY MARK THE ALIGNMENT RELATIVE TO THE OUTFALL RISER ON THE EXISTING SHEET PILE WALL.
5. PROTECT OUTFALL PIPE IN PLACE.
6. CONSTRUCT ENERGY DISSIPATION STRUCTURE CONSISTING OF GABION MATTRESS FOUNDATION.
7. IF ABANDONED OUTFALL 2076 IS ENCOUNTERED DURING REMOVAL OF DEBRIS OR DREDGING, THE PIPE SHALL BE CUT AT THE FACE OF THE WALL AND PLUGGED WITH 2FT OF UNDERWATER CEMENT GROUT.

REFERENCE DRAWINGS:

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

OUTFALL 2075
PHOTO 1
SCALE: NONE

OUTFALL 2073
PHOTO 2
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

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

BRIGHT ENGINEERING, INC.
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DECEMBER 2023

STATE OF WASHINGTON — JOSEPH A. BRIGHT — 1858 — PROFESSIONAL ENGINEER — 11/02/2023

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

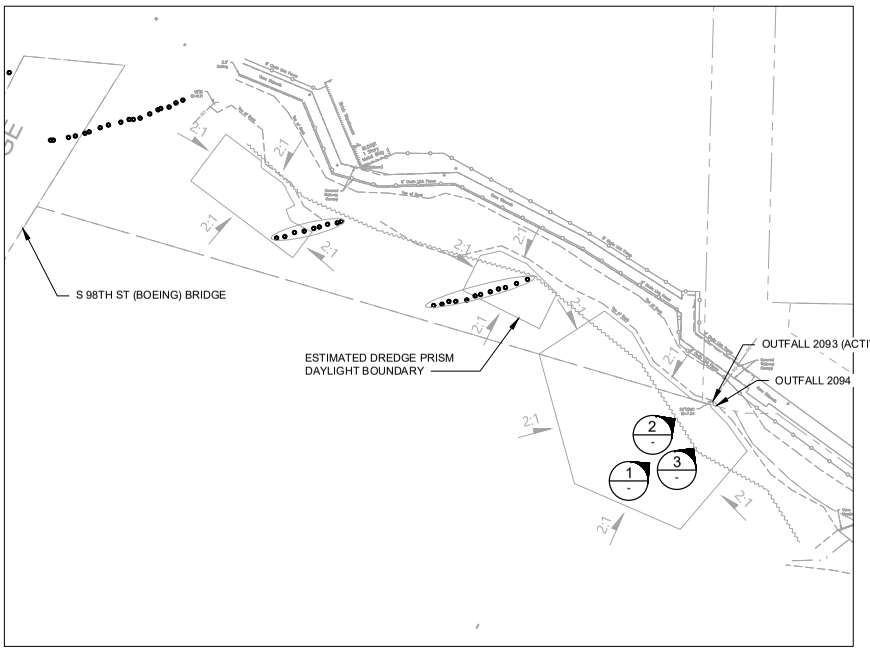
King County

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

OUTFALLS 2075 & 2073 PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S200**
SHT NO / TOTAL: 88 / 91
REV NO:

G-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.
2. WORK AROUND OR DEMOLISH INACTIVE OUTFALLS THAT MAY BE ENCOUNTERED.

KEY NOTES:

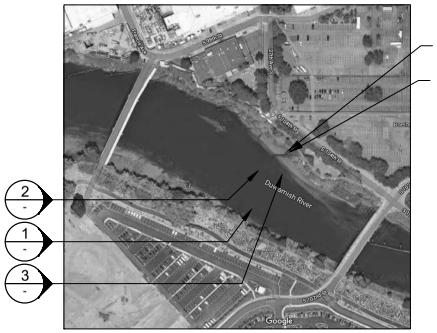
1. FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
2. PROTECT OUTFALL PIPE IN PLACE.
3. PROTECT AND MAINTAIN 3'-0" CONSTRUCTION EQUIPMENT OFFSET FROM ACTIVE OUTFALLS UNLESS INDICATED OTHERWISE.
4. CONSTRUCT ENERGY DISSIPATION STRUCTURE CONSISTING OF GABION MATTRESS FOUNDATION.

REFERENCE DRAWINGS:

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

OUTFALLS
PHOTO 1 - SCALE: NONE

OUTFALL 2093
PHOTO 2 - SCALE: NONE



AERIAL VIEW
SCALE: NONE

OUTFALL 2094
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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City of Seattle / King County / The Boeing Company

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DECEMBER 2023

STATE OF WASHINGTON — JOSEPH ABDALKHANI — 11/02/2023 — PROFESSIONAL ENGINEER

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

King County

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

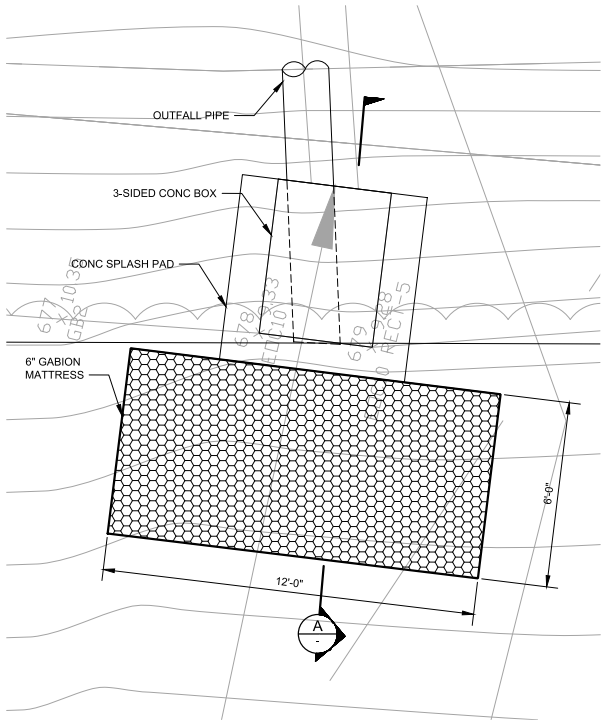
OUTFALLS 2094 & 2093 PLAN AND PHOTOS

DATE: DECEMBER 2023
DRAWING NO: **S201**
SHT NO 89 / TOTAL 91 | REV NO:

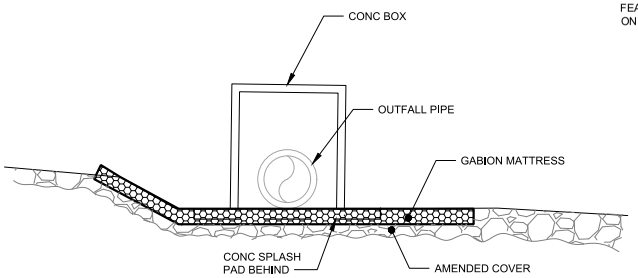
G-021

GENERAL NOTES:

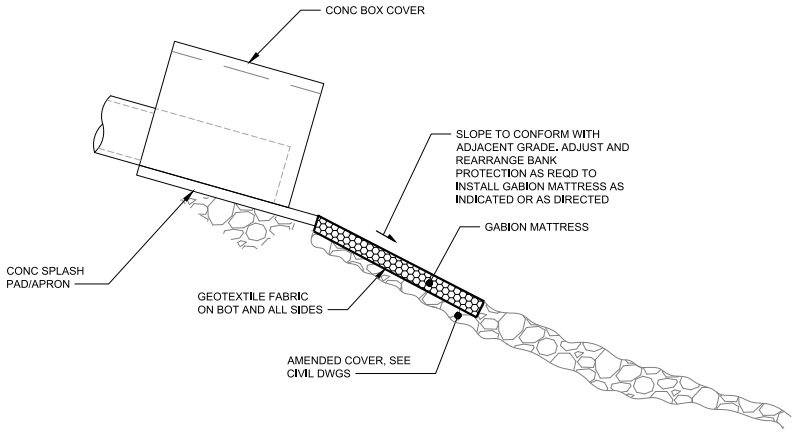
1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.



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



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



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

NO	REVISION DESCRIPTION	BY	APVD	DATE

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

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DECEMBER 2023

STATE OF WASHINGTON — ANDREW J. BRIGHT — 19859 — PROFESSIONAL ENGINEER
11/02/2023

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

King County

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

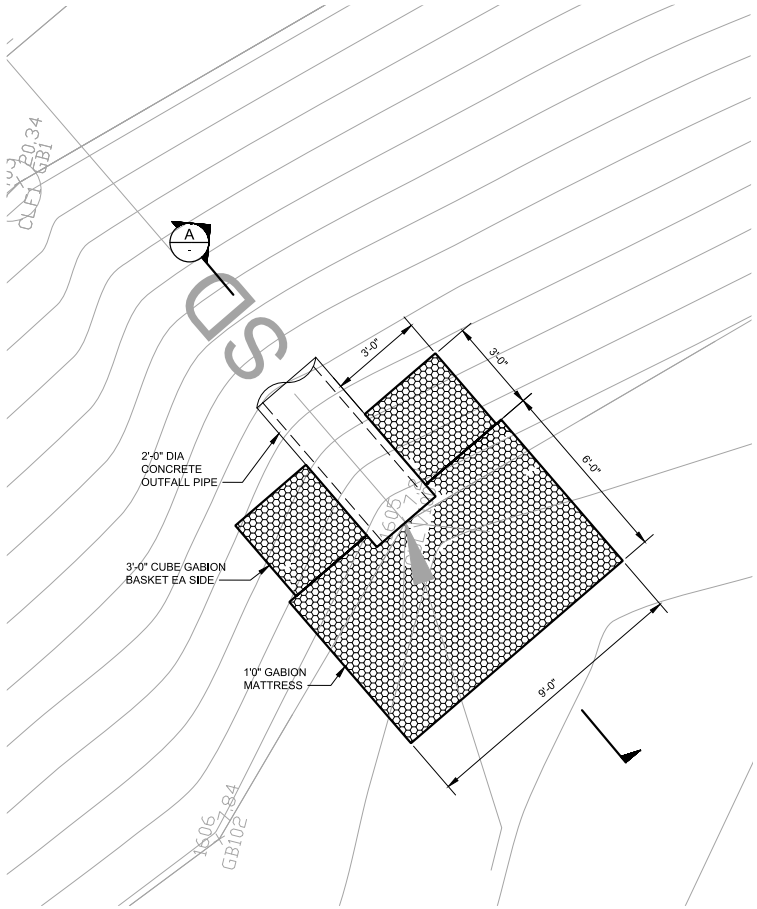
OUTFALLS ENERGY DISSIPATION PLANS, ELEVATIONS AND SECTION 1 OF 2

DATE: DECEMBER 2023
DRAWING NO: **S202**
SHT NO / TOTAL: 90 / 91
REV NO:

1-022

GENERAL NOTES:

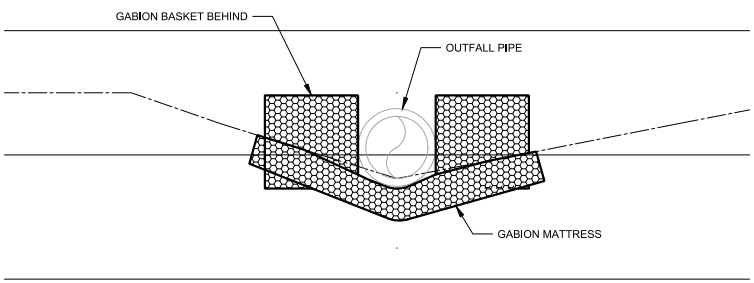
1. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.



OUTFALL 2093

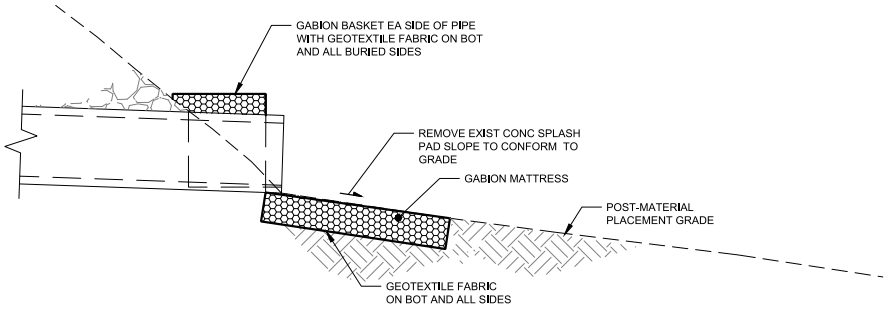
PARTIAL PLAN

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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DECEMBER 2023

STATE OF WASHINGTON — 19858 — REGISTERED PROFESSIONAL ENGINEER
11/02/2023

DESIGNED/DRAWN: S. LOR	CHECKED: I. IKEDA
PROJECT ENGINEER: A. BRIGHT	SCALE: AS NOTED
DESIGN APPROVAL: J. ABDALKHANI	PROJECT FILE NO: E00559E18
PROJECT ACCEPTANCE: G. STEINER	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 SECTIONS 2 OF 2

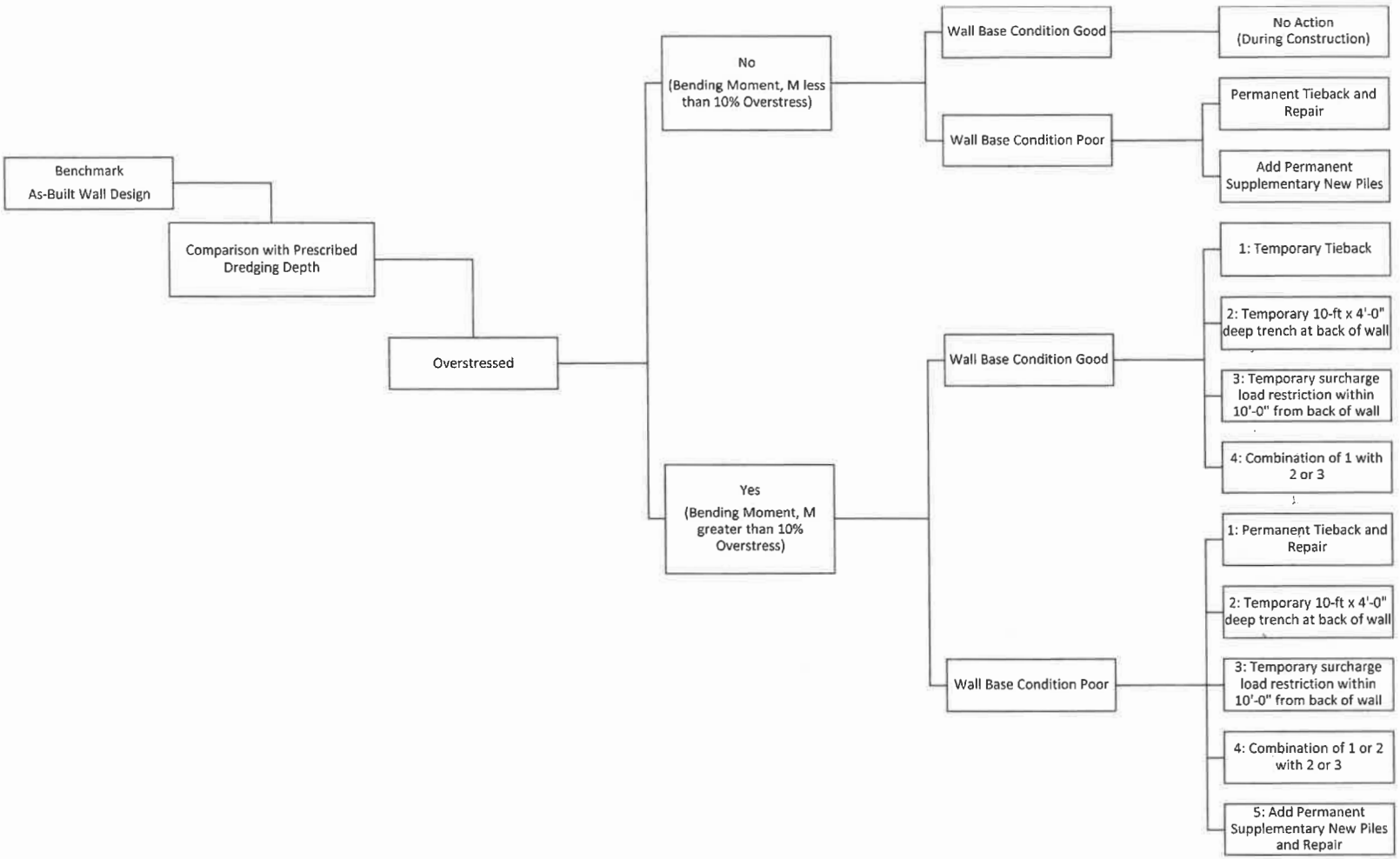
DATE: DECEMBER 2023

DRAWING NO: **S203**

SHT NO / TOTAL: 91 / 91

REV NO: 1-023

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



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Consulting Structural and Civil Engineering

