Appendix A

Alameda Main Street Ferry Terminal Refurbishment Project Plans

WATER EMERGENCY TRANSPORTATION AUTHORITY

2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

DRAWING LIST

DRAWING NUMBER	DATE	DESCRIPTION
S-00	12-20-21	TITLE SHEET AND DRAWING LIST
S-01	12-20-21	PROJECT DESCRIPTION, EXISTING AND PROPOSED SHADE
S-02	12-20-21	VICINITY MAP
S-03	12-20-21	PROJECT SITE LOCATION
S-04	12-20-21	EXISTING SITE PLAN WITH MAJOR FEATURES
S-05	12-20-21	EXISTING BRIDGE PLAN AND SECTION ELEVATION SHEET 1 OF 2
S-06	12-20-21	EXISTING BRIDGE PLAN AND SECTION ELEVATION SHEET 2 OF 2
S-07	12-20-21	EXISTING 60' GANGWAY PLAN AND SECTION ELEVATIONS
S-08	12-20-21	EXISTING FLOAT PLAN AND SECTION ELEVATION
S-09	12-20-21	PROPOSED SITE PLAN WITH MAJOR FEATURES
S-10	12-20-21	PROPOSED BRIDGE PLAN AND SECTION ELEVATION SHEET 1 OF 2
S-11	12-20-21	PROPOSED BRIDGE PLAN AND SECTION ELEVATION SHEET 2 OF 2
S-12	12-20-21	PROPOSED 80- GANGWAY SECTION ELEVATION AT MHHW AND MLLW
S-13	12-20-21	PROPOSED 80' GANGWAY PLAN AND SECTION ELEVATION
S-14	12-20-21	PROPOSED FLOAT PLAN AND SECTION ELEVATION

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
SENIOR PLANNER/PROJECT MANAGER
MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

TITLE SHEET AND DRAWING LIST

SCALE: NTS

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-00

DATE: 12-20-2021

PROJECT DESCRIPTION:

THE PROJECT INCLUDES:

- REPLACEMENT OF APPROACH SLAB LEADING TO ALUMINUM BRIDGE
- REPLACEMENT OF EXISTING ALUMINUM BRIDGE
- REPLACEMENT OF EXISTING ALUMINUM GANGWAY
- REPLACEMENT OF EXISTING FLOAT
- REMOVAL OF FOUR EXISTING STEEL FLOAT 30-INCH DIAMETER STEEL PIPE PILES
- INSTALL FOUR NEW 36-INCH DIAMETER STEEL PIPE PILES
- INSTALL TWO NEW 36-INCH DIAMETER DONUT FENDER PILES
- INSTALL TWO NEW 72-INCH DIAMETER DONUT FENDER
- INSTALL ELECTRICAL CONDUIT RACK ALONG PERIMETER OF BRIDGE, GANGWAY AND FLOAT FOR FUTURE UPGRADES.

GENERAL NOTES:

1. APPROACH SLAB, ALUMINUM BRIDGE, ALUMINUM GANGWAY, FLOAT, FLOAT PILES, AND DONUT FENDER/FENDER PILES DESIGN SHOWN IS CONCEPTUAL. DETAILED DESIGN TO BE PROVIDED IN SUBSEQUENT SUBMITTALS.
2. ALL WORK SHALL CONFORM WITH THE CITY OF ALAMEDA PUBLIC WORKS STANDARD.
3. REFERENCES CIVIL AND ELECTRICAL SHEETS FOR FERRY TERMINAL MECHANICAL AND ELECTRICAL EQUIPMENT DETAILS NOT SHOWN HERE.
4. ALUMINUM STRUCTURES AND PILE INFORMATION PROVIDED FOR PERMITTING ONLY. DRAWING NOT TO BE USED TO LOCATE OR INSTALL PILES OR ALUMINUM STRUCTURES. LOCATIONS TO BE PROVIDED IN CONTRACTOR'S SEAL DESIGN SUBMITTALS.

EXISTING AND PROPOSED SHADE

EXISTING SHADE AREA OF STRUCTURES TO BE REMOVED

ITEM	QTY.	DIMENSIONS		SHADE AREA (FT2)	NOTES
	EA	FT	FT		
APPROACH SHELTER	-1	24.5	8.25	-202	
CONCRETE ABUTMENT	-1	12	2.5	-30	
BRIDGE	-1	106	8	-849	
GANGWAY	-1	60	8.25	-495	
STEEL FLOAT	-1	112	33	-3696	
GUIDE PILES	-4	30" OD; 28" ID		-3	CROSS SECTIONAL STEEL AREA
GUIDE PILE COLLARS	-4	1	12	-48	
EXISTING SHADE AREA				**-5323**	

NEW SHADE AREA OF STRUTURE TO BE INSTALLED

ITEM	QTY.	DIMENSIONS		SHADE AREA (FT2)	NOTES
	EA	FT	FT		
APPROACH SHELTER	1	24.5	9	220.5	
CONCRETE CAP AND 2-24" PIPE PILES	1	4	7	28	CAP BEAM IS 16' LONG X 4' WIDE AND LOCATED PARTLY UNDERNEARTH BRIDGE. CAP BEAM SHADOW AREA OUTSIDE BRIDGE AREA IS ACCOUNTED FOR HERE
BRIDGE	1	107.5	9	968	
ELECTRICAL CONDUIT RACK	1	3.5	167.5	586	
CONCRETE CAP AND MONOPILE	1	1	3.3	3	CAP IS 10'X12'-4" WIDE UNDERNEARTH BRIDGE. CAP BEAM SHADOW AREA OUTSIDE BRIDGE AREA IS ACCOUNTED FOR HERE
GANGWAY	1	60	9	540	GANGWAY IS 80'-0" LONG BUT ONLY 60 IS OVER WATER. NEW FILL OVER WATER IS 60'-0"
STEEL FLOAT	1	112	33	3696	
GUIDE PILES	4	36" OD; 33.5" ID		4	CROSS SECTIONAL STEEL AREA
GUIDE PILE COLLARS	4	1	16	64	
DONUT PILES	2	36" OD; 34" ID		2	CROSS SECTIONAL STEEL AREA
DONUT PILE FENDER	2	72" OD; 36" ID		42	CROSS SECTIONAL AREA OF DONUT FENDER ONLY. PIPE PILE AREA PREVIOUSLY ACCOUNTED FOR.
NEW SHADE AREA				**6153**	

PROJECT NET SHADE AREA	FILL AREA (FT2)
EXISTING SHADE AREA	-5323
NEW SHADE AREA	6153
NEW SHADE	**830**

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
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SAN FRANCISCO, CA

CONTACT: CHAD MASON
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MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROJECT DESCRIPTION, EXISTING AND PROPOSED SHADE

SCALE: NTS

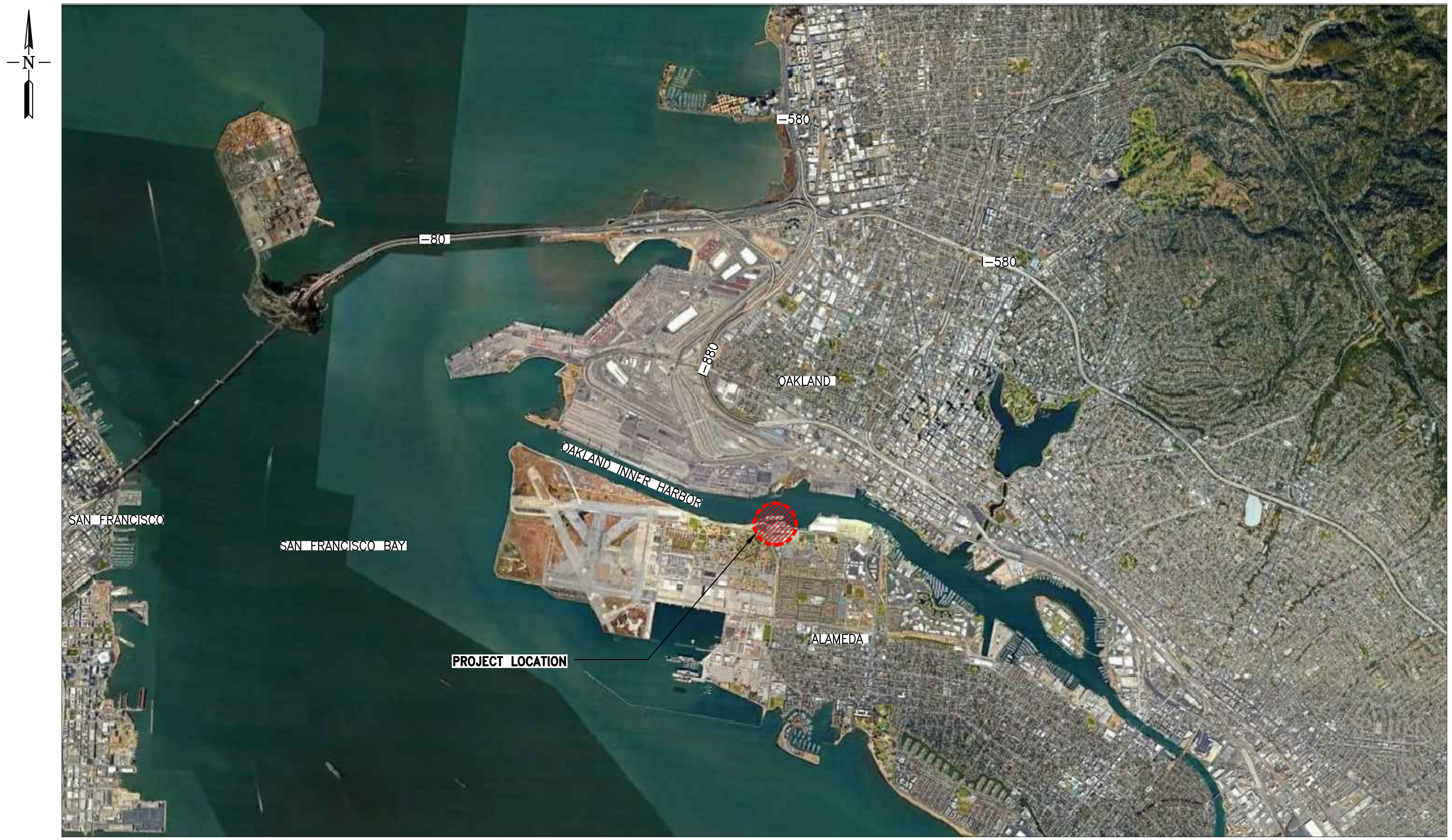
WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-01

DATE: 12-20-2021



APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY PIER 9, SUIT 111, THE EMBARCADERO SAN FRANCISCO, CA CONTACT: CHAD MASON SENIOR PLANNER/PROJECT MANAGER MASON@WATERTRANSIT.ORG (415) 291-3377 EXT. 745	DRAWING BY: COWI N.A 555 12TH STREET, SUITE 1700 OAKLAND CA 94607 CONTACT: JESSICA RIVAS (510) 839-8972 DATUM: MLLW	VICINITY MAP SCALE: 1"=6000' **WATER EMERGENCY TRANSPORTATION AUTHORITY** **2990 MAIN STREET** **ALAMEDA, CA 94501**	ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT APPLICATION BY WETA SHEET S-02 DATE: 12-20-2021

N

APPLICANT : SAN FRANCISCO BAY AREA WATER
EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
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MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROJECT SITE LOCATION

SCALE: 1" = 40'

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-03

DATE: 12-20-2021

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
SENIOR PLANNER/PROJECT MANAGER
MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

EXISTING SITE PLAN WITH MAJOR FEATURES

SCALE: 1" = 100'

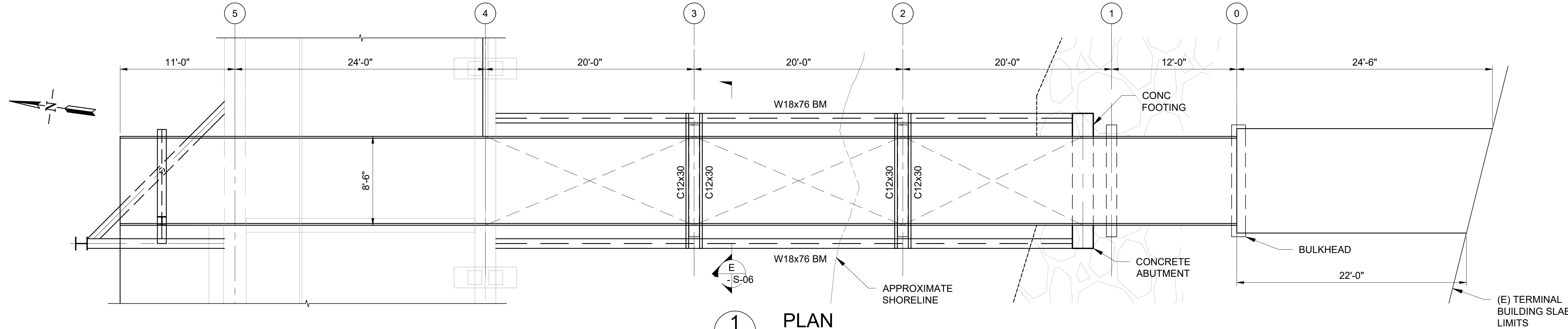
WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

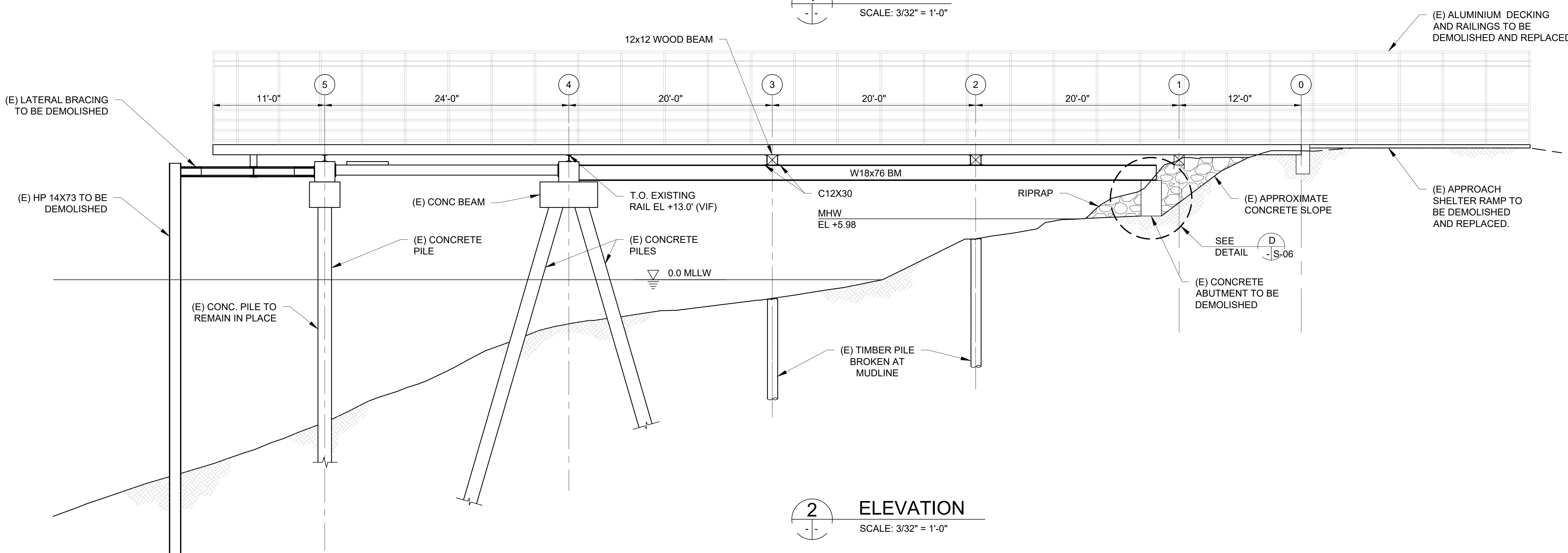
APPLICATION BY
WETA

SHEET S-04

DATE: 12-20-2021

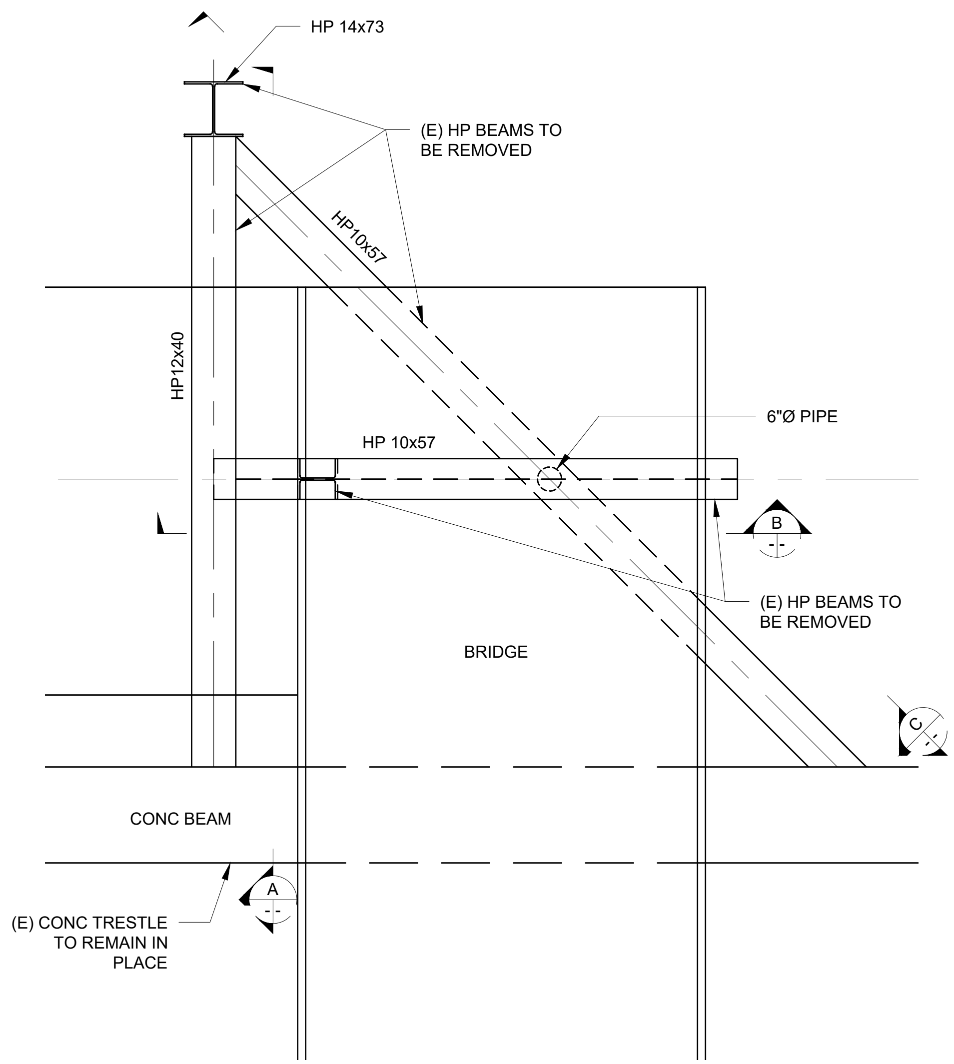


1 PLAN
SCALE: 3/32" = 1'-0"

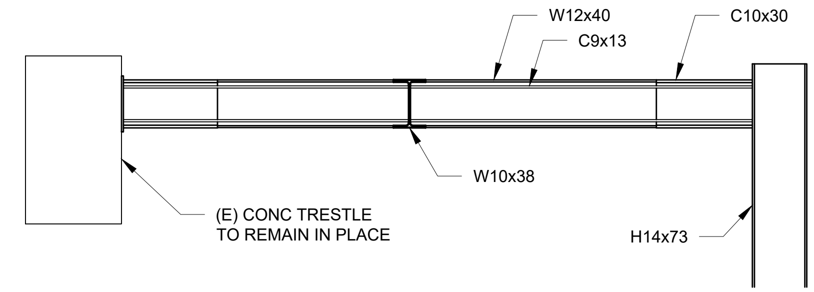


2 ELEVATION
SCALE: 3/32" = 1'-0"

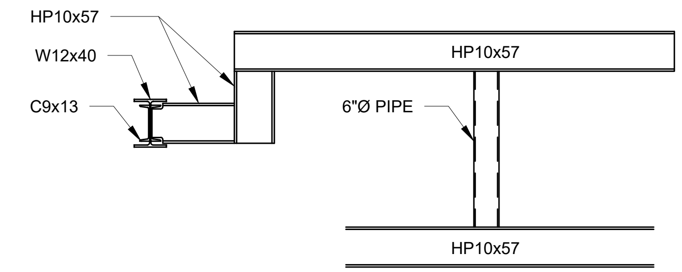
APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY PIER 9, SUIT 111, THE EMBARCADERO SAN FRANCISCO, CA CONTACT: CHAD MASON SENIOR PLANNER/PROJECT MANAGER MASON@WATERTRANSIT.ORG (415) 291-3377 EXT. 745	DRAWING BY: COWI N.A 555 12TH STREET, SUITE 1700 OAKLAND CA 94607 CONTACT: JESSICA RIVAS (510) 839-8972 DATUM: MLLW	EXISTING BRIDGE PLAN AND SECTION ELEVATION SHEET 1 OF 2 SCALE: 1" = 40' **WATER EMERGENCY TRANSPORTATION AUTHORITY** **2990 MAIN STREET** **ALAMEDA, CA 94501**	ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT APPLICATION BY WETA SHEET S-05 DATE: 12-20-2021



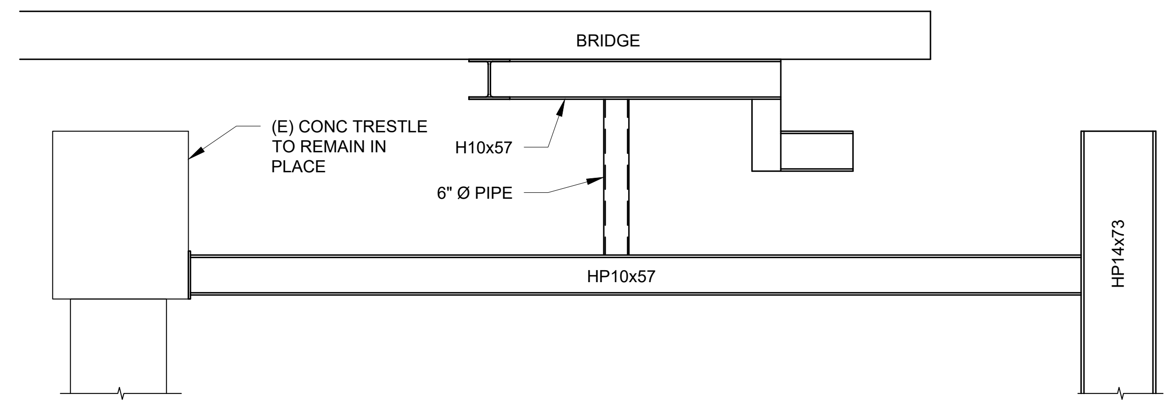
1 DETAIL
SCALE: 1/4" = 1'-0"



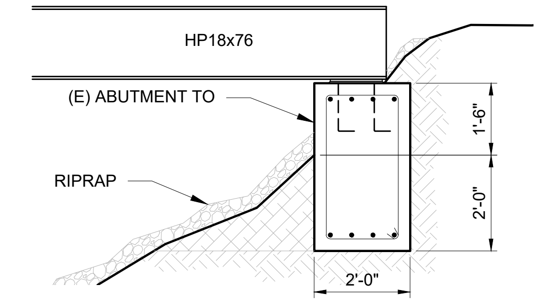
A SECTION TO BE DEMOLISHED
SCALE: 1/4" = 1'-0"



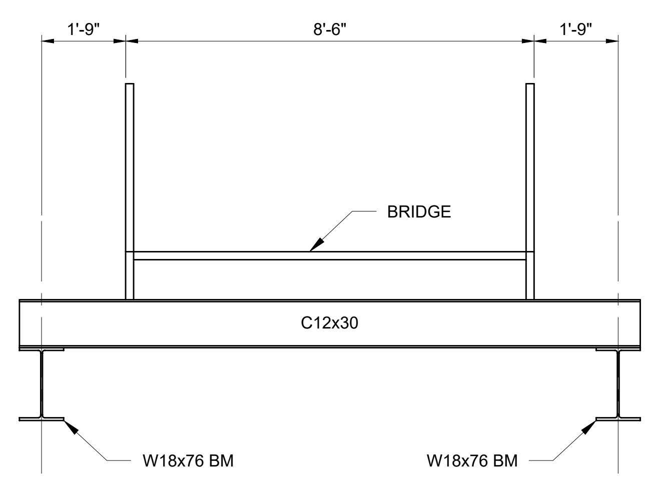
B SECTION TO BE DEMOLISHED
SCALE: 1/4" = 1'-0"



C SECTION TO BE DEMOLISHED
SCALE: 1/4" = 1'-0"



D S-05 SECTION TO BE DEMOLISHED
SCALE: 1/4" = 1'-0"



E S-05 SECTION TO BE DEMOLISHED
SCALE: 1/4" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER
EMERGENCY TRANSPORTATION AUTHORITY
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CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

EXISTING BRIDGE PLAN AND SECTION
ELEVATION SHEET 2 OF 2

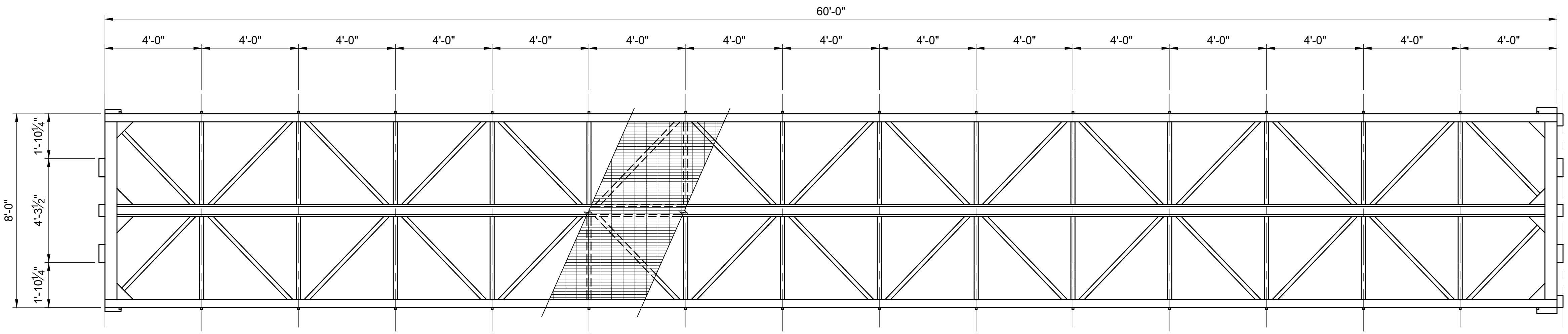
SCALE: ¼" = 1'-0"

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

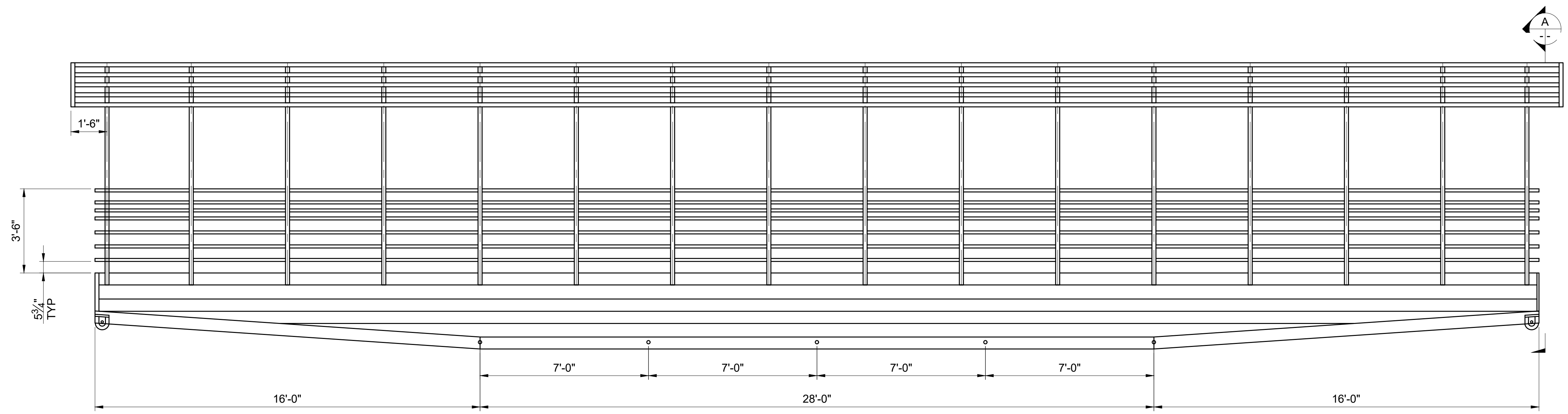
ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

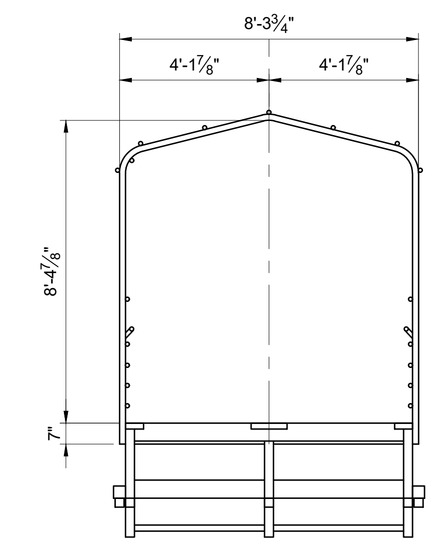
SHEET S-06 | DATE: 12-20-2021



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



2 SECTION ELEVATION
SCALE: 3/16" = 1'-0"



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

APPLICANT : SAN FRANCISCO BAY AREA WATER
EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

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DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

EXISTING 60'-0" GANGWAY PLAN AND SECTION ELEVATIONS

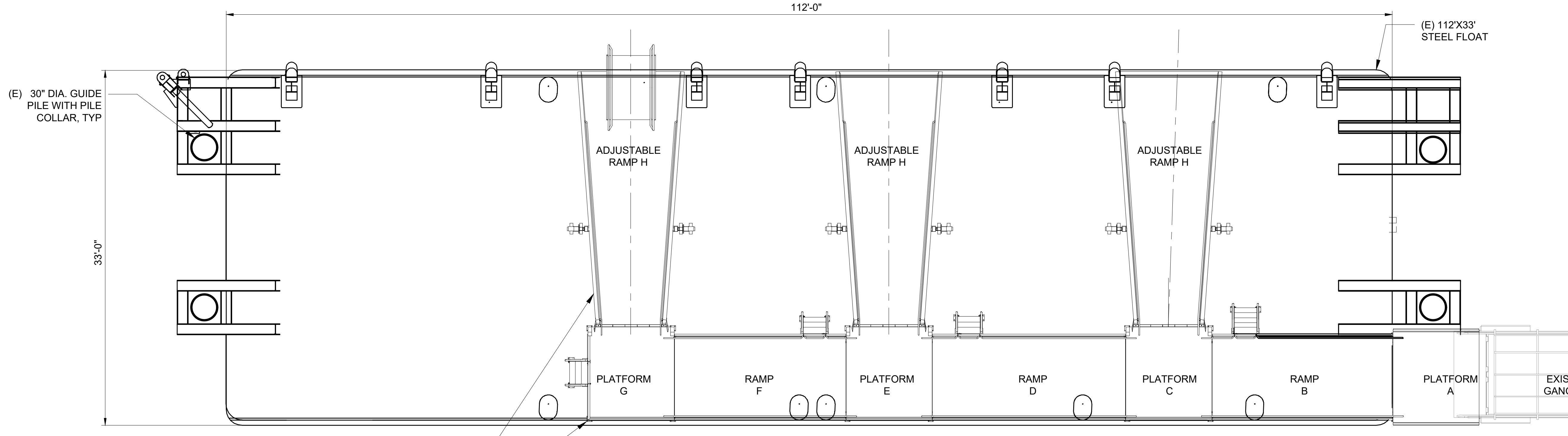
SCALE: 3/16" = 1'-0"

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

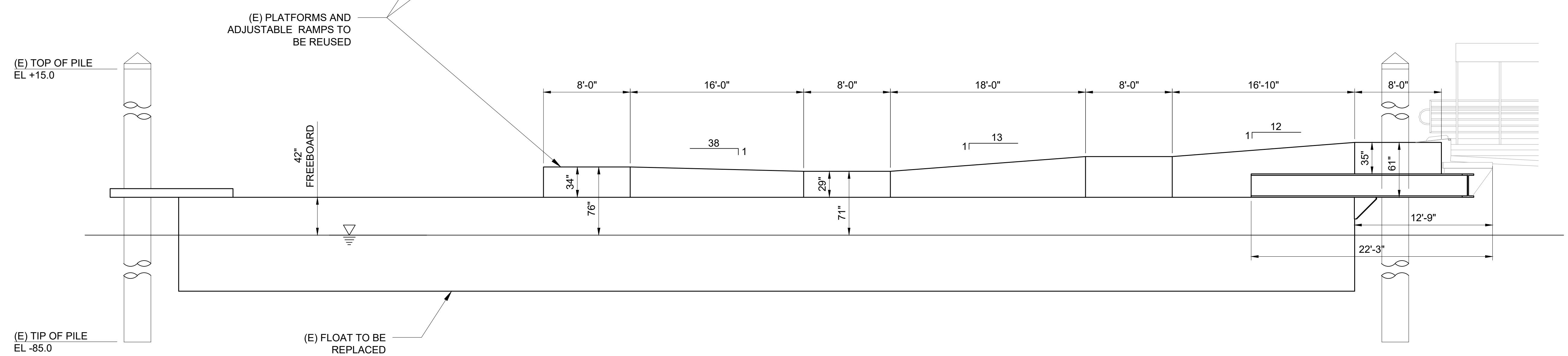
ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-07 | DATE: 12-20-2021



1 PLAN VIEW
SCALE: 3/32" = 1'-0"



2 SECTION ELEVATION
SCALE: 3/32" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER
EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
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CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

EXISTING FLOAT PLAN AND SECTION ELEVATION

SCALE: 3/32" = 1'-0"

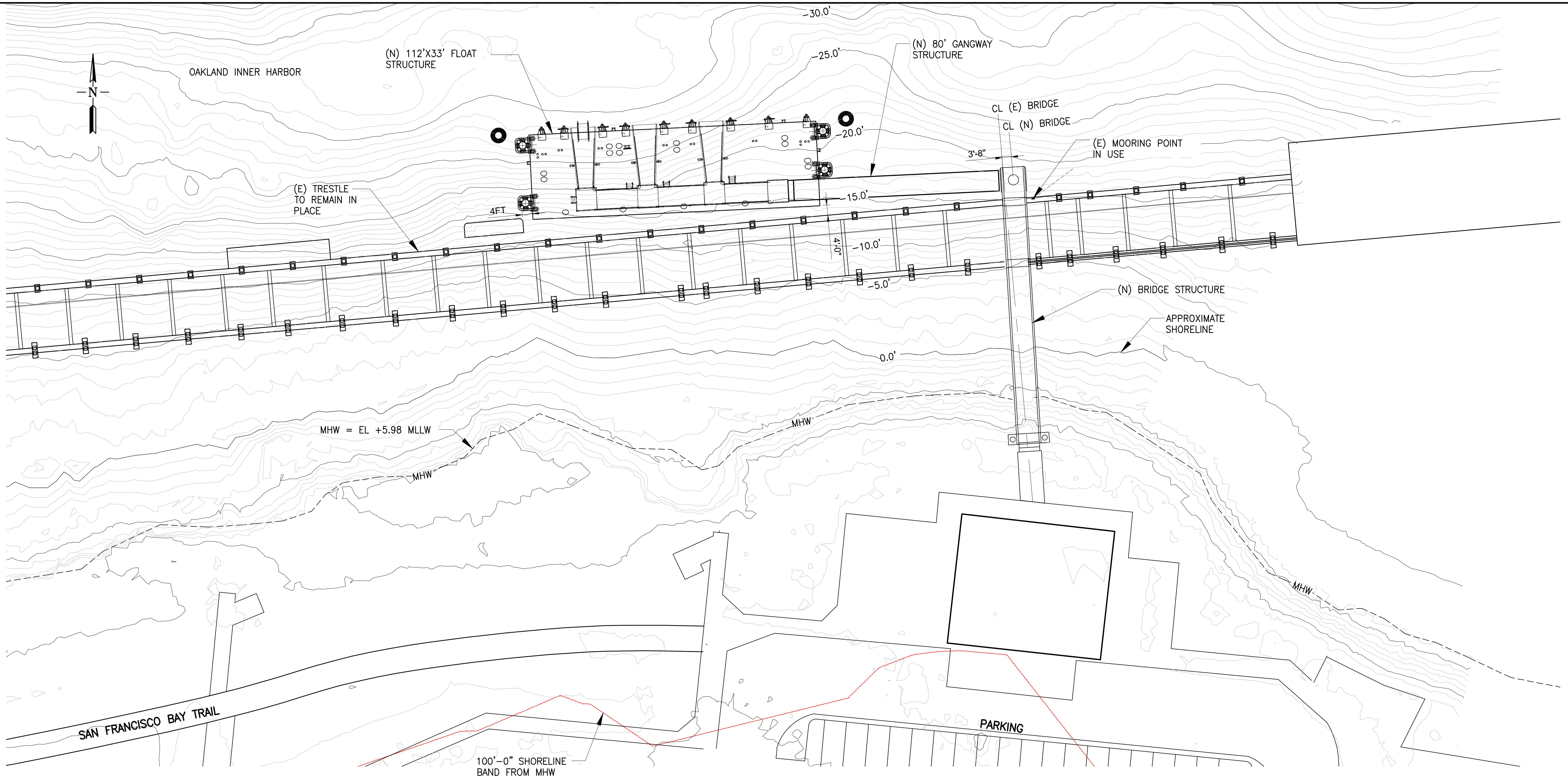
WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-08

DATE: 12-20-2021



APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
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DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
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DATUM: MLLW

PROPOSED SITE PLAN WITH MAJOR FEATURES

SCALE: 1" = 40'

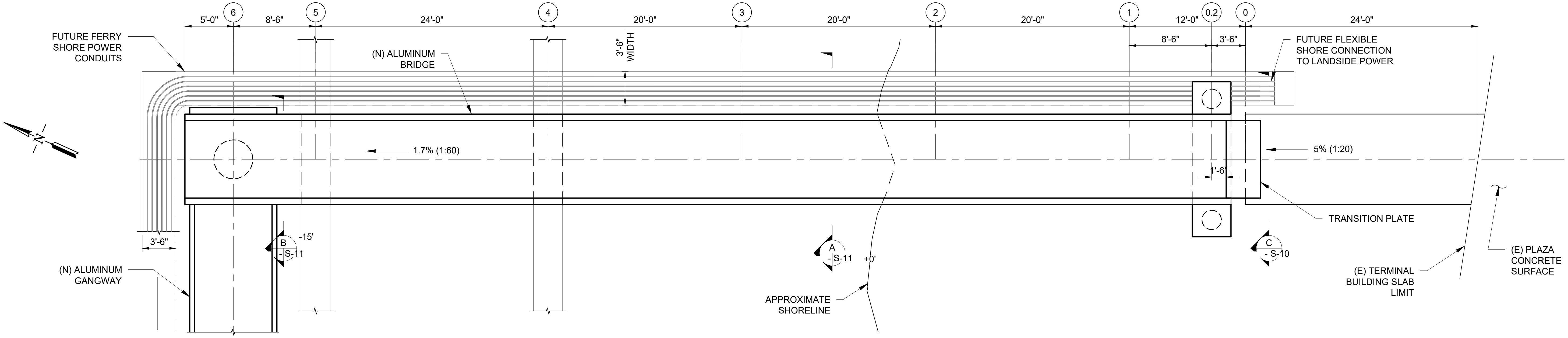
WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY WETA

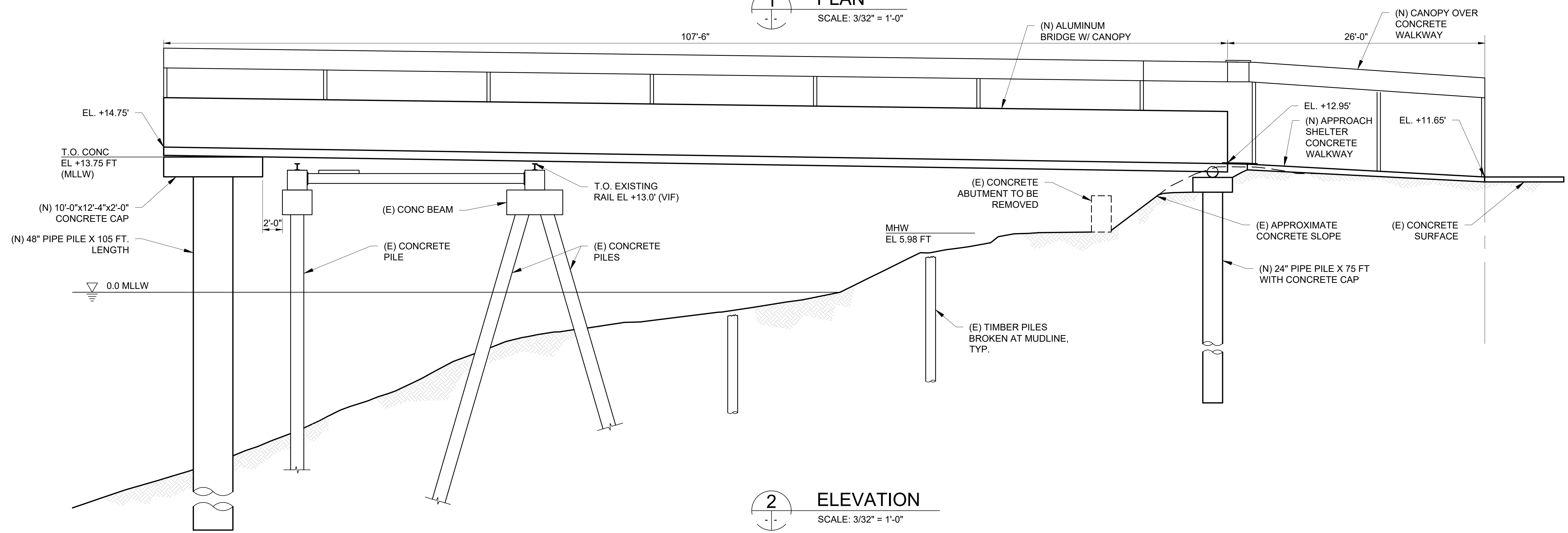
SHEET S-09

DATE: 12-20-2021



1 PLAN

SCALE: 3/32" = 1'-0"



2 ELEVATION

SCALE: 3/32" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
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MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROPOSED BRIDGE PLAN AND SECTION ELEVATION SHEET 1 OF 2

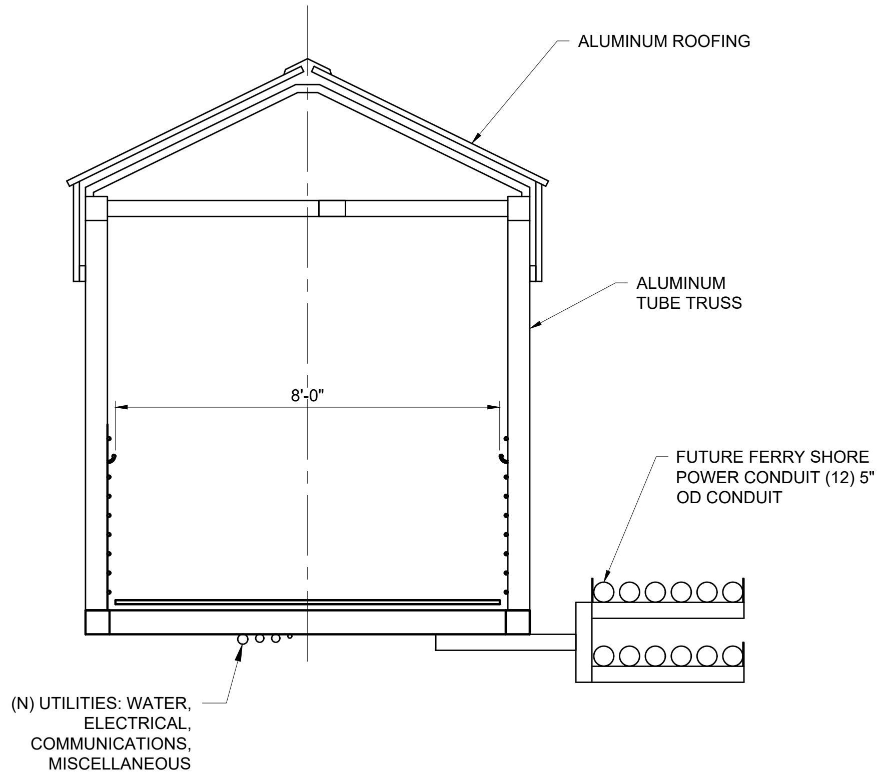
SCALE: 1" = 40'

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

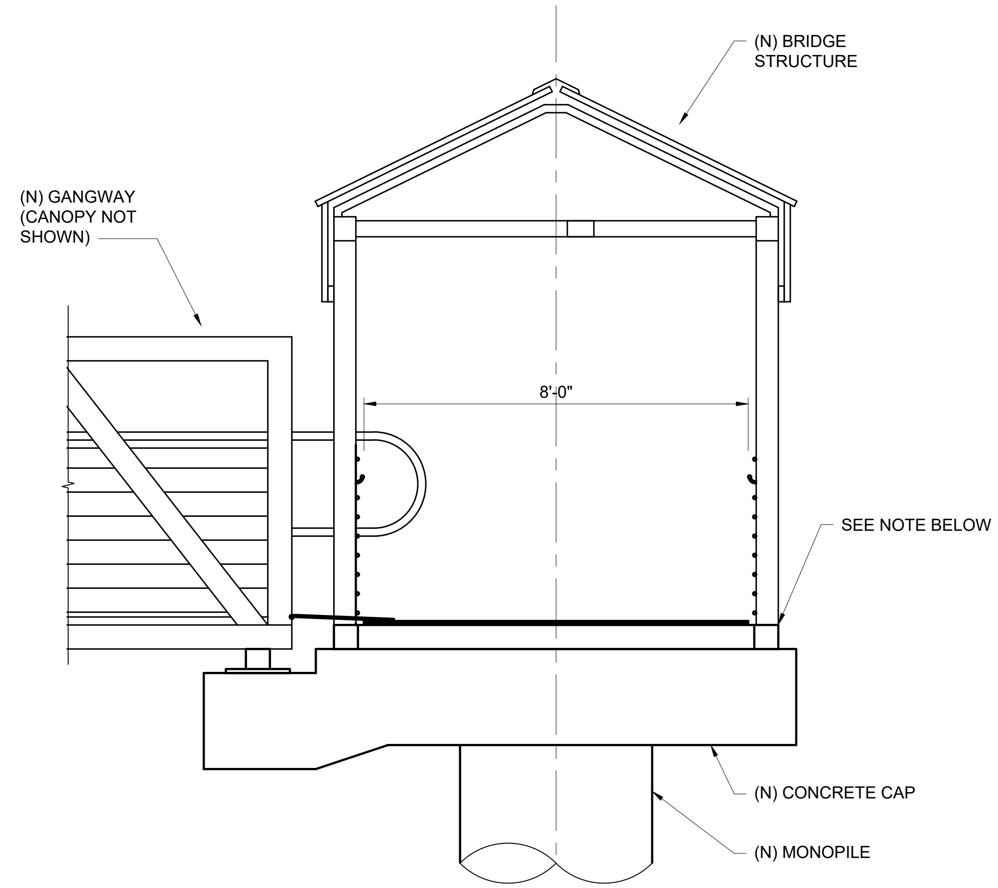
ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY WETA

SHEET S-10 | DATE: 12-20-2021

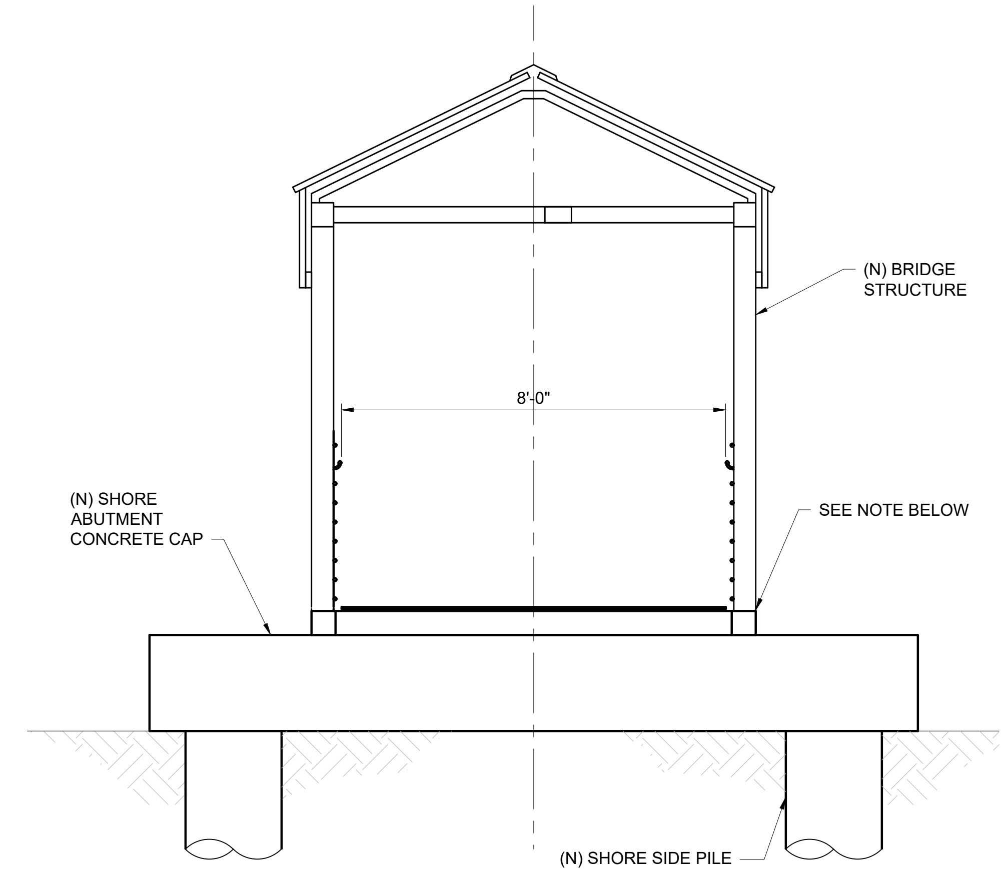


A SECTION
S-10
SCALE: 1/4" = 1'-0"



NOTE: FUTURE FERRY SHORE POWER CONDUITS NOT SHOWN FOR CLARITY

B SECTION
S-10
SCALE: 1/4" = 1'-0"



NOTE: FUTURE FERRY SHORE POWER CONDUITS NOT SHOWN FOR CLARITY

C SECTION
S-10
SCALE: 1/4" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
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OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROPOSED BRIDGE PLAN AND SECTION
ELEVATION SHEET 2 OF 2

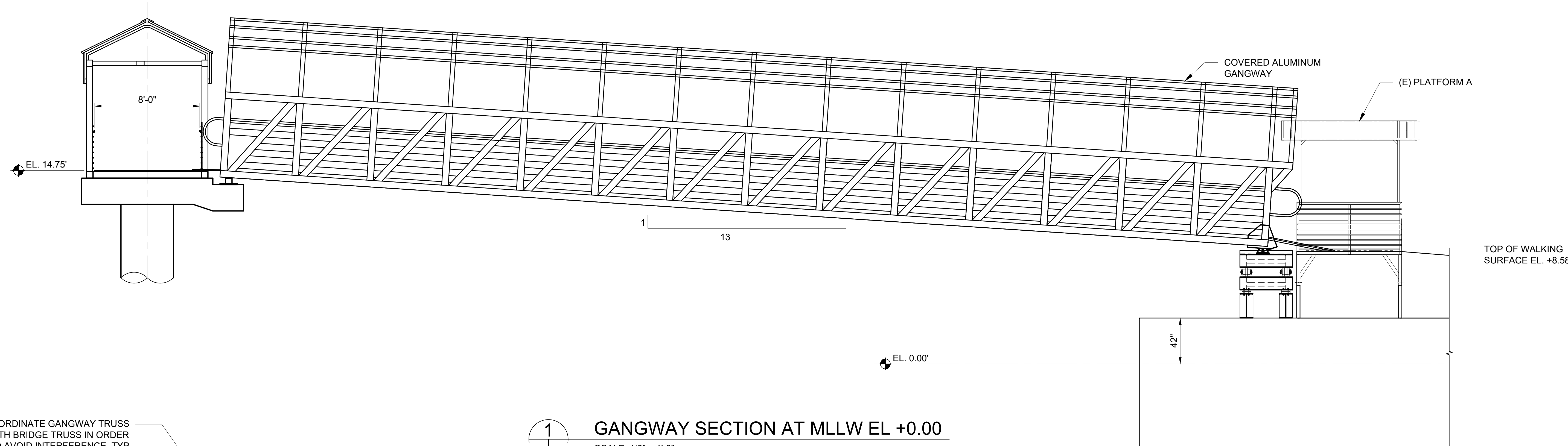
SCALE: 1" = 40'

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

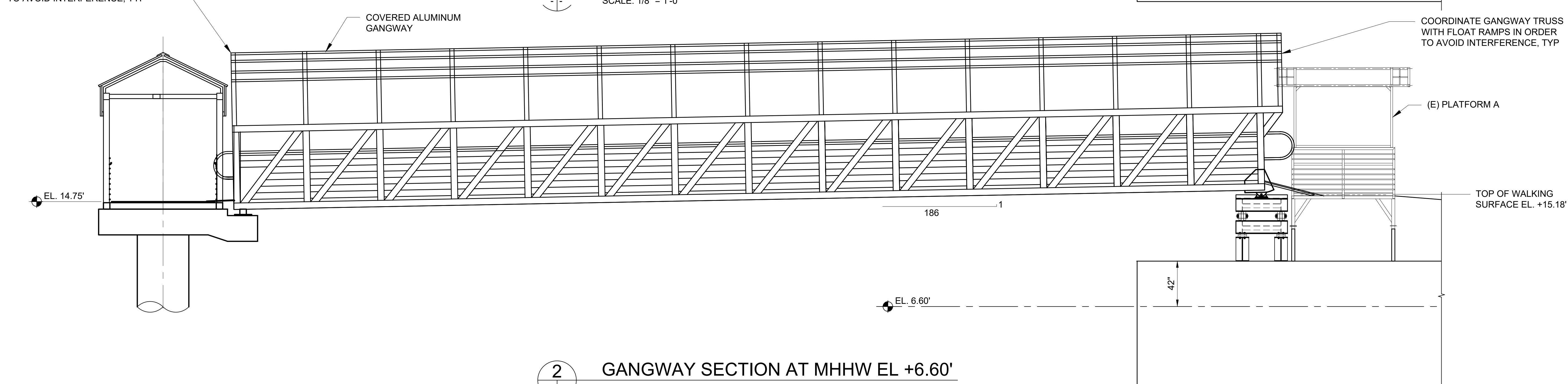
ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-11 | DATE: 12-20-2021



1 GANGWAY SECTION AT MLLW EL +0.00
SCALE: 1/8" = 1'-0"



2 GANGWAY SECTION AT MHHW EL +6.60'
SCALE: 1/8" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
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555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROPOSED 80' GANGWAY SECTION ELEVATION AT MLLW AND MHHW

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

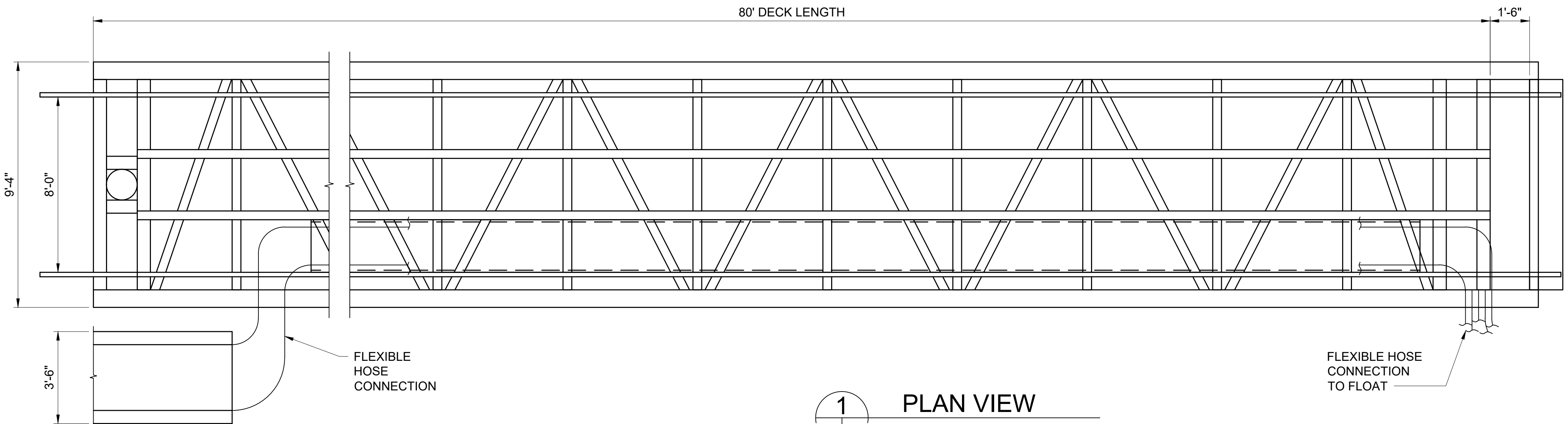
WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

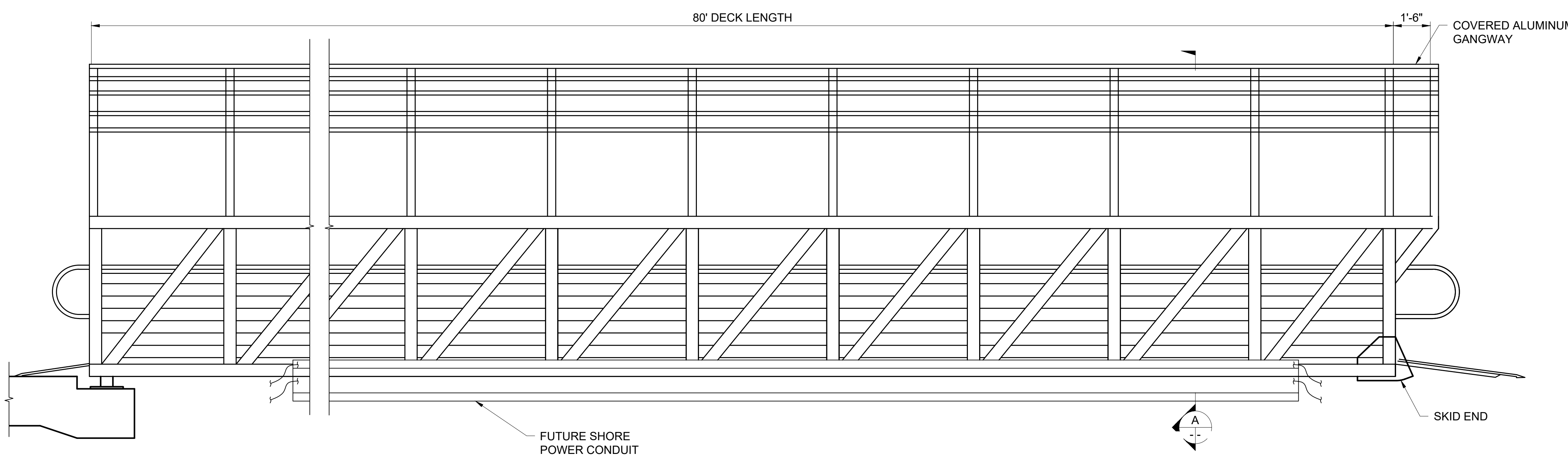
APPLICATION BY
WETA

SHEET S-12

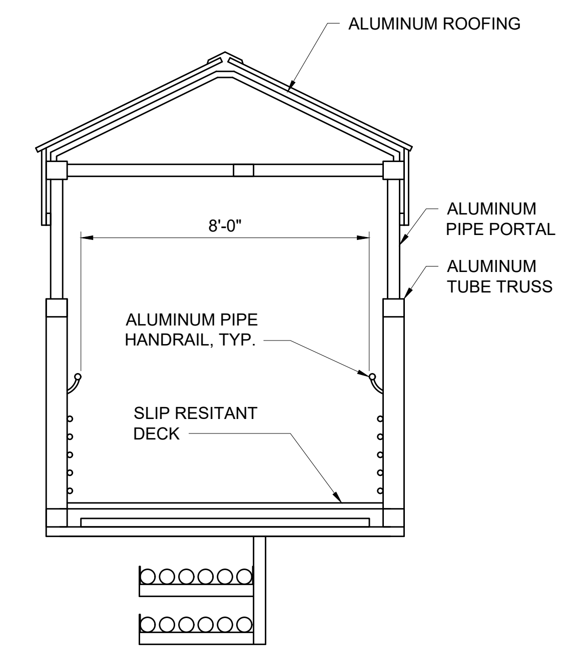
DATE: 12-20-2021



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



2 SECTION ELEVATION
SCALE: 3/16" = 1'-0"



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

APPLICANT : SAN FRANCISCO BAY AREA WATER
EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
SENIOR PLANNER/PROJECT MANAGER
MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROPOSED 80'-0" GANGWAY PLAN AND SECTION ELEVATION

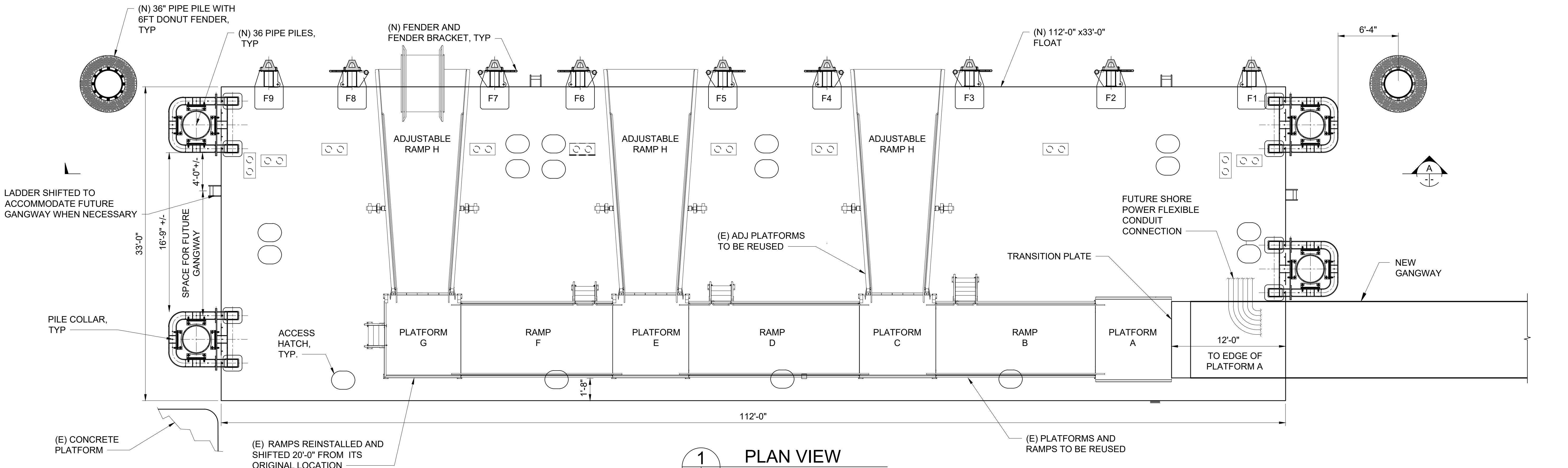
SCALE: 3/16" = 1'-0"

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT

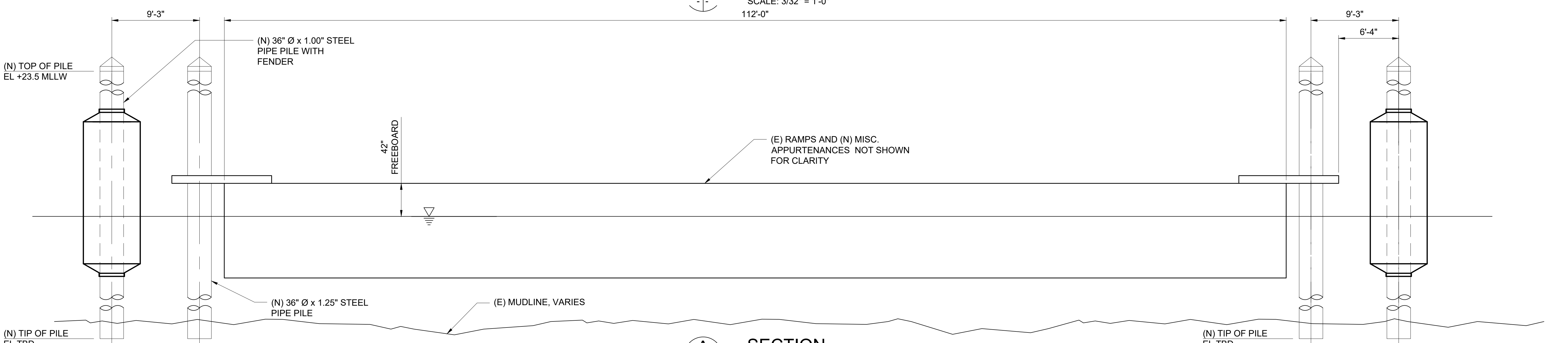
APPLICATION BY
WETA

SHEET S-13 | DATE: 12-20-2021



1 PLAN VIEW

SCALE: 3/32" = 1'-0"



A SECTION

SCALE: 3/32" = 1'-0"

APPLICANT : SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
PIER 9, SUIT 111, THE EMBARCADERO
SAN FRANCISCO, CA

CONTACT: CHAD MASON
SENIOR PLANNER/PROJECT MANAGER
MASON@WATERTRANSIT.ORG
(415) 291-3377 EXT. 745

DRAWING BY: COWI N.A
555 12TH STREET, SUITE 1700
OAKLAND CA 94607

CONTACT: JESSICA RIVAS
(510) 839-8972

DATUM: MLLW

PROPOSED FLOAT PLAN AND SECTION ELEVATION

SCALE: 3/32" = 1'-0"

WATER EMERGENCY TRANSPORTATION AUTHORITY
2990 MAIN STREET
ALAMEDA, CA 94501

ALAMEDA MAIN STREET
FERRY TERMINAL REFURBISHMENT PROJECT

APPLICATION BY
WETA

SHEET S-14

DATE: 12-20-2021

Appendix B

Air Quality CalEEMod and Harborcraft Data

Alameda Main Street Terminal Rehabilitation Project

Alameda County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	10.00	1000sqft	0.23	10,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2024
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	453.21	**CH4 Intensity (lb/MWhr)**	0.033	**N2O Intensity (lb/MWhr)**	0.004

1.3 User Entered Comments & Non-Default Data

Project Characteristics - Alameda Terminal Rehabilitation Project

Land Use - Replacement of existing float, gangway, and bridge

Construction Phase - Duration based on applicant input

Off-road Equipment - Equipment based on applicant input. Bore/Drill rig representative of pile driver

Off-road Equipment - Equipment based on applicant input

Trips and VMT - Adjusted based on applicant input. Hauling will be done via barge

On-road Fugitive Dust - Default

Vehicle Trips - No operational changes. Modeling construction only.

Consumer Products - No operational changes. Modeling construction only.

Area Coating - No operational changes. Modeling construction only.

Landscape Equipment - No operational changes. Modeling construction only.

Energy Use - No operational changes. Modeling construction only.

Water And Wastewater - No operational changes. Modeling construction only.

Solid Waste - No operational changes. Modeling construction only.

Construction Off-road Equipment Mitigation - Mitigation: Equipment above 200 HP shall have Tier 4 Final engines

Table Name	Column Name	Default Value	New Value
tblAreaCoating	Area_Parking	600	0
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	100.00	20.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblOffRoadEquipment	HorsePower	221.00	1,200.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	UsageHours	4.00	12.00
tblTripsAndVMT	VendorTripNumber	0.00	2.00
tblTripsAndVMT	VendorTripNumber	2.00	4.00
tblTripsAndVMT	WorkerTripNumber	13.00	12.00
tblTripsAndVMT	WorkerTripNumber	4.00	16.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0276	0.2396	0.2615	5.2000e-004	2.0700e-003	0.0112	0.0132	5.6000e-004	0.0109	0.0115	0.0000	45.2820	45.2820	4.9400e-003	1.8000e-004	45.4600
Maximum	**0.0276**	**0.2396**	**0.2615**	**5.2000e-004**	**2.0700e-003**	**0.0112**	**0.0132**	**5.6000e-004**	**0.0109**	**0.0115**	**0.0000**	**45.2820**	**45.2820**	**4.9400e-003**	**1.8000e-004**	**45.4600**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0219	0.1695	0.2768	5.2000e-004	2.0700e-003	8.1700e-003	0.0102	5.6000e-004	8.1700e-003	8.7300e-003	0.0000	45.2820	45.2820	4.9400e-003	1.8000e-004	45.4599
Maximum	**0.0219**	**0.1695**	**0.2768**	**5.2000e-004**	**2.0700e-003**	**8.1700e-003**	**0.0102**	**5.6000e-004**	**8.1700e-003**	**8.7300e-003**	**0.0000**	**45.2820**	**45.2820**	**4.9400e-003**	**1.8000e-004**	**45.4599**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**20.39**	**29.28**	**-5.85**	**0.00**	**0.00**	**26.86**	**22.66**	**0.00**	**25.18**	**23.89**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

EMFAC Off-Model Adjustment Factors for Gasoline Light Duty Vehicle to Account for the SAFE Vehicle Rule Not Applied

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**6-1-2023**	**8-31-2023**	0.2671	0.1913
		Highest	0.2671	0.1913

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	6.5000e-004	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**6.5000e-004**	**0.0000**	**9.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**1.8000e-004**	**1.8000e-004**	**0.0000**	**0.0000**	**1.9000e-004**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	6.5000e-004	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**6.5000e-004**	**0.0000**	**9.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**1.8000e-004**	**1.8000e-004**	**0.0000**	**0.0000**	**1.9000e-004**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	6/1/2023	6/10/2023	7	10	
2	Building Construction	Building Construction	6/11/2023	6/30/2023	7	20	

EMFAC Off-Model Adjustment Factors for Gasoline Light Duty Vehicle to Account for the SAFE Vehicle Rule Not Applied

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0.23

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Air Compressors	2	8.00	78	0.48
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	1	8.00	231	0.29
Demolition	Generator Sets	2	8.00	84	0.74
Demolition	Rubber Tired Dozers	0	1.00	247	0.40
Demolition	Tractors/Loaders/Backhoes	0	6.00	97	0.37
Building Construction	Air Compressors	2	8.00	78	0.48
Building Construction	Bore/Drill Rigs	1	0.50	1200	0.50
Building Construction	Cranes	1	12.00	231	0.29
Building Construction	Forklifts	0	6.00	89	0.20
Building Construction	Generator Sets	2	12.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	0	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	5	12.00	2.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	6	16.00	4.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Demolition - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	7.3700e-003	0.0636	0.0700	1.3000e-004		3.0200e-003	3.0200e-003		2.9600e-003	2.9600e-003	0.0000	11.5912	11.5912	1.2700e-003	0.0000	11.6230
Total	**7.3700e-003**	**0.0636**	**0.0700**	**1.3000e-004**		**3.0200e-003**	**3.0200e-003**		**2.9600e-003**	**2.9600e-003**	**0.0000**	**11.5912**	**11.5912**	**1.2700e-003**	**0.0000**	**11.6230**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0000e-005	4.4000e-004	1.3000e-004	0.0000	7.0000e-005	0.0000	7.0000e-005	2.0000e-005	0.0000	2.0000e-005	0.0000	0.1934	0.1934	0.0000	3.0000e-005	0.2021
Worker	1.6000e-004	1.1000e-004	1.3300e-003	0.0000	4.7000e-004	0.0000	4.8000e-004	1.3000e-004	0.0000	1.3000e-004	0.0000	0.3694	0.3694	1.0000e-005	1.0000e-005	0.3728
Total	**1.7000e-004**	**5.5000e-004**	**1.4600e-003**	**0.0000**	**5.4000e-004**	**0.0000**	**5.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**0.0000**	**0.5628**	**0.5628**	**1.0000e-005**	**4.0000e-005**	**0.5749**

3.2 Demolition - 2023

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	5.9700e-003	0.0461	0.0738	1.3000e-004		2.2700e-003	2.2700e-003		2.2700e-003	2.2700e-003	0.0000	11.5912	11.5912	1.2700e-003	0.0000	11.6230
Total	**5.9700e-003**	**0.0461**	**0.0738**	**1.3000e-004**		**2.2700e-003**	**2.2700e-003**		**2.2700e-003**	**2.2700e-003**	**0.0000**	**11.5912**	**11.5912**	**1.2700e-003**	**0.0000**	**11.6230**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0000e-005	4.4000e-004	1.3000e-004	0.0000	7.0000e-005	0.0000	7.0000e-005	2.0000e-005	0.0000	2.0000e-005	0.0000	0.1934	0.1934	0.0000	3.0000e-005	0.2021
Worker	1.6000e-004	1.1000e-004	1.3300e-003	0.0000	4.7000e-004	0.0000	4.8000e-004	1.3000e-004	0.0000	1.3000e-004	0.0000	0.3694	0.3694	1.0000e-005	1.0000e-005	0.3728
Total	**1.7000e-004**	**5.5000e-004**	**1.4600e-003**	**0.0000**	**5.4000e-004**	**0.0000**	**5.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**0.0000**	**0.5628**	**0.5628**	**1.0000e-005**	**4.0000e-005**	**0.5749**

3.3 Building Construction - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0196	0.1735	0.1859	3.6000e-004		8.1300e-003	8.1300e-003		7.9400e-003	7.9400e-003	0.0000	31.3692	31.3692	3.6100e-003	0.0000	31.4595
Total	**0.0196**	**0.1735**	**0.1859**	**3.6000e-004**		**8.1300e-003**	**8.1300e-003**		**7.9400e-003**	**7.9400e-003**	**0.0000**	**31.3692**	**31.3692**	**3.6100e-003**	**0.0000**	**31.4595**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.0000e-005	1.7500e-003	5.3000e-004	1.0000e-005	2.6000e-004	1.0000e-005	2.7000e-004	8.0000e-005	1.0000e-005	9.0000e-005	0.0000	0.7738	0.7738	1.0000e-005	1.2000e-004	0.8086
Worker	4.2000e-004	2.9000e-004	3.5600e-003	1.0000e-005	1.2700e-003	1.0000e-005	1.2700e-003	3.4000e-004	1.0000e-005	3.4000e-004	0.0000	0.9850	0.9850	3.0000e-005	3.0000e-005	0.9940
Total	**4.6000e-004**	**2.0400e-003**	**4.0900e-003**	**2.0000e-005**	**1.5300e-003**	**2.0000e-005**	**1.5400e-003**	**4.2000e-004**	**2.0000e-005**	**4.3000e-004**	**0.0000**	**1.7588**	**1.7588**	**4.0000e-005**	**1.5000e-004**	**1.8026**

3.3 Building Construction - 2023

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0154	0.1208	0.1974	3.6000e-004		5.8800e-003	5.8800e-003		5.8800e-003	5.8800e-003	0.0000	31.3692	31.3692	3.6100e-003	0.0000	31.4595
Total	**0.0154**	**0.1208**	**0.1974**	**3.6000e-004**		**5.8800e-003**	**5.8800e-003**		**5.8800e-003**	**5.8800e-003**	**0.0000**	**31.3692**	**31.3692**	**3.6100e-003**	**0.0000**	**31.4595**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.0000e-005	1.7500e-003	5.3000e-004	1.0000e-005	2.6000e-004	1.0000e-005	2.7000e-004	8.0000e-005	1.0000e-005	9.0000e-005	0.0000	0.7738	0.7738	1.0000e-005	1.2000e-004	0.8086
Worker	4.2000e-004	2.9000e-004	3.5600e-003	1.0000e-005	1.2700e-003	1.0000e-005	1.2700e-003	3.4000e-004	1.0000e-005	3.4000e-004	0.0000	0.9850	0.9850	3.0000e-005	3.0000e-005	0.9940
Total	**4.6000e-004**	**2.0400e-003**	**4.0900e-003**	**2.0000e-005**	**1.5300e-003**	**2.0000e-005**	**1.5400e-003**	**4.2000e-004**	**2.0000e-005**	**4.3000e-004**	**0.0000**	**1.7588**	**1.7588**	**4.0000e-005**	**1.5000e-004**	**1.8026**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.569946	0.056495	0.180011	0.112201	0.020944	0.005169	0.013608	0.012941	0.000792	0.000570	0.024535	0.000337	0.002451

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	6.5000e-004	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004
Unmitigated	6.5000e-004	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	6.5000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.0000e-005	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004
Total	**6.6000e-004**	**0.0000**	**9.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**1.8000e-004**	**1.8000e-004**	**0.0000**	**0.0000**	**1.9000e-004**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	6.5000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.0000e-005	0.0000	9.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.8000e-004	1.8000e-004	0.0000	0.0000	1.9000e-004
Total	**6.6000e-004**	**0.0000**	**9.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**1.8000e-004**	**1.8000e-004**	**0.0000**	**0.0000**	**1.9000e-004**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator - Main Engine Emission Rates

Calendar Year: 2023 **Number of Entries:** 2

Vessel/Engine Information								Emission Rates (lb/hr; estimates for each row are totals over the number of engines listed in column J for that row)										Emission Rates for a Single Engine (g/bhp-hr)									
Vessel Name	Vessel Number	Home Port	Vessel Type	Engine Model Year	Engine Rated Power (hp)	Engine Load Factor	Number of engines	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Support Tug			Tug Boats	2002	1167	0.50	2	1.241	1.105	21.580	1.814	6.341	0.014	1521.118	0.062	0.012	1526.338	0.482	0.429	8.385	0.705	2.464	0.006	591.045	0.024	0.005	593.1
Small Skiff			Crew and Supply	1995	384	0.38	1	0.140	0.124	3.487	0.274	0.792	0.002	189.982	0.008	0.002	190.634	0.434	0.387	10.849	0.853	2.464	0.006	591.045	0.024	0.005	593.1

SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator - Auxiliary Engine Emission Rates

Calendar Year: 2023 **Number of Entries:** 1

Vessel/Engine Information									Emission Rates (lb/hr; estimates for each row are totals over the number of engines listed in column K for that row)										Emission Rates for a Single Engine (g/bhp-hr)									
Vessel Name	Vessel Number	Home Port	Vessel Type	Auxiliary Engine Type	Engine Model Year	Engine Rated Power (hp)	Engine Load Factor	Number of Engines	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Support Tug			Tug Boats	Tug Boats Generator	2000	86	0.31	1	0.039	0.035	0.465	0.064	0.245	0.000	34.782	0.001	0.000	34.901	0.67	0.60	7.90	1.09	4.17	0.006	591.04	0.02	0.00	593.1

Appendix C

Alameda Main Street Ferry Terminal Refurbishment Project Biological Technical Report

Biological Technical Report

Alameda Main Street Ferry Terminal Refurbishment Project

NOVEMBER 2022

Prepared for:

WETA
SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
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Table of Contents

SECTION **PAGE NO.**

FIGURES

APPENDICES

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Acronyms and Abbreviations

Acronym	Definition
ADA	Americans with Disabilities Act
AMS	Alameda Main Street
Bay	San Francisco Bay
BMP	best management practice
BCDC	Bay Conservation and Development Commission
BO	Biological Opinion
BSA	biological survey area
CARB	California Air Resources Board
CCC	Central California Coast
CEQA	California Environmental Quality Act
CEQA Guidelines	State of California CEQA Guidelines
CESA	California Endangered Species Act
CDFA	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
County	Alameda County
CRPR	California Rare Plant Rank
CZMA	Coastal Zone Management Act
CWA	Clean Water Act
CWMP	Construction Waste Management Plan
DPS	Distinct Population Segment
DWR	California Department of Water Resources
EFH	Essential Fish Habitat
EPA	U. S. Environmental Protection Agency
ESU	Evolutionarily Significant Unit
FESA	federal Endangered Species Act
FMPs	Fisheries Management Plans
General Plan	Alameda County General Plan 2040
GIS	geographic information system
HCP	Habitat Conservation Plan
IHA	Incidental Harassment Authorization
IPaC	Information for Planning and Consultation
ITP	Incidental Take Permit
I-880	Interstate Highway 880
MBTA	Migratory Bird Treaty Act
MLLW	Mean lower low water
MMPA	Marine Mammal Protection Act
MRF	Materials Recovery Facility
NCCP	Natural Community Conservation Plans

Acronym	Definition
NMFS	National Marine Fisheries Service
NPSC	Non-Point Source Control Program
OHWM	ordinary high-water mark
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
project	Alameda Main Street Ferry Terminal Refurbishment Project
RMS	root-mean-square pressure
RWQCB	regional water quality control board (SFRWQCB is San Francisco)
SB	State Bill
SEL	sound exposure level
SR 61	State Route 61
SWP	California State Water Project
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WETA	San Francisco Bay Area Water Emergency Transportation Authority

1 Introduction

1.1 Project Summary and Background

This report describes the results of a comprehensive biological resources assessment conducted for San Francisco Bay Area Water Emergency Transportation Authority's (WETA) proposed Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (project). WETA was established in 2007 under Senate Bill (SB) 976 to replace the Water Transit Authority and serve as a regional ferry system that responds to natural or manmade disasters, such as earthquakes, that would affect access in and out of San Francisco. In 2009, WETA issued a Transition Plan, which outlined WETA's plans for operating, financing, and transferring city-run ferry services in the cities of Vallejo and Alameda to WETA. Operation of the City of Alameda ferry services transitioned to WETA in 2011.

The AMS Ferry offers five routes including daily service to and from downtown San Francisco, weekday service to and from South San Francisco's Oyster Point, weekday service to and from Main Street Alameda, event/gameday service to and from the Chase Center in San Francisco, and event/gameday service from Oracle Park in San Francisco. The AMS Ferry Terminal was constructed in 1991 has been operational since. In 1997, timber piles supporting the bridge structure failed. Repairs were made to the terminal and steel piles/beams were installed to attach the bridge structure to the concrete trestle. In 2014, the terminal was relocated approximately 100 feet to the west. No further upgrades or repairs have been made to the Ferry Terminal since 2014.

1.1.1 Report Format and Approach

The purpose of this report is to (1) describe the conditions of biological resources within the project site in terms of vegetation communities, plants, wildlife, wildlife habitats, and wetlands; (2) quantify potential direct and indirect impacts to biological resources that would result from the proposed project; (3) discuss those impacts in terms of biological significance in view of federal, state, and local laws and Alameda County (County) policies; and (4) specify measures to avoid, minimize, and/or mitigate any adverse impacts that would occur to biological resources as a result of project implementation. This assessment is intended to support the project's Initial Study/Mitigated Negative Declaration, which is currently being prepared as part of the environmental review pursuant to the California Environmental Quality Act (CEQA).

1.2 Project Description

1.2.1 Project Location

The project is in the City of Alameda in Alameda County, California. The City of Alameda occupies approximately 10.6 square miles of land area immediately south of the City of Oakland and the Oakland-Alameda Estuary, east of San Francisco, and north and east of the San Francisco Bay. Alameda Island makes up approximately 80 percent of the City's land area, with the remainder on Bay Farm Island across the San Leandro Channel (See Figure 1). Regional access to the City of Alameda is provided by a variety of transportation modes. Interstate 880 (I-880) through Oakland—the nearest freeway to the project site—provides regional access for automobiles and transit. Regional traffic accesses the project site via State Route 61 (SR 61) through the Webster-Posey Tubes, the Park Street Bridge, the Miller Sweeney Bridge, and the High Street Bridge connecting the island of Alameda and the City of Oakland.

The project site is located at 2990 Main Street (Assessor Parcel Numbers 74-890-1-17, 74-1368-13-1, 74-1368-1, and 999-9999-999) and includes the existing AMS Ferry Terminal, which consists of a trestle, steel float structure, aluminum gangway, and bridge structure (See Figure 2). The site is designated under the General and Maritime Industry land use and zoned as General Industrial (M-2). Much of the project site is within the Oakland Inner Harbor, with a portion of the bridge structure extending onto the landside of Alameda. The project site is accessible by vehicle via Main Street and by ferry within the harbor. The project is within a developed area of Alameda and is bounded by the Oakland Inner Harbor to the north, industrial uses to the east, the San Francisco Bay Trail, Ferry parking lot, and residential uses to the south, as well as the Main Street Dog Park and undeveloped uses to the east.

1.2.2 Project Purpose

To address structure aging, deterioration, and stabilization issues (i.e., compliance with current seismic safety requirements) associated with existing AMS Ferry terminal components, WETA has identified the need to refurbish several portions of the terminal.

1.2.3 Project Elements

Project elements would include replacement of the existing bridge walkway and foundation, replacement of the gangway, float, guide piles, and upgrades to utilities at the project site. All project features would be compliant with Americans with Disabilities Act (ADA) standards. These details are further described, below.

- **Terminal Bridge and Foundation Replacement.** Project activities would involve demolishment of existing bridge/walkway and bridge foundation and replacement with a new aluminum truss bridge. Onshore and landside support would be installed and would consist of a 48-inch monopile and two 24-inch pipe piles with cap beams, respectively.
- **Gangway Replacement.** The project would include removal of the existing 60-foot gangway and replacement with an 80-foot covered aluminum gangway.
- **Float Demolition/Replacement.** The existing terminal float would be removed and replaced-in-kind with a new steel float. Ramps that had been previously installed on the float would be removed, protected in place, and reused once the new float is installed. Float ramps would be shifted to the west to provide additional room for a longer gangway. The four existing 30-foot guide piles would be removed and replaced with four (4) new 36-inch guide piles. To achieve a more safe, efficient berthing capacity and enable ingress and egress in a timely manner, float demolition/replacement activities would also involve installation of two (2) new 36-inch donut fender piles and two (2) 72-inch donut fender piles.
- **Utility Upgrades.** Utility upgrades associated with the project would involve replacement of existing razor equipment, installation of electrical service for new lighting, ramp controls, outlets, a new potable water line, as well as conduit for future upgrades on bridge, gangway, and float structures. The new potable water line will connect to an existing line at the Ferry Terminal restroom facility. The new line will be used for intermittent terminal cleaning activities, as needed. No other utility improvements are planned.

Overall, the footprint of the project site is expected to increase the AMS Ferry Terminal shade area by approximately 830 square feet. No changes in operational demand (i.e., an increase in ferry users) are anticipated, and no physical impacts beyond the project boundaries (see Figure 2) are anticipated as part of the project. Vehicular and pedestrian access to the AMS Ferry Terminal is not anticipated to change.

The water depth at the project site varies between 14 inches to 28 inches mean lower low water (MLLW). Most construction activities will occur above or at the waterline. The only elements that will extend below the mudline are the new piles that will have a maximum tip elevation of approximately 110 inches MLLW.

1.2.4 Construction

Construction of the project is expected to occur over a period of approximately 4-6 weeks, beginning in Summer 2023 with an anticipated completion date of late Summer 2023. It is estimated that project construction would require 4-8 daily construction crew members, with the possibility for up to 15 onsite construction workers during major operations (e.g., concrete pours).

The following construction equipment is anticipated to be used during construction of the project:

- One (1) Derrick crane barge,
- One (1) Skiff,
- One (1) support tug,
- One (1) support barge,
- One (1) vibratory hammer,
- One (1) impact hammer,
- One (1) delivery truck,
- One (1) concrete truck,
- One (1) pump truck
- Construction personnel trucks (approximately 3-6)
- Generator/compressors (1 generator/1 compressor at any given time)Where feasible and available, diesel construction equipment would be powered by Tier 3 or Tier 4 engines as designated by the California Air Resources Board (CARB) and U.S. Environmental Protection Agency. In addition, if available for on-site delivery, diesel construction equipment would be powered with renewable diesel fuel that is compliant with California's Low Carbon Fuel Standards and certified as renewable by the CARB executive officer.

The project would require removal of existing piles and material placement for installation of steel pipe piles for the new float and donut fenders, and bridge support. It is estimated the approximate 162 square feet (sf) of existing piles would be removed, and approximately 240 sf of steel pipe piles, fender piles, and bridge support piles would be installed. A net total of 78 sf of pilings (total piling installed minus pilings removed) would be installed.

Most project components would be fabricated off-site and transferred to the project site via barge. Debris generated during construction and site clearing activities would consist of the existing steel float, steel guide piles, gangway, bridge structure, bridge structure steel support system (H-Pile and steel beams), concrete approach slab, and miscellaneous electrical/mechanical conduit attached to the existing elements to be removed. In accordance with Section 5.408 of the CALGreen Code, the project would implement a Construction Waste Management Plan (CWMP) for recycling and/or salvaging for reuse of a minimum of 65 percent of nonhazardous construction/demolition debris. Solid waste collected throughout the City is hauled to the Davis Street Transfer Station in the City of San Leandro, where it is loaded into higher-capacity trailer trucks and hauled to Altamont Landfill in eastern Alameda County. Recyclable materials, which are collected from residential and commercial customers in separate bins, are hauled to ACI's Aladdin Materials Recovery Facility (MRF) and Transfer Facility in the City of San Leandro, which sorts, separates, and bundles the recyclables for sale to secondary markets (City of Alameda 2021a). Materials removed from the project site would be removed via a support barge in the Oakland Inner Harbor.

Consistent with Section 4-10.7 of the Alameda Municipal Code, noise-generating construction activities would be limited to occur between 7:00 a.m. and 7:00 p.m. Monday through Friday and 8:00 a.m. and 5:00 p.m. on Saturdays. It is anticipated that project construction would occur Monday through Friday, 7:00 a.m. to 3:30 p.m., with the potential for Saturday work.

Project construction staging would occur within the AMS Ferry Terminal parking lot. Before construction activities begin on any project component, signage would be posted surrounding the project site notifying the public of temporary parking lot closure. No street closures are anticipated. Because the project would be limited to the project site and construction/staging activities would not impede into the local roadways, a traffic control plan would not be implemented. The San Francisco Bay Trail, which traverses east-west through the AMS Ferry Terminal and project site, would remain open for pedestrian access with the potential for brief interruptions with minor rerouting during certain construction activities, such as concrete installation for the new bridge structure landside cap beam. Access and use of the San Francisco Bay Trail would return to its original condition upon project completion.

1.3 Previous Agency Consultation

U. S. Army Corps of Engineers (USACE)

- Application filed under the federal Clean Water Act (CWA) Section 404 and Rivers & Harbors Act (RHAA) 1899 Section 10 (File No. 2013-00401S) on 01/10/22
- Biological Assessment submitted 01/26/22; Revised 02/12/22
- USACE/National Marine Fisheries Service (NMFS) Invitation to Consultation, 02/02/22
- NMFS Letter of Nonconcurrence (LNC), Endangered Species Act, Section, 7 Main Street Ferry Terminal Refurbishment Project (Corps File No. 2013-00401S), filed 02/24/22.

S. F. Bay Regional Water Quality Control Board (RWQCB)

- Application for Notice of Applicability (NOA) under the General Waste Discharge Requirements for Projects under Construction and Maintenance of Overwater Structures in San Francisco Bay (Order Number R- 2- 2018-0009) filed 02/07/22.

San Francisco Bay Conservation and Development Commission (BCDC)

- Application for a Non-Material Amendment No. 8 to BCDC Permit No. 1991.001.00 (City of Alameda) for the WETA Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (Project), filed 01/04/22.
- California Department of Fish and Wildlife (CDFW) consultation initiated 02/13/22. Continued discussion with CDFW (Arn Aarreberg) resulting in CDFW's recommendation that WETA file an Incidental Take Permit (ITP) based on potential noise impacts to longfin smelt.

2 Regulatory Setting

2.1 Federal

2.1.1 Federal Endangered Species Act

The federal Endangered Species Act (FESA) of 1973 (16 USC 1531 et seq.), as amended, is administered by the U.S. Fish and Wildlife Service (USFWS) for most plant and animal species, and by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) for certain marine species. This legislation is intended to provide a means to conserve the ecosystems upon which endangered and threatened species depend and provide programs for the conservation of those species, thus preventing the extinction of plants and wildlife. The FESA defines an endangered species as "any species that is in danger of extinction throughout all or a significant portion of its range." A threatened species is defined as "any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Under FESA, it is unlawful to "take" any listed species, and "take" is defined as, "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

FESA allows for the issuance of incidental take permits for listed species under Section 7, which is generally available for projects that also require other federal agency permits or other approvals, and under Section 10, which provides for the approval of habitat conservation plans on private property without any other federal agency involvement.

2.1.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 USC 703 et seq.), as amended, prohibits the intentional take of any migratory bird or any part, nest, or eggs of any such bird. Under the MBTA, "take" is defined as pursuing, hunting, shooting, capturing, collecting, or killing, or attempting to do so. In December 2017, Department of the Interior Principal Deputy Solicitor Jorjani issued a memorandum (M-37050) that interprets the Migratory Bird Treaty Act's "take" prohibition to apply only to affirmative actions that have as their purpose the taking or killing of migratory birds, their nests, or their eggs. Unintentional or accidental take is not prohibited. Additionally, Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, requires that any project with federal involvement address impacts of federal actions on migratory birds with the purpose of promoting conservation of migratory bird populations (66 FR 3853–3856). The Executive Order requires federal agencies to work with USFWS to develop a memorandum of understanding. USFWS reviews actions that might affect these species.

2.1.3 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (MMPA), as amended, establishes federal responsibility for protection and conservation of marine mammal species by prohibiting the act of hunting, killing, capture, and/or harassment of any marine mammal, defined as "take" by the MMPA. The MMPA also prohibits the import, export, or sale of any marine mammals, parts, or products within the United States. The NMFS and USFWS are responsible for the implementation of the MMPA; the USFWS ensures protection of sea otters, marine otters, walruses, polar bears, three species of manatees, and dugongs, the NMFS protects pinnipeds (seals and sea lions) and cetaceans (whales and dolphins). The MMPA, as amended, also provides for "incidental take" of marine mammals if NMFS determines that the "take" would have a negligible impact on small numbers of non-listed marine mammal species.

2.1.4 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. Sections 1801–1884) as amended in with the Sustainable Fisheries Act of 1996 (Public Law 104-297), establishes Essential Fish Habitat (EFH) descriptions in federal Fisheries Management Plans (FMPs) and requires federal agencies to consult with NMFS on activities that may adversely affect EFH. More generally the Magnuson-Stevens Act provides conservation and management of U.S. fisheries, development of domestic fisheries, and phasing out of foreign fishing activities in federal waters that extend to 200 miles offshore.

The Central Bay region of the San Francisco Bay-Delta, including the waters encompassing the project site, is designated as EFH for fish managed under Fishery Management Plans and as a Habitat Area of Particular Concern under Fishery Management Plans.

2.1.5 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) was enacted by Congress in 1972 to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The CZMA is administered by NOAA's Office of Ocean and Coastal Resource Management.

Under Section 307 of the CZMA (16 USC § 1456), activities that are undertaken by federal agencies or receive federal funding and may affect coastal uses or resources require a federal license or permit and must be consistent with a state's federally approved coastal management program. California's California Coastal Act, the McAteer-Petris Act, and the Suisun Marsh Protection Act are these federally approved coastal management programs and are implemented by the California Coastal Commission for activities affecting coastal resources outside of San Francisco Bay. The Bay Conservation and Development Commission (BCDC) implements the McAteer-Petris Act and the Suisun Marsh Preservation Act and performs federal consistency reviews for activities affecting the San Francisco Bay and Delta and the Bay shoreline.

2.1.6 Clean Water Act

The Clean Water Act (CWA) provides guidance for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. Section 401 requires a project operator for a federal license or permit that allows activities resulting in a discharge to waters of the United States to obtain state certification, thereby ensuring that the discharge will comply with provisions of the CWA. The regional water quality control boards (RWQCBs) administer the certification program in California. Section 402 establishes a permitting system for the discharge of any pollutant (except dredged or fill material) into waters of the United States. Section 404 establishes a permit program administered by the U.S. Army Corps of Engineers (USACE) that regulates the discharge of dredged or fill material into waters of the United States, including wetlands. USACE implementing regulations are found at 33 CFR 320 and 330. Guidelines for implementation are referred to as the Section 404(b)(1) Guidelines, which were developed by the U.S. Environmental Protection Agency in conjunction with USACE (40 CFR 230). The guidelines allow the discharge of dredged or fill material into the aquatic system only if there is no practicable alternative that would have less adverse impacts.

Wetlands and Other Waters of the United States

Under Section 404 of the CWA, USACE has the authority to regulate activities that could discharge fill or dredge material or otherwise adversely modify wetlands or other waters of the United States. USACE implements the federal policy embodied in Executive Order 11990, which, when implemented, is intended to result in no net loss of wetland values or function. On January 23, 2020, USACE and the U.S. Environmental Protection Agency finalized the "Navigable Waters Protection Rule," which establishes a new definition of Waters of the United States under the CWA. The new Navigable Waters Protection Rule (Rule) repeals the Obama Administration-era 2015 Clean Water Rule and replaces it with a definition that drastically limits the scope of federal regulation to a much narrower collection of aquatic resource features. Among the greatest changes, the Rule eliminates "significant nexus" determinations to determine if potential tributaries have a significant effect on the "chemical, physical, and biological integrity of downstream traditional navigable waters." The Rule also redefines the term "adjacent." In order for an adjacent wetland to be jurisdictional, it must touch "at least one point or side of a jurisdictional water" or have a direct hydrological surface connection to a traditional navigable waterway. Hydrological connections through groundwater, which have been suggested to maintain federal jurisdiction in the past, are now outside of the scope of federal purview. Most importantly, the Rule identifies four specific categories of aquatic resource features that will be regulated by the federal government under the CWA, leaving oversight for other "excluded" waterbodies to states and tribes. The following four specific categories of aquatic resources are regulated under the CWA:

1. Territorial seas and traditional navigable waters
2. Perennial and intermittent tributaries
3. Certain lakes, ponds, and impoundments
4. Wetlands that are adjacent to jurisdictional waters

The revised Rule does not expand federal regulation to include new categories of aquatic features; however, it does provide a list of excluded features that would no longer be considered waters of the United States under the final Rule. Most significantly, "ephemeral" streams and other features that only flow in direct response to precipitation, and are particularly prevalent in the western United States, would no longer be subject to CWA regulation.

The State Water Resources Control Board has authority over wetlands through Section 401 of the CWA, as well as the Porter–Cologne Water Quality Control Act (Porter–Cologne Act), California Code of Regulations Section 3831(k), and California Wetlands Conservation Policy. The CWA requires that an applicant for a Section 404 permit (to discharge dredge or fill material into waters of the United States) first obtain certification from the appropriate state agency stating that the fill is consistent with the state's water quality standards and criteria. In California, the authority to either grant certification or waive the requirement for permits is delegated by the State Water Resources Control Board to the nine regional boards. A request for certification is submitted to the regional board at the same time that an application is filed with USACE.

2.2 State

2.2.1 California Endangered Species Act

The California Endangered Species Act (CESA) (California Fish and Game Code, Section 2050–2068) provides protection and prohibits the take of plant, fish, and wildlife species listed by the State of California. Unlike FESA, under CESA state-listed plants have the same degree of protection as wildlife, but insects and other invertebrates may not be listed. Take is defined similarly to FESA and is prohibited for both listed and candidate species. Take authorization may be obtained by the project applicant from CDFW under CESA Section 2081, which allows take of a listed species for educational, scientific, or management purposes. In this case, private developers consult with CDFW to develop a set of measures and standards for managing the listed species, including full mitigation for impacts, funding of implementation, and monitoring of mitigation measures.

2.2.2 California Fish and Game Code

Fully Protected Species

Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code outline protection for fully protected species of mammals, birds, reptiles, amphibians, and fish. Species that are fully protected by these sections may not be taken or possessed at any time. CDFW cannot issue permits or licenses that authorize the “take” of any fully protected species, except under certain circumstances, such as scientific research and live capture and relocation of such species pursuant to a permit for the protection of livestock. Furthermore, it is the responsibility of the CDFW to maintain viable populations of all native species. Toward that end, the CDFW has designated certain vertebrate species as Species of Special Concern, because declining population levels, limited ranges, and/or continuing threats have made them vulnerable to extinction.

Section 5901

Section 5901 makes it unlawful to construct or maintain any device or contrivance that prevents, impedes, or tends to prevent or impede, the passing of fish up and down stream. Fish are defined in Section 45 as a wild fish, mollusk, crustacean, invertebrate, amphibian, or part, spawn, or ovum of any of those animals.

Section 5937

Section 5937 requires that the owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. During the minimum flow of water in any river or stream, permission may be granted by the department to the owner of any dam to allow sufficient water to pass through a culvert, waste gate, or over or around the dam, to keep in good condition any fish that may be planted or exist below the dam, when, in the judgment of the department, it is impracticable or detrimental to the owner to pass the water through the fishway.

Section 1600–1616

CDFW jurisdiction includes ephemeral, intermittent, and perennial watercourses (including dry washes) and lakes characterized by the presence of (1) definable bed and banks and (2) existing fish or wildlife resources. CDFW takes jurisdiction to the top of bank of the stream, or the limit of the adjacent riparian vegetation, which may include oak woodlands in canyon bottoms. Historical court cases have further extended CDFW jurisdiction to include watercourses that seemingly disappear but reemerge elsewhere. Under the CDFW definition, a watercourse need not exhibit evidence of an ordinary high-water mark (OHWM) to be claimed as jurisdictional. CDFW does not have jurisdiction over ocean or shoreline resources.

Under California Fish and Game Code, Sections 1600–1616, CDFW has the authority to regulate work that will substantially divert or obstruct the natural flow of, or substantially change or use any material from, the bed, channel, or bank of any river, stream, or lake. CDFW also has the authority to regulate work that will deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. This regulation takes the form of a requirement for a Lake or Streambed Alteration Agreement and is applicable to all projects. Applications to CDFW must include a complete certified CEQA document.

California Native Plant Protection Act

The Native Plant Protection Act of 1977 (see Section 1900 et seq. of the California Fish and Game Code) directed CDFW to carry out the Legislature's intent to "preserve, protect and enhance rare and endangered plants in this State." The Native Plant Protection Act gave the California Fish and Game Commission the power to designate native plants as "endangered" or "rare" and protect endangered and rare plants from take. CESA expanded on the original Native Plant Protection Act and enhanced legal protection for plants, but the Native Plant Protection Act remains part of the California Fish and Game Code. To align with federal regulations, CESA created the categories of "threatened" and "endangered" species. It converted all "rare" animals into the act as threatened species, but did not do so for rare plants. Thus, there are three listing categories for plants in California: rare, threatened, and endangered. Because rare plants are not included in CESA, mitigation measures for impacts to rare plants are specified in a formal agreement between CDFW and the project proponent.

Nesting Birds

Section 3503 of the California Fish and Game Code states that it is unlawful to take, possess, or needlessly destroy the nests or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto. Section 3503.5 protects all birds of prey (raptors) and their eggs and nests. Section 3511 states that fully protected birds or parts thereof may not be taken or possessed at any time. Section 3513 states that it is unlawful to take or possess any migratory non-game bird as designated in the MBTA.

2.2.3 California Environmental Quality Act

CEQA requires identification of a project's potentially significant impacts on biological resources and ways that such impacts can be avoided, minimized, or mitigated. The act also provides guidelines and thresholds for use by lead agencies for evaluating the significance of proposed impacts.

The State of California CEQA Guidelines (CEQA Guidelines) Section 15380(b)(1) defines endangered animals or plants as species or subspecies whose "survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors." A rare animal or plant is defined in Section 15380(b)(2) as a species that, although not presently threatened with extinction, exists "in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens; or … [t]he species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered 'threatened' as that term is used in the federal Endangered Species Act." Additionally, an animal or plant may be presumed to be endangered, rare, or threatened if it meets the criteria for listing, as defined further in CEQA Guidelines Section 15380(c).

CDFW has developed a list of "Special Species" as "a general term that refers to all of the taxa the California Natural Diversity Database (CNDDB) is interested in tracking, regardless of their legal or protection status." This is a broader list than those species that are protected under the FESA, CESA, and other California Fish and Game Code provisions, and includes lists developed by other organizations, including for example the Audubon Watch List Species. Guidance documents prepared by other agencies, including the Bureau of Land Management Sensitive Species and USFWS Birds of Special Concern, are also included on this CDFW Special Species list. Additionally, CDFW has concluded that plant species listed as California Rare Plant Rank (CRPR) 1 and 2 by the California Native Plant Society (CNPS), and potentially some CRPR 3 plants, are covered by CEQA Guidelines Section 15380.

Section IV, Appendix G (Environmental Checklist Form), of the CEQA Guidelines requires an evaluation of impacts to "any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service."

2.2.4 San Francisco Bay Plan

The San Francisco BCDC is responsible for analyzing, planning, and regulating San Francisco Bay and its shoreline under the McAteer-Petris Act. This jurisdiction includes the waters of the Bay as well as a shoreline band that extends inland 100 feet from the high tide line. Any fill, excavation of material, or substantial change in use within BCDC jurisdiction requires a permit from BCDC. The San Francisco Bay Plan (Bay Plan) specifies goals, objectives, and policies for existing and proposed waterfront land use and other areas and is also implemented by the BCDC. Specific Bay Plan policies that are relevant to the project are as follows:

> **Policy 4(a):** The Commission should consult with the California Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, whenever a proposed project may adversely affect an endangered or threatened plant, fish, other aquatic organism or wildlife species.
>
> **Policy 4(b):** The Commission should not authorize projects that would result in the "taking" of any plant, fish, other aquatic organism or wildlife species listed as endangered or threatened pursuant to the state or federal Endangered Species Acts, or the federal Marine Mammal Protection Act, or species that are candidates for listing under these acts, unless the project applicant has obtained the appropriate "take" authorization from the U.S. Fish and Wildlife Service, National Marine Fisheries Service or the California Department of Fish and Wildlife.
>
> **Policy 4(c):** The Commission should give appropriate consideration to the recommendations of the California Department of Fish and Wildlife, the National Marine Fisheries Service or the U.S. Fish and Wildlife Service in order to avoid possible adverse effects of a proposed project on fish, other aquatic organisms and wildlife habitat.

2.2.5 Porter–Cologne Water Quality Control Act

Pursuant to provisions of the Porter–Cologne Act, the RWQCBs regulate discharging waste, or proposing to discharge waste, within any region that could affect a water of the state (California Water Code, Section 13260[a]). The State Water Resources Control Board defines waters of the state as "any surface water or groundwater, including saline waters, within the boundaries of the state" (California Water Code, Section 13050[e]). As of April 2019, the State Water Resources Control Board has narrowed their definition of a waters of the state to include the following:

1. Natural wetlands
2. Wetlands created by modification of a surface water of the state
3. Artificial wetlands that meet any of the following criteria:
    a. Approved by an agency as compensatory mitigation for impacts to other waters of the state, except where the approving agency explicitly identifies the mitigation as being of limited duration
    b. Specifically identified in a water quality control plan as a wetland or other water of the state
    c. Resulted from historic human activity, is not subject to ongoing operation and maintenance, and has become a relatively permanent part of the natural landscape
    d. Greater than or equal to 1 acre in size unless the artificial wetland was constructed and is currently used and maintained, primarily for one or more of the following purposes: industrial or municipal wastewater treatment or disposal; settling of sediment; detention, retention, infiltration, or treatment of stormwater runoff and other pollutants or runoff subject to regulation under a municipal, construction, or industrial permitting program; treatment of surface waters; agricultural crop irrigation or stock watering; fire suppression; industrial processing or cooling water; active surface mining – even if the site is managed for interim wetlands functions and values; log storage; treatment, storage, or distribution of recycled water; maximizing groundwater recharge (this does not include wetlands that have incidental groundwater recharge benefits); or fields flooded for rice growing.

All waters of the United States are waters of the state. Wetlands, such as isolated seasonal wetlands, that are not generally considered waters of the United States are considered waters of the state if, "under normal circumstances, (1) the area has continuous or recurrent saturation of the upper substrate caused by groundwater, or shallow surface water, or both; (2) the duration of such saturation is sufficient to cause anaerobic conditions in the upper substrate; and (3) the area's vegetation is dominated by hydrophytes or the area lacks vegetation." (SWRCB 2019). If a CWA Section 404 permit is not required for a project, the RWQCB may still require a permit (waste discharge requirements) for impacts to waters of the state under the Porter–Cologne Act.

2.3 Local

2.3.1 Alameda County General Plan

The Alameda County General Plan Open Space and Conservation Element contains the following objectives and policies for biological resources protection relevant to the proposed project:

> **5.1.a:** Preserve and enhance all wetlands and water-related habitat. Water-related habitat includes open water, Bay bottom, mudflats, uplands, sandy areas, lagoons, and sloughs. Since the various Bay wetlands are linked ecologically, preservation of nearby Arrowhead, Fan, and Damon marshes

would aid in the preservation and enhancement of Alameda's wetlands, including those at the Elsie D. Roemer Bird Sanctuary and Bayview Shoreline Preserve.

5.1.b: Protect Open Space-Habitat areas, including sensitive submerged tidelands areas (mudflats) and eelgrass beds, from intrusions by motorized recreational craft, including jet skis and hovercraft.

5.1.c: Continue to prohibit filling of water-related habitat except in those limited cases in which a strong public need clearly outweighs the habitat preservation need, and where approval is granted by the appropriate agencies.

5.1.g: Conduct all dredging in compliance with the Long-Term Management Strategy, Management Plan, prepared by the USACE, USEPA, BCDC, and SFRWQCB.

5.1.j: Use the City of Alameda Street Tree Management Plan as the guiding reference when considering action which would affect the trees contained in the urban forest. After presenting a thorough inventory of the location, composition, condition, and maintenance needs of City-maintained trees, the Street Tree Management Plan presents recommendations for planting and tree maintenance.

5.1.n: Inventory existing wetlands and water-related and other habitats to create a comprehensive map of sensitive biological and botanical resources, to better protect these resources.

5.1.o: Complete the Bayview Shoreline Preserve Improvement Plan.

5.1.r: Continue to participate in the Alameda County Non-Point Source Task Force. The Task Force is made up of public works directors or representatives from each city within Alameda County and is engaged in organizing the implementation of the Non-Point Source Control Program, to ensure continued improvement of Bay water quality. Non-point sources of pollution include polluted urban runoff, construction site erosion, pollutants in freshwater inflow, pollutants from toxic waste sites and dumps, direct spills of pollutants to the Bay, dredging, and vessel waste discharges.

5.1.s: Participate in the Non-Point Source Control Program (NPSC). Although not fully designed, the NPSC Program is anticipated to include measures for prevention of contamination and source control of pollutants. Treatment of urban runoff, while potentially effective, is costly, and prevention and source control are the preferred methods of abatement. The main objective of the NPSC Program is to ensure that only storm water enters the storm drains, which will involve eliminating illegal connections and strict surveillance and enforcement "of "no dumping" mandates. Educational as well as regulatory strategies are under consideration.

5.1.t: Consider adopting City standards in addition to those adopted by the County, to deal with non-point source water pollution problems such as sheet flow storm runoff and sedimentation affecting sensitive water habitats.

5.1.w: Require new marinas and encourage existing marinas to provide easily accessible waste disposal facilities for sewage and bilge and engine oil residues.

5.1.x: Prevent migration of runoff off-site or into wetlands areas and water related habitat by requiring that proposed projects include design features ensuring detention of sediment and contaminants.

5.1.bb: Require a biological assessment of any proposed project site where species or the habitat of species defined as sensitive or special status by the California Department of Fish and Game or the U.S. Fish and Wildlife Service might be present. Listings of sensitive and special status species change from year to year, but might include birds, animals, and plants such as the California Least Tern, California Clapper Rail, Burrowing Owl, Alameda Island Mole, Salt Marsh Wandering Shrew, Adobe Sanicle, Pt. Reyes Bird's Beak, and Monterey Spineflower.

5.2.a: Protect and preserve Bay waters and vegetation as nurseries and spawning grounds for fish and other aquatic species, both as a part of habitat preservation and to encourage continued use of the Bay for commercial fishing production.

2.3.2 City of Alameda General Plan 2040

The City of Alameda General Plan 2040 Conservation and Climate Action Element, as well as the Parks and Open Space Element include the following biological resource policies relevant to the project:

- **Policy CC-27:** Habitat and Biological Resource Protection and Restoration. Protect and restore natural habitat in support of biodiversity and protect sensitive biological resources to prepare for climate change.
- **Policy CC-33:** Green Infrastructure. Protect San Francisco Bay, San Leandro Bay, and the Alameda Oakland Estuary by promoting, requiring, and constructing green infrastructure that improves stormwater runoff quality, minimizes stormwater impacts on stormwater infrastructure, improves flood management, and increases groundwater recharge.
- **Policy CC-34:** New Development. Promote the preservation of on-site natural elements in new development, when feasible, that contribute to the community's native plant and wildlife species value and to aesthetic character.
- **Policy OS-12:** Wildlife Habitat. Promote the preservation, protection and expansion of wildlife habitat areas, open space corridors, and ecosystems as essential pieces of the overall network and important contributors to building citywide resilience.

2.3.3 City of Alameda Tree Preservation Policies

The City of Alameda protects trees according to species, size and location of tree as follows:

- All coast live oaks (*Quercus agrifolia*) in Alameda with a ten inch (10") or greater diameter measured four and a half feet (4.5') above ground.
- All Mexican fan palms (*Washingtonia robusta*) and California fan palms (*Washingtonia filifera*) in the public rights of way on both sides of Burbank Street, Portola Avenue, and Eighth Street between Central and Portola Avenues.
- All trees in the three median islands on Thompson Avenue between High Street and Fernside Boulevard, known as Christmas Tree Lane. First island: Atlas Cedar (*Cedrus atlantica*); Coast Redwood (*Sequoia sempervirens*). Second island: Atlas Cedar; Coast Redwood; Monterey Pine (*Pinus radiate*). Third island: Atlas Cedar; Coast Redwood; Jellicote Pine (*Pinus patula*); Bradford Pear (*Pyrus calleryana*).

- All sycamore (London plane trees) (*Platanus acerifolia*) in the public rights of way on both sides of Central Avenue between Fernside Boulevard a[nd] 5th Street.

The removal of Protected Trees requires a permit, referred to as a Certificate of Approval from the City, and the removal of trees that were planted as part of a City-approved landscape plan requires an approval called a Zoning Compliance Determination (City of Alameda, 2015). In addition, no building shall be moved within the City unless provision be made for the protection of and prevention of injury to any tree, shrub or plant located in any street, park or other public place in the City (Municipal Code 13-17.14; Ord. No. 865 N.S.)

3 Methods

Data regarding biological resources present within the biological survey area (BSA) was obtained through a review of pertinent literature, field reconnaissance, and habitat assessments, which are described in detail in this section. For purposes of this report, special-status resources are defined as follows:

- Special-status plant species include (1) species designated as either rare, threatened, or endangered by CDFW or USFWS and are protected under either the CESA (California Fish and Game Code Section 2050 et seq.) or the FESA (16 USC 1531 et seq.); (2) species that are candidate species being considered or proposed for listing under FESA or CESA; (3) species that are included on the CDFW Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2022a), or species with a CRPR of 1 or 2 in the CNPS Inventory of Rare and Endangered Plants of California (CNPS Inventory) (CNPS 2022).
- Special-status wildlife species include (1) species designated as either rare, threatened, or endangered by CDFW or USFWS/NMFS and are protected under either the CESA (California Fish and Game Code Section 2050 et seq.) or the FESA (16 USC 1531 et seq.); (2) species that are candidate species being considered or proposed for listing under FESA or CESA; (3) species that are included on the CDFW Special Animals List (CDFW 2022b).
- Special-status vegetation communities are those designated as sensitive by the CDFW or those that provide habitat for special-status species.

3.1 Literature Review

Prior to conducting a field assessment, a literature search and database review were conducted by Dudek biologists to evaluate the natural resources found or potentially occurring within the BSA. The database review included the most recent versions of the CNDDB and special-status species lists (CDFW 2022a, 2022b), and the CNPS Inventory (CNPS 2022). These databases were reviewed to identify sensitive biological resources present or potentially present for the U.S. Geological Survey 7.5-minute quadrangle on which the BSA is located (Oakland West) and the eight surrounding quadrangles (Oakland East, Richmond, Briones Valley, San Francisco North, San Francisco South, Hunters Point, San Leandro, San Quentin). The CDFW occurrence data and critical habitat databases were queried using geographic information system (GIS) software based on a 5-mile buffer around the project site. Potential and/or historic drainages and aquatic features were investigated based on a review of U.S. Geological Survey topographic maps (1:24,000-scale), aerial photographs, the USFWS National Wetland Inventory database (USFWS 2022), and the Natural Resource Conservation Service's Web Soil Survey (USDA 2022a).

3.2 Field Surveys

On July 8, 2022, Dudek fisheries and wildlife biologist, Andy Hatch, conducted a reconnaissance-level field survey of the BSA to document biological resources and vegetation communities.

3.2.1 Vegetation Community and Land Cover Mapping

Dudek used CDFW's Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFW 2018) and List of Vegetation Alliances and Associations (CDFW 2019b), also referred to as the Natural Communities List, to map the entire BSA. Vegetation communities and land covers were delineated to the vegetation alliance level, and where appropriate the association level. Some modifications, such as the Preliminary Descriptions of the Terrestrial natural Communities of California (Holland 1986; Oberbauer et al. 2008), were incorporated to accommodate the lack of conformity of the observed communities to those included in these references.

3.2.2 Plants

Latin and common names for plant species with a CRPR follow the CNPS Inventory (CNPS 2022). For plant species without a CRPR, Latin names follow the Jepson Interchange List of Currently Accepted Names of Native and Naturalized Plants of California (Jepson Flora Project 2022) and common names follow the U.S. Department of Agriculture's Natural Resources Conservation Service Plants Database (USDA 2022b).

3.2.3 Wildlife

All wildlife species detected during the field surveys by sight, vocalizations, burrows, tracks, scat, and other signs were recorded. The site was visually scanned with and without binoculars to identify wildlife. Latin and common names of animals follow Crother (2012) for reptiles and amphibians, American Ornithologists' Union for birds (AOU 2016), Wilson and Reeder (2005) for mammals, and Moyle (2002) for fish.

3.2.4 Survey Limitations

Limitations of the survey include a diurnal bias and the absence of trapping for small mammals, reptiles, fish, and amphibians. The survey was conducted during the daytime to maximize the detection of most wildlife. Most birds are active in the daytime, so diurnal surveys maximize the number of bird observations. Conversely, diurnal surveys usually result in few observations of mammals, many of which may only be active at night. In addition, many species of reptiles and amphibians are secretive in their habits and are difficult to observe using standard meandering transects.

3.3 Special-Status Species Habitat Assessment

Appendix A, Special-Status Plants Potentially Occurring within the BSA, and Appendix B, Special-Status Wildlife (including fish and marine species) Potentially Occurring within the BSA, provide tables of all special-status species whose geographic ranges fall within the general BSA vicinity. Special-status species potential to occur within the BSA were evaluated based on known species distribution, species-specific habitat preferences, and Dudek biologists' knowledge of regional biological resources. Species potentially occurring within the BSA are identified as having moderate or high potential to occur based on habitat conditions on site, and species for which there is little or no suitable habitat are identified as not expected to occur or having low potential to occur.

4 Environmental Setting

The purpose of this section is to describe the general existing conditions within and adjacent to the BSA to document the baseline conditions for this report and subsequent analysis.

4.1 Climate

The BSA is located in Alameda County, which experiences seasons of dry and warm summers and cooler, wetter winter seasons with monthly average temperatures ranging from 48°F to 65°F. Annual precipitation averages approximately 19.5 inches per year, with most precipitation received between October and April.

4.2 Geology and Topography

The BSA is located within the San Francisco Bay, in the Central Bay, and more specifically the Oakland-Alameda Estuary. Originally a tidal slough, the Oakland-Alameda Estuary has been dredged since the 1800s to create a shipping channel and support the port of Oakland which loads and discharges almost all the containerized goods moving through Northern California. The Oakland-Alameda Estuary receives freshwater input from creeks, stormwater drainage, and direct surface runoff. Tides and marine currents also impact the movements of sediments within the shipping channel and marine waters of the San Francisco Bay.

4.3 Soils

According to the Natural Resource Conservation Service's Web Soil Survey (USDA 2022a), the BSA occurs within the Alameda County, Western Part. The BSA consists of two soil types, Urban Land and Xeropsamments, fill (along the shoreline).

4.4 Surrounding Land Uses

The BSA is in the Oakland Inner Harbor, in a developed portion of Alameda Island. Residential neighborhoods are to the south of the BSA, and developed industrial sites are situated to the east. The Oakland Inner Harbor shipping channel and terminal are located north of the BSA, and a dog park and some undeveloped (but highly disturbed) shoreline occur west of the BSA, running out to the former Alameda naval air station, now known as Alameda Point.

4.5 Watersheds and Hydrology

The BSA is located within the North Alameda watershed, which compromises the majority of Alameda Island. Because the topography of Alameda Island is flat and has a lot of filled baylands, no creeks or streams occur but surface water is transported to the San Francisco Bay through a series of storm drains.

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5 Results

This section describes the results of the literature review, field surveys, and habitat assessments within the BSA.

5.1 Vegetation Communities and Land Covers

The BSA supports the following vegetation communities and landcovers: Ruderal and Non-Native Grassland and Urban/Developed Land. Marine resources are discussed in more detail in Section 5.2.

5.1.1 Ruderal and Non-Native Grassland

Ruderal vegetation and non-native grassland occur along undeveloped portions of the Oakland Inner Harbor shoreline, adjacent to the bay fill and rip-rap that make up the shoreline proper. These areas are subject to human disturbance; opportunistic plant species that can handle high levels of disturbance dominate in these conditions. While some native species may occur, these areas are typically dominated by non-native and often highly invasive species. The BSA included very limited ruderal vegetation and non-native grassland, including fennel (*Foeniculum vulgare*), and non-native grasses that may include foxtail brome (*Bromus madritensis*), rattail sixweeks grass (*Festuca myuros*), or wild oat (*Avena* spp.), but were not identified due to recent vegetation management and human disturbance.

5.1.2 Urban and Developed Land

According to Oberbauer et al. (2008), urban/developed land represents areas that have been constructed upon or otherwise physically altered to an extent that native vegetation communities are not supported. This land cover type generally consists of semi-permanent structures, homes, parking lots, pavement or hardscape, and landscaped areas that require maintenance and irrigation (e.g., ornamental greenbelts). Typically, this land cover type is unvegetated or supports a variety of ornamental plants and landscaping.

The majority of the BSA Is urban/developed land and includes the parking area, ferry terminal building, and walkways.

5.2 Marine Resources

Open water, aquatic, and subtidal habitat occurs in the BSA in the vicinity of the terminal dock and in the Oakland Inner Harbor, which is part of the Central Bay, and Oakland-Alameda Estuary. The estuary has been dredged for years to create the port and shipping channel, altering the pre-developed tidal slough condition that would have occurred there. Inflows of fresh water are primarily through storm drain and urban run-off with some natural creeks. Open water habitat in the San Francisco Bay provides wintering and stop-over sites for avian species using the Pacific Flyway. While the BSA and surrounding Alameda Island is largely urbanized, open water surrounding the island could support a variety of marine waterfowl including black oystercatcher (*Haematopus bachmani*), Canada goose (*Branta canadensis*), California brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocoraxuratuss*), various gulls (*Larus* spp.), and others.

Aquatic vegetation in the BSA could include algae species or common subtidal plants including pondweed (*Potamogeton* spp.) and widgeon grass (*Ruppia maritima*). The greater San Francisco Bay and the Oakland-Alameda Estuary supports a large variety of invertebrates, crustaceans, mollusks, pelagic species, and a wide variety of fishes.

San Francisco Bay and the Oakland-Alameda Estuary, and the BSA, could also support the following special-status species: Central California Coast (CCC) steelhead Distinct Population Segment (DPS) (*Oncorhynchus mykiss*), Central Valley fall/late-fall run Chinook salmon Evolutionarily Significant Unit (ESU) (*Oncorhynchus tshawytscha*), and the southern DPS of North American green sturgeon (*Acipenser medirostris*). Pacific herring (*Clupea pallasii*) is a common pelagic species within the San Francisco Bay and is regulated by the CDFW due to declines. Marine mammal species, including harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*) also occur within the San Francisco Bay, and have been observed in the Oakland Inner Harbor. WETA ferry boat captains have reported frequently seeing both harbor seals and California sea lions in the estuary channel and near Bay Ship and Yacht within the inner harbor but did not report seeing either species or other marine mammals near the ferry dock/platform. Whales (no species reported but likely gray whales, *Eschrichtius robustus*) were reported to have been seen occasionally spotted in the Bay during winter and spring (WETA, pers. Comm. 2022).

5.3 Plants and Wildlife Observed

5.3.1 Plants

A total of 7 species of native or naturalized plants, were recorded in the BSA. The majority of the site is developed, with ornamental vegetation including ornamental rosemary (*Sal20egra20inusinus*) and ornamental pear (*Pyrus calleryana*). Ruderal and nonnative grassland habitat species included fennel, foxtail brome, rattail sixweeks grass, wild oat, and black mustard (*Brass egraegra*).

5.3.2 Wildlife

A total of 8 wildlife species were recorded within the BSA or vicinity during surveys. Wildlife species detected on or in the immediate vicinity of the BSA included California ground squirrel (*Otospermophilus beecheyi*), Canada goose (*Branta canadensis*), common raven (*Corvus corax*), European starling (*Sturnus vulgaris*), California gull (*Larus californicus*), rock pigeon (*Columba livia*), common tern (*Sterna hirundo*), and black oystercatcher (*Haematopus bachmani*).

5.4 Special-Status Biological Resources

Appendix A and Appendix B provide tables of all special-status species whose geographic ranges fall within the general BSA vicinity. Special-status species' potential to occur within the BSA were evaluated based on known species distribution, species-specific habitat preferences, and Dudek biologists' knowledge of regional biological resources. Species potentially occurring within the BSA are identified as having moderate or high potential to occur based on habitat conditions on site, and species for which there is little or no suitable habitat are identified as not expected to occur or having low potential to occur.

5.4.1 Special Status Plants

Special-status plants include those listed, or candidates for listing, as threatened or endangered by USFWS and CDFW, and species identified as rare by the CNPS (particularly CRPR 1A, presumed extinct in California; CRPR 1B, rare, threatened, or endangered throughout its range; and CRPR 2, rare or endangered in California, more common elsewhere).

Dudek biologists performed an extensive desktop review of literature, existing documentation, and GIS data to evaluate the potential for special-status plant species to occur within the BSA. Each special-status plant species was assigned a rating of “not expected,” “low,” “moderate,” or “high” potential to occur based on relative location to known occurrences, vegetation community, soil, and elevation. Based on the results of the literature review and database searches, 105 special-status plant species were identified as potentially occurring within the region of the BSA. None of these species were determined to have the potential to occur within the BSA based on the soils, vegetation communities (habitat) present, elevation range, and previous known locations based on the CNDDb, IPaC, and CNPS Inventory.

5.4.2 Special Status Fish, Wildlife, and Marine Species

Special-status fish, wildlife, and marine species include those listed, or candidates for listing, as threatened or endangered by USFWS and CDFW, and those designated as species of special concern by CDFW and as sensitive by USFWS.

Similar to special-status plants, Dudek biologists performed an extensive desktop review of literature, existing documentation, and GIS data to evaluate the potential for special-status fish, wildlife, and marine species to occur within the BSA. Each special-status species was assigned a rating of “not expected,” “low,” “moderate,” or “high” potential to occur based on relative location to known occurrences and vegetation community/habitat association. Based on the results of the literature review and database searches, 86 special-status fish, wildlife, and marine species were reported in the CNDDB, NMFS, and USFWS databases as occurring in the vicinity of the BSA. Of these, the following were determined to have a moderate or high potential to occur within the BSA based on habitat present and previous known locations in the CNDDB and Information for Planning and Consultation (IpaC) records: California Central Valley steelhead DPS, Central Coast Steelhead DPS, southern DPS of North American green sturgeon, Sacramento River winter-run ESU (endangered), Central Valley spring-run ESU (threatened), Central Valley spring-run ESU (San Joaquin River experimental population, non-essential), Central Valley fall-run/late fall-run (species of concern), longfin smelt (*Spirinchus thaleichthys*), and marine mammals. These species are discussed below.

5.4.2.1 Special Status Wildlife Species

No special status terrestrial wildlife species were determined to have a moderate or high potential to occur within the BSA.

5.4.2.2 Special Status Fish Species

5.4.2.2.1 California Central Valley/Central Coast Steelhead (DPS)

Two Distinct Population Segments (DPSs) of steelhead could occur within the BSA, the California Central Valley Steelhead DPS which includes populations in California’s Sacramento and San Joaquin Rivers and their tributaries, and the Central

California Coast Steelhead DPS which range from the Russian River (Sonoma County) south to Aptos Creek (Santa Cruz County). Both the California Central Valley and Central California Coast DPS were listed as threatened under the ESA in 1998. Critical habitat was designated in 2005; the BSA is not within designated critical habitat.

Steelhead generally migrate farther into tributaries and headwater streams than salmon where cool, well-oxygenated water is available year-round. Central California steelhead typically enter freshwater streams, estuaries, and rivers between December and February, with spawning peaking between February to April. Adults typically spend up to two years in freshwater locations, and one year in the ocean prior to returning to spawn. In some smaller coastal watersheds, steelhead may be able to spawn more than once due to the relatively short migration from the ocean to suitable spawning habitat. Newly emerged steelhead fry use shallow, protected areas along streambanks but move to faster, deeper areas of the river as they grow. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates. Juvenile steelhead rear throughout the year and may spend 1–3 years in freshwater before emigrating to the ocean. Smoltification, the physiological adaptation that juvenile salmonids undergo to tolerate saline waters, occurs in juveniles as they begin their downstream migration. Smolting steelhead generally emigrate from March to June.

Suitable habitat for steelhead occurs in perennial creeks, larger streams and rivers, and estuaries. Estuaries, including the San Francisco Bay provide a holding area for adults prior to the upstream migrations and juveniles use estuaries for rearing and smoltification. While the BSA could provide estuarine habitat for steelhead, any steelhead using habitat within the BSA are only likely to use that habitat temporarily during migrations and there is a low overall likelihood of steelhead occurring within the BSA due to the lack of suitable rearing and holding habitat present in the BSA and the lack of natal streams in the vicinity (Leidy *et al*. 2005).

5.4.2.2.2 North American Green Sturgeon (Southern DPS)

On April 7, 2006, NMFS listed the Southern DPS of the North American green sturgeon as threatened under the ESA. The Southern DPS includes individual reproductive populations south of the Eel River. The populations north of the Eel River, grouped as the northern DPS, currently do not warrant listing. Critical habitat was designated in 2009 and includes open water habitat within the BSA.

Green sturgeon are found in the lower reaches of large rivers, including the Sacramento–San Joaquin River basin, and in the Eel, Mad, Klamath, and Smith Rivers. The green sturgeon is a primitive, bottom-dwelling fish found from Ensenada, Mexico, to the Bering Sea and Japan (Moser *et al.* 2016). It is characterized by its large size (up to 7 feet long and 350 pounds), a long, round body, and “scutes,” or plates along dorsal and lateral sides. It is known to migrate up to 600 miles between freshwater and saltwater environments and is commercially caught in the Columbia River and coastal Washington (Moser *et al*. 2016). Very little is known about the life history of the green sturgeon relative to other fish species. It is an anadromous fish that spends most of its life in salt water and returns to spawn in freshwater. It is slow growing and late maturing and may spawn as little as every 4 to 11 years. Individuals congregate in the bays of these systems in summer, while some may travel upstream to spawn in spring and summer.

Spawning occurs in the lower reaches of large rivers with swift currents and large cobble. Adults broadcast spawn in the water column and fertilized eggs sink and attach to bottom substrate until they hatch (PSMFC 1996). Flow has been identified as the key determinant to larval survival, therefore water diversions and low dam releases may negatively impact green sturgeon survival rates (PSMFC 1996). Juveniles feed on algae and small invertebrates and migrate downstream before they enter their third year of life. They may remain in the estuary for a short time before entering the ocean to feed on benthic invertebrates and fish.

Green sturgeon typically enter the San Francisco Bay between February and May and migrate up the Sacramento River to spawning grounds; cool sections of the upper Sacramento where they find deep, turbulent flows and clean substrate. Juveniles migrate and rear in the Delta and San Francisco Bay estuary then migrate back out to the ocean. The BSA could provide rearing habitat for juvenile or sub-adult green sturgeon.

5.4.2.2.3 Chinook Salmon

Multiple Chinook Salmon runs occur within the San Francisco Bay including the Sacramento River winter-run ESU (endangered), Central Valley spring-run ESU (threatened), Central Valley spring-run ESU (San Joaquin River experimental population, non-essential), and Central Valley fall-run (species of concern). Critical habitat was designated for Sacramento River winter-run ESU on June 16, 1993, and Central Valley spring-run ESU on September 2, 2005; the BSA is not within designated critical habitat- portions of the San Francisco Bay estuary north of the BSA are designated critical habitat for Sacramento River winter-run ESU.

Chinook salmon moving from the ocean through the San Francisco Bay and into the Sacramento-San Joaquin River system are part of the distinct runs described above, each entering the estuary at different times of year. Migrations often follow storms, and many adults will hold in the estuary prior to migrating upstream. Fall-run Chinook Salmon migrate upstream from July through December and spawn from early October through late December. Spring-run enter the Sacramento River from late March through September. Sacramento River winter-run migrate from November through May and spawn in the upper mainstem Sacramento River from mid-April through August. After emerging from their redds, juveniles migrate downstream within a few months. Smolts use food-rich tidal or flooded habitats with overhanging cover or undercut banks to forage before migrating out to the ocean where they mature for two-three years before returning to spawn.

Like steelhead, suitable habitat occurs in perennial creeks, larger streams and rivers, and estuaries. Estuaries, including the San Francisco Bay, provide a holding area for adults prior to the upstream migrations and juveniles use estuaries for rearing and smoltification. While the BSA could provide estuarine habitat, any chinook using habitat within the BSA are only likely to use that habitat temporarily during migrations and there is a low overall likelihood of chinook occurring within the BSA due to the lack of suitable rearing and holding habitat present in the BSA and the lack of natal streams in the vicinity.

5.4.2.2.4 Longfin Smelt

CDFW has designated the longfin smelt as threatened under CESA. The Bay-Delta DPS is currently under review by the USFWS, and the San Francisco Bay-Delta population is currently a candidate species under FESA.

Historically, longfin smelt populations were found in the Klamath, Eel, and Bay-Delta estuaries and in Humboldt Bay. In the Central Valley, longfin smelt are rarely found upstream from Rio Vista or Medford Island (northwest of Stockton) in the Delta. Adults concentrate in Suisun, San Pablo, and north San Francisco Bays (Moyle 2002).

Longfin smelt are found in San Pablo Bay from April through June and disperse in late summer. In fall and winter, yearlings move upstream into fresh water to spawn. Longfin smelt spawn downstream from Medford Island in the San Joaquin River and downstream from Rio Vista on the Sacramento River. Spawning may occur as early as November, and larval surveys indicate that it may extend into June (Moyle 2002). Longfin smelt use estuarine wetland and slough habitat as adults before spawning runs and as juveniles for rearing habitat, they also have a low tolerance for warm water.

Because longfin smelt are typically a pelagic species, the BSA does not provide wetland or slough habitat, and no spawning habitat is present in the vicinity of the BSA, presence of longfin smelt within the BSA is likely to be temporary.

5.4.2.3 Species Status Marine Species

5.4.2.3.1 Marine Mammals

Two species protected by the MMPA could occur within the BSA, harbor seal (*Phoca vitulina richardii*) and California sea lion (*Zalophus californianus*). Both species are residents of the San Francisco Bay estuary and are known to occur within the vicinity of the Oakland Inner Harbor and BSA. The closest known haul-out for either species is a harbor seal haul-out at the breakwater island at Alameda Point. Harbor seals feed on a variety of fish, such as perch, gobies, herring, and sculpin and tend to feed in the deepest waters of the bay. The California sea lion is a common and abundant marine mammal, found throughout the West Coast, generally within 10 miles of shore hauling out on offshore rocks, sandy beaches, and onto floating docks, wharfs, vessels, and other man-made structures in the bay and coastal waters of the state. California sea lions feed on a wide variety of seafood, mainly squid and fish and sometimes clams. Both harbor seals and California sea lions may occasionally forage in the waters of the BSA.

5.4.3 Critical Habitat and Essential Fish Habitat

"Critical habitat" is defined in Section 3(5)(A) of the federal Endangered Species Act, and designated by USFWS and NMFS, as habitat (lands or waters) that contain physical or biological features considered essential to the species' conservation within the species' range, as well as habitat determined to be essential to the species conservation outside of the current range of that species. The open water habitat in the BSA includes areas designated as critical habitat for green sturgeon and is adjacent to portions of the San Francisco Bay estuary designated as critical habitat for Sacramento River winter-run Chinook Salmon ESU.

Essential Fish Habitat (EFH) includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" as defined by congress in the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297). The open water habitat within the BSA is designated EFH for fish managed in the following federal fisheries management plans (FMPs):

- The Pacific Groundfish FMP
- The Coastal Pelagic FMP
- The Pacific Coast Salmon FMP

5.5 Potential Jurisdictional Waters

The BSA includes portions of the San Francisco Bay estuary and Oakland Inner Harbor, which are considered navigable waters of the United States. The open water portion of the BSA is therefore a "jurisdictional" water regulated by the USACE under Section 10 of the Rivers and Harbors Act up to mean high water and Section 404 of the CWA up to the high tide line. These waters are also regulated by the San Francisco Bay RWQCB as Waters of the State and by the San Francisco BCDC, which has jurisdiction over all areas of San Francisco Bay that are subject to tidal action, as well as a shoreline band that extends inland 100 feet from the high tide line (see Figure 2). No wetlands are present within the BSA.

5.6 Wildlife Corridors and Habitat Linkages

Wildlife corridors are linear features that connect large patches of natural open space and provide avenues for the migration of animals. Wildlife corridors contribute to population viability by ensuring continual exchange of genes between populations, providing access to adjacent habitat areas for foraging and mating, and providing routes for recolonization of habitat after local extirpation or ecological catastrophes (e.g., fires).

Habitat linkages are small patches that join larger blocks of habitat and help reduce the adverse effects of habitat fragmentation. Habitat linkages provide a potential route for gene flow and long-term dispersal of plants and animals and may also serve as primary habitat for smaller animals, such as reptiles and amphibians. Habitat linkages may be continuous habitat or discrete habitat islands that function as steppingstones for dispersal.

Terrestrial habitats within the BSA are developed, surrounded by development, and do not provide native species with migratory habitat or connectivity between suitable habitats.

5.7 Marine and Aquatic Corridors

The San Francisco Bay estuary and the Oakland Inner Harbor serves as a local movement corridor that connects habitat for certain birds (e.g., shorebirds, marine species), marine mammals, and fish species. Special status fish species described in Section 5.4.2 use the Bay during migrations from the ocean to and from breeding habitat either in the estuary or in freshwater habitat upstream of the Delta in the Sacramento River, San Joaquin River, or other suitable perennial stream habitat. The vast majority of these migrations occur in the northern portions of the Bay and these migrating species are not expected to occur frequently in the Oakland Inner Harbor. No suitable breeding habitat for anadromous fish species is accessed through the Oakland Inner Harbor.

Since the proposed project would not significantly alter habitat conditions in the Oakland Inner Harbor and would only temporarily make a small portion of the Oakland Inner Harbor unavailable to fish, wildlife or marine species, it is not expected to contribute to the impediment of local or seasonal movement of wildlife through the surrounding habitat.

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6 Impacts and Mitigation

6.1 Explanation of Findings of Significance

Impacts to special-status vegetation communities, plant and wildlife species, and jurisdictional waters, including wetlands, must be quantified and analyzed to determine whether such impacts are significant under CEQA. CEQA Guidelines Section 15064(b) states that an ironclad definition of "significant" effect is not possible, because the significance of an activity may vary with the setting. Appendix G of the CEQA Guidelines, however, does provide "examples of consequences which may be deemed to be a significant effect on the environment" (14 CCR 15064[e]). These effects include substantial effects on rare or endangered species of animal or plant or the habitat of the species. CEQA Guidelines Section 15065(a) is also helpful in defining whether a project may have a significant effect on the environment. Under that section, a proposed project may have a significant effect on the environment if the project has the potential to (1) substantially degrade the quality of the environment, (2) substantially reduce the habitat of a fish or wildlife species, (3) cause a fish or wildlife population to drop below self-sustaining levels, (4) threaten to eliminate a plant or animal community, (5) reduce the number or restrict the range of a rare or endangered plant or animal, or (6) eliminate important examples of a major period of California history or prehistory.

The following are the significance thresholds for biological resources provided in the CEQA Guidelines Appendix G Environmental Checklist, which states that a project would potentially have a significant effect if it does any of the following:

- **Impact BIO-1.** Has a substantial adverse effect, either directly or through habitat modifications, on any species identified as being a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS.
- **Impact BIO-2.** Has a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by CDFW or USFWS.
- **Impact BIO-3.** Has a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.
- **Impact BIO-4.** Interferes substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impedes the use of native wildlife nursery sites.
- **Impact BIO-5.** Conflicts with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- **Impact BIO-6.** Conflicts with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan.

The evaluation of whether an impact to a particular biological resource is significant must consider both the resource itself and the role of that resource in a regional context. Substantial impacts are those that contribute to, or result in, permanent loss of an important resource, such as a population of a rare plant or wildlife species. Impacts may be important locally, because they result in an adverse alteration of existing site conditions but considered not significant because they do not contribute substantially to the permanent loss of that resource regionally. The severity of an impact is the primary determinant of whether that impact can be mitigated to a level below significance.

The following significance determinations were made based on the impacts of the proposed project.

6.2 Impact BIO-1: Special Status Species

6.2.1 Special-Status Plants

No special-status plants are expected to occur within the project site or be impacted by project activities; therefore, impacts to special-status plants would be less than significant.

6.2.2 Special-Status Fish and Wildlife

The following special status fish and wildlife species could occur within the project site during construction: California Central Valley steelhead DPS, Central Coast Steelhead DPS, southern DPS of North American green sturgeon, Sacramento River winter-run chinook salmon ESU, Central Valley spring-run chinook salmon ESU, Central Valley fall-run chinook salmon (species of concern), longfin smelt, and marine mammals.

The demolition of the existing bridge/walkway and bridge foundation, and replacement of the existing terminal float will require in-water work to remove existing piles and install new steel pipe piles. The special-status fish and marine mammals that could occur in the BSA could be adversely impacted by these project activities through impacts to water quality and release of sediments into the water and underwater noise impacts. Because species regulated by the NMFS, USFWS, and CDFW could occur and be potentially impacted by project construction, it is anticipated that the appropriate project permits will be obtained prior to project implementation and may include a Biological Opinion (BO) from NMFS and USFWS, an Incidental Take permit (ITP) from CDFW, and an Incidental Harassment Authorization (IHA) from NMFS.

6.2.2.1 Impacts to Water Quality

The demolition of the existing bridge/walkway and bridge foundation, and replacement of the existing terminal float will require in-water work to remove existing piles and install new steel pipe piles which has the potential to result in short-term, temporary disturbance of benthic sediments. Existing piles planned for removal will be pulled, or if removal is not feasible, piles will be cut two feet below the mudline. Suspended sediments could result in decreased water quality due to increased turbidity, the release of harmful chemicals into the water column, and may result in harmful effects to fish and wildlife in the vicinity. While removal of piles could result in the release of sediments, it is expected that the sediment release and increased turbidity would be of relatively short duration and generally confined within a few hundred feet of the activity, and that background levels would be restored within hours.

6.2.2.2 Underwater Noise Impacts

Installation of steel pipe piles can produce intense underwater noise that may lead to physical damage to swim bladders or other soft tissues, or cause alterations to swimming, sleeping, or foraging behaviors in fish and marine mammals. The installation of the new pipe piles for the float and bridge support are expected to use a vibratory hammer, with an impact hammer used only if needed. The NMFS has developed injury criteria for fish and for marine mammals; these injury criteria are typically reported as peak levels (peak), root-mean-square pressure (RMS), and sound exposure levels (SEL). While injury criteria have been established, lower sound levels that result in altered behavior would also be considered harassment to any ESA listed fish species.

To evaluate the potential project noise impacts related to pile installation, an acoustic assessment was conducted by Illingworth and Rodkin in 2022 (Appendix C). The analysis indicated that impact pile driving of the largest piles (48 inches) could result in maximum underwater noise impacts exceeding the marine mammal thresholds extending out to about 997 meters for the Level A Injury zone for Pinnipeds while extending out to about 4,200 meters for the Level B Harassment Zones (See Appendix C for a more in-depth discussion of the NMFS criteria and results of the noise analysis). Impact pile driving of the largest (48”) piles could cause acoustic impacts at distances extending out to 4,200 m and 1,010 m for the root-mean-square (RMS) (150 decibel [dB] re 1 micropascal [μPa]) and Cumulative sound exposure level (SEL) (187 dB re 1μPa2-sec) respectively for the adopted fish thresholds. While all impact hammer use would be conducted between June 1 and November 30, when the likelihood of sensitive fish species being present in the work area is minimal, sensitive fish species could be present in the vicinity of the project area and could be impacted by noise from pile driving. Therefore, project construction activities would result in a potentially significant impact to special-status fish and marine wildlife.

Potentially significant impacts to special-status fish and marine wildlife would be mitigated to a less-than-significant level through implementation of **MM-BIO-1** which outlines methods for reducing potentially harmful noise impacts during installation of piles. Water quality impacts including turbidity and sedimentation from pile removal and demolition of existing structures are addressed in Section 6.4, below.

MM-BIO-1a: Minimize and Avoid Underwater Noise Impacts. WETA and their construction contractor shall implement the following noise minimization and avoidance measures during project construction activities.

- All piling installation shall be conducted between June 1 and November 30, when the likelihood of sensitive fish species being present in the work area is minimal.
- Vibratory pile driving shall be conducted following the United States. Army Corps of Engineers. 2018. “U.S. Army Corps of Engineers Proposed Additional Procedures and Criteria for Permitting Projects under a Programmatic Determination of Not Likely to Adversely Affect Select Listed Species in California (the 2018 NLAA Program)”. p 1-37. San Francisco, CA.
- To the extent feasible, all pilings shall be installed and removed with vibratory pile driver hammer only.
- An impact pile driver may only be used where necessary to complete installation of larger steel pilings in accordance with seismic safety or other engineering criteria.
  - If an impact pile driver is used it will be cushioned using a 12-inch-thick wood cushion block.
  - A Hydro Acoustic Monitoring Plan shall be prepared to be implemented in the event that an impact hammer is used. The sound monitoring results will be made available to CDFW and NMFS.
  - This Plan will provide detail on the sound attenuation system, the methods used to monitor and verify sound levels during impact pile driving activities,
  - The Plan shall include the use of a bubble curtain during any impact pile driving of piles in the water. The bubble curtain will be operated in a manner consistent with the following performance standards:
  - The bubble curtain will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.
  - The lowest bubble ring will be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100% mudline contact. No parts of the ring or other objects shall prevent full mudline contact.

- Air flow to the bubblers must be balanced around the circumference of the pile.

- A "soft start" technique shall be employed in all pile driving to give marine mammals an opportunity to vacate the area.
- Soft Start: When initiating pile driving, or when there has been downtime of 30 minutes or more without pile driving, the contractor will initiate the driving with ramp-up procedures described below.
- For vibratory hammers, the contractor will initiate the driving for 15 seconds at reduced energy, followed by a 30-second waiting period. This procedure will be repeated two additional times before continuous driving is started.
- For impact driving, an initial set of three strikes would be made by the hammer at 40% energy, followed by a 30-second waiting period, then two subsequent three-strike sets at 40% energy, with 30-second waiting periods, before initiating continuous driving.
- A biological monitor will be present during all pile driving to observe the work area before, during, and after pile driving. The monitor will be present as specified by NMFS during the impact pile-driving phases of construction.
- A safety zone, based on the results of the noise analysis (Appendix C) will be established based on the type of pile driving required for the protection of marine mammals. Pile driving will be halted if a marine mammal is observed within the safety zone and will not re-start until 15 minutes after the animal has left the safety zone.
- All necessary permits including a BO from USFWS and NMFS, an IHA from NMFS, and an ITP will be obtained and adhered to during construction for in-water work that requires impact pile driving and is not covered under one of the existing programmatic consultations for federally listed species.

MM-BIO-1b: Compensatory Mitigation for Longfin Smelt. Prior to construction, WETA shall obtain an ITP from the CDFW in accordance with California Fish & Game Code § 2081 (b), which states that, "the impacts of the authorized take shall be minimized and fully mitigated". In addition to the noise impact minimization measures described above (Mitigation Measure MM-BIO-1a), WETA shall provide compensatory mitigation for potential noise impacts to the longfin smelt by purchasing mitigation credits at a CDFW-approved conservation bank or contribute funds to a CDFW-approved mitigation project. Specific details for the compensatory mitigation including the number of credits, schedule and payment terms shall be outlined in the conditions of the ITP.

6.3 Impact BIO-2: Sensitive Natural Communities

No riparian habitat, or eelgrass and native oyster beds occur within the BSA. The BSA does include Critical Habitat for green sturgeon, and essential fish habitat (EFH) as defined under the Pacific Groundfish, Coastal pelagics, and Pacific Coast Salmon Fisheries Management Plans. Pile removal and replacement activities during project construction could result in water quality and noise impacts, as described under Impact BIO-1, and would temporarily limit the suitability of the open water habitat present in the BSA. No long-term impacts to this habitat (including habitat created by the presents of pilings- submerged vegetation or aquatic organisms can attach to pilings) is expected as a result of the project.

Another potential concern resulting from in-water work is the spread of invasive marine species. Project activities, including disturbance and temperature changes as a result of construction activities, could result in the spread of invasive marine species which could limit the future suitability of both EFH and green sturgeon critical habitat. Any adverse effect to critical habitat or other sensitive natural communities, including EFH and green sturgeon, would result in a potentially significant impact. Potentially significant impacts to special-status fish and marine wildlife habitat from the spread of invasive species would be mitigated to less than significant through implementation of **MM-BIO-2** which outlines methods for reducing the potential introduction and spread of invasive marine species.

MM-BIO-2: Avoid any spread or introduction of Invasive Marine Species. WETA and their construction contractor will ensure that standard Best Management Practices (BPMs) to avoid introduction or spread of marine invasive species are followed during construction and in-water work. Specific BMPs will be provided on the contractor's design drawings and will include but not be limited to the following:

- Environmental training of construction personnel involved in in-water work.
- Cleaning and sanitizing procedures for equipment and machinery used for in-water work.
- Procedures for the safe removal and disposal of any invasive taxa observed.

6.4 Impact BIO-3: Jurisdictional Wetlands and Waters

No federally or state-defined wetlands occur within the BSA and thus no impacts to wetlands would occur. However, implementation of the proposed project would have minor temporary impacts to non-wetland waters under the jurisdiction of the USACE, RWQCB, and BCDC. The San Francisco Bay and Oakland Inner Harbor is a navigable water of the United States and is regulated by the Corps under Section 10 of the Rivers and Harbors Act up to mean high water and Section 404 of the CWA up to the high tide line. These waters are also regulated by the San Francisco Bay RWQCB as Waters of the State and by the BCDC. As described in Section 1.2, Project Description, a net total of 78 sf of additional pilings (total piling installed minus pilings removed) would be installed as part of the terminal rehabilitation. The 78 sf of material to be introduced would consist of piling and fender components and is not considered fill material. As discussed in Section 7.1 (Impact BIO-1), temporary project impacts associated with installation of new pilings could decrease water quality and increase turbidity within the immediate project area. Any adverse effect on jurisdictional wetlands and/or water would result in a potentially significant impact.

Potentially significant impacts to non-wetland waters would be mitigated to less than significant through implementation of **MM-BIO-3.**

MM-BIO-3: Implement BMPs and Follow Approved Agency Requirements for In-Water Construction. Best management practices (BMPs) will be employed during project construction activities to protect special status species and their aquatic habitats. The contractor undertaking construction work will exercise every reasonable precaution to protect listed species and ESA-protected species and their habitat(s) from construction by-products and pollutants such as construction chemicals, fresh cement or other deleterious materials. Construction may be conducted from both land and water. Care will be used by equipment operators to control debris so that it does not enter the Bay. WETA's contractors shall prepare the plans covering the BMPs as follows: Stormwater Pollution Prevention Plan, Erosion and Sediment Control Plan, Oil Spill Prevention and Control Plan to specify restrictions and procedures for fuel storage location, fueling activities, and equipment maintenance locating fueling stations away from potentially jurisdictional features, and Construction Debris Management Plan.

The measures identified in these four plans listed above will be based on Best Available Technology and will include but not be limited to the following:

- All debris will be off hauled, processed, and properly disposed of. The piles will be cut at the mudline and pulled out of the water. Timber piles that have been treated with creosote, or that contain other potentially hazardous materials, will be handled properly and disposed of at a facility permitted to handle hazardous waste. Any debris found on the seafloor in the ferry terminal's vicinity will be removed and disposed of on land.
  - Measures to ensure that fresh cement or concrete will not be allowed to enter the Bay. Construction waste will be collected and transported to an authorized upland disposal area, as appropriate, and per federal, state and local laws and regulations.
  - All hazardous material will be stored upland in storage trailers and/or shipping containers designed to provide adequate containment. Short-term laydown of hazardous materials for immediate use will be permitted with the same anti-spill precautions:
  - All construction material, wastes, debris, sediment, rubbish, trash, fencing, etc., will be removed from the site once the proposed project is completed and transported to an authorized disposal area, as appropriate, in compliance with applicable federal, state and local laws and regulations;
  - Construction material will need to be covered every night and during any rainfall event (if there is one);
  - Construction crews will reduce the amount of disturbance within the Project site to the minimum necessary to accomplish the project;
  - Measures to prevent debris from entering the Bay;
  - Vessels and equipment that rely on internal combustion engines for power and/or propulsion will be kept in good working condition and compliant with California emission regulations;
  - No in-water fueling at the Project site will be permitted. Vehicles and equipment that are used during the course of construction will be fueled and serviced offsite. Fueling locations will be inspected after fueling to document that no spills have occurred. Any spills will be cleaned up immediately.

6.5 Impact BIO-4: Wildlife Corridors and Migratory Routes

No significant direct permanent impacts would occur on wildlife movement or use of native wildlife nursery sites associated with project activities. Construction activities would not likely result in permanent impacts to wildlife movement because no new structures that would impede wildlife movement are proposed.

During construction activities, temporary disturbance to local species may occur, but would not substantially degrade the quality or use of the marine communities in the vicinity. The Oakland Inner Harbor does not provide a migratory corridor for sensitive fish species; as described in Section 5.6, fish migrating into and out of spawning habitat either in the Sacramento or San Joaquin River systems, or suitable perennial streams located in other parts of the Bay, are not likely to be found moving through the Oakland Inner Harbor. Following temporary construction disturbances, the function and values of the Oakland Inner Harbor are expected to remain the same.

Indirect impacts to localized wildlife movement could occur during construction activities due to construction-related noise, including during pile driving. However, construction-generated noise would be temporary and would not be expected to significantly, nor permanently, disrupt wildlife movement during and following construction activities.

Therefore, direct and indirect impacts on wildlife corridors and migratory routes resulting from the proposed project would be less than significant.

6.6 Impact BIO-5: Local Policies or Ordinances

Potentially significant impacts resulting from implementation of the proposed project were analyzed for compliance with the County's General Plan Open Space and Conservation Element. General Plan Policy CC-28 involves maintenance and improvement measures for the Alameda Nature Reserve, which is located approximately one mile west of the project site and does not apply to the proposed project. General Plan Policy CC-34 involves preservation of existing natural areas/elements and protection of native plant and wildlife species through actions such as implementing BMPs during construction, conducting biological surveys, consultation with applicable agencies, and implementing mitigation measures, The project would involve refurbishment of the existing AMS Ferry terminal which would include temporary construction activities within the Oakland Inner Harbor. During construction, the project would comply with applicable General Plan policies, including Policy CC-34, and would also implement mitigation measures, described in Sections 6.2, 6.3, and 6.4, to reduce any potential biological resource impacts to a less-than-significant level. Further, the project does not propose any changes nor modifications to existing policies or ordinances that would conflict with measures intended to protect biological resources. Because the project would comply with existing General Plan 2040 policies and would not conflict with any policies or ordinances protecting biological resources, impacts would be less than significant.

6.7 Impact BIO-6: Habitat Conservation Plans

There are no habitat conservation plans (HCPs) or natural community conservation plans (NCCPs) covering the project site. As described above, the project would not conflict with any local policies or ordinances. Because no HCPs or NCCPs cover the project site, no impacts would result.

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7 References and Preparers

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7.2 Personal Communications

WETA, 2022. Email from Aden Anderson, Operations Manager, Blue and Gold Fleet to Chad Mason, WETA, August 4, 2022.