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

Subject: LDW Upper Reach

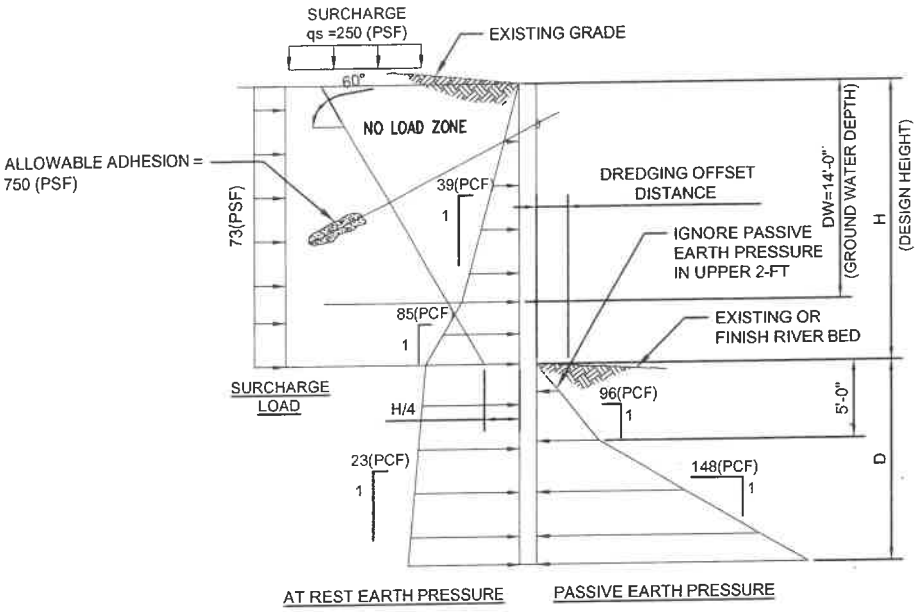
D- case C (4Ft x 10Ft Wide trench behind back of wall)
1. condition 2 (0 dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)
2. condition 3 (3Ft dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)

E - Case C.1 (2Ft0 x 10Ft wide trench behind back of wall)
1. condition 2 (0 dredging offset)
(a) Without Surcharge (S=0)
(b) With Surcharge (S=73)

Bright Engineering, Inc. Consulting Structural and Civil Engineering

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:

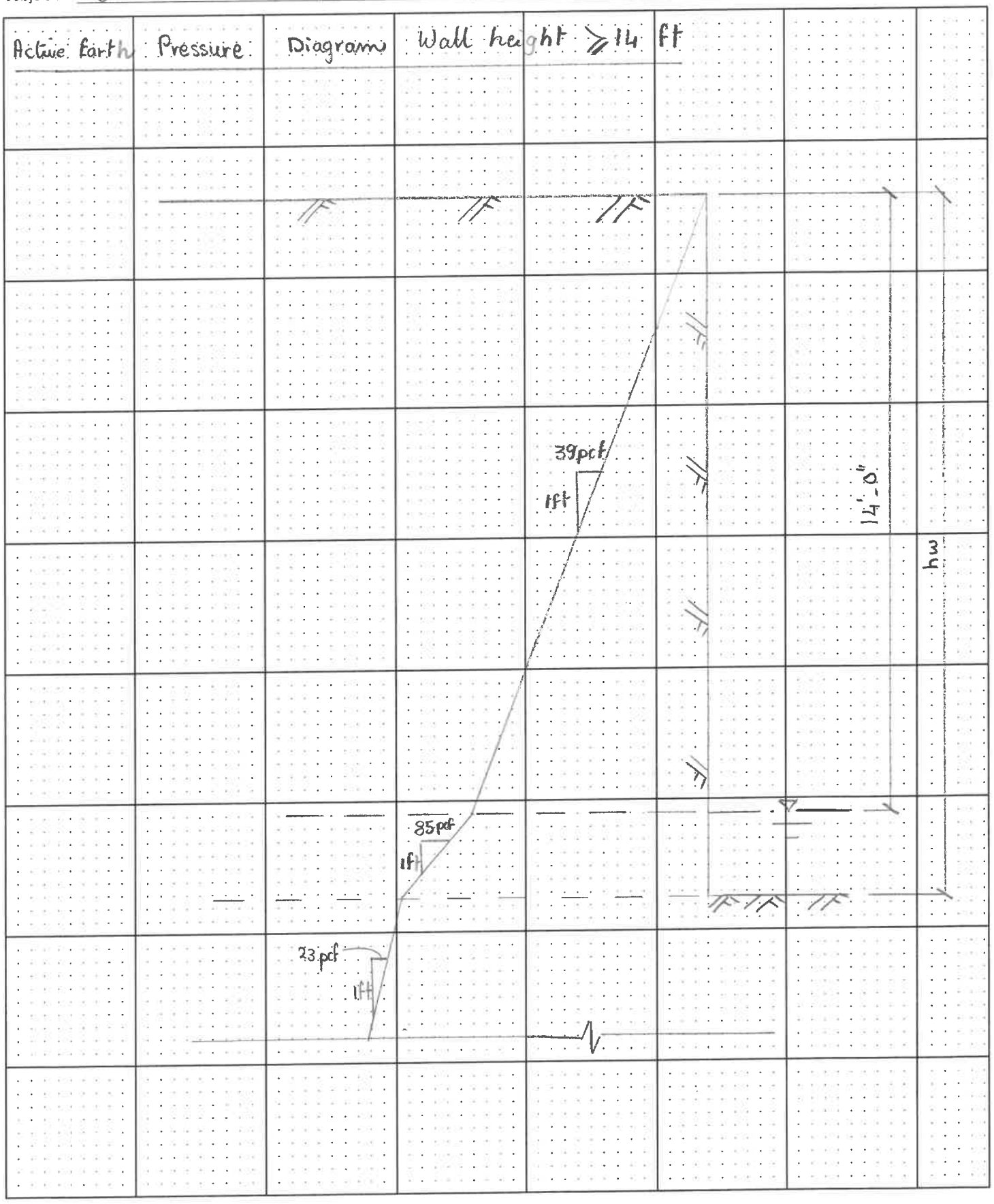
1. DIAGRAM APPLIES TO DRILLED SOLDIER PILE WALLS WITH TIMBER LAGGING AND SHEET PILE WALLS DESIGNED AS A CANTILEVERED WALL OR WITH A SINGLE ROW OF TIEBACK.
2. ALL PRESSURES EXPRESSED AS AN EQUIVALENT FLUID UNIT WEIGHT.
3. ACTIVE EARTH AND SURCHARGE PRESSURES ACT OVER THE PILE SPACING WITHIN RETAINED WALL 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.

Bright Engineering, Inc.
Consulting Structural and Civil Engineering

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

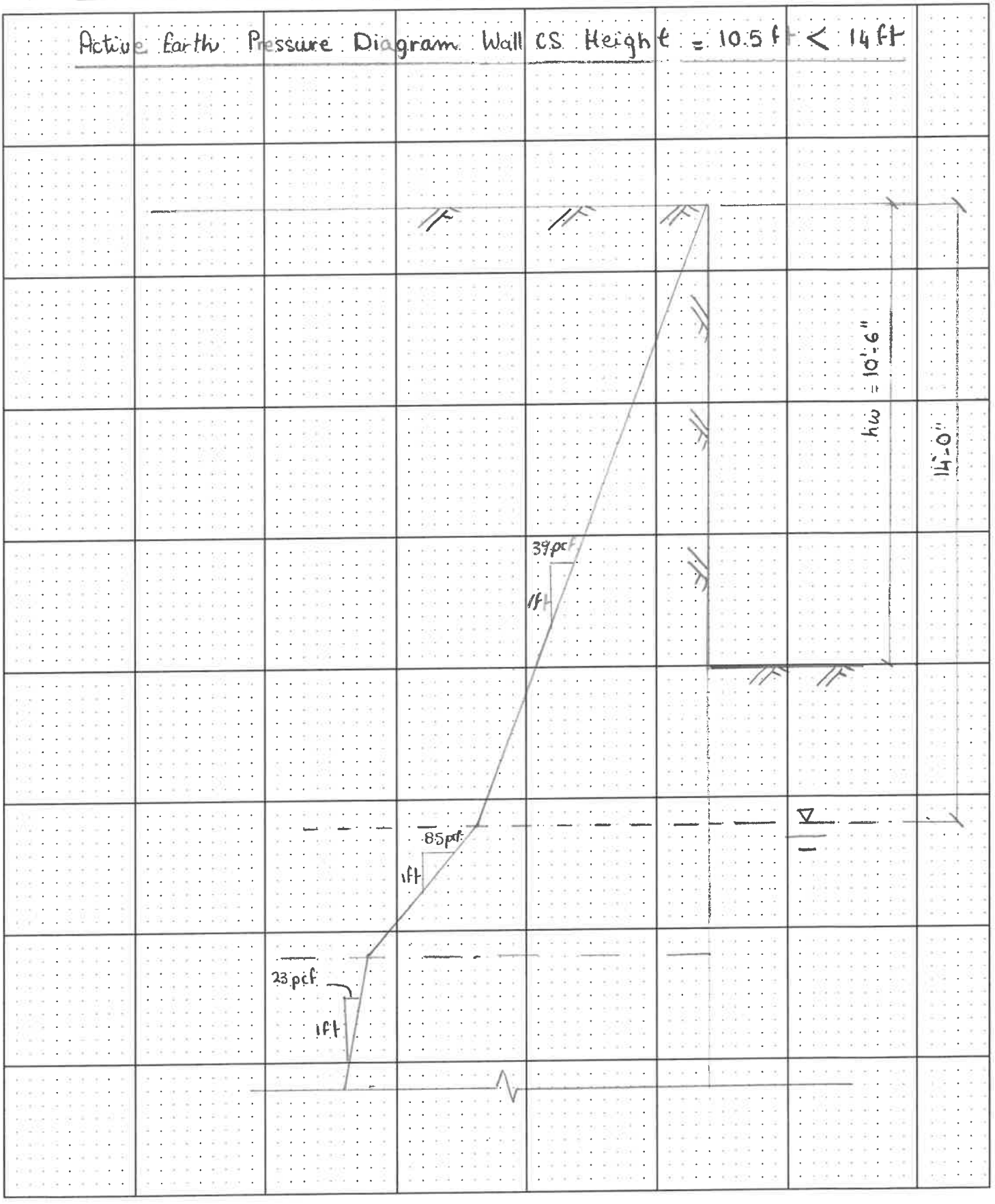


Bright Engineering, Inc.
Consulting Structural and Civil Engineering

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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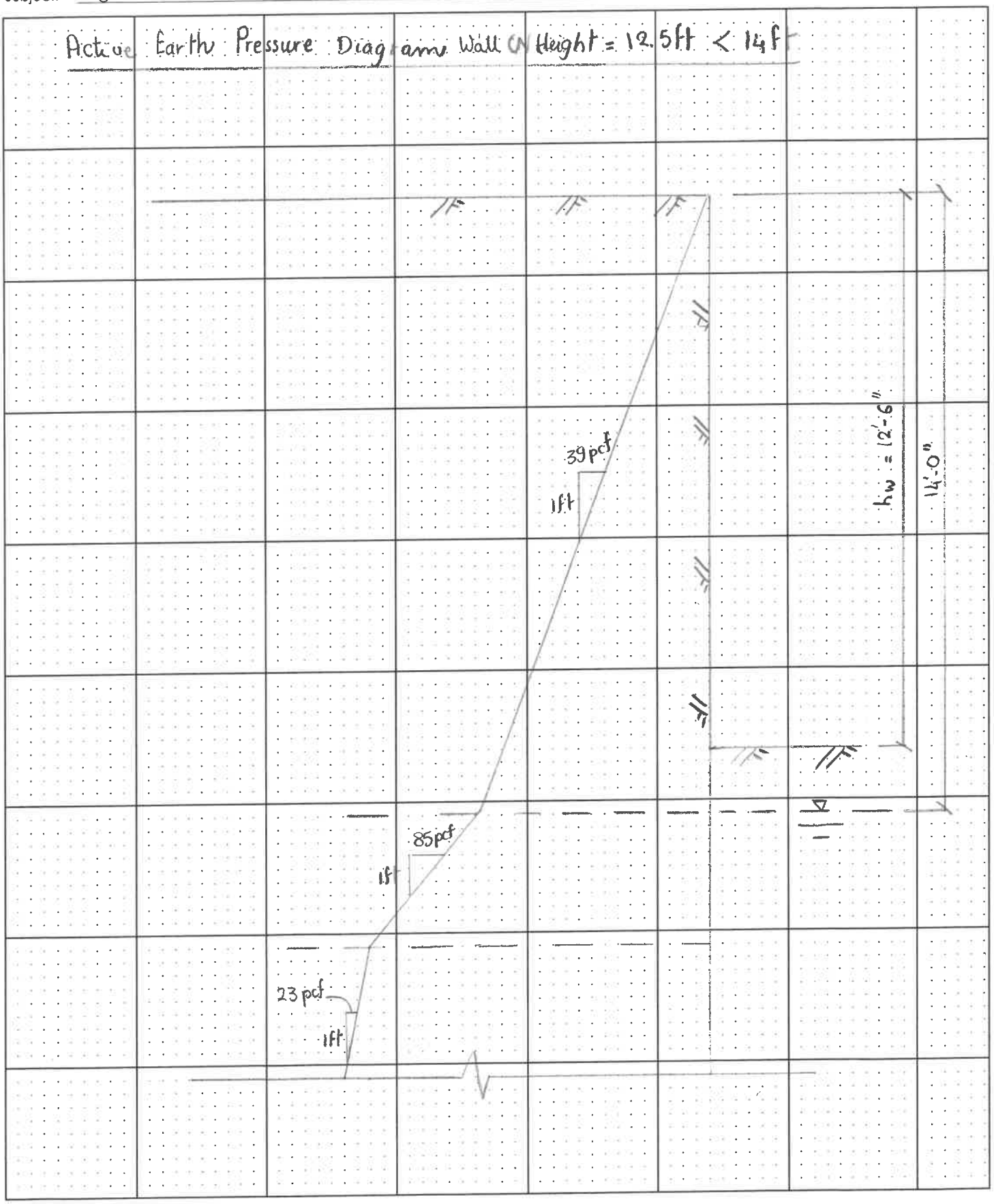
Consulting Structural and Civil Engineering

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

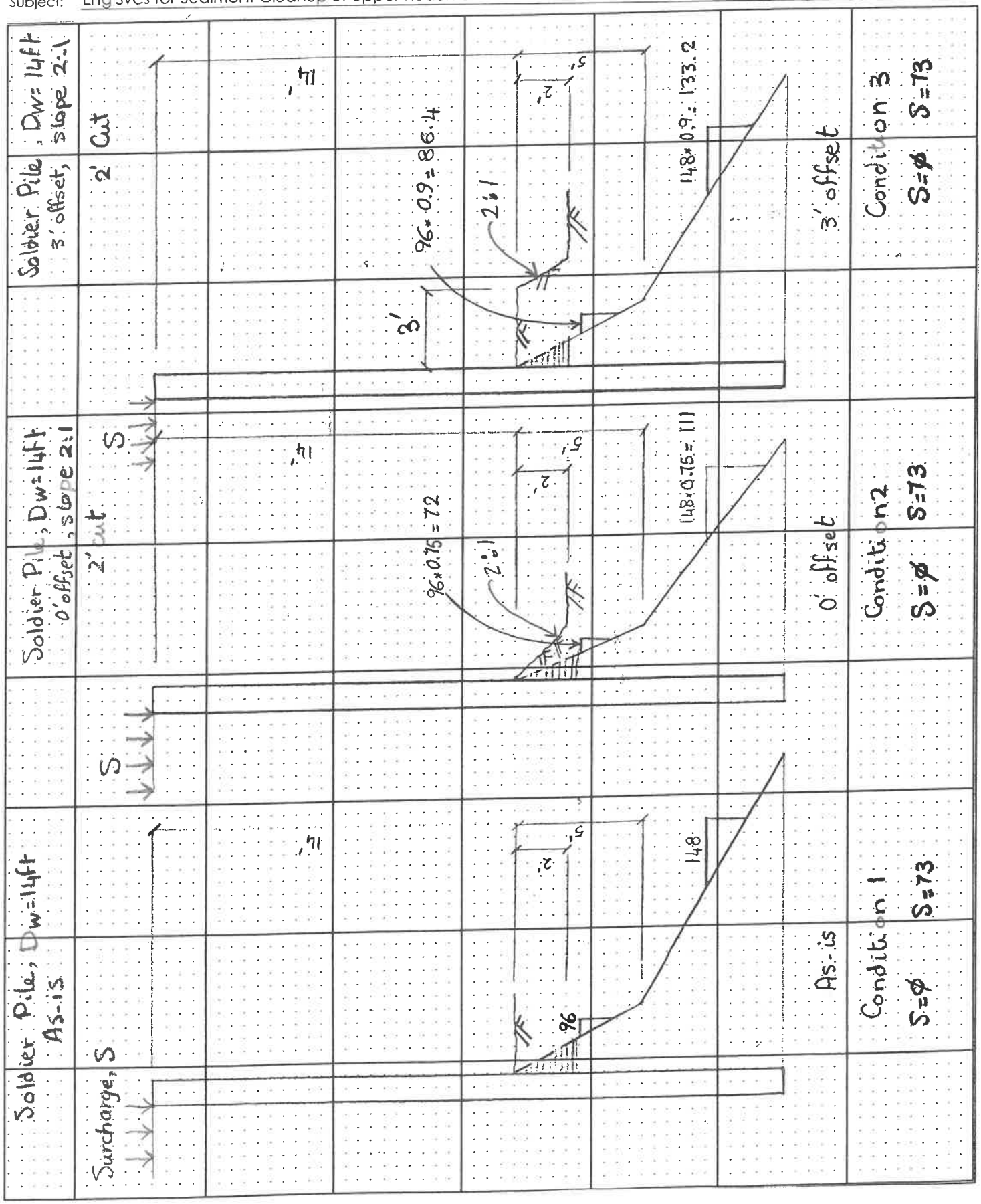
Active Earth Pressure Diagram Wall Height = 12.5ft < 14ft



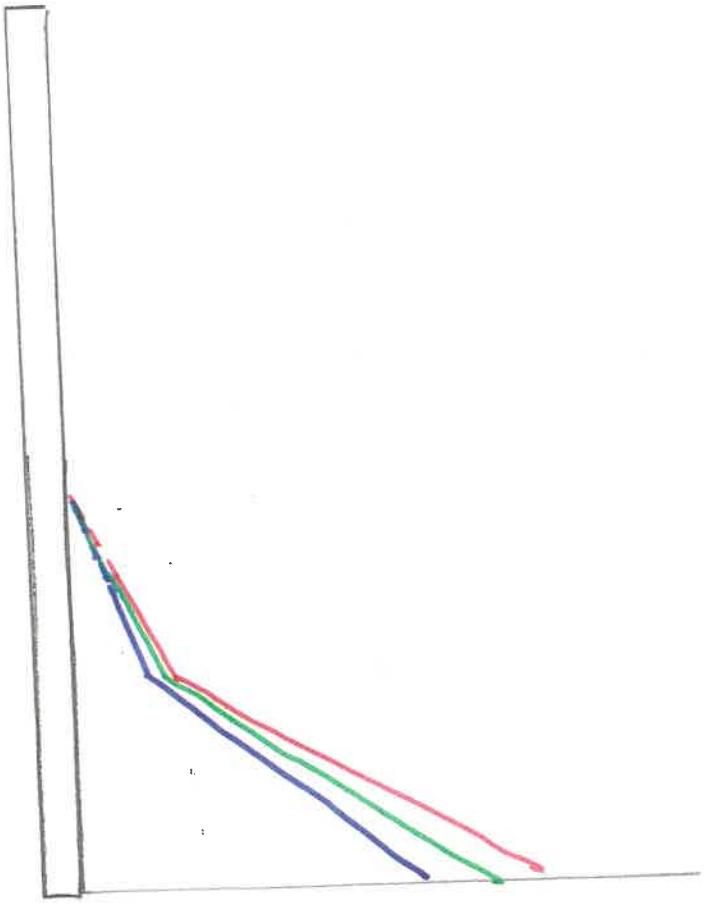
Bright Engineering, Inc.
Consulting Structural and Civil Engineering

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.

Bright Engineering, Inc.
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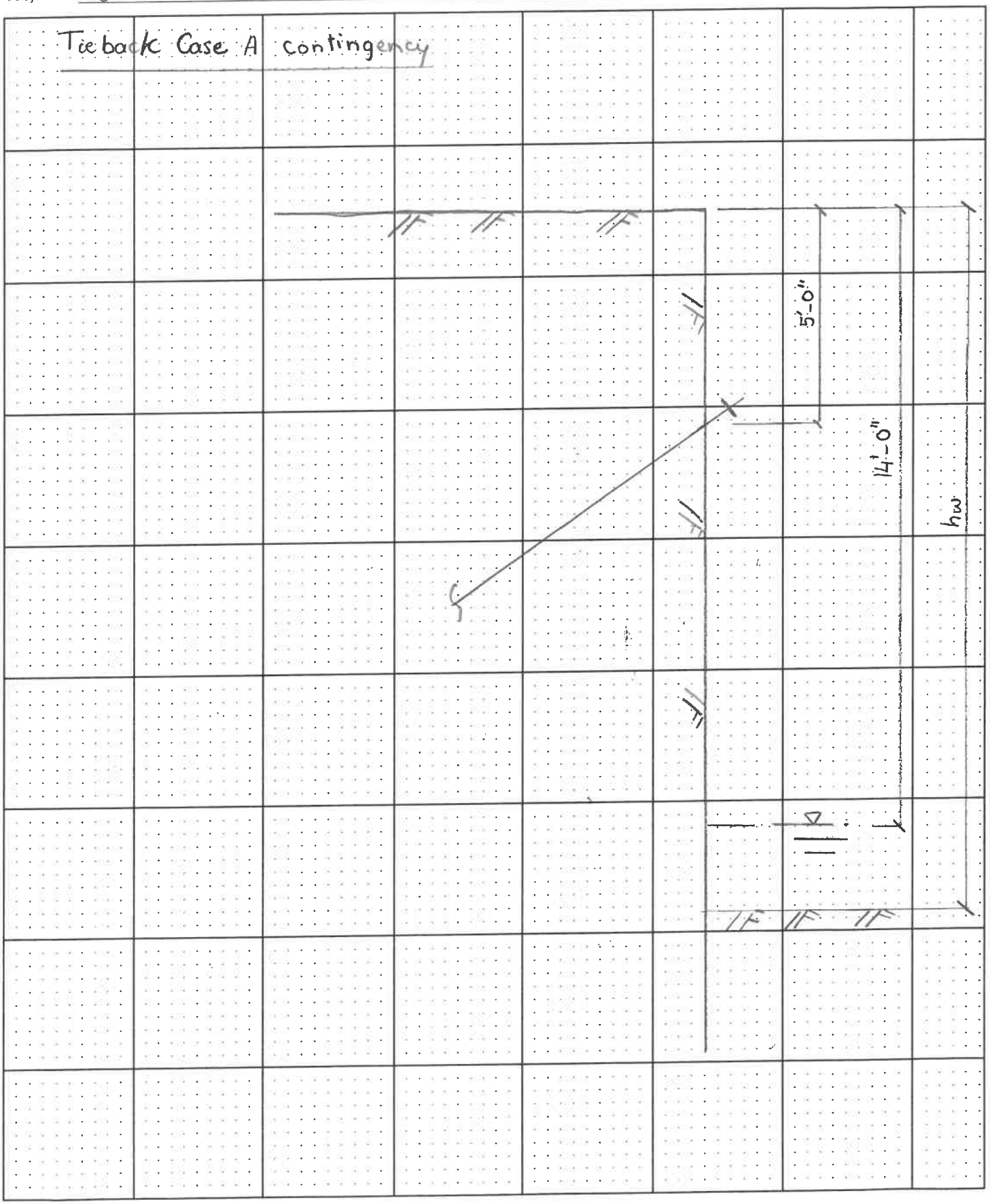
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 1 of ___ Sheets

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

Tieback Case A contingency



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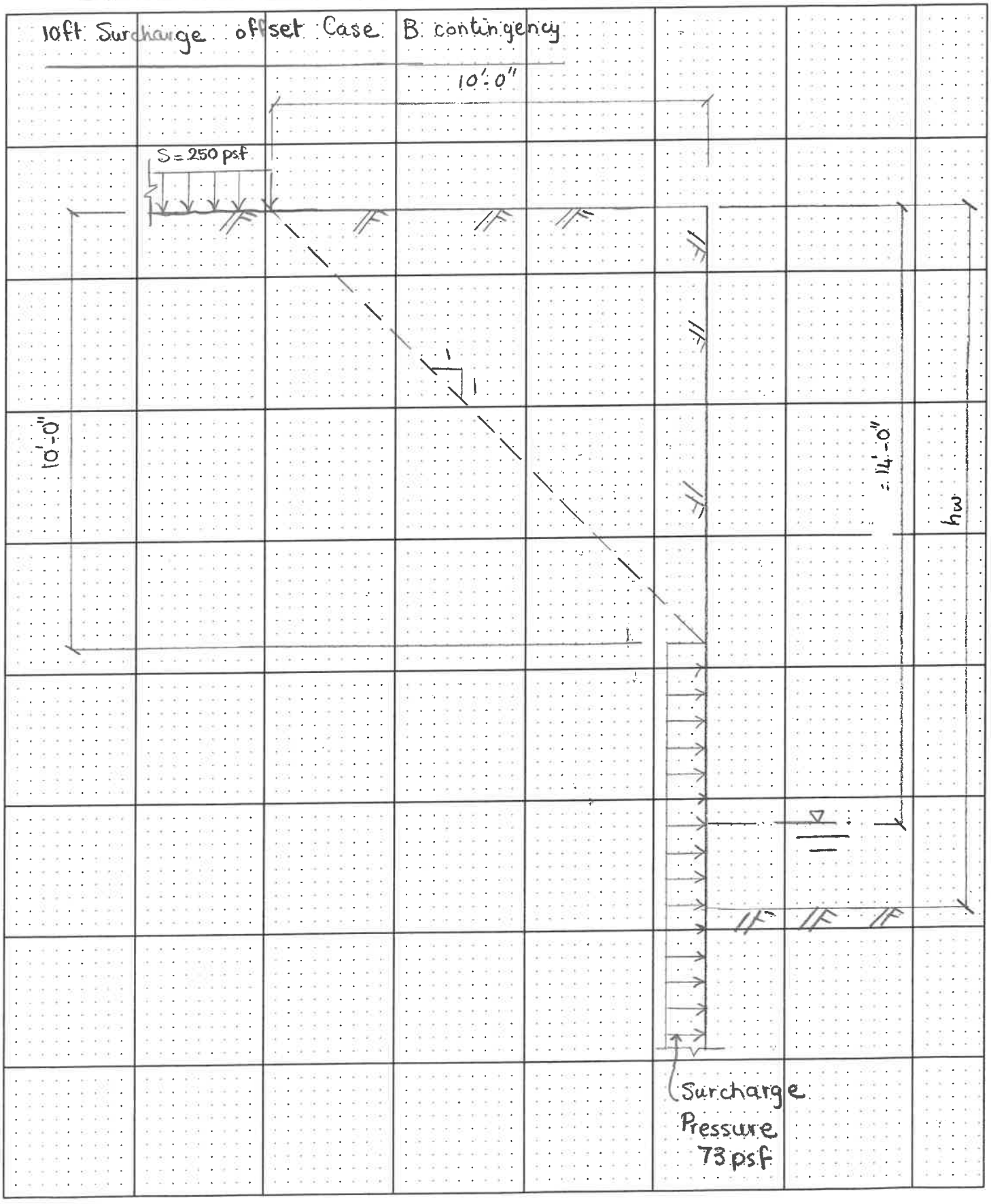
Consulting Structural and Civil Engineering

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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Consulting Structural and Civil Engineering