7.3 Preparers

Report Preparation

Andy Hatch, Fish and Wildlife Biologist

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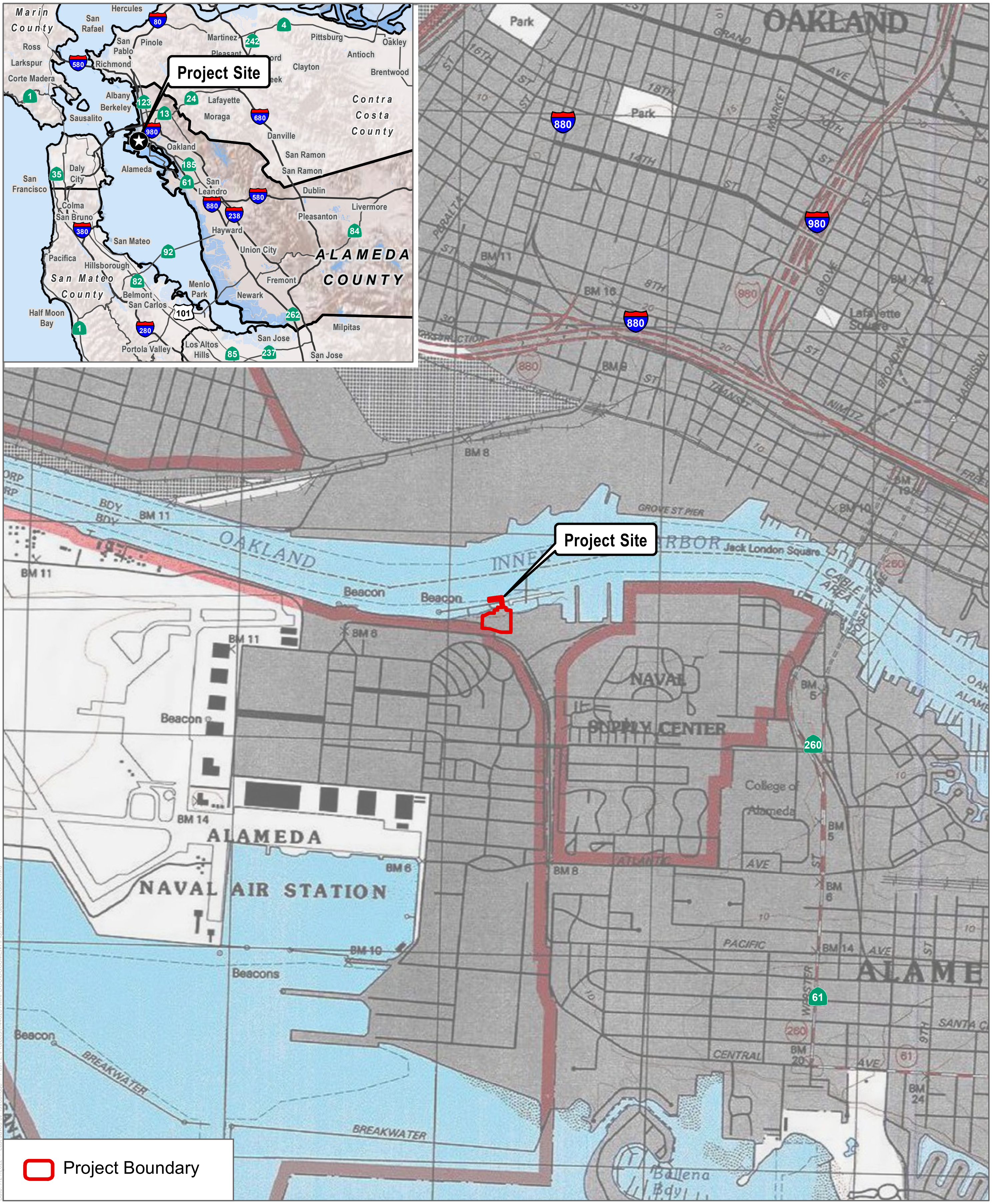

SOURCE: USGS 7.5-minute Series Oakland West Quadrangle

DUDEK

0 1,000 2,000 Feet

FIGURE 1

Project Location

Alameda Main Street Terminal Refurbishment Project

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SOURCE: Bing Maps 2021

FIGURE 2

Project Site

Alameda Main Street Terminal Refurbishment Project

DUDEK

0 70 140 Feet

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Appendix A

Special-Status Plants Potentially Occurring within the BSA

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Allium peninsulare var. *franciscanum*	Franciscan onion	None/None/1B.2	Cismontane woodland, Valley and foothill grassland; Clay, Serpentinite (often), Volcanic/perennial bulbiferous herb/(Apr)May–June/170–1,000	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Amorpha californica var. *napensis*	Napa false indigo	None/None/1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland/perennial deciduous shrub/Apr–July/ 165–6,560	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Amsinckia lunaris	bent-flowered fiddleneck	None/None/1B.2	Cismontane woodland, Coastal bluff scrub, Valley and foothill grassland/annual herb/Mar–June/10–1,640	Y	Y	N	Not expected to occur. No suitable vegetation present.
Androsace elongata ssp. *acuta*	California androsace	None/None/4.2	Chaparral, Cismontane woodland, Coastal scrub, Meadows and seeps, Pinyon and juniper woodland, Valley and foothill grassland/annual herb/ Mar–June/490–4,280	Y	Y	N	Not expected to occur. No suitable vegetation present.
Arabis blepharophylla	coast rockcress	None/None/4.3	Broadleafed upland forest, Coastal bluff scrub, Coastal prairie, Coastal scrub; Rocky/perennial herb/Feb–May/10–3,605	Y	Y	N	Not expected to occur. No suitable vegetation present.
Arctostaphylos franciscana	Franciscan manzanita	FE/None/1B.1	Coastal scrub/perennial evergreen shrub/ Feb–Apr/195–985	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Arctostaphylos imbricata	San Bruno Mountain manzanita	None/SE/1B.1	Chaparral, Coastal scrub; Rocky/perennial evergreen shrub/Feb–May/900–1,210	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Arctostaphylos montana ssp. *ravenii*	Presidio manzanita	FE/SE/1B.1	Chaparral, Coastal prairie, Coastal scrub/perennial evergreen shrub/Feb–Mar/150–705	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Arctostaphylos montaraensis	Montara manzanita	None/None/1B.2	Chaparral, Coastal scrub/perennial evergreen shrub/Jan–Mar/260–1,640	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Arctostaphylos pacifica	Pacific manzanita	None/SE/1B.1	Chaparral, Coastal scrub/evergreen shrub/ Feb–Apr/1,080–1,080	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Arctostaphylos pallida	pallid manzanita	FT/SE/1B.1	Broadleafed upland forest, Chaparral, Cismontane woodland, Closed-cone coniferous forest, Coastal scrub/perennial evergreen shrub/Dec–Mar/ 605–1,525	Y	Y	N	Not expected to occur. No suitable vegetation present.
Arenaria paludicola	marsh sandwort	FE/SE/1B.1	Marshes and swamps; Openings, Sandy/perennial stoloniferous herb/May–Aug/10–560	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Aspidotis carlotta-halliae	Carlotta Hall's lace fern	None/None/4.2	Chaparral, Cismontane woodland; Serpentinite (usually)/perennial rhizomatous herb/Jan–Dec/ 330–4,590	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Astragalus nuttallii var. nuttallii	ocean bluff milk-vetch	None/None/4.2	Coastal bluff scrub, Coastal dunes/perennial herb/Jan–Nov/10–395	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Astragalus tener var. *tener*	alkali milk-vetch	None/None/1B.2	Playas, Valley and foothill grassland, Vernal pools; Alkaline/annual herb/Mar–June/5–195	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there are no suitable vegetation or vernal pools present.
Calamagrostis ophitidis	serpentine reed grass	None/None/4.3	Chaparral, Lower montane coniferous forest, Meadows and seeps, Valley and foothill grassland; Rocky, Serpentinite/perennial herb/Apr–July/ 295–3,490	Y	Y	N	Not expected to occur. No suitable vegetation present.
Calochortus pulchellus	Mt. Diablo fairy-lantern	None/None/1B.2	Chaparral, Cismontane woodland, Riparian woodland, Valley and foothill grassland/perennial bulbiferous herb/Apr–June/100–2,755	Y	Y	N	Not expected to occur. No suitable vegetation or soils present.
Calochortus tiburonensis	Tiburon mariposa-lily	FT/ST/1B.1	Valley and foothill grassland/perennial bulbiferous herb/Mar–June/165–490	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Calochortus umbellatus	Oakland star-tulip	None/None/4.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Lower montane coniferous forest, Valley and foothill grassland; Serpentinite (often)/perennial bulbiferous herb/Mar–May/330–2,295	Y	Y	N	Not expected to occur. No suitable vegetation present.
Calystegia purpurata ssp. *saxicola*	coastal bluff morning-glory	None/None/1B.2	Coastal bluff scrub, Coastal dunes, Coastal scrub, North Coast coniferous forest/perennial herb/(Mar)Apr–Sep/0–345	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Carex comosa	bristly sedge	None/None/2B.1	Coastal prairie, Marshes and swamps, Valley and foothill grassland/perennial rhizomatous herb/ May–Sep/0–2,050	Y	Y	N	Not expected to occur. No suitable vegetation present.
Carex praticola	northern meadow sedge	None/None/2B.2	Meadows and seeps/perennial herb/May–July/ 0–10,495	Y	Y	N	Not expected to occur. No suitable vegetation present.
Castilleja affinis var. *neglecta*	Tiburon paintbrush	FE/ST/1B.2	Valley and foothill grassland/perennial herb (hemiparasitic)/Apr–June/195–1,310	Y	Y	N	Not expected to occur. No suitable vegetation present.

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Castilleja ambigua var. *ambigua*	johnny-nip	None/None/4.2	Coastal bluff scrub, Coastal prairie, Coastal scrub, Marshes and swamps, Valley and foothill grassland, Vernal pools/annual herb (hemiparasitic)/ Mar–Aug/0–1,425	Y	Y	N	Not expected to occur. No suitable vegetation or vernal pools present.
Centromadia parryi ssp. *congdonii*	Congdon's tarplant	None/None/1B.1	Valley and foothill grassland/annual herb/ May–Oct (Nov)/0–755	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Centromadia parryi ssp. *parryi*	pappose tarplant	None/None/1B.2	Chaparral, Coastal prairie, Marshes and swamps, Meadows and seeps, Valley and foothill grassland; Alkaline (often)/annual herb/May–Nov/0–1,375	Y	Y	N	Not expected to occur. No suitable vegetation present.
Chloropyron maritimum ssp. *palustre*	Point Reyes salty bird's-beak	None/None/1B.2	Marshes and swamps/annual herb (hemiparasitic)/June–Oct/0–35	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Chorizanthe cuspidata var. *cuspidata*	San Francisco Bay spineflower	None/None/1B.2	Coastal bluff scrub, Coastal dunes, Coastal prairie, Coastal scrub; Sandy/annual herb/ Apr–July(Aug)/10–705	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Chorizanthe robusta var. *robusta*	robust spineflower	FE/None/1B.1	Chaparral, Cismontane woodland, Coastal dunes, Coastal scrub; Gravelly (sometimes), Sandy (sometimes)/annual herb/Apr–Sep/10–985	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Cicuta maculata var. *bolanderi*	Bolander's water-hemlock	None/None/2B.1	Marshes and swamps/perennial herb/July–Sep/ 0–655	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Cirsium andrewsii	Franciscan thistle	None/None/1B.2	Broadleafed upland forest, Coastal bluff scrub, Coastal prairie, Coastal scrub; Mesic, Serpentinite (sometimes)/perennial herb/Mar–July/0–490	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Cirsium hydrophilum var. *vaseyi*	Mt. Tamalpais thistle	None/None/1B.2	Broadleafed upland forest, Chaparral, Meadows and seeps; Seeps, Serpentinite/perennial herb/May–Aug/785–2,030	Y	Y	N	Not expected to occur. No suitable vegetation present.
Cirsium occidentale var. *compactum*	compact cobwebby thistle	None/None/1B.2	Chaparral, Coastal dunes, Coastal prairie, Coastal scrub/perennial herb/Apr–June/15–490	Y	N	N	Not expected to occur. The site is outside of the species' known elevation

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
							range and there is no suitable vegetation present.
Clarkia concinna ssp. *automixa*	Santa Clara red ribbons	None/None/4.3	Chaparral, Cismontane woodland/annual herb/(Apr)May–June(July)/295–4,920	Y	Y	N	Not expected to occur. No suitable vegetation present.
Clarkia franciscana	Presidio clarkia	FE/SE/1B.1	Coastal scrub, Valley and foothill grassland/annual herb/May–July/80–1,095	Y	Y	N	Not expected to occur. No suitable vegetation present.
Collinsia corymbosa	round-headed Chinese-houses	None/None/1B.2	Coastal dunes/annual herb/Apr–June/0–65	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Collinsia multicolor	San Francisco collinsia	None/None/1B.2	Closed-cone coniferous forest, Coastal scrub; Serpentinite (sometimes)/annual herb/(Feb)Mar–May/100–900	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Collomia diversifolia	serpentine collomia	None/None/4.3	Chaparral, Cismontane woodland; Gravelly (sometimes), Rocky (sometimes), Serpentinite (sometimes)/annual herb/May–June/655–1,965	Y	Y	N	Not expected to occur. No suitable vegetation present.
Dirca occidentalis	western leatherwood	None/None/1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Closed-cone coniferous forest, North Coast coniferous forest, Riparian forest, Riparian woodland; Mesic/perennial deciduous shrub/Jan–Mar(Apr)/ 80–1,390	Y	Y	N	Not expected to occur. No suitable vegetation present.
Equisetum palustre	marsh horsetail	None/None/3	Marshes and swamps/perennial rhizomatous herb/Unk/150–3,280	Y	Y	N	Not expected to occur. No suitable vegetation present.
Eriogonum luteolum var. *caninum*	Tiburon buckwheat	None/None/1B.2	Chaparral, Cismontane woodland, Coastal prairie, Valley and foothill grassland; Gravelly, Sandy, Serpentinite/annual herb/May–Sep/0–2,295	Y	Y	N	Not expected to occur. No suitable vegetation present.
Eryngium jepsonii	Jepson's coyote-thistle	None/None/1B.2	Valley and foothill grassland, Vernal pools; Clay/perennial herb/Apr–Aug/10–985	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Erysimum franciscanum	San Francisco wallflower	None/None/4.2	Chaparral, Coastal dunes, Coastal scrub, Valley and foothill grassland; Granitic (often), Roadsides (sometimes), Serpentinite (often)/perennial herb/Mar–June/0–1,800	Y	Y	N	Not expected to occur. No soils present.
Erythranthe laciniata	cut-leaved monkeyflower	None/None/4.3	Chaparral, Lower montane coniferous forest, Upper montane coniferous forest; Granitic, Mesic/annual herb/Apr–July/1,605–8,690	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
							suitable vegetation present.
Erythranthe nudata	bare monkeyflower	None/None/4.3	Chaparral, Cismontane woodland; Seeps, Serpentinite/annual herb/May–June/655–2,295	Y	Y	N	Not expected to occur. No suitable vegetation present.
Extriplex joaquinana	San Joaquin spearscale	None/None/1B.2	Chenopod scrub, Meadows and seeps, Playas, Valley and foothill grassland; Alkaline/annual herb/ Apr–Oct/5–2,735	Y	Y	N	Not expected to occur. No suitable vegetation present.
Fissidens pauperculus	minute pocket moss	None/None/1B.2	North Coast coniferous forest/moss//35–3,355	Y	Y	N	Not expected to occur. No suitable vegetation present.
Fritillaria liliacea	fragrant fritillary	None/None/1B.2	Cismontane woodland, Coastal prairie, Coastal scrub, Valley and foothill grassland; Serpentinite (often)/perennial bulbiferous herb/Feb–Apr/10–1,345	Y	Y	N	Not expected to occur. No suitable vegetation present.
Gilia capitata ssp. *chamissonis*	blue coast gilia	None/None/1B.1	Coastal dunes, Coastal scrub/annual herb/ Apr–July/5–655	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Gilia millefoliata	dark-eyed gilia	None/None/1B.2	Coastal dunes/annual herb/Apr–July/5–100	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Grindelia hirsutula var. *maritima*	San Francisco gumplant	None/None/3.2	Coastal bluff scrub, Coastal scrub, Valley and foothill grassland; Sandy (sometimes), Serpentinite (sometimes)/perennial herb/June–Sep/50–1,310	Y	Y	N	Not expected to occur. No suitable vegetation present.
Helianthella castanea	Diablo helianthella	None/None/1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland, Valley and foothill grassland; Azonal soils, Partial Shade (often), Rocky (usually)/perennial herb/ Mar–June/195–4,265	Y	Y	N	Not expected to occur. No suitable vegetation present.
Hemizonia congesta ssp. *congesta*	congested-headed hayfield tarplant	None/None/1B.2	Valley and foothill grassland; Roadsides (sometimes)/annual herb/Apr–Nov/65–1,835	Y	Y	N	Not expected to occur. No suitable vegetation present.
Hesperevax caulescens	hogwallow starfish	None/None/4.2	Valley and foothill grassland, Vernal pools; Alkaline (sometimes)/annual herb/Mar–June/0–1,655	Y	Y	N	Not expected to occur. No suitable vegetation or alkali soils present.
Hesperevax sparsiflora var. *brevifolia*	short-leaved evax	None/None/1B.2	Coastal bluff scrub, Coastal dunes, Coastal prairie/annual herb/Mar–June/0–705	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Hesperolinon congestum	Marin western flax	FT/ST/1B.1	Chaparral, Valley and foothill grassland; Serpentinite/annual herb/Apr–July/15–1,210	Y	Y	N	Not expected to occur. No suitable vegetation present.
Heteranthera dubia	water star-grass	None/None/2B.2	Marshes and swamps; Alkaline/perennial herb (aquatic)/July–Oct/100–4,900	Y	Y	N	Not expected to occur. No suitable vegetation present.
Hoita strobilina	Loma Prieta hoita	None/None/1B.1	Chaparral, Cismontane woodland, Riparian woodland; Mesic, Serpentinite (usually)/perennial herb/ May–July (Aug–Oct)/100–2,820	Y	Y	N	Not expected to occur. No suitable mesic vegetation present.
Holocarpha macradenia	Santa Cruz tarplant	FT/SE/1B.1	Coastal prairie, Coastal scrub, Valley and foothill grassland; Clay (often), Sandy/annual herb/ June–Oct/35–720	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Horkelia cuneata var. *sericea*	Kellogg's horkelia	None/None/1B.1	Chaparral, Closed-cone coniferous forest, Coastal dunes, Coastal scrub; Gravelly (sometimes), Openings, Sandy (sometimes)/perennial herb/ Apr–Sep/35–655	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Horkelia marinensis	Point Reyes horkelia	None/None/1B.2	Coastal dunes, Coastal prairie, Coastal scrub; Sandy/perennial herb/May–Sep/15–2,475	Y	Y	N	Not expected to occur. No suitable vegetation present.
Hosackia gracilis	harlequin lotus	None/None/4.2	Broadleafed upland forest, Cismontane woodland, Closed-cone coniferous forest, Coastal bluff scrub, Coastal prairie, Coastal scrub, Marshes and swamps, Meadows and seeps, North Coast coniferous forest, Valley and foothill grassland; Roadsides/perennial rhizomatous herb/Mar–July/0–2,295	Y	Y	N	Not expected to occur. No suitable vegetation present.
Hypogymnia schizidiata	island tube lichen	None/None/1B.3	Chaparral, Closed-cone coniferous forest/foliose lichen/1,180–1,325	Y	Y	N	Not expected to occur. No suitable vegetation present.
Iris longipetala	coast iris	None/None/4.2	Coastal prairie, Lower montane coniferous forest, Meadows and seeps; Mesic/perennial rhizomatous herb/Mar–May(June)/0–1,965	Y	Y	N	Not expected to occur. No suitable mesic vegetation present.
Isocoma arguta	Carquinez goldenbush	None/None/1B.1	Valley and foothill grassland/perennial shrub/ Aug–Dec/5–65	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Juglans californica	Southern California black walnut	None/None/4.2	Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland/perennial deciduous tree/ Mar–Aug/165–2,950	Y	Y	N	Not expected to occur. No suitable vegetation present.
Lasthenia conjugens	Contra Costa goldfields	FE/None/1B.1	Cismontane woodland, Playas, Valley and foothill grassland, Vernal pools; Mesic/annual herb/ Mar–June/0–1,540	Y	Y	N	Not expected to occur. No suitable vegetation or vernal pools present.

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Layia carnosa	beach layia	FE/SE/1B.1	Coastal dunes, Coastal scrub/annual herb/ Mar–July/0–195	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Leptosiphon acicularis	bristly leptosiphon	None/None/4.2	Chaparral, Cismontane woodland, Coastal prairie, Valley and foothill grassland/annual herb/ Apr–July/180–4,920	Y	Y	N	Not expected to occur. No suitable vegetation present.
Leptosiphon ambiguus	serpentine leptosiphon	None/None/4.2	Cismontane woodland, Coastal scrub, Valley and foothill grassland; Serpentinite (usually)/annual herb/Mar–June/395–3,705	Y	Y	N	Not expected to occur. No suitable vegetation present.
Leptosiphon grandiflorus	large-flowered leptosiphon	None/None/4.2	Cismontane woodland, Closed-cone coniferous forest, Coastal bluff scrub, Coastal dunes, Coastal prairie, Coastal scrub, Valley and foothill grassland; Sandy (usually)/annual herb/Apr–Aug/15–4,000	Y	Y	N	Not expected to occur. No suitable vegetation present.
Leptosiphon latisectus	broad-lobed leptosiphon	None/None/4.3	Broadleafed upland forest, Cismontane woodland/annual herb/Apr–June/560–4,920	Y	Y	N	Not expected to occur. No suitable vegetation present.
Leptosiphon rosaceus	rose leptosiphon	None/None/1B.1	Coastal bluff scrub/annual herb/Apr–July/0–330	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Lessingia germanorum	San Francisco lessingia	FE/SE/1B.1	Coastal scrub/annual herb/(June)July–Nov/80–360	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Lessingia hololeuca	woolly-headed lessingia	None/None/3	Broadleafed upland forest, Coastal scrub, Lower montane coniferous forest, Valley and foothill grassland; Clay, Serpentinite/annual herb/June–Oct/50–1,000	Y	Y	N	Not expected to occur. No suitable vegetation present.
Malacothamnus arcuatus	arcuate bush-mallow	None/None/1B.2	Chaparral, Cismontane woodland/perennial deciduous shrub/Apr–Sep/50–1,160	Y	Y	N	Not expected to occur. No suitable vegetation present.
Meconella oregana	Oregon meconella	None/None/1B.1	Coastal prairie, Coastal scrub/annual herb/ Mar–Apr/820–2,030	Y	Y	N	Not expected to occur. No suitable vegetation present.
Micropus amphibolus	Mt. Diablo cottonweed	None/None/3.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Valley and foothill grassland; Rocky/annual herb/Mar–May/150–2,705	Y	Y	N	Not expected to occur. No suitable vegetation present.
Microseris paludosa	marsh microseris	None/None/1B.2	Cismontane woodland, Closed-cone coniferous forest, Coastal scrub, Valley and foothill grassland/perennial herb/Apr–June (July)/15–1,160	Y	Y	N	Not expected to occur. No suitable vegetation present.

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
Monardella sinuata ssp. *nigrescens*	northern curly-leaved monardella	None/None/1B.2	Chaparral, Coastal dunes, Coastal scrub, Lower montane coniferous forest; Sandy/annual herb/(Apr)May–July(Aug–Sep)/0–985	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Monolopia gracilens	woodland woollythreads	None/None/1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland, North Coast coniferous forest, Valley and foothill grassland/annual herb/(Feb)Mar–July/ 330–3,935	Y	Y	N	Not expected to occur. No suitable vegetation present.
Pentachaeta bellidiflora	white-rayed pentachaeta	FE/SE/1B.1	Cismontane woodland, Valley and foothill grassland/annual herb/Mar–May/115–2,030	Y	Y	N	Not expected to occur. No suitable vegetation present.
Piperia michaelii	Michael's rein orchid	None/None/4.2	Chaparral, Cismontane woodland, Closed-cone coniferous forest, Coastal bluff scrub, Coastal scrub, Lower montane coniferous forest/perennial herb/Apr–Aug/10–3,000	Y	Y	N	Not expected to occur. No suitable vegetation present.
Plagiobothrys chorisianus var. *chorisianus*	Choris' popcornflower	None/None/1B.2	Chaparral, Coastal prairie, Coastal scrub/annual herb/Mar–June/10–525	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Plagiobothrys diffusus	San Francisco popcornflower	None/SE/1B.1	Coastal prairie, Valley and foothill grassland/annual herb/Mar–June/195–1,180	Y	Y	N	Not expected to occur. No suitable vegetation present.
Plagiobothrys glaber	hairless popcornflower	None/None/1A	Marshes and swamps, Meadows and seeps/annual herb/Mar–May/50–590	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Polemonium carneum	Oregon polemonium	None/None/2B.2	Coastal prairie, Coastal scrub, Lower montane coniferous forest/perennial herb/Apr–Sep/0–6,000	Y	Y	N	Not expected to occur. No suitable vegetation present.
Polygonum marinense	Marin knotweed	None/None/3.1	Marshes and swamps/annual herb/(Apr)May–Aug (Oct)/0–35	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Ranunculus lobbii	Lobb's aquatic buttercup	None/None/4.2	Cismontane woodland, North Coast coniferous forest, Valley and foothill grassland, Vernal pools/annual herb (aquatic)/Feb–May/50–1,540	Y	Y	N	Not expected to occur. No suitable vegetation present.
Sanicula maritima	adobe sanicle	None/SR/1B.1	Chaparral, Coastal prairie, Meadows and seeps, Valley and foothill grassland/perennial herb/ Feb–May/100–785	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no

Scientific Name	Common Name	Status (Federal/State/CRPR)	Primary Habitat Associations/ Life Form/ Blooming Period/ Elevation Range (feet)	Blooming during survey?	Elevation appropriate?	Habitats Appropriate?	Potential to Occur
							suitable vegetation present.
Senecio aphanactis	chaparral ragwort	None/None/2B.2	Chaparral, Cismontane woodland, Coastal scrub/annual herb/Jan–Apr(May)/50–2,620	Y	Y	N	Not expected to occur. No suitable vegetation present.
Silene scouleri ssp. *scouleri*	Scouler's catchfly	None/None/2B.2	Coastal bluff scrub, Coastal prairie, Valley and foothill grassland/perennial herb/(Mar–May) June–Aug(Sep)/0–1,965	Y	Y	N	Not expected to occur. No suitable vegetation present.
Silene verecunda ssp. *verecunda*	San Francisco campion	None/None/1B.2	Chaparral, Coastal bluff scrub, Coastal prairie, Coastal scrub, Valley and foothill grassland/perennial herb/(Feb)Mar–July(Aug)/100–2,115	Y	Y	N	Not expected to occur. No suitable vegetation present.
Spergularia macrotheca var. *longistyla*	long-styled sand-spurrey	None/None/1B.2	Marshes and swamps, Meadows and seeps/perennial herb/Feb–May/0–835	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Stebbinsoseris decipiens	Santa Cruz microseris	None/None/1B.2	Broadleafed upland forest, Chaparral, Closed-cone coniferous forest, Coastal prairie, Coastal scrub, Valley and foothill grassland/annual herb/Apr–May/35–1,640	Y	Y	N	Not expected to occur. No suitable vegetation present.
Streptanthus albidus ssp. *peramoenus*	most beautiful jewelflower	None/None/1B.2	Chaparral, Cismontane woodland, Valley and foothill grassland/annual herb/(Mar)Apr–Sep (Oct)/ 310–3,280	Y	Y	N	Not expected to occur. No suitable vegetation present.
Streptanthus glandulosus ssp. *niger*	Tiburon jewelflower	FE/SE/1B.1	Valley and foothill grassland/annual herb/ May–June/100–490	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Stuckenia filiformis ssp. *alpina*	northern slender pondweed	None/None/2B.2	Marshes and swamps/perennial rhizomatous herb (aquatic)/May–July/985–7,050	Y	Y	N	Not expected to occur. No suitable vegetation present.
Suaeda californica	California seablite	FE/None/1B.1	Marshes and swamps/perennial evergreen shrub/July–Oct/0–50	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Symphyotrichum lentum	Suisun Marsh aster	None/None/1B.2	Marshes and swamps/perennial rhizomatous herb/(Apr)May–Nov/0–10	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Trifolium amoenum	two-fork clover	FE/None/1B.1	Coastal bluff scrub, Valley and foothill grassland/annual herb/Apr–June/15–1,360	Y	Y	N	Not expected to occur. No suitable vegetation present.

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Trifolium hydrophilum	saline clover	None/None/1B.2	Marshes and swamps, Valley and foothill grassland, Vernal pools/annual herb/Apr–June/0–985	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Triphysaria floribunda	San Francisco owl's-clover	None/None/1B.2	Coastal prairie, Coastal scrub, Valley and foothill grassland/annual herb/Apr–June/35–525	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Triquetrella californica	coastal triquetrella	None/None/1B.2	Coastal bluff scrub, Coastal scrub/moss/35–330	Y	N	N	Not expected to occur. The site is outside of the species' known elevation range and there is no suitable vegetation present.
Viburnum ellipticum	oval-leaved viburnum	None/None/2B.3	Chaparral, Cismontane woodland, Lower montane coniferous forest/perennial deciduous shrub/ May–June/705–4,590	Y	Y	N	Not expected to occur. No suitable vegetation present.

Appendix B
Special-Status Wildlife Potentially Occurring within the BSA

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Amphibians					
Ambystoma californiense pop. 1	California tiger salamander - central California DPS	FT/ST, WL	Annual grassland, valley–foothill hardwood, and valley–foothill riparian habitats; vernal pools, other ephemeral pools, and (uncommonly) along stream courses and man-made pools if predatory fishes are absent	N	Not expected to occur. No suitable vegetation or aquatic habitat present. Site is developed. Historic CNDDB occurrence records approximately 3 miles east are extirpated.
Dicamptodon ensatus	California giant salamander	None/SSC	Known from wet coastal forests and chaparral near streams and seeps from Mendocino Co. south to Monterey Co. and east to Napa Co. Aquatic larvae found in cold, clear streams, occasionally in lakes and ponds. Adults known from wet forests under rocks and logs near streams and lakes.	N	Not expected to occur. No CNDDB occurrences within 5 miles of the site. No suitable vegetation or aquatic habitat present.
Rana boylii pop. 1	foothill yellow-legged frog - north coast DPS	FPE/SE	Rocky streams and rivers with open banks in forest, chaparral, and woodland	N	Not expected to occur. No suitable vegetation or upland habitat present. Site is on Oakland Inner Harbor Channel within the Oakland Estuary Channel, and the Alameda-Oakland Ferryway causes existing disturbance and turbidity not suitable for this species to persist.
Rana draytonii	California red-legged frog	FT/SSC	Lowland streams, wetlands, riparian woodlands, livestock ponds; dense, shrubby or emergent vegetation associated with deep, still or slow-moving water; uses adjacent uplands	N	Not expected to occur. No suitable vegetation or adjacent upland habitat present. Site is developed. Historic CNDDB occurrence records approximately 4 miles east are extirpated.
Birds					
Accipiter cooperii (nesting)	Cooper's hawk	None/WL	Nests and forages in dense stands of live oak, riparian woodlands, or other woodland habitats often near water	Y	Low potential to occur. Although site is partially on water, no suitable woodland vegetation present. CNDDB occurrence records from 2003 are approximately 2.5 miles northeast of the site at Lake Merritt.
Aquila chrysaetos (nesting and wintering)	golden eagle	None/FP, WL	Nests and winters in hilly, open/semi-open areas, including shrublands, grasslands, pastures, riparian areas, mountainous canyon land, open desert rimrock terrain; nests in large trees and on cliffs in open areas and forages in open habitats	N	Not expected to occur. No suitable vegetation or riparian habitat present. No CNDDB occurrence records within 5 miles of the site.
Ardea alba (nesting colony)	great egret	None/None	Nests and roosts in large trees over water or on islands, both in freshwater and marine estuarine habitats; forages in wetlands, including marshes, streams, ditches, and fish-rearing ponds, but also in irrigated pastures and croplands	Y	Low potential to occur. Estuary habitat onsite is heavily disturbed. No CNDDB occurrence records within 5 miles of the site.
Ardea herodias (nesting colony)	great blue heron	None/None	Nests in large trees or snags; forages in wetlands, water bodies, watercourses, and opportunistically in uplands, including pasture and croplands	Y	Low potential to occur. Suitable aquatic foraging habitat onsite. No CNDDB occurrence records within 5 miles of the site.
Asio flammeus (nesting)	short-eared owl	BCC/SSC	Grassland, prairies, dunes, meadows, irrigated lands, and saline and freshwater emergent wetlands	N	Not expected to occur. No suitable vegetation, dunes, or emergent wetlands present. No CNDDB occurrence records within 5 miles of the site.

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Athene cunicularia (burrow sites and some wintering sites)	burrowing owl	BCC/SSC	Nests and forages in grassland, open scrub, and agriculture, particularly with ground squirrel burrows	N	Not expected to occur. No suitable vegetation or soils to support animal burrows present. No CNDDB occurrence records within 5 miles of the site.
Branta hutchinsii leucopareia (wintering)	cackling (=Aleutian Canada) goose	FPD/WL	Winters in lacustrine, fresh emergent wetlands, and moist grasslands, croplands, pastures, and meadows	N	Not expected to occur. No suitable vegetation or emergent wetlands present. No CNDDB occurrence records within 5 miles of the site.
Charadrius nivosus nivosus (nesting)	western snowy plover	FT, BCC/SSC	On coasts nests on sandy marine and estuarine shores; in the interior nests on sandy, barren or sparsely vegetated flats near saline or alkaline lakes, reservoirs, and ponds	Y	Low potential to occur. Disturbed estuary habitat onsite. CNDDB occurrence records from 1979 approximately 5 miles southeast of the site.
Circus hudsonius (nesting)	northern harrier	BCC/SSC	Nests in open wetlands (marshy meadows, wet lightly-grazed pastures, old fields, freshwater and brackish marshes); also in drier habitats (grassland and grain fields); forages in grassland, scrubs, rangelands, emergent wetlands, and other open habitats	N	Low potential to occur. No suitable vegetation or march habitat present. However, open ocean immediately adjacent to site. No CNDDB occurrence records within 5 miles.
Coturnicops noveboracensis	yellow rail	BCC/SSC	Nesting requires wet marsh/sedge meadows or coastal marshes with wet soil and shallow, standing water	Y	Low potential to occur. No suitable vegetation or mesic soil present. Historic CNDDB occurrence records from 1905 approximately 3 miles southeast of the site are presumed extant. Site is on artificial land over historic coastal brackish marsh.
Egretta thula (nesting colony)	snowy egret	None/None	Nests in dense marshes and trees; forages in wetlands or aquatic habitats, including estuaries, emergent wetlands, slow-moving rivers, irrigation ditches, and wet fields	Y	Low potential to occur. No vegetation present, although suitable aquatic and disturbed estuarine habitat occurs onsite. No CNDDB occurrence records within 5 miles.
Elanus leucurus (nesting)	white-tailed kite	None/FP	Nests in woodland, riparian, and individual trees near open lands; forages opportunistically in grassland, meadows, scrubs, agriculture, emergent wetland, savanna, and disturbed lands	N	Not expected to occur. Although disturbed lands onsite, no suitable vegetation or emergent wetlands present. No CNDDB occurrence records within 5 miles.
Falco peregrinus anatum (nesting)	American peregrine falcon	FPD/FP, SCD	Nests on cliffs, buildings, and bridges; forages in wetlands, riparian, meadows, croplands, especially where waterfowl are present	Y	Low potential to occur. Suitable aquatic foraging habitat with waterfowl present onsite. CNDDB occurrence records from 2014 approximately 2.5 miles east of the site. May prey on waterfowl in Oakland Estuary Channel. Known to nest in SF Bay on artificial structures, but unlikely to nest within the BSA due to lack of suitable nesting locations.
Geothlypis trichas sinuosa	saltmarsh common yellowthroat	BCC/SSC	Nests and forages in emergent wetlands including woody swamp, brackish marsh, and freshwater marsh	Y	Low potential to occur. CNDDB occurrence records from 1989 located 2.8 miles northwest of the site. No suitable vegetation or wetlands present. Aquatic habitat onsite is disturbed tidal estuary on artificial land that was historic brackish marsh.

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Haliaeetus leucocephalus (nesting and wintering)	bald eagle	FPD/FP, SE	Nests in forested areas adjacent to large bodies of water, including seacoasts, rivers, swamps, large lakes; winters near large bodies of water in lowlands and mountains	Y	Low potential to occur. Site is on large body of water but no suitable vegetation present. May forage, but not suitable for nesting. No CNDDB occurrence records within 5 miles.
Hydroprogne caspia (nesting colony)	Caspian tern	None/None	Coastal estuarine, saltmarsh, and barrier islands; nests on islands in rivers and salt lakes	Y	Low potential to occur. Disturbed coastal estuary onsite but no suitable vegetation present. No CNDDB occurrence records within 5 miles.
Laterallus jamaicensis coturniculus	California black rail	None/FP, ST	Tidal marshes, shallow freshwater margins, wet meadows, and flooded grassy vegetation; suitable habitats are often supplied by canal leakage in Sierra Nevada foothill populations	N	Not expected to occur. No suitable vegetation present. Historic CNDDB occurrence records approximately 1 mile southeast of the site are possibly extirpated. CNDDB occurrence records from 2009 are 3 miles north past SF Bay.
Melospiza melodia maxillaris	Suisun song sparrow	None/SSC	Nests and forages in tidal salt and brackish marsh	N	Not expected to occur. No suitable marsh habitat present. No CNDDB occurrence records within 5 miles of the site.
Melospiza melodia pusillula	Alameda song sparrow	BCC/SSC	Nests and forages in tidal saltmarsh	Y	Low potential to occur. No suitable vegetation present. Historic CNDDB occurrence records from 1900 onsite are presumed extant. Multiple occurrences from 2004 within 3 miles of the site. However, Oakland estuary channel is heavily disturbed with existing marine commercial development and unlikely to support this species.
Melospiza melodia samuelis	San Pablo song sparrow	BCC/SSC	Nests and forages in tidal and muted tidal saltmarsh	N	Not expected to occur. No marsh habitat present. No CNDDB occurrence records within 5 miles of the site.
Nycticorax nycticorax (nesting colony)	black-crowned night-heron	None/None	Nests in dense-foliaged trees and dense fresh or brackish emergent wetlands associated with marshes, ponds, reservoirs, and estuaries	Y	Low potential to occur. Disturbed coastal estuary onsite but no suitable vegetation present. No CNDDB occurrence records within 5 miles.
Pandion haliaetus (nesting colony)	Osprey	None/WL	Wetlands where fish are present. Nests within site of permanent water and will nest on artificial structures.	Y	Low potential to occur. May forage in the Oakland Estuary channel and not likely to nest on artificial structures onsite. Known to nest at Alameda Point (2017).
Rallus obsoletus obsoletus	Ridgway's rail	FE/FP, SE	Coastal salt or brackish marshes	N	Not expected to occur. No suitable vegetation present for cover, nesting, or foraging. CNDDB occurrence records from 2006 located 3 miles southeast of the site. Site is on artificial fill over historic brackish marsh

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Riparia riparia (nesting)	bank swallow	None/ST	Nests in riparian, lacustrine, and coastal areas with vertical banks, bluffs, and cliffs with sandy soils; open country and water during migration	Y	Low potential to occur. No suitable vegetation present. Although coastal habitat onsite could support this species during migration, no sandy soils or cliffs for nesting. No CNDDB occurrences within 5 miles of the site.
Rynchops niger (nesting colony)	black skimmer	BCC/SSC	Nests on barrier beaches, shell banks, spoil islands, and saltmarsh; forages over open water; roosts on sandy beaches and gravel bars	Y	Low potential to occur, May forage over Oakland estuary channel's open water or nest along disturbed shoreline onsite. No CNDDB occurrence records within 5 miles of the site.
Sternula antillarum browni (nesting colony)	California least tern	FE/FP, SE	Forages in shallow estuaries and lagoons; nests on sandy beaches or exposed tidal flats	Y	Low potential to occur. Site is developed so no vegetation present. However, project is on Oakland estuary channel which is tidal with disturbed shoreline. CNDDB occurrence records from 1996 approximately 1.5 miles west of the site are on Alameda point, an extant successful breeding colony. May use the estuary for foraging while in CA from April-August.
Xanthocephalus xanthocephalus (nesting)	yellow-headed blackbird	None/SSC	Nests in marshes with tall emergent vegetation, often along borders of lakes and ponds; forages in emergent wetlands, open areas, croplands, and muddy shores of lacustrine habitat	N	Not expected to occur. No suitable vegetation, emergent wetland, or lacustrine habitat present. No CNDDB occurrence within 5 miles.
Nannopterum auritum (nesting colony)	double-crested cormorant	None/WL	Nests in riparian trees near ponds, lakes, artificial impoundments, slow-moving rivers, lagoons, estuaries, and open coastlines; winter habitat includes lakes, rivers, and coastal areas	Y	Low potential to occur. Disturbed estuary habitat onsite along coast. CNDDB occurrence records from 1988 approximately 3 miles northwest of the site. No nesting or roosting habitat present, but may forage within Oakland Estuary channel or perch on artificial dock structures onsite.
Fishes					
Acipenser medirostris pop. 1	green sturgeon - southern DPS	FT/None	Spawns in deep pools in large, turbulent, freshwater rivers; adults live in oceanic waters, bays, and estuaries	Y	High potential to occur. Suitable estuarine habitat present for adults to persist. CNDDB occurrence records onsite from 2016. Site is in critical habitat for this species.
Archoplites interruptus (within native range only)	Sacramento perch	None/SSC	Historically found in the sloughs, slow-moving rivers, and lakes of the Central Valley	N	Not expected to occur. No suitable aquatic habitat present. CNDDB occurrence records from 1980 located approximately 8 miles north.
Eucyclogobius newberryi	tidewater goby	FE/None	Brackish water habitats along the California coast from Agua Hedionda Lagoon, San Diego County, to the mouth of the Smith River	Y	Low potential to occur. Suitable brackish aquatic habitat present. CNDDB occurrence records 2 miles northeast are from an unknown year in the 1900's, in Lake Merritt.
Mylopharodon conocephalus	hardhead	None/SSC	Low- to mid-elevation streams in the Sacramento–San Joaquin drainage; also present in the Russian River	N	Not expected to occur. No CNDDB occurrences within 10 miles of the site. No

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
					suitable vegetation or aquatic habitat present.
Oncorhynchus mykiss	steelhead - central valley and central CA coast DPS	FT/None	Anadromous, migrating to central bay waters between freshwater spawning and rearing areas in the Central Valley and Pacific Ocean. San Francisco Bay waters surrounding Alameda Island are designated critical habitat.	Y	Moderate potential to occur. May migrate seasonally through waters in the project site (Central Valley is all waters of SF Bay north of Bay Bridge). Spawning runs and emigrating steelhead use tributaries of SF Bay as migration corridor to ocean.
Oncorhynchus tshawytscha	Chinook salmon - central valley winter run	FE/SE (winter), FT/ST (spring run), None/CSS (fall/late fall)	Winter run: Anadromous, adults migrate to central bay waters from November through December. Juveniles migrate through SF bay en route to the pacific ocean as a wildlife corridor. Spring run: adults in SF bay during migratory period in spring, while juveniles have potential to inhabitat Bay in the fall, winter, and spring.	Y	Moderate potential to occur. Suitable foraging habitat present within San Francisco Bay for all subspecies. All runs may occur during respective outmigration periods or as holding habitat prior to spawning runs.
Spirinchus thaleichthys	longfin smelt	FC/ST	Aquatic, estuary	Y	Moderate potential to occur. Suitable estuarine habitat present. CNDDB occurrence records in the vicinity from 2010. Known to inhabit waters of the Central Bay.
Thaleichthys pacificus	eulachon	FT, BCC/None	Found in Klamath River, Mad River, and Redwood Creek and in small numbers in Smith River and Humboldt Bay tributaries	N	Not expected to occur. No suitable tributaries or rivers onsite. No CNDDB occurrence records within 10 miles.
Invertebrates					
Adela oplerella	Opler's longhorn moth	None/None	Serpentine grassland	N	Not expected to occur. No suitable vegetation or soils present. No CNDDB occurrence records within 10 miles.
Banksula incredula	incredible harvestman	BCC/None	Known only from the type locality San Bruno Mountain, San Mateo County. Trailside talus slope with Franciscan sandstone and dense chaparral canopy.	N	Not expected to occur. No suitable vegetation present. No CNDDB occurrence records within 3 miles.
Bombus caliginosus	obscure bumble bee	None/None	Inhabits the west coast from Washington to Southern California, as far south as the San Jacinto Mountains. Seen on plants belonging to *Asteracea, Fabaceae,* and *Ericaceae* families. Habitats include open grassy coastal prairies and coast range meadows.	N	Not expected to occur. No suitable vegetation or floral sources onsite. Historic CNDDB occurrence records 0.5 miles north of the site are presumed extant.
Bombus crotchii	Crotch bumble bee	None/None	Open grassland and scrub communities supporting suitable floral resources.	N	Not expected to occur. No suitable vegetation or floral resources present onsite.
Bombus occidentalis	western bumble bee	None/None	Once common and widespread, species has declined precipitously from central California to southern British Columbia, perhaps from disease	N	Not expected to occur. No suitable vegetation present. Historic CNDDB occurrence records approximately 3 miles north from 1965 are presumed extant.
Caecidotea tomalensis	Tomales isopod	None/None	Inhabits localized freshwater ponds or streams with still or near-still water in several Bay Area counties	N	Not expected to occur. No freshwater wetland habitat present. No CNDDB occurrences within 10 miles.
Callophrys mossii bayensis	San Bruno elfin butterfly	FE/None	Coastal chaparral, on steep north-facing slopes, and in fog-belt of the mountains near San Francisco Bay	N	Not expected to occur. No suitable vegetation or north-facing slopes present.

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Cicindela hirticollis gravida	sandy beach tiger beetle	None/None	Inhabits areas adjacent to non-brackish water along the coast of California from San Francisco Bay to northern Mexico	N	Not expected to occur. No suitable vegetation present. Historic CNDDB occurrence records from 1920 approximately 4 miles west are extirpated.
Danaus plexippus pop. 1	monarch	FC/None	Wind-protected tree groves with nectar sources and nearby water sources	N	Not expected to occur. No suitable vegetation present. CNDDB occurrence records from 2014 located 4 miles west of the site.
Dufourea stagei	Stage's dufourine bee	None/None	Ground-nesting	N	Not expected to occur. Site is developed with no suitable soils for ground nesting.
Euphydryas editha bayensis	Bay checkerspot butterfly	FT/None	Serpentine or serpentine-like grasslands	N	Not expected to occur. No suitable vegetation or soils present. CNDDB occurrence records from 1980 located 6 miles east are extirpated.
Gonidea angulata	western ridged mussel	None/None	Primarily creeks and rivers and, less often, lakes; originally in most of state, now extirpated from Central and Southern California	N	Not expected to occur. No suitable lacustrine habitat present.
Helminthoglypta nickliniana bridgesi	Bridges' coast range shoulderband	None/None	Inhabits open hillsides of Alameda and Contra Costa Counties	N	Not expected to occur. No suitable vegetation or hillsides present.
Hydroporus leechi	Leech's skyline diving beetle	None/None	Aquatic	Y	Not expected to occur. Although suitable aquatic habitat is present, no CNDDB occurrence records within 10 miles of the site.
Icaricia icarioides missionensis	Mission blue butterfly	FE/None	Coastal chaparral and coastal grasslands; host plants are silver lupine (*Lupinus albifrons*), summer lupine (*L. formosus*), and many colored lupine (*L. variicolor*)	N	Not expected to occur. No suitable vegetation or host plants present.
Icaricia icarioides pheres	Pheres blue butterfly	None/None	Coastal dunes of San Francisco	N	Not expected to occur. No suitable vegetation or coastal dunes present.
Ischnura gemina	San Francisco forktail damselfly	None/None	Endemic to the San Francisco Bay Area	Y	Low potential to occur. Site is within SF Bay. CNDDB occurrence records located 9 miles southwest from 1997.
Lichnanthe ursina	bumblebee scarab beetle	None/None	Inhabits coastal sand dunes from Sonoma County south to San Mateo County	N	Not expected to occur. No suitable vegetation present.
Microcina leei	Lee's micro-blind harvestman	None/None	Xeric habitats in the San Francisco Bay region	N	Not expected to occur. No suitable vegetation or xeric habitat present. CNDDB occurrence records from 1983 located 6 miles north are presumed extant.
Microcina tiburona	Tiburon micro-blind harvestman	None/None	Open, hilly grassland habitat in areas of serpentine bedrock	N	Not expected to occur. No suitable vegetation or soils present.
Pomatiopsis californica	Pacific walker	None/None	Freshwater	N	Not expected to occur. No suitable freshwater habitat present. Historic CNDDB occurrence records 1 mile north of the site are extirpated

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Speyeria callippe callippe	callippe silverspot butterfly	FE/None	Native grassland and associated habitats in the San Francisco Bay area	N	Not expected to occur. No suitable vegetation present, although site is within SF Bay. CNDDB occurrences from 2010 located 8 miles southwest.
Trachusa gummifera	San Francisco Bay Area leaf-cutter bee	None/None	(blank)	N	Not expected to occur. No suitable vegetation present.
Tryonia imitator	mimic tryonia (=California brackish water snail)	None/None	Inhabits coastal lagoons, estuaries, and saltmarshes, from Sonoma County south to San Diego County	Y	Low potential to occur. Suitable estuary habitat present. CNDDB occurrence records from an unknown year within 3 miles of the site in Lake Merritt are extirpated.
Vespericola marinensis	Marin hesperian	None/None	Found in moist spots in coastal brushfield and chaparral vegetation in Marin County	N	Not expected to occur. No suitable vegetation present.
Mammals					
Aeorestes cinereus	northern hoary bat	None/None	Forest, woodland riparian, and wetland habitats; also juniper scrub, riparian forest, and desert scrub in arid areas; roosts in tree foliage and sometimes cavities, such as woodpecker holes	Y	Low potential to occur. No suitable vegetation present. Suitable wetland habitat with artificial cavities. No CNDDB occurrences within 5 miles of the site.
Antrozous pallidus	pallid bat	None/SSC	Grasslands, shrublands, woodlands, forests; most common in open, dry habitats with rocky outcrops for roosting, but also roosts in man-made structures and trees	N	Not expected to occur. No suitable vegetation or dry habitats present. Man-made structures onsite could support roosting. CNDDB occurrence records from 1945 located 5 miles north are presumed extant.
Corynorhinus townsendii	Townsend's big-eared bat	None/SSC	Mesic habitats characterized by coniferous and deciduous forests and riparian habitat, but also xeric areas; roosts in limestone caves and lava tubes, man-made structures, and tunnels	N	Not expected to occur. No suitable vegetation present. Man-made structures onsite could support roosting and area is mesic. However, CNDDB occurrences from 1938 located 6 miles north are possibly extirpated.
Dipodomys heermanni berkeleyensis	Berkeley kangaroo rat	None/None	Open, grassy hilltops and open spaces in chaparral and blue oak/digger pine woodlands	N	Not expected to occur. No suitable vegetation present. Historic CNDDB occurrences from 1916 located 6 miles north are presumed extant.
Enhydra lutris nereis	southern sea otter	FT/SSC, FP	Nearshore marine environments	Y	Low potential to occur. Nearshore marine habitat present but heabily disturbed by industrial and commercial marine development. No CNDDB occurrences within 5 miles of the site. NOAA occurrences?? Potential underwater acoustic impacts from pile driving.
Erethizon dorsatum	North American porcupine	None/None	Forested habitats in the Sierra Nevada, Cascade, and Coast ranges, with scattered observations from forested areas in the Transverse Ranges (CDFW 2018).	N	Not expected to occur. No suitable vegetation present. No CNDDB occurrence records within 5 miles

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Eumetopias jubatus	Steller (=northern) sea-lion	FPD/SSC	Beaches, ledges, and rocky reefs	Y	Low potential to occur. Site lies on Oakland Inner Harbor Channel; sea lions may rest on man-made structures onsite or locally migrate within Oakland estuary channel. No CNDDB occurrence records within 5 miles. NOAA occurrences? Potential underwater acoustic impacts from pile driving.
Lasionycteris noctivagans	silver-haired bat	None/None	Old-growth forest, maternity roosts in trees, large snags 50 feet aboveground; hibernates in hollow trees, rock crevices, buildings, mines, caves, and under sloughing bark; forages in or near coniferous or mixed deciduous forest, stream or river drainages	N	Not expected to occur. No suitable vegetation or caves present. No suitable stream or river drainages onsite. Historic CNDDB occurrence records from 1920 located 3.5 miles northeast are presumed extant.
Lasiurus blossevillii	western red bat	None/SSC	Forest, woodland, riparian, mesquite bosque, and orchards, including fig, apricot, peach, pear, almond, walnut, and orange; roosts in tree canopy	N	Not expected to occur. No suitable vegetation present. No CNDDB occurrence records within 5 miles.
Microtus californicus sanpabloensis	San Pablo vole	BCC/SSC	Saltmarshes of San Pablo Creek	N	Not expected to occur. No suitable vegetation present. Site is not on or adjacent to San Pablo Creek.
Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	None/SSC	Forest habitats with a moderate canopy and moderate to dense understory	N	Not expected to occur. No suitable vegetation present. No CNDDB occurrences within 5 miles of the site.
Nyctinomops macrotis	big free-tailed bat	None/SSC	Rocky areas; roosts in caves, holes in trees, buildings, and crevices on cliffs and rocky outcrops; forages over water	Y	Low potential to occur. Development onsite could support roosting and Oakland estuary channel could support foraging. Historic CNDDB occurrence records from 1916 located 5 miles north are presumed extant.
Reithrodontomys raviventris	salt-marsh harvest mouse	FE/FP, SE	Saline emergent wetlands, preference for pickleweed saline emergent wetlands; also uses adjacent grasslands	N	Not expected to occur. No suitable vegetation or emergent wetlands present. CNDDB occurrences from 1986 located approximately 3 miles southeast.
Scapanus latimanus insularis	Angel Island mole	None/None	Confined to Angel Island; moist soil under chaparral	N	Not expected to occur. No suitable vegetation or moist soils present. Site is not on Angel island.
Scapanus latimanus parvus	Alameda Island mole	BCC/SSC	Confined to Alameda Island; variety of habitats including annual and perennial grasslands	Y	Low potential to occur. No suitable vegetation present although site is on Alameda Island. Historic CNDDB occurrence records approximately 0.5 miles south of the site are presumed extant. Multiple historic occurrences within 3 miles.
Sorex vagrans halicoetes	salt-marsh wandering shrew	None/SSC	Saltmarsh inundated daily by tidal waters	N	Not expected to occur. No suitable vegetation or natural saltmarsh present. Tidal waters are disturbed daily. No CNDDB occurrence records within 5 miles.

	Common Name	Status (Federal/ State)	Habitat	Appropriate habitats?	Potential to Occur
Taxidea taxus	American badger	None/SSC	Dry, open, treeless areas; grasslands, coastal scrub, agriculture, and pastures, especially with friable soils	N	Not expected to occur. No suitable vegetation or xeric habitat present. No CNDDB occurrence records within 5 miles.
Zapus trinotatus orarius	Point Reyes jumping mouse	None/SSC	Wet, marshy coastal meadows, coast redwood forests, riparian thickets, and grassy areas in coniferous forests	N	Not expected to occur. No suitable vegetation present. No CNDDB occurrence records within 5 miles.
Reptiles					
Emys marmorata	western pond turtle	None/SSC	Slow-moving permanent or intermittent streams, ponds, small lakes, and reservoirs with emergent basking sites; adjacent uplands used for nesting and during winter	N	Not expected to occur. No suitable upland habitat or lacustrine/riparian habitat present. No CNDDB occurrence records within 5 miles.
Masticophis lateralis euryxanthus	Alameda whipsnake	FT/ST	Open areas in chaparral and scrub habitat; also adjacent grassland, oak savanna, and woodland	N	Not expected to occur. No suitable vegetation present. Historic CNDDB occurrence records from 1953 located 6 miles east.
Thamnophis sirtalis tetrataenia	San Francisco garter snake	FE/FP, SE	Wide range of habitats including grasslands or wetlands adjacent to ponds, marshes, and sloughs	N	Not expected to occur. No suitable vegetation or freshwater wetlands present. CNDDB occurrence records from 2014 located 6 miles southwest.

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Appendix C

Alameda Main Street Ferry Terminal
Refurbishment Project
Hydroacoustic Impact Assessment

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT HYDROACOUSTIC ASSESSMENT

Alameda, California

November 1, 2022

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EXECUTIVE SUMMARY

This report summarizes the results of an acoustic assessment performed to evaluate the effects of construction activity noise on aquatic species. The construction activities for the refurbishment of the Alameda Main Street (AMS) Ferry Terminal includes replacement of the terminal bridge and foundation, gangway replacement, float demolition and replacement, and utility upgrades. The purpose of this assessment is to predict construction noise levels that may occur during the project so that permitting regulatory agencies can address concerns and answer questions raised about the potential project effects on sensitive habitat and aquatic species. The assessment focuses on predicting underwater noise levels from pile-driving activities. Because the design and construction details are preliminary at this time, an analysis that predicts conditions that are expected to cause reasonably worst-case acoustic conditions were analyzed. Under this worst-case scenario, piles would be driven using both vibratory and impact hammers. Note that impact pile driving would only occur if vibratory driving were not able to install piles to their tip elevation. Results of this assessment are summarized as follows:

- **48-inch-diameter steel pipe pile (Monopile)**: Impact pile driving of these piles in water could cause acoustic impacts at distances extending out to 4,200 meters (m) and 1,010 m for the root-mean-square (RMS) (150 decibel [dB] re 1 micropascal [µPa]) and Cumulative sound exposure level (SEL) (187 dB re 1µPa^2-sec) respectively for the adopted fish thresholds. Note that sounds would travel further to the west. Distances where sound levels exceed the marine mammal thresholds could extend out to about 997 m for the Level A Injury Zone for Pinnipeds while extending out to about 4,200 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 158 m for the RMS (150 dB re 1µPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to the mouth of the Middle Harbor at 4,200 m for the marine mammal thresholds. Use of attenuation methods (e.g., air bubble curtains), would reduce these distances.

- **36-inch steel pipe pile (guide piles & donut fender piles)**: Impact driving of these piles in water could result in sounds above thresholds extending out to the mouth of the Middle harbor at 4,200 m and 1,166 m for the RMS (150 dB re 1µPa) and Cumulative SEL (187 dB re 1µPa^2-sec) respectively for the adopted fish thresholds. Distances where sound levels exceed the marine mammal thresholds could extend out to about 1,311 m for the Level A Injury Zone for Pinnipeds while extending out to about 1,848 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 117 m for the RMS (150 dB re 1µPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to 4,200 m for the marine mammal thresholds. Use of attenuation methods (e.g., air bubble curtains), would reduce these distances.

- **24-inch steel pipe pile:** These piles would be driven on land, which could result in impact distances extending out to 736 m and 64 m for the RMS (150 dB re 1µPa) and Cumulative

SEL (187 dB re 1µPa^2-sec) respectively for the adopted fish thresholds. Distances where sound levels exceed the marine mammal thresholds could extend out to about 63 m for the Level A Injury Zone for Pinnipeds while extending out to about 158 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 5 m for the RMS (150 dB re 1µPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to 541 m for the marine mammal thresholds.

Note, the maximum anticipated distances to various fish and marine mammal thresholds calculated for each type of pile using NMFS guidelines, are constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the edge of the shipping channel ~ 4,200 m to the west of the ferry terminal site and ~1,700 m to the east. Substantial noise from piling activity is not anticipated to propagate past these bends. The computed distances for vibratory driving using the standard attenuation rate (15 Log of the distance) are 11.6 to 15.8 km, which extend beyond the harbor mouth. However, measurements in the Bay have shown greater attenuation rates of 18 Log of the distance that reduce this distance to 3.6 to 4.6 km. Given this higher attenuation rate and the narrow channel that sound would propagate, sounds above the threshold would not extend beyond the Middle Harbor.

Attachment A depicts the areas where sound effects above thresholds are predicted.

INTRODUCTION

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) is proposing the Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (project) to support WETA ferry operations within the Oakland Inner Harbor.

The project site is located at 2990 Main Street in Alameda (City), California and includes the existing AMS Ferry Terminal, which consists of a trestle, steel float structure, aluminum gangway, and bridge structure. The site is designated under the General and Maritime Industry land use and zoned as General Industrial (M-2). Much of the project site is within the Oakland Inner Harbor, with a portion of the bridge structure extending onto the landside of the City. The landside of the project site consists of various bay rocks, rip-rap, and dirt/sand. The project site is accessible by vehicle via Main Street and by ferry within the Oakland Inner Harbor. The project is within a developed area of the City and is bounded by the Oakland Inner Harbor to the north, industrial uses to the east, the San Francisco Bay Trail, AMS Ferry Terminal parking lot, and residential uses to the south, as well as the Main Street Dog Park and undeveloped land uses to the east.

Project elements would include replacement of the existing bridge walkway and foundation, and replacement of the gangway, float, guide piles, and upgrades to utilities at the project site. All project features would be compliant with Americans with Disabilities Act (ADA) standards. These details rely on project plans and are further described, below.

Terminal Bridge and Foundation Replacement. Project activities would involve demolishment of existing bridge/walkway and bridge foundation and replacement with a new aluminum truss bridge. Onshore and landside support would be installed and would consist of a 48-inch (in) monopile and two 24-in pipe piles with cap beams, respectively.

Gangway Replacement. The project would include removal of the existing 60-foot gangway and replacement with an 80-foot covered aluminum gangway.

Float Demolition/Replacement. The existing terminal float would be removed and replaced-in-kind with a new steel float. Ramps that had been previously installed on the float would be removed, protected in place, and reused once the new float is installed. Float ramps would be shifted to the west to provide additional room for a longer gangway. The four (4) existing 30-foot guide piles would be removed and replaced with four (4) new 36-in guide piles. To achieve a more safe, efficient berthing capacity and enable ingress and egress in a timely manner, float demolition/replacement activities would also involve installation of two (2) new 36-in steel pipe piles and two (2) 72-in donut fender piles.

Utility Upgrades. Utility upgrades associated with the project would involve replacement of existing razor equipment, installation of electrical service for replacement lighting, ramp controls, and outlets and a new potable water line. The new potable water line will connect to an existing line at the Ferry Terminal restroom facility. The new line will be used for intermittent terminal cleaning activities as needed. No other utility improvements are planned. The bridge, gangway, and float structures are designed to accommodate additional conduit related to an electric shorepower system that is to be constructed in the future as part of a separate project. The shorepower system will allow for charging of electric ferry vessels that will berth at AMS Ferry Terminal.

Overall, the footprint of the project site is expected to increase the AMS Ferry Terminal shade area by approximately 830 square feet. No changes in operational demand (i.e., an increase in ferry users) are anticipated, and no physical impacts beyond the project boundaries (see Figure 2) are anticipated as part of the project. Vehicular and pedestrian access to the AMS Ferry Terminal is not anticipated to change.

The water depth at the project site varies between 14-in to 28-in mean lower low water (MLLW). Most construction activities will occur above or at the waterline. The only elements that will extend below the mudline are the new piles that will have a maximum tip elevation of approximately 110-in MLLW.

This study is an assessment of potential underwater noise levels generated by planned construction activities involved with the refurbishment of the AMS Ferry Terminal. The study was requested in order to aid regulatory biologists in assessing underwater sound impacts on fish and marine species that may be present in the area when construction occurs. This assessment is based on information provided by project designers consisting of a location map, draft layout sheets, estimated pile-driving data, a review of potential construction activities to be conducted at the site, a review of related studies, the modeling, and a semi-quantitative analysis of underwater noise levels. This study assesses the sound levels associated with potential pile-driving activities that could affect aquatic species. This study does not address environmental impacts associated with the project.

UNDERWATER SOUNDS FROM PILE-DRIVING ACTIVITIES

Fundamentals of Underwater Noise

Impact pile driving can produce high underwater sound levels. When a pile-driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, the ground, and the air. Sound pressure pulse as a function of time is referred to as the waveform. In terms of acoustics, these sounds are described by the peak pressure, the root-mean-square (RMS) pressure, and the sound exposure level (SEL). The peak pressure is the highest absolute value of the measured waveform and can be a negative or positive pressure peak. For pile-driving pulses, RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that comprises that portion of the waveform containing the sound energy (Richardson et al. 1995; ISO 18406:2017(E).). The pulse RMS has been approximated in the field for pile-driving sounds by measuring the signal with a precision sound level meter set to the "impulse" RMS setting and is typically used to assess impacts to marine mammals. Another measure of the pressure waveform that can be used to describe the pulse is the sound energy itself. The total sound energy in the pulse is referred to in many ways, most commonly as the "total energy flux" (Finerran 2002). The "total energy flux" is equivalent to the un-weighted SEL for a plane wave propagating in a free field, a common unit of sound energy used in airborne acoustics to describe short-duration events. The unit used is decibels (dB) re 1 micropascal (μPa)^2-second (sec). In this report, peak pressure levels are expressed as the absolute maximum pressure of a pulse in dB re 1 μPa; however, in other literature, peak pressure levels can take varying forms, such as pascals or pounds per square inch. The total sound energy in an impulse accumulates over the duration of that pulse and the duration of a pile driving event. Figure 1 illustrates the acoustical characteristics of an underwater pile-driving pulse. Table 1 includes the definitions of terms commonly used to describe underwater sounds.

The variation of instantaneous pressure over the duration of a sound event is referred to as the waveform. The waveform can provide an indication of rise time or the rapidity with which pressure fluctuates with time; however, rise time differences are not clearly apparent for pile-driving sounds because of the numerous rapid fluctuations that are characteristic of this impulse type. A plot showing the accumulation of sound energy over the duration of the pulse (or at least the portion of time during which much of the energy accumulates) illustrates the differences in source strength and rise time. An example of the underwater acoustical characteristics of a typical pile-driving pulse is shown on Figure 1.

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile-driving pulse or many pulses, such as pile driving for one pile or for one day of pile driving. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL associated with the driving of a pile can be estimated using the single-strike SEL value and the number of pile strikes through the following equation:

$$SEL_{cumulative} = SEL_{single-strike} + 10log(\#of\ pile\ strikes)$$

For example, if a single-strike SEL for a pile is 165 dB, and it takes 1,000 strikes to drive the pile, the cumulative SEL is 195 dBA (165 dB + 30 dB = 195 dB), where 10 * $Log_{10}(1000)$ = 30.

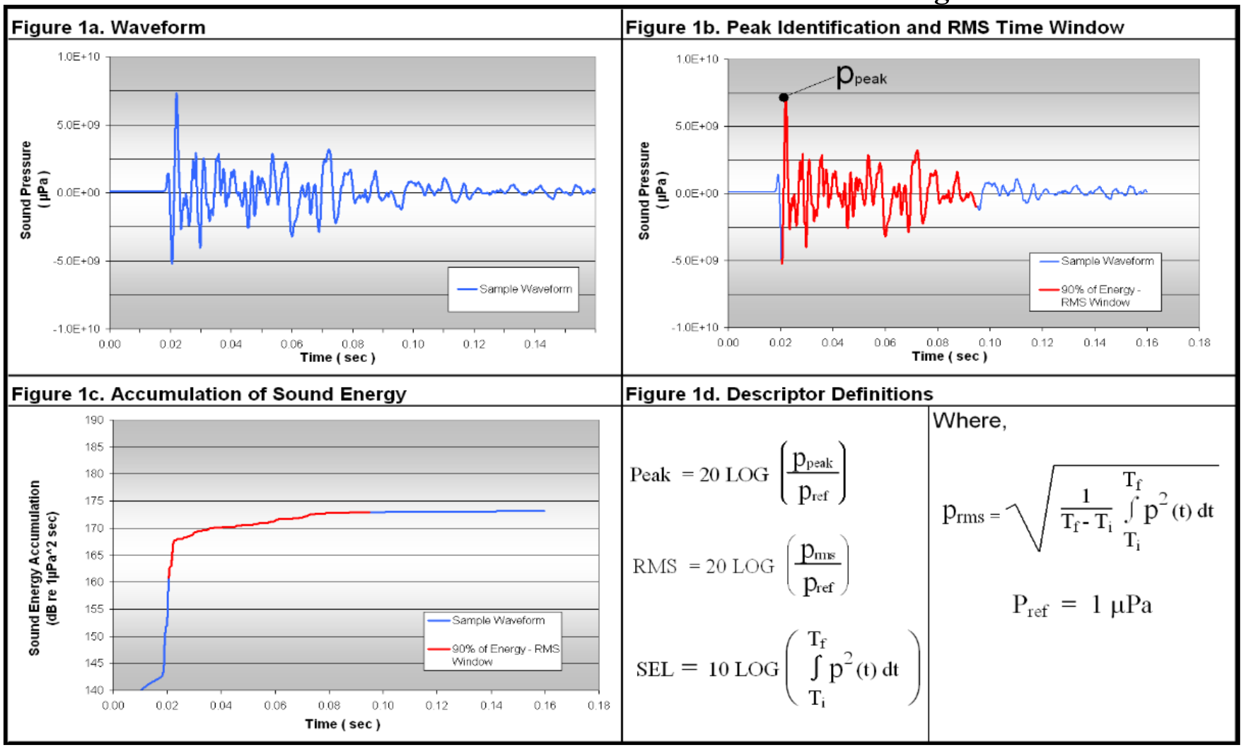
TABLE 1 Definition of Underwater Acoustical Terms

Term	Definition
Peak Sound Pressure, unweighted (dB)	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a dB (referenced to a pressure of 1 μPa) but can also be expressed in units of pressure, such as μPa or pounds per square inch.
RMS Sound Pressure Level, (NMFS Criterion) dB re 1 μPa	The squared root of the average of the squared pressures over the time that comprises that portion of the waveform containing 90 percent of the sound energy for one pile-driving impulse.[1] This measure is typically used to assess acoustical impacts on marine mammals.

[1] The underwater sound measurement results obtained during a Pile Installation Demonstration Project indicated that most pile-driving impulses occurred over a 50- to 100-msec period. Most of the energy was contained in the first 30 to 50 msec. Analysis of that underwater acoustic data for various pile strikes at various distances demonstrated that the acoustic signal measured using the standard "impulse exponential-time-weighting" (35-msec rise time) correlated to the RMS (impulse) used by NMFS.
Notes: msec = millisecond(s)
NMFS = National Marine Fisheries Service

SEL, dB re 1 μPa^2-sec	Proportionally equivalent to the time integral of the squared pressure and is described in this report in terms of dB re 1 μPa^2-sec over the duration of the impulse. Similar to the unweighted SEL standardized in airborne acoustics to study noise from single events.
Cumulative SEL	Measure of the total energy received through a pile-driving event (here defined as pile driving that occurs within a day).
Waveforms, μPa over time	A graphical plot illustrating the time history of positive and negative sound pressures of individual pile strikes shown as a plot of μPa over time (i.e., seconds).
Frequency Spectra, dB over frequency range	A graphical plot illustrating the distribution of sound pressure vs. frequency for a waveform; dimension in RMS pressure and defined frequency bandwidth.

FIGURE 1 Underwater Acoustical Characteristics of a Pile-driving Pulse



Underwater Sound Thresholds

Fish

In 2008, NOAA's NMFS; U.S. Fish and Wildlife Service; California, Oregon, and Washington Departments of Transportation; California Department of Fish and Game; and the U.S. Federal Highway Administration agreed in principle to interim criteria to protect fish from pile-driving activities. The agreed-upon criteria are presented in Table 2.

TABLE 2 Adopted Fish Criteria

Interim Criteria for Injury	Sound Levels Agreed-upon in Principle
Peak	206 dB re 1 μPa (for all sizes of fish)
Cumulative SEL	187 dB re 1 μPa^2-sec – for fish size of 2 grams or greater[a] 183 dB re 1 μPa^2-sec – for fish size of less than 2 grams[a]

[a] Applies to pile strikes of 150 dB SEL (single strike) or greater.

The adopted criteria listed in Table 2 are for pulse-type sounds (e.g., impact pile driving) and do not address sound from vibratory driving. The SEL criteria are not applied to vibratory driving sounds. The in-water areas with project sound levels above 150 dB RMS are considered by NMFS to be acoustically affected given possible behavioral changes in fish; however, these levels are not anticipated to trigger any mitigation requirements (Caltrans 2020).

<u>Marine Mammals</u>

Under the Marine Mammal Protection Act, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild” (NMFS 2018). Level B harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering” (NMFS 2018).

Table 3 outlines the current adopted Level A and Level B (behavioral harassment) criteria. The application of the 120-dB RMS threshold for vibratory pile driving can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. For continuous sounds, NMFS Northwest Region has provided guidance for reporting RMS sound pressure levels. RMS levels are based on a time-constant of 10 seconds; RMS levels should be averaged across the entire event. For impact pile driving, the overall RMS level should be characterized by integrating sound for each acoustic pulse across 90 percent of the acoustic energy in each pulse and averaging all the RMS levels for all pulses.

NMFS has provided marine mammal acoustic technical guidance for predicting the onset of permanent threshold shift (PTS) and temporary threshold shifts in marine mammal hearing from sound sources (NMFS 2018). For this project location, the functional hearing groups are expected to be limited to phocid pinnipeds (harbor seals), and otariid pinnipeds (California sea lions). For impact pile driving, the majority of the acoustic energy is confined to frequencies below 2 kilohertz (kHz), and there is very little energy above 20 kHz. Similarly, much of the acoustic energy for vibratory driving is in the frequency range below 2.5 kHz. The underwater acoustic criteria for phocid and otariid pinnipeds are provided in Table 3. Table 4 lists the functional hearing groups and their hearing ranges as defined by the NMFS guidance (NMFS 2018).

TABLE 3 Underwater Acoustic Criteria for Pinnipeds

<table>
<tr><th rowspan="3">Species</th><th colspan="5">Underwater Noise Thresholds (dB re 1 µPa)</th></tr>
<tr><th rowspan="2">Vibratory Pile-driving Disturbance Threshold (Level B Harassment)</th><th rowspan="2">Impact Pile-driving Disturbance Threshold (Level B Harassment)</th><th rowspan="2">Marine Mammal Hearing Group (see Table 4)</th><th colspan="2">PTS SEL_{cum} Threshold
Peak – dB re 1 µPa
SEL_{cum} – dB re 1 $µPa^2$-sec</th></tr>
<tr><th>Impulsive (Impact Pile Driving)</th><th>Non-Impulsive (Vibratory Pile Driving)</th></tr>
<tr><td rowspan="2">Pinnipeds</td><td rowspan="2">120 dB RMS</td><td rowspan="2">160 dB RMS</td><td>Phocid</td><td>218 dB Peak
185 dB SEL_{cum}</td><td>201 dB SEL_{cum}</td></tr>
<tr><td>Otariid</td><td>232 dB Peak
203 dB SEL_{cum}</td><td>219 dB SEL_{cum}</td></tr>
</table>

TABLE 4 Definition of Marine Mammal Hearing Group for Pinnipeds

Marine Mammal Hearing Groups	
Functional Hearing Group	**Functional Hearing Range**
Phocid Pinnipeds – true seals, including harbor seals	50 Hz to 86 kHz
Otariid Pinnipeds – sea lions and fur seals	60 Hz to 39 kHz

Note: Hz = hertz

PROJECT UNDERWATER SOUND-GENERATING ACTIVITIES

The primary type of activity that has the potential to elevate underwater noise levels is the installation of piles using an impact pile driver. For this project however, vibratory driving is expected to be used for majority of the pile installation with the possibility of using an impact hammer if piles hit refusal prior to the required tip elevation. Pile installation activities for the project include installation of a single (1) 48-inch steel pipe monopile in water for the terminal bridge along with two (2) 24-inch steel pipe piles with concrete cap beams on land. The project also involves installation of four (4) 36-inch guide piles and two (2) 36-inch donut fender piles in water for the terminal float.

Pile driving in the water causes sound energy to radiate directly into the water by vibrating the pile between the surface of the water and the riverbed, and indirectly as a result of ground-borne vibration at the riverbed. Airborne sound does not make a substantial contribution to underwater sound levels because of the attenuation of sound at the air/water interface. Pile driving on land would generate low-frequency ground-borne vibration that could cause localized sound pressures in the water that are radiated from the streambed. A minimum water depth is required to allow sound to propagate. For pile-driving sounds, the minimum depth is 1 m (3 feet). Pile-driving activities conducted on land near water bodies have been found to transmit low-frequency sound into the water. The mechanisms for transmitting this sound into the water are complex and difficult, if not impossible, to predict.

Table 5 summarizes the proposed pile-driving activities, the number of piles anticipated per day, and the duration of the pile driving activity for vibratory driving.

TABLE 5 Pile-driving Activities for the Proposed Project

New Structure	Pile Type	Pile Location	Duration/Estimated Blows per Pile[1]	Piles per Day
Terminal Bridge and Foundation Replacement	48-inch steel pipe	In Water	45 mins vibrate 1,015 strikes impact	1
Terminal Bridge and Foundation Replacement	24-inch steel pipe	On Land	45 mins vibrate 1,015 strikes impact	2
Float Replacement (Guide piles & Donut Fender piles)	36-inch steel pipe	In Water	45 mins vibrate 1,015 strikes impact	6

[1] Impact driving if needed, assumes about 20 to 30 minutes of driving with a total of about 1,015 strikes per pile.

Predicted Underwater Sound Levels from Construction

This assessment predicts underwater sound levels associated with the different piling activities that are anticipated. Piling activities include the impact and/or vibratory installation of steel piles. The prediction of sound levels associated with this activity are based on measurements from similar activities.

The prediction of sound levels from pile-driving activities proposed for this project relies on data collected from other sites with similar conditions. The following studies were identified and used to aid in predicting underwater noise levels and calculating the distances to thresholds for fishes and marine mammals discussed in this report.

Underwater Sound Levels from Project Pile Driving

Data in the following studies were reviewed for the various pile-driving activities summarized in Table 6. The values in Table 6 are for sound levels measured at 10 m (33 feet) from the piles for conditions similar to those that would occur at this project. Detailed information on the measurements that make up these levels below are provided in the references.