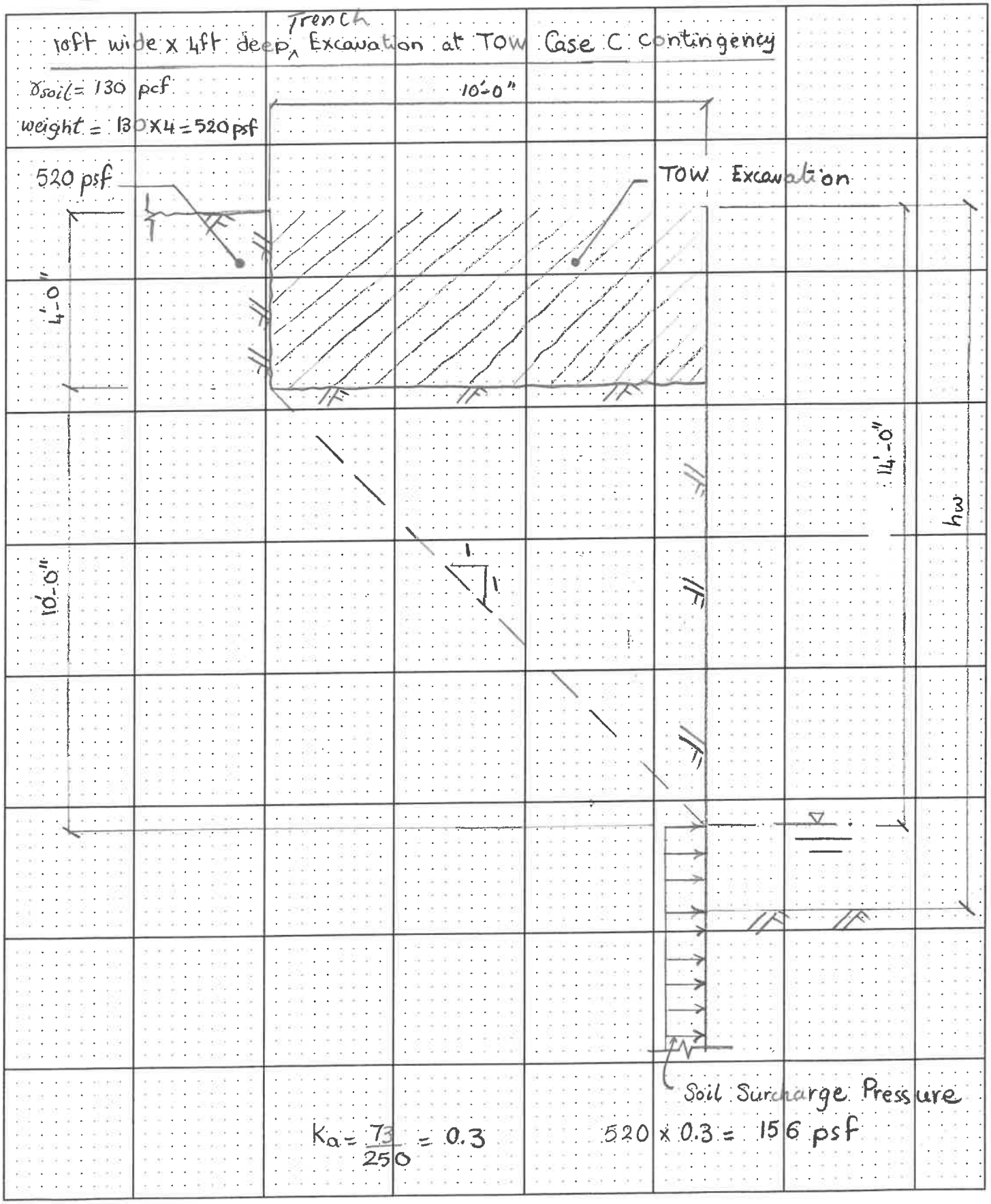
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 3 of ___ Sheets

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

Bright Engineering, Inc.
Consulting Structural and Civil Engineering

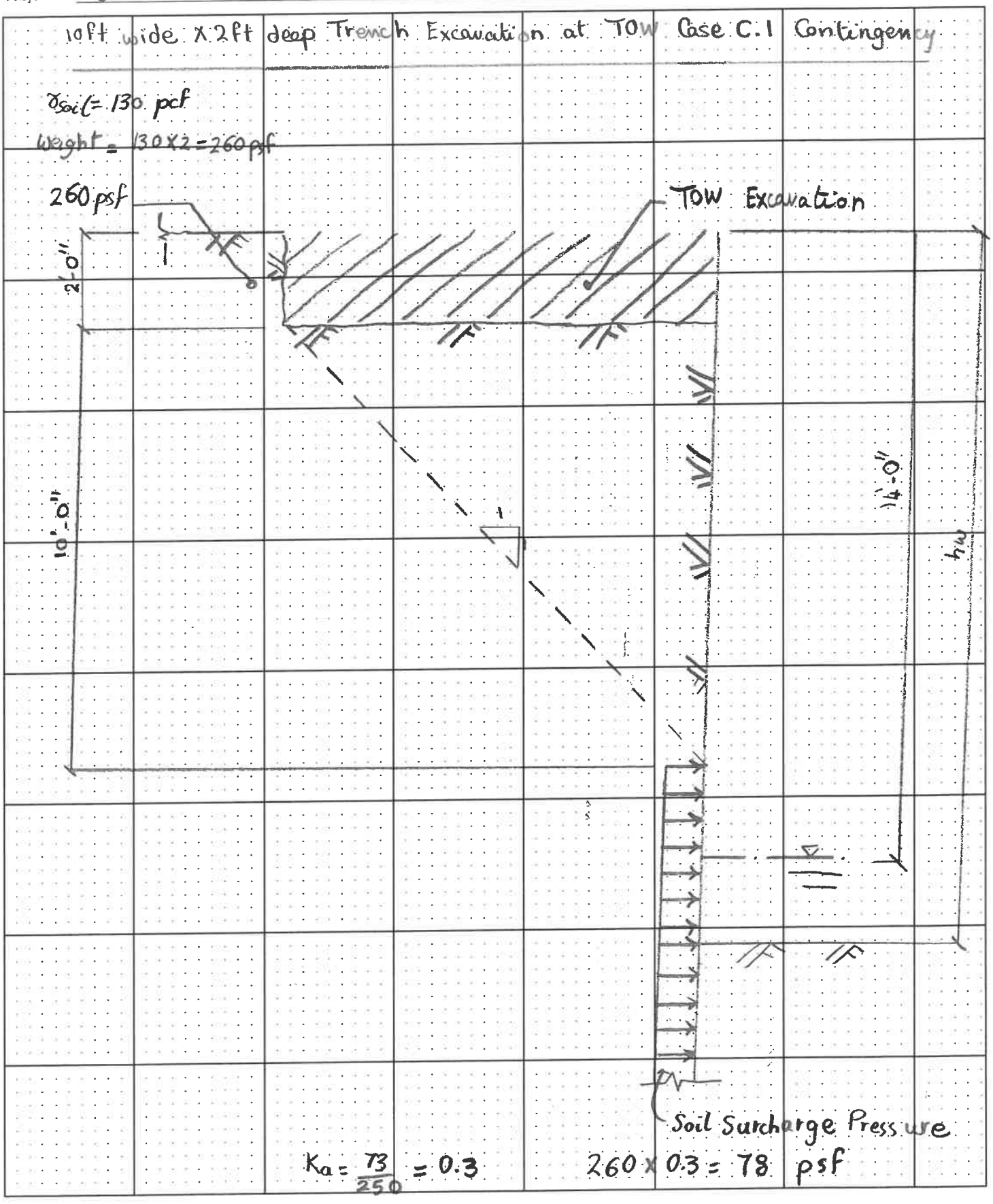
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. ____ of ____ Sheets

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

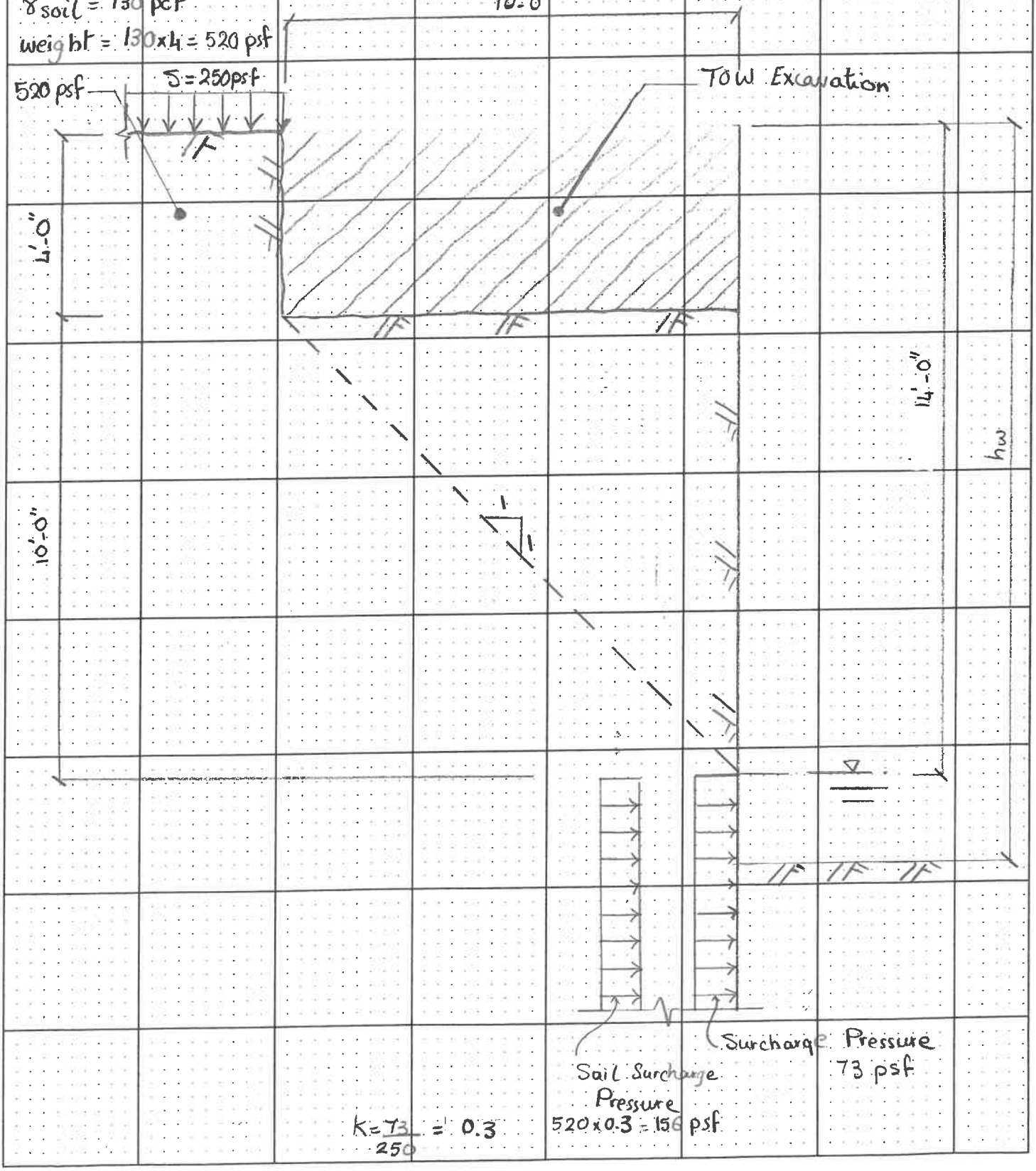
Date: Mar 2023 By: MS BEI No. 252.01 Sheet No. 4 of ___ Sheets

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.

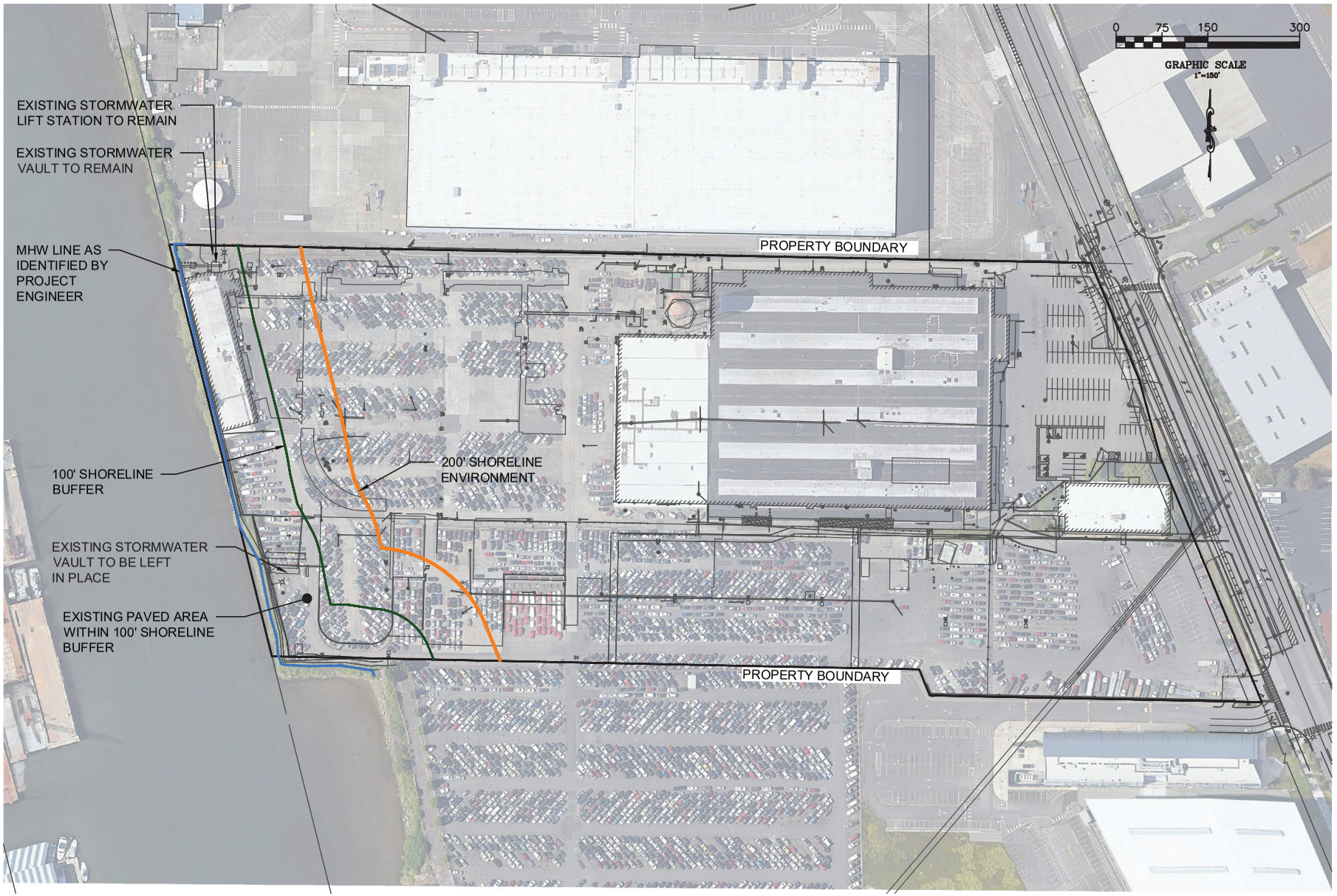
FINAL ANALYSIS

RECENT REMEDIATION LANDSCAPING AND DEVELOPMENTS OF THIS SITE NEGATES USE OF ANY OF THE OPTIONS LOADING CASES AND CONDITIONS A B, AND C AS WELL AS THE CONTIGENCIES NOTED 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. NEW WALL WILL RESIST 100% OF LATERAL LOADS.