TABLE 6 Measured Levels for Pile-driving Activities

Driving Method	Pile Type	Size	Sound Pressure Level in dB re 1 µPa at 10 Meters			Notes
			Peak	RMS	SEL	
Impact	Steel pipe pile on land	24-inch	195	178	166	Assumed 15 dB lower than levels in water using data from Naval Base Kitsap, Bangor, WA
Impact	Steel pipe pile in water	36-inch	211	194	181	Naval Base Kitsap at Bangor Test Pile Program, Bangor, WA
Impact	Steel pipe pile in water	48-inch	215	200	187	Anchorage Port Modernization Program – Test Pile Program (POA 2016)
Vibrate	Steel pipe pile on land	24-inch	185	146	146	Assumed 15 dB lower than levels in water using data from Naval Base Kitsap, Bangor, WA
Vibrate	Steel pipe pile in water	36-inch	200	166	166	Naval Base Kitsap at Bangor Test Pile Program, Bangor, WA
Vibrate	Steel pipe pile in water	48-inch	200	168	168	Anchorage Port Modernization Program – Test Pile Program (POA 2016)

Table 7 shows the predicted sound levels expected at 10-m (33-foot) distances from different pile-driving activities expected from the project. Included are the unattenuated sound levels (peak, RMS, SEL) expected, also at 10 m (33 feet) from the piles. Table 7 also shows expected attenuated levels that correspond to a 5-dB reduction because of different attenuation mechanisms like bubble curtains or isolation casing that may be used during the in-water pile-driving activities. These levels, which have been taken from past projects, provide an estimate of the levels to be expected from the pile-driving activities proposed for the project. Impacts on fishes and marine mammals are then calculated using these levels (both unattenuated and attenuated). No methods are available to further attenuate land-based pile-driving sounds.

TABLE 7 Sound Levels Used for Predicting Underwater Sound Impacts

Driving Method	Pile Type	Size	Sound Pressure Level Measured in dB re 1 µPa at 10 Meters					
			Unattenuated			Attenuated[a]		
			Peak	RMS	SEL	Peak	RMS	SEL
Impact	Steel pipe pile on land	24-inch	195	178	166	Sounds from piles driven on land cannot be further attenuated		
Impact	Steel pipe pile in water	36-inch	211	194	181	206	189	176
Impact	Steel pipe pile in water	48-inch	215	200	187	210	195	182
Vibrate	Steel pipe pile on land	24-inch	185	146	146	Sounds from piles driven on land cannot be further attenuated		
Vibrate	Steel pipe pile in water	36-inch	200	166	166	<5 dB attenuation expected from vibrated piles		
Vibrate	Steel pipe pile in water	48-inch	200	168	168	<5 dB attenuation expected from vibrated piles		

[a] Attenuated condition assumes minimum 5-dB lower sounds.

Predicted Impacts on Fishes

Table 8 shows the anticipated distances (in meters and in feet) to the various adopted interim fish thresholds. Distances are shown for both unattenuated and attenuated piles (5-dB attenuation). Also, when the piles are installed with a vibratory hammer, the cumulative SEL thresholds for fish do not apply, and the 150-dB RMS level provides an estimated zone of possible acoustic effects. The distance to each threshold was computed using the transmission loss coefficient of 15 times the Log_{10} of the distance, as recommended by NMFS when there is no site-specific information for the area. This attenuation rate was used in the computations; however, it should be noted that attenuation rates of 18 times the Log_{10} of the distance were measured during pile driving for the San Francisco-Oakland Bay Bridge East Span project (Caltrans 2020)[2]. Cumulative SEL was further computed by adding 10 times the Log_{10} of the number of impact pile strikes. Impact strikes used in these computations are the sum of the anticipated strikes per pile times the number of piles per day.

Note that sound propagation in the Oakland Inner Harbor is limited by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel boundaries. Substantial sound is not anticipated to travel beyond 4,200 m to the west (out the shipping channel) and 1,700 m east of the project site (where the channel bends). Therefore, the distance for noise impacts from this project is limed to 4,200 m west and 1,700 m east under the worst-case conditions.

[2] Technical Guidance for Assessment of the Hydroacoustic Effects of Pile Driving on Fish, Chapter I.9 San Francisco-Oakland Bay Bridge East Span Replacement Project page I-229

TABLE 8 Distance to Adopted Fish Thresholds for All Piles

Driving Method	Pile Type	Size	Piles per Day	Estimated No. of Strikes per Pile	Condition[a]	Distance to Adopted Fish Thresholds			
						Peak 206 dB[b]	RMS 150 dB[b]	Cumulative SEL	
								187 dB[c]	183 dB[c]
Impact	Steel pile on land	24-in	2	1,015[e]	Unattenuated	--[d]	736 m *[2,414 ft]*	64 m *[209 ft]*	117 m [383 ft]
Impact	Steel pile in water	36-in	6	1,015[e]	Unattenuated	22 m [71 *ft*]	4,200/1,700[g] m *[13,780/5,577 ft]*	1,166 m [3,825 ft]	1,166 m [3,825 ft]
					Attenuated	10 m [33 *ft*]	3,981/1,700[g] m *[13,061/5,577 ft]*	541 m *[1,775 ft]*	541 m *[1,775 ft]*
Impact	Steel pile in water	48-in	1	1,015[e]	Unattenuated	40 m *[131 ft]*	4,200/1,700[g] m *[13,780/5,577 ft]*[g]	1,010 m *[3,314 ft]*	1,866 m *[6,123 ft]*
					Attenuated	18 m *[61 ft]*	4,200/1,700[g] m *[13,780/5,577 ft]*	469 m *[1,538 ft]*	866 m *[2,842 ft]*
Vibrate	Steel pile on land	24-in	2	--[f]	Unattenuated	--[d]	5 m *[18 ft]*	N/A	N/A
Vibrate	Steel pile in water	36-in	6	--[f]	Unattenuated	--[d]	117 m *[383 ft]*	N/A	N/A
Vibrate	Steel pile in water	48-in	1	--[f]	Unattenuated	--[d]	158 m *[520 ft]*	N/A	N/A

[a] Attenuated condition assumes 5-dB lower sounds.
[b] dB re 1 µPa
[c] dB re 1 µPa^2-sec
[d] Within the near-field of the sound source - < 10 meters [33 feet]
[e] Assuming impact hammer usage for 20-30 mins with about 1015 strikes per pile.
[f] Piles vibrated in at 45 minutes each (2,700 sec.).
[g] Constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel, 4,200 m [13,780 ft] west and 1, 700 m [5,577 ft] east.

Predicted Impacts on Marine Mammals

The following threshold distances were computed to assess impacts on pinnipeds:

- Distance to onset PTS isopleth for each hearing group (considered Level A impacts)
  - Unattenuated
  - Attenuated
- Distance for unweighted 120-dB vibratory and 160-dB impulse behavior isopleth (considered Level B impacts)
  - Unattenuated
  - Attenuated

The Companion User Spreadsheet (Version 2.2 [2020]) to the *NMFS Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* was used to predict zones where the onset of PTS to marine mammal hearing could occur. A spreading loss calculation is included in the spreadsheet to predict the distance to the onset PTS from accumulated SEL and peak sound pressure. The spreadsheet incorporates a frequency weighting function that accounts for sensitivity for different hearing groups when computing the accumulated SEL. These are referred to as weighting frequency adjustments. The default weighting frequency adjustments are 2 kHz for impact pile driving and 2.5 kHz for vibratory driving. Because the onset of PTS based on SEL_{cum} is computed as further from the pile than it would be using peak sound pressure computations, the onset of PTS is based on SEL computations; therefore, the onset of PTS based on peak sound levels is not provided in this assessment.

The extent of the Level B Zone was calculated using the 10-meter (33-foot) sound levels and applying a transmission loss coefficient of 15 times the Log_{10} of the distance, as recommended by NMFS when there is no site-specific information for the area. Substantial sound is not expected to propagate outside the Middle Harbor because of the narrow propagation path westward combined with the higher sound attenuation rates that have been measured in the Bay (see Caltrans 2020)[3].

Table 9 presents the anticipated distances to the adopted marine mammal thresholds (Level A and Level B Zones). When the piles are installed with a vibratory hammer, the cumulative SEL thresholds do not apply, and the peak PTS thresholds that apply to marine mammals will not be reached. Distances are shown for both unattenuated and attenuated pile-driving activities expected from the project, for the estimated number of strikes and piles per day proposed.

Attenuation Methods

Air bubble curtains, either confined or un-confined, have been shown to reduce sound pressure levels for pile driving in water by up to about 5 to 20 dB within 300 meters of the pile. However, in accordance with Caltrans guidance, only a 5-dB reduction was used for calculating the distances to the fish and marine mammal thresholds (Caltrans 2020). The amount of attenuation may be more, especially at distant locations from the pile because of the contribution of sound propagating through the bottom substrate. At the Benicia-Martinez Bridge and San Francisco-Oakland Bay Bridge projects (Caltrans 2020), more than 10 dB of sound reduction was obtained using bubble curtains. At the Humboldt Bay Seismic Retrofit Project, reductions of between 12 and 16 dB were achieved using either an unconfined bubble ring or a bubble ring in an isolation casing, with the best results being the unconfined bubble ring (Caltrans 2020).

The design of the specific bubble ring configuration will depend on several factors, such as the depth of water and the water current, and must be designed individually for each project and location within the project. Air bubble curtain systems are used during production pile driving to reduce underwater sound pressures. Typically, a system consists of stacked rings to generate air bubbles throughout the entire water column surrounding the piles, even with currents. A bubble curtain system is generally composed of air compressors, supply lines to deliver the air, distribution manifolds or headers, perforated aeration pipes, and a frame. The frame is used to facilitate transportation and placement of the system, keep the aeration pipes stable, and provide ballast to counteract the buoyancy of the aeration pipes during pile-driving operations. Bubble curtain designs consist of single or multiple concentric layers of perforated aeration pipes (stacked vertically). Pipes in any layer are arranged in a geometric pattern that allows the pile-driving operation to be completely enclosed by bubbles for the full depth of the water column. The lowest layer of perforated aeration pipe is designed to ensure contact with the mud line without sinking

[3] Technical Guidance for Assessment of the Hydroacoustic Effects of Pile Driving on Fish, Chapter I.9 San Francisco-Oakland Bay Bridge East Span Replacement Project page I-229

into the bottom substrates. A proper combination of bubble density and closeness of bubbles to the pile is most effective. Numerous smaller bubbles are more effective because they displace more water between the bubbles. This pattern has to be maintained throughout the water column.

TABLE 9 Distance to the Adopted Marine Mammal Thresholds for Different Pile-driving Activities – Level A and B Zones

Driving Method	Pile Type	Size	Piles per Day	Estimated No. of Strikes per Pile	Condition[a]	Level A Injury Zone Using SEL_{cum} Threshold		Level B Harassment Zone
						Pinnipeds		
						Phocid	Otariid	
Impact	Steel pipe pile on land	24-inch	2	1,015[e]	Unattenuated	63 m *[207 ft]*	--[b]	158 m *[518 ft]*
Impact	Steel pipe pile in water	36-inch	6	1,015[e]	Unattenuated	1,311 m *[4,301 ft]*	96 m *[314 ft]*	1,848/1,700[d] m *[6,061/5,577 ft]*
					Attenuated	609 m *[1,998 ft]*	44 m *[144 ft]*	858 m *[2,815 ft]*
Impact	Steel pipe pile in water	48-inch	1	1,015[e]	Unattenuated	997 m *[3,271 ft]*	73 m *[239 ft]*	4,200/1,700[d] m *[13,780/5,577 ft]*
					Attenuated	463 m *[1,519 ft]*	34 m *[111 ft]*	2,154/1,700[d] m *[7,067/5,577 ft]*
Vibrate	Steel pipe pile on land	24-inch	2	--[c]	Unattenuated	--[b]	--[b]	541 m *[1,775 ft]*
Vibrate	Steel pipe pile in water	36-inch	6	--[c]	Unattenuated	24 m *[78 ft]*	--[b]	4,200/1,700[d] m *[13,780/5,577 ft]*
Vibrate	Steel pipe pile in water	48-inch	1	--[c]	Unattenuated	10 m *[33 ft]*	--[b]	4,200/1,700[d] m *[13,780/5,577 ft]*

[a] Attenuated condition assumes 5-dB lower sounds.
[b] Within the near-field of the sound source - < 10 meters [33 feet]
[c] Piles vibrated in at 45 minutes each.
[d] Constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel, 4,200 m [13,780 ft] west and 1, 700 m [5,577 ft] east.

Illustration of Impacts

Attachment A includes Google Earth maps displaying the extent of both fish injury zones and marine mammal Level A and B Zones around the proposed project site for the piles driven.

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Attachment A

Maps Illustrating the 187-dB Cumulative SELs, 206-dB Peak Adopted Fish Injury Zones and Marine Mammal Level A and B Zones (Source: Google Earth 2022)

Figure A1 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 24-inch Steel pile on Land impact driven

Figure A2 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 36-inch Steel pile impact driven

Figure A3 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 48-inch monopile impact driven

Figure A4 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 24-inch Steel pile on Land driven using a vibratory hammer

Figure A5 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 36-inch Steel pile driven using a vibratory hammer

Figure A6– Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 48-inch monopile driven using a vibratory hammer

Figure A7 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 24-inch Steel pile on Land impact driven

Figure A8 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 36-inch Steel pile impact driven

Figure A9 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 48-inch monopile impact driven

Figure A10 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 24-inch Steel pile on Land driven using a vibratory hammer

Figure A11 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 36-inch Steel pile driven using a vibratory hammer

Figure A12 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 48-inch monopile driven using a vibratory hammer

Appendix D

WETA Alameda Main Street Ferry Refurbishment Project Preliminary Geotechnical Report

WETA ALAMEDA MAIN STREET FERRY REFURBISHMENT PROJECT

ALAMEDA, CALIFORNIA

PRELIMINARY GEOTECHNICAL REPORT

SUBMITTED TO
Mr. James Connolly
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PREPARED BY
ENGEO Incorporated

January 14, 2022
Revised January 19, 2022

PROJECT NO.
19542.000.001

ENGEO
Expect Excellence

ENGEO
Expect Excellence

GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES
COASTAL/MARINE GEOTECHNICS

Project No.
19542.000.001

January 14, 2022
Revised January 19, 2022

Mr. James Connolly
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Subject: WETA Alameda Main Street Ferry Refurbishment Project
Alameda, California

PRELIMINARY GEOTECHNICAL REPORT

Dear Mr. Connolly:

We are pleased to present this preliminary geotechnical report for the proposed Water Emergency Transportation Authority (WETA) Alameda Main Street Ferry Refurbishment project located in Alameda, California. This report presents our preliminary geotechnical observations and findings, as well as our conclusions and recommendations for the project. We understand that a design-build contractor will be selected for the future phases of this project and that this preliminary report will serve as a basis-of-design document.

We performed analyses for preliminary design of the new foundation elements in collaboration with you and published several letters presenting our findings. As the design evolved, we updated our analyses to reflect the changes. We incorporated the most recent iteration of all of our analyses in this report to provide a single document for reference in preliminary design. These include the results summarized in the following correspondence.

1. Preliminary Piling Recommendations, letter dated November 8, 2021, and revised November 15, 2021.
2. Preliminary Kinematic Loading on Piles, letter dated November 23, 2021.
3. Lateral Pile Analysis for Float Piles and Donut Piles, letter dated December 13, 2021.
4. Lateral Pile Analysis and Revised p-y Springs for Shore-side Piles, electronic-mail delivered December 13, 2021.
5. Lateral Pile Analysis and Revised p-y Springs for Monopile, electronic-mail delivered December 15, 2021.

Based on the results of our exploration, the planned improvements at the site are feasible from a geotechnical standpoint. Recommendations presented in this report should be implemented through the project design and construction.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

We prepared this preliminary geotechnical report for design of the WETA Alameda Main Street Ferry Refurbishment project located in Alameda, California. The purpose of this report is to provide an assessment of geotechnical conditions associated with the proposed development, provide subsurface data for design builder teams, and to provide preliminary recommendations for design. Our services included the following tasks.

- Review of available literature and geologic maps.
- Review of historic geotechnical reports in our files.
- Review of historic aerial photographs.
- Review of geotechnical exploration data provided to us.
- Performance of a subsurface field exploration and laboratory testing program.
- Interpretation of subsurface field exploration data.
- Analysis of geotechnical data and evaluation of potential geotechnical concerns.
- Preparation of recommendations and this report.

For our use, we received the following documents:

1. H.V. Anderson Engineers and DCC Engineering Co., Inc.; As-built Plans and Calculations, Alameda Gateway Ferry Terminal; 1991.
2. W.B. Clausen Structural Engineer; Alameda Ferry, Bridge Repair, Construction Plans; 2007.
3. eTrac; Hydrographic and Topographic Survey, Alameda Main Street Ferry Terminal Refurbishment; electronic transmittal dated October 26, 2021.
4. COWI North America, Inc.; Permit Drawings, Alameda Main Street Ferry Terminal Refurbishment Project; December 20, 2021.

In addition, we reviewed the following documents from surrounding projects from our database of subsurface investigations:

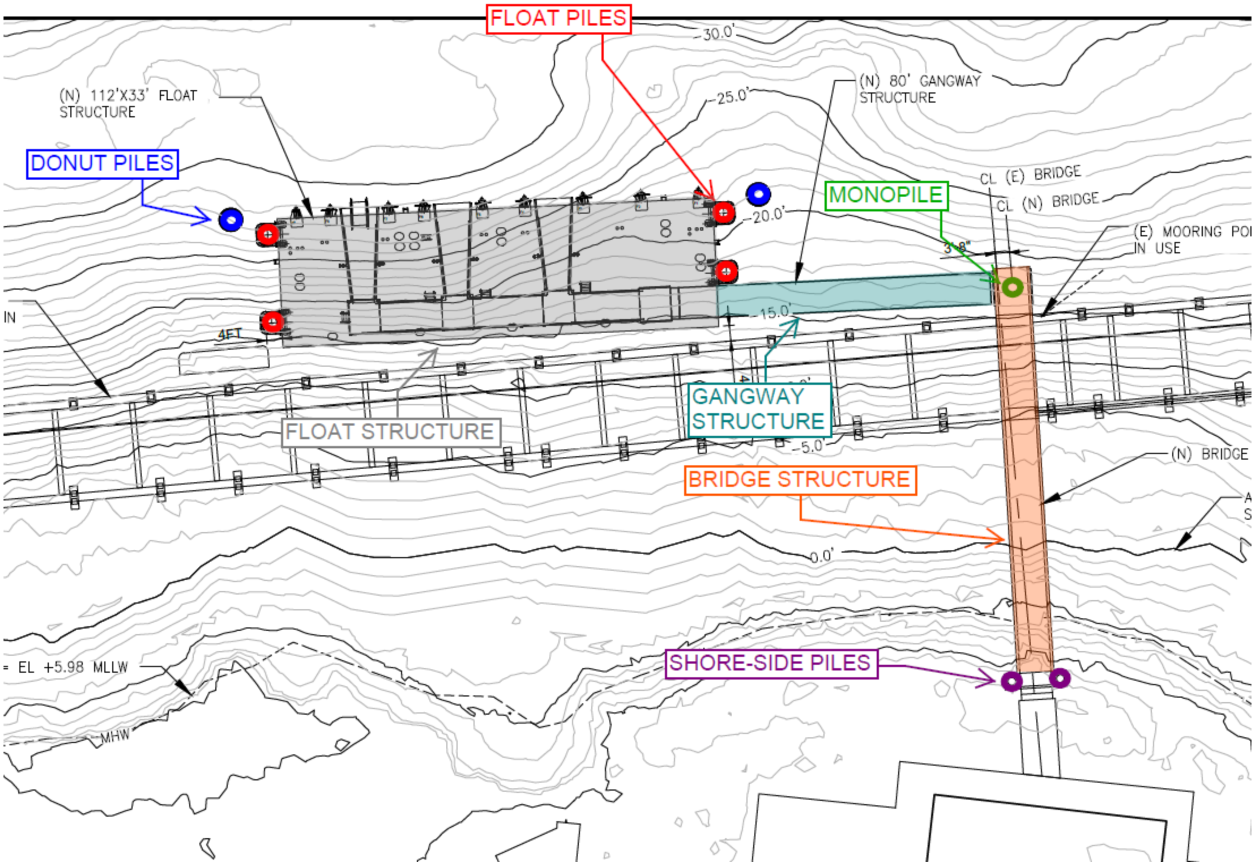
1. Dames & Moore; Foundation Investigations, Proposed Expansion of Ship Repair Facilities; 1944.
2. Peter Kaldveer and Associates, Inc.; Soil Investigation, Alameda Naval Air Station Housing; 1981.
3. Subsurface Consultants, Inc; Geotechnical Investigation, Oakland Harbor Navigation Improvement (-50 Foot) Project, Port of Oakland; 1999.
4. ENGEO; Preliminary Geotechnical Exploration, Alameda Point Development; 2003.
5. Moffatt & Nichol Engineers; Widening of Inner Harbor Turning Basin, Port of Oakland, Phase 1B – Bulkhead, Dredging, and Partial Demolition of Piers 2 & 5, Alameda County, California; July 1, 2004.

We prepared this report for the exclusive use of our client and project consultants for the design of this project. If any changes are made in the character, design, or layout of the development, we must be contacted to review the conclusions and recommendations contained in this report to evaluate whether modifications are recommended. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 PROPOSED DEVELOPMENT

As shown in the permit drawings dated December 20, 2021, the ferry terminal refurbishment will consist of construction of replacement bridge, gangway, and float structures. New piles will be constructed to support the new structures. Exhibit 1.2-1, below, shows the planned new structures and associated pile foundations.

EXHIBIT 1.2-1: Proposed Improvements



1.3 ELEVATION DATUM

The elevation datum used for this project is the Mean Lower Low Water (MLLW). Elevations shown in this report are project datum unless noted otherwise.

2.0 FINDINGS

2.1 SITE HISTORY

We reviewed historical aerial photographs and topographic maps available through www.historicaerials.com, University of California Santa Barbara's (UCSB's) online aerial photograph frame finder tool, Google Earth imagery, and the documents provided to us, as listed in Section 1.1. The following summarizes the site history based on review of historical site documents.

TABLE 2.1-1: Summary of Site History based on Review of Historical Aerials and Topographical Maps

<u>1850s – 1930s</u>

The location of the existing ferry terminal is outside the limits of the earliest topographic map of Alameda Island and the surrounding tidal marsh. In the 1910s through 1930s, Alameda Island underwent significant dredging and filling operations to straighten and extend the shoreline to near its current condition. Specifically, the project site underwent significant filling operations between 1911 and 1918.

1857 Topographic Map

Historic Fill Map, 1911 - Present*

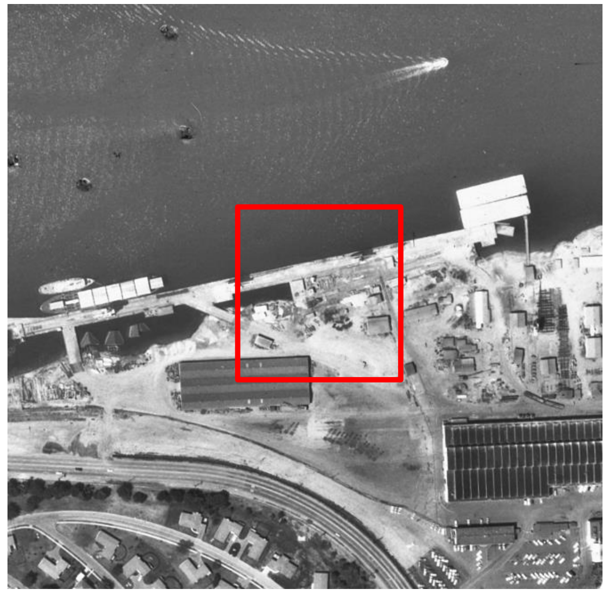
** Lime Green with Red Hatch = original limits of tidal marsh, Gray = filled land circa 1911, Red Hatch = filled land 1911-1918, Tan = filled land 1918-1930*

1940s – 1970s

By 1946, a timber wharf structure was constructed at the location of the project site. By 1965, a large warehouse structure was constructed adjacent to the project site. Additional filling and extension of the shoreline since the timber wharf was constructed can be seen in aerial photographs from 1958 and 1965.

1947 Historic Aerial

1965 Historic Aerial

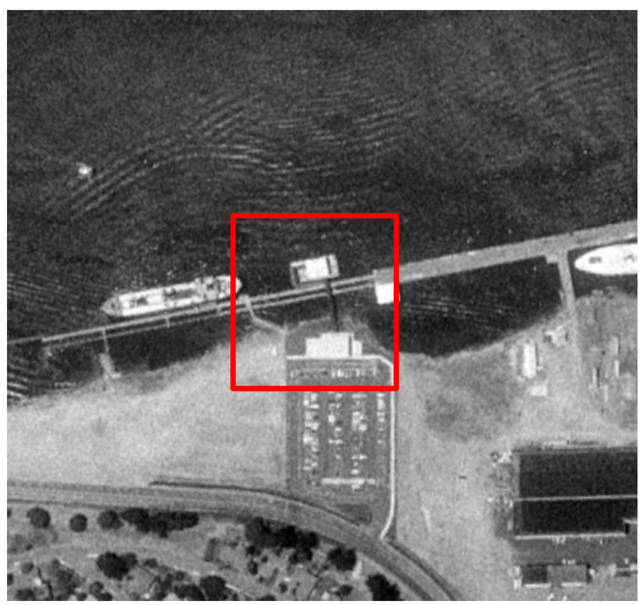


1980s – 1990s

By 1980, the previous timber wharf structure was demolished with a new pier constructed in its place. By 1988, the shore-side warehouse structure was demolished. By 1993, the current shore-side ferry building, parking lot, and gangway were constructed along the existing pier. A new dock was also constructed by this time.

1980 Historic Aerial

1993 Historic Aerial

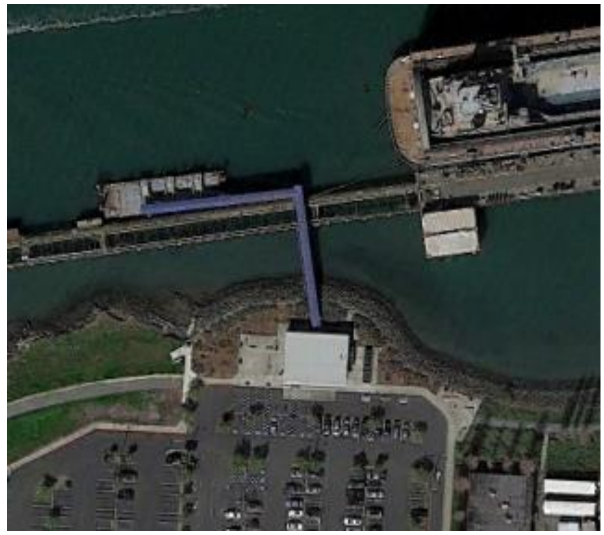


2000s - Present

The walkway and dock structure underwent changes within this timeframe. Repairs on the gangway were performed sometime after issuance of repair plans in 2007.

2002 Historic Aerial

2021 Aerial



2.2 REGIONAL GEOLOGIC SETTING

The site is located within the California Coast Ranges, which are a series of northwesterly trending uplifted ranges and intervening valleys. The Coast Ranges were formed by Miocene to Quaternary tectonic activity within the San Andreas Fault zone at the boundary between the North American and Pacific Plates.

According to geologic mapping by Witter (2006), the site is underlain by artificial fill deposits over bay mud (afbm). Regional geologic mapping by Graymer (2000) describes the site as underlain by artificial fill deposits, as depicted on Figure 3. In general, the stratigraphy of the site vicinity, from youngest to oldest, consists of, (1) artificial fill, a heterogeneous surficial layer of fill material composed of sand, gravel, and clay, (2) Young Bay Mud deposits, a highly compressible fat to lean silty clay, (3) San Antonio Formation, a fine clean to silty sand, and (4) Old Bay Clay, a moderate to very dense silt or clay with interbedded sand deposits.

2.3 PREVIOUS GEOTECHNICAL INVESTIGATIONS

The following historical explorations were performed within the immediate vicinity of the project site:

- In 1943 and 1944, Dames & Moore drilled nine borings on the project site, shore-side and offshore, to depths of up to approximately 150 feet. The quality of the scanned report is poor; however, we were able to use one of the boring logs to aid in our review.
- A previous on-site exploration completed by Cooper-Clark in 1967 is graphically depicted in the calculation set by H.V. Anderson from 1991. The exploration included a boring drilled approximately 65 feet below mudline, close to the location of the future monopile.

In addition to the explorations described above, the following geotechnical studies were performed in the vicinity of the project site:

- In 1981, Peter Kaldveer and Associates drilled one boring immediately south of Main Street to a depth of 100 feet as part of the geotechnical investigation Alameda Naval Air Station Housing.
- In 1997, Subsurface Consultants, Inc. drilled one boring across the channel to a depth of at least 45 feet. The geologic unit thicknesses are described in Table 1 of the geotechnical report for Port of Oakland.
- Our preliminary geotechnical report for Alameda Point, dated 2003, provides geotechnical information for the greater Alameda Island, including the project site. The report provides estimated contours of elevation of base of Young Bay Mud, geologic cross sections, and a map of historic fill operations.
- Immediately east of the project site is the Turning Basin for the Port of Oakland. In the plans for widening of the Turning Basin by the Moffatt & Nicholl Engineers, dated 2004, a number of shore-side and offshore borings are graphically depicted to depths of up to approximately 100 feet.

We provide the previous exploration data used in formulating these preliminary conclusions and recommendations in Appendix B and the approximate locations of the borings are shown on Figure 2.

2.4 FIELD EXPLORATION

We performed a limited subsurface exploration program comprising two cone penetration tests (CPTs). The locations of the CPTs, 1-sCPT01 and 1-sCPT02, are shown in Figure 2. We performed our field exploration on October 28, 2021. We approximated the locations of our explorations located by estimating from site features and by GPS. We estimated existing ground-surface elevations at the exploration locations using the hydrographic and topographic survey prepared by eTrac (electronic transmittal dated October 26, 2021). The locations and elevations of our explorations should be considered accurate only to the degree implied by the methods used. We permitted and backfilled our explorations in accordance with Alameda County Public Works Agency requirements. As required, we also prepared a Work Plan for our geotechnical exploration that was reviewed and approved by City of Alameda for encroachment.

1-sCPT01 experienced shallow refusal after multiple attempts, and the CPT crew terminated 1-sCPT02 at an approximate depth of 115 feet below the existing ground surface. The CPT had a 20-ton compression-type cone with a 10-square-centimeter (cm^2) base area, an apex angle of 60-degrees, and a friction sleeve with a surface area of 225 cm^2. The cone, connected with a series of rods, was pushed into the ground at a constant rate. Cone readings were collected at approximately 5-centimeter (cm) intervals with a penetration rate of 2 cm per second in accordance with ASTM D5778. Measurements include the tip resistance to penetration of the cone (Qc), the resistance of the surface sleeve (Fs), and undrained pore pressure (U) (Robertson and Campanella, 1988). We measured the shear-wave velocity (V_s) at 1-sCPT02 to aid in the site response analysis. CPT logs, shear-wave velocity data, and pore pressure dissipation test results are presented in Appendix A. We graphically depict the subsurface conditions encountered at the time of the exploration in the geologic cross section (Figure 8).

2.5 SUBSURFACE CONDITIONS

Based on review of the available geotechnical exploration data and our understanding of the site history, the site can be divided into two generalized subsurface profiles – shore-side and offshore. As described in Section 2.1, numerous dredging and filling activities occurred throughout the history of the site, with material likely dredged from San Francisco Bay then placed as fill material on the existing marshland. Due to loading from fill placement shore-side, the underlying soil behaves differently from the same geologic unit offshore.

In general, the deposits encountered at the project site include, from youngest to oldest, (1) artificial fill, (2) Young Bay Mud deposits, and (3) San Antonio Formation. Offshore, artificial fill was not encountered in the explorations we reviewed. We provide additional generalized description of the deposits noted above, in the following sections. We provide an idealized geologic cross section through the project site in Figure 8.

ARTIFICIAL FILL

As a consequence of the land reclamation and prior construction activities at the project site, a heterogeneous surficial layer of fill material exists shore-side. The fill material comprises a mixture of sand, gravel, and clayey materials, much of which was likely dredged from San Francisco Bay and placed on an existing marshland.

At the project site, we estimate the artificial fill to vary between 10 and 20 feet in thickness. The fill consistency is generally loose to medium dense.

YOUNG BAY MUD

The explorations encountered Young Bay Mud (YBM) directly underneath the artificial fill. The YBM encountered consists of greenish gray to blue gray soft, plastic clay and silt as well as clayey and silty sand. YBM is highly compressible and typically very soft with strength increasing with depth.

The YBM shore-side differs from the YBM offshore. Due to the placement of fill many years ago, the YBM shore-side is stiffer and has already experienced some amount of compression. The YBM offshore is typically softer, with strength increasing more slowly with depth as compared to the YBM shore-side. At the project site, we estimate the YBM to be approximately 70 feet in thickness.

SAN ANTONIO FORMATION

The San Antonio formation is composed of alluvium deposited in environments ranging from alluvial fans and flood plains to lakes and beaches, and is sometimes interbedded with YBM or Old Bay Clay. This unit is generally moderately dense to very dense sand and stiff to hard silt and clay. At the project site, we do not have explorations that penetrate beyond the San Antonio Formation.

2.6 GROUNDWATER CONDITIONS

During our exploration, we performed pore-pressure dissipation testing in our CPT explorations. At 1-sCPT1, the pore-pressure dissipation testing indicated groundwater approximately 6½ feet below ground surface (bgs). We did not achieve equilibrium at 1-sCPT2 to estimate depth to groundwater.

The Seismic Hazard Zone Report for Oakland West (CGS, 2003) indicates a historic high groundwater at a depth of 5 feet or less. For the purpose of our analyses, we used a design groundwater Elevation of 5 feet (MLLW), which corresponds to a depth of 5 feet below the average shore-side elevation surrounding the ferry terminal.

2.7 SEISMICITY

Numerous small earthquakes occur every year in the San Francisco Bay Region, and larger earthquakes have been recorded and can be expected to occur in the future. The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone and no known surface expression of active faults is believed to exist within the site. An active fault is defined by the State Mining and Geology Board as one that has had surface displacement within Holocene time (about the last 11,700 years) (Bryant and Hart, 2007).

Figure 5 shows the approximate locations of these faults and significant historic earthquakes recorded within the San Francisco Bay Region. The nearest active faults are the Hayward and San Andreas faults. We list other active faults in proximity to the site in Table 2.7-1.

TABLE 2.7-1: Closest Active Faults Capable of Producing Significant Ground Shaking at the Site

FAULT NAME	MAXIMUM MOMENT MAGNITUDE (M_W)	CLOSEST DISTANCE FROM SITE (miles)	FAULT MECHANISM
Hayward (No) [0]	7.2	5.4	Strike Slip
San Andreas (Peninsula) [11]	7.9	13.7	Strike Slip
Hayward (So) [7]	6.8	6.9	Strike Slip
Hayward (No) [1]	7.0	5.4	Strike Slip
Hayward (No) [2]	6.9	6.1	Strike Slip
Calaveras (No) [0]	7.2	14.0	Strike Slip
San Gregorio (No) [4]	7.8	17.3	Strike Slip

The Uniform California Earthquake Rupture Forecast (UCERF 3) (Field et al, 2015) estimates the 30-year probability for a magnitude 6.7 or greater earthquake in the San Francisco region at approximately 72 percent, considering the known active seismic sources in the region.

3.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

3.1 SEISMIC DESIGN CRITERIA

Based on our discussions with you, we followed the guidelines presented in ASCE 61: Seismic Design of Piers and Wharves as they relate to seismic design criteria. ASCE 61 recommends the following seismic design scenarios be considered in evaluation of seismic hazard and performance:

TABLE 3.1-1: ASCE 61 Seismic Design Scenarios

SCENARIO	GROUND MOTION PROBABILITY OF EXCEEDANCE OR SEISMIC HAZARD LEVEL
Operating Level Earthquake (OLE)	50 Percent in 50 years (72-year return period)

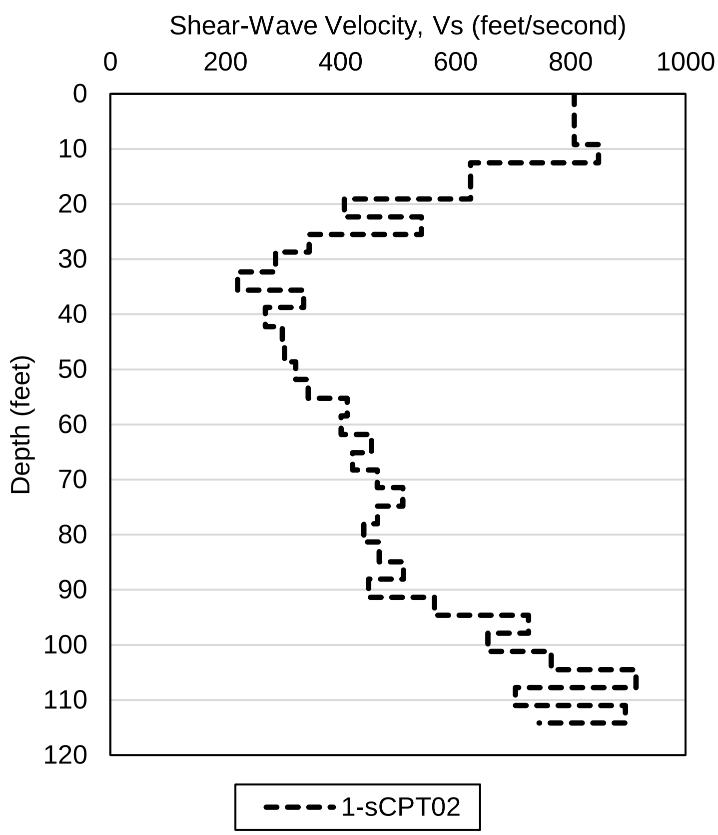
SCENARIO	GROUND MOTION PROBABILITY OF EXCEEDANCE OR SEISMIC HAZARD LEVEL
Contingency Level Earthquake (CLE)	10 Percent in 50 years (475-year return period)
Design Earthquake (DE)	Design earthquake per ASCE 7

3.1.1 Site Class Determination

As described in Section 2.5, the site can be divided into two generalized subsurface profiles – shore-side and offshore. The shore-side subsurface profile consists of loose to medium dense sandy artificial fill, soft YBM, and dense sandy or stiff clayey San Antonio Formation. The offshore subsurface profile consists of softer (relative to shore-side) YBM overlying San Antonio Formation.

As described in Section 2.4, we performed two cone penetration tests (CPTs), 1-sCPT01 and 1-sCPT02. Of the two CPTs, the CPT contractor pushed 1-sCPT02 to a depth of 115 feet below the ground surface (bgs) and measured shear-wave velocity. We estimated a V_{S30} (shear wave velocity averaged over the top 30 meters [100 feet]) value of 419 feet per second (200 meters per second) based on the V_S profile measured at 1-sCPT02, as shown in Exhibit 3.1.1-1.

EXHIBIT 3.1.1-1: Summary of Shear-Wave Velocity Profile, V_S



Based on the measured V_{S30}, we classified the site as borderline Site Class E. However, due to presence of the loose sandy material below the estimated groundwater table (about 5 feet below ground surface), the site is characterized as potentially liquefiable and is classified as a Site Class F.

3.1.2 Site Response Analysis

For a Site Class F condition, ASCE 61 requires that a site-specific ground response analysis be performed to develop the DE, OLE, and CLE ground motion parameters, and references the site response analysis procedures outlined in the ASCE document titled "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," (ASCE/SEI 7-16).

We performed a site-specific ground response analysis and attached the report containing the results of our analysis in Appendix C.

3.2 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, ground lurching, liquefaction, lateral spreading, and tsunami. The following sections present a discussion of these hazards as they apply to the site. Based on topographic and lithologic data, the risk of regional subsidence or uplift, landslides, flooding or seiches is considered low to negligible at the site.

3.2.1 Ground Rupture

Since there are no known active faults crossing the property and the site is not located within an Earthquake Fault Special Study Zone, ground rupture is unlikely at the subject property.

3.2.2 Ground Shaking

Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the actual forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse, but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

3.2.3 Liquefaction

Soil liquefaction is a temporary loss of strength due to increased pore pressure that develops during cyclic loading, such as imposed by earthquakes. The soil considered most susceptible to liquefaction is clean, loose, saturated, uniformly graded, fine-grained sand; however research indicates that low-plasticity silt and clay is also potentially liquefiable (or subject to cyclic softening). The California Geological Survey mapped the site within an area susceptible to earthquake-induced liquefaction (Figure 6).

To evaluate the liquefaction potential of the site soil, we performed liquefaction analysis on 1-sCPT02. We assigned peak ground accelerations (PGA) associated with the OLE, CLE, and MCE_R scenarios. The PGAs used are based on the results of our site response analysis, as provided in the report in Appendix C. We performed our analyses using a moment magnitude of

7.2 associated with the Hayward fault. We used a design groundwater level of 5 feet in our analysis, as described in Section 2.6. We evaluated liquefaction potential at the site using the computer program, Cliq.

We performed our liquefaction analyses using the methods developed by Idriss and Boulanger (2008) and Robertson (2009). We evaluated the potential liquefaction-induced ground settlements and summarize these for each method and provide the complete analysis results in Appendix D.

TABLE 3.2.3-1: Total Liquefaction-Induced Ground Settlement Based on 1-sCPT02 (inches)

SEISMIC DESIGN SCENARIO	PGA (g)	IDRISS & BOULANGER (2008)	ROBERTSON (2009)
OLE	0.252	¾	0.4
CLE	0.297	1	½
MCE_R	0.546	1¼	1

The analysis results indicate that potential liquefaction-induced ground settlement up to approximately 1 inch may occur during the CLE event. As described in Section 2.5, the soil profile shore-side consists of artificial fill over YBM. Based on our analysis, the potentially liquefiable soil deposits are within the artificial fill between 5 and 20 feet below ground surface. Due to the heterogeneity of the artificial fill with alternating layers of clay and silty sand the entire layer does not appear to be liquefiable; rather, our analysis of liquefaction of the artificial fill results in a factor of safety less than 1.0 specifically for the sandy layers within the fill.

3.2.3.1 Liquefaction-Induced Surface Rupture

We evaluated the capping effect of overlying non-liquefiable soil using the methods provided by Ishihara (1985) and Youd and Garris (1995). For liquefaction-induced ground failure to occur, the pore water pressure generated within the liquefied strata must exert a force sufficient to break through the overlying soil and vent to the surface resulting in sand boils or fissures.

Based on the results of our analysis, the liquefiable sandy layers within the fill are cumulatively less than 3 feet in thickness, with a non-liquefiable cap of 5 feet. Based on our analysis, this non-liquefiable soil thickness should be sufficient to result in the risk of sand boils forming to be low.

3.2.3.2 Lateral Spreading

Lateral spreading is a flow failure within a nearly horizontal soil zone (possibly due to liquefaction in sand layers) that causes the overlying soil mass to move toward a free face or down a gentle slope. We distinguish this phenomenon from seismic slope stability, which is a failure of soft soil due to seismic loading. Generally, the effects of lateral spreading are most significant at the free face or the crest of a slope and diminish with distance from the slope. The topographic and hydrographic survey performed by eTrac indicates an approximately 60-foot, 3½:1 (horizontal:vertical) slope from the top of slope to the bottom of the channel.

Due to the heterogeneity of the fill and the nominal thicknesses of liquefiable layers within the fill, we opine that the risk of lateral spreading is low; however, our slope stability analysis shows that the slope is subject to seismic-induced slope deformations that are not tied to lateral spreading. We discuss our findings related to slope stability in Section 3.3.

3.2.4 Tsunamis

The project site is mapped within a tsunami hazard zone on the California Geologic Survey 2021 tsunami hazard map for the County of Alameda, indicating that it is within inundation limits corresponding to a 975-year average return period tsunami event. We show the limits of potential inundation on Figure 7.

3.3 SLOPE STABILITY

We developed an idealized geologic cross-section (section A-A'), shown in Figure 8, based on existing and historical data, for use in our slope stability analyses. We performed two-dimensional limit-equilibrium slope stability analyses of the existing slope based on cross-section A-A'. We used the computer slope stability software Slide2 Version 9.019 (Rocscience, 2021), and analyzed stability of the slope using Spencer's method of slices (Spencer, 1967) with circular failure surfaces. We performed slope stability analyses under the following conditions:

- Static loading
- Post-liquefaction flow
- Calculation of yield acceleration to estimate seismically induced lateral displacement

In evaluating the potential lateral movement of the slope under seismic conditions, we used the methodology presented in the report, "Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments; Report 611," published by the National Cooperative Highway Research Program (Anderson et al., 2009). The methodology requires calculation of a yield acceleration, k_y, which is the horizontal acceleration (in terms of the gravitational constant, *g*) at which the slope will initiate failure during a seismic event, corresponding to a factor of safety of 1.

3.3.1 Estimation of Soil Properties

For the purposes of slope stability evaluation, we estimated strength parameters for the site soil from previous laboratory data and correlations with the CPT logs from our current investigation.

Under seismic conditions, we modeled soil identified as not likely to liquefy using Mohr-Coulomb or undrained strength soil parameters. We modeled liquefiable fill with residual shear strengths that we estimated using the recent CPT data and the correlation presented in the report "Soil Liquefaction during Earthquakes" published by Idriss and Boulanger (2008).

We summarize the soil parameters used in our analysis in the table below.

TABLE 3.3.1-1: SUBSURFACE MODEL SOIL PROPERTIES

MATERIAL	STRENGTH TYPE	STRENGTH PROPERTIES
Fill	Mohr-Coulomb	Friction angle, ϕ = 32 degrees (°)
Liquefied fill – Seismic Condition only	Undrained (residual)	Undrained strength, S_u = 200 pounds per square foot (psf)

MATERIAL	STRENGTH TYPE	STRENGTH PROPERTIES
YBM – Shore-side	Undrained	S_u = 550 psf at the top of YBM layer, increasing at a rate of 16 psf per foot depth; this assumed behavior mimics the effects of consolidation from existing fill.
YBM – Offshore	Undrained	S_u = 100 psf at the elevation corresponding to top of shore-side YBM layer, increasing at a rate of 13 psf per foot depth; this assumed behavior mimics the effects of normally consolidated soil and historic dredging to form the shoreline slope.
San Antonio Formation	Mohr-Coulomb	ϕ = 35°

3.3.2 Results of Slope Stability Analyses

Appendix E graphically shows the results of our static, post-liquefaction flow stability analyses, and yield acceleration calculations. The results are summarized in the table below.

TABLE 3.3.2-1: Summary of Slope Stability Analyses

CROSS SECTION	MIN STATIC FS	PSEUDO-STATIC K_Y ANALYSIS	MIN POST-LIQUEFACTION FS
A-A'	2.3	See Section 3.3.3	1.5

The results of the static analysis indicate the slope is acceptably stable under static loading. The results of the post-liquefaction analyses indicate that the risk of flow failure of the potentially liquefiable soil is low.

3.3.3 Seismically-Induced Slope Displacements

As described in Section 3.3, we evaluated the potential lateral movement of the slope under seismic conditions by calculating a yield acceleration resulting in an overall slope stability factor of safety equal to 1. We calculated a yield acceleration of 0.17g, as shown in Appendix E. This yield acceleration corresponds to slip surfaces that extend from the surface to near the base of the YBM layer. We also analyzed for potential displacement along a failure surface through the liquefied fill. Our results indicate that localized, shallow failure resulting in relatively large soil displacement may occur; however, as shown in our results in Appendix E, the failure surfaces do not encroach within the location of the future monopile and shore-side piles and this potential displacement should not adversely impact operations of the facility due to the shallow nature. Some shoreline and revetment repair may be required after a large earthquake at the site if liquefaction is triggered and shallow slope movement occurs.

We estimated displacement using Anderson et al., 2009 and the earthquake response spectra presented in Section 3.1.2. We provide estimated soil displacement at each pile location for the DE, OLE, and CLE event in Table 3.3.3-1. Assuming a normal distribution for the method used to calculate displacement, the variation could be as large as half to two times the estimated displacements provided in Table 3.3.3-1.

TABLE 3.3.3-1: ESTIMATED MAXIMUM SOIL DISPLACEMENTS

EVENT	MAXIMUM SOIL DISPLACEMENT (INCHES)	
	Monopile	Shore-side piles
DE	4	4
OLE	½	½
CLE	3	3

We provide the results of our slope stability and soil displacement analysis in Appendix E. To model the effect of the lateral soil movement acting against the pile as a displacement field, we recommend assuming that the soil displacement is equal to zero at the base of the slip surface (as shown in red in the analysis output) and linearly increases to the full value of displacement at the ground surface.

3.4 NEW PILE DESIGN

Based on our discussions with you, we understand that the ferry terminal refurbishment will include construction of the following piles:

- Offshore monopile will consist of a 48-inch-diameter pipe pile with 1-inch wall thickness.
- Offshore float piles will consist of 36-inch-diameter pipe piles with 1¼-inch wall thickness.
- Offshore donut piles will consist of 36-inch-diameter pipe piles with 1-inch wall thickness.
- Shore-side piles will consist of 24-inch-diameter pipe piles with 5/8-inch wall thickness.

3.4.1 Vertical Capacities

As requested by you, we calculated allowable vertical capacities for the monopile and shore-side piles.

We provide allowable vertical capacities in the table below, along with the minimum depth of embedment below mudline or surface grade to achieve the allowable capacity. Due to liquefaction during the OLE, CLE, and DE scenarios, our calculations neglect capacity in the liquefiable artificial fill shore-side. We also provide the downdrag load caused by settlement of the liquefiable artificial fill. Vertical pile capacity charts showing vertical capacity versus foundation depth are presented in Appendix F.

TABLE 3.4.1-1: Deep Foundations

PILE	PILE TYPE	ALLOWABLE CAPACITY (KIPS)	DEPTH OF EMBEDMENT INTO SOIL TO ACHIEVE ALLOWABLE CAPACITY (FT)	DOWNDRAG LOAD (KIPS)
Monopile	48-inch pipe pile	650	110	N/A
Shore-side piles	24-inch pipe pile	500	110	40

3.4.2 Lateral Capacities

We used the software LPILE v2015 to estimate the lateral capacity and pile response for the piles described in Section 3.4.

3.4.2.1 Soil Properties Used in Analysis

For each pile location, we used the following parameters to model the soil resistance to lateral loading. For the YBM, referenced in the tables below as the Soft Clay (Matlock) model, we estimated the cohesion using the strength increase for offshore and shore-side conditions as described in Section 3.3.1.

TABLE 3.4.2.1-1: Soil Parameters - Monopile

SOIL TYPE	THICKNESS (feet)	UNIT WEIGHT (pcf)	COHESION (psf)	FRICTION ANGLE (deg)
N/A – pile above mudline	33	--	--	--
Soft Clay (Matlock)	62	33	367 to 1173	--
API Sand (O'Neill)	100	63	--	35

TABLE 3.4.2.1-2: Soil Parameters – Float Piles and Donut Piles

SOIL TYPE	THICKNESS (feet)	UNIT WEIGHT (pcf)	COHESION (psf)	FRICTION ANGLE (deg)
N/A – pile above mudline	Float piles: 40 Donut piles: 46	--	--	--
Soft Clay (Matlock)	45	33	370 to 840	--
API Sand (O'Neill)	100	63	--	35

TABLE 3.4.2.1-3: Soil Parameters – Shore-side Piles

SOIL TYPE	THICKNESS (feet)	UNIT WEIGHT (pcf)	COHESION (psf)	FRICTION ANGLE (deg)
API Sand	11	120	--	32
Liquefied Sand	4	58	--	--
Soft Clay (Matlock)	76	33	550 to 1766	--
API Sand (O'Neill)	100	63	--	35

3.4.2.2 Soil Springs

We prepared p-y springs for the monopile and for the shore-side piles. We prepared the p-y springs assuming a top of pile elevation of approximately 13 feet for the monopile and the shore-side piles. We provide a summary of the p-y springs as Appendix G.

3.4.2.3 Lateral Pile Response

We evaluated the pile deflection, moment, and shear responses for the conditions presented in Table 3.4.2.3-1, as requested by you. We present the deflection, moment, and shear diagrams in Appendix H.

TABLE 3.4.2.3-1: Lateral Pile Conditions Analyzed

PILE	LOADING SCENARIO
Monopile	Lateral soil movement acting against the pile based on the results of our slope stability and soil displacement analysis described in Section 3.3.3. We modeled the soil displacement under the scenario resulting in greatest lateral displacement – the DE scenario. We modeled the lateral displacement as 4 inches at the

PILE	LOADING SCENARIO
	mudline decreasing to zero at the base of the slip surface, 52 feet below the mudline. We were not provided with inertial loading of the monopile at the time of this writing. We can provide deflection, moment, and shear diagrams under inertial loading in a supplemental letter, if requested. Additionally, we can provide recommended combination factors to analyze the inertial and kinematic demands concurrently.
Shore-side piles	Lateral soil movement acting against the pile based on the results of our slope stability and soil displacement analysis described in Section 3.3.3. We modeled the soil displacement under the scenario resulting in greatest lateral displacement – the DE scenario. We modeled the lateral displacement as 4 inches at surface grade decreasing to zero at the base of the slip surface, 47 feet below surface grade. We were not provided with inertial loading of the shore-side piles at the time of this writing. We can provide deflection, moment, and shear diagrams under inertial loading in a supplemental letter, if requested. Additionally, we can provide recommended combination factors to analyze the inertial and kinematic demands concurrently.
Float piles	Lateral load of 72 kips applied at Elevation 12½ feet. Assumed axial load of 18 kips under free-head condition.
Donut piles	Lateral load of 5 kips applied at Elevation 16½ feet. Assumed axial load of 18 kips under free-head condition.

3.4.3 Minimum Pile Embedment

The piles must be embedded sufficiently deep to satisfy the vertical and lateral demands with the capacities described in Sections 3.4.1 and 3.4.2. Settlement may occur if the piles are terminated within the YBM under relatively larger vertical loads; therefore, we recommend that the monopile and shore-side piles, which will support the new bridge and gangway structures, be embedded into the San Antonio Formation.

4.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents preliminary geotechnical recommendations for design of the improvements discussed in Section 1.2 for the Alameda Main Street Ferry Refurbishment Project. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, designers, and contractors. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; there is no warranty, express or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data are representative of the actual subsurface conditions across the site. Considering possible underground variability of soil and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, we must be notified immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

In addition, our geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, the proper regulatory officials must be notified immediately.

This document must not be subject to unauthorized reuse, that is, reuse without our written authorization. Such authorization is essential because it requires us to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to our documents. Therefore, we must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If our scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, we cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

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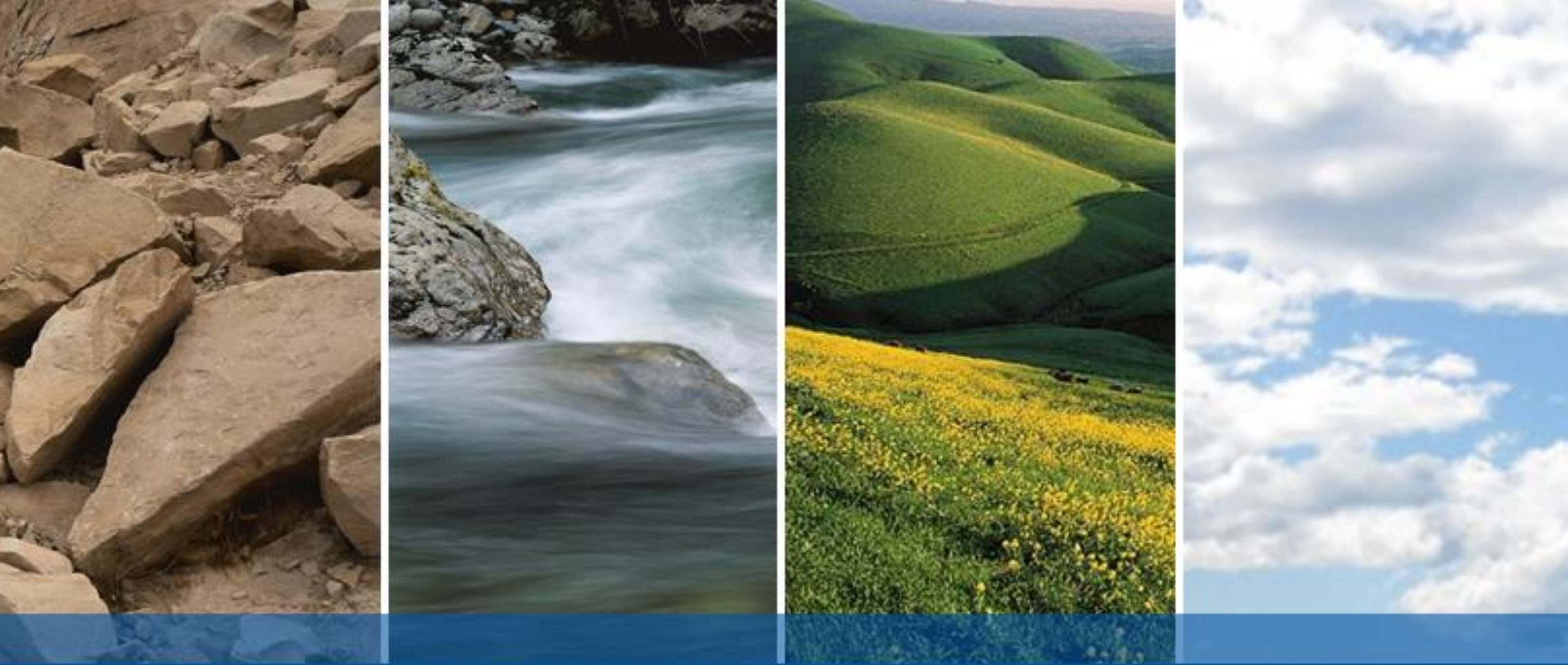
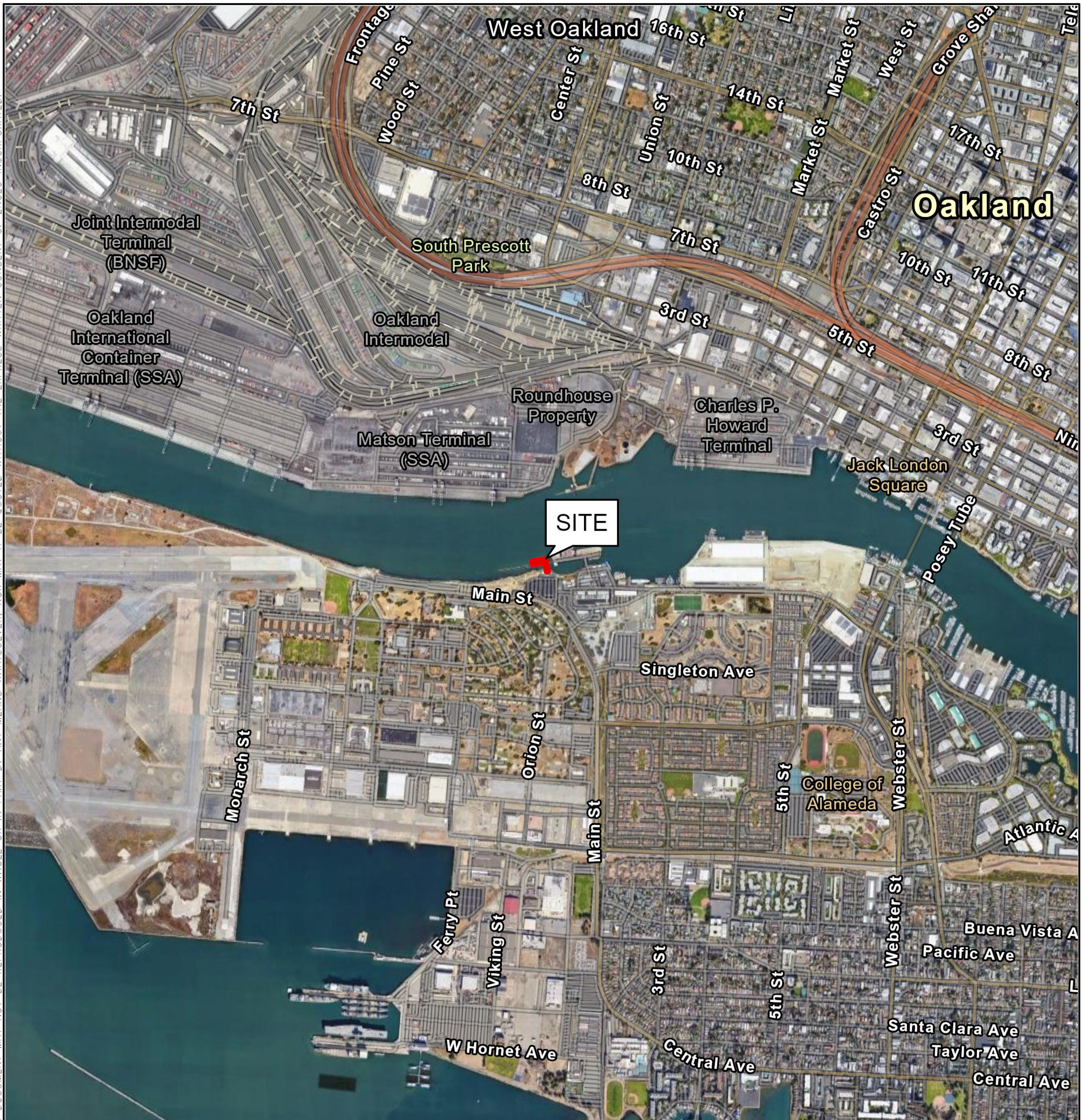


FIGURES



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FEET

BASEMAP SOURCE: ESRI MAPPING SERVICE 9/27/2021

ENGEO
Expect Excellence

VICINITY MAP
ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT
ALAMEDA, CALIFORNIA

PROJECT NO.: 19542.000.001
SCALE: AS SHOWN
DRAWN BY: JV
CHECKED BY: TMK
FIGURE NO. 1

PATH: G:\DRAFTING\PROJECTS_18000 TO 19999\19542\19542000001\GEOTECH\GEX\19542000001_GEX.APRX
LAYOUT: VICINITY USER: JVERGARA

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EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

1-sCPT02	CONE PENETRATION TEST (ENGEO, 2021)
285.GB29	BORING (SCI, 1997)
EB-17	BORING (PETER KALDVEER AND ASSOCIATES, 1981)
BORING 6	BORING (COOPER-CLARK, 1967)
BORING 8	BORING (DAMES & MOORE, 1944)
A — A'	CROSS SECTION

BASE MAP SOURCE: BING MAPPING SERVICE

ENGEO
Expect Excellence

SITE PLAN
ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT
ALAMEDA, CALIFORNIA

PROJECT NO.: 19542.000.001		FIGURE NO. 2
SCALE: AS SHOWN		
DRAWN BY: JV	CHECKED BY: TMK	

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ORIGINAL FIGURE PRINTED IN COLOR

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

afbm	ARTIFICIAL FILL OVER BAY MUD
Qds	DUNE SAND (HOLOCENE AND PLEISTOCENE)

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FEET

BASEMAP SOURCE: R. WITTER

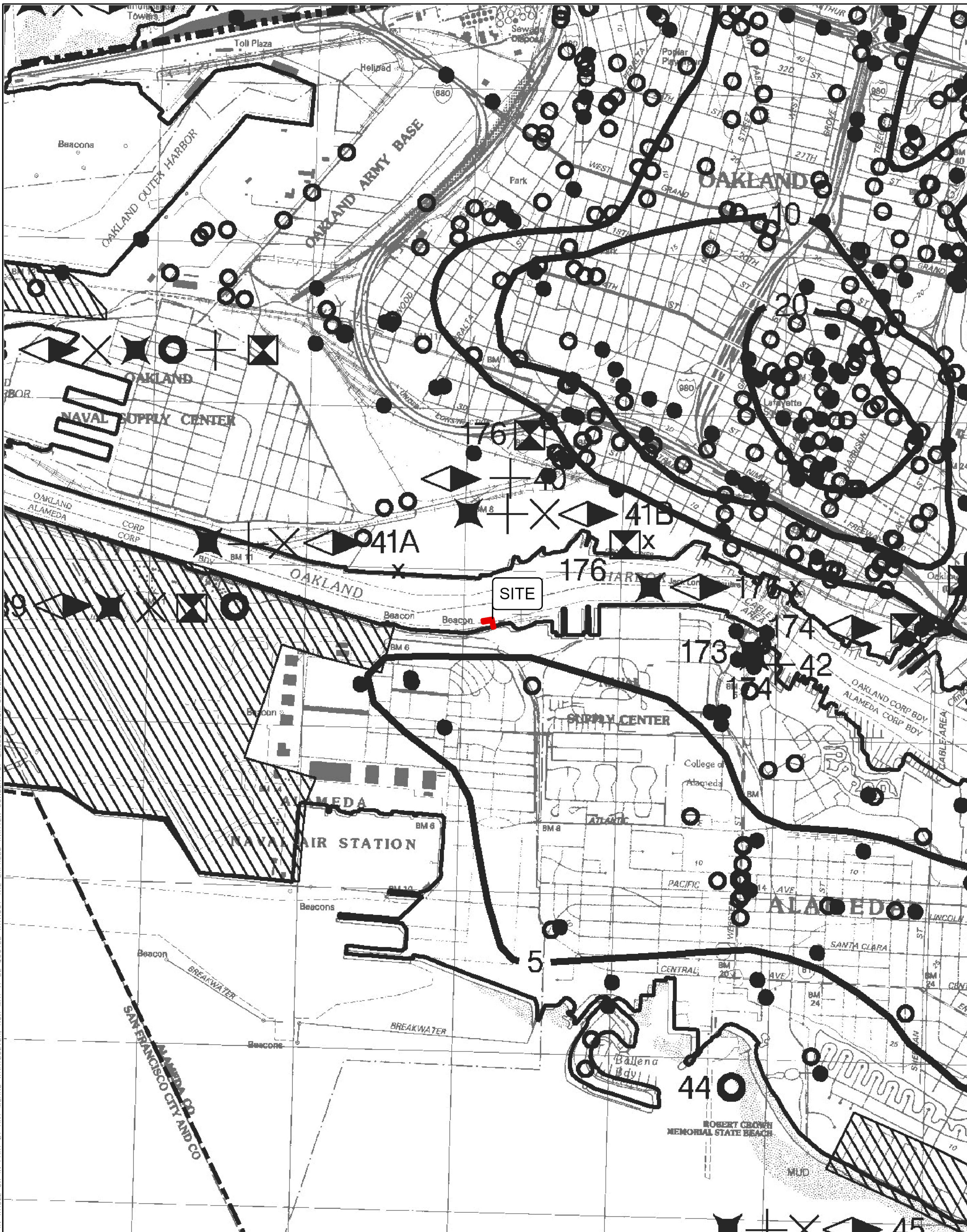
ENGEO
Expect Excellence

REGIONAL GEOLOGIC MAP

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT

ALAMEDA, CALIFORNIA

PROJECT NO. : 19542.000.001		FIGURE NO. 3
SCALE: AS SHOWN		
DRAWN BY: JV	CHECKED BY: TMK	



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- Miscellaneous effects
- Ground settlement
- Lateral spread
- Sand boil
- Pipeline break
- Cracks in streets or ground
- Absence of ground failure noted

x Location of multiple ground effects. (See corresponding symbols)

Areas within which multiple failures were recorded. Symbols show failure types.

Stretch of highway along which multiple failures were recorded. Symbols show failure types.

174 Number assigned to ground failure site (adapted from Youd and Hoose (1978) and Tinsley and others (1998) by Knudsen and others (2000))

20 Depth to ground water, in feet (5, 10, 20 foot contours)

● Geotechnical borings used in liquefaction evaluation

○ Ground-water level data provided by the California State Water Resources Control Board

B Bedrock
See "Bedrock and Surficial Geology" in Section 1 of report for descriptions of units.

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BASEMAP SOURCE: CGS, 2003

ENGEO
Expect Excellence

HISTORIC HIGH GROUNDWATER
ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT
ALAMEDA, CALIFORNIA

PROJECT NO.: 19542.000.001	FIGURE NO. 4
SCALE: AS SHOWN	
DRAWN BY: JV	CHECKED BY: TMK

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LAYOUT: HISTORIC HIGH GW USER: JVERGARA

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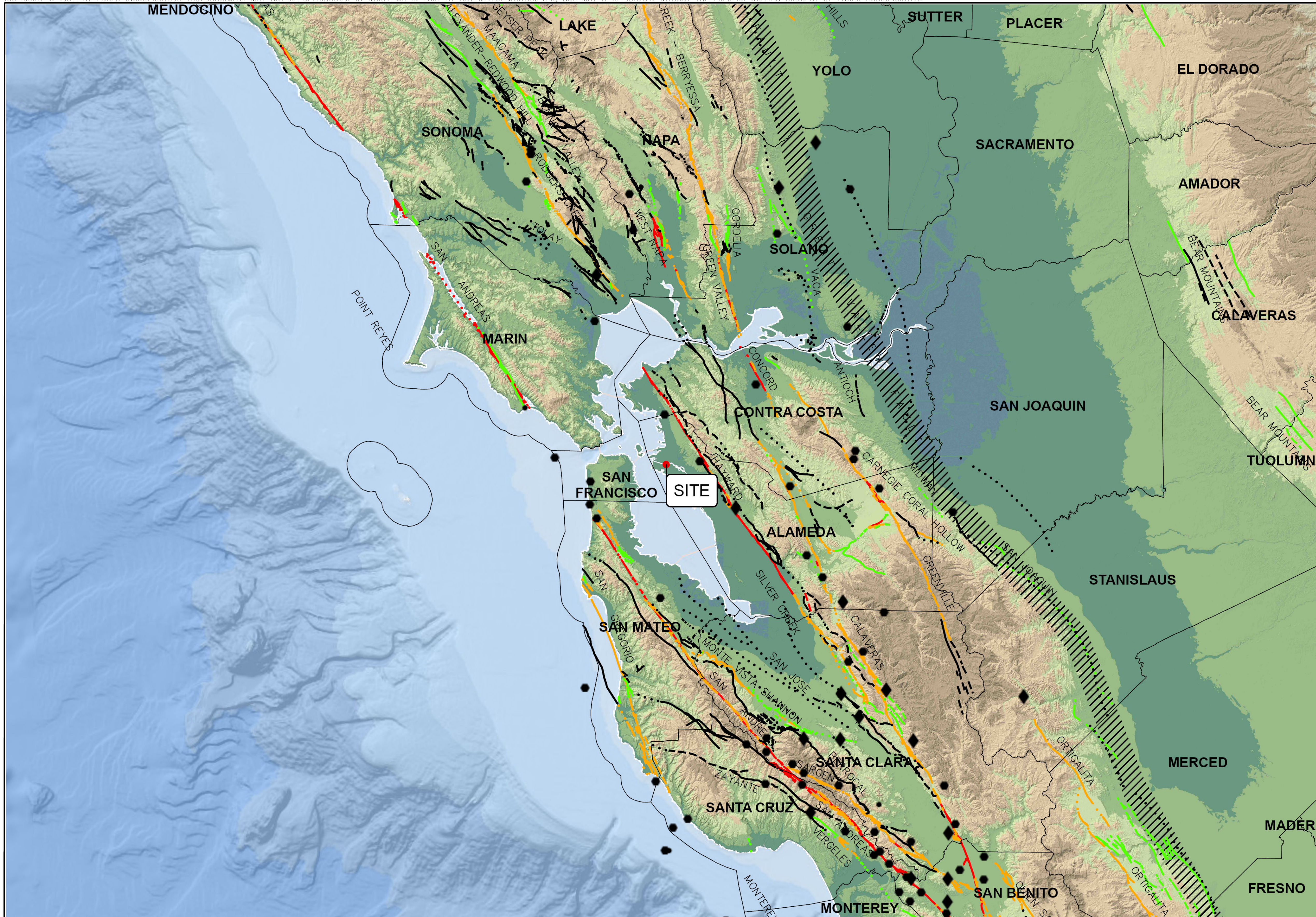

N

0 7.5 15

Miles

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

EARTHQUAKE

- MAGNITUDE 7+
- MAGNITUDE 6-7
- MAGNITUDE 5-6

QUATERNARY FAULTS

BASED ON TIME OF MOST RECENT SURFACE DEFORMATION

- HISTORICAL (<150 YEARS), WELL CONSTRAINED LOCATION
- HISTORICAL (<150 YEARS), MODERATELY CONSTRAINED LOCATION
- HISTORICAL (<150 YEARS), INFERRED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), WELL CONSTRAINED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), MODERATELY CONSTRAINED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), INFERRED LOCATION
- LATE QUATERNARY (<130,000 YEARS), WELL CONSTRAINED LOCATION
- LATE QUATERNARY (<130,000 YEARS), MODERATELY CONSTRAINED LOCATION
- LATE QUATERNARY (<130,000 YEARS), INFERRED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), WELL CONSTRAINED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), MODERATELY CONSTRAINED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), INFERRED LOCATION
- GREAT VALLEY FAULT ZONE

BASE MAP SOURCE
ESRI, GEBCO, DELORME, NATURALVUE
COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATA SET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, 2020
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-PRESENT)
U.S.G.S OPEN-FILE REPORT 96-705

ENGEO
Expect Excellence

REGIONAL FAULTING AND SEISMICITY ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT ALAMEDA, CALIFORNIA	PROJECT NO.: 19542.000.001	FIGURE NO.
	SCALE: AS SHOWN	5
	DRAWN BY: JV / CHECKED BY: TMK	

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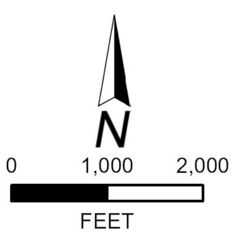
LAYOUT: FAULT&SEISMICITY USER: JVERGARA

ORIGINAL FIGURE PRINTED IN COLOR

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

LIQUEFACTION ZONE
AREAS WHERE THE HISTORICAL OCCURRENCE OF LIQUEFACTION, OR LOCAL GEOLOGICAL, GEOTECHNICAL AND GROUND WATER CONDITIONS INDICATE A POTENTIAL FOR PERMANENT GROUND DISPLACEMENTS SUCH THAT MITIGATION AS DEFINED IN PUBLIC RESOURCES CODE SECTION 2693(C) WOULD BE REQUIRED



BASEMAP SOURCE: ESRI MAPPING SERVICE
CALIFORNIA DEPARTMENT OF CONSERVATION, CALIFORNIA GEOLOGICAL SURVEY

ENGEO Expect Excellence	SEISMIC HAZARDS ZONE MAP	PROJECT NO.: 19542.000.001	FIGURE NO.
	ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT	SCALE: AS SHOWN	6
	ALAMEDA, CALIFORNIA	DRAWN BY: JV / CHECKED BY: TMK	

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LAYOUT: SEISMIC HAZARD USER: JVERGARA

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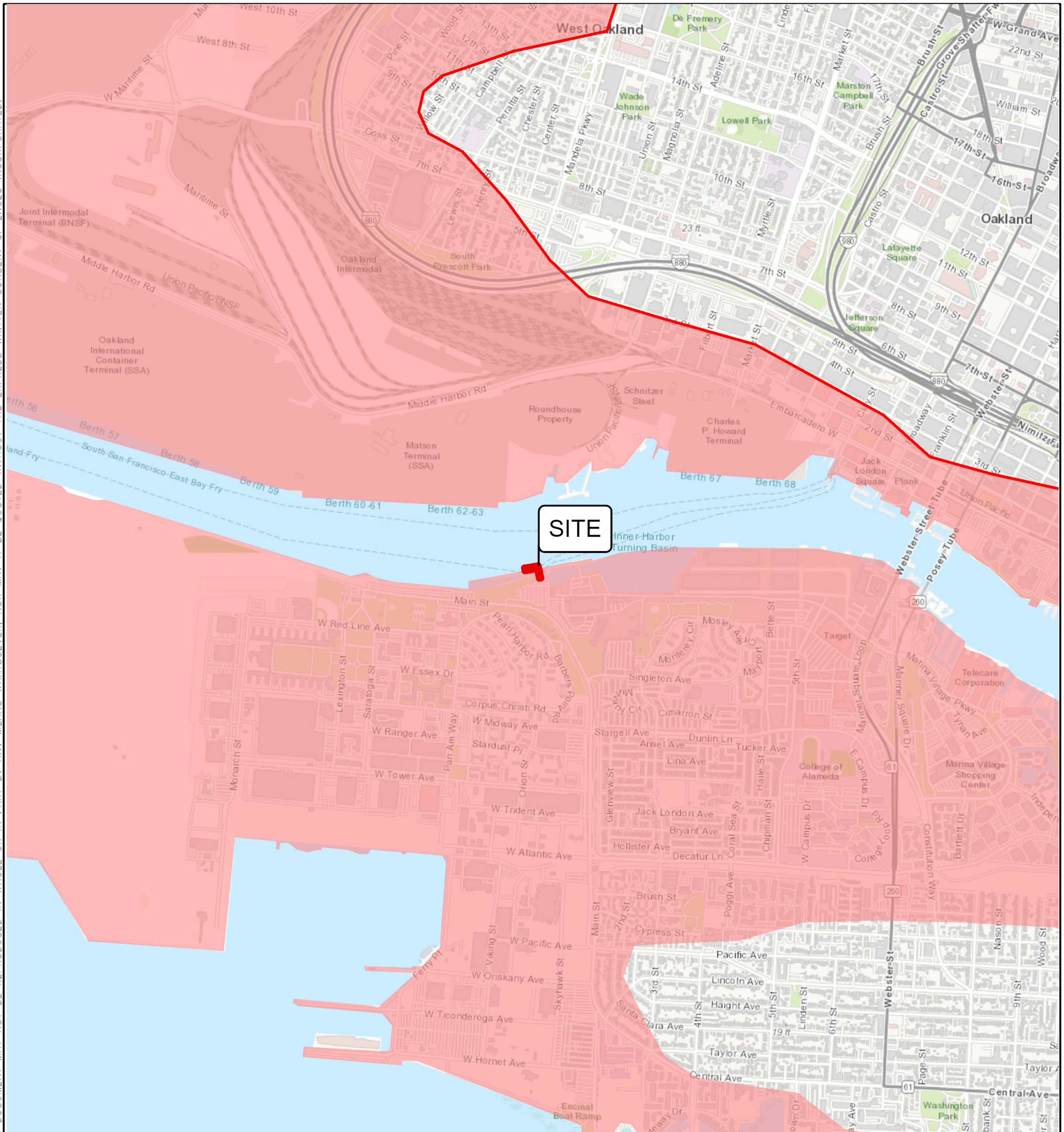

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- PROJECT SITE
- TSUNAMI INUNDATION AREA
- TSUNAMI INUNDATION LINE

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FEET

BASEMAP SOURCE: CALIFORNIA GEOLOGICAL SURVEY, 2009

ENGEO Expect Excellence

TSUNAMI INUNDATION MAP ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT ALAMEDA, CALIFORNIA	PROJECT NO.: 19542.000.001		FIGURE NO. 7
	SCALE: AS SHOWN		
	DRAWN BY: JV	CHECKED BY: TMK	

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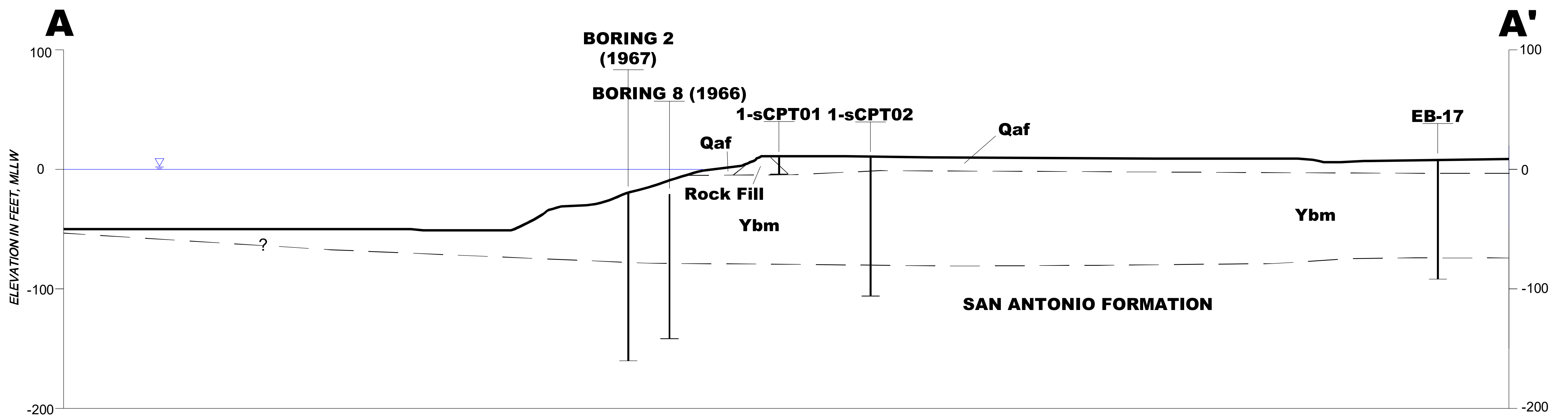
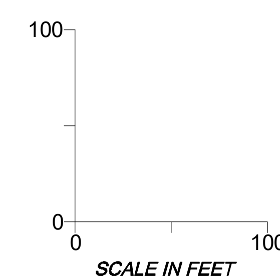


SECTION A-A'

1"= 100'



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Qaf	ARTIFICIAL FILL
Ybm	YOUNG BAY MUD
1-sCPT02	CONE PENETRATION TEST
285.GB29	BORING

ENGEO Expect Excellence	CROSS SECTION A-A' ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT ALAMEDA, CALIFORNIA	PROJECT NO.: 19542.000.001 SCALE: AS SHOWN DRAWN BY: JV CHECKED BY: TMK	FIGURE NO. 8

APPENDIX A

CONE PENETRATION TEST DATA

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

ConeTec

Job No:	21-56-23219
Client:	ENGEO Incorporated
Project:	Alameda Main Street Ferry Terminal
Start Date:	28-Oct-2021
End Date:	28-Oct-2021

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Northing[2] (m)	Easting[2] (m)	Elevation[3] (ft)	Refer to Notation Number
1-sCPT01	21-56-23219_SP01	28-Oct-2021	811:T1500F15U35	6.4	13.78	4182827	562136	11	4
1-sCPT02	21-56-23219_SP02	28-Oct-2021	811:T1500F15U35	6.4	115.73	4182824	562183	12	5

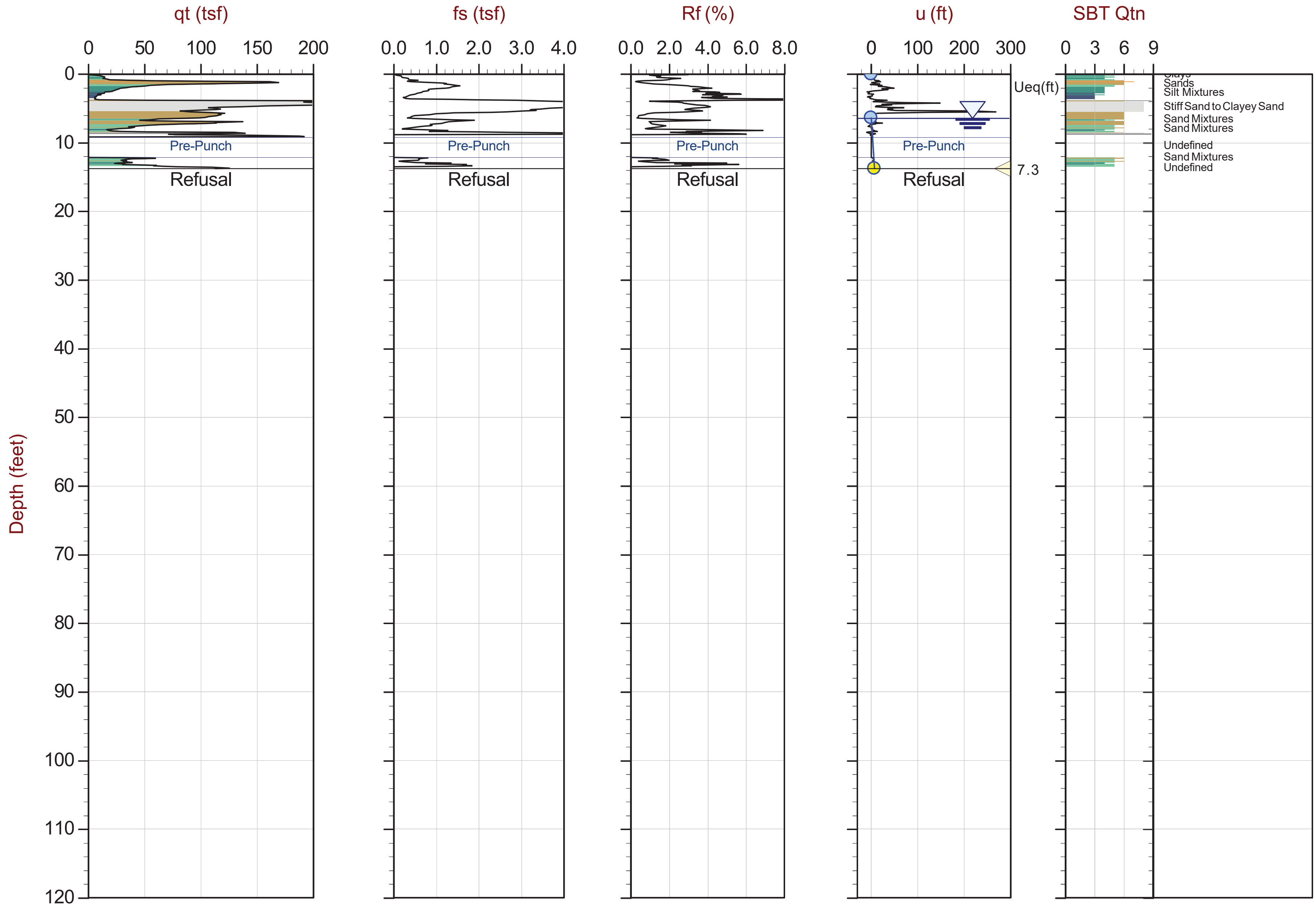
1. The assumed phreatic surface was based on the shallowest pore pressure dissipation tests performed within or nearest the sounding. Hydrostatic conditions are assumed for the calculated parameters.
2. The coordinates were acquired using consumer grade GPS equipment, datum: WGS 1984 / UTM Zone 10S.
3. Elevations are referenced to the ground surface and were acquired from the Google Earth Elevation for the recorded coordinates.
4. Seven total attempts were made at the location to pre-punch, but none were successful.
5. The assumed phreatic surface is based on the pore pressure dissipation test at 1-SCPT1.

CONETEC

ENGEO

Job No: 21-56-23219
Date: 2021-10-28 10:37
Site: Alameda Main Street Ferry Terminal

Sounding: 1-sCPT01
Cone: 811:T1500F15U35



Max Depth: 4.200 m / 13.78 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-56-23219_SP01.COR
Unit Wt: SBTQtn (PKR2009)

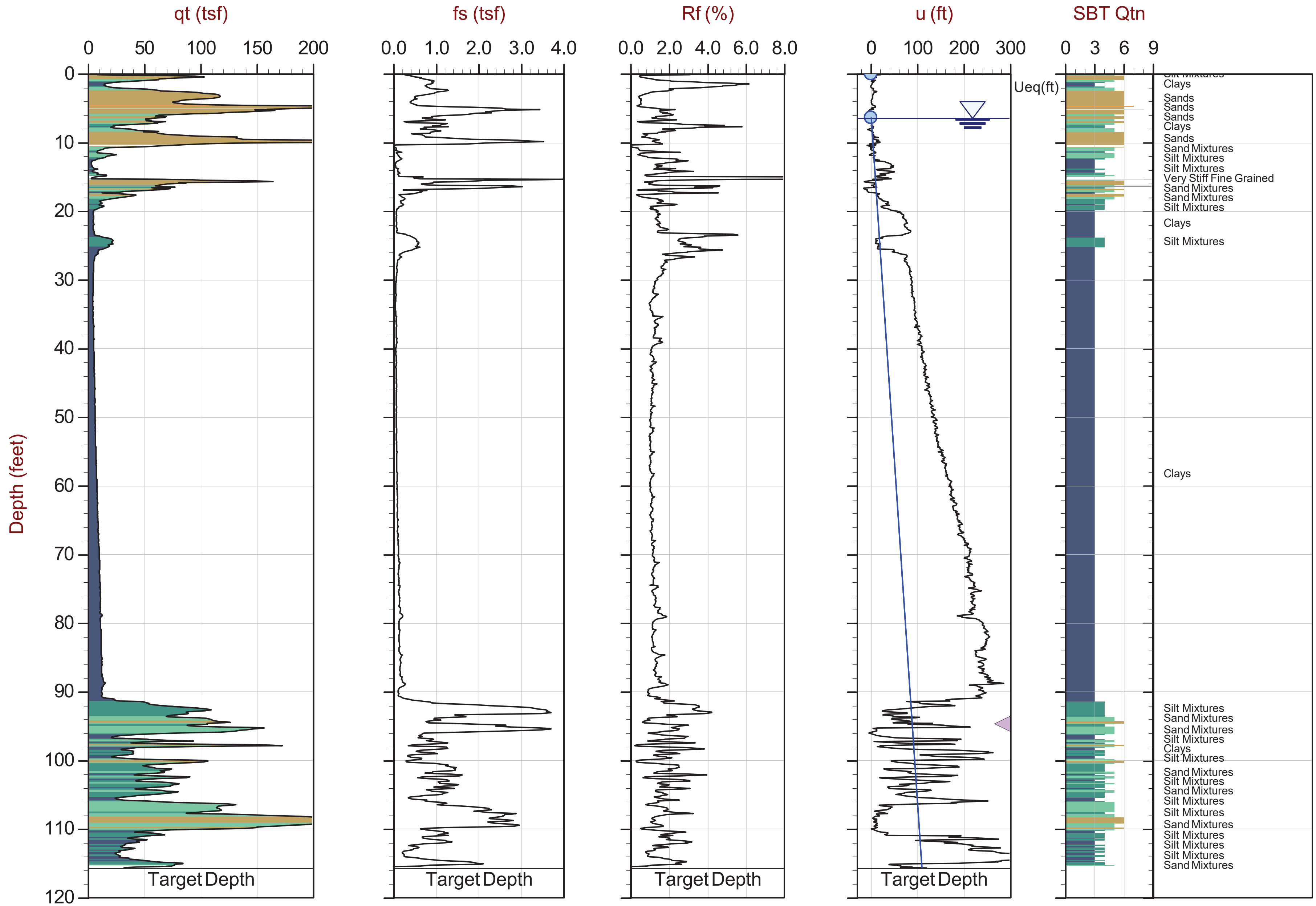
SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4182827m E: 562136m
Sheet No: 1 of 1

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ENGEO

Job No: 21-56-23219
Date: 2021-10-28 09:06
Site: Alameda Main Street Ferry Terminal
Sounding: 1-sCPT02
Cone: 811:T1500F15U35



Max Depth: 35.275 m / 115.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-56-23219_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4182824m E: 562183m
Sheet No: 1 of 1

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results

Job No:	21-56-23219
Client:	ENGEO
Project:	Alameda Main Street Ferry Terminal
Sounding ID:	1-sCPT01
Date:	10:28:21 10:37

Seismic Source:	Beam
Seismic Offset (ft):	1.87
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.89	2.08	2.79			
12.40	11.59	11.74	8.95	12.30	728
13.78	12.97	13.10	1.36	1.61	844

CONETEC

Job No: 21-56-23219
Client: ENGEO
Project: Alameda Main Street Ferry Terminal
Sounding ID: 1-sCPT02
Date: 10:28:21 09:06

Seismic Source: Beam
Seismic Offset (ft): 1.87
Source Depth (ft): 0.00
Geophone Offset (ft): 0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.46	1.65	2.49			
6.00	5.19	5.52	3.03	3.75	806
9.19	8.37	8.58	3.06	3.61	849
12.53	11.72	11.87	3.29	5.25	626
19.09	18.28	18.38	6.51	16.01	407
22.31	21.50	21.58	3.20	5.92	541
25.53	24.71	24.78	3.21	9.28	345
28.71	27.90	27.96	3.17	11.06	287
32.32	31.50	31.56	3.60	16.27	221
35.60	34.79	34.84	3.28	9.75	336
38.78	37.97	38.01	3.18	11.80	269
42.26	41.45	41.49	3.47	11.62	299
45.44	44.63	44.67	3.18	10.51	303
48.62	47.81	47.85	3.18	9.87	322
51.84	51.03	51.06	3.21	9.33	344
55.28	54.47	54.50	3.44	8.37	412
58.46	57.65	57.68	3.18	7.93	401
61.84	61.03	61.06	3.38	7.45	454
65.13	64.31	64.34	3.28	7.78	421
68.24	67.43	67.46	3.12	6.71	464
71.46	70.65	70.67	3.22	6.32	508
74.80	73.99	74.02	3.35	7.20	465
78.02	77.21	77.23	3.21	7.30	441
81.30	80.49	80.51	3.28	7.02	468
84.91	84.10	84.12	3.61	7.08	509
88.09	87.28	87.30	3.18	7.08	449
91.37	90.56	90.58	3.28	5.82	564
94.65	93.84	93.86	3.28	4.51	727
97.87	97.06	97.07	3.21	4.90	656
101.21	100.40	100.42	3.35	4.37	767
104.50	103.68	103.70	3.28	3.59	914

Job No: 21-56-23219
Client: ENGEO
Project: Alameda Main Street Ferry Terminal
Sounding ID: 1-sCPT02
Date: 10:28:21 09:06

Seismic Source: Beam
Seismic Offset (ft): 1.87
Source Depth (ft): 0.00
Geophone Offset (ft): 0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
107.78	106.96	106.98	3.28	4.66	704
110.99	110.18	110.20	3.22	3.59	896
114.17	113.36	113.38	3.18	4.27	745

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Job No:	21-56-23219
Client:	ENGEO Incorporated
Project:	Alameda Main Street Ferry Terminal
Start Date:	28-Oct-2021
End Date:	28-Oct-2021

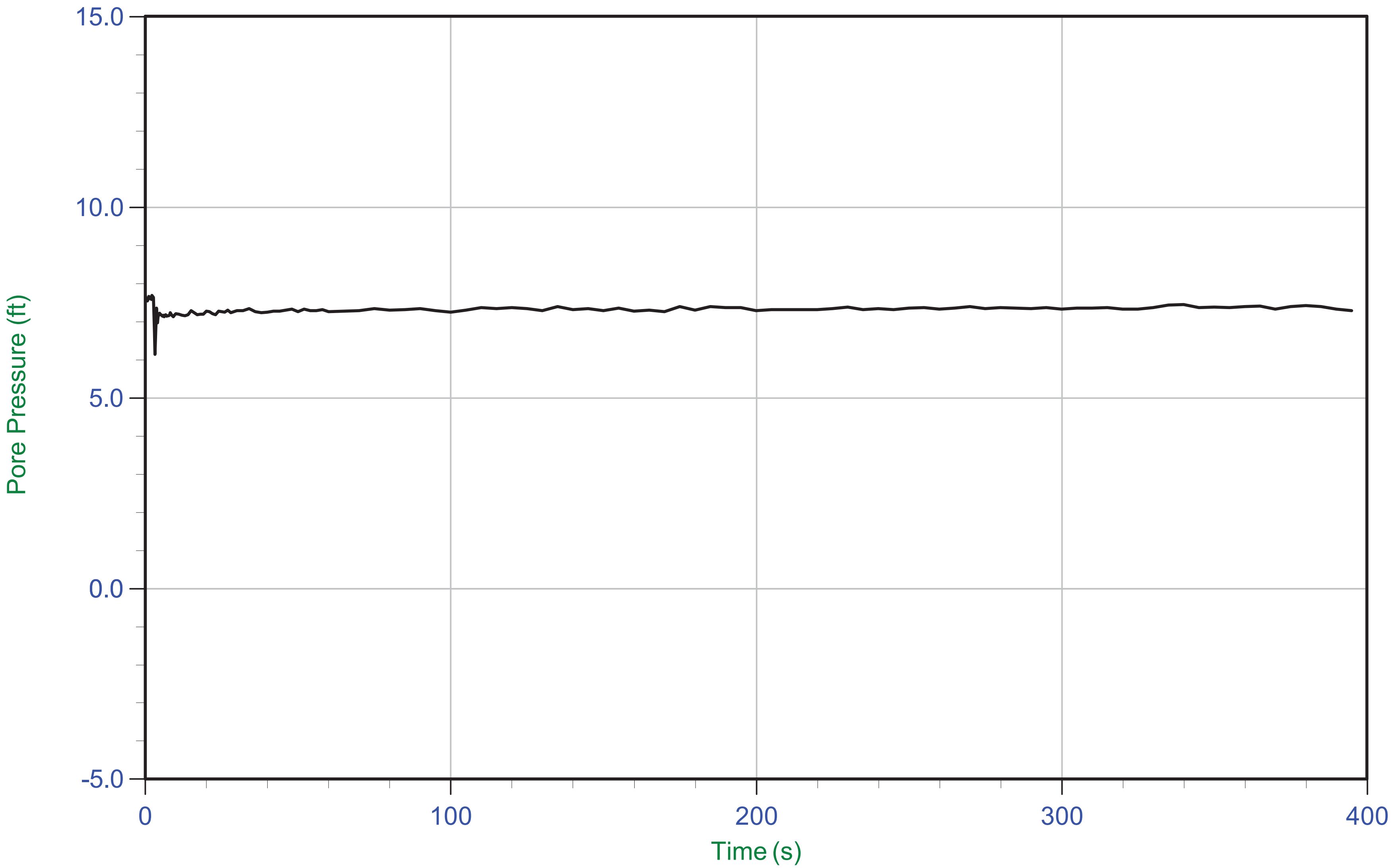
CPTu PORE PRESSURE DISSIPATION SUMMARY

Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)
1-sCPT01	21-56-23219_SP01	15	395	13.78	7.3	6.4
1-sCPT02	21-56-23219_SP02	15	370	94.65	Not Achieved	

ENGEO

Job No: 21-56-23219
Date: 10/28/2021 10:37
Site: Alameda Main Street Ferry Terminal

Sounding: 1-sCPT01
Cone: 811:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-56-23219_SP01.ppd2
Depth: 4.200 m / 13.779 ft
Duration: 395.0 s

u Min: 6.1 ft
u Max: 7.7 ft
u Final: 7.3 ft

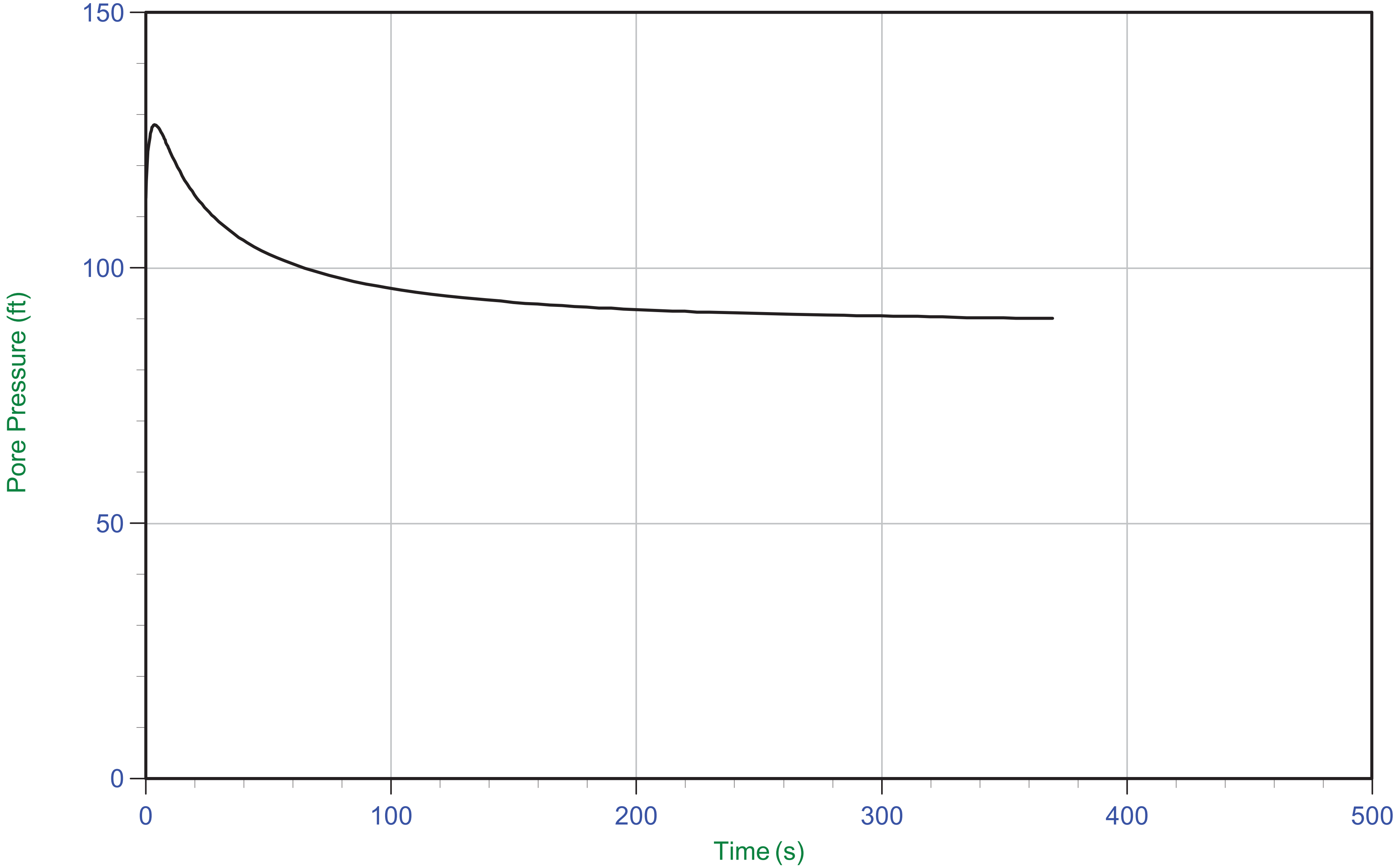
WT: 1.961 m / 6.433 ft
Ueq: 7.3 ft

CONETEC

ENGEO

Job No: 21-56-23219
Date: 10/28/2021 09:06
Site: Alameda Main Street Ferry Terminal

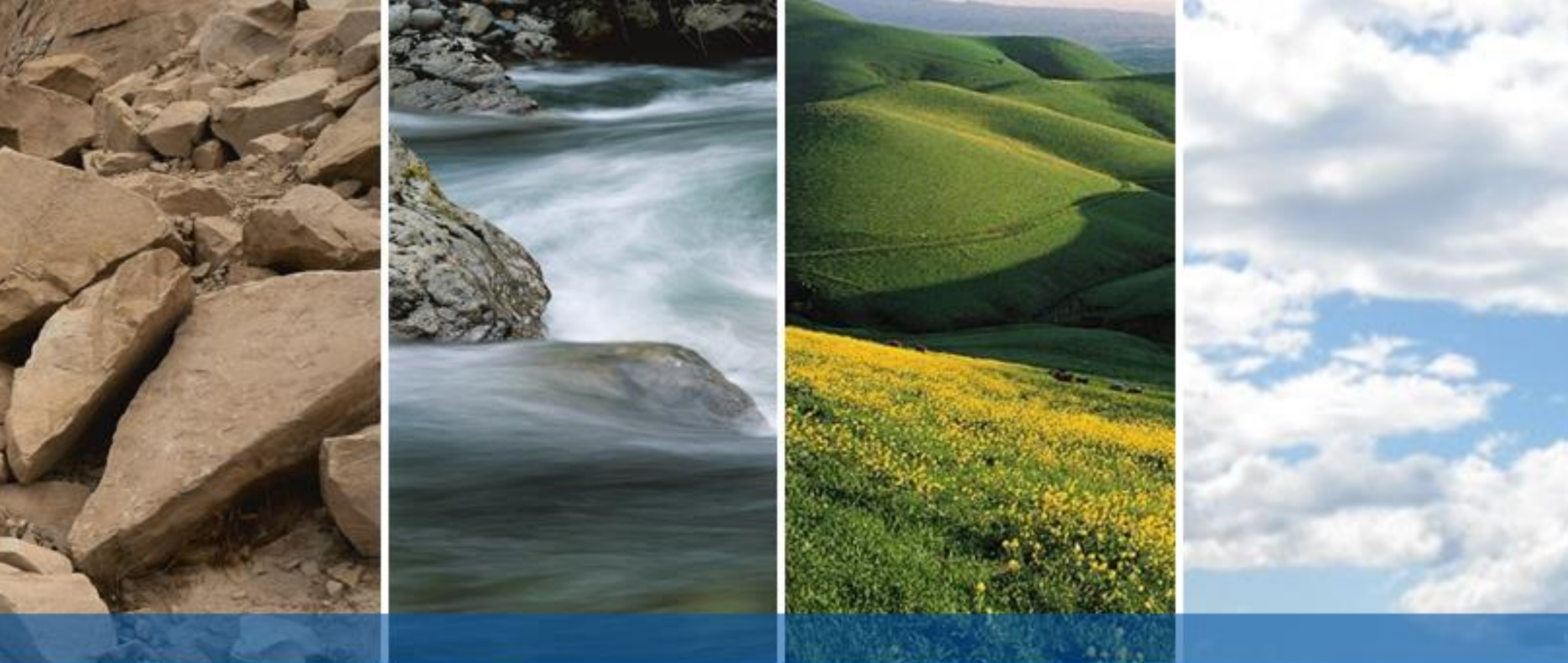
Sounding: 1-sCPT02
Cone: 811:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-56-23219_SP02.ppd2
Depth: 28.850 m / 94.651 ft
Duration: 370.0 s

u Min: 90.1 ft
u Max: 128.0 ft
u Final: 90.2 ft

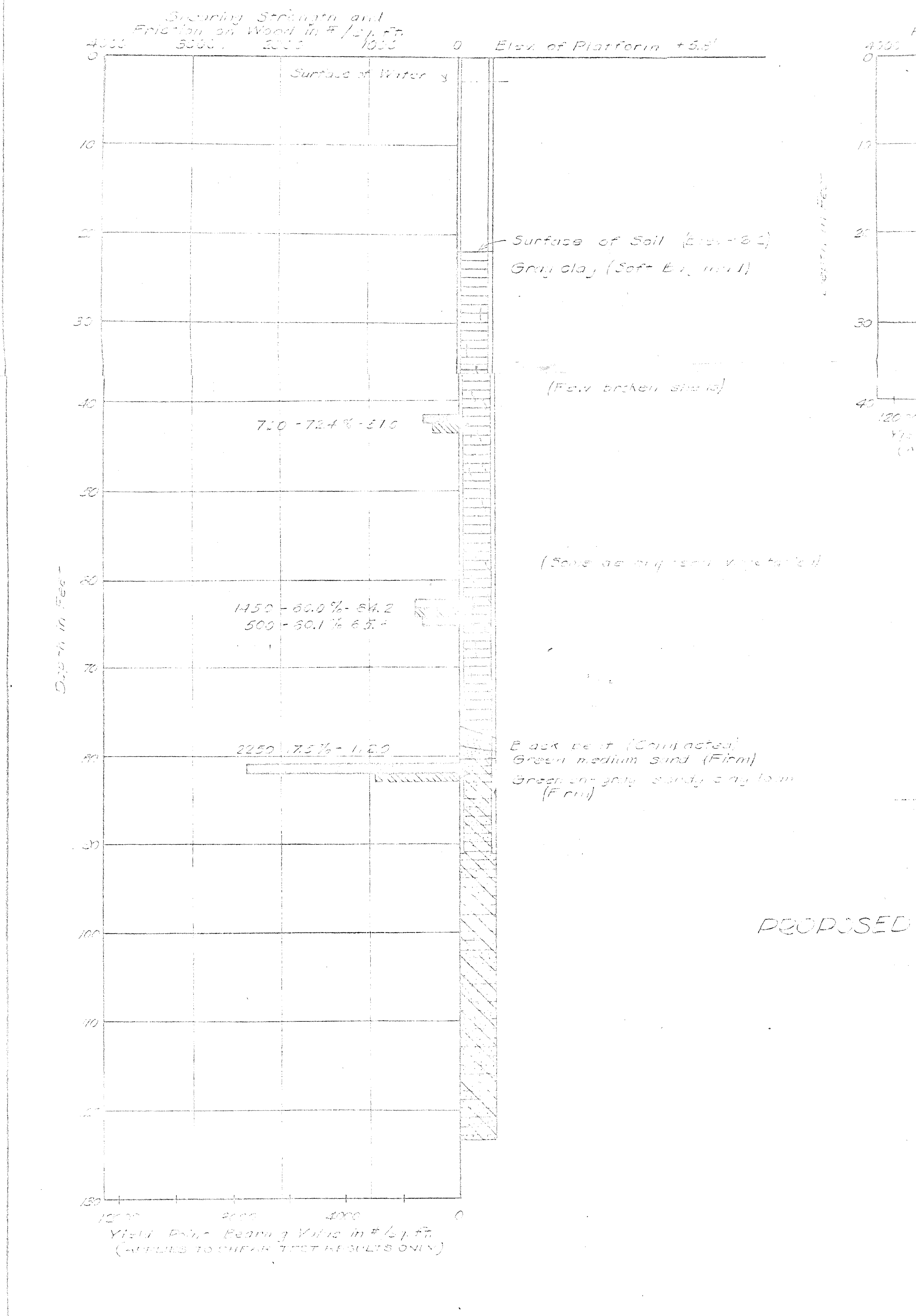


APPENDIX B

PREVIOUS EXPLORATION DATA

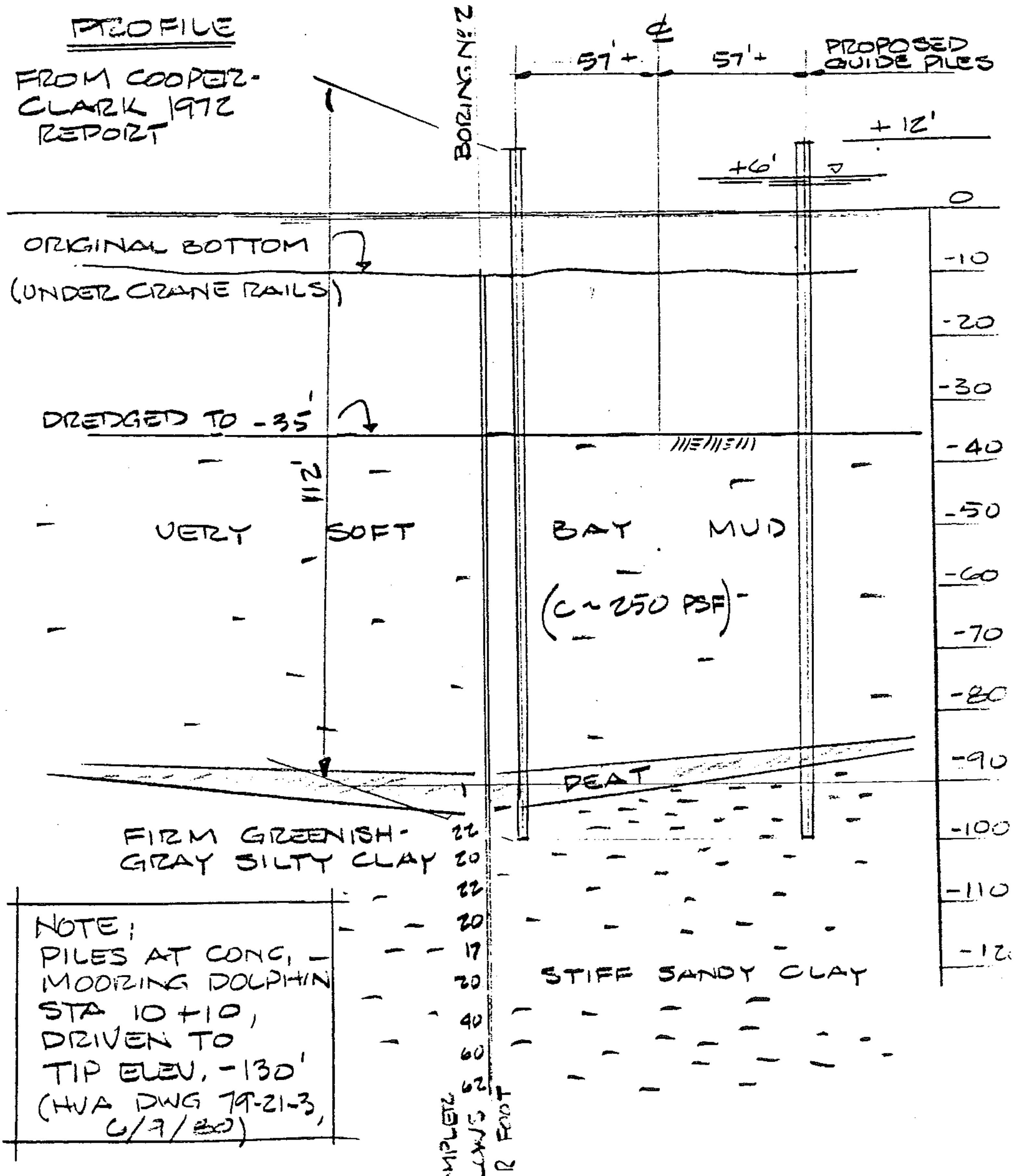
BORING NO.8

4" Diameter Wash Boring



H. V. ANDERSON ENGINEERS

Investigations & Reports / Conceptual Planning / Design Reviews / Construction Engineering



SECTION D CA

DRILL RIG Rotary Wash	SURFACE ELEVATION 111.0 Feet ±	LOGGED BY F.M./M.B.
DEPTH TO GROUNDWATER 5' (see Note 3)	BORING DIAMETER 6 Inches	DATE DRILLED 10/31/80

DESCRIPTION AND CLASSIFICATION				DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE						
SAND (fine- to coarse-grained), silty with some gravel	brown	medium dense	SM	1		15			
						27*			
SILT, clayey with traces of sand (fine-grained) (FILL)	mottled grey-brown	stiff	ML	5			▽		
CLAY with some silt and traces of shells (Bay Mud)	mottled grey-black	very soft	CL	10		1			
SAND (fine-grained) with some silt, clay and shells	grey	medium dense	SP	15		41*	21	106	
				20					
		very dense		25		30			
CLAY, silty with traces of shells (Bay Mud)	grey	soft	CL	30					
				35		5*			
				40					

Peter Kaldveer and Associates

Geotechnical Consultants

EXPLORATORY BORING LOG

ALAMEDA NAVAL AIR STATION HOUSING
Alameda, California

PROJECT NO.	DATE	BORING NO.
K529-31	January 1981	17

SECTION D CA

DRILL RIG Rotary Wash	SURFACE ELEVATION 111.0 Feet ±	LOGGED BY F.M./M.B.
DEPTH TO GROUNDWATER 5' (see Note 3)	BORING DIAMETER 6 Inches	DATE DRILLED 10/31/80

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)
CLAY, silty with traces of shells (Bay Mud) (continued)	grey	firm	CH	41					
				45		push 300 psi			
				50					
(grading with less shells)		soft		55		2			
				60					
(grading with organics)		stiff		65		16*			
				70					
(grading with traces of organics)		firm		75		7			
				80					

Peter Kaldveer and Associates

Geotechnical Consultants

EXPLORATORY BORING LOG

ALAMEDA NAVAL AIR STATION HOUSING
Alameda, California

PROJECT NO.	DATE	BORING NO.
K529-31	January 1981	17

SECTION D CA

DRILL RIG Rotary Wash	SURFACE ELEVATION 111.0 Feet ±	LOGGED BY F.M./M.B.
DEPTH TO GROUNDWATER 5' (see Note 3)	BORING DIAMETER 6 Inches	DATE DRILLED 10/31/80

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)
CLAY, silty with traces of organics (Bay Mud) (continued)	grey	firm	CH	81					
SAND (fine-grained) with silt, clayey	grey	medium dense	SC	85					
				90	X	53*			
				95					
SILT, clayey with sand (fine-grained)	blue-green	very stiff	ML			17			
Bottom of Boring = 100 Feet				100					
				105					
				110					
				115					
				120					

Notes:
1. The stratification lines represent the approximate boundaries between soil types and the transitions may be gradual.
2. For an explanation of penetration resistance values marked with an asterisk (*), see page A-1.
3. Groundwater level measured 3 days after drilling.

Peter Kaldveer and Associates

Geotechnical Consultants

EXPLORATORY BORING LOG

ALAMEDA NAVAL AIR STATION HOUSING
Alameda, California

PROJECT NO.	DATE	BORING NO.
K529-31	January 1981	17

TABLE 1.
DATA POINT LITHOLOGY SUMMARY
Oakland Harbor Navigation Improvement (-50 Foot) Project
Port of Oakland

Data Point Number [1]	Coordinates [2] (feet) Easting	Coordinates [2] (feet) Northing	Ground Surface or Mudline Elevation [3] (feet)	Depth of Data Point Relative to Ground Surface or Mudline (feet)	Depth to Water Table Relative to Ground Surface or Mudline (feet)	Water Table Elevation (feet)	Depth to Top of Geologic Unit below Ground Surface or Mudline (feet) (Blank if Unit Not Encountered): Fill	Young Bay Mud	San Antonio	Older Bay Mud	Alameda Formation	Bedrock	Elevation of Top of Geologic Unit (feet): Fill	Younger Bay Mud	San Antonio Formation [4]	Older Bay Mud	Alameda Formation	Bedrock	Thickness of Geologic Unit (feet): Fill	Younger Bay Mud	San Antonio	Older Bay Mud	Alameda Formation	Type of Data Point [5]	Report Containing Original Data	Date of Data Collection	Remarks
266.OW-398	6028338.7	2121769.9	-35.2	13.1				0	5					-35.2	-40.2					5	>8			EB		5/15/97	No groundwater data available.
266.TC-366	6044677.3	2116600.9	-42.8	10.0				0	2.5					-42.8	-45.3					2.5	>8			EB		7/31/97	No groundwater data available.
266.TC-368	6044687.3	2116339.7	-39.9	15.0					0	7.7					-39.9	-47.6					7.7			EB		7/31/97	No groundwater data available.
266.TC-394	6044716.9	2115776.8	-44.4	7.7					0	2.6					-44.4	-47					2.6			EB		8/4/97	No groundwater data available.
266.TC-396	6045009.4	2115946.9	-40.7	12.5					0						-40.7						>13			EB		8/4/97	No groundwater data available.
266.TW-378	6044749.7	2115428.3	-24.7	14.8				0	10					-24.7	-34.7						>5			EB		9/15/97	No groundwater data available.
267.K99.DW02	6039780.05	2125602.04	11.8	40.5	8	3.8	0	16.5	25				11.8	-4.7	-13.2				16.5	8.5	>16			MW	Kleinfelder, 1997	10/14/97	
267.K99.BM01	6039789.96	2125586.34	11.8	25	8	3.8	0	14.5					11.8	-2.7					14.5	>11				MW		5/29/97	
267.K99.DW01	6039795.41	2125585.23	11.63	40	6.5	5.13	0	14.5	28				11.63	-2.87	-16.37				14.5	13.5	>12			MW		5/29/97	
267.K160.DW01	6036987.62	2126697.82	10.05	63.5	6.5	3.55	0	26		56			10.05	-15.95		-45.95			26	30		>8		MW		6/4/97	
267.K738.BM01	6039414.58	2123993.65	13.76	15			0	7.5					13.76	6.26					7.5	>8				MW		5/30/97	No groundwater data available.
267.K738.DW01	6039422.18	2123992.04	13.83	39			0	9.5	24.5				13.83	4.33	-10.67				9.5	15	>15			MW		6/2/97	No groundwater data available.
267.K807.BM01	6042387.72	2125775.48	12.42	23.5			0	11					12.42	1.42					11	>13				MW		6/3/97	No groundwater data available.
273.G1	6038755	2126644	-32.5	69	-33.5	1		0		7				-32.5		-39.5				7		>62		GB	Geomatrix Consultants, 1997	4/24/97	
273.G2	6038045	2125978	-44	85.5	-45	1				0						-44						>86		GB		4/17/97	
273.G3	6030434	2120368	-17.5	52	-17.5	0		0	9	47.5				-17.5	-26.5	-65				9	38.5	>5		GB		5/5/97	
273.G4	6031673	2119705	-10	63	-10	0		0	19	57				-10	-29	-67				19	38	>6		GB		5/9/97	
273.G5	6033562	2121269	-13.5	68.5	-13.5	0		0	17.5	62.5				-13.5	-31	-76				17.5	45	>6		GB		5/7/97	
273.G6	6034025	2120617	-39	36.5	-39	0		0	2	28				-39	-41	-67				2	26	>9		GB		5/8/97	
273.G7	6034657	2120161	-30	101	-30	0		0	10	43				-30	-40	-73				10	33	>58		GB		5/1/97	
273.G8	6033403	2118707	13.5	91.5			0	19	27	84			13.5	-5.5	-13.5	-70.5			19	8	57	>8		GB		4/23/97	No groundwater data available.
273.G9	6034547	2118521	12	135.5			0	15	25	82			12	-3	-13	-70			15	10	57	>54		GB		4/22/97	No groundwater data available.
273.G10	6035735	2118097	12.5	91			0	10	27	83			12.5	2.5	-14.5	-70.5			10	17	56	>8		GB		4/18/97	No groundwater data available.
273.G11	6036481	2117837	13	91			0	14	26	88			13	-1	-13	-75			14	12	62	>3		GB		4/17/97	No groundwater data available.
273.G12	6037206	2117617	11	91.5	3	8	0	13	60	84			11	-2	-49	-73			13	47	24	>8		GB		4/21/97	
273.G13	6037759	2117198	13	141.5			0	19	36	88			13	-6	-23	-75			19	17	52	>54		GB		4/26/97	No groundwater data available.
273.G14	6038262	2117133	13.5	91.5			0	13.5	28	88			13.5	0	-14.5	-74.5			13.5	14.5	60	>4		GB		4/24/97	No groundwater data available.
273.G15	6039374	2116808	12.5	91.5			0	8	21	88			12.5	4.5	-8.5	-75.5			8	13	67	>4		GB		4/25/97	No groundwater data available.
273.H1	6033833	2121380	12.6	36			0	18	22				12.6	-5.4	-9.4				18	4	>14			GB		4/14/97	No groundwater data available.
273.H2	6034252	2120944	11.9	42.5			0	31	34				11.9	-19.1	-22.1				31	3	>9			GB		4/15/97	No groundwater data available.
273.H3	6037093	2121134	13.5	31.5			0	11	17				13.5	2.5	-3.5				11	6	>15			GB		4/15/97	No groundwater data available.
273.H4	6037601	2120193	11	51			0	19	42				11	-8	-31				19	23	>9			GB		4/15/97	No groundwater data available.
273.H5	6035894	2118751	12.9	36			0	11	17				12.9	1.9	-4.1				11	6	>19			GB		4/16/97	No groundwater data available.
273.H6	6038404	2118909	13.8	43.5			0	10	29				13.8	3.8	-15.2				10	19	>15			GB		4/16/97	No groundwater data available.
273.H7	6037137	2117853	13.5	45.5			0	9	34				13.5	4.5	-20.5				9	25	>12			GB		4/16/97	No groundwater data available.
275.1	6036291	2123379	12	551			0	18	21	66	130	502	12	-6	-9	-54	-118	-490	18	3	45	64	372	GB	USGS, 1992	12/10/90	Elevation estimated from topo map and other data; no groundwater data
275.2	6039011	2114129	5	468			0	16	46	84	130	463	5	-11	-41	-79	-125	-458	16	30	38	46	333	GB		5/20/91	Elevation estimated from topo map and other data; no groundwater data
276.1	6051927	2120605	20	201			0		4	103	157		20		16	-83	-137		4		99	54	>44	GB	USGS, 1991	4/22/91	No datum referenced; no groundwater data available.
285.GB1	6037240	2126510	-42.7	21	-44.6	1.9		0		7				-42.7		-49.7				7		>14		GB	SCI - this report	9/20/97	
285.GB2	6037083.2	2126783.8	9.0	88.5	13	-4	0	27	48	51.5			9	-18	-39	-42.5			27	21	3.5	>37		GB		8/15/97	
285.GB3	6036580	2125730	-45	17.5	-49.3	4.3		0	6	12				-45	-51	-57				6	6	>5.5		GB		9/10/97	
285.GB4	6033840	2124280	-4.8	32.5	-8.5	3.7		0	30					-4.8	-34.8					30	>2.5			GB		9/23/97	
285.GB5	6030950	2123640	-8.5	52	-10.2	1.7		0	25	51				-8.5	-33.5	-59.5				25	26	>1		GB		10/2/97	
285.GB6	6031000	2123550	-9.2	53.5	-11	1.8		0	24	51.5				-9.2	-33.2	-60.7				24	27.5	>2		GB		10/1/97	
285.GB7	6037190	2126660	-36	33.5	-39	3		0		18				-36		-54				18		>15.5		GB		9/9/97	
285.GB8	6025980	2120710	-33	41.5	-38	5		0						-33						>41.5				GB		9/26/97	
285.GB9	6024100	2119660	-43.3	6	-46	2.7		0						-43.3						>6				GB		9/22/97	
285.GB10	6026250	2119560	-37.1	42.5	-41	3.9		0						-37.1						>42.5				GB		9/24/97	
285.GB11	6028880	2119150	-32	65	-33.7	1.7		0	37	62.5				-32	-69	-94.5				37	25.5	>2.5		GB		10/3/97	
285.GB12	6032920	2117980	-34.1	35	-36	1.9		0	1					-34.1	-35.1					1	>34			GB		9/19/97	
285.GB13A	6032870	2117750	12.5	9.5			0						12.5						>9.5					GB		7/23/97	No groundwater data available.
285.GB13B	6032826.5	2117821.6	12.5	266	9	3.5	0	25	33	85	178		12.5	-12.5	-20.5	-72.5	-165.5		25	8	52	93	>88	GB		7/30/97	
285.GB14	6037100	2116590	-19.5	52	-20.6	1.1		0	34	50				-19.5	-53.5	-69.5				34	16	>2		GB		9/18/97	
285.GB15	6041220	2115410	-12	55.5	-16	4		0	20					-12	-32					20	>35.5			GB		9/29/97	
285.GB16	6041178.9	2115211.5	8.6	79.5	5.5	3.1	0	7	54	77			8.6	1.6	-45.4	-68.4			7	47	23	>2.5		GB		8/1/97	
285.GB17	6044310	2115640	-23.5	42.5	-28	4.5		0	3.5	24				-23.5	-27	-47.5				3.5	20.5	>18.5		GB		9/15/97	
285.GB18	6044087.0	2115354.7	9.8	76	6.5	3.3	0	10	40	58.5			9.8	-0.2	-30.2	-48.7			10	30	18.5	>17.5		GB		9/23/97	
285.GB19	6044680	2115270	-18.2	59	-21	2.8		0	5	32.5				-18.2	-23.2	-50.7				5	27.5	>26.5		GB		9/13/97	
285.GB20	6044671.9	2115125.4	10	92.5	4	6	0	16.5	36	57			10	-6.5	-26	-47			16.5	19.5	21	>35.5		GB		9/19/97	
285.GB21	6044667.9	2115036.3	9.1	71			0	17	35.5	57			9.1	-7.9	-26.4	-47.9			17	18.5	21.5	>14		GB		9/24/97	No groundwater data available.
285.GB22	6045120	2115680	-29	34.5	-33.5	4.5		0	4	18.5				-29	-33	-47.5				4	14.5	>16		GB		9/13/97	
285.GB23	6045400.1	2115503.9	9.8	83	4	5.8	0	22	31	55			9.8	-12.2	-21.2	-45.2			22	9	24	>28		GB		8/5/97	
285.GB24	6045471.8	2115444.4	9.9	104.5	6	3.9	0	7	24.5	56.5			9.9	2.9	-14.6	-46.6			7	17.5	32	>48		GB		8/7/97	
285.GB25	6046040	2115860	-24.8	44	-27.5	2.7		0	13	26				-24.8	-37.8	-50.8				13	13	>18		GB		9/12/97	
285.GB26	6046204.5	2115512.6	9.2	200.5	6	3.2	0	10	47	85	130		9.2	-0.8	-37.8	-75.8	-120.8		10	37	38	45	>70.5	GB		8/12/97	
285.GB27	6044910	2116850	-8.9	53.5	-12	3.1	0		10	42			-8.9		-18.9	-50.9			10		32	>11.5		GB		9/16/97	
285.GB28	6043176.3	2116562.7	12.2	90	9	3.2	0	9	27	65			12.2	3.2	-14.8	-52.8			9	18	38	>25		GB		8/14/97	
285.GB29	6043010	2116310	-27.3	37.5	-29	1.7		0	8	29				-27.3	-35.3	-56.3				8	21	>8.5		GB		9/17/97	
285.MW1C	6036337.0	2126080.3	10.9	315	8.5	2.4	0	28	36	57.5	124		10.9	-17.1	-25.1	-46.6	-113.1		28	8	21.5	66.5	>191	MW		7/22/97	
285.MW2C	6036970.4	2124294.0	13.1	231.5			0		25.5	68.5	134		13.1		-12.4	-55.4	-120.9		25.5		43	65.5	>97.5	MW		7/29/97	No groundwater data available.
285.MW3C	6029798.0	2120647.1	14.3	243.5	9	5.3	0		43	79.5	184		14.3		-28.7	-65.2	-169.7		43		36.5	104.5	>59.5	MW		8/13/97	
285.MW4C	6034296.1	2120879.1	12	223.5			0		23	82.5	156		12		-11	-70.5	-144		23		59.5	73.5	>67.5	MW		8/26/97	No groundwater data available.
285.MW5C	6037335.3	2120969.5	13.2	200.8			0	13	20	94	141		13.2	0.2	-6.8	-80.8	-127.8		13	7	74	47	>59.8	MW		8/11/97	No groundwater data available.

APPENDIX C

SITE RESPONSE ANALYSIS

Project No.
19542.000.001

January 14, 2022

Mr. James Connolly
COWI North America, Inc.
555 12th Street, Suite 1700
Oakland, CA 94607

Subject: WETA Alameda Main Street Ferry Refurbishment Project
Alameda, California

SITE-RESPONSE ANALYSIS

Dear Mr. Connolly:

This document summarizes our site-response analysis for the subject site located in Alameda, California. We performed the analysis using subsurface and geophysical data collected by us, as described in our geotechnical report dated January 14, 2022, and previous exploration data provided to us. We followed the guidance in the 2014 version of the American Society of Civil Engineers (ASCE) document titled "Seismic Design of Piers and Wharves," (ASCE/COPRI 61-14). ASCE 61-14 recommends that three scenarios be considered in the design: Design Earthquake (DE), Operating Level Earthquake (OLE), and Contingency Level Earthquake (CLE). As described in Section 3.1.1 of our geotechnical report, we classified the site as Site Class F, and as described in Section 2.5 of our geotechnical report, the site can be divided into two subsurface profiles – onshore and offshore. For a Site Class F condition, ASCE 61-14 requires that a site-specific ground response analysis be performed to develop the DE, OLE, and CLE spectra and ground motion parameters; ASCE 61-14 references the site-response analysis procedures outlined in the ASCE document titled "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," (ASCE/SEI 7-16).

Our analysis involved the following steps, which are described in further detail below.

- Developing the following response spectra for the base-of-profile:
  - Risk-Targeted, Maximum-Rotated Maximum Considered Earthquake (MCE_R) and DE.
  - OLE – 72-year return period event
  - CLE – 475-year return period event
- Selecting and scaling a suite of ground-motion time histories to be compatible with the base-of-profile spectra.
- Developing subsurface one-dimensional liquefiable and non-liquefiable soil profiles for use in the site-response analysis for both onshore and offshore subsurface conditions based on site data from our geotechnical exploration and from previous studies within the project vicinity.
- Propagating ground motions through ground models to obtain surface-to-base response spectral ratios (calculated period by period) under MCE_R, OLE, and CLE scenarios.

- Obtaining response spectra at the ground surface by multiplying the base motions by the average of the aforementioned ratios.
  - Note-1: We enveloped the results from Onshore, Offshore, liquefiable, and non-liquefiable profiles to obtain one surface spectrum for each scenario.
  - Note-2: The MCE_R and DE response spectra at the ground surface were compared with 80-percent of the code spectra per Chapter 21 of ASCE 7-16, and the maximum response was taken.

BASE-OF-PROFILE CONDITION AND SEISMIC HAZARD ANALYSIS

As described in Section 2.5 of the geotechnical report, we encountered a thick layer of soft Young Bay Mud (YBM) above dense and stiff San Antonio Formation onshore and offshore. Based on the shear wave velocity profiled measured in 1-sCPT02, we established the base-of-profile in our analysis model at the top of the San Antonio Formation, where the shear wave velocity is estimated to be significantly greater than that of the YBM; the YBM has a measured shear wave velocity low as 200 feet per second (ft/s) with in the San Antonio Formation we measured velocities greater than 800 ft/s. We established the base-of-profile condition with a V_{S30}[1] of 860 feet per second (ft/sec), as described below, which corresponds to a Site Class D condition. We completed the following steps to develop the response spectra for the base-of-profile condition:

- Performing probabilistic seismic-hazard analysis (PSHA) to develop:
  - Risk-targeted, maximum-rotated response spectra corresponding to a 2-percent probability of exceedance in 50 years (2,475-year return period) for the MCE_R scenario
  - Response spectrum corresponding to a 50-percent probability of exceedance in 50 years (72-year return period) for the OLE scenario
  - Response spectrum corresponding to a 10-percent probability of exceedance in 50 years (475-year return period) for the CLE scenario
- For the MCE_R and DE conditions only:
  - Performing deterministic seismic-hazard analysis (DSHA) to develop an 84th-percentile maximum-rotated response spectrum
  - Comparing the DSHA response spectrum with the Deterministic Lower Limit in accordance with Section 21.2.2 of ASCE 7-16 and Supplement No. 1
  - Comparing the risk-targeted and maximum-rotated probabilistic and the max-rotated deterministic response spectra to obtain the site-specific MCE_R response spectrum for the base-of-profile condition
  - Multiplying the site-specific MCE_R response spectrum by two-thirds to obtain the site-specific DE spectrum for the base-of-profile condition
  - Comparing the MCE_R and DE response spectra developed in the previous step with their corresponding 80-percent Site Class D mapped response spectra to develop the recommended site-specific MCE_R and DE response spectra at the base-of-profile

[1] Time-averaged shear wave velocity in the upper 30 meters (100 feet) of soil profile.

Ground Motion Models and Site Parameters

We used four semi-empirical ground motion models (GMMs) from the Next Generation Attenuation West 2 (NGA West 2) project in the seismic-hazard analysis for this project. These include Abrahamson et al. (2014), Boore et al. (2014), Campbell and Bozorgnia (2014), and Chiou and Youngs (2014). We performed our analysis using all four GMMs for a spectral damping of 5 percent of critical damping. We used the logic-tree approach and assigned equal weight (0.25) to the four GMMs in our analysis.

The ground-motion models incorporate "site parameters" to model how subsurface soil will amplify or attenuate ground motions as they propagate from deeper, underlying bedrock. These site parameters include:

- Time-averaged shear-wave velocity over the top 100 feet or 30 meters (V_{S30})
- Depth at which the shear-wave velocity (V_S) reaches 3,280 feet/sec or 1.0 kilometer/sec ($z_{1.0}$)
- Depth at which V_S reaches 8,200 feet/sec or 2.5 kilometers/sec ($z_{2.5}$)

The V_S measurements collected at 1-sCPT02 are relevant to the onshore condition, and terminate approximately 25 feet, or 7½ meters, into the San Antonio Formation. We used V_S correlations with mean effective stress to extend the profile to 30 meters into the San Antonio Formation for the onshore condition. For the offshore condition, we assumed the same V_S profile from 1-sCPT02 in the upper 7½ meters of the San Antonio Formation would apply; however, we adjusted the depth to the top of the layer to the estimated average depth to the San Antonio Formation based on previous offshore explorations. We then used the same V_S correlation with mean effective stress to extend the profile to 30 meters into the San Antonio Formation.

For the onshore condition, we estimated a V_{S30} value of 873 feet/sec (266 meters/sec). For the offshore condition, we estimated a V_{S30} value of 845 feet/sec (258 meters/sec). Based on our review of the onshore and offshore V_{S30} values, as well as the soil profiles above the San Antonio Formation, we decided that an "averaged" profile with an average value of 860 feet/sec (262 meters/sec) for V_{S30} would be appropriate for subsequent analyses.

This base-of-profile condition corresponds to Site Class D, per Chapter 20 of ASCE 7-16. We used the USGS Bay Area Velocity Model version 8.3.0 Basin Depth models as implemented in the USGS Site Data Application Software (OpenSHA) to estimate $z_{1.0}$ and $z_{2.5}$, and subtracted the depth to the base-of-profile. We used $z_{1.0}$ and $z_{2.5}$ values of 604 and 2,730 feet (184 and 832 meters) in our analysis, respectively.

Probabilistic Seismic-Hazard Analysis

Fault Database and Probabilistic Model

We performed a probabilistic seismic-hazard analysis (PSHA) for the project site for a return period of 2,475 years (MCE_R), 72 years (OLE), and 475 years (CLE). We utilized the Third California Earthquake Rupture Forecast model (UCERF3). This is the most up-to-date rupture forecast model for the state of California; use of the latest fault database is required by ASCE 7-16. We calculated the seismic hazard using the standard methodology for hazard analysis (McGuire, 2004). The seismic-hazard calculations can be represented by the following equation, which is an application of the total-probability theorem.

$$H(a) = \sum_i v_i \iint P[A > a|m,r]\, f_{Mi}(\mathrm{m})\, f_{Ri|Mi}(\mathrm{r},\mathrm{m}) drdm$$

In this equation, the hazard **H*(a)*** is the annual frequency of earthquakes that produce a ground motion amplitude ***A*** higher than ***a***. Amplitude ***A*** may represent peak ground acceleration, velocity, or it may represent spectral pseudo-acceleration (PSa) at a given frequency. The summation in the equation shown extends over all sources (i.e. over all faults and areas). In the above equation, v_i is the annual rate of earthquakes (with magnitude higher than some threshold M_i) in source ***i***, and f_{Mi} ***(m)*** and $f_{Ri|Mi}$ ***(r,m)*** are the probability density functions on magnitude and distance, respectively. ***P[A > a|m, r]*** is the probability that an earthquake of magnitude ***m*** at distance ***r*** produces a ground-motion amplitude ***A*** at the site that is greater than ***a***. Seismic sources may be either faults or area sources; the specification of source geometries and the calculation of $f_{Ri|Mi}$, are performed differently for these two types of sources.

Disaggregation of the Seismic Hazard: for Use in MCE_R Base-of-Profile Spectrum Formulation

We disaggregated the hazard associated with the 2,475-year return period (DE) seismic hazard at the peak ground acceleration, and at periods of 0.5, 1.0, and 2.0 seconds. These disaggregation results are presented in Appendix A. Since we did not perform a deterministic seismic-hazard analysis for formulation of the base-of-profile spectra for the OLE and CLE scenarios, we did not disaggregate the hazard associated with these scenarios.

We summarize the dominant scenarios and their relative contributions to the hazard at each period for the DE event in Table 1.

TABLE 1: Summary of Disaggregation Results for a 2,475-Year Return Period*

SOURCE	R_{RUP}		M_W	PERCENT CONTRIBUTION			
	(km)	(miles)		PGA	0.5s	1.0s	2.0s
Hayward (No) [1]	8.8	5.5	7.31	24.9	26.7	28.8	28.6
Hayward (No) [0]	8.7	5.4	7.32	21.8	23.6	25.7	25.9
San Andreas (Peninsula) [11]	22.1	13.8	7.97	12.6	16.9	19.0	24.3
Hayward (So) [7]	11.1	6.9	6.88	5.0	5.3	4.9	3.6
Hayward (No) [2]	9.8	6.1	7.08	3.3	3.5	3.4	3.0
Calaveras (No) [0]	22.5	14.0	7.37	2.4	3.0	2.5	2.1
San Gregorio (North) [4]	27.8	17.3	7.79	< 1.0	2.4	2.5	2.9
Hayward (So) [6]	16.0	10.0	6.78	< 1.0	2.1	< 1.0	< 1.0

*Based on USGS Unified Hazard Tool: Dynamic Conterminous U.S. 2014 (update) (v4.2.0)

These results represent sources contributing at least one percent to the seismic hazard at the site for the spectral periods considered and for the given return period. Gridded or areal sources are not presented. The assigned moment magnitudes (M_W) are based on values assigned according to UCERF 3, and the numbers in square brackets after the fault names correspond to fault subsections assigned by UCERF 3.

Deterministic Seismic-Hazard Analysis for Use in MCE_R Base-of-Profile Spectrum Formulation

The deterministic seismic-hazard analysis (DSHA) involves developing the 84th percentile (i.e., lognormal mean plus one standard deviation) maximum-rotated response spectrum for a spectral damping of 5 percent of critical damping considering characteristic magnitudes of significant faults, without background seismicity, and the aforementioned ground-motion models. However, it is important to note that the definition of the characteristic magnitude is ambiguous when using the UCERF3 model due to its complexity. Based on our communications with developers of UCERF3 and the 2020 NEHRP Provisions, in deterministic analyses, “scenario” earthquakes with significant contribution to hazard should be used in lieu of “characteristic” earthquakes when using UCERF3. We identified the scenario earthquakes by considering the results of the disaggregation. Accordingly, we considered the scenarios in Table 1, as described below.

We considered the magnitudes in Table 1 and associated distances (R_{RUP}, R_{JB}, R_X) to calculate the deterministic spectrum. We estimated additional ground motion model parameters (e.g., rupture width, depth to top of rupture, etc.) for each fault/scenario based on fault-specific information published on the United States Geologic Survey (USGS) website. Our analyses, along with considering the percent contribution to the hazard, indicate controlling events on the Hayward Fault with a moment magnitude (M_W) of 7.32 within 5.4 miles (8.7 kilometers) of the site, at periods smaller or equal to 6 seconds, and on the San Andreas Fault with a M_W of 7.97 within 13.8 miles (22.1 kilometers) of the site, at periods longer than 6 seconds.

Resulting Base-of-Profile Response Spectrum

MCER and DE Spectra

Following the steps described above, we developed probabilistic and deterministic median-component (RotD50) response spectra. To convert the RotD50 response spectra to maximum-rotated response spectra, we applied the maximum rotation factors discussed in Shahi and Baker (2014). We also applied the mapped risk factors defined in Section 21.2.1.1 of ASCE 7-16 to the probabilistic response spectrum in order to develop a risk-targeted spectrum. We then compared the maximum-rotated deterministic response spectrum with the lower limit deterministic response spectrum defined in Section 21.2.2 of ASCE 7-16 and Supplement No. 1 to finalize the deterministic spectrum.

According to Section 21.2.3 of ASCE 7-16, the MCE_R is controlled by the lesser of the maximum-rotated and risk-targeted probabilistic and the 84th percentile maximum-rotated deterministic response spectra. At this site, the spectral accelerations associated with the deterministic response spectrum are less than the probabilistic response spectrum. Additionally, the MCE_R and DE are not permitted to be lower than 80 percent of the mapped MCE_R and DE spectra (i.e., the code minimum), respectively. Exhibit 1 presents the development of the max-rotated 84th percentile deterministic and risk-targeted and max-rotated probabilistic response spectra. Exhibits 2 and 3 depict the recommended site-specific MCE_R and DE spectra for the base-of-profile condition at project site, respectively.

EXHIBIT 1: (a) Deterministic and (b) Probabilistic Seismic-Hazard Analysis Results

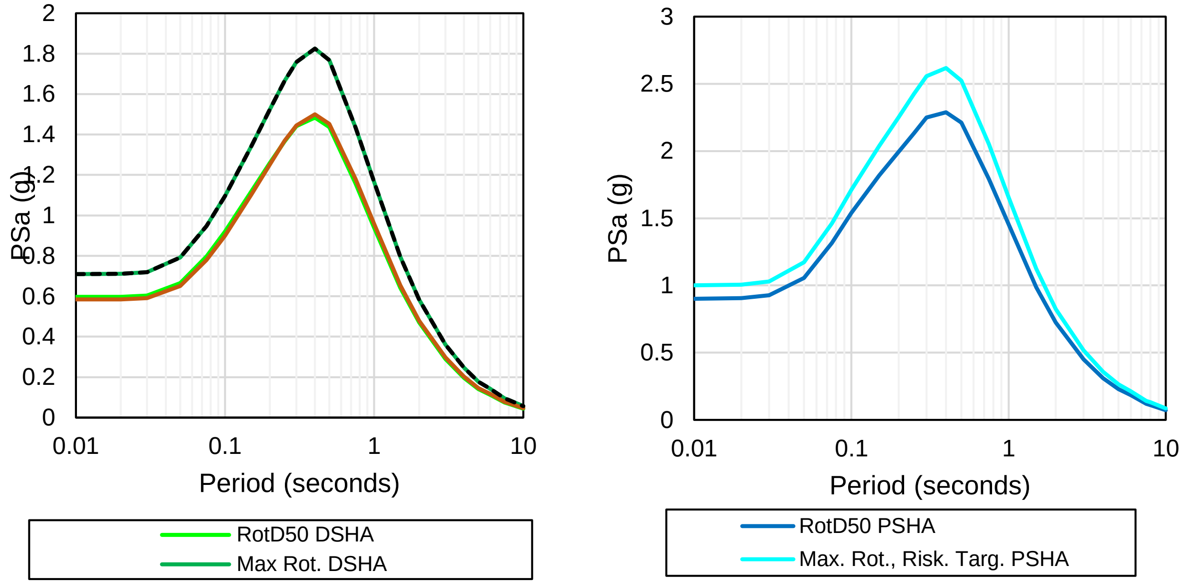


EXHIBIT 2: Site-Specific MCE$_R$ Response Spectra at the Base-of-Profile Condition

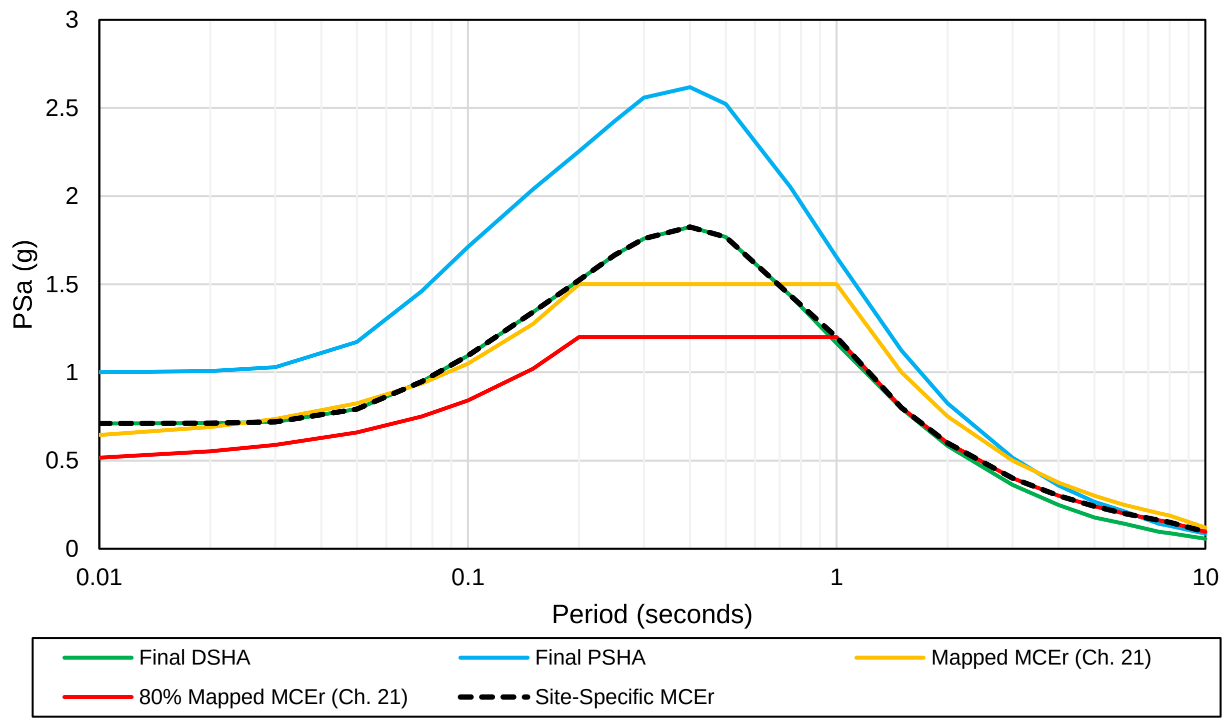
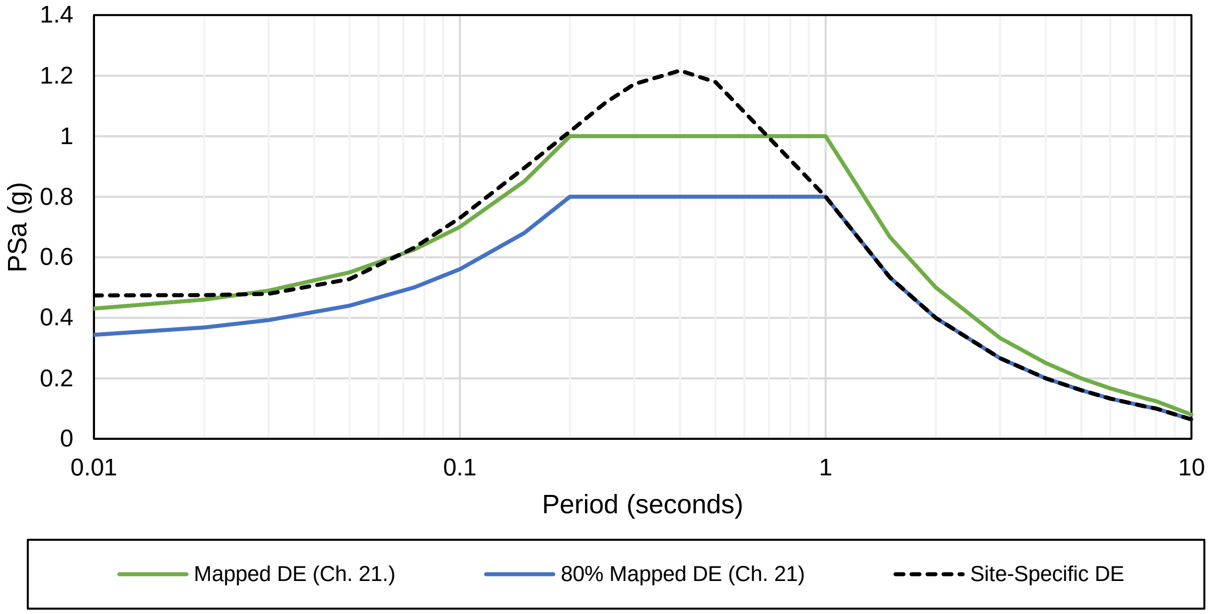


EXHIBIT 3: Site-Specific DE Response Spectra at the Base-of-Profile Condition



OLE and CLE Spectra

We developed RotD50 (average component) response spectra corresponding to a 50 percent probability of exceedance in 50 years (72-year return period) for the OLE response spectra, and corresponding to a 10 percent probability of exceedance in 50 years (475-year return period) for the CLE response spectra. ASCE 61 does not require these response spectra to be rotated for the maximum direction.

Exhibits 4 and 5 present the recommended site-specific OLE and CLE response spectra for the base-of-profile condition at project site.

EXHIBIT 4: Site-Specific OLE Response Spectra at the Base-of-Profile Condition

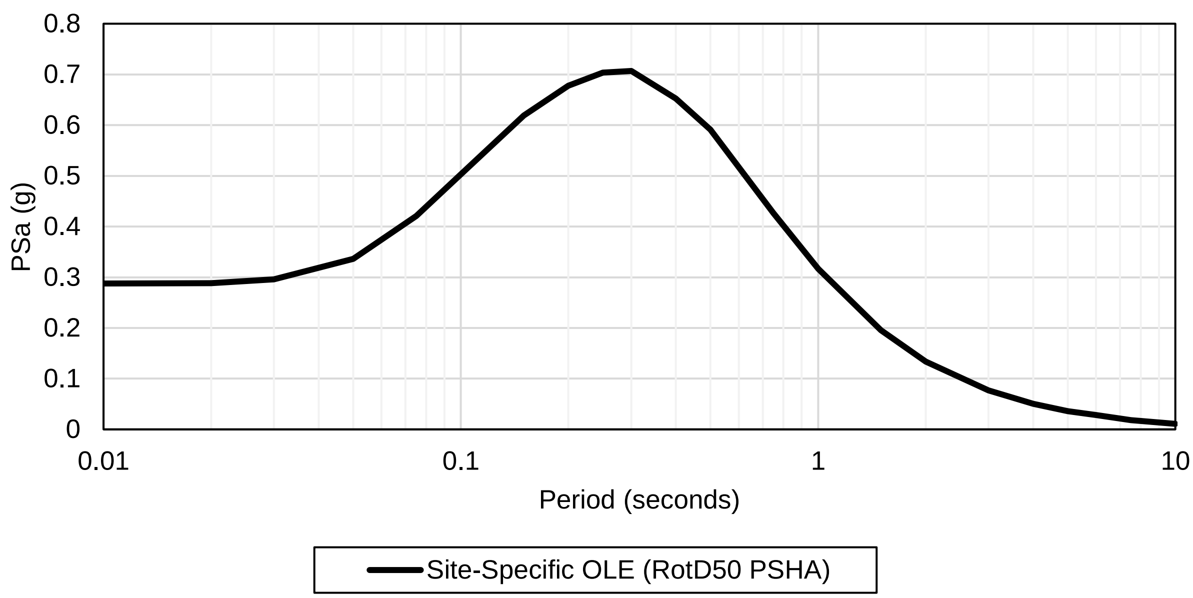
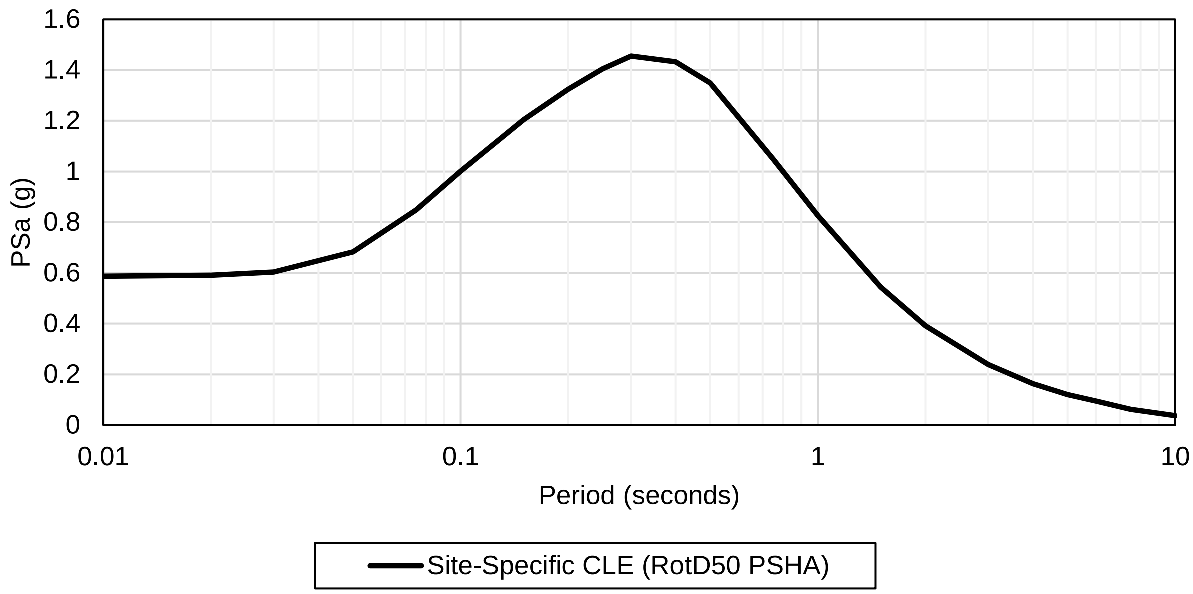


EXHIBIT 5: Site-Specific CLE Response Spectra at the Base-of-Profile Condition



HORIZONTAL GROUND-MOTION SELECTION AND SCALING

We selected and scaled a suite of ground-motion time histories consisting of 11 pairs of horizontal, orthogonal acceleration records for use in our site-response analysis from the NGA West 2 database (Ancheta et al., 2014). We scaled the selected ground-motions to the base-of-profile, site-specific MCE_R, DE, OLE, and CLE target spectra shown in Exhibits 2 through 5. We selected spectral scaling rather than spectral matching as scaling more closely preserves the critical features of the ground-motions. In order to guide our ground-motion selection, we considered disaggregation of the seismic hazard for return periods of 2,475 years, 475 years, and 72 years, corresponding to the MCE_R, CLE, and OLE target response spectra, respectively. We considered the dominant magnitudes, source distances, and fault mechanisms. We also developed criteria for significant duration, $D_{5\text{-}95}$, based on the Kempton and Stewart (2006) model, and Arias Intensity, I_A, based on the Abrahamson et al. (2016) model. Tables 2 through 4 provide summaries of the selected ground motion suites.

We selected two to five ground motions with a velocity pulse based on the criteria in Hayden et al. (2014) and Shahi and Baker (2011). We selected pulse-like ground motions with pulse periods ranging from 0.9 to 10.4 seconds, with an average pulse period of 4.2 seconds.