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
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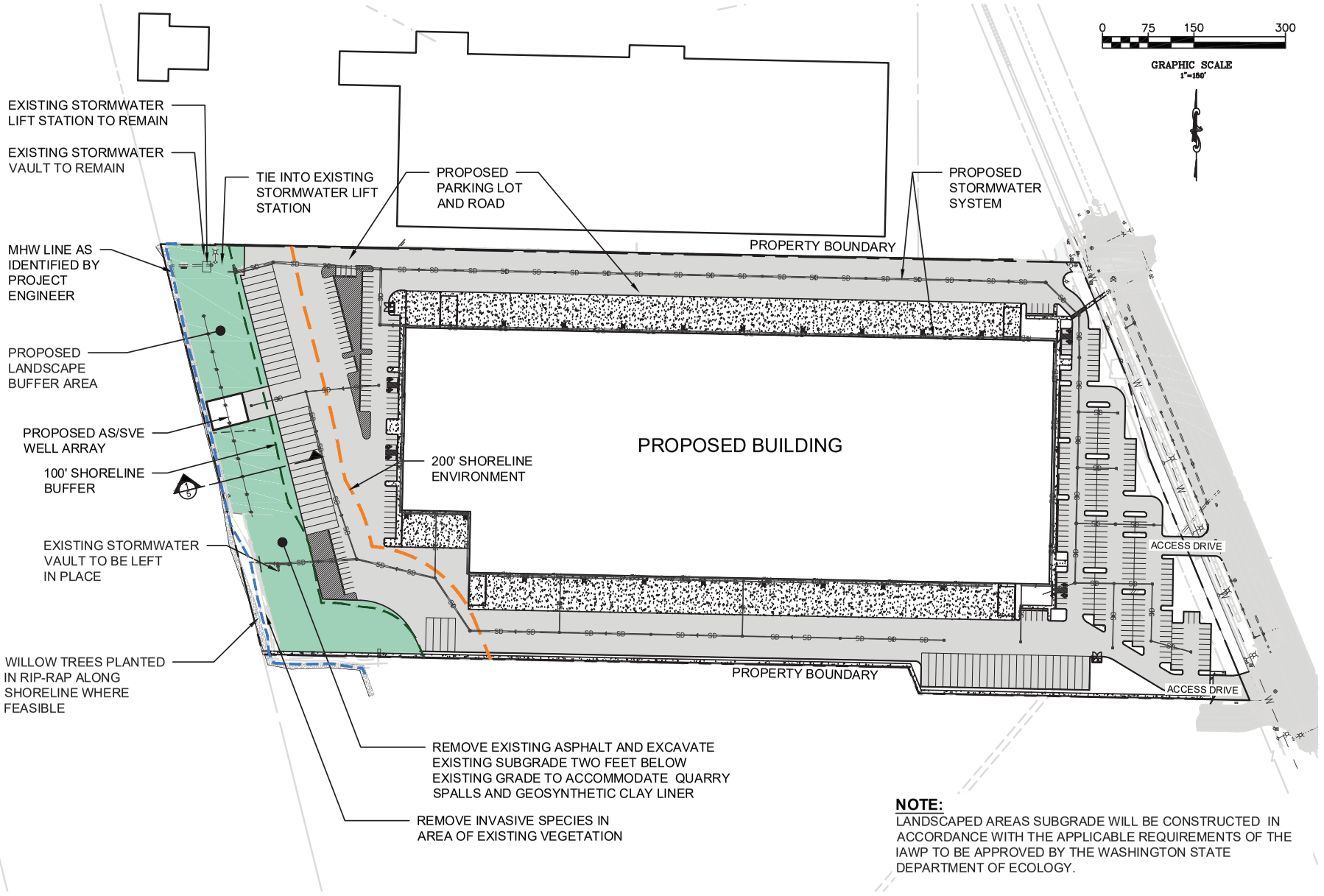
CENTERPOINT TUKWILA
8801 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108

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.
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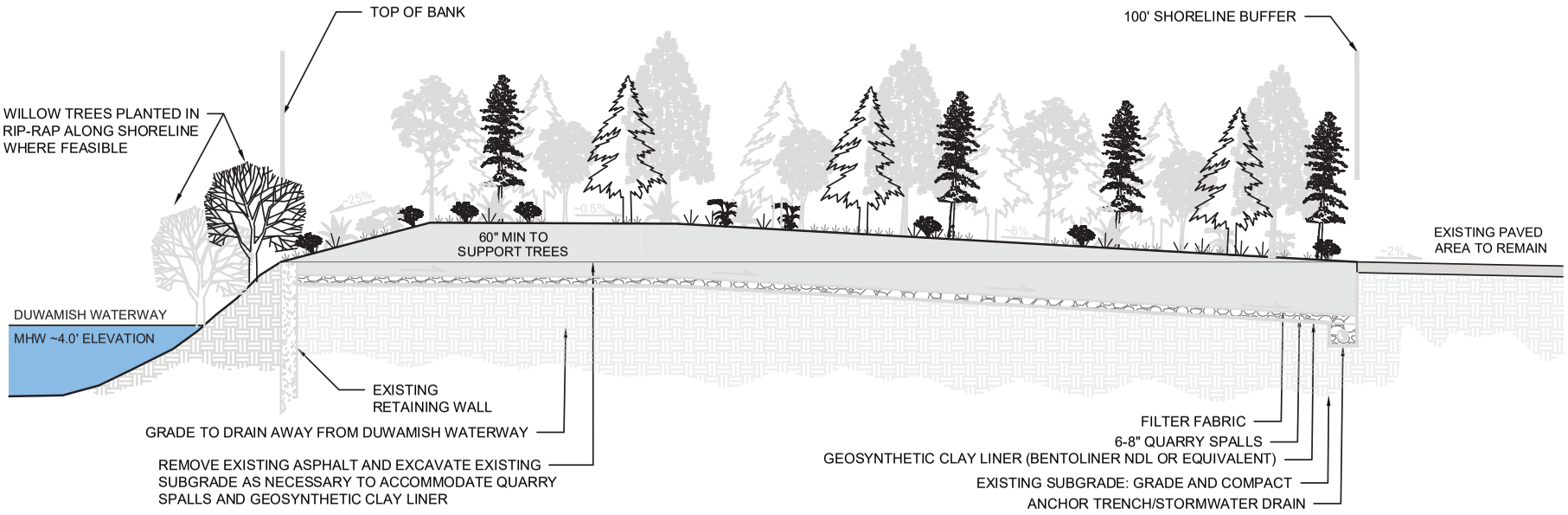
CENTERPOINT TUKWILA
8801 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108
THE SE¼ OF SECTION 33, TOWNSHIP 24N, RANGE 04E, W.M.

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

CENTERPOINT TUKWILA - PROPOSED SHORELINE CROSS-SECTION



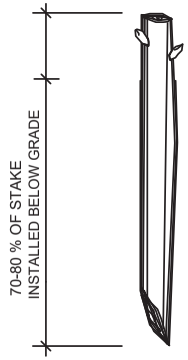
PROPOSED SHORELINE CROSS-SECTION

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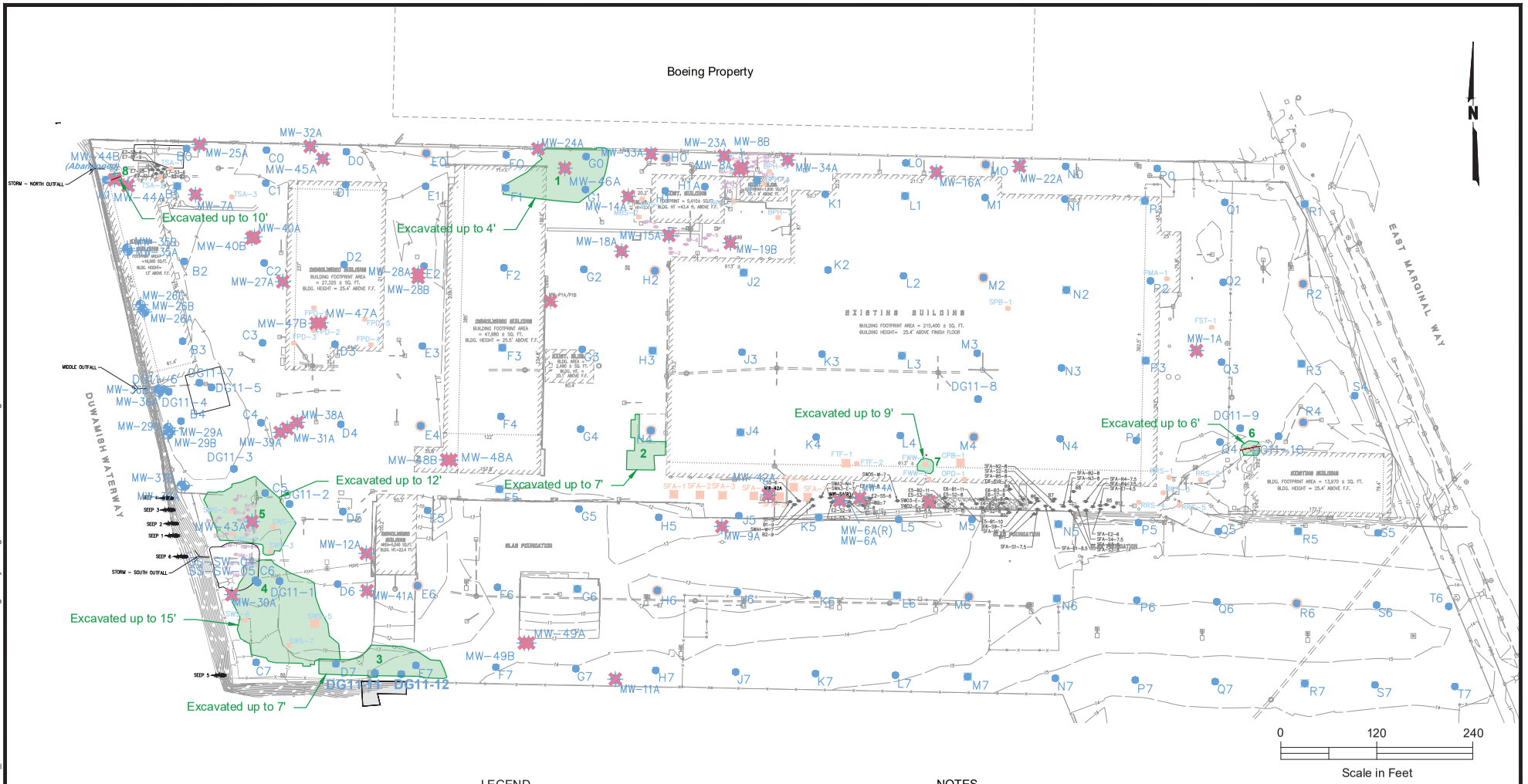
THE SE¼ OF SECTION 33, TOWNSHIP 24N, RANGE 04E, W.M.

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

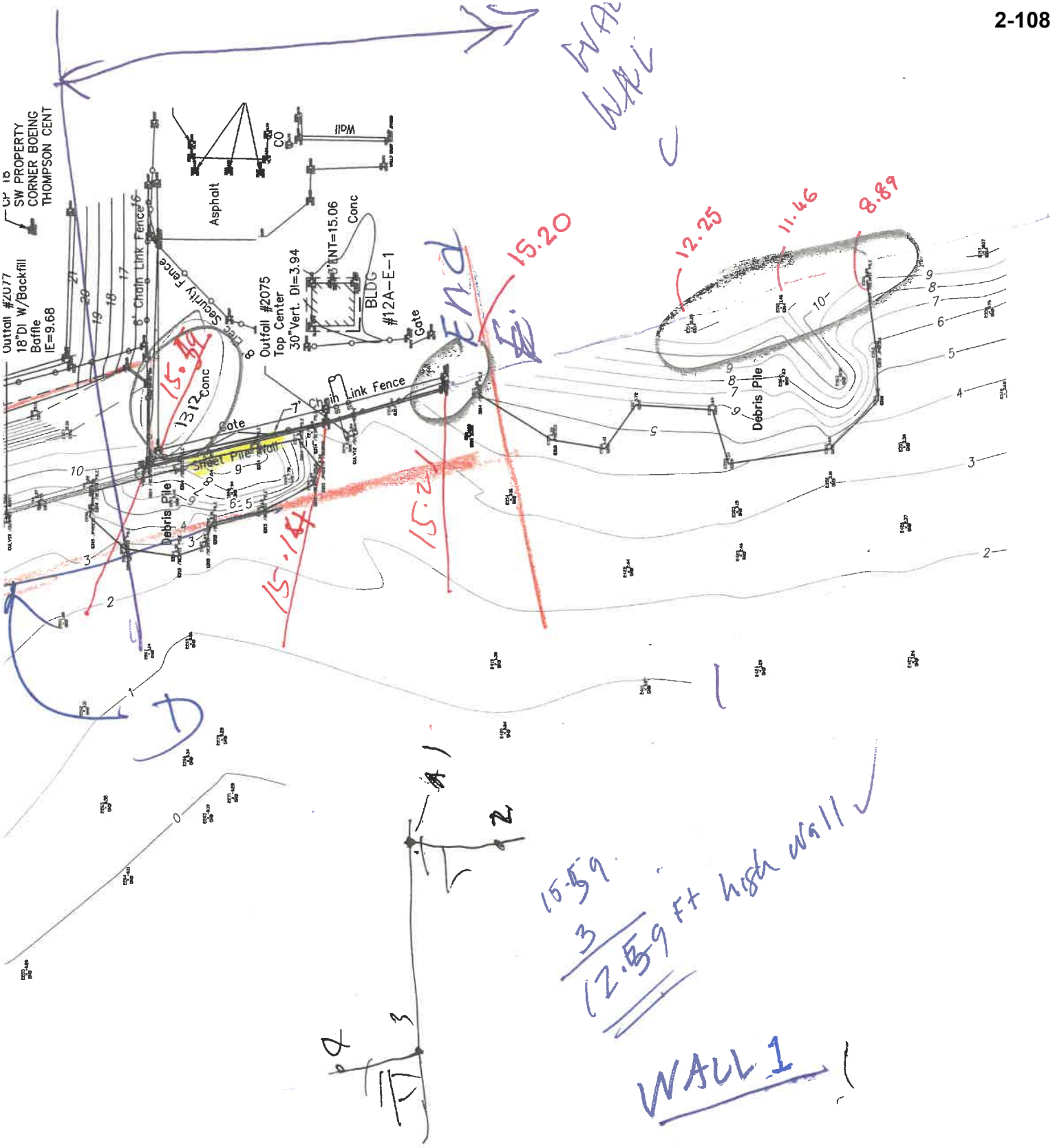
N
0 25 50 Feet

Monitoring Well Locations
AS/SVE Wells and Underground Pipes
AS-SVE Underground Pipes