Per Section 21.1.1 of ASCE 7-16, we spectrally scaled the ground motions such that the average response spectrum is in agreement with the base target response spectra. Specifically, we scaled the GMs such that the average median-component (RotD50) response spectrum of all ground motions is in satisfactory agreement with the target spectrum. We limited the scale factors to be less than 3.5. We also applied a scaled factor of 2/3 to the MCE_R ground motions to develop a suite based on target DE response spectrum. Table 2 through 4 present the ground motions characteristics and Exhibits 6 through 8 show the RotD50 response spectra for each ground motion, along with the mean and base target response spectra.

TABLE 2: Ground Motions and Scale Factors Used in the Site-response Analysis (MCE_R Target Response Spectrum)

EARTHQUAKE	RSN	PULSE PERIOD (sec)	M_W	R_{RUP} (km)	FAULT TYPE	V_{S30} (m/s)	D_{5-95} (sec)	Scaled Ia (m/s)	SCALE FACTOR
Imperial Valley-06	179	4.8	6.53	7.1	Strike Slip	209	10.3	9.5	2.60
Superstition Hills-02	723	2.4	6.54	1.0	Strike Slip	349	11.0	13.4	1.90
Loma Prieta	776	-	6.93	27.9	Reverse Oblique	282	28.8	16.0	2.70
Loma Prieta	803	5.6	6.93	9.3	Reverse Oblique	348	11.1	10.9	2.90
Northridge-01	1045	3.0	6.69	5.5	Reverse	286	8.8	6.0	2.00
Kobe_Japan	1101	-	6.90	11.3	Strike Slip	256	19.4	10.6	2.30
Kocaeli_Turkey	1176	4.9	7.51	4.8	Strike Slip	297	15.1	7.5	2.40
Chi-Chi_Taiwan	1203	-	7.62	16.0	Reverse Oblique	233	32.8	13.9	2.70
Iwate_Japan	5814	-	6.90	31.1	Reverse	248	48.3	14.4	2.50
El Mayor-Cucapah_ Mexico	5823	-	7.20	19.5	Strike Slip	242	51.2	24.3	3.25
Darfield_New Zealand	6923	-	7.00	30.5	Strike Slip	255	20.1	10.0	2.50

EXHIBIT 6: RotD50 Response Spectra of the Ground Motions Used in Site-response Analysis (MCE_R Target Response Spectrum)

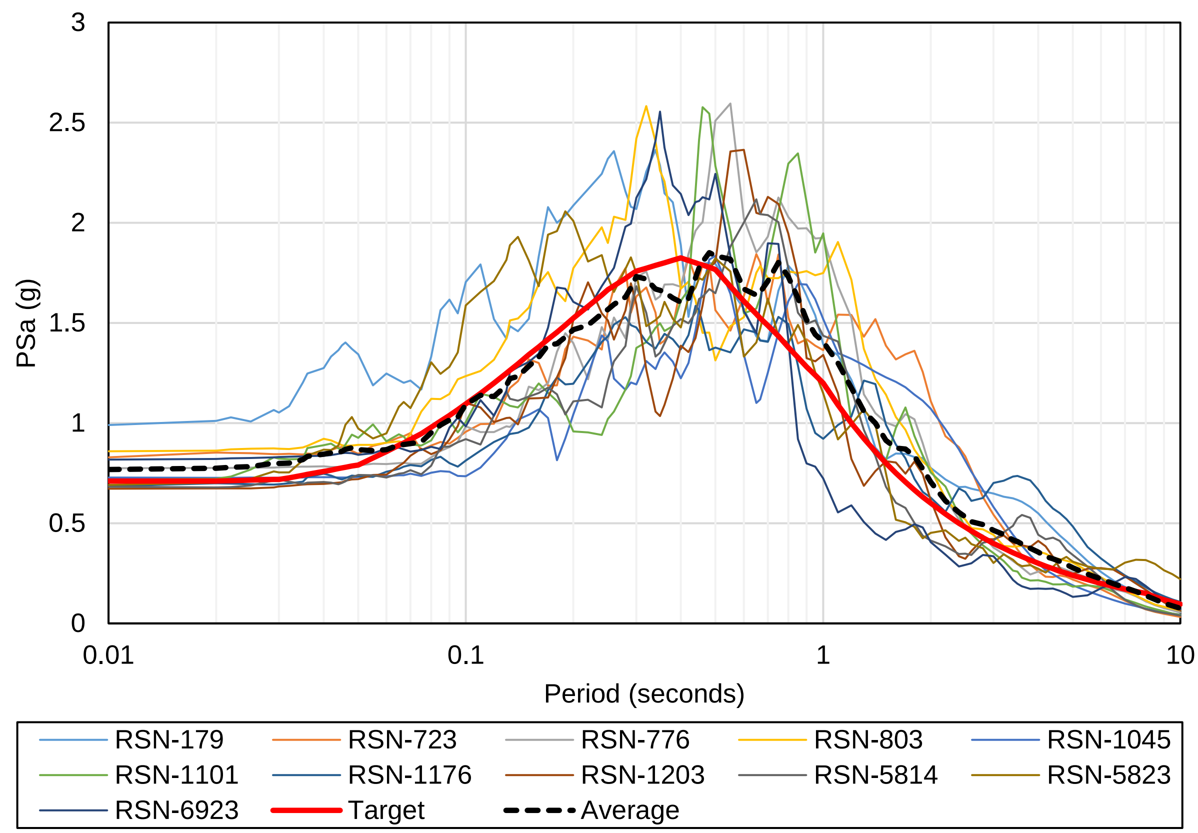


TABLE 3: Ground Motions and Scale Factors Used in the Site-response Analysis (CLE Target Response Spectrum)

EARTHQUAKE	RSN	PULSE PERIOD (sec)	M_W	R_{RUP} (km)	FAULT TYPE	V_{S30} (m/s)	D_{5-95} (sec)	Scaled Ia (m/s)	SCALE FACTOR
Imperial Valley-02	6	-	6.95	6.1	Strike Slip	213	24.2	12.1	2.75
Loma Prieta	778	-	6.93	24.8	Reverse Oblique	216	13.3	5.5	2.35
Loma Prieta	803	5.6	6.93	9.3	Reverse Oblique	348	11.1	5.7	2.10
Landers	900	7.5	7.28	23.6	Strike Slip	354	18.9	6.8	2.75
Chi-Chi_Taiwan	1491	10.4	7.62	7.6	Reverse Oblique	350	28.9	9.4	2.80
Cape Mendocino	3749	-	7.01	20.4	Reverse	355	15.0	3.3	1.60
Montenegro_ Yugoslavia	4458	2.0	7.10	5.8	Reverse	319	26.0	9.1	2.25
Chuetsu-oki_Japan	4860	-	6.80	23.2	Reverse	278	23.2	7.2	1.90
El Mayor-Cucapah_Mexico	5827	-	7.20	15.9	Strike Slip	242	34.5	9.5	1.25
Darfield_New Zealand	6890	-	7.00	17.6	Strike Slip	204	20.0	6.9	2.50
Duzce_Turkey	1602	0.9	7.14	12.0	Strike Slip	294	9.0	2.4	0.80

EXHIBIT 7: RotD50 Response Spectra of the Ground Motions Used in Site-response Analysis (CLE Target Response Spectrum)

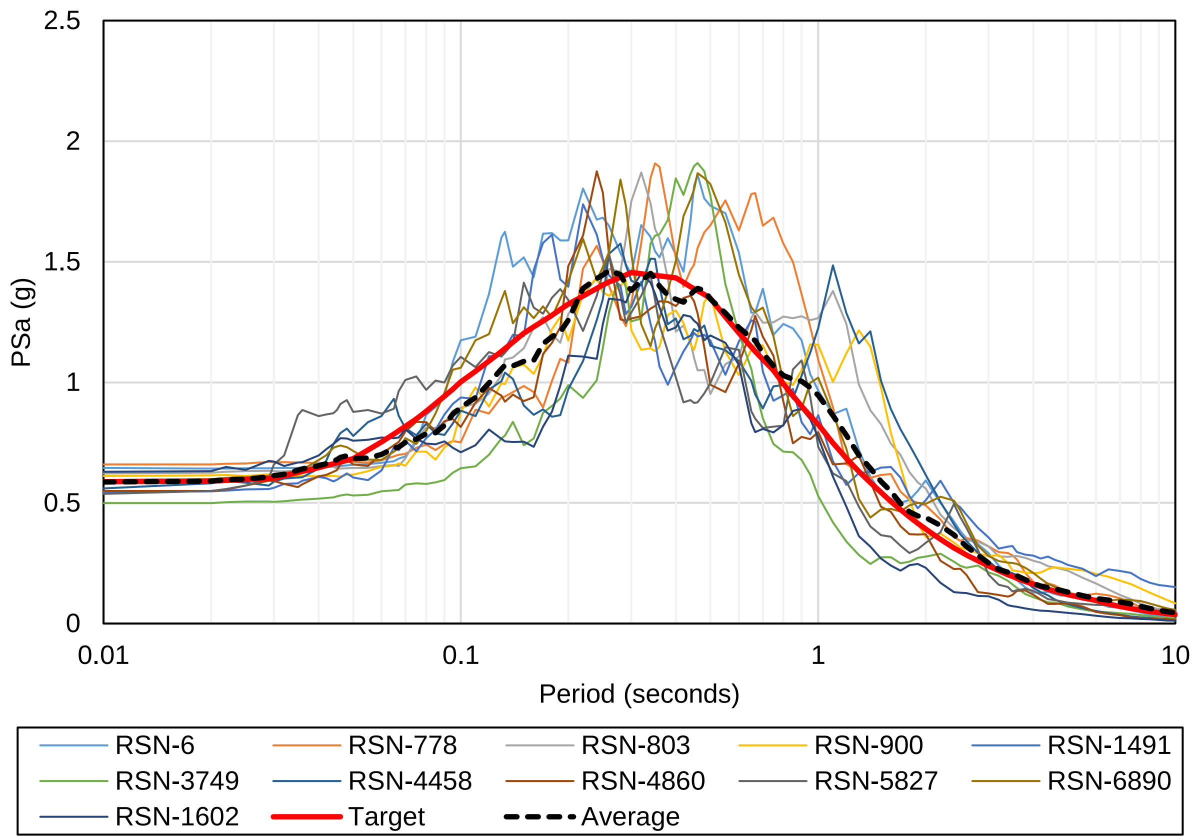
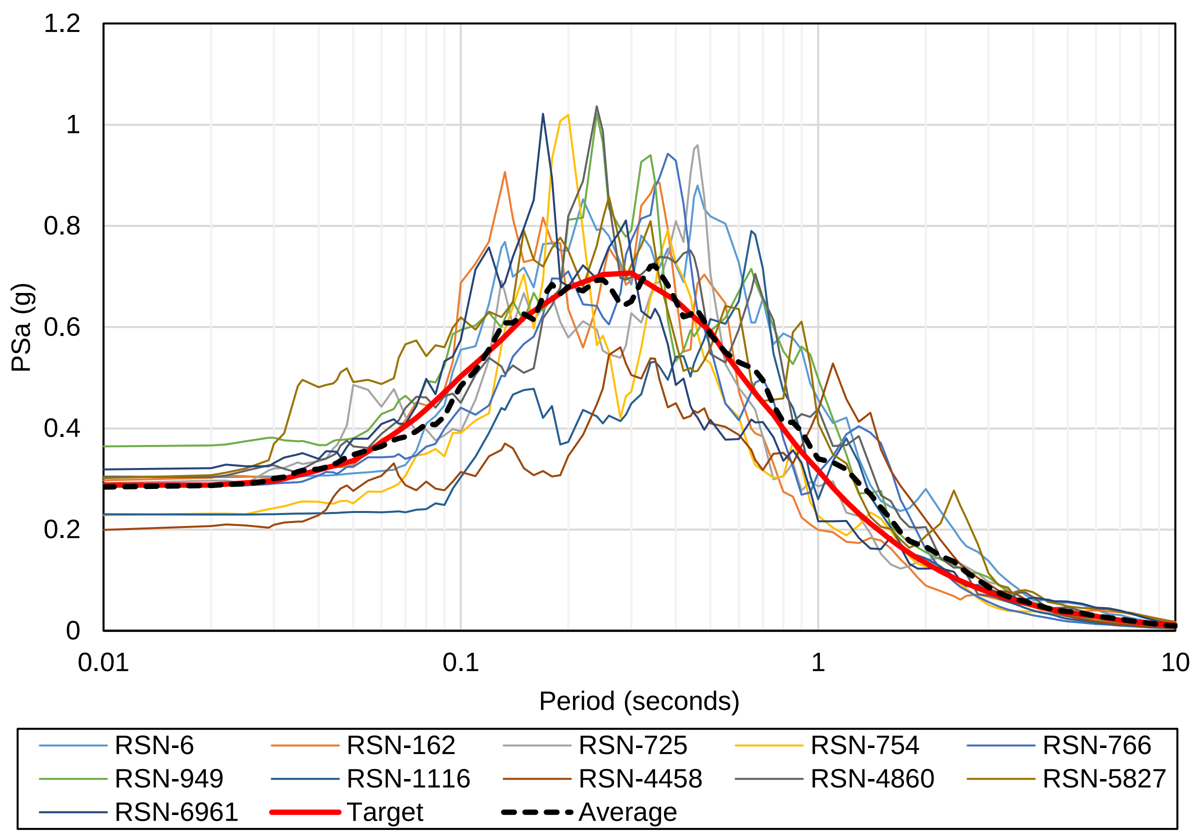


TABLE 4: Ground Motions and Scale Factors Used in the Site-response Analysis (OLE Target Response Spectrum)

EARTHQUAKE	RSN	PULSE PERIOD (sec)	M_W	R_{RUP} (km)	FAULT TYPE	V_{S30} (m/s)	$D_{5\text{-}95}$ (sec)	Scaled Ia (m/s)	SCALE FACTOR
Imperial Valley-02	6	-	6.95	6.1	Strike Slip	213	24.2	2.7	1.30
Imperial Valley-06	162	-	6.53	10.5	Strike Slip	231	14.8	1.4	1.25
Superstition Hills-02	725	-	6.54	11.2	Strike Slip	317	13.7	1.5	0.85
Loma Prieta	754	-	6.93	20.8	Reverse Oblique	295	13.4	1.0	1.40
Loma Prieta	766	1.7	6.93	11.1	Reverse Oblique	271	11.0	0.8	0.80
Northridge-01	949	-	6.69	8.7	Reverse	298	13.5	1.8	1.10
Kobe_Japan	1116	-	6.90	19.2	Strike Slip	256	11.6	0.8	1.00
Montenegro_Yugoslavia	4458	2.0	7.10	5.8	Reverse	319	26.0	1.2	0.80
Chuetsu-oki_Japan	4860	-	6.80	23.2	Reverse	278	23.2	2.2	1.05
El Mayor-Cucapah_Mexico	5827	-	7.20	15.9	Strike Slip	242	34.5	3.0	0.70
Darfield_New Zealand	6961	-	7.00	16.5	Strike Slip	296	20.3	1.7	1.85

EXHIBIT 8: RotD50 Response Spectra of the Ground Motions Used in Site-response Analysis (OLE Target Response Spectrum)



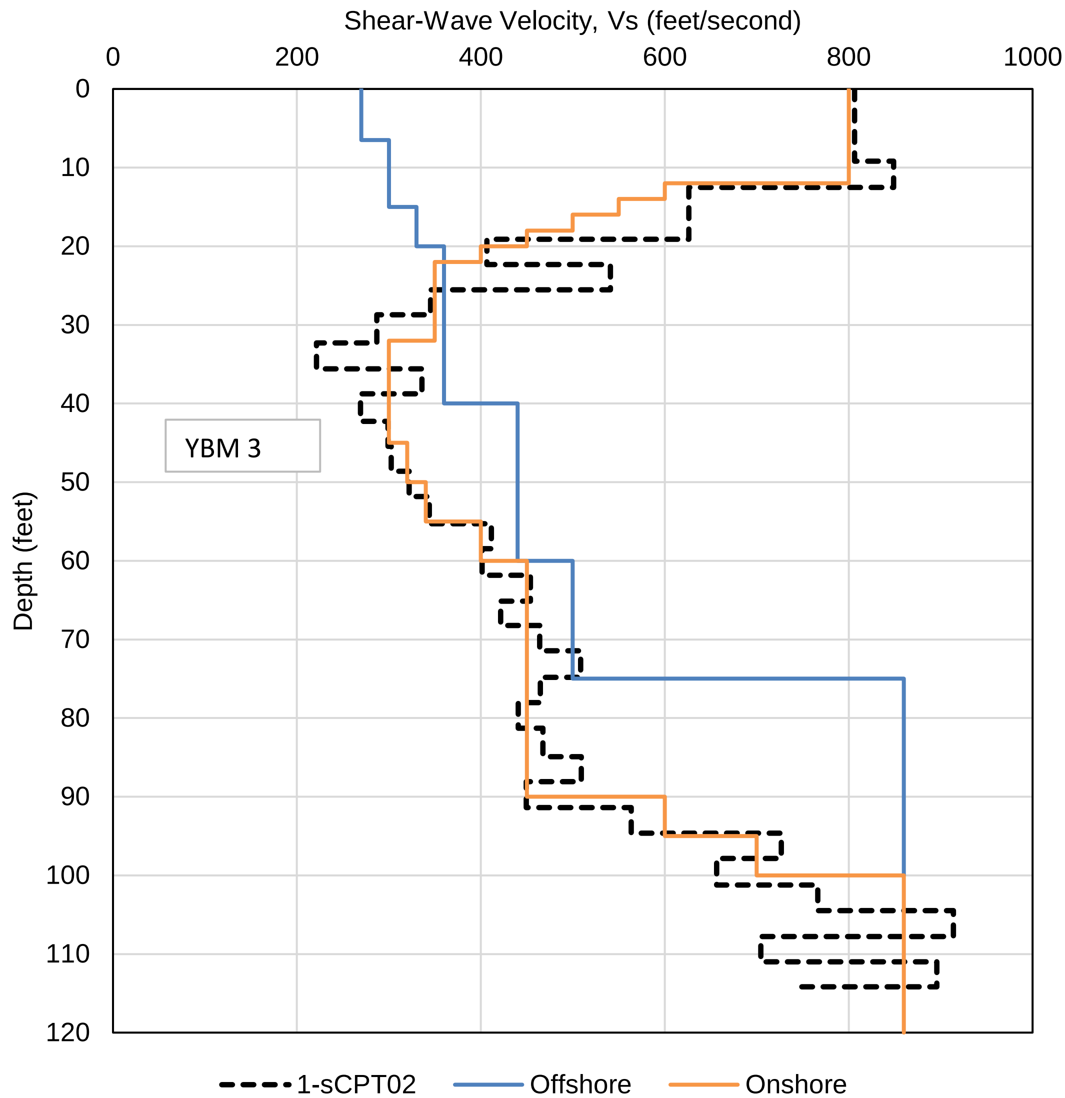
SITE-RESPONSE ANALYSIS

In order to perform a site-response analysis, a model of the soil profile is required. Each soil layer in the model is defined by a thickness, shear-wave velocity (V_S), and unit weight (γ). Additionally, nonlinear modulus reduction (G/G_{max}) and damping ratio (D) curves are required for each layer. This section describes how we developed the site-response models and the analysis procedures.

V_s Profile Development

To perform a site-response analysis, a profile of the shear-wave velocity (V_S) as a function of depth is required. As described earlier in this report, we developed two idealized V_S profiles for onshore and offshore subsurface conditions. We present this idealized profile in Exhibit 9.

EXHIBIT 9: Idealized V_S Profile Considered in Site-response Analysis



Modulus Reduction and Damping Curves

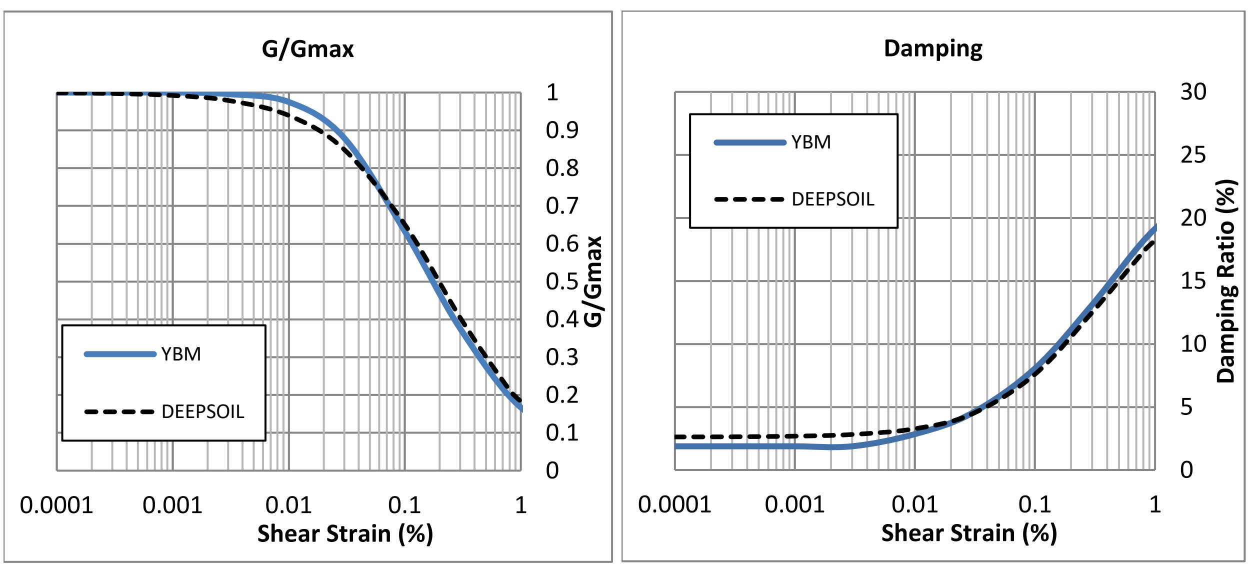
Nonlinear modulus reduction (G/G_{max}) and damping (D) curves are required for each soil layer considered in the site-response analysis. For the fill material in the onshore profile, we assigned G/G_{max} and D curves based on the confining pressure and material-dependent relationships provided in Darendeli (2001). We estimated the parameters for the Darendeli (2001) model from the available CPT, borings, and laboratory data.

At large strains (greater than approximately 0.5 percent), the G/G_{max} curves from empirical relationships are unbounded by laboratory measurements and can imply unrealistic shear strengths. Thus, when large strains are expected in the site-response analysis, it is necessary to adjust the large-strain portions of the G/G_{max} curves to account for the soil shear strength. Accordingly, we adjusted the high-strain G/G_{max} values in all layers to reflect the estimated shear strength of the soil. We estimated shear strengths based on CPT and boring data.

We estimated the undrained shear strength (S_u) for cohesive soil using CPT correlations based on tip resistance. For granular soil, we used a friction angle of 32 degrees based on the available blow count data. We converted the friction angle to shear strength by taking the tangent and multiplying by the vertical effective stress.

For YBM, we used the G/G_{max} and damping curves that were specifically developed for this type of material and are used widely in the Bay Area projects. These curves are shown below in Exhibit 6.

EXHIBIT 10: Modulus Reduction (G/Gmax) and Damping Curves for YBM and the DEEPSOIL fit



Analysis Procedures

We used the General Quadratic/Hyperbolic (GQ/H) constitutive model, as implemented in DEEPSOIL v7.1 (Groholski et al. 2016; Hashash et al. 2017), to perform non-linear (NL) site-response analyses. Note that NL analyses are performed in the time domain and solve for the dynamic response of multi-degree-of-freedom systems subject to base excitation (Kim et al., 2016).

Thus, the NL analyses did not directly use the G/G_{max} and damping curves above. Rather, the constitutive model parameters are calibrated such that the nonlinear behavior implied by the G/G_{max} and damping curves is captured.

We performed two analyses for the onshore profile. We performed a site-response analysis that assumes no liquefaction occurs ("non-liquefied analysis") and an analysis, which accounts for the generation of excess pore pressures and liquefaction in the fill material ("liquefied analysis"). We considered both cases because it is uncertain whether the fill will liquefy during intense ground shaking. For the offshore profile, we only performed the non-liquefied analysis since there was no fill present in this profile.

We performed the non-liquefied analysis at the DE level with ground motions scaled to the DE target response spectrum. In order to perform this analysis, we scaled the MCE_R-level ground motions by a factor of 2/3 and propagated them through the profile. We used the amplification factors from the analysis to calculate a DE response spectrum at the surface, and then multiplied by a factor of 1.5 to develop a non-liquefied surface MCE_R response spectrum.

We performed the liquefied analysis using MCE_R-level ground motions, because these ground motions are more likely to induce high excess pore pressures and liquefaction. Our liquefied analysis used the pore water pressure generation and dissipation model based on Sand-Vucetic-Dobry (Vucetic and Dobry, 1988; Matasovic and Vucetic, 1995) as described in the DEEPSOIL v7.1 manual. This set of analyses comprises effective stress analyses with generation and dissipation of pore water pressure. We selected the associated parameters based on subsurface data from Harding Lawson Associates (1984) and Gregg Drilling (2021), shear wave velocity profile presented in Exhibit 9, and suggested values in the DEEPSOIL v7.1 manual.

We also performed both analyses for the CLE and OLE spectra using the associate scaled ground motions.

Results

We calculated amplification factors (AF) for the profile and each ground motion and we present them in Appendix B.

We calculated the surface response spectrum for each ground motion by applying the period-dependent amplification factors to the appropriate base-of-profile response spectrum (DE-level or MCE_R-level).

SURFACE MCE_R AND DE RESPONSE SPECTRA

We used the Site AF values in Exhibits 11 and 12 to develop MCE_R response spectra for the non-liquefied and liquefiable conditions, as shown in Exhibit 15. Note that since we performed the non-liquefied analysis on DE-level ground motions, we multiplied the mean surface response spectrum by a factor of 1.5 to obtain an MCE_R-level response spectrum.

Based on the measured shear-wave velocity, the time-averaged shear wave velocity in the upper 30 meters (V_{S30}) of the project site is 128 meters per second (420 feet per second). Per Section 20.3.3 and Table 20.3-1 of ASCE 7-16, the project site is a Site Class E in the absence of liquefaction. Therefore, we developed the 80 percent of mapped spectrum, accordingly. We also used F_a of 1 and F_v of 4 to develop the mapped spectra. We show the mapped MCE_R response spectrum for Site Class E (defined in Chapters 11 and 21 of ASCE 7-16) and 80 percent of this mapped spectrum (i.e., the code minimum) in Exhibit 11. In order to develop the recommended surface MCE_R for the site, we compared the code minimum to the surface response spectra from our site-response analyses and enveloped the results. The final site-specific surface MCE_R response spectrum is shown in Exhibit 11 and tabulated in Table 5. In addition, the DE response spectrum (2/3 of the MCE_R response spectrum) is provided in Table 5 and shown in Exhibit 12. Table 6 summarizes the site-specific design acceleration parameters per Section 21.4 and 21.5 of ASCE 7-16.

EXHIBIT 11: Recommended surface MCE_R response spectrum

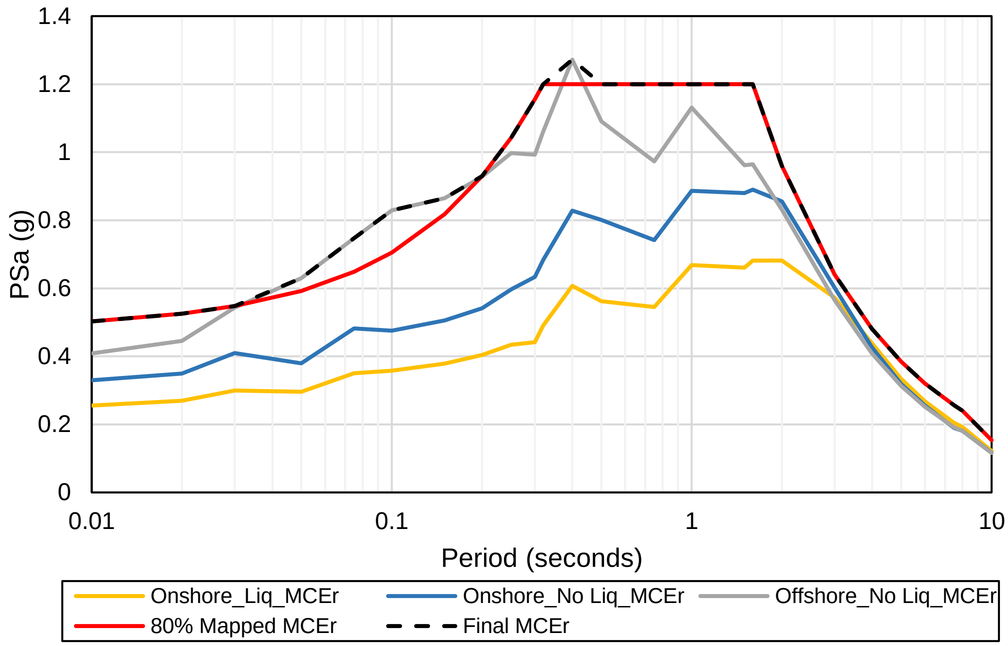


EXHIBIT 12: Recommended surface DE response spectrum

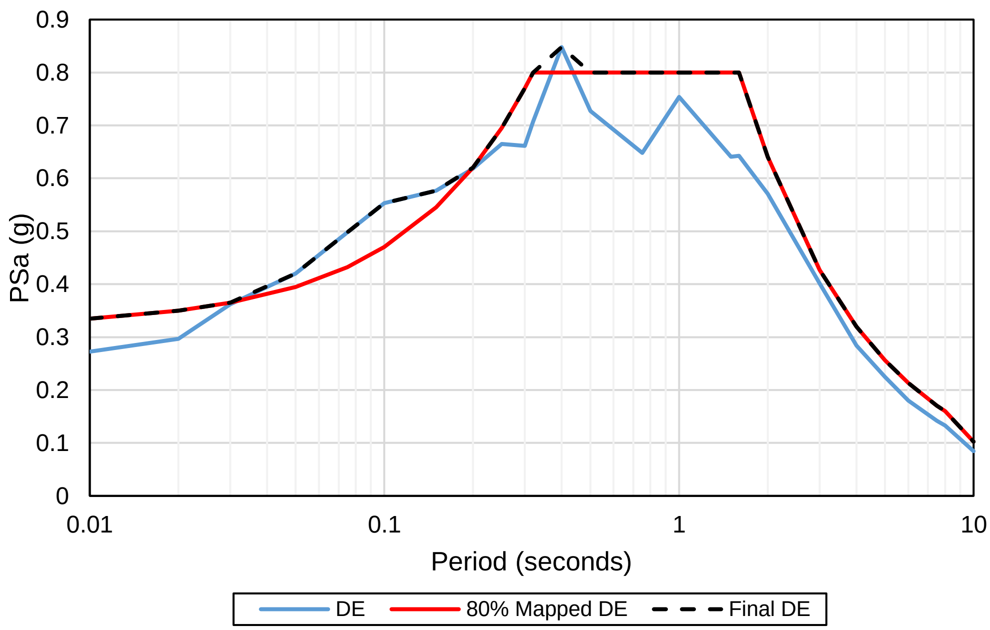


TABLE 5: Recommended Surface MCE_R and DE Response Spectra

PERIOD (seconds)	RECOMMENDED SPECTRAL ACCELERATION (g)	
	MCE_R	DE
0.01	0.50	0.34
0.02	0.53	0.35
0.03	0.55	0.37
0.05	0.63	0.42
0.075	0.75	0.50
0.1	0.83	0.55
0.15	0.86	0.58
0.2	0.93	0.62
0.25	1.04	0.70
0.3	1.16	0.77
0.32	1.20	0.80
0.4	1.27	0.85
0.5	1.20	0.80
0.75	1.20	0.80
1	1.20	0.80
1.5	1.20	0.80
1.6	1.20	0.80
2	0.96	0.64
3	0.64	0.43
4	0.48	0.32
5	0.38	0.26
6	0.32	0.21
7.5	0.26	0.17
8	0.24	0.16
10	0.15	0.10

TABLE 6: Design Acceleration Parameters based on ASCE 7-16 Section 21.4 and 21.5

ACCELERATION PARAMETER	VALUE (g)
Mapped MCE_R Spectral Response Acceleration at Short Periods, S_S	1.5
Mapped MCE_R Spectral Response Acceleration at 1-second Period, S_1	0.6
MCE_R Spectral Response Acceleration at Short Periods, S_{MS}	1.2
MCE_R Spectral Response Acceleration at 1-second Period, S_{M1}	1.92
Design Spectral Response Acceleration at Short Periods, S_{DS}	0.8
Design Spectral Response Acceleration at 1-second Period, S_{D1}	1.28
Site-Specific Peak Ground Acceleration, PGA_M	0.55

SURFACE OLE AND CLE RESPONSE SPECTRA

We used the Site AF values in Exhibits 13 and 14 to develop OLE and CLE response spectra for the non-liquefied and liquefiable conditions, as shown in Exhibits 13 and 14. Per ASCE 61-14, there is no code minimum associated with the CLE and the OLE. The spectral values for the OLE and CLE response spectra are presented in Table 7.

EXHIBIT 13: Recommended surface OLE response spectrum

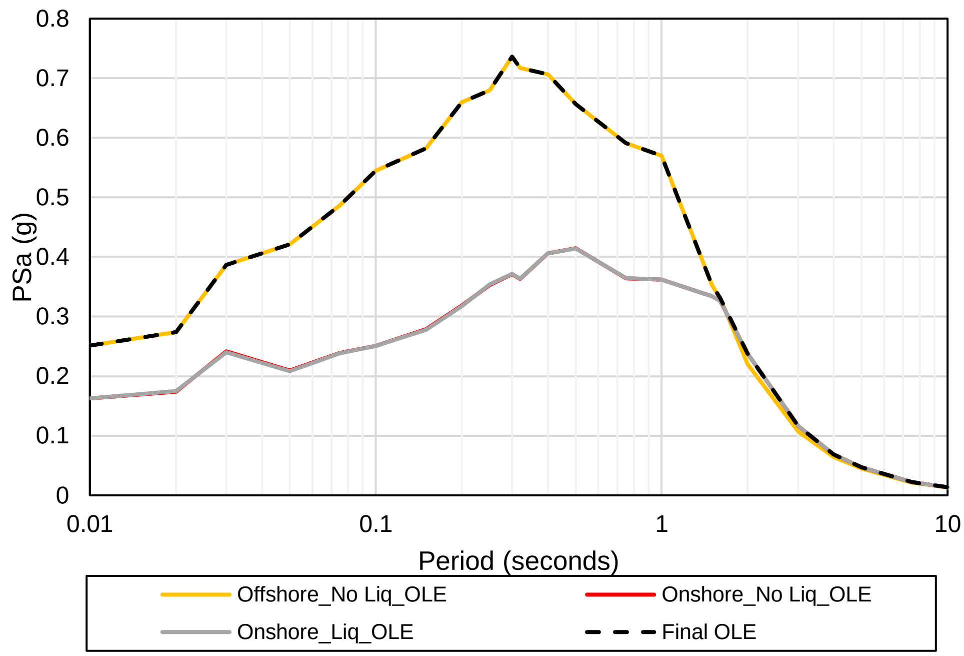


EXHIBIT 14: Recommended surface CLE response spectrum

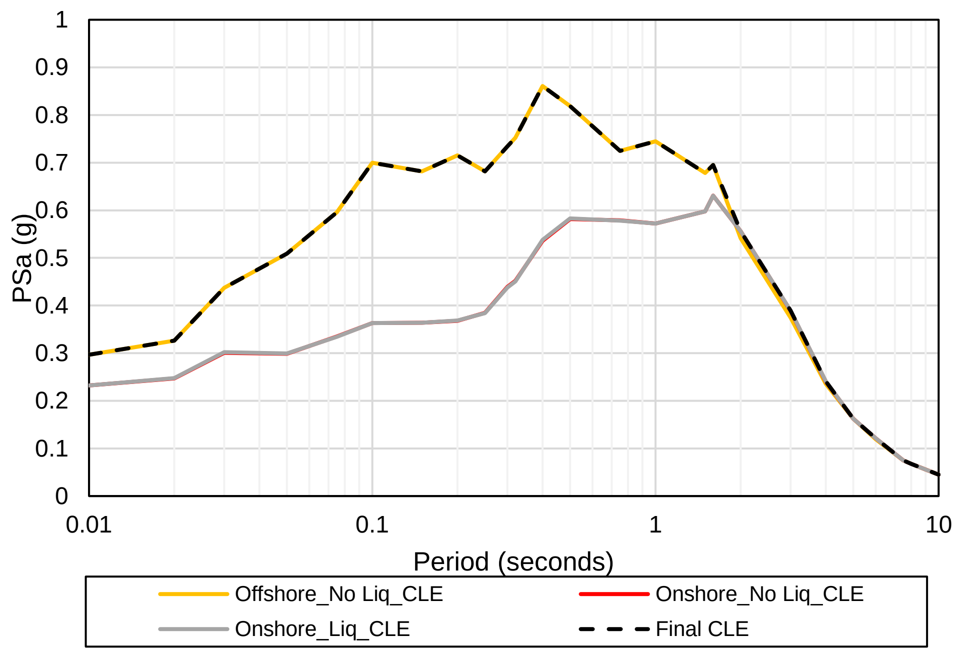


TABLE 7: Recommended Surface OLE and CLE Response Spectra

PERIOD (seconds)	RECOMMENDED SPECTRAL ACCELERATION (g)	
	OLE	CLE
0.01	0.25	0.30
0.02	0.27	0.33
0.03	0.39	0.44
0.05	0.42	0.51
0.075	0.49	0.60
0.1	0.54	0.70
0.15	0.58	0.68
0.2	0.66	0.72
0.25	0.68	0.68
0.3	0.74	0.73
0.32	0.72	0.75
0.4	0.71	0.86
0.5	0.66	0.82
0.75	0.59	0.72
1	0.57	0.74
1.5	0.35	0.68
1.6	0.33	0.70
2	0.24	0.56
3	0.12	0.39
4	0.07	0.24
5	0.05	0.16
6	0.04	0.12
7.5	0.02	0.07
8	0.02	0.07
10	0.01	0.05

The similarities between the total and effective stress analyses at the OLE and CLE level are due to negligible excess pore pressure generation at these ground-motion intensities. Conversely, there is significant excess pore pressure generation at the MCE_R level, which is demonstrated by the differences between the total and effective stress analyses.

If you have any questions or comments regarding this letter, please contact us and we will be glad to discuss them with you.

Sincerely,

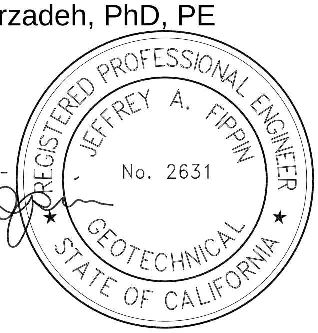
ENGEO Incorporated

Teresa Klotzback, PE

Bahareh Heidarzadeh, PhD, PE

Chris Nicas, PE

Jeff Fippin, GE



tk/bh/ch/jaf/dt

Attachments: References
Appendix A – Disaggregation Results
Appendix B – Amplification Ratios and Surface Response Spectra

SELECT REFERENCES

1. American Society of Civil Engineers. (2014). Seismic Design of Piers and Wharves (ASCE/COPRI 61-14).
2. American Society of Civil Engineers. (2016). Minimum Design Loads for Buildings and other Structures (ASCE/SEI 7-16), Reston, VA: American Society of Civil Engineers.
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4. Darendeli, M.B. (2001). "Development of A New Family of Normalized Modulus Reduction and Material Damping Curves." Ph.D. Dissertation, School of Civil, Architectural and Environmental Engineering, The University of Texas at Austin, Austin, TX.
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12. Shahi, S. K., & Baker, J. W. (2011). An empirically calibrated framework for including the effects of near-fault directivity in probabilistic seismic hazard analysis. Bulletin of the Seismological Society of America, 101(2), 742-755.
13. Vucetic, M., & Dobry, R. (1988). Degradation of marine clays under cyclic loading. Journal of Geotechnical Engineering, 114(2), 133-149.

APPENDIX A

Disaggregation Results

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Latitude

Decimal degrees

37.79105

Longitude

Decimal degrees, negative values for western longitudes

-122.294051

Site Class

259 m/s (Site class D)

Spectral Period

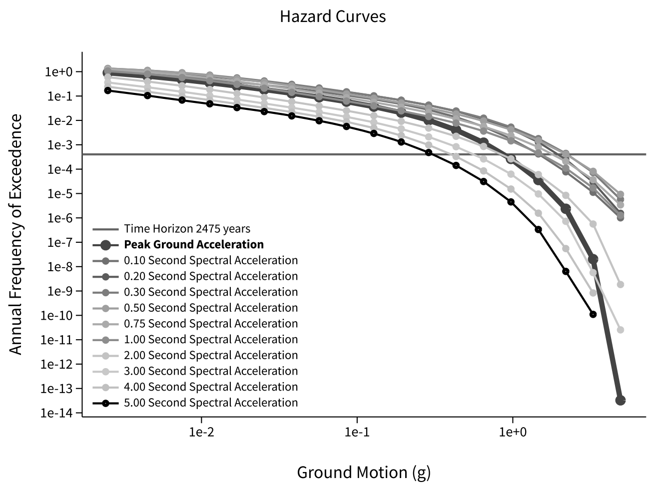
Peak Ground Acceleration

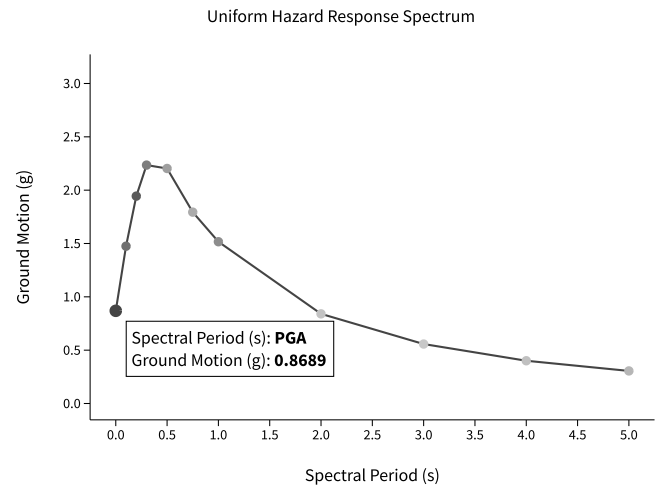
Time Horizon

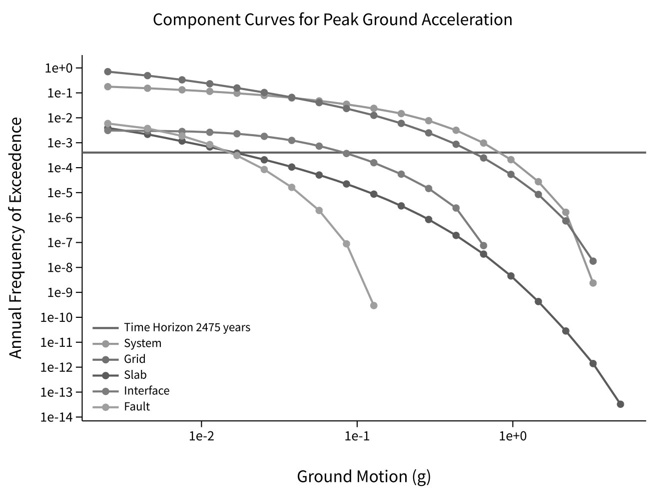
Return period in years

2475

Hazard Curve





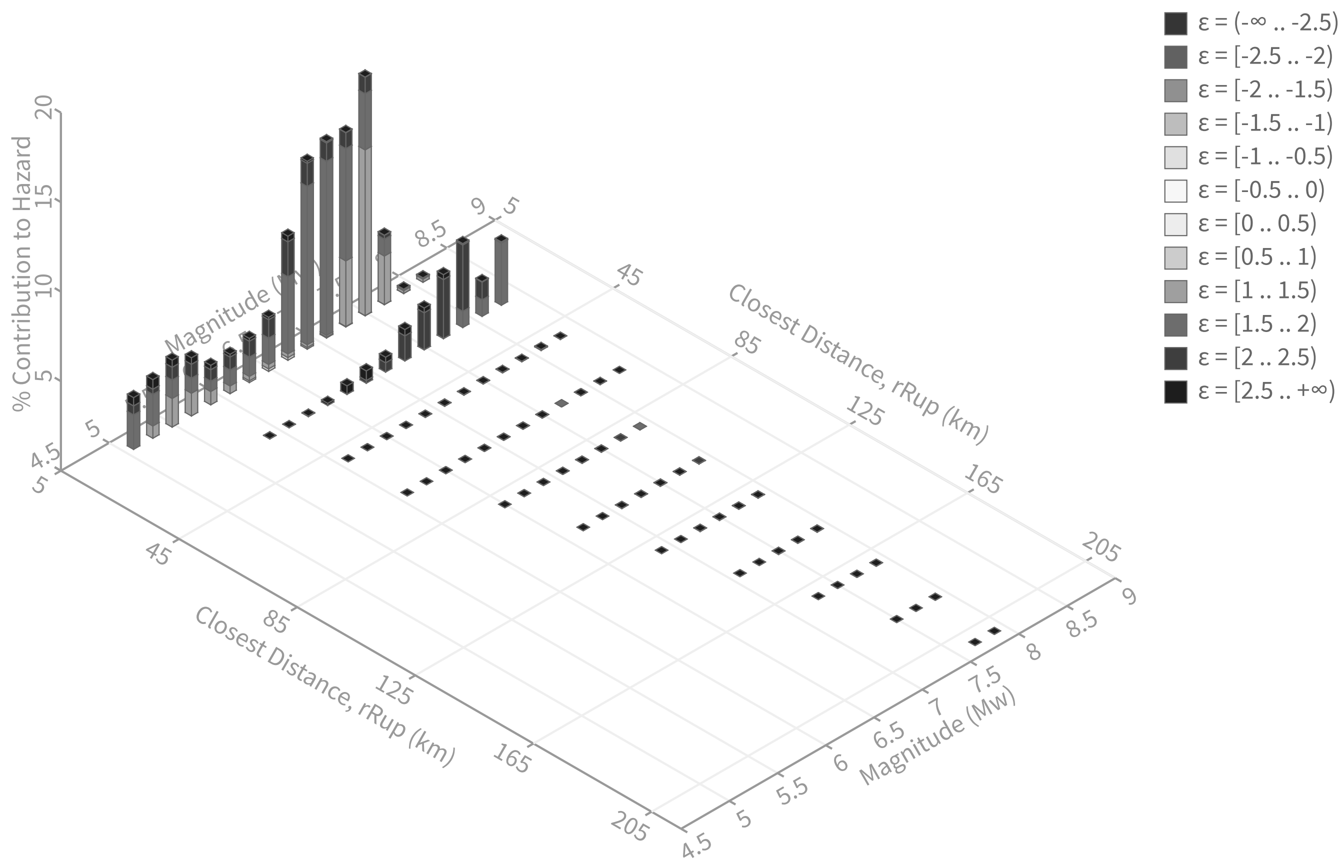


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.86887138 g

Recovered targets

Return period: 3251.3702 yrs
Exceedance rate: 0.00030756264 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.04 %

Mean (over all sources)

m: 6.97
r: 11.78 km
ε_0: 1.82 σ

Mode (largest m-r bin)

m: 7.51
r: 8.95 km
ε_0: 1.52 σ
Contribution: 13.33 %

Mode (largest m-r-ε_0 bin)

m: 7.09
r: 9.2 km
ε_0: 1.66 σ
Contribution: 9.72 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							39.73
Hayward (No) [0]		8.65	7.24	1.60	122.207°W	37.824°N	64.08	21.76
San Andreas (Peninsula) [11]		22.13	7.93	2.07	122.488°W	37.664°N	230.41	6.32
Hayward (So) [7]		11.07	6.81	1.97	122.172°W	37.786°N	92.96	2.46
Hayward (No) [1]		8.77	6.99	1.72	122.212°W	37.832°N	58.10	1.87
Hayward (No) [2]		9.78	6.92	1.84	122.239°W	37.865°N	30.30	1.68
Calaveras (No) [0]		22.51	7.22	2.37	122.049°W	37.842°N	75.24	1.15
UC33brAvg_FM31	System							39.09
Hayward (No) [1]		8.82	7.22	1.62	122.212°W	37.832°N	58.10	22.99
San Andreas (Peninsula) [11]		22.13	7.93	2.07	122.488°W	37.664°N	230.41	6.28
Hayward (So) [7]		11.07	6.82	1.97	122.172°W	37.786°N	92.96	2.57
Hayward (No) [2]		9.78	6.95	1.83	122.239°W	37.865°N	30.30	1.66
Calaveras (No) [0]		22.51	7.22	2.37	122.049°W	37.842°N	75.24	1.21
UC33brAvg_FM31 (opt)	Grid							10.74
PointSourceFinite: -122.294, 37.805		5.22	5.59	1.55	122.294°W	37.805°N	0.00	3.27
PointSourceFinite: -122.294, 37.805		5.22	5.59	1.55	122.294°W	37.805°N	0.00	3.27
UC33brAvg_FM32 (opt)	Grid							10.45
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PointSourceFinite: -122.294, 37.805		5.22	5.59	1.55	122.294°W	37.805°N	0.00	3.15

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Latitude

Decimal degrees

37.79105

Longitude

Decimal degrees, negative values for western longitudes

-122.294051

Site Class

259 m/s (Site class D)

Spectral Period

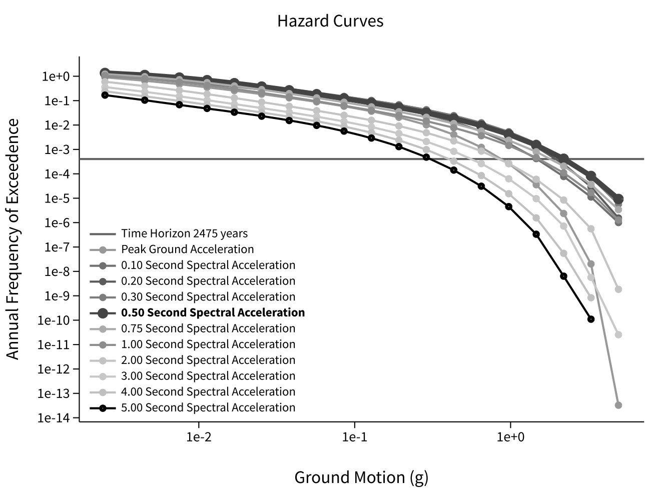
0.50 Second Spectral Acceleration

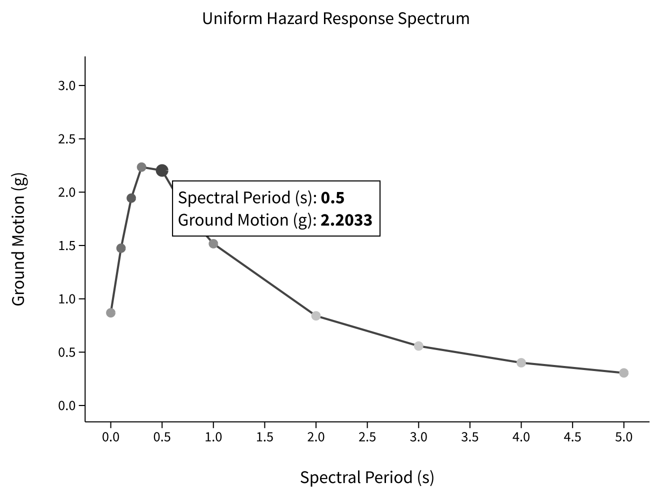
Time Horizon

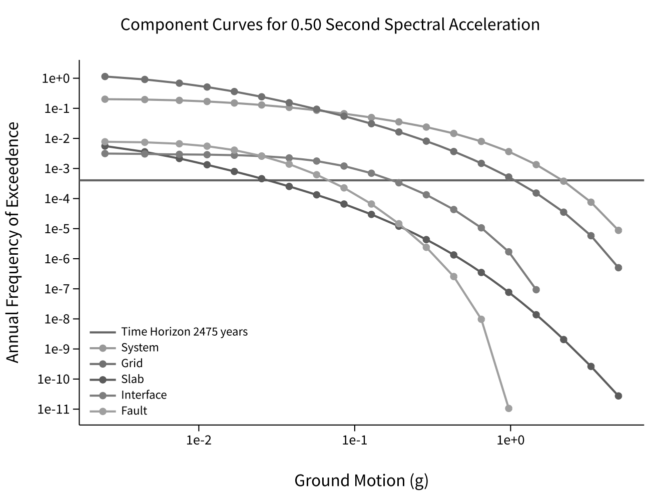
Return period in years

2475

Hazard Curve





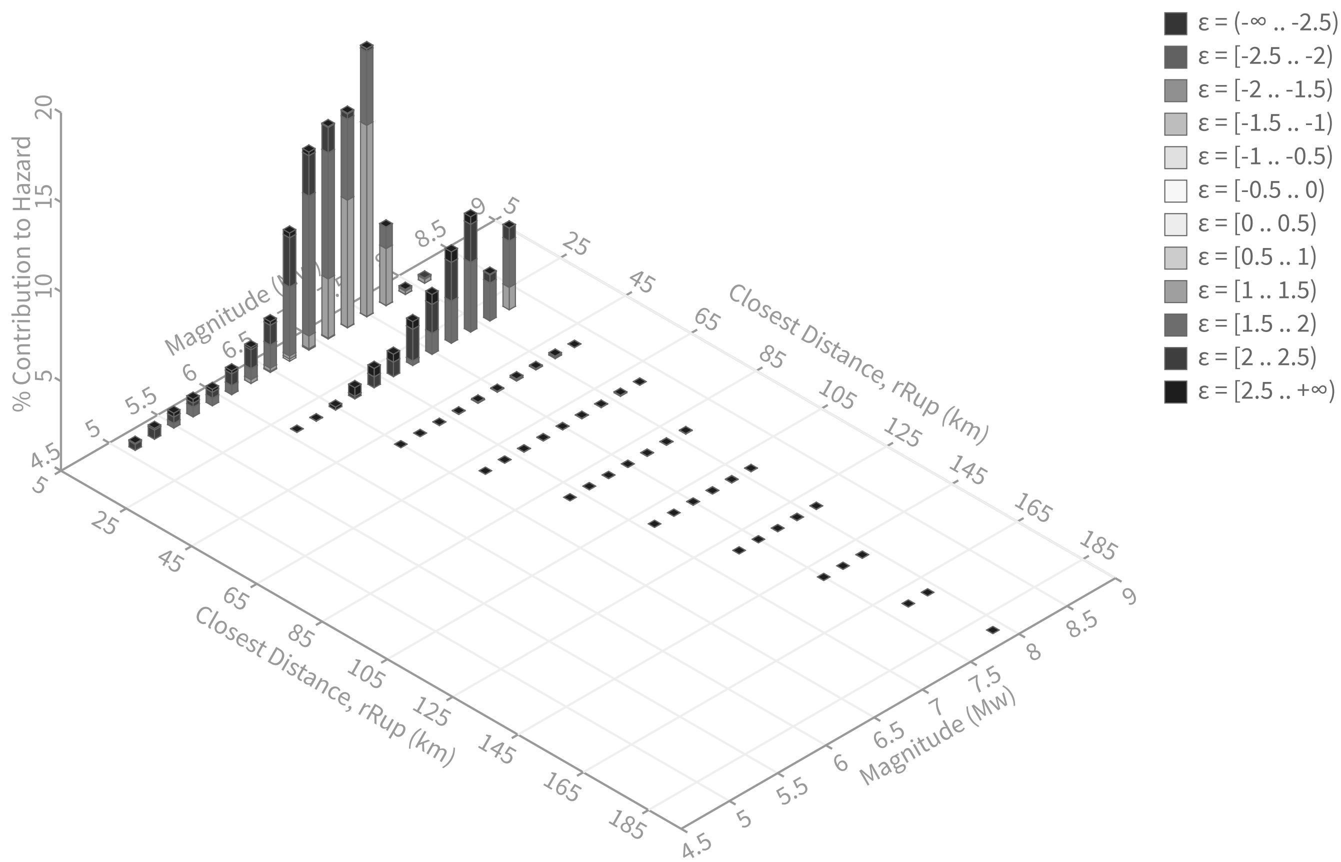


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
0.5 s SA ground motion: 2.2032876 g

Recovered targets

Return period: 3143.6814 yrs
Exceedance rate: 0.00031809839 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.07 %

Mean (over all sources)

m: 7.24
r: 13.44 km
ε_0: 1.79 σ

Mode (largest m-r bin)

m: 7.51
r: 8.99 km
ε_0: 1.46 σ
Contribution: 14.96 %

Mode (largest m-r-ε_0 bin)

m: 7.51
r: 8.74 km
ε_0: 1.31 σ
Contribution: 10.68 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							46.19
Hayward (No) [0]		8.65	7.26	1.55	122.207°W	37.824°N	64.08	23.57
San Andreas (Peninsula) [11]		22.13	7.93	1.92	122.488°W	37.664°N	230.41	8.46
Hayward (So) [7]		11.07	6.82	1.94	122.172°W	37.786°N	92.96	2.60
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Hayward (No) [2]		9.78	6.96	1.82	122.239°W	37.865°N	30.30	1.73
Calaveras (No) [0]		22.51	7.24	2.25	122.049°W	37.842°N	75.24	1.46
San Gregorio (North) [4]		27.80	7.76	2.16	122.594°W	37.711°N	251.42	1.18
Hayward (So) [6]		16.01	6.78	2.31	122.129°W	37.735°N	113.12	1.07
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San Andreas (Peninsula) [11]		22.13	7.92	1.92	122.488°W	37.664°N	230.41	8.40
Hayward (So) [7]		11.07	6.83	1.94	122.172°W	37.786°N	92.96	2.72
Hayward (No) [2]		9.78	6.98	1.81	122.239°W	37.865°N	30.30	1.72
Calaveras (No) [0]		22.51	7.24	2.25	122.049°W	37.842°N	75.24	1.53
San Gregorio (North) [4]		27.80	7.76	2.16	122.594°W	37.711°N	251.42	1.19
Hayward (So) [6]		16.01	6.78	2.31	122.129°W	37.735°N	113.12	1.05
UC33brAvg_FM31 (opt)	Grid							4.23
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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

1.00 Second Spectral Acceleration

Latitude

Decimal degrees

37.79105

Time Horizon

Return period in years

2475

Longitude

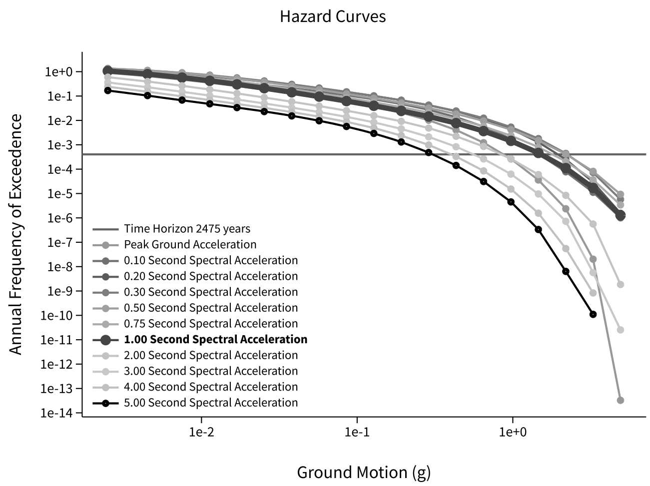
Decimal degrees, negative values for western longitudes

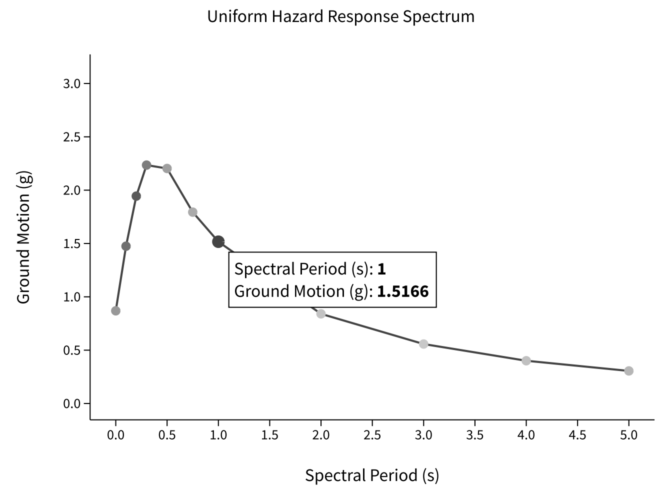
-122.294051

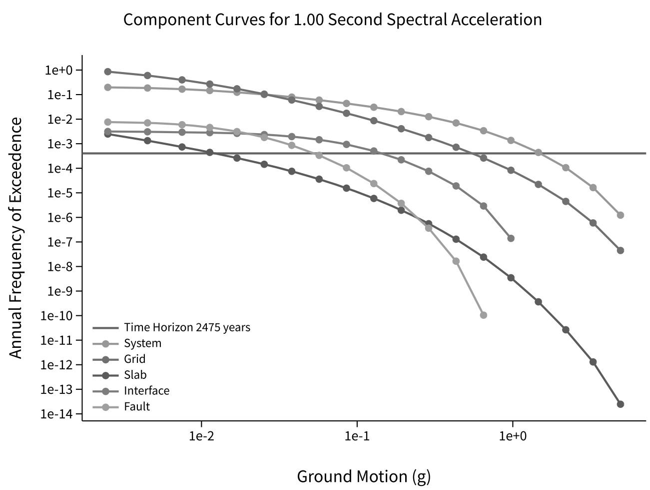
Site Class

259 m/s (Site class D)

Hazard Curve





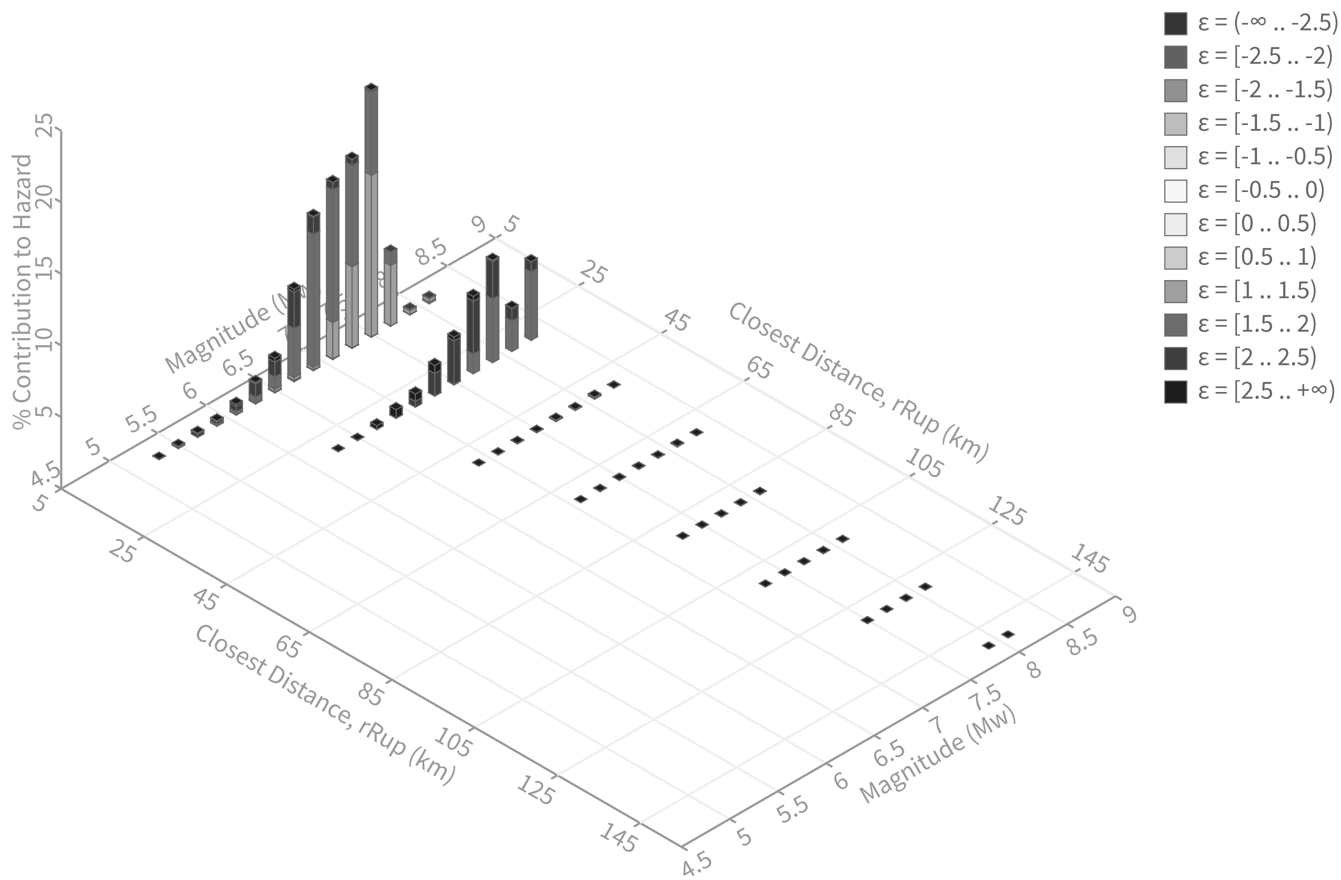


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
1.0 s SA ground motion: 1.5166107 g

Recovered targets

Return period: 2970.4507 yrs
Exceedance rate: 0.00033664925 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.1 %

Mean (over all sources)

m: 7.34
r: 13.39 km
ε_0: 1.75 σ

Mode (largest m-r bin)

m: 7.51
r: 8.95 km
ε_0: 1.4 σ
Contribution: 17.22 %

Mode (largest m-r-ε_0 bin)

m: 7.51
r: 8.74 km
ε_0: 1.3 σ
Contribution: 11.29 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							48.05
Hayward (No) [0]		8.65	7.28	1.51	122.207°W	37.824°N	64.08	25.67
San Andreas (Peninsula) [11]		22.13	7.94	1.93	122.488°W	37.664°N	230.41	9.53
Hayward (So) [7]		11.07	6.83	1.99	122.172°W	37.786°N	92.96	2.38
Hayward (No) [1]		8.77	7.06	1.67	122.212°W	37.832°N	58.10	1.98
Hayward (No) [2]		9.78	7.00	1.81	122.239°W	37.865°N	30.30	1.72
San Gregorio (North) [4]		27.80	7.78	2.23	122.594°W	37.711°N	251.42	1.23
Calaveras (No) [0]		22.51	7.29	2.35	122.049°W	37.842°N	75.24	1.23
UC33brAvg_FM31	System							47.27
Hayward (No) [1]		8.82	7.26	1.53	122.212°W	37.832°N	58.10	26.81
San Andreas (Peninsula) [11]		22.13	7.94	1.93	122.488°W	37.664°N	230.41	9.46
Hayward (So) [7]		11.07	6.84	1.98	122.172°W	37.786°N	92.96	2.49
Hayward (No) [2]		9.78	7.02	1.79	122.239°W	37.865°N	30.30	1.72
Calaveras (No) [0]		22.51	7.29	2.35	122.049°W	37.842°N	75.24	1.29
San Gregorio (North) [4]		27.80	7.77	2.23	122.594°W	37.711°N	251.42	1.24
UC33brAvg_FM31 (opt)	Grid							2.36
UC33brAvg_FM32 (opt)	Grid							2.33

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Latitude

Decimal degrees

37.79105

Longitude

Decimal degrees, negative values for western longitudes

-122.294051

Site Class

259 m/s (Site class D)

Spectral Period

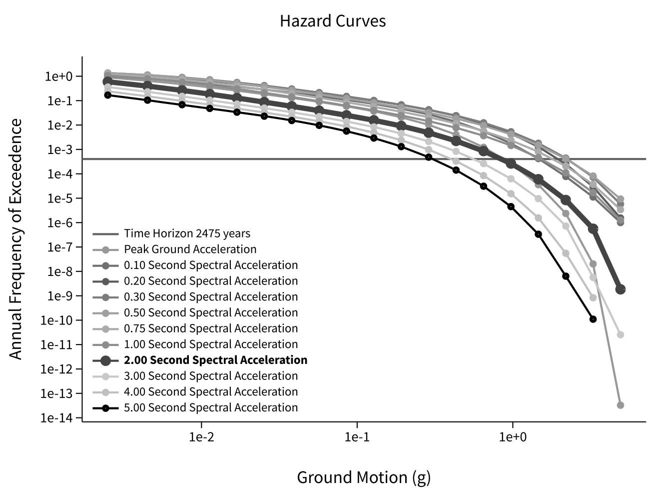
2.00 Second Spectral Acceleration

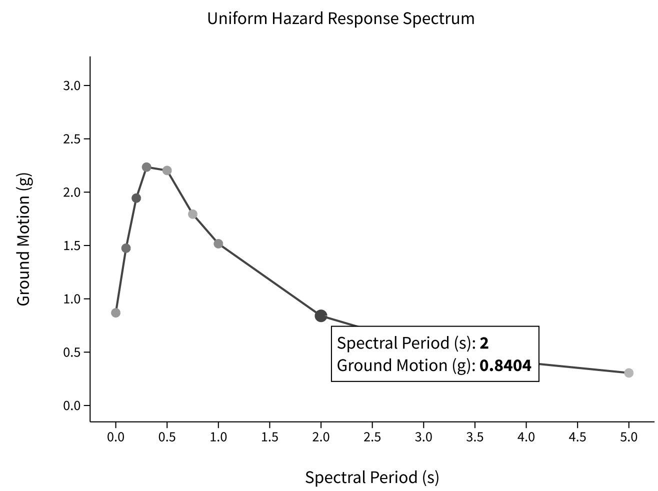
Time Horizon

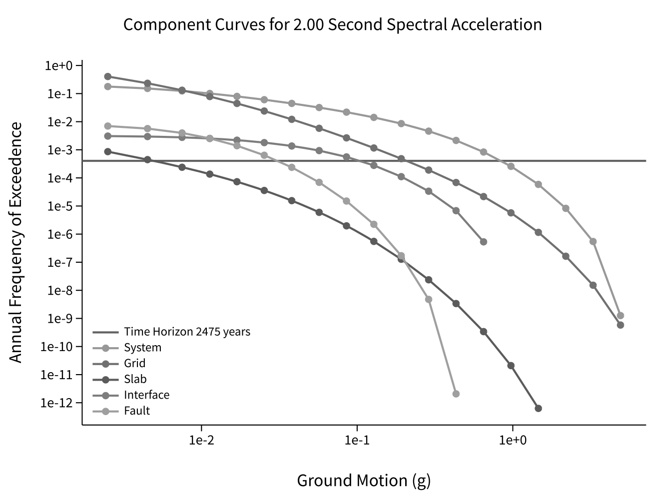
Return period in years

2475

Hazard Curve





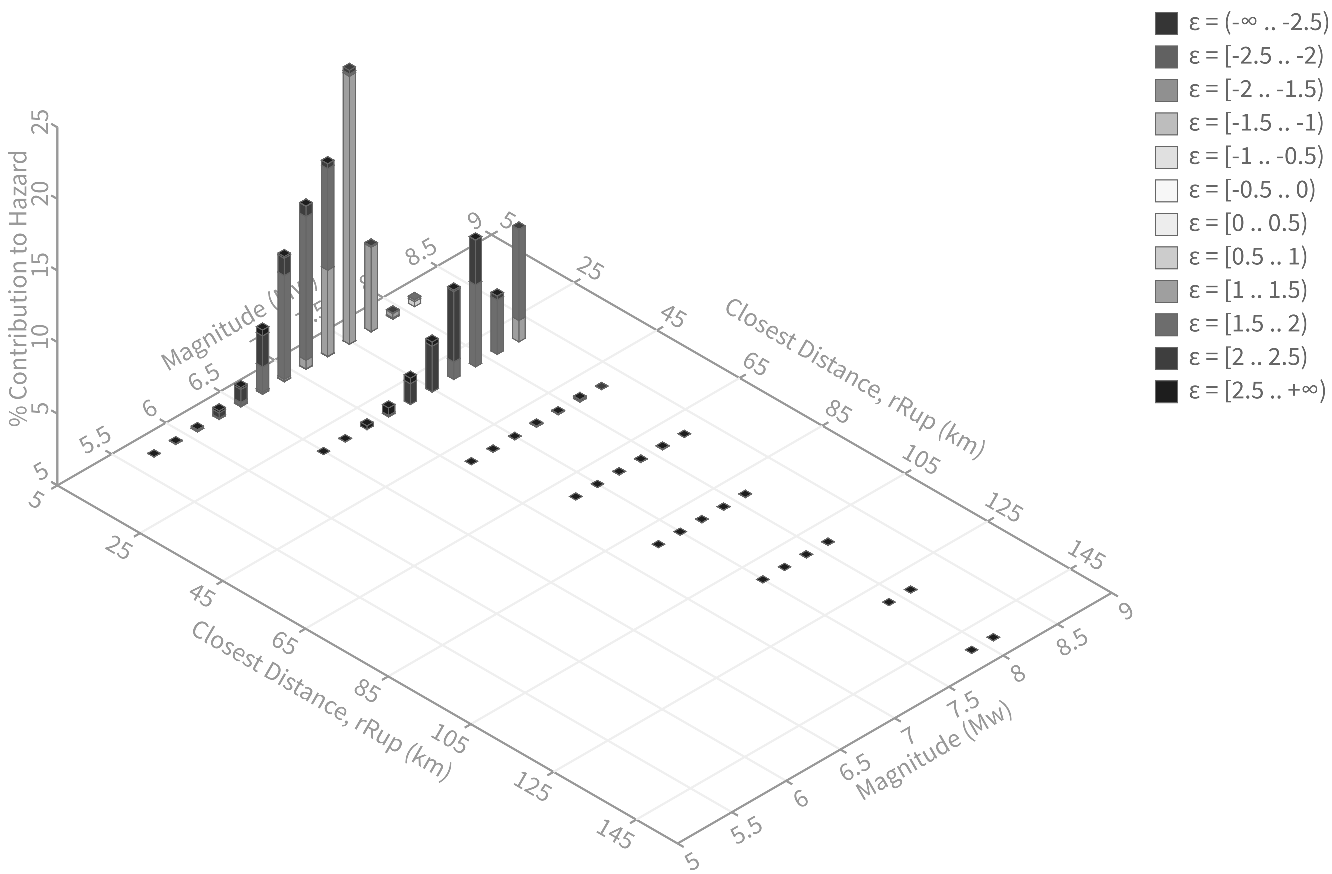


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
2.0 s SA ground motion: 0.84039399 g

Recovered targets

Return period: 2867.1112 yrs
Exceedance rate: 0.00034878312 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.09 %

Mean (over all sources)

m: 7.46
r: 14.01 km
ε_0: 1.7 σ

Mode (largest m-r bin)

m: 7.51
r: 8.94 km
ε_0: 1.35 σ
Contribution: 19.12 %

Mode (largest m-r-ε_0 bin)

m: 7.51
r: 8.74 km
ε_0: 1.33 σ
Contribution: 18.7 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

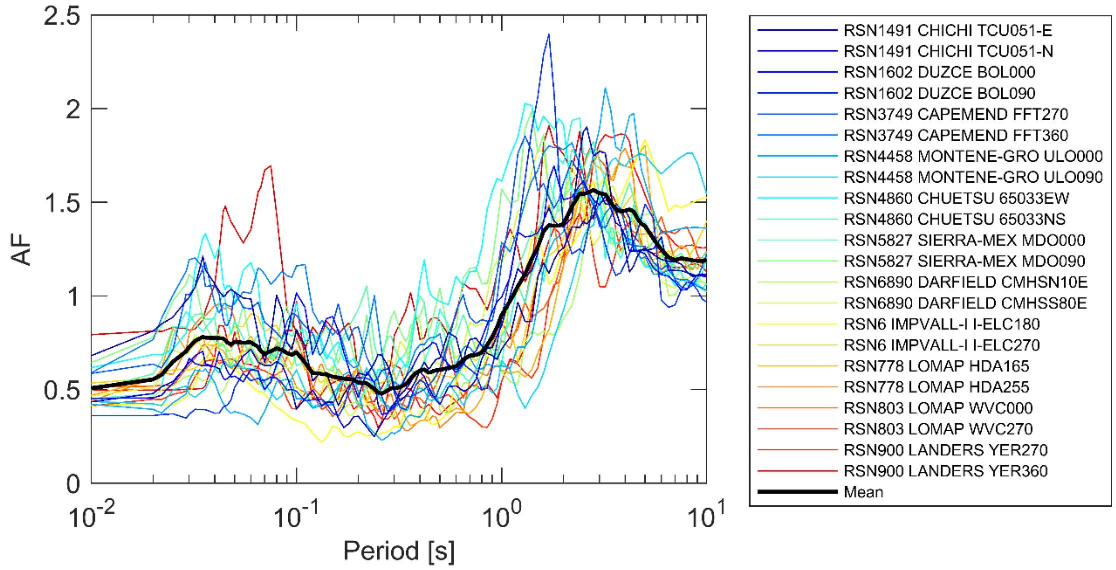
Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							49.23
Hayward (No) [0]		8.65	7.32	1.47	122.207°W	37.824°N	64.08	25.85
San Andreas (Peninsula) [11]		22.13	7.97	1.83	122.488°W	37.664°N	230.41	12.17
Hayward (No) [1]		8.77	7.12	1.65	122.212°W	37.832°N	58.10	1.79
Hayward (So) [7]		11.07	6.87	2.05	122.172°W	37.786°N	92.96	1.77
Hayward (No) [2]		9.78	7.07	1.80	122.239°W	37.865°N	30.30	1.47
San Gregorio (North) [4]		27.80	7.79	2.20	122.594°W	37.711°N	251.42	1.44
Calaveras (No) [0]		22.51	7.37	2.33	122.049°W	37.842°N	75.24	1.02
UC33brAvg_FM31	System							48.42
Hayward (No) [1]		8.82	7.31	1.49	122.212°W	37.832°N	58.10	26.76
San Andreas (Peninsula) [11]		22.13	7.97	1.83	122.488°W	37.664°N	230.41	12.08
Hayward (So) [7]		11.07	6.88	2.04	122.172°W	37.786°N	92.96	1.87
Hayward (No) [2]		9.78	7.08	1.78	122.239°W	37.865°N	30.30	1.50
San Gregorio (North) [4]		27.80	7.78	2.20	122.594°W	37.711°N	251.42	1.46
Calaveras (No) [0]		22.51	7.36	2.34	122.049°W	37.842°N	75.24	1.08
UC33brAvg_FM31 (opt)	Grid							1.18
UC33brAvg_FM32 (opt)	Grid							1.17