June 2023
Site Map
Figure 2

2-106

WALL 1 - Looking West



15.59

3

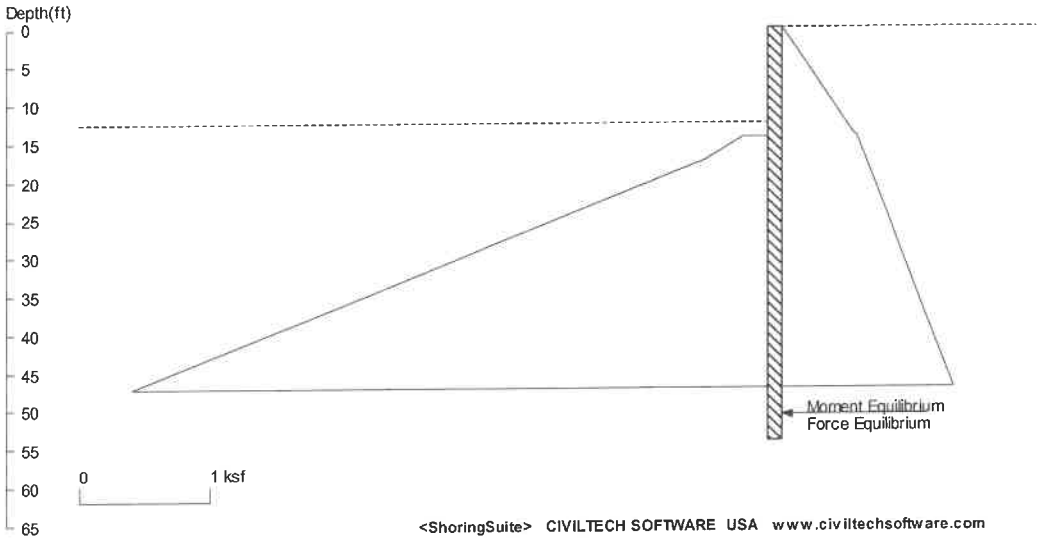
12.59 ft high wall

3/3

WALL 1 (W/o Surcharge)

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, 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 E00

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)

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

USE AZ48 ($I = 87.68 in^4$, $S = 8.8 in^3$) min

Reinforce ZPE ~~all~~ void space w/ $A_s = 0.002 \times 24 \times 12 = 0.6 in^2/EW$ for 10% #5@12 EW, EF

$\Delta_{max} \approx 1.68$ in, would be less than 1" with combined resistance of Exist sheetpile and Cement grout fill

WALL 1

PASSIVE SPACING:

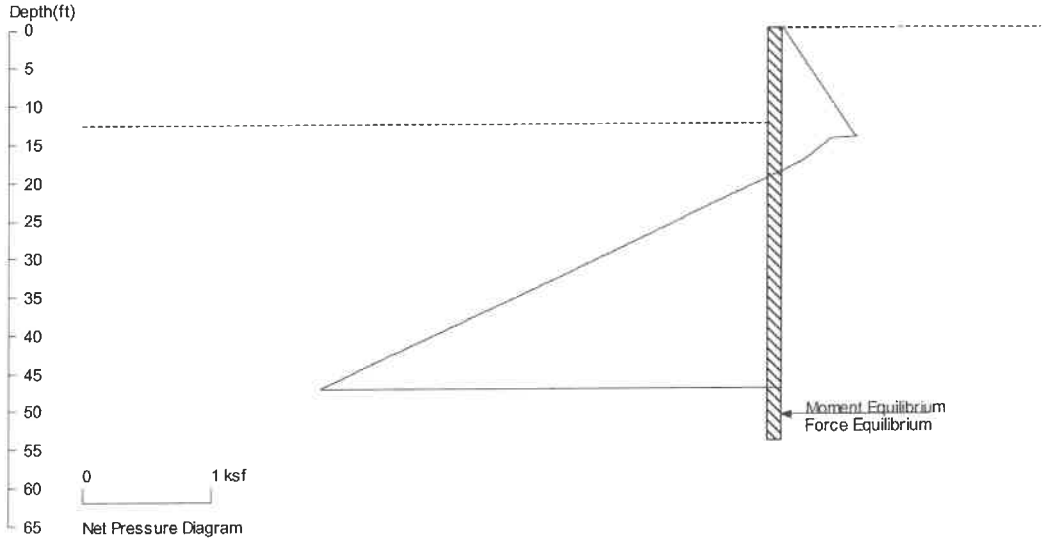
No.	Z depth	Spacing
1	14.50	1.00
2	99.00	1.00

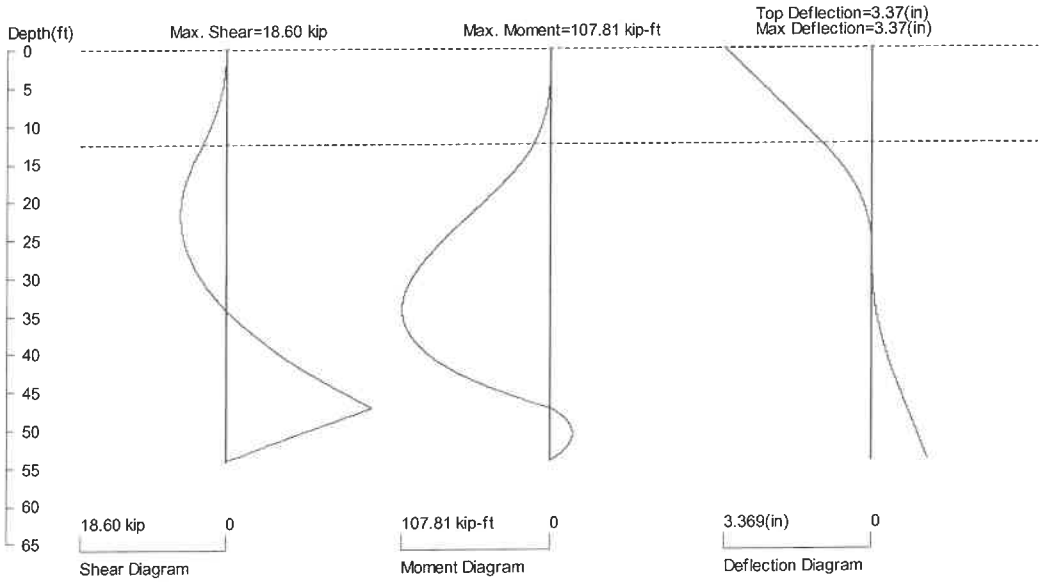
UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

WALL 1

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

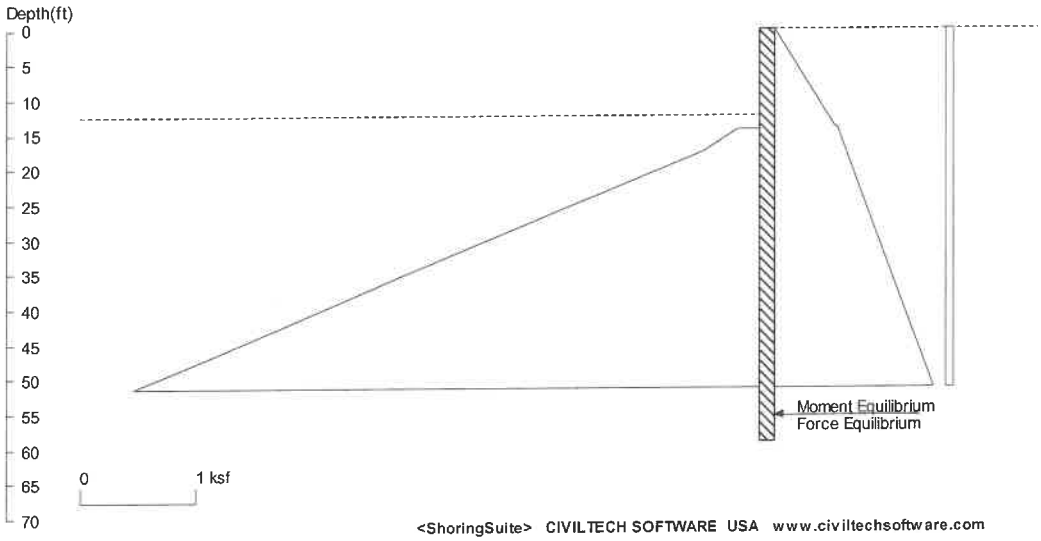
First Suitable Pile: CZ148: E(ksi)=29000.0, I(in4)/foot=273.9

nchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00559E18\Calculations\MS\Soldier and Sheet Pile Walls\Wall 1\SP

WALL 1 (W/ Surcharge)

12.5ft High Sheet Pile, Dw=14ft

Apparent As-Built Condition 1, S=73



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Licensed to 4324324234 3424343 Date: 7/20/2023

File: T:\252 Series - Anchor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00

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)

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

WALL 1

PASSIVE SPACING:

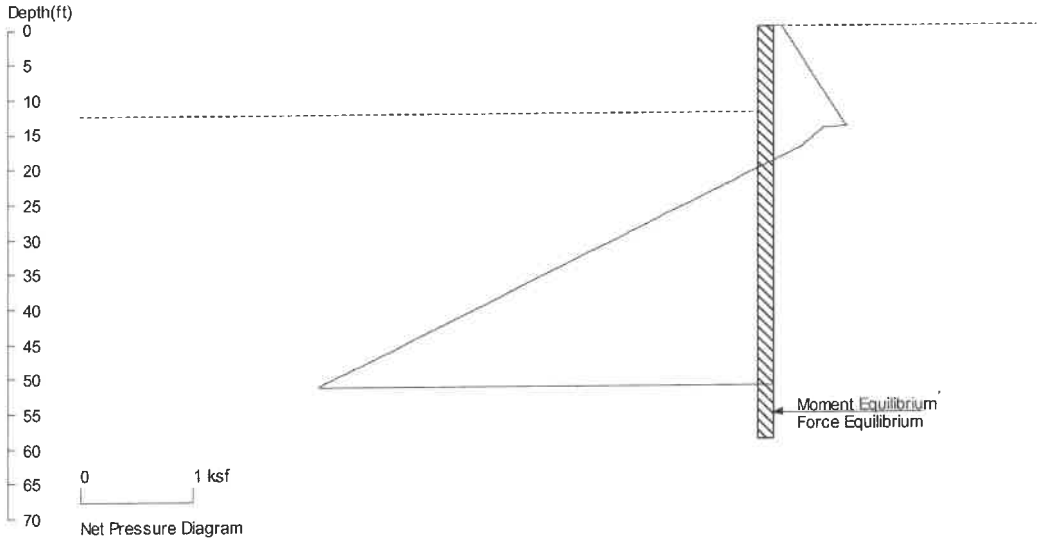
No.	Z depth	Spacing
1	14.50	1.00
2	99.00	1.00

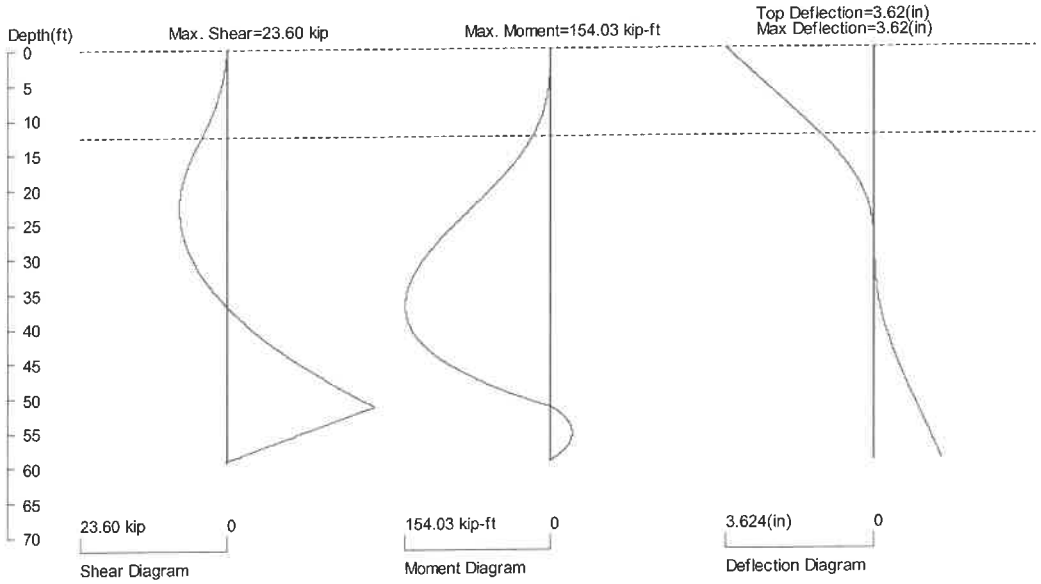
UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

WALL 1

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

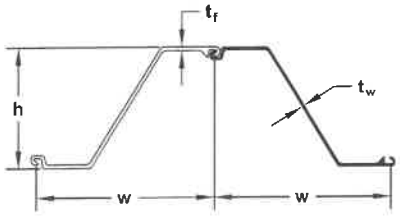
First Suitable Pile: H215: E(ksi)=29000.0, I(in4)/foot=392.2

chor QEA\252.01 Eng Svcs for Sediment Cleanup of Upper Reach of Lower Duwamish Waterway E00559E18\Calculations\MS\Soldier and Sheet Pile Walls\Wall 1\SP

NUCOR SKYLINE

AZ

AZ Hot Rolled Steel Sheet Pile



SECTION	Width (w) in mm	Height (h) in mm	THICKNESS Flange (t_f) in mm	THICKNESS Web (t_w) in mm	Cross Sectional Area in²/ft cm²/m	WEIGHT Pile lb/ft kg/m	WEIGHT Wall lb/ft² kg/m²	SECTION MODULUS Elastic in³/ft cm³/m	SECTION MODULUS Plastic in³/ft cm³/m	Moment of Inertia in⁴/ft cm⁴/m	COATING AREA Both Sides ft²/ft of single m²/m	COATING AREA Wall Surface ft²/ft² m²/m²
AZ 12-770	30.31 770	13.52 344	0.335 8.5	0.335 8.5	5.67 120.1	48.78 72.6	19.31 94.3	23.2 1245	27.5 1480	156.9 21430	6.07 1.85	1.20 1.20
AZ 13-770	30.31 770	13.54 344	0.354 9.0	0.354 9.0	5.94 125.8	51.14 76.1	20.24 98.8	24.2 1300	28.8 1546	163.7 22360	6.07 1.85	1.20 1.20
◆ AZ 14-770	30.31 770	13.56 345	0.375 9.5	0.375 9.5	6.21 131.5	53.42 79.5	21.14 103.2	25.2 1355	30.0 1611	170.6 23300	6.07 1.85	1.20 1.20
AZ 17-700	27.56 700	16.52 420	0.335 8.5	0.335 8.5	6.28 133.0	49.12 73.1	21.38 104.4	32.2 1730	37.7 2027	265.3 36230	6.10 1.86	1.33 1.33
AZ 18-700	27.56 700	16.54 420	0.354 9.0	0.354 9.0	6.58 139.2	51.41 76.5	22.39 109.3	33.5 1800	39.4 2116	276.8 37800	6.10 1.86	1.33 1.33
◆ AZ 19-700	27.56 700	16.56 421	0.375 9.5	0.375 9.5	6.88 145.6	53.76 80.0	23.35 114.3	34.8 1870	41.0 2206	288.4 39380	6.10 1.86	1.33 1.33
AZ 20-700	27.56 700	16.57 421	0.394 10.0	0.394 10.0	7.18 152.0	56.11 83.5	24.43 119.3	36.2 1945	42.7 2296	300.0 40960	6.10 1.86	1.33 1.33
AZ 18-800	31.5 800	17.68 449	0.335 8.5	0.335 8.5	6.07 128.6	54.26 80.7	20.67 100.9	34.2 1840	39.7 2135	302.6 41320	6.82 2.08	1.30 1.30
AZ 20-800	31.5 800	17.72 450	0.375 9.5	0.375 9.5	6.66 141.0	59.50 88.6	22.67 110.7	37.2 2000	43.3 2330	329.9 45050	6.82 2.08	1.30 1.30
AZ 22-800	31.5 800	17.76 451	0.413 10.5	0.413 10.5	7.25 153.5	64.77 96.4	24.68 120.5	40.3 2165	47.0 2525	357.3 48790	6.82 2.08	1.30 1.30
AZ 23-800	31.50 800	18.66 474	0.453 11.5	0.354 9.0	7.12 150.6	63.56 94.6	24.22 118.2	43.3 2330	49.9 2680	404.6 55260	6.94 2.11	1.32 1.32
AZ 25-800	31.50 800	18.70 475	0.492 12.5	0.394 10.0	7.71 163.3	68.91 102.6	26.26 128.2	46.5 2500	53.8 2890	435.1 59410	6.94 2.11	1.32 1.32
AZ 27-800	31.50 800	18.74 476	0.531 13.5	0.433 11.0	8.31 176.0	74.26 110.5	28.29 138.1	49.7 2670	57.6 3100	465.5 63570	6.94 2.11	1.32 1.32
AZ 24-700	27.56 700	18.07 459	0.441 11.2	0.441 11.2	8.23 174.1	64.30 95.7	28.00 136.7	45.2 2430	53.5 2867	408.8 55820	6.33 1.93	1.38 1.38
◆ AZ 26-700	27.56 700	18.11 460	0.480 12.2	0.480 12.2	8.84 187.2	69.12 102.9	30.10 146.9	48.4 2600	57.1 3070	437.3 59720	6.33 1.93	1.38 1.38
AZ 28-700	27.56 700	18.15 461	0.520 13.2	0.520 13.2	9.46 200.2	73.93 110.0	32.19 157.2	51.3 2760	60.9 3273	465.9 63620	6.33 1.93	1.38 1.38
AZ 28-750	29.53 750.0	20.04 509.0	0.472 12.00	0.394 10.00	8.09 171.2	67.73 100.80	27.53 134.40	52.3 2810	60.3 3245	523.9 71540	6.93 2.11	1.41 1.41
AZ 30-750	29.53 750.0	20.08 510.0	0.512 13.00	0.433 11.00	8.73 184.7	73.08 108.80	29.70 145.00	55.9 3005	64.8 3485	561.5 76670	6.93 2.11	1.41 1.41
AZ 32-750	29.53 750.0	20.12 511.0	0.551 14.00	0.472 12.00	9.37 198.3	78.44 116.70	31.88 155.60	59.5 3200	69.2 3720	599.0 81800	6.93 2.11	1.41 1.41
AZ 36-700N	27.56 700	19.65 499	0.591 15.0	0.441 11.2	10.20 215.9	79.72 118.6	34.71 169.5	66.8 3590	76.4 4110	656.2 89610	6.73 2.05	1.47 1.47
◆ AZ 38-700N	27.56 700	19.69 500	0.630 16.0	0.480 12.2	10.87 230.0	84.94 126.4	36.98 180.6	70.6 3795	81.1 4360	694.5 94840	6.73 2.05	1.47 1.47
AZ 40-700N	27.56 700	19.72 501	0.669 17.0	0.520 13.2	11.54 244.2	90.16 134.2	39.26 191.7	74.3 3995	85.7 4605	732.9 100080	6.73 2.05	1.47 1.47
AZ 42-700N	27.56 700	19.65 499	0.709 18.0	0.551 14.0	12.22 258.7	95.51 142.1	41.59 203.1	78.2 4205	90.3 4855	768.4 104930	6.75 2.06	1.47 1.47
AZ 44-700N	27.56 700	19.69 500	0.748 19.0	0.591 15.0	12.89 272.8	100.74 149.9	43.87 214.2	81.9 4405	95.0 5105	806.6 110150	6.75 2.06	1.47 1.47
AZ 46-700N	27.56 700	19.72 501	0.787 20.0	0.630 16.0	13.56 287.0	105.97 157.7	46.14 225.3	85.7 4605	99.5 5350	844.9 115370	6.75 2.06	1.47 1.47
AZ 46	22.83 580	18.94 481	0.709 18.0	0.551 14.0	13.76 291.2	89.10 132.6	46.82 228.6	85.5 4595	98.5 5295	808.8 110450	6.20 1.89	1.63 1.63
→ AZ 48	22.83 580	18.98 482	0.748 19.0	0.591 15.0	14.48 306.5	93.81 139.6	49.28 240.6	89.3 4800	103.3 5553	847.0 115670	6.20 1.89	1.63 1.63
AZ 50	22.83 580	19.02 483	0.787 20.0	0.630 16.0	15.22 322.2	98.58 146.7	51.80 252.9	93.3 5015	108.2 5816	886.5 121060	6.20 1.89	1.63 1.63
→ AZ 48-700	27.56 700.0	19.80 503.0	0.866 22.00	0.591 15.00	13.63 288.4	106.49 158.50	46.37 226.40	88.4 4755	102.1 5490	876.2 119650	6.70 2.04	1.46 1.46
AZ 50-700	27.56 700.0	19.84 504.0	0.906 23.00	0.630 16.00	14.30 302.6	111.73 166.30	48.65 237.50	92.2 4955	106.7 5735	914.6 124890	6.70 2.04	1.46 1.46
AZ 52-700	27.56 700.0	19.88 505.0	0.945 24.00	0.669 17.00	14.97 317.0	116.97 174.10	50.93 248.70	95.9 5155	111.3 5985	953.0 130140	6.70 2.04	1.46 1.46

◆ In stock.

NUCOR SKYLINE

AZ

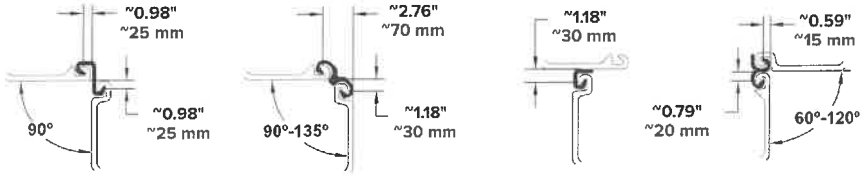
AZ Hot Rolled Steel Sheet Pile

Available Steel Grades

AMERICAN			CANADIAN			EUROPEAN			AMLoCor®**		
ASTM	YIELD STRENGTH		CSA G40.21	YIELD STRENGTH		EN 10248	YIELD STRENGTH			YIELD STRENGTH	
	ksi	MPa		ksi	MPa		ksi	MPa		ksi	MPa
A 328	39	270	Grade 260 W	38	260	S 240 GP	35	240	Blue 320	46	320
A 572 Gr. 42	42	290	Grade 300 W	43	300	S 270 GP	39	270	Blue 355	51	355
A 572 Gr. 50	50	345	Grade 350 W	51	355	S 320 GP	46	320	Blue 390	57	390
A 572 Gr. 55	55	380	Grade 400 W	58	400	S 355 GP	51	355			
A 572 Gr. 60	60	415				S 390 GP	57	390			
A 572 Gr. 65	65	450				S 430 GP	62	430			
A 690	50	345				S 460 AP	67	460			
A 690*	57	390									

Highlighted fields represent the most commonly used and readily available steel grades. *Not available for AZ48/50/52-700. ** Corrosion resistant steel, check for availability

Corner Piles



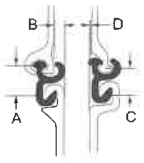
C 14
Grade: S 355 GP
Weight: 9.68 lb/ft
14.4 kg/m

Omega 18
Grade: S 430 GP
Weight: 12.10 lb/ft
18.0 kg/m

E 22
Grade: S 355 GP
Weight: 6.87 lb/ft
10.2 kg/m

Delta 13
Grade: S 355 GP
Weight: 8.73 lb/ft
13.0 kg/m

Transitional Piles



SKAP

Gr:	A 572 Gr. 50/60	
Wt:	8.95 lb/ft	13.3 kg/m
A:	1.97"	50.0 mm
B:	0.69"	17.5 mm
C:	1.61"	40.9 mm
D:	0.02"	0.5 mm

Delivery Conditions & Tolerances

	ASTM A 6		EN 10248	
Mass	± 2.5%		± 5%	
Length	+ 5 in.	– 0 in.	± 200 mm	
Height			± 7 mm	
Thickness			≤ 8.5 mm	± 0.5 mm
			> 8.5 mm	± 6%
Single Pile Width			± 2%	
Double Pile Width			± 3%	
Straightness			0.2% of the length	
Ends out of Square			2% of the width	

Delivery Forms

Single Pile Position A

Double Pile Form I Standard

Single Pile Position B

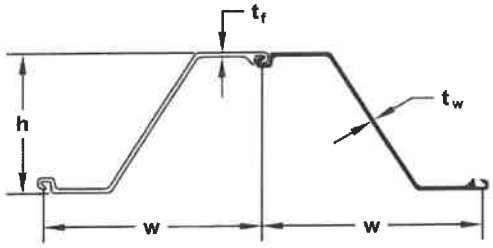
Double Pile Form II on Request

Maximum Rolled Lengths†

AZ	101.7 ft.	31.0 m
E 22	59.1 ft.	18.0 m
C 14	59.1 ft.	18.0 m
Delta 13	55.8 ft.	17.0 m
Omega 18	52.0 ft.	16.0 m

† Longer lengths may be possible upon request.

JD FIELDS CONSTRUCTION PRODUCTS



JD Fields & Company Inc
55 Waugh Drive, Suite 12
Houston, TX 770(
www.jdfields.cc
281 5587195

Technical: 855 GRADE6

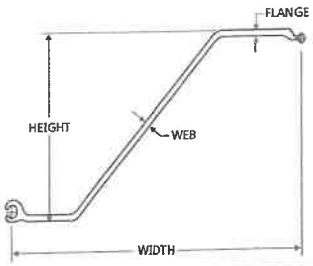
DOUBLE Z HOT ROLLED SHEET PILE SERIES

Section	Width (w)	Height (h)	Flange (tf)	Web (tw)	Per Single Section: Cross Sec Area (A)	Per Single Section: Weight (m)	Per Single Section: Coating Area (A)	Per Unit of Wall: Cross Sec Area (A)	Per Unit of Wall: Weight (m)	Per Unit of Wall: Moment of Inertia (Iy)	Per Unit of Wall: Elastic Modulus (Sx)	Per Unit of Wall: Plastic Modulus (Sx)	60 ksi Allow Bend Moment [No S.F.] (Mmax)	65 ksi Allow Bend Moment [No S.F.] (Mmax)
	mm	mm	mm	mm	cm^2	kg/m	m^2/m	cm^2/m	kg/m^2	cm^4/m	cm^3/m	cm^3/m	kN-m/m	kN-m/m
	in	in	in	in	in^2	lbs/ft	ft^2/ft	in^2/ft	lbs/ft^2	in^4/ft	in^3/ft	in^3/ft	kip-ft/ft	kip-ft/ft
ZZ12-700	700	314.2	8.6	8.5	86.47	67.9	1.82	123.5	97.0	18,971	1,208	1,418	500	541
	27.56	12.37	0.339	0.335	13.40	45.62	5.97	5.84	19.86	138.9	22.5	26.4	112.3	121.7
ZZ13-700	700	315.2	9.6	9.5	94.47	74.2	1.82	135.0	105.9	20,611	1,308	1,543	541	586
	27.56	12.41	0.378	0.374	14.64	49.84	5.97	6.38	21.70	150.9	24.3	28.7	121.7	131.8
ZZ14-700	700	316.2	10.6	10.5	102.50	80.5	1.82	146.4	114.9	22,262	1,408	1,669	582	631
	27.56	12.45	0.417	0.413	15.89	54.07	5.97	6.92	23.54	163.0	26.2	31.0	131.0	141.9
ZZ12-770	770	343.5	8.6	8.5	92.99	72.8	1.96	120.8	94.5	21,496	1,252	1,488	518	561
	30.31	13.52	0.339	0.335	14.41	48.92	6.44	5.71	19.37	157.4	23.3	23.3	116.4	126.1
ZZ13-770	770	344	9.1	9	97.40	76.2	1.96	126.5	99.0	22,433	1,304	1,551	540	585
	30.31	13.54	0.358	0.354	15.10	51.22	6.44	5.98	20.28	164.3	24.3	24.3	121.3	131.4
ZZ14-770	770	344.5	9.6	9.5	101.80	79.6	1.96	132.2	103.4	23,370	1,357	1,613	561	608
	30.31	13.56	0.378	0.375	15.78	53.52	6.44	6.25	21.19	171.1	25.2	25.2	126.2	136.7
ZZ17-700	700	420	8.5	8.4	92.99	73.3	1.97	132.8	104.7	36,425	1,735	2,032	717	777
	27.56	16.54	0.335	0.331	14.41	49.26	6.47	6.28	21.45	266.7	32.3	37.8	161.3	174.7
ZZ18-700	700	420.5	9.1	9	97.40	76.7	1.97	139.1	109.6	38,001	1,807	2,132	748	810
	27.56	16.56	0.358	0.354	15.10	51.58	6.47	6.57	22.46	278.3	33.6	39.8	168.1	182.1
ZZ19-700	700	421	9.6	9.5	101.80	80.2	1.97	145.4	114.6	39,578	1,880	2,210	778	843
	27.56	16.57	0.378	0.375	15.78	53.90	6.47	6.87	23.47	289.8	35.0	41.2	174.9	189.4
ZZ20-700	700	421.5	10.1	10	106.20	83.7	1.97	151.7	119.5	41,155	1,953	2,304	808	875
	27.56	16.59	0.398	0.394	16.46	56.22	6.47	7.17	24.48	301.4	36.3	42.9	181.6	196.7
ZZ24-700	700	459.2	11.3	11.2	122.06	95.8	2.05	174.4	136.9	55,949	2,437	2,875	1,008	1,092
	27.56	18.08	0.445	0.441	18.92	64.39	6.71	8.24	28.04	409.7	45.3	53.7	226.7	245.5
ZZ26-700	700	460.2	12.3	12.2	131.18	103.0	2.05	187.4	147.1	59,843	2,601	3,071	1,076	1,166
	27.56	18.12	0.484	0.480	20.33	69.21	6.72	8.85	30.13	438.2	48.4	57.1	241.9	262.1
ZZ27-700	700	460.7	12.8	12.7	135.50	106.4	2.05	193.6	152.0	61,641	2,676	3,089	1,107	1,199
	27.56	18.14	0.504	0.500	21.00	71.48	6.72	9.14	31.12	451.4	49.8	57.5	248.9	269.6
ZZ28-700	700	461.2	13.3	13.2	140.30	110.1	2.05	200.4	157.3	63,740	2,764	3,278	1,144	1,239
	27.56	18.16	0.524	0.520	21.75	74.02	6.72	9.47	32.23	466.8	51.4	61.0	257.1	278.5
ZZ36-700	700	499.2	15.1	11.2	151.27	118.7	2.18	216.1	169.6	89,753	3,596	4,151	1,488	1,612
	27.56	19.65	0.594	0.441	23.45	79.80	7.14	10.21	34.75	657.2	66.9	77.3	334.5	362.3
ZZ38-700	700	500.2	16.1	12.2	161.16	126.5	2.18	230.2	180.7	94,984	3,798	4,363	1,571	1,702
	27.56	19.69	0.634	0.480	24.98	85.02	7.14	10.88	37.02	695.6	70.6	81.2	353.2	382.6
ZZ40-700	700	501.2	17.1	13.2	171.06	134.3	2.18	244.4	191.8	100,219	3,999	4,610	1,655	1,792
	27.56	19.73	0.673	0.520	26.51	90.24	7.15	11.54	39.29	733.9	74.4	85.8	372.0	402.9
ZZ42-700	700	499.2	18.1	14	182.12	143.0	2.17	260.2	204.2	105,543	4,228	4,882	1,749	1,895
	27.56	19.65	0.713	0.551	28.23	96.08	7.11	12.29	41.83	772.9	78.7	90.9	393.3	426.0
ZZ44-700	700	500.2	19.1	15	192.02	150.7	2.17	274.3	215.3	110,942	4,436	5,096	1,835	1,988
	27.56	19.69	0.752	0.591	29.76	101.30	7.11	12.96	44.11	812.4	82.5	94.8	412.6	446.9
ZZ46-700	700	501.2	20.1	16	201.93	158.5	2.17	288.5	226.5	116,159	4,635	5,343	1,918	2,077
	27.56	19.73	0.791	0.630	31.30	106.53	7.11	13.63	46.38	850.6	86.2	99.4	431.1	467.0
→ ZZ48-700	700	503.2	22.1	15	202.99	159.3	2.17	290.0	227.6	120,467	4,788	5,528	1,981	2,146
	27.56	19.81	0.870	0.591	31.46	107.09	7.11	13.70	46.63	882.2	89.1	102.9	445.3	482.4
ZZ50-700	700	504.2	23.1	16	212.41	166.7	2.17	303.4	238.2	125,358	4,973	5,713	2,057	2,229
	27.56	19.85	0.909	0.630	32.92	112.06	7.11	14.34	48.79	918.0	92.5	106.3	462.5	501.0
ZZ52-700	700	505.2	24.1	17	222.07	174.3	2.17	317.2	249.0	130,403	5,162	5,951	2,136	2,314
	27.56	19.89	0.949	0.669	34.42	117.15	7.11	14.99	51.01	954.9	96.0	110.7	480.2	520.2
ZZ48-580	580	482	19.2	15.1	178.17	139.9	2.01	307.2	241.1	115,712	4,801	5,555	1,986	2,152
	22.83	18.98	0.756	0.594	27.62	93.99	6.59	14.52	49.40	847.3	89.3	103.3	446.6	483.8