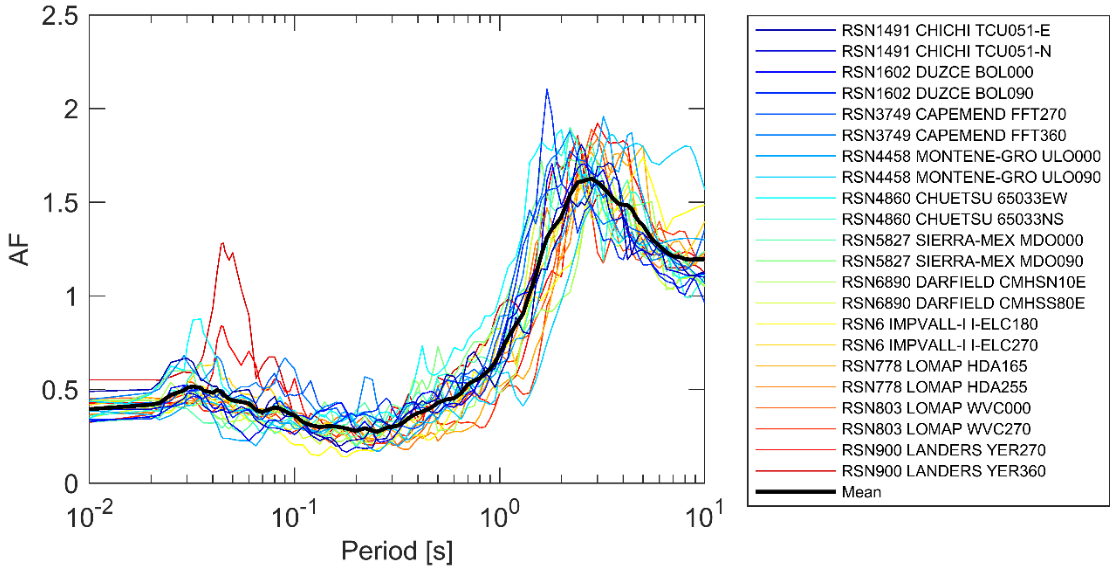
APPENDIX B

Amplification Ratios

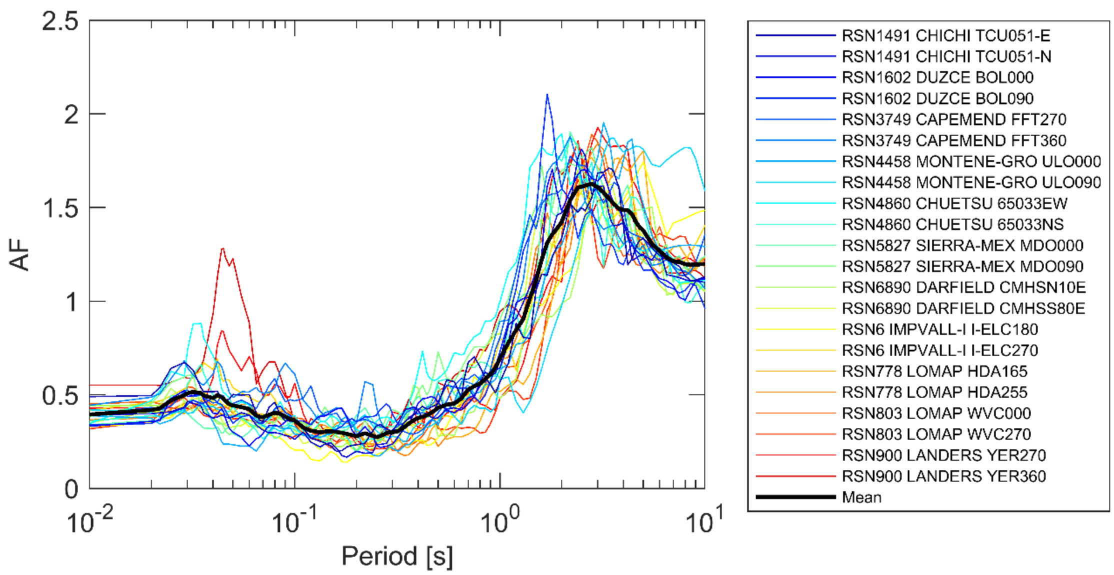
19542.000.001
January 14, 2022



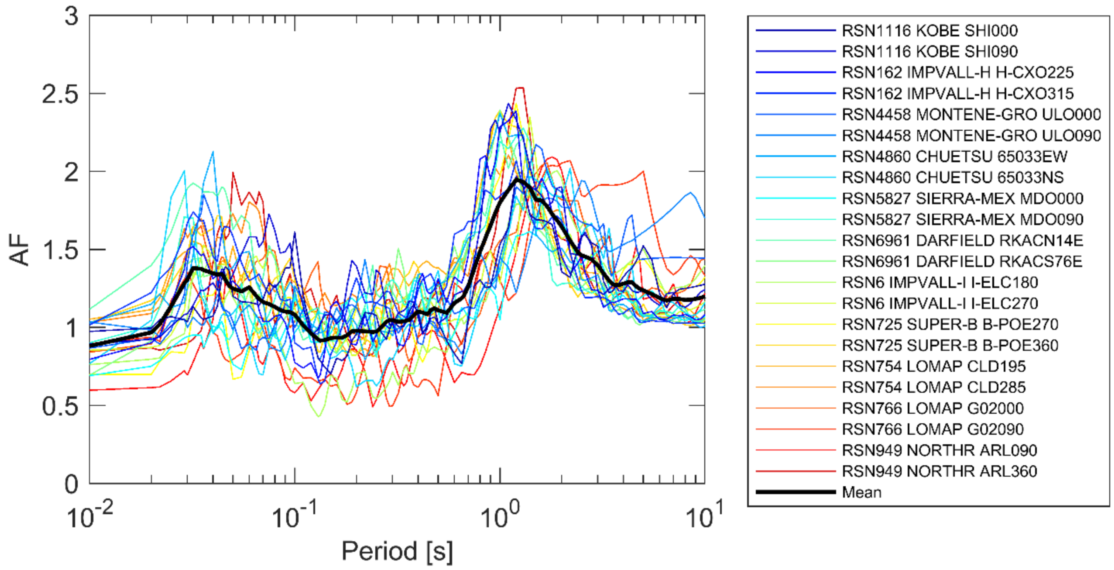
Offshore Non-Liquefiable Profile
CLE Scenario



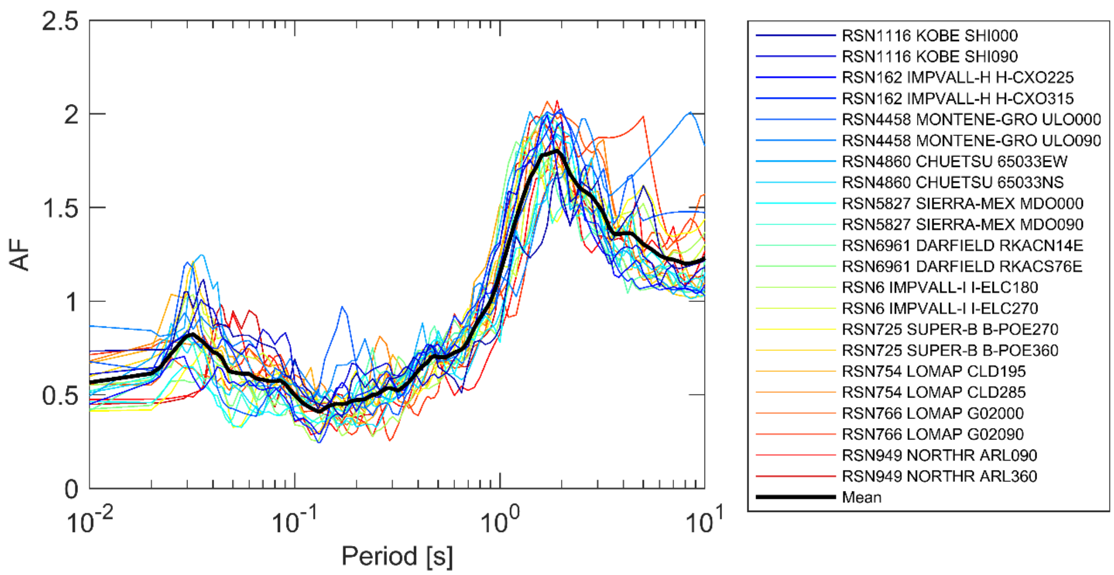
Onshore Non-Liquefiable Profile
CLE Scenario



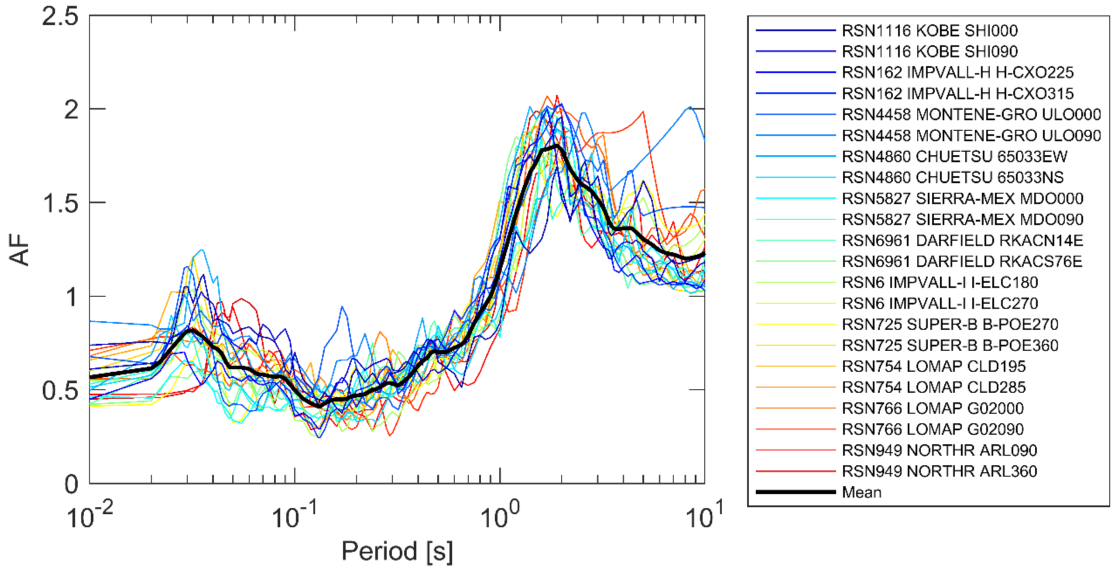
Onshore Liquefiable Profile
CLE Scenario



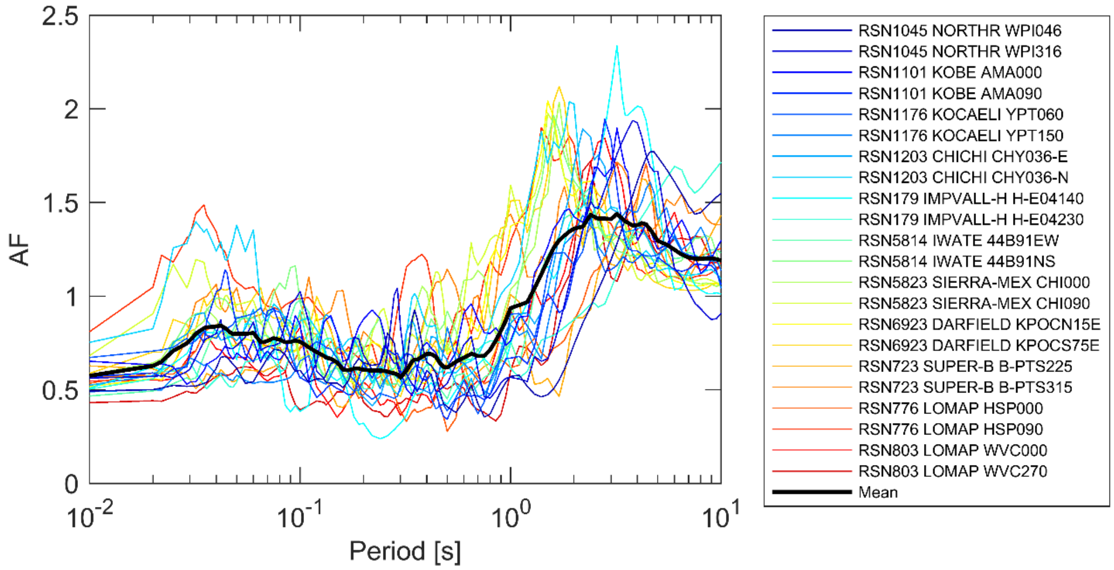
Offshore Non-Liquefiable Profile
OLE Scenario



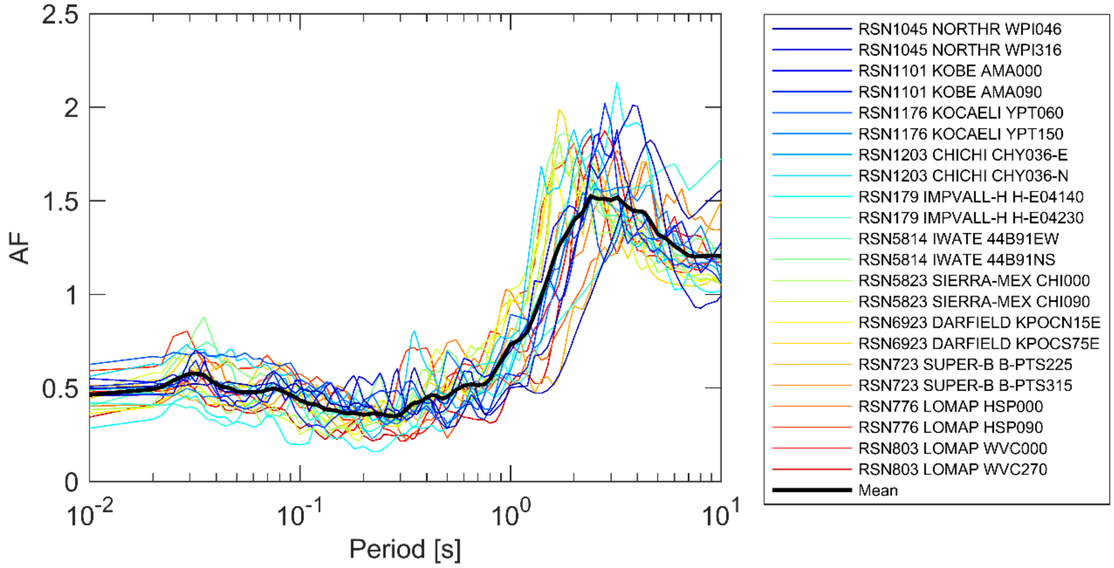
Onshore Non-Liquefiable Profile
OLE Scenario



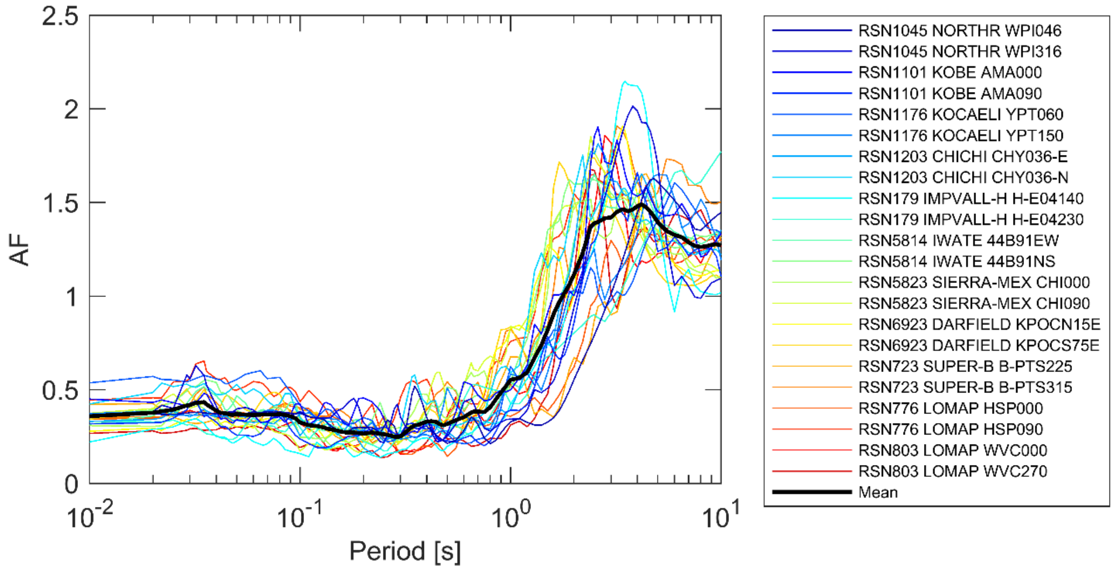
Onshore Liquefiable Profile
OLE Scenario



Offshore Non-Liquefiable Profile
DE Scenario



Onshore Non-Liquefiable Profile
DE Scenario



Onshore Liquefiable Profile
MCE_R Scenario

APPENDIX D

LIQUEFACTION ANALYSIS

OLE: IDRISS & BOULANGER

ENGEO

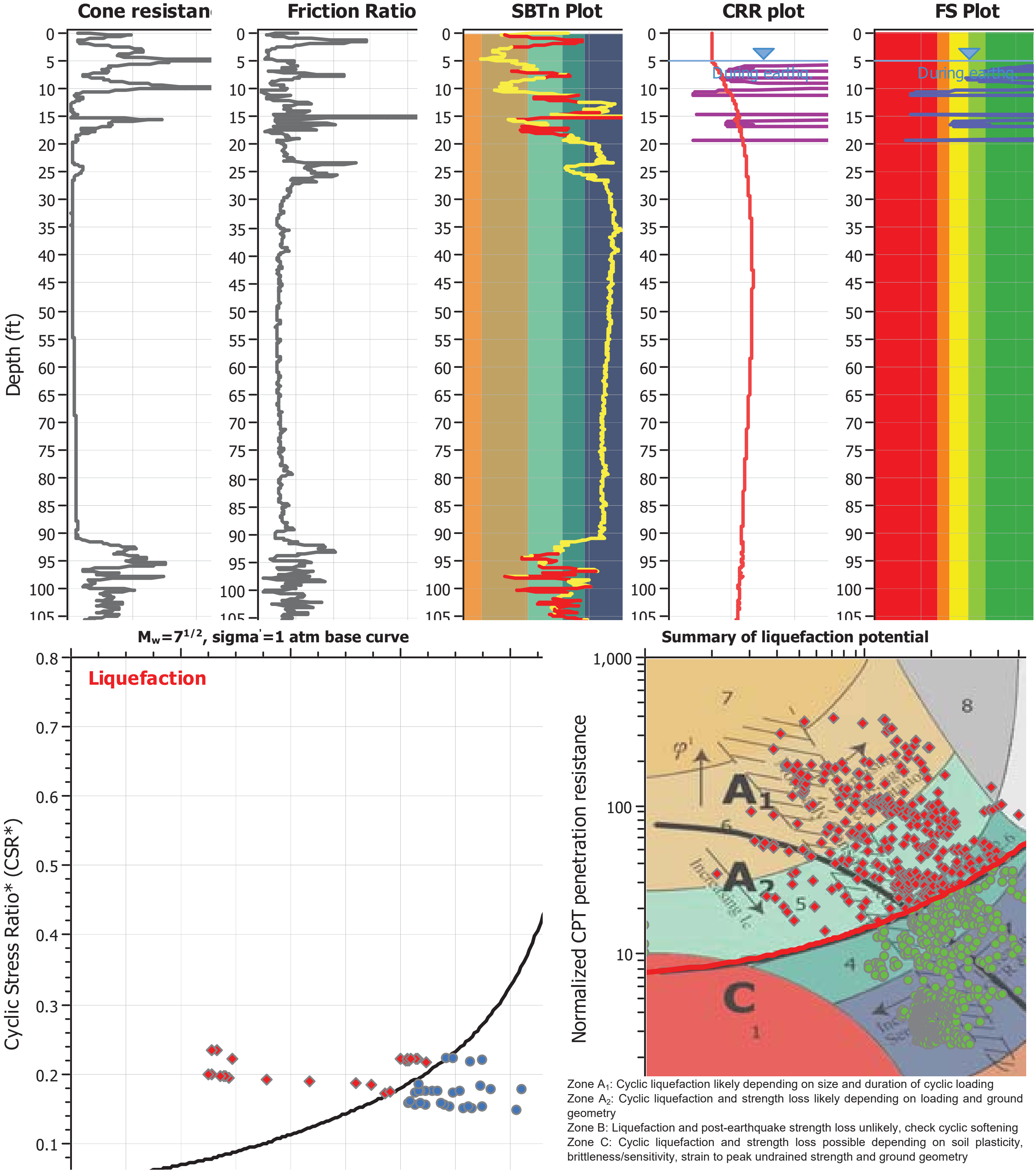
LIQUEFACTION ANALYSIS REPORT

Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

CPT file : 1-sCPT02

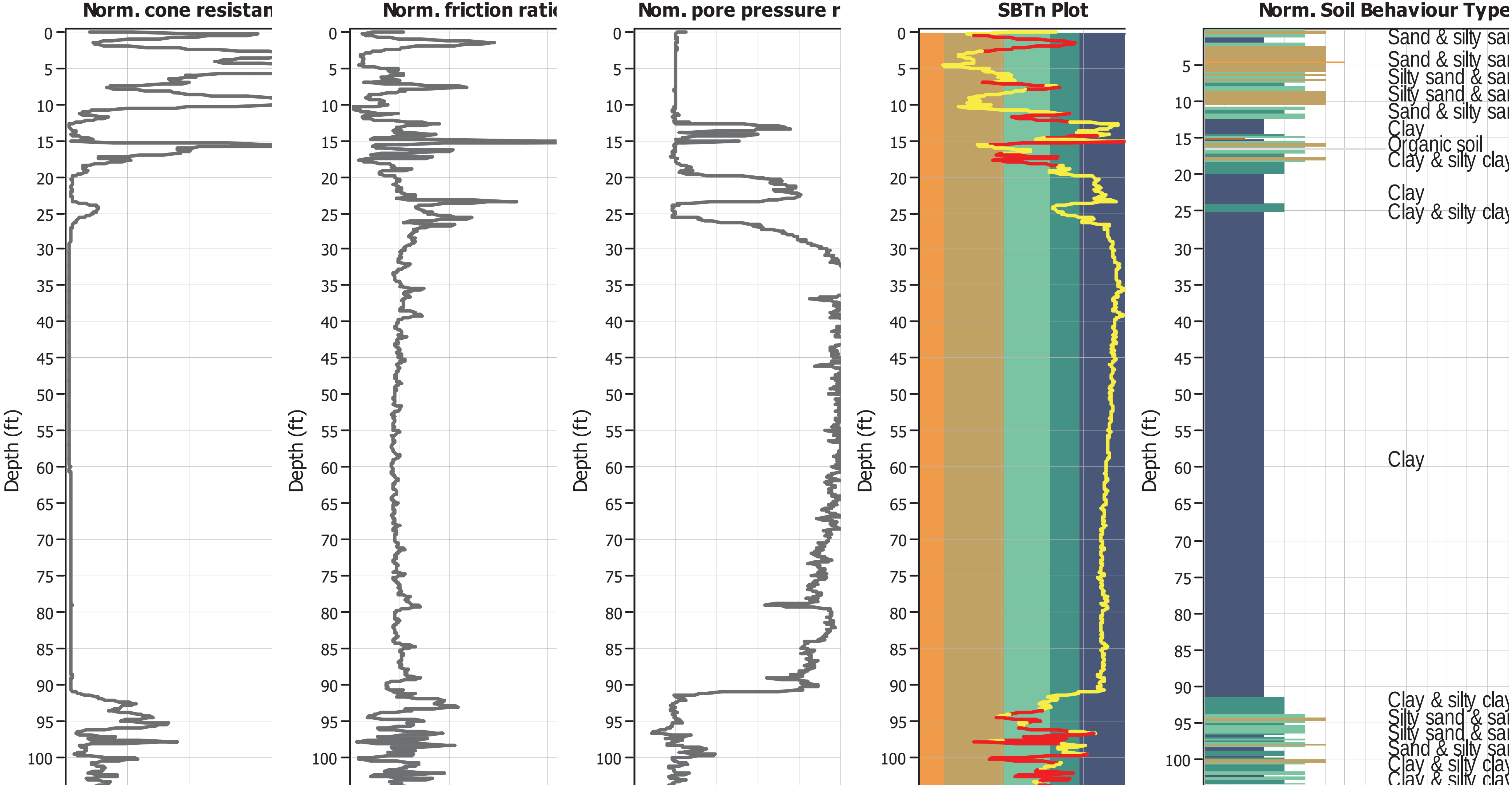
Input parameters and analysis data

Analysis method:	I&B (2008)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	90.00 ft
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



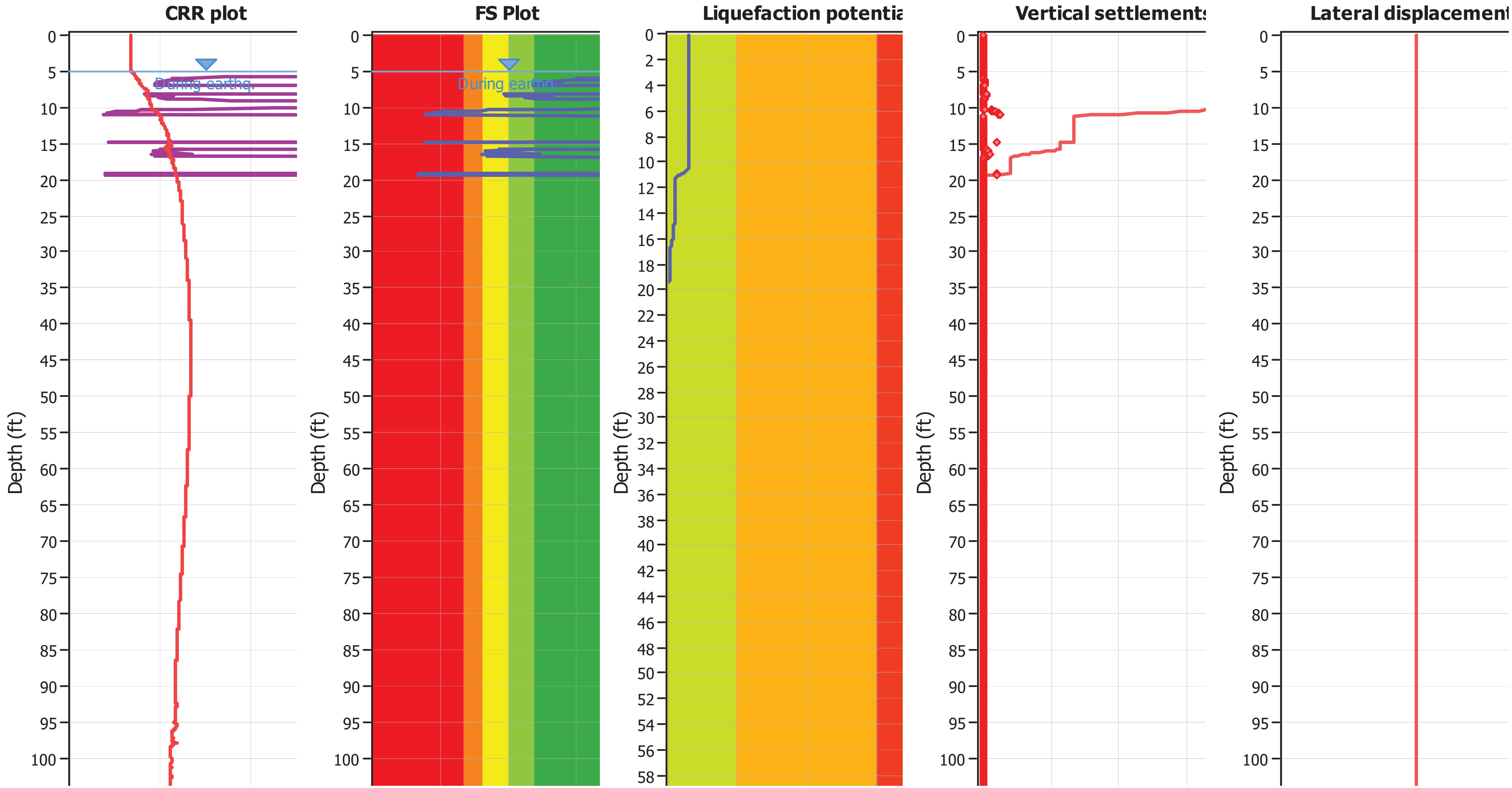
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

OLE: ROBERTSON

ENGEO

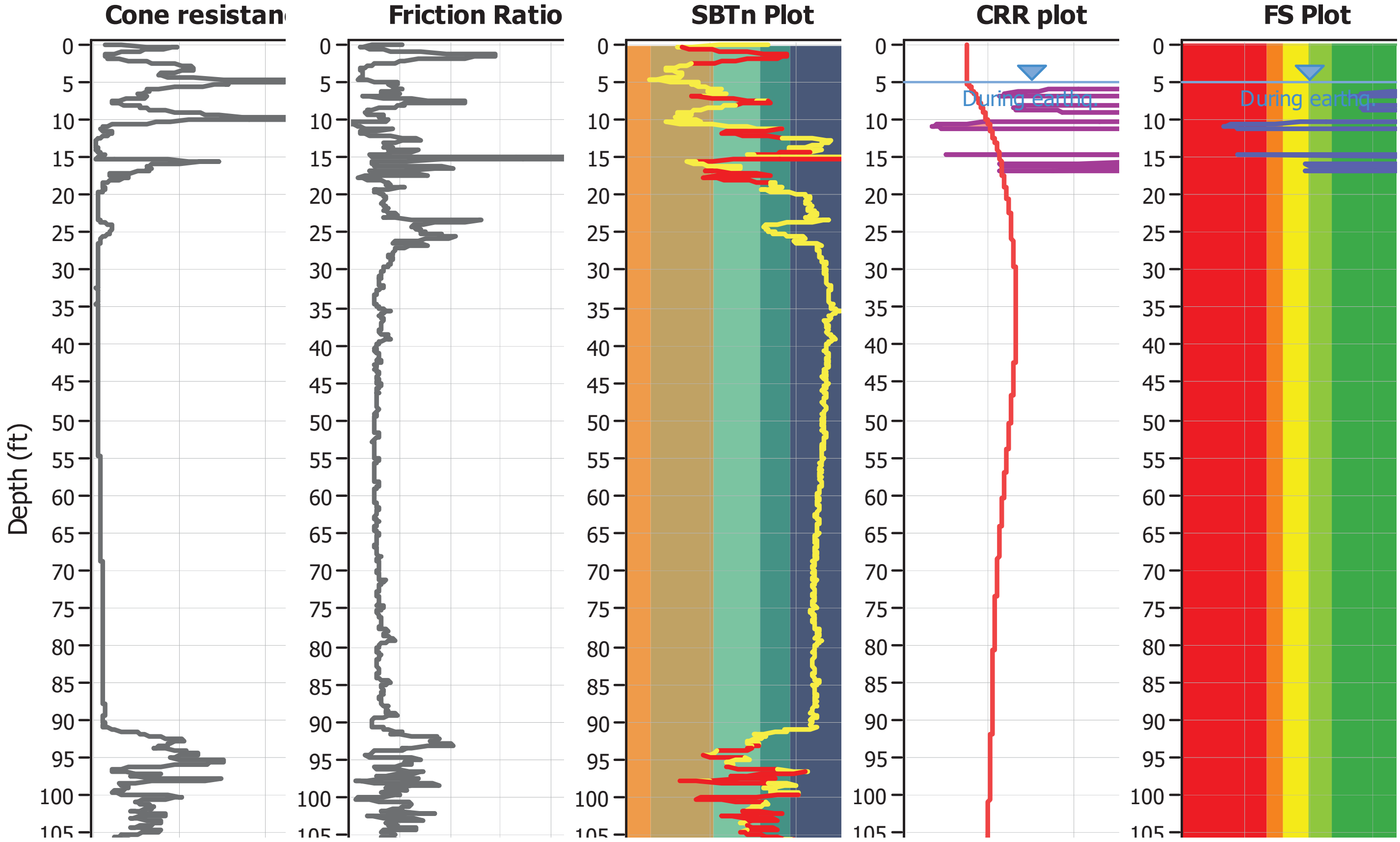
LIQUEFACTION ANALYSIS REPORT

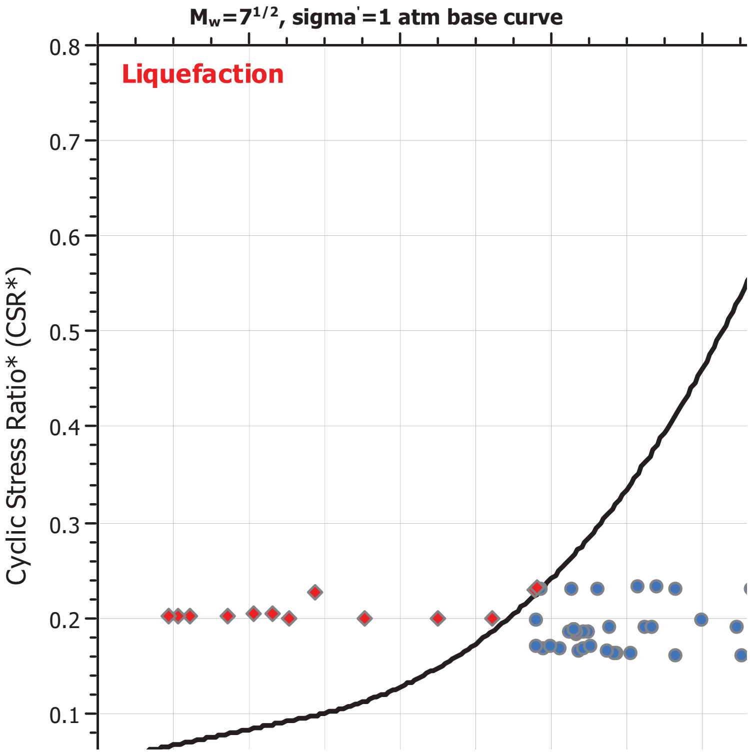
Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

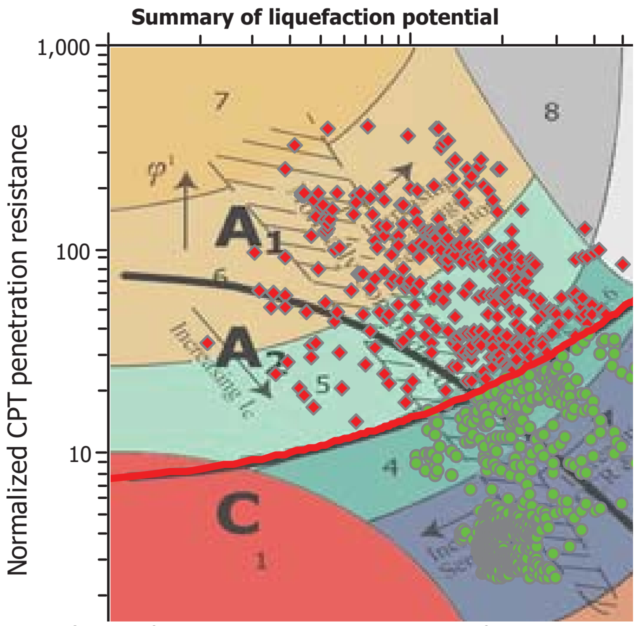
CPT file : 1-sCPT02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	90.00 ft
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

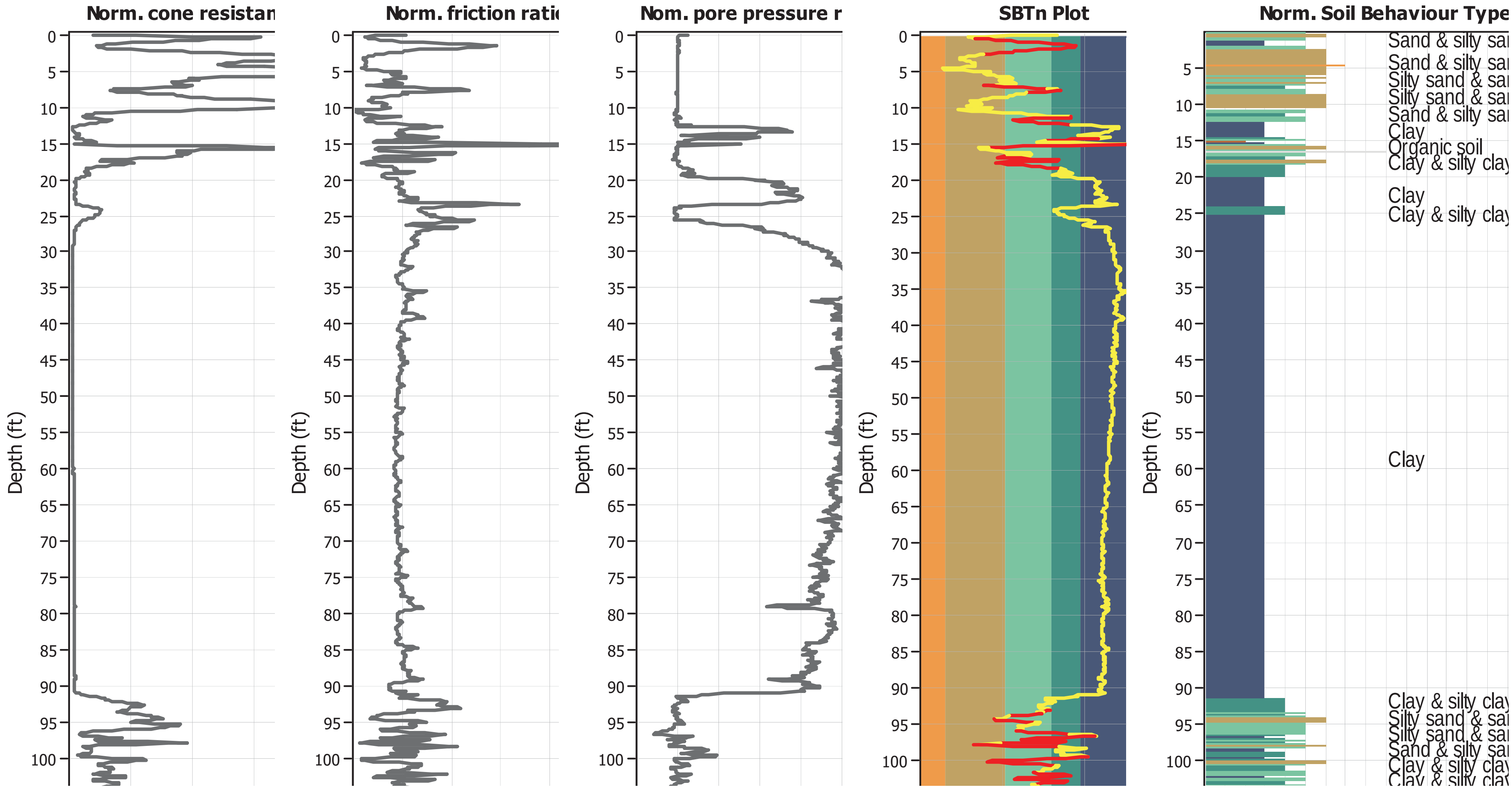






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



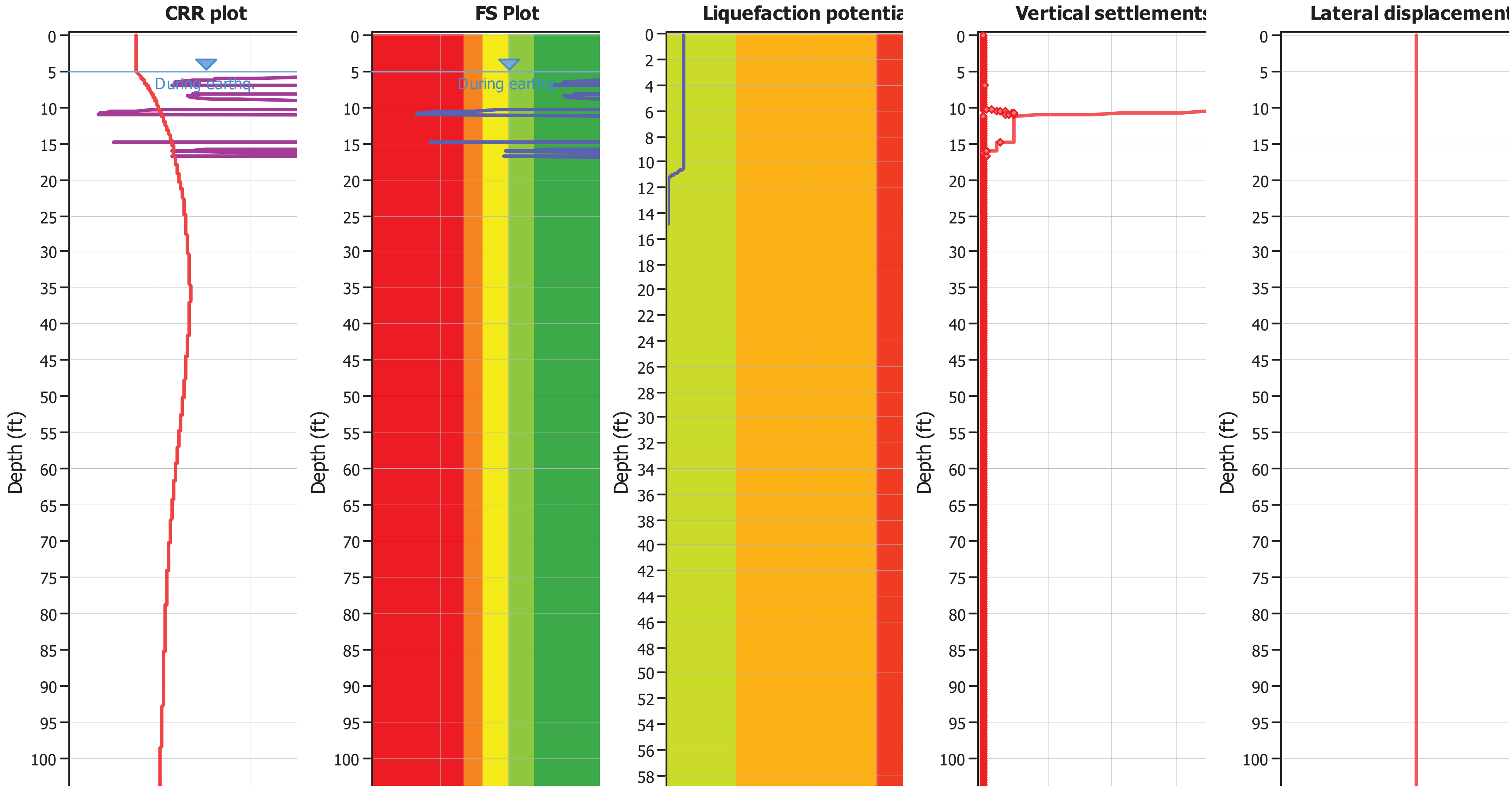
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

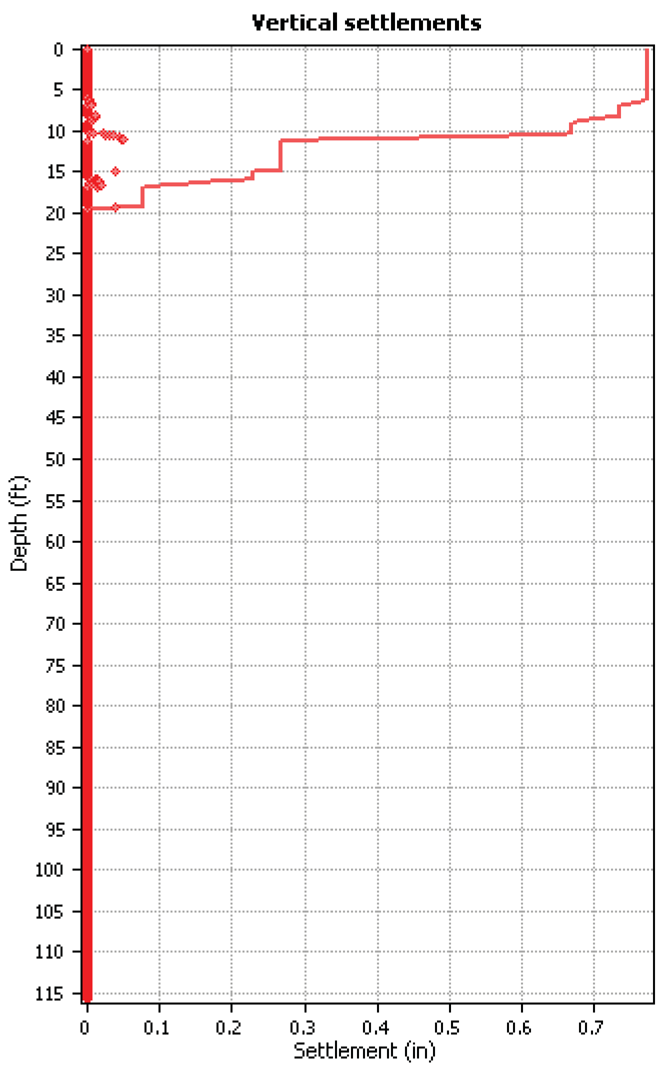
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

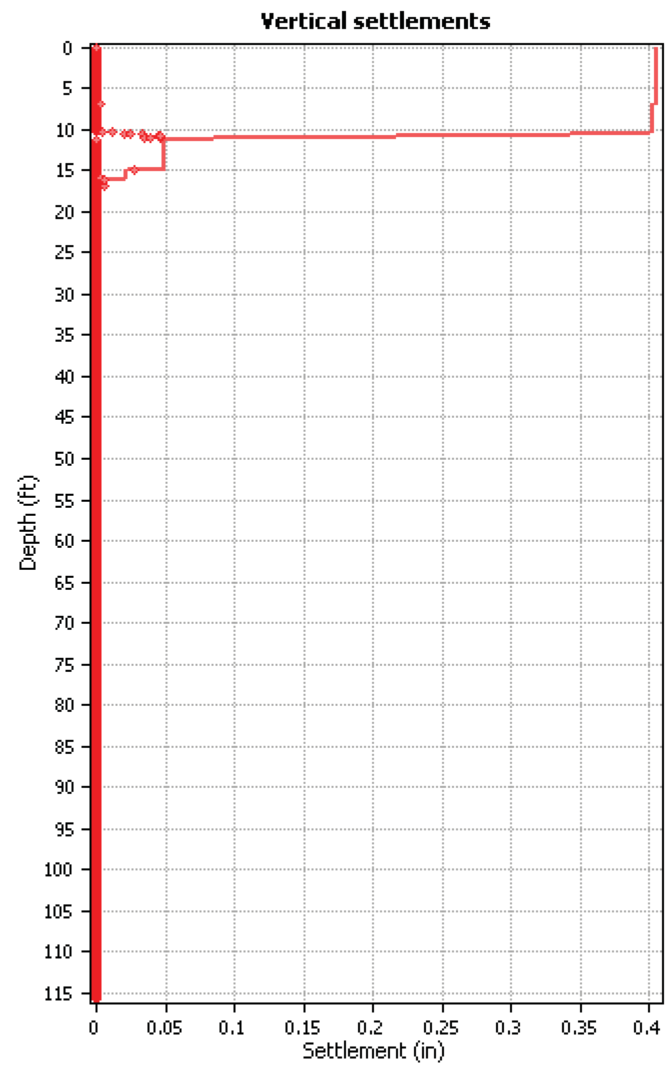
LPI color scheme

- Very high risk
- High risk
- Low risk

OLE: Idriss & Boulanger



OLE: Robertson



CLE: IDRISS & BOULANGER

ENGEO

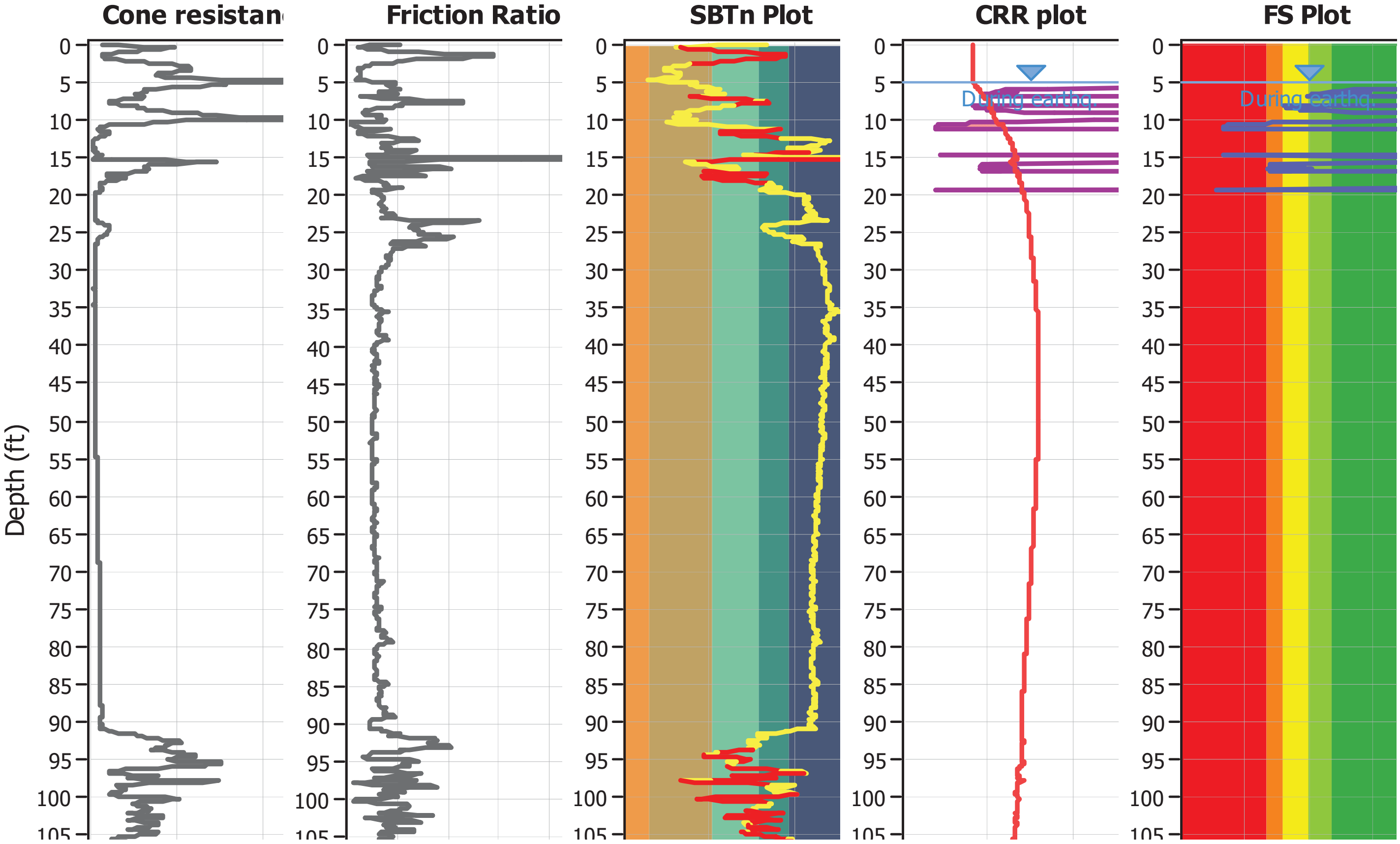
LIQUEFACTION ANALYSIS REPORT

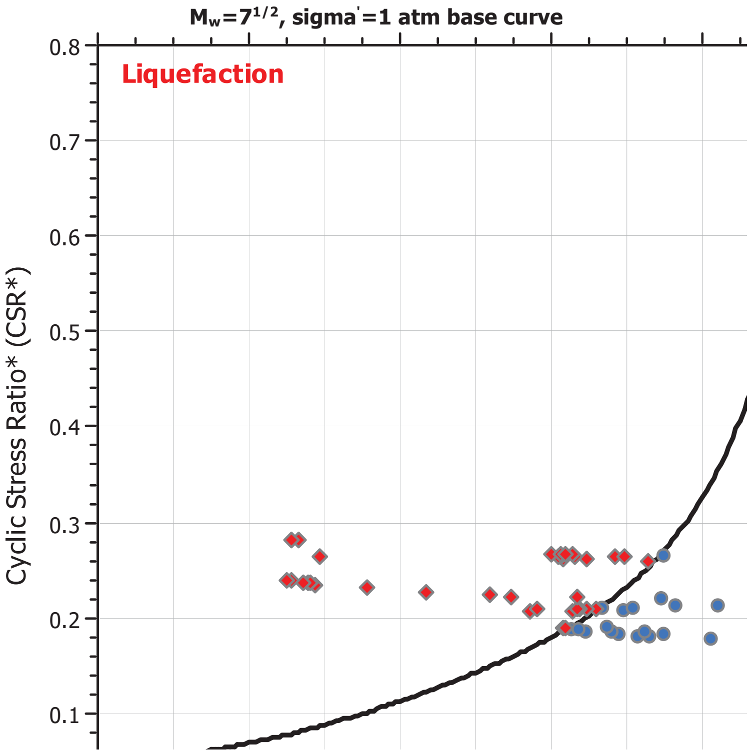
Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

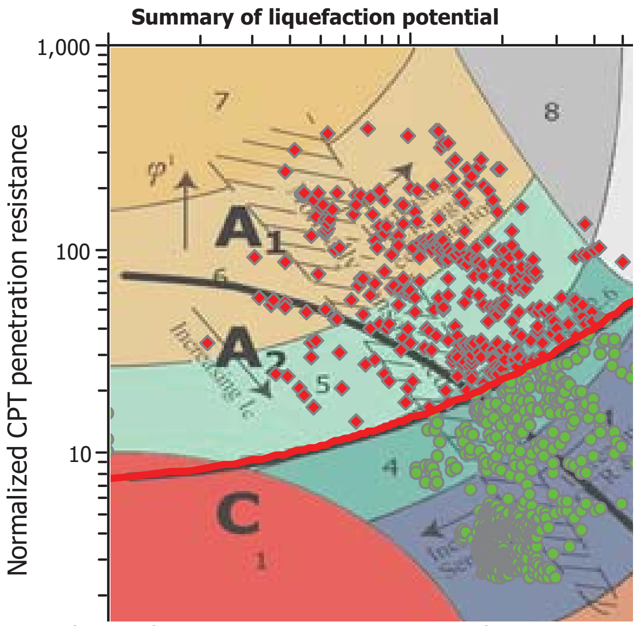
CPT file : 1-sCPT02

Input parameters and analysis data

Analysis method:	I&B (2008)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	90.00 ft
Peak ground acceleration:	0.30	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method

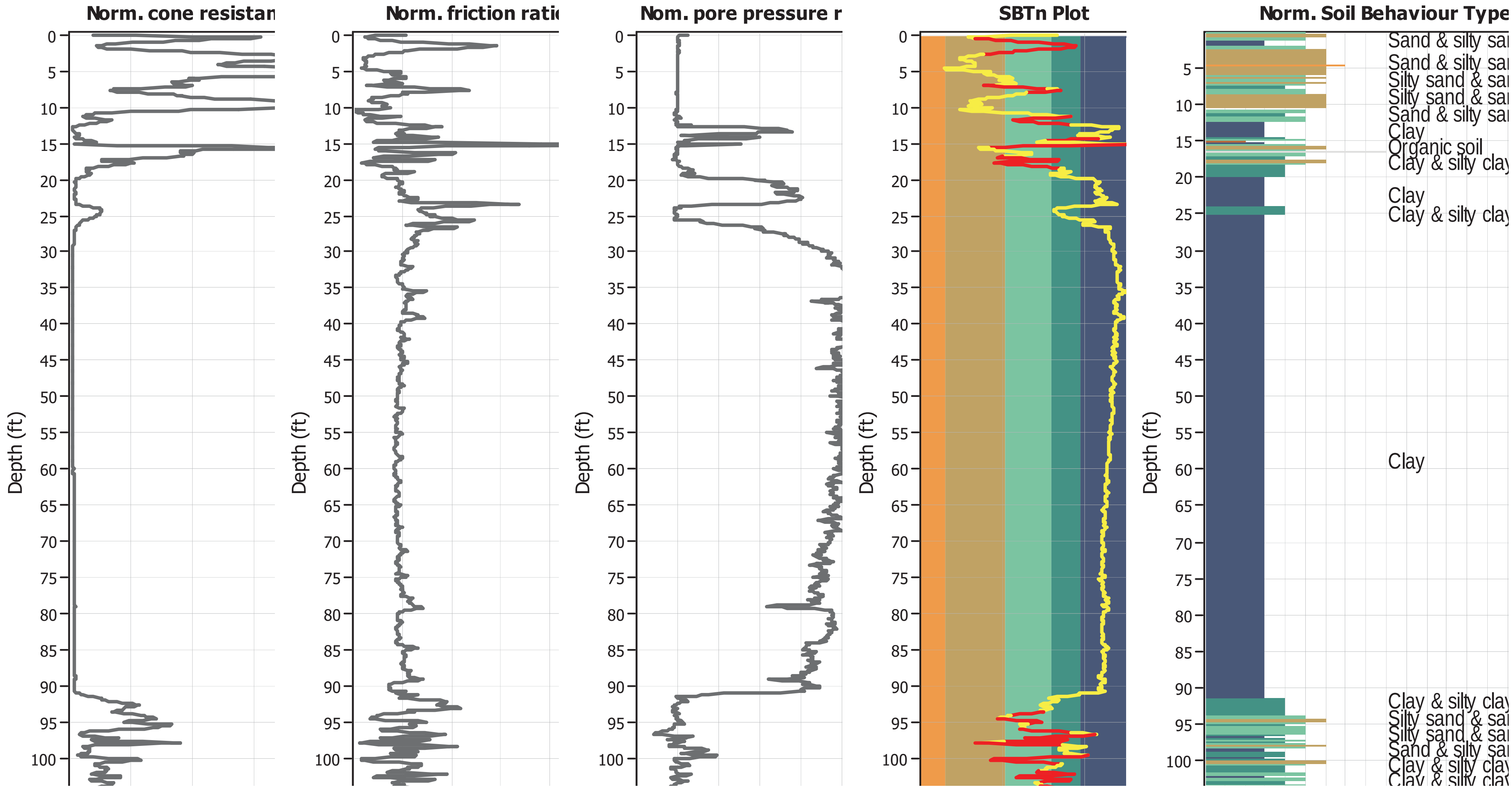






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



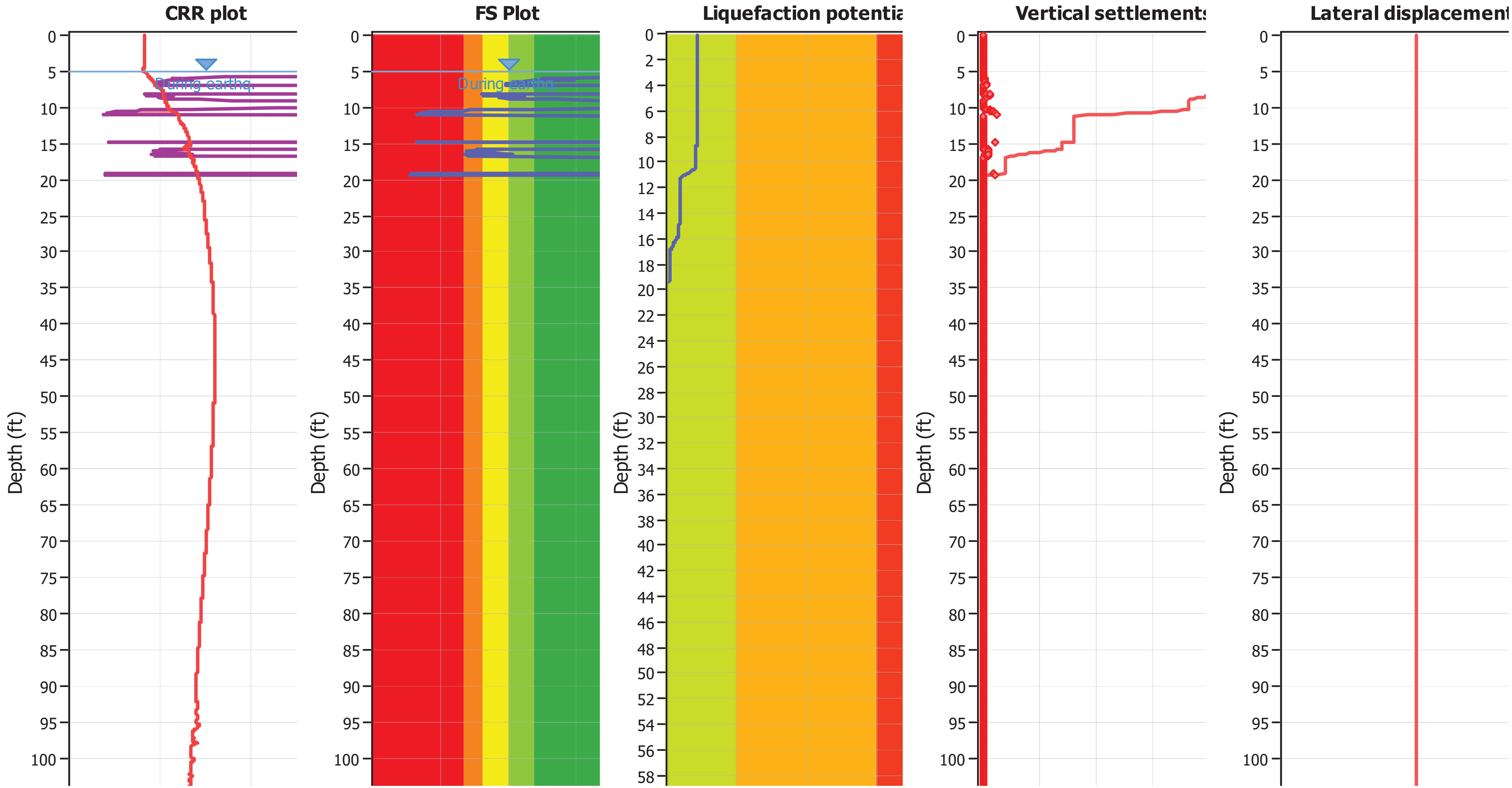
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CLE: ROBERTSON

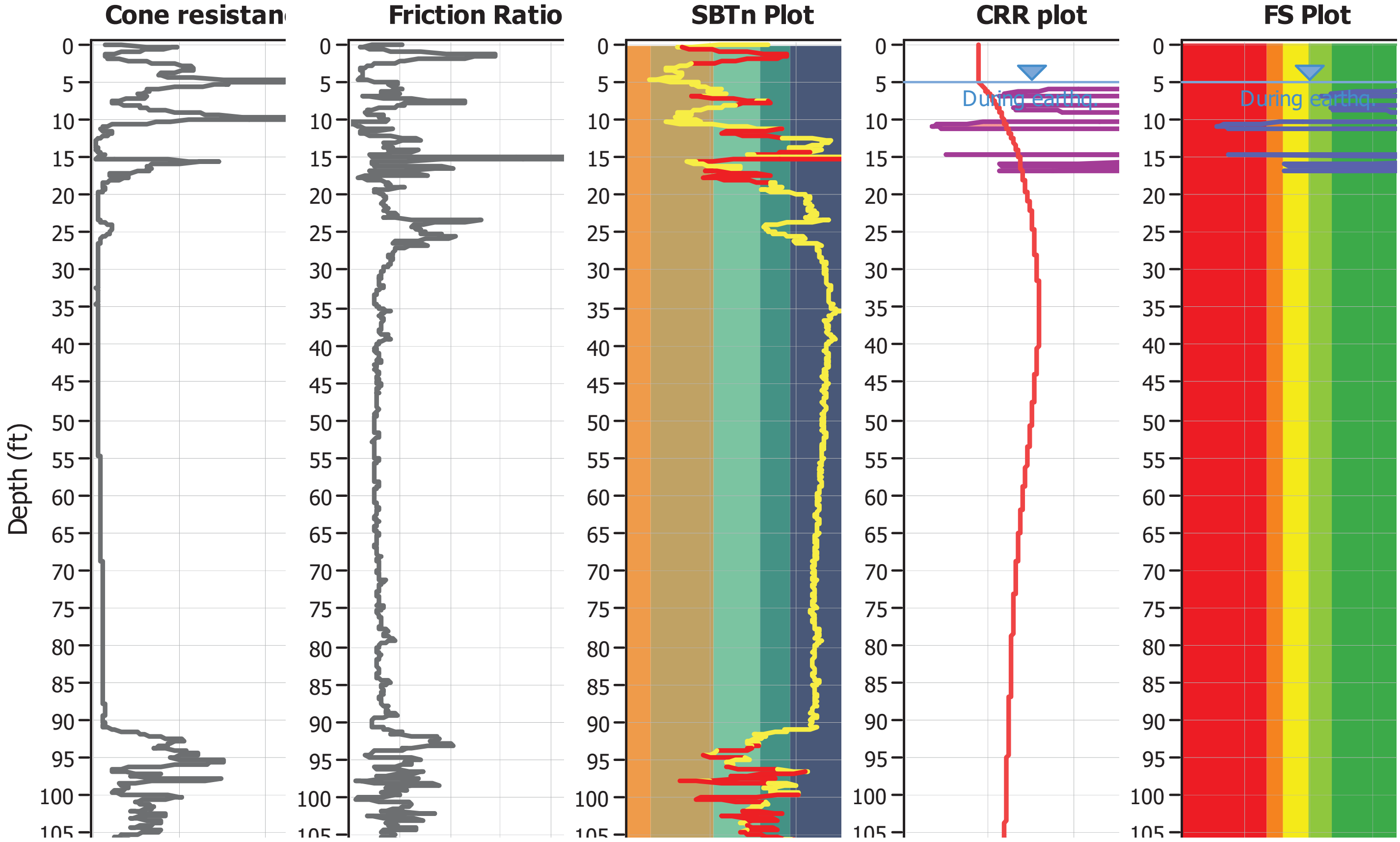
LIQUEFACTION ANALYSIS REPORT

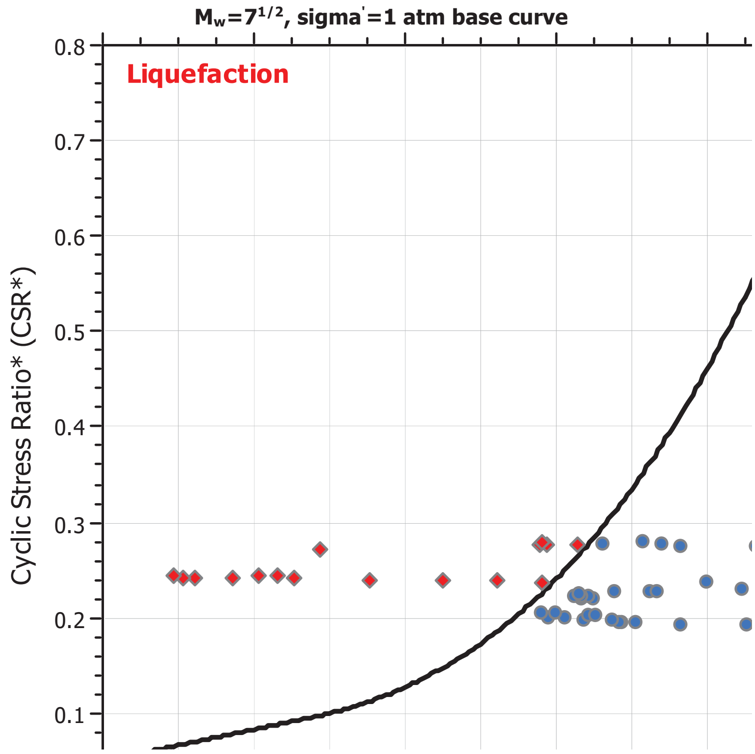
Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

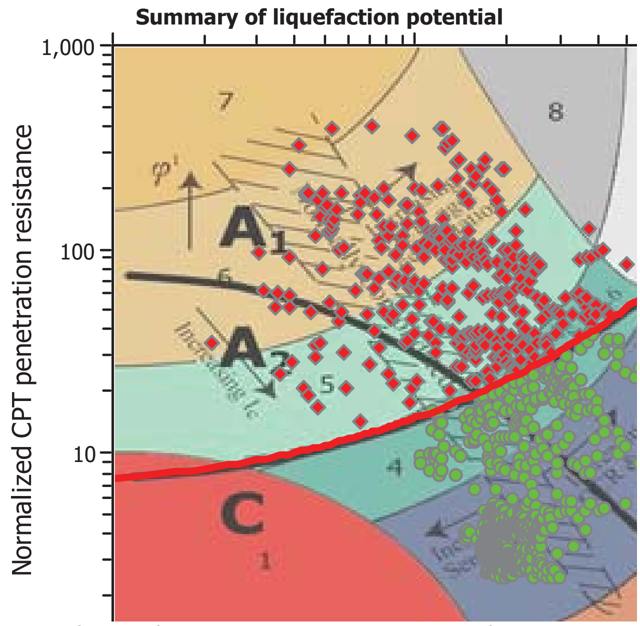
CPT file : 1-sCPT02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	90.00 ft
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.30	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

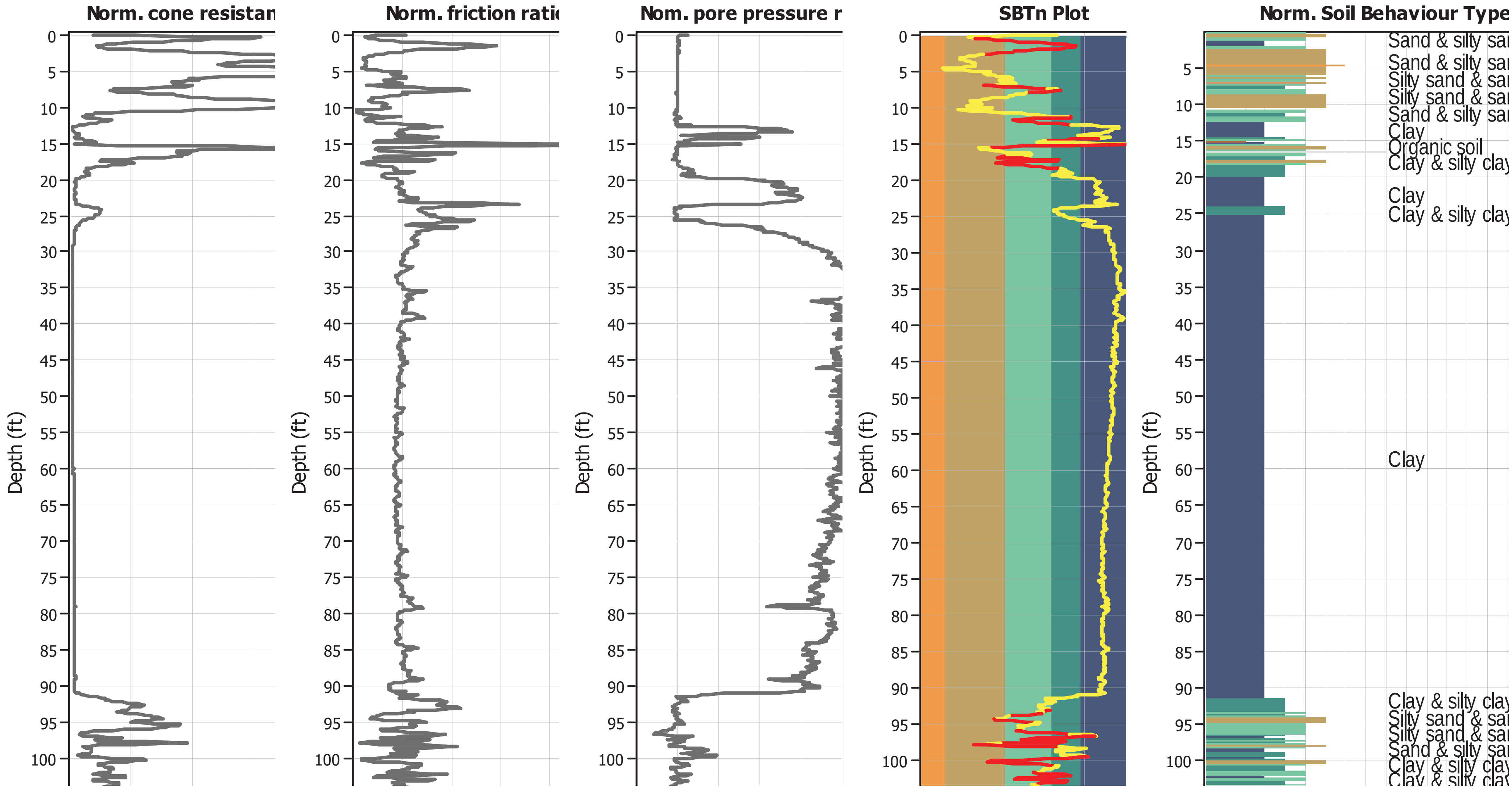






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



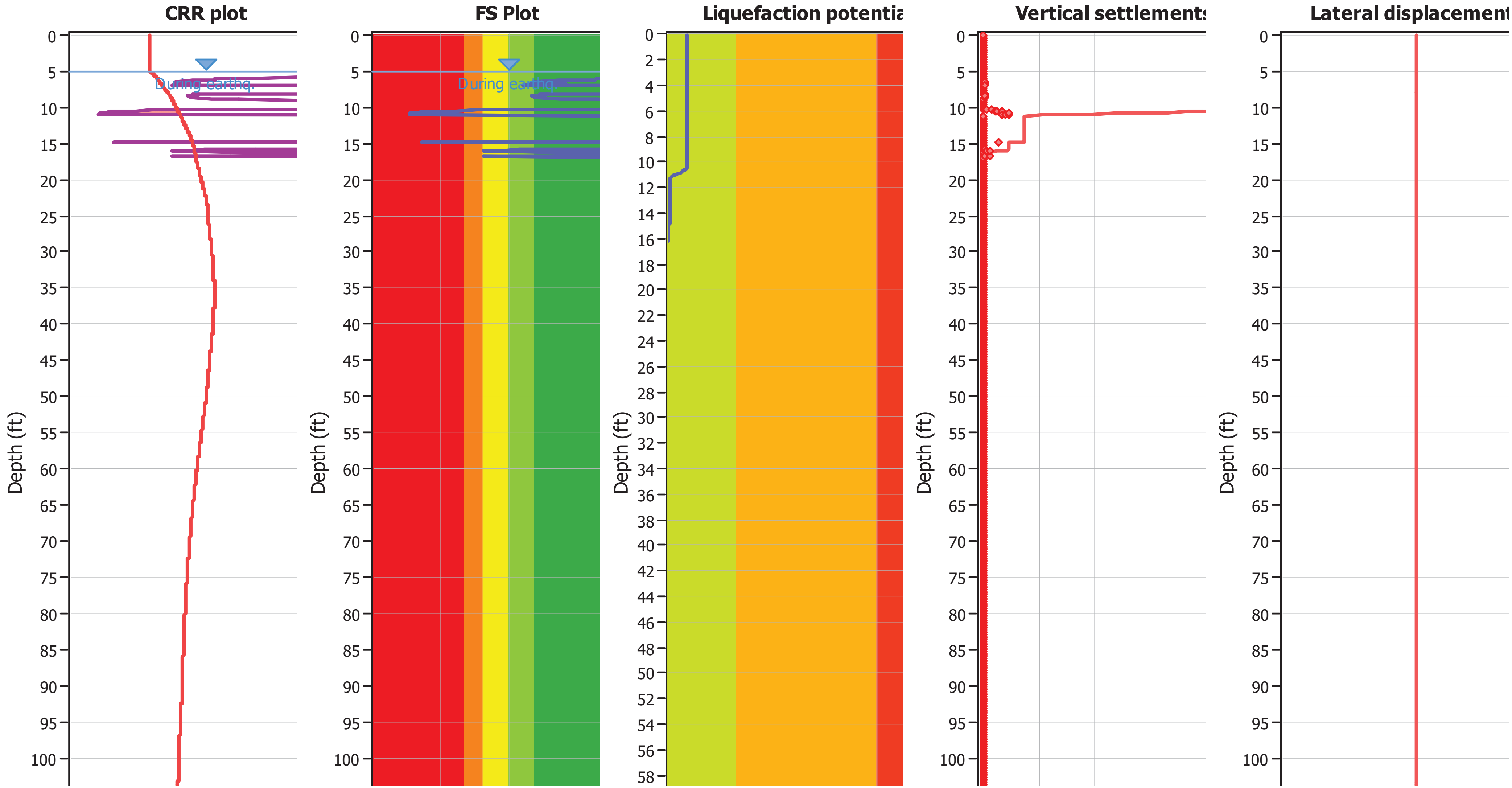
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

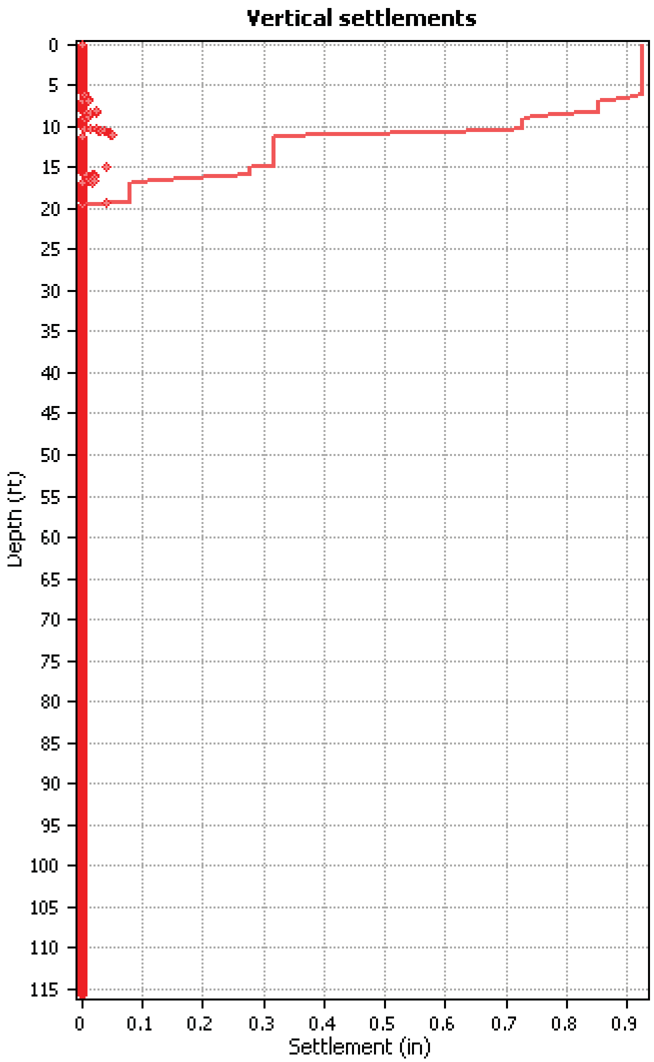
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