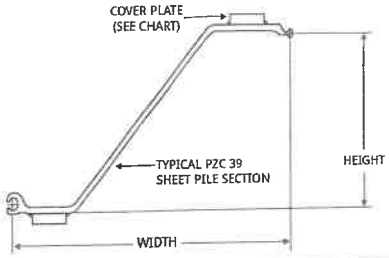
→ Indicates standard stocking sections. Please check with your local sales agent for material availability.

LBFoster Piling

Z Pile Profile



Cover Plated Z Profile



Section	Width+	Height+	Web Thickness+	Flange Thickness+	Weight		Moment of Inertia		Section Modulus		Nominal Coating Area*
	in	in	in	in	lb / lft	lb / ft²	in⁴	in⁴ / wft	in³	in³ / wft	ft² / lft
	mm	mm	mm	mm	kg / lm	kg / m²	cm⁴	cm⁴ / wm	cm³	cm³ / wm	m² / lm
PZC 13	**27.88**	**12.56**	**0.375**	**0.375**	**50.4**	**21.7**	**353.0**	**152.0**	**56.2**	**24.2**	**5.60**
	708	**319**	**9.5**	**9.5**	**75.1**	**106.0**	**14,690**	**20,760**	**920**	**1,300**	**1.71**
PZC 14	27.88	12.60	0.420	0.420	55.0	23.7	381.6	164.3	60.5	26.0	5.60
	708	320	10.7	10.7	81.8	115.5	15,890	22,440	990	1,400	1.71
PZC 18	**25.00**	**15.25**	**0.375**	**0.375**	**50.4**	**24.2**	**532.2**	**255.5**	**69.8**	**33.5**	**5.60**
	635	**387**	**9.5**	**9.5**	**75.1**	**118.2**	**22,150**	**34,890**	**1,145**	**1,800**	**1.71**
PZC 19	25.00	15.30	0.420	0.420	55.0	26.4	576.3	276.6	75.3	36.1	5.60
	635	388	10.7	10.7	81.8	128.8	23,990	37,780	1,235	1,945	1.71
PZC 25	27.88	17.66	0.485	0.560	69.4	29.9	938.7	404.1	106.3	45.7	6.15
	708	449	12.3	14.2	103.3	145.9	39,070	55,190	1,740	2,455	1.87
PZC 26	**27.88**	**17.70**	**0.525**	**0.600**	**73.9**	**31.8**	**994.3**	**428.1**	**112.4**	**48.4**	**6.15**
	708	**450**	**13.3**	**15.2**	**110.0**	**155.4**	**41,390**	**58,460**	**1,840**	**2,600**	**1.87**
PZC 28	27.88	17.75	0.570	0.645	79.0	34.0	1,057	455.1	119.1	51.3	6.15
	708	451	14.5	16.4	117.6	166.1	44,000	62,150	1,950	2,755	1.87
PZC 37	22.50	21.02	0.488	0.563	69.6	37.1	1,349	719.6	128.4	68.5	6.15
	572	534	12.4	14.3	103.6	181.2	56,160	98,270	2,100	3,680	1.87
PZC 39	**22.50**	**21.05**	**0.525**	**0.600**	**74.0**	**39.5**	**1,429**	**762.1**	**135.6**	**72.3**	**6.15**
	572	**535**	**13.3**	**15.2**	**110.2**	**192.8**	**59,480**	**104,100**	**2,220**	**3,890**	**1.87**
PZC 41	22.50	21.09	0.561	0.636	78.4	41.8	1,507	803.6	142.7	76.1	6.15
	572	536	14.2	16.2	116.6	204.1	62,720	109,700	2,340	4,090	1.87

Available Grades: ASTM A572 Gr. 50 and 60, A588 and A690
+Values stated are nominal
*Both sides of sheet excludes socket interior and ball interlock

PZC™ is a trademar

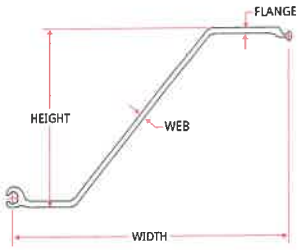
Section	Normal Width	Plate Size	Per Single Section				Per Unit of Wall			
							Weight		Moment of Inertia	Section Modulus
			Area	Weight	Total Surface Area	Nominal Coating Area*	Full Length Plates	Half Length Plates		
	in	in	in²	lb / ft	ft² / lft	ft² / lft	lb / ft²	lb / ft²	in⁴ / wft	in³ / wft
	mm	mm	cm²	kg / m	m² / lm	m² / lm	kg / m²	kg / m²	cm⁴ / wm	cm³ / wm
PZC 46-CP (PZC39)	**22.50**	**3 x 0.500**	**24.76**	**84.2**	**6.82**	**6.32**	**44.9**	**42.1**	**947.8**	**86**
	572	76 x 13	159.8	125.2	2.08	1.93	219.3	205.6	129,400	4,630
PZC 48-CP (PZC39)	**22.50**	**3 x 0.625**	**25.51**	**86.7**	**6.86**	**6.36**	**46.3**	**42.9**	**997**	**89.4**
	572	76 x 16	164.6	129.0	2.09	1.94	226.1	209.5	136,100	4,810
PZC 54-CP (PZC39)	**22.50**	**3 x 1.00**	**27.76**	**94.4**	**6.96**	**6.48**	**50.3**	**44.9**	**1151**	**99.9**
	572	76 x 25.4	179.1	140.5	2.13	1.98	245.6	218.5	157,100	5,370

Available Grades: ASTM A572 Gr. 50

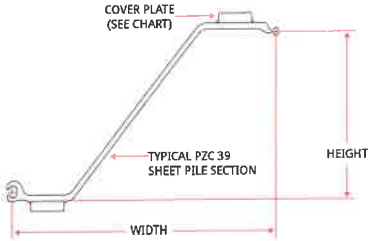
*Excludes socket interior and ball interlock
- Best economy is obtained when plate length is limited to area of high moment.
- Filet weld should be sized to adequately resist design loads and should be continuous and all around.
- Cover plate length depends upon bending moment curve.
- Weld requirements should be specified by design engineer.

LBFoster Piling

Z Pile Profile



Cover Plated Z Profile



Section	Width+	Height+	Web Thickness+	Flange Thickness+	Weight		Moment of Inertia		Section Modulus		Nominal Coating Area*
	in	in	in	in	lb / lft	lb / ft²	in⁴	in⁴ / wft	in³	in³ / wft	ft² / lft
	mm	mm	mm	mm	kg / lm	kg / m²	cm⁴	cm⁴ / wm	cm³	cm³ / wm	m² / lm
PZC 13	**27.88**	**12.56**	**0.375**	**0.375**	**50.4**	**21.7**	**353.0**	**152.0**	**56.2**	**24.2**	**5.60**
	708	**319**	**9.5**	**9.5**	**75.1**	**106.0**	**14,690**	**20,760**	**920**	**1,300**	**1.71**
PZC 14	27.88	12.60	0.420	0.420	55.0	23.7	381.6	164.3	60.5	26.0	5.60
	708	320	10.7	10.7	81.8	115.5	15,890	22,440	990	1,400	1.71
PZC 18	**25.00**	**15.25**	**0.375**	**0.375**	**50.4**	**24.2**	**532.2**	**255.5**	**69.8**	**33.5**	**5.60**
	635	**387**	**9.5**	**9.5**	**75.1**	**118.2**	**22,150**	**34,890**	**1,145**	**1,800**	**1.71**
PZC 19	25.00	15.30	0.420	0.420	55.0	26.4	576.3	276.6	75.3	36.1	5.60
	635	388	10.7	10.7	81.8	128.8	23,990	37,780	1,235	1,945	1.71
PZC 25	27.88	17.66	0.485	0.560	69.4	29.9	938.7	404.1	106.3	45.7	6.15
	708	449	12.3	14.2	103.3	145.9	39,070	55,190	1,740	2,455	1.87
PZC 26	**27.88**	**17.70**	**0.525**	**0.600**	**73.9**	**31.8**	**994.3**	**428.1**	**112.4**	**48.4**	**6.15**
	708	**450**	**13.3**	**15.2**	**110.0**	**155.4**	**41,390**	**58,460**	**1,840**	**2,600**	**1.87**
PZC 28	27.88	17.75	0.570	0.645	79.0	34.0	1,057	455.1	119.1	51.3	6.15
	708	451	14.5	16.4	117.6	166.1	44,000	62,150	1,950	2,755	1.87
PZC 37	22.50	21.02	0.488	0.563	69.6	37.1	1,349	719.6	128.4	68.5	6.15
	572	534	12.4	14.3	103.6	181.2	56,160	98,270	2,100	3,680	1.87
PZC 39	**22.50**	**21.05**	**0.525**	**0.600**	**74.0**	**39.5**	**1,429**	**762.1**	**135.6**	**72.3**	**6.15**
	572	**535**	**13.3**	**15.2**	**110.2**	**192.8**	**59,480**	**104,100**	**2,220**	**3,890**	**1.87**
PZC 41	22.50	21.09	0.561	0.636	78.4	41.8	1,507	803.6	142.7	76.1	6.15
	572	536	14.2	16.2	116.6	204.1	62,720	109,700	2,340	4,090	1.87

Available Grades: ASTM A572 Gr. 50 and 60, A588 and A690
+Values stated are nominal
*Both sides of sheet excludes socket interior and ball interlock

PZC™ is a trademark of Gerdau

Section	Normal Width	Plate Size	Per Single Section				Per Unit of Wall			
			Area	Weight	Total Surface Area	Nominal Coating Area*	Weight		Moment of Inertia	Section Modulus
							Full Length Plates	Half Length Plates		
	in	in	in²	lb / ft	ft² / lft	ft² / lft	lb / ft²	lb / ft²	in⁴ / wft	in³ / wft
	mm	mm	cm²	kg / m	m² / lm	m² / lm	kg / m²	kg / m²	cm⁴ / wm	cm³ / wm
PZC 46-CP (PZC39)	**22.50**	**3 x 0.500**	**24.76**	**84.2**	**6.82**	**6.32**	**44.9**	**42.1**	**947.8**	**86**
	572	76 x 13	159.8	125.2	2.08	1.93	219.3	205.6	129,400	4,630
PZC 48-CP (PZC39)	**22.50**	**3 x 0.625**	**25.51**	**86.7**	**6.86**	**6.36**	**46.3**	**42.9**	**997**	**89.4**
	572	76 x 16	164.6	129.0	2.09	1.94	226.1	209.5	136,100	4,810
PZC 54-CP (PZC39)	**22.50**	**3 x 1.00**	**27.76**	**94.4**	**6.96**	**6.48**	**50.3**	**44.9**	**1151**	**99.9**
	572	76 x 25.4	179.1	140.5	2.13	1.98	245.6	218.5	157,100	5,370

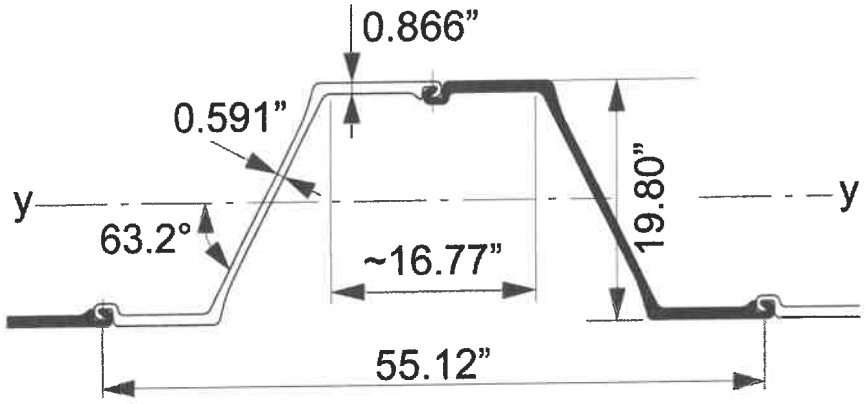
*Excludes socket interior and ball interlock
- Best economy is obtained when plate length is limited to area of high moment.
- Filet weld should be sized to adequately resist design loads and should be continuous and all around.
- Cover plate length depends upon bending moment curve.
- Weld requirements should be specified by design engineer.

Available Grades: ASTM A572 Gr. 50

ArcelorMittal

Sheet Piling

ArcelorMittal Europe Long Products



AZ 48-700

	A	G	I_y	$W_{el,y}$	r_g	A_L
	in^2	lb/ft	in^4	in^3	in	ft^2/ft
Per S	31.29	106.49	2 012.2	203.1	8.02	3.35
Per D	62.58	212.98	4 024.4	406.4	8.02	6.69
Per ft of wall	13.63	46.37	876.2	88.5	8.02	1.46

A	Sectional area
G	Mass per ft
I_y	Moment of inertia about the main neutral axis y-y
$W_{el,y}$	Elastic section modulus
r_g	Radius of gyration about the y-y axis
A_L	Coating area. One side, excludes inside of interlocks
S	Single pile
D	Double pile