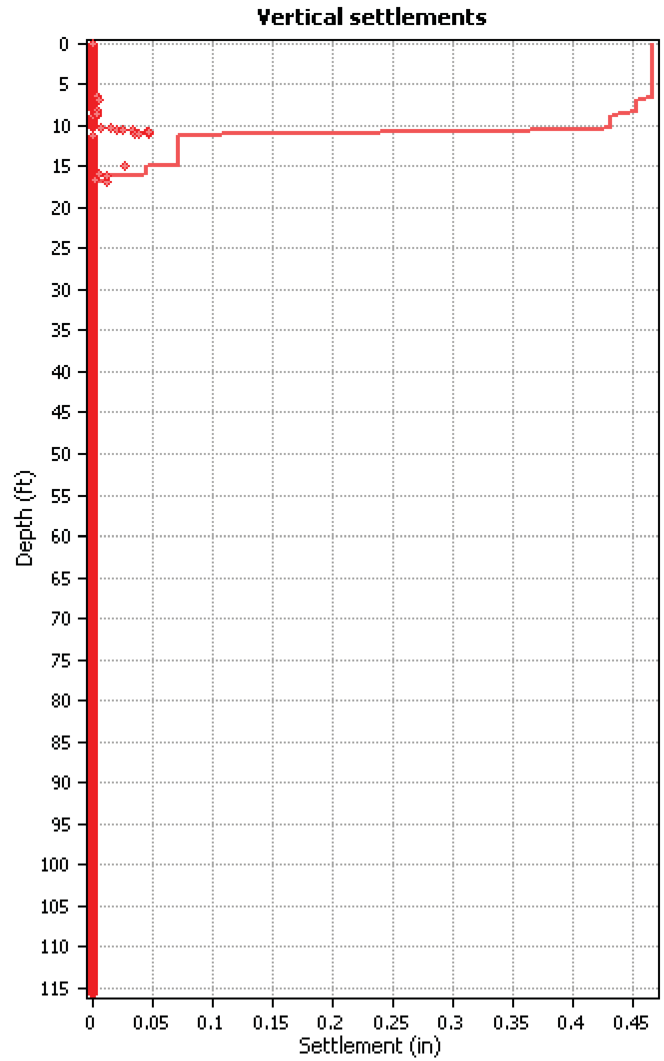
LPI color scheme

- Very high risk
- High risk
- Low risk

CLE: Idriss & Boulanger



CLE: Robertson



MCER: IDRISS & BOULANGER

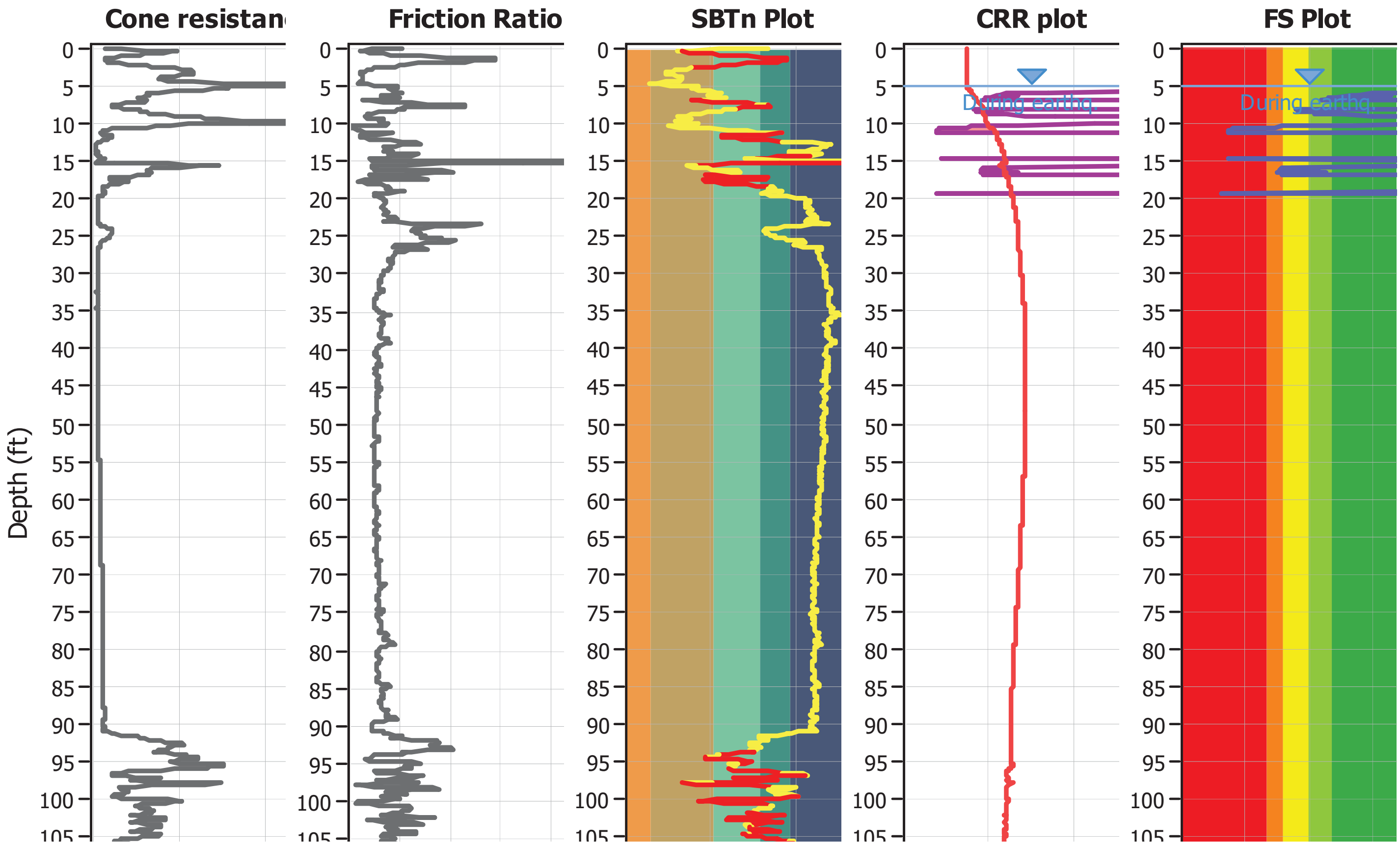
LIQUEFACTION ANALYSIS REPORT

Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

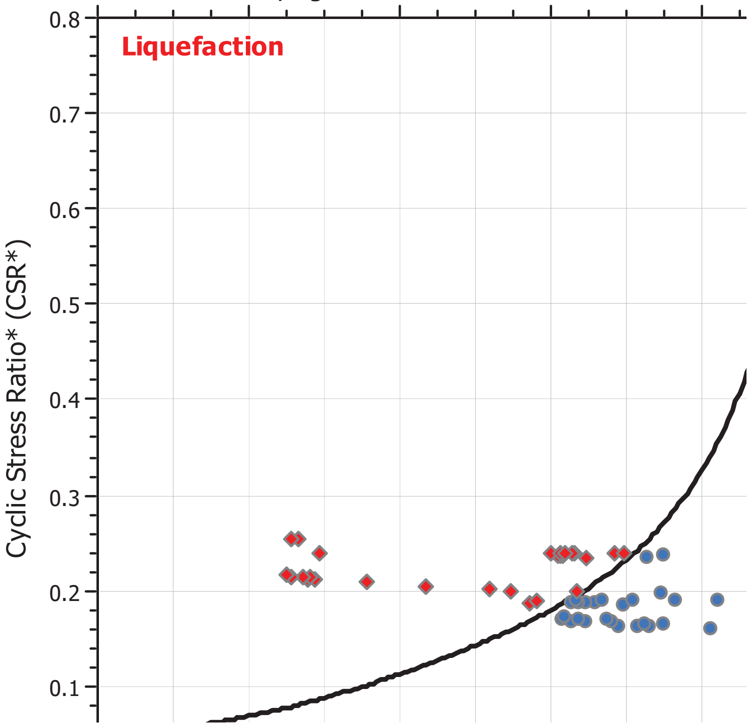
CPT file : 1-sCPT02

Input parameters and analysis data

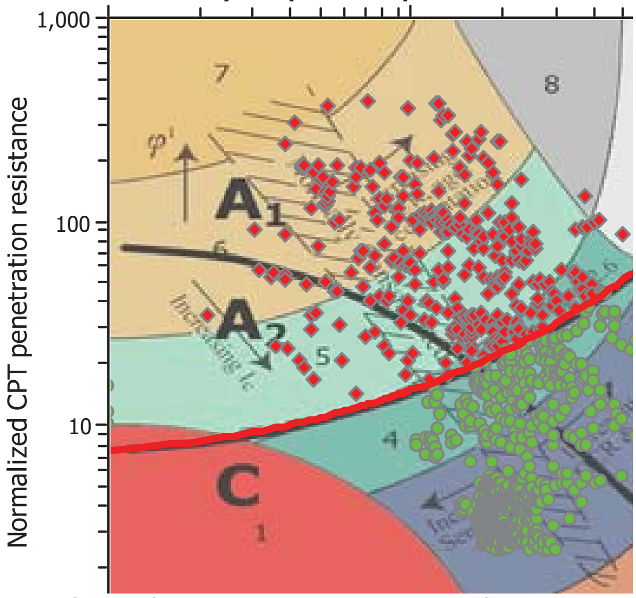
Analysis method:	I&B (2008)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	90.00 ft
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.27	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



$M_w=7^{1/2}$, sigma'=1 atm base curve

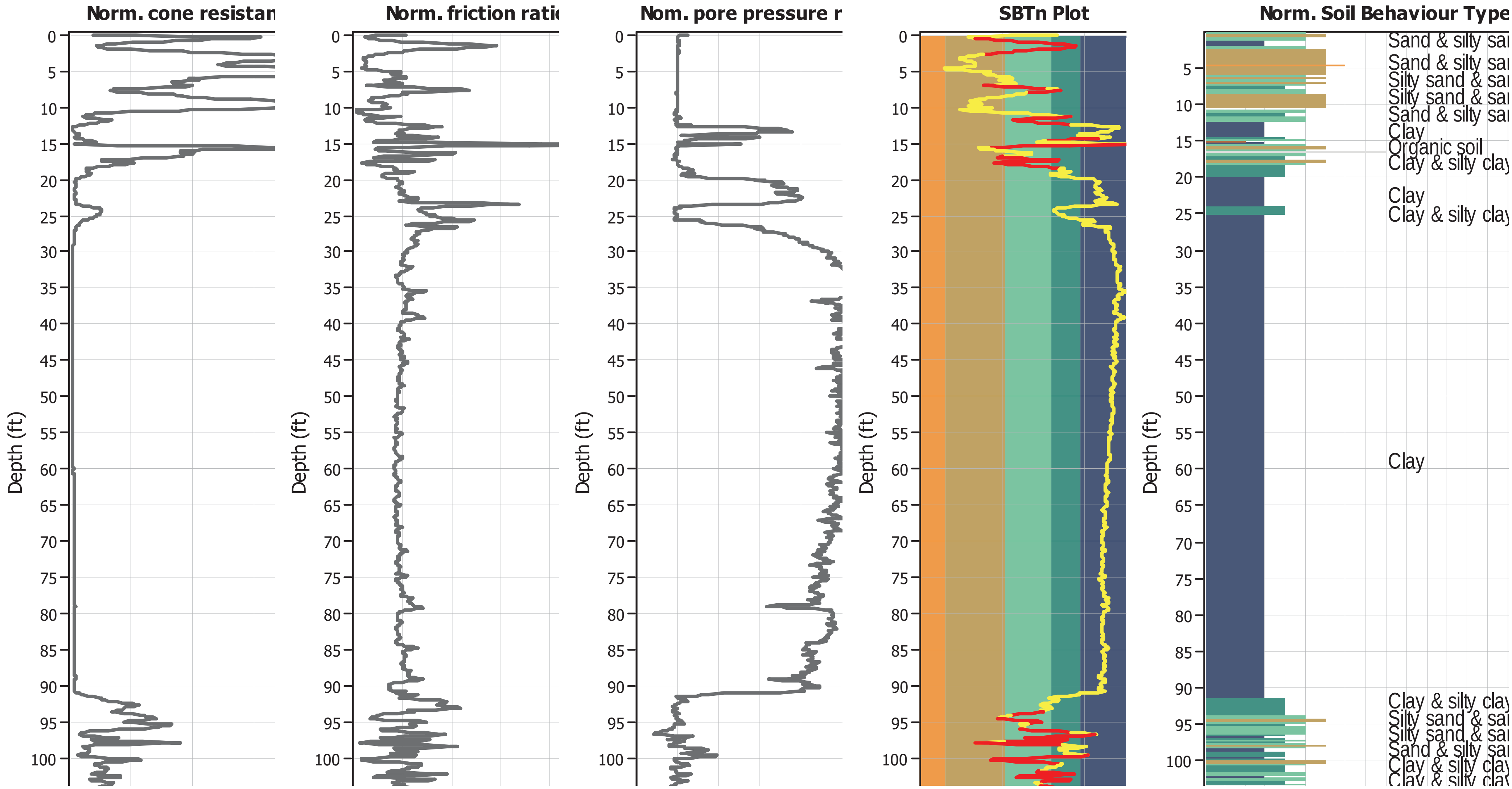


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



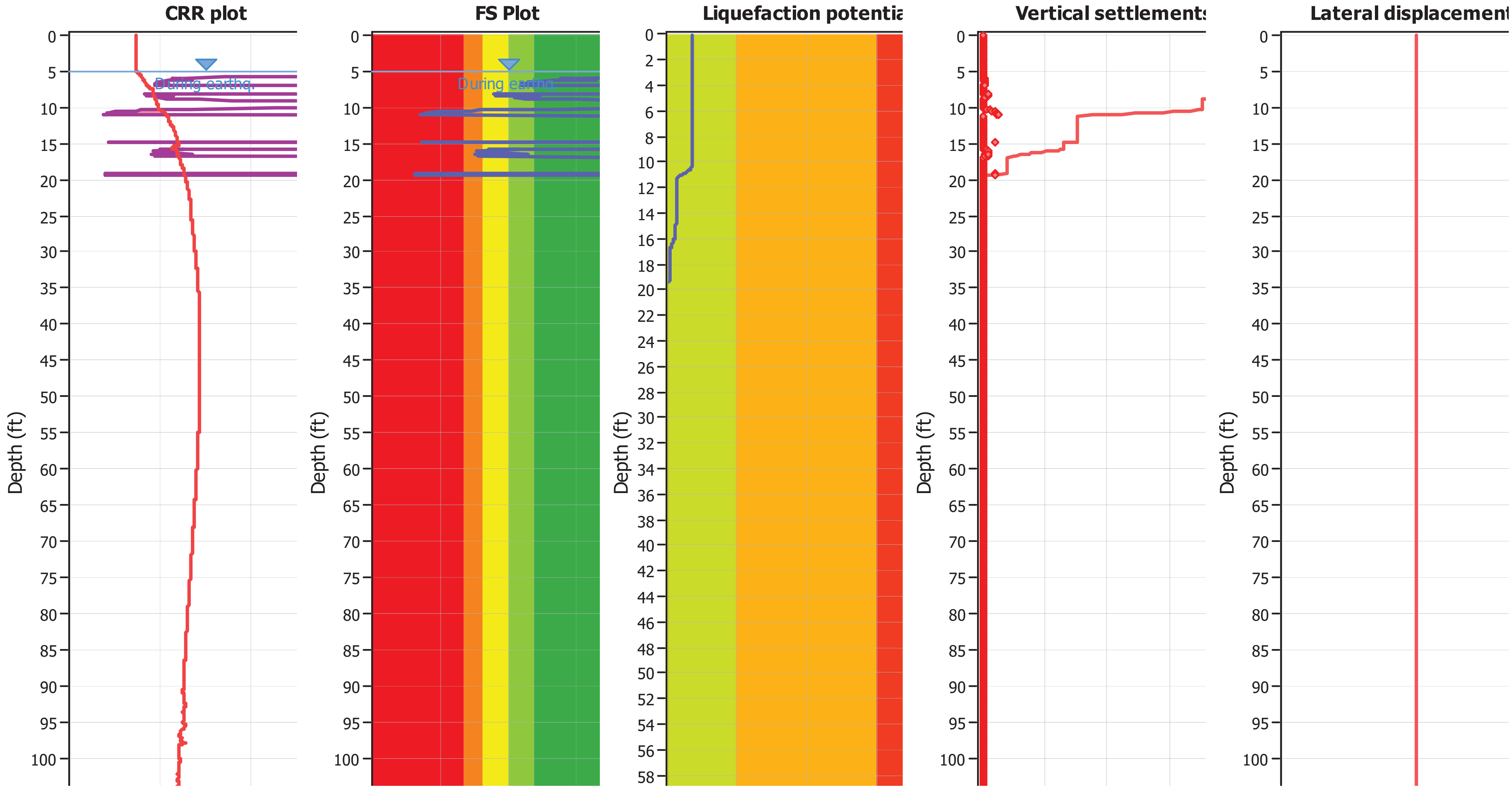
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.27	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.27	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

MCER: ROBERTSON

ENGEO

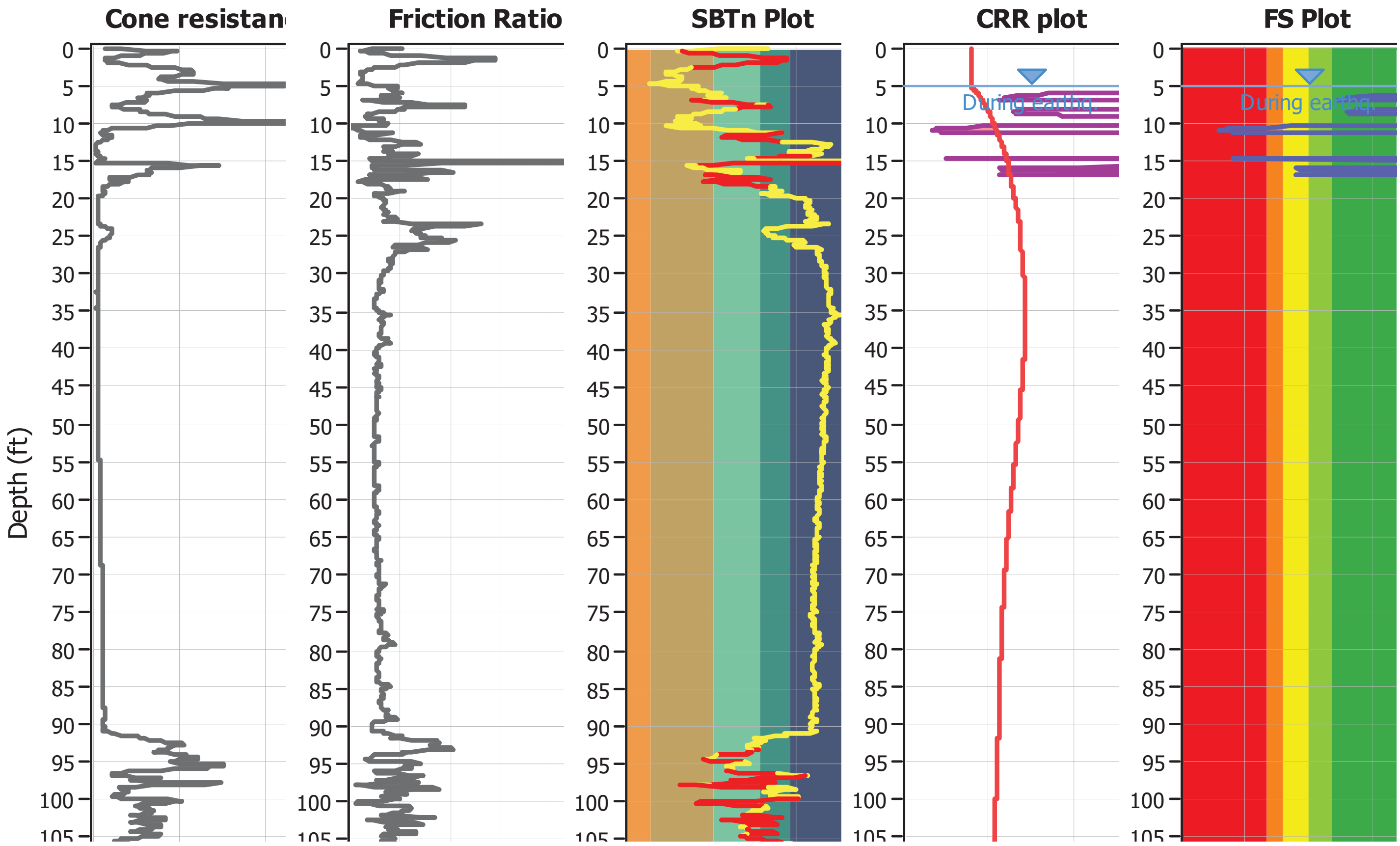
LIQUEFACTION ANALYSIS REPORT

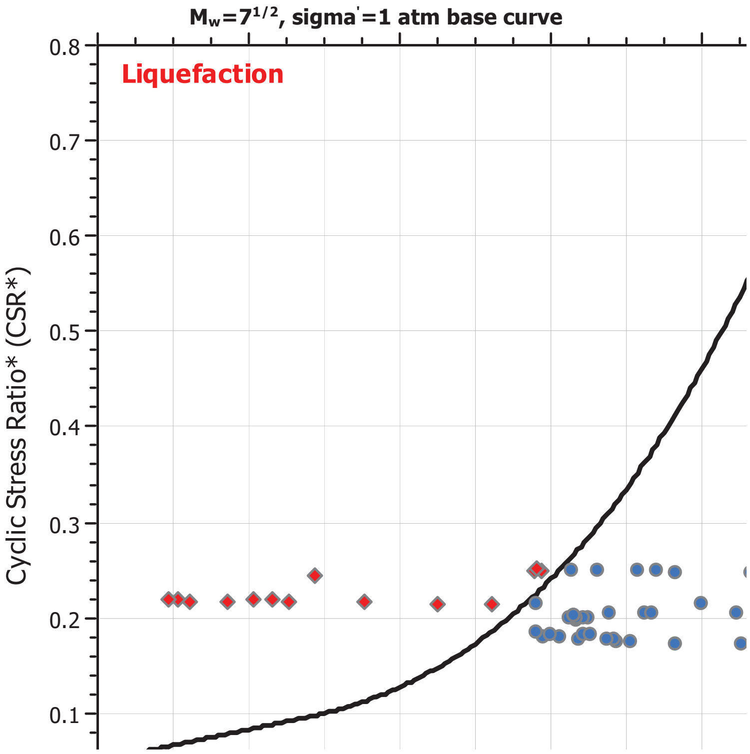
Project title : Alameda Main St Ferry Terminal **Location : Alameda, CA**

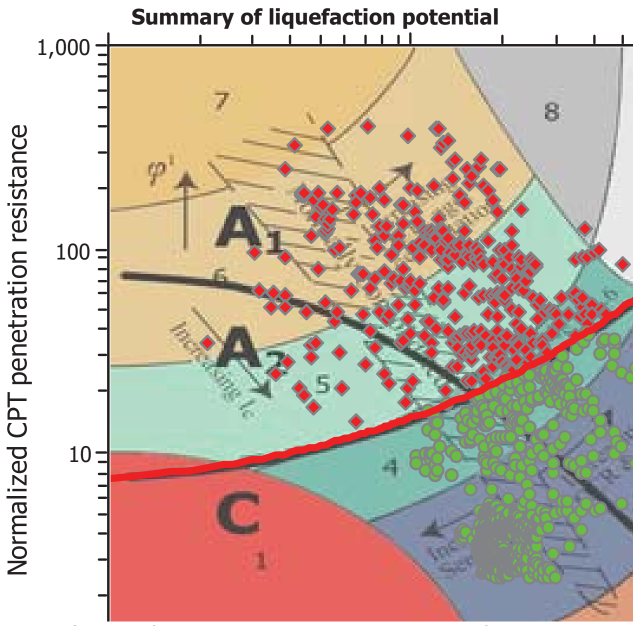
CPT file : 1-sCPT02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	90.00 ft
Earthquake magnitude M_w:	7.23	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.27	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

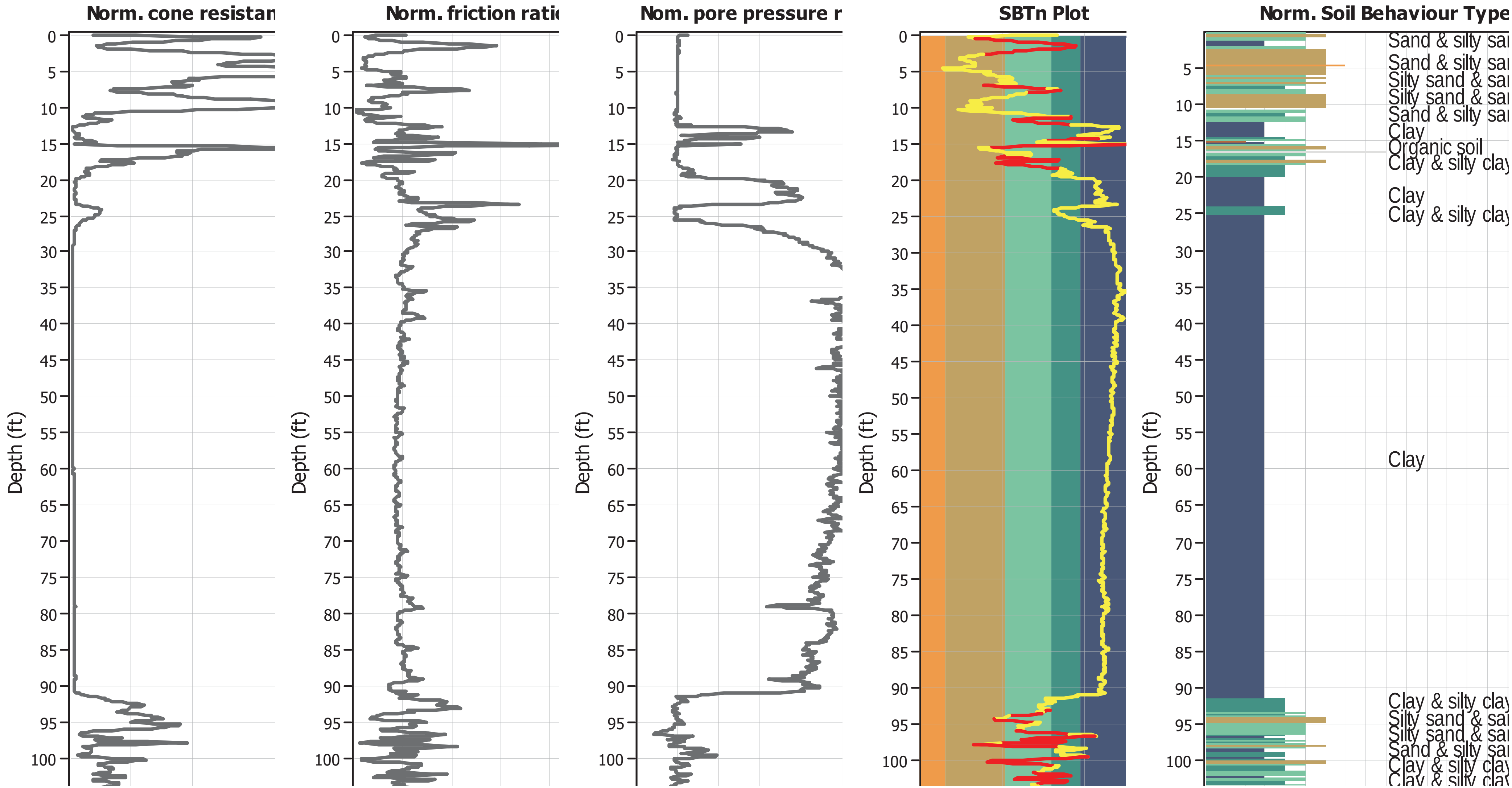






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



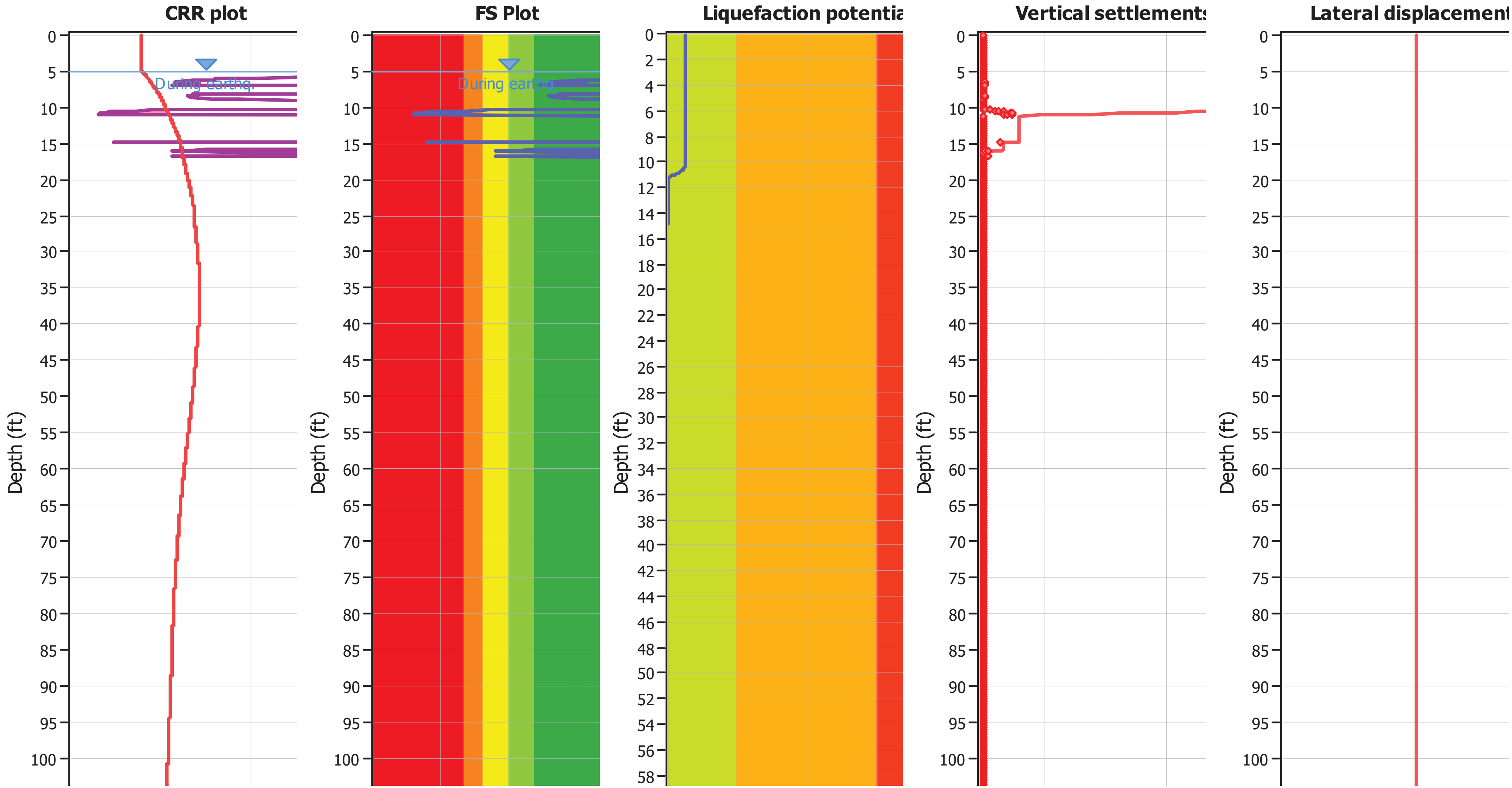
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.27	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.23	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.27	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	90.00 ft

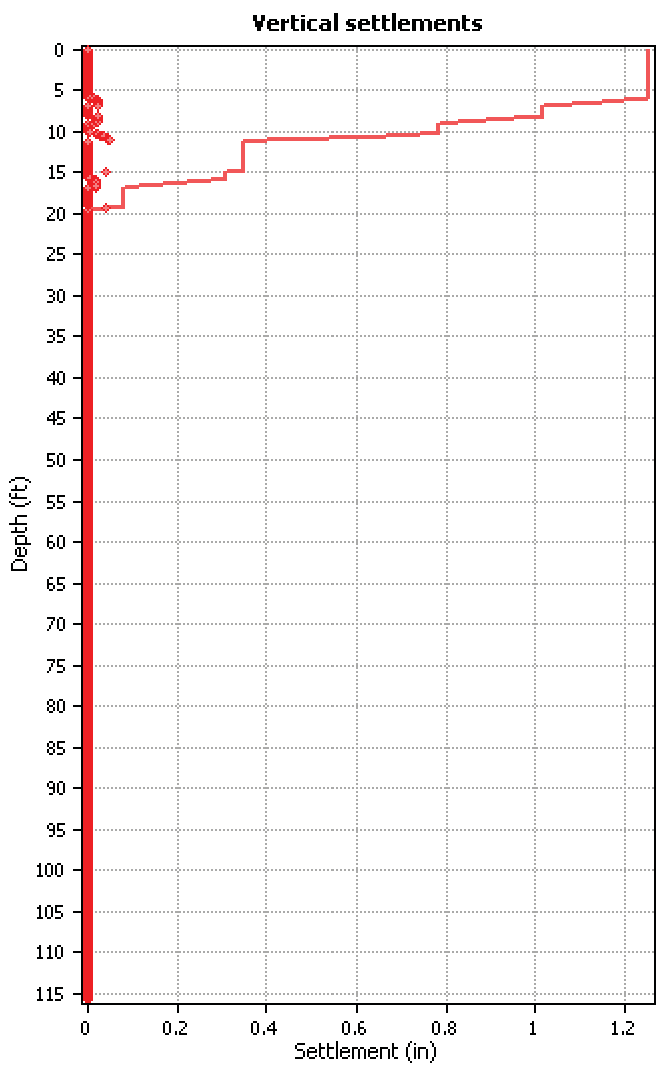
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

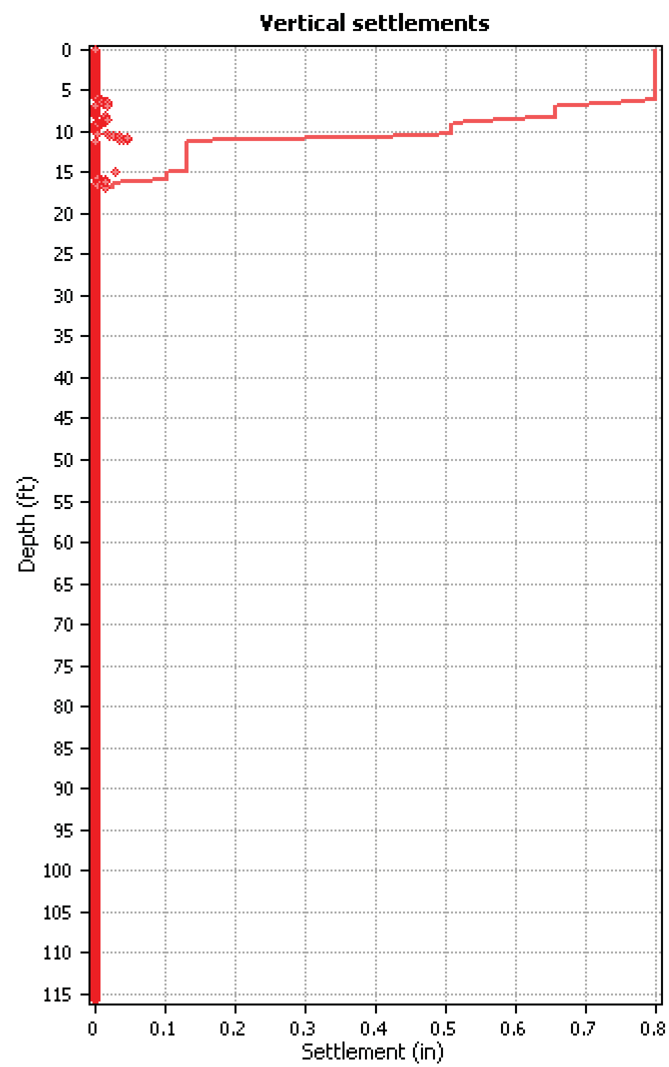
LPI color scheme

- Very high risk
- High risk
- Low risk

MCE$_R$: Idriss & Boulanger



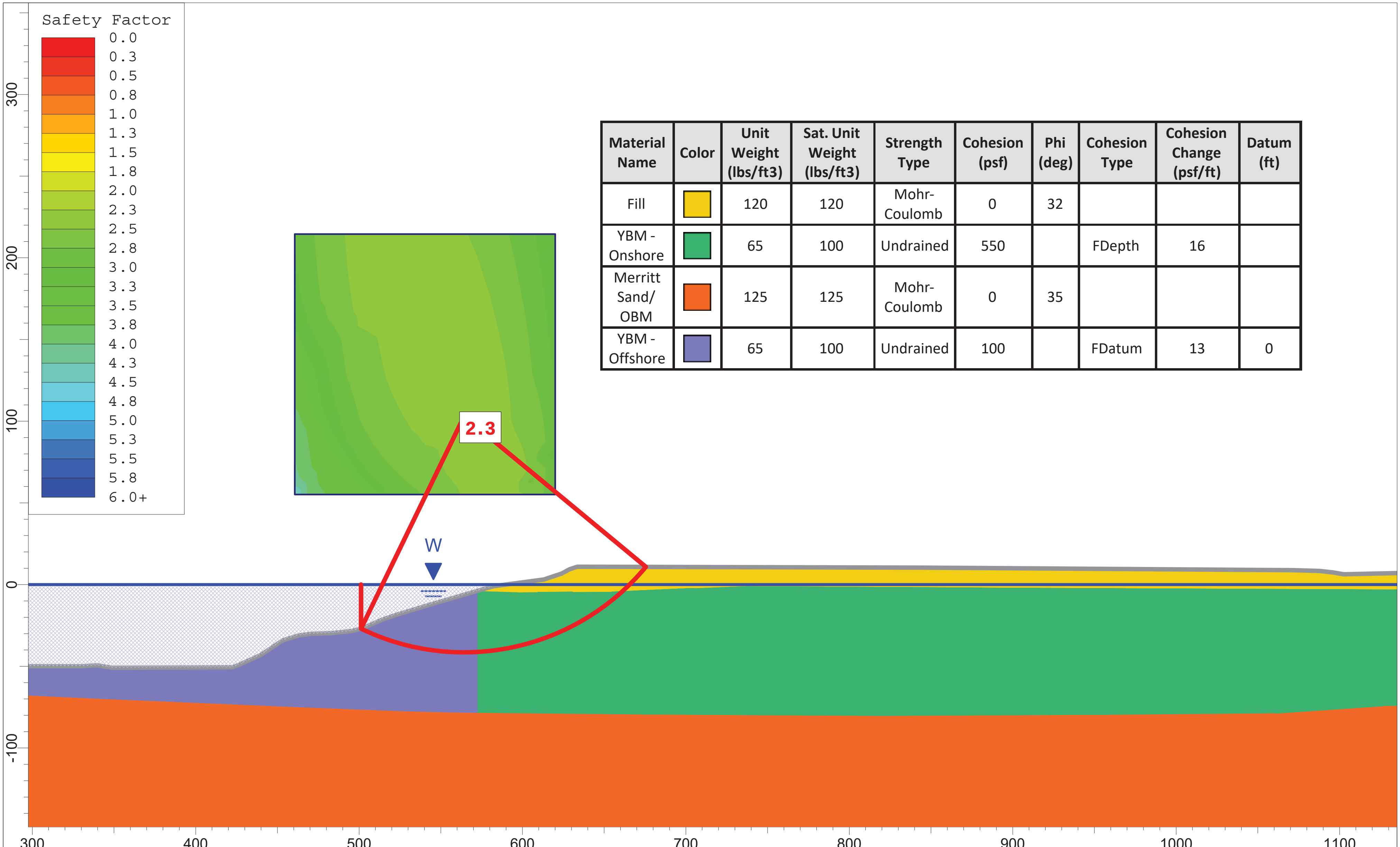
MCE$_R$: Robertson



APPENDIX E

SLOPE STABILITY ANALYSIS

STATIC ANALYSIS



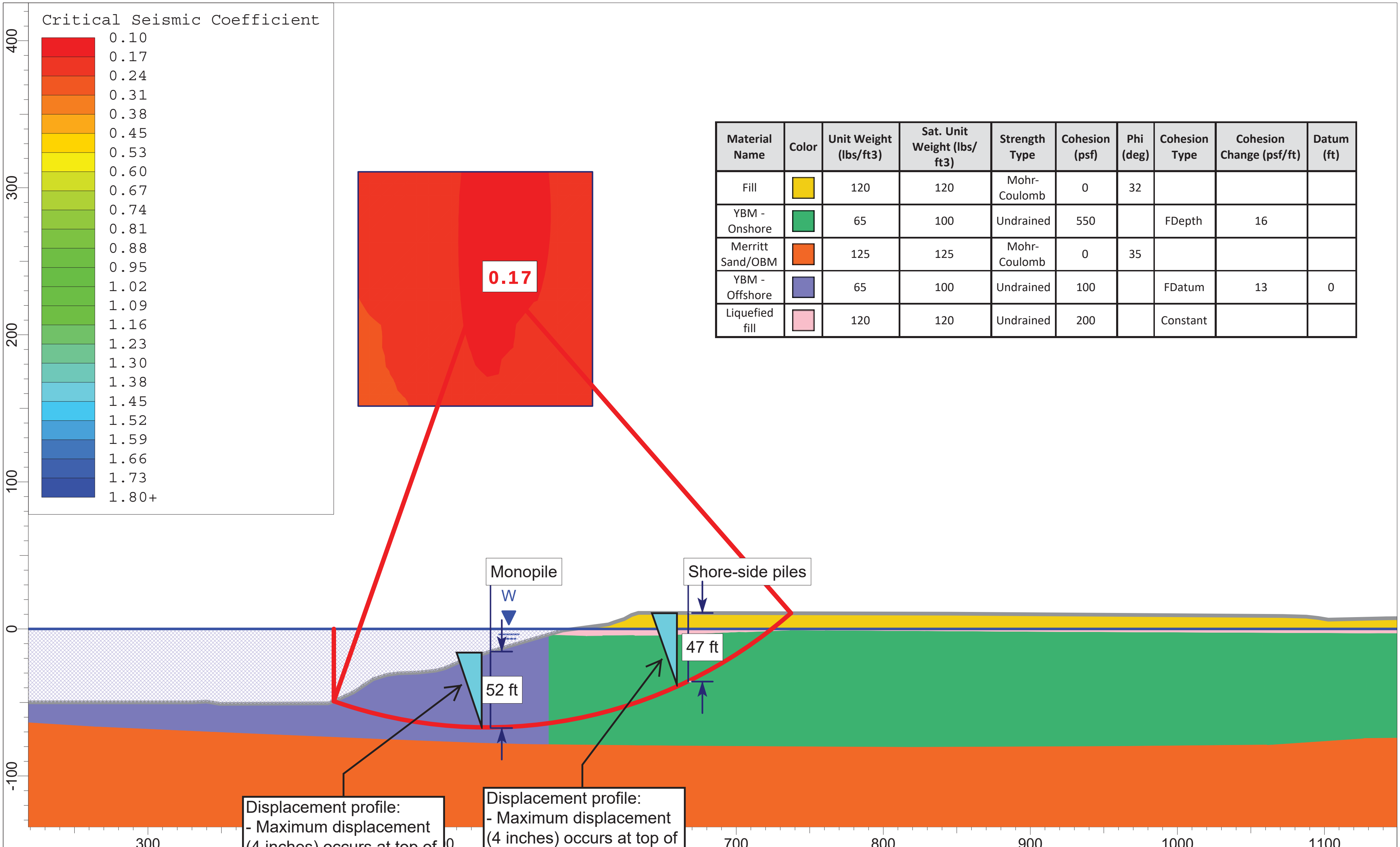
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
Merritt Sand/ OBM		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0

ENGEO

Project	Alameda Main Street Ferry Terminal		
Analysis Description	Static		
Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Static_v3.slmd

SLIDEINTERPRET 9.020

K_Y ANALYSIS: DE SCENARIO



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
Merritt Sand/OBM		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

ENGEO

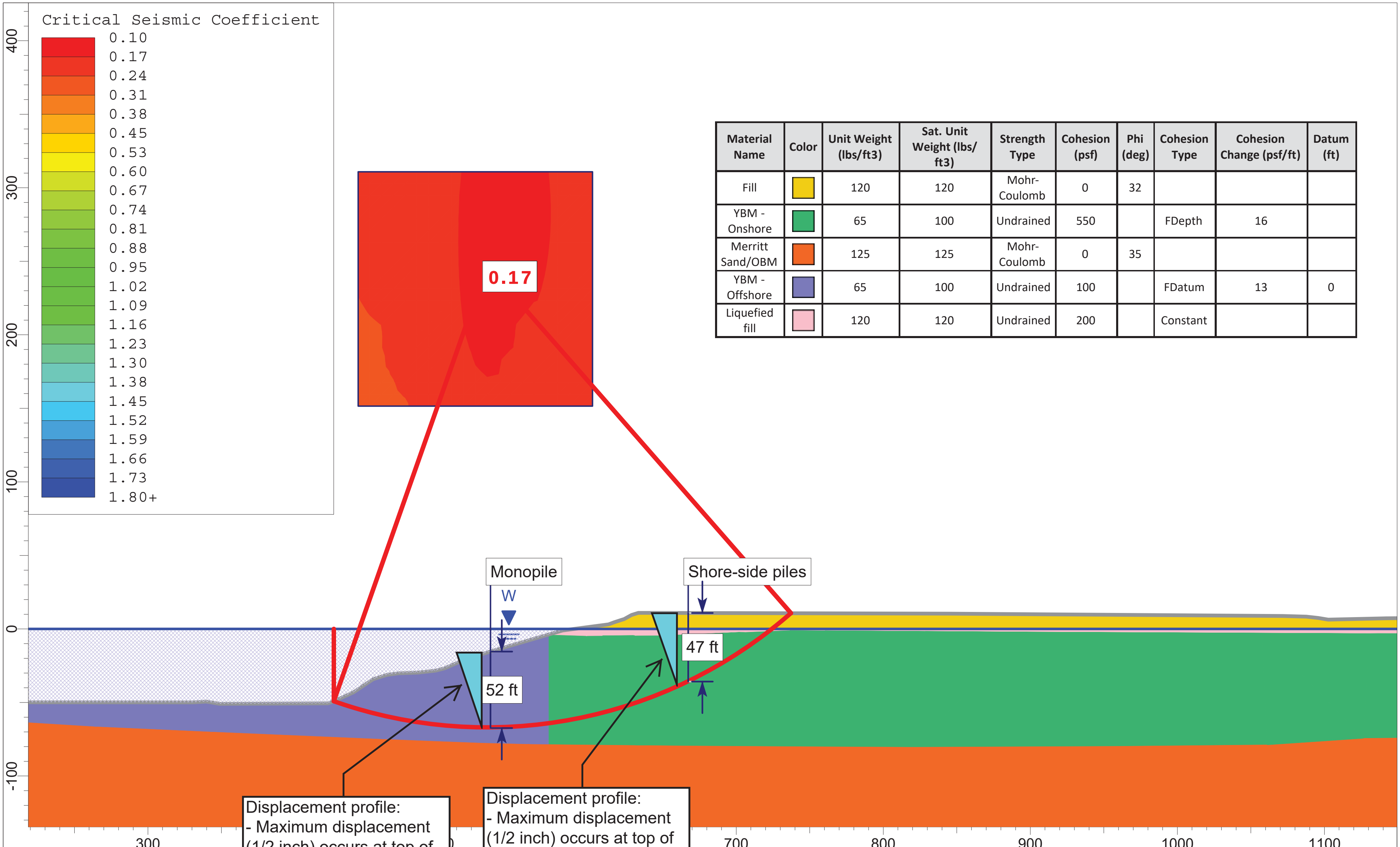
Alameda Main Street Ferry Terminal

Yield Coefficient, ky

Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Seismic - ky_TK_v4.slmd

SLIDEINTERPRET 9.020

K_Y ANALYSIS: OLE SCENARIO

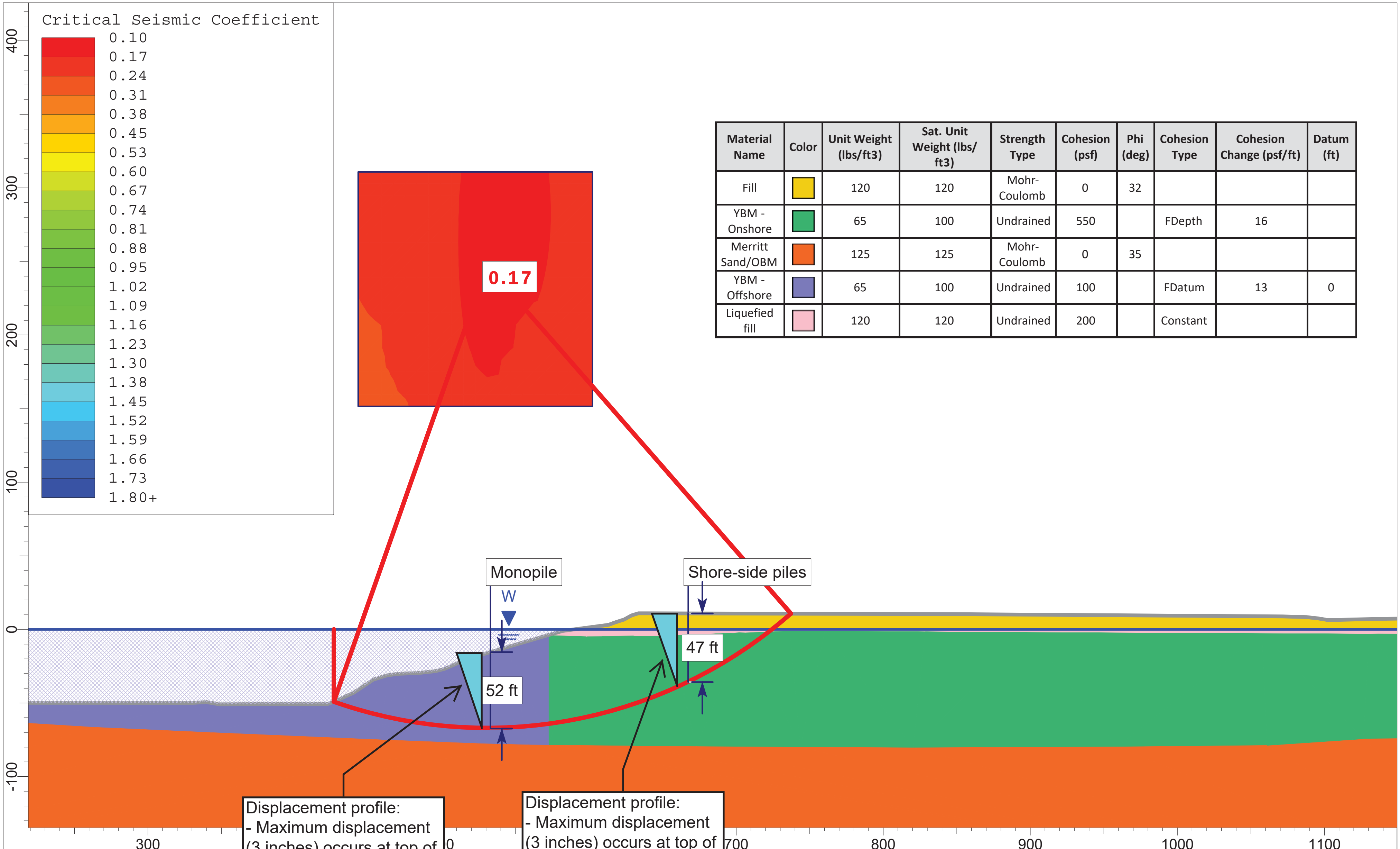


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
Merritt Sand/OBM		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

Alameda Main Street Ferry Terminal			
Yield Coefficient, ky			
Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Seismic - ky_TK_v4.slmd

SLIDEINTERPRET 9.020

K_Y ANALYSIS: CLE SCENARIO



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
Merritt Sand/OBM		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

ENGEO

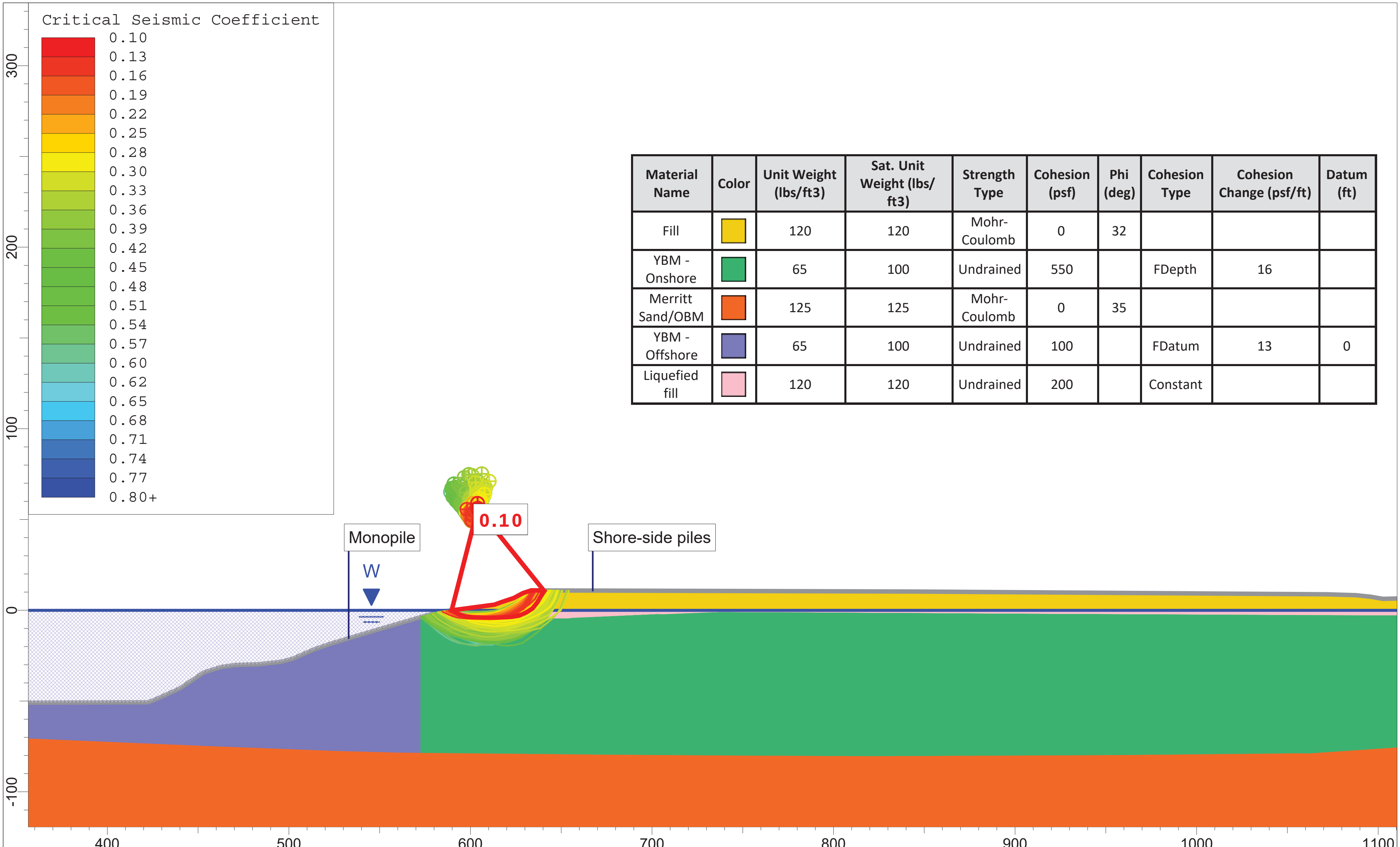
Alameda Main Street Ferry Terminal

Yield Coefficient, ky

Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Seismic - ky_TK_v4.slmd

SLIDEINTERPRET 9.020

K_Y ANALYSIS: FAILURE THROUGH LIQUEFIED MATERIAL

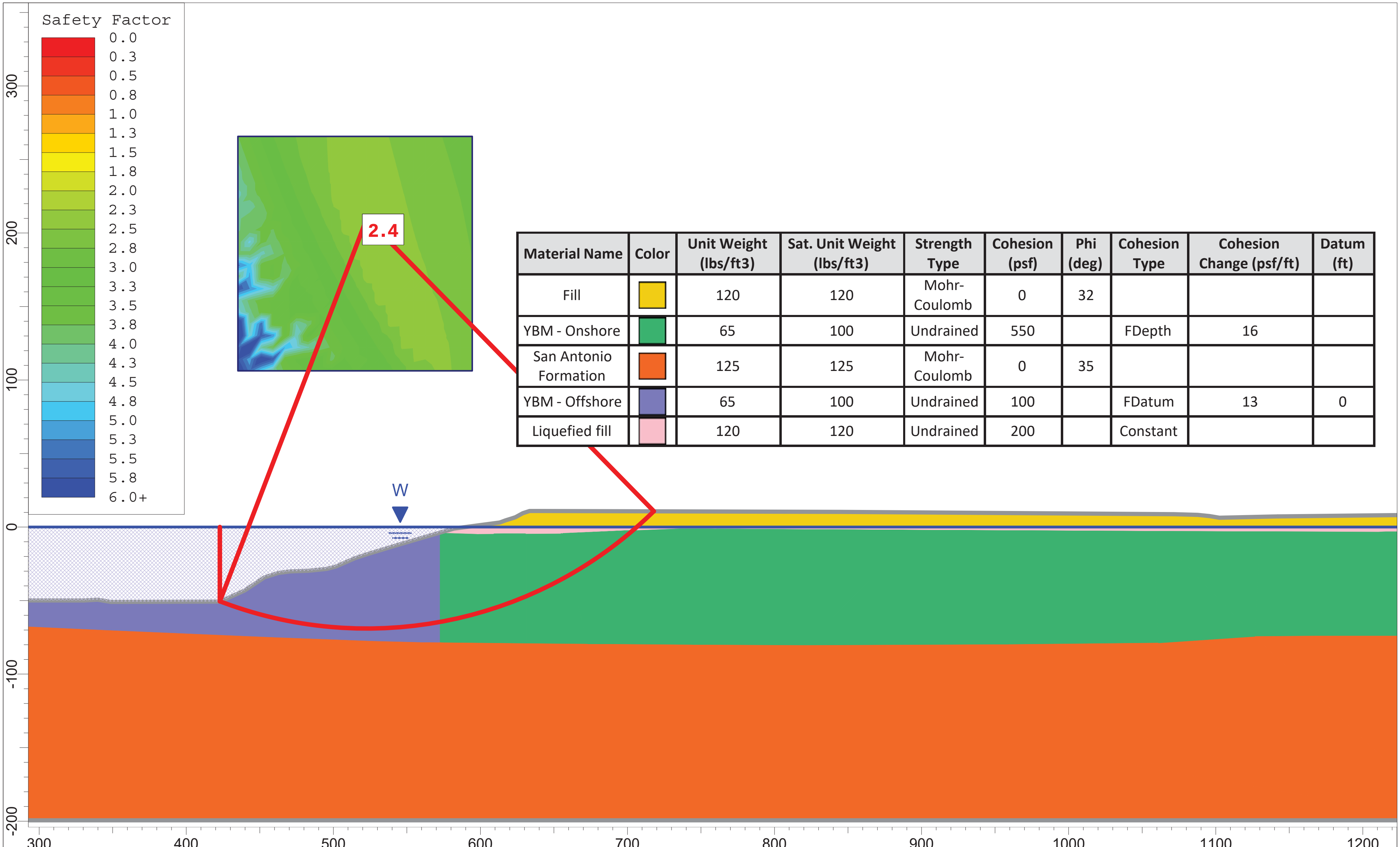


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
Merritt Sand/OBM		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

Project	Alameda Main Street Ferry Terminal		
Analysis Description	Yield Coefficient, ky		
Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Seismic - ky_TK_v4 non-circular.slmd

SLIDEINTERPRET 9.020

POST-LIQUEFACTION FLOW ANALYSIS



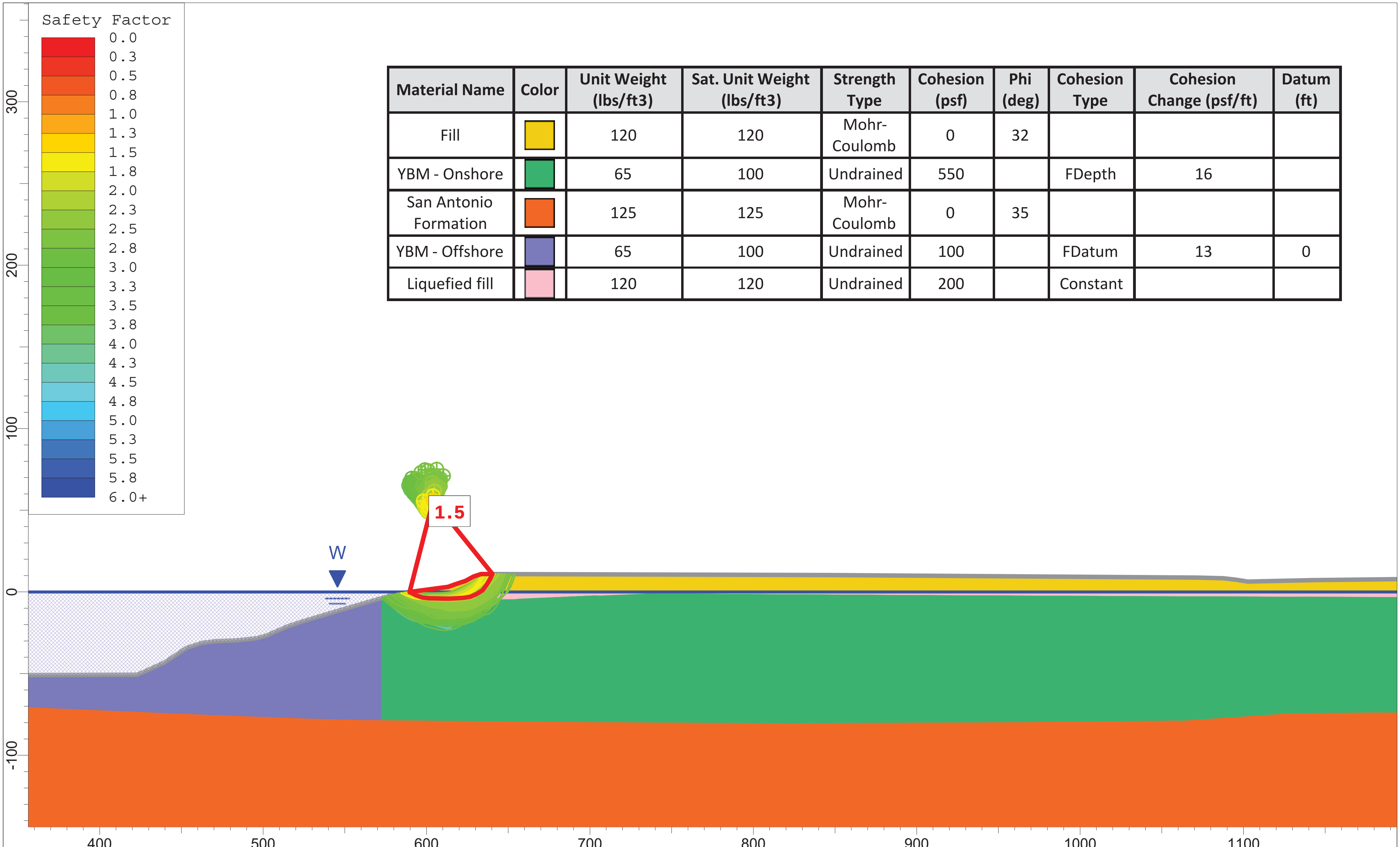
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
San Antonio Formation		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

ENGEO

SLIDEINTERPRET 9.020

Project	Alameda Main Street Ferry Terminal		
Analysis Description	Post-liquefaction Flow		
Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Post-liquefaction Flow.slmd

POST-LIQUEFACTION FLOW ANALYSIS: FAILURE THROUGH LIQUEFIED MATERIAL



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		120	120	Mohr-Coulomb	0	32			
YBM - Onshore		65	100	Undrained	550		FDepth	16	
San Antonio Formation		125	125	Mohr-Coulomb	0	35			
YBM - Offshore		65	100	Undrained	100		FDatum	13	0
Liquefied fill		120	120	Undrained	200		Constant		

Project	Alameda Main Street Ferry Terminal		
Analysis Description	Post-liquefaction Flow		
Analyzed by	TK	*Company*	ENGEO
Date	1/12/22	*File Name*	Section A - Post-liquefaction Flow.slmd

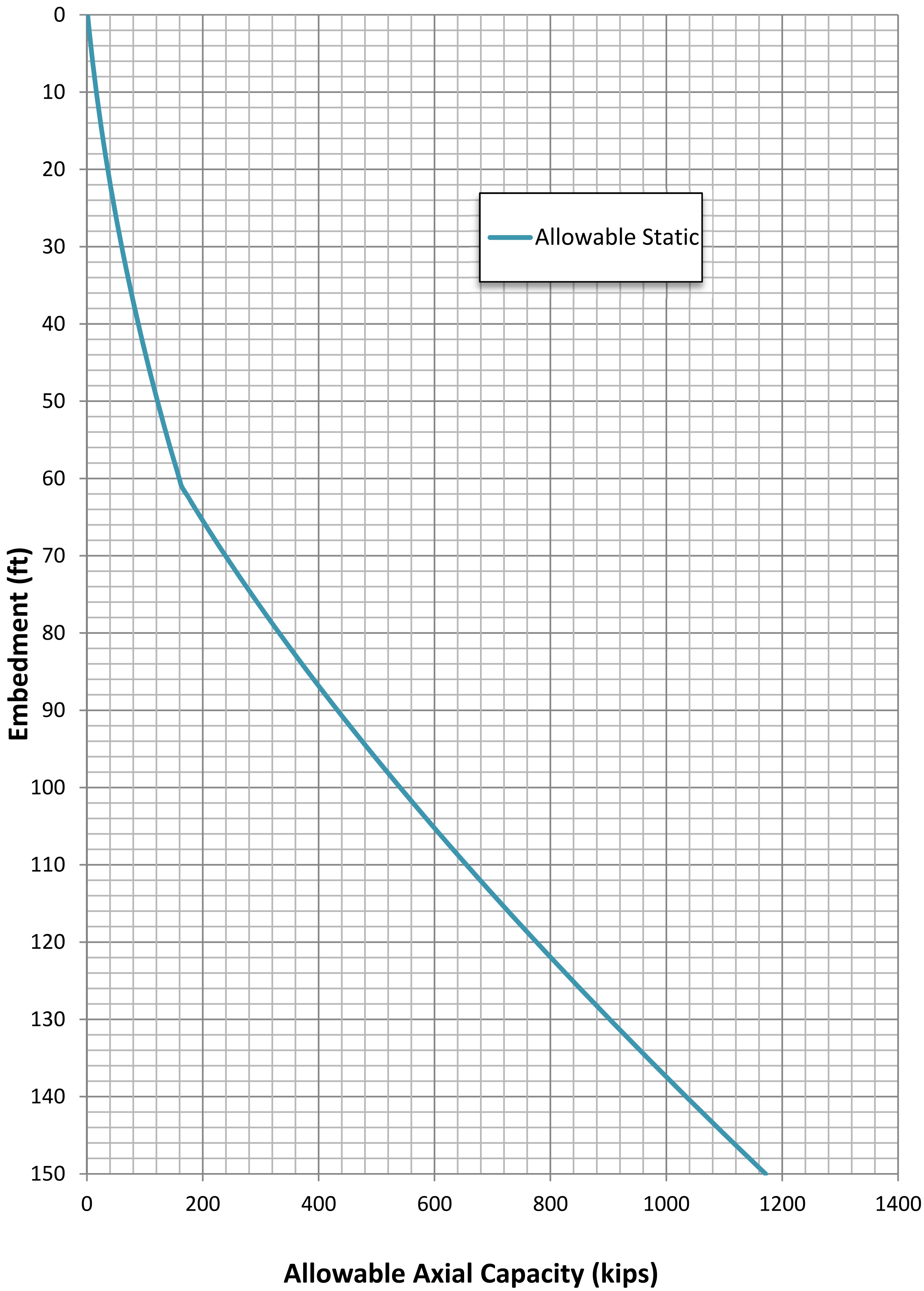
ENGEO

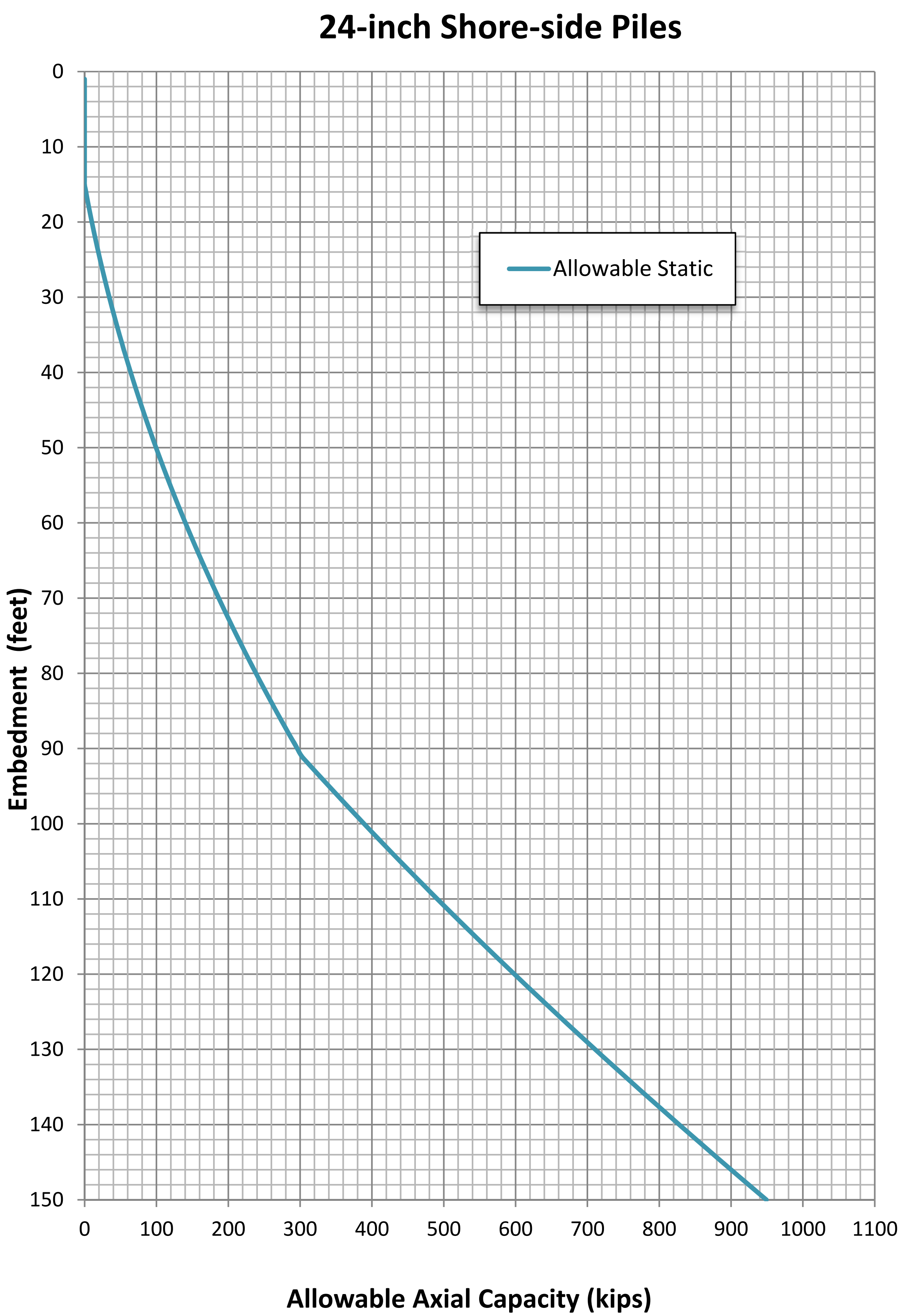
SLIDEINTERPRET 9.020

APPENDIX F

VERTICAL PILE CAPACITY ANALYSIS

48-inch Monopile




24-inch Shore-side Piles
Allowable Static
Embedment (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
0
100
200
300
400
500
600
700
800
900
1000
1100
Allowable Axial Capacity (kips)

APPENDIX G

LATERAL PILE ANALYSIS: SOIL SPRINGS

Section	Monopile - 48" Diameter											
Upper Bound												
Material	Depth Below Mudline (ft.)	Elevation (MLLW ft.)	P0 (lbs/in)	Y0 (in)	P1 (lbs/in)	Y1 (in)	P2 (lbs/in)	Y2 (in)	P3 (lbs/in)	Y3 (in)	P4 (lbs/in)	Y4 (in)
YBM	0.1	-20.1	0	0	185	1.23	309	5.69	463	19.20	463	20.40
YBM	61.9	-81.9	0	0	1757	1.23	3221	7.57	4392	19.20	4392	20.40
San Antonio	62.1	-82.1	0	0	26821	0.40	37511	0.81	40673	1.51	40747	1.61
San Antonio	107.0	-127.0	0	0	64005	0.56	89513	1.12	97060	2.09	97235	2.23

Section	Monopile - 48" Diameter											
Lower Bound												
Material	Depth Below Mudline (ft.)	Elevation (MLLW ft.)	P0 (lbs/in)	Y0 (in)	P1 (lbs/in)	Y1 (in)	P2 (lbs/in)	Y2 (in)	P3 (lbs/in)	Y3 (in)	P4 (lbs/in)	Y4 (in)
YBM	0.1	-20.1	0	0	119	1.23	198	5.69	296	19.20	296	20.40
YBM	61.9	-81.9	0	0	1124	1.23	2061	7.57	2811	19.20	2811	20.40
San Antonio	62.1	-82.1	0	0	17166	0.40	24007	0.81	26031	1.51	26078	1.61
San Antonio	107.0	-127.0	0	0	40963	0.56	57288	1.12	62119	2.09	62230	2.23

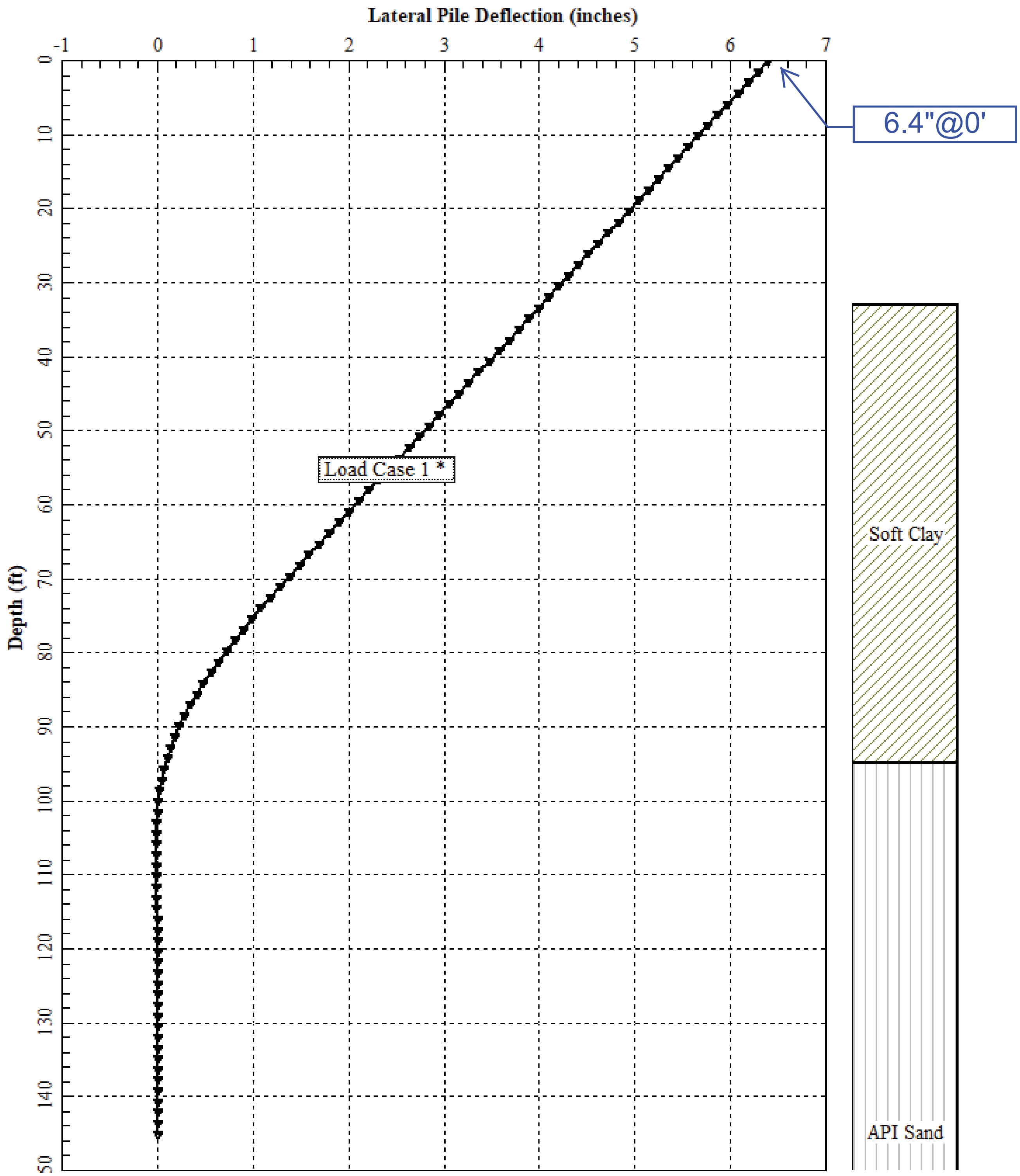
Section	Shoreside-24" Diameter												
Upper Bound													
Material	Depth Below Grade (ft.)	Elevation (MLLW ft.)	P0 (lbs/in)	Y0 (in)	P1 (lbs/in)	Y1 (in)	P2 (lbs/in)	Y2 (in)	P3 (lbs/in)	Y3 (in)	P4 (lbs/in)	Y4 (in)
Artificial Fill (Non-liquefiable)	0.1	12.4	0	0	15	0.14	20	0.25	22	0.46	23	0.57
Artificial Fill (Non-liquefiable)	4.9	7.6	0	0	2474	0.22	3318	0.38	3673	0.60	3758	0.87
Artificial Fill (Liquefiable)	5.1	7.4	0	0	52	0.20	126	0.41	239	0.68	398	1.07
Artificial Fill (Liquefiable)	9.9	2.6	0	0	58	0.13	134	0.26	245	0.44	398	0.69
YBM	10.1	2.4	0	0	345	0.36	621	2.07	1034	9.60	1034	10.20
YBM	91.9	-79.4	0	0	1103	0.36	1985	2.07	3308	9.60	3308	10.20
San Antonio	92.1	-79.6	0	0	26685	0.27	37320	0.55	40466	1.02	40539	1.09
San Antonio	100.0	-87.5	0	0	30370	0.28	42473	0.57	46055	1.06	46137	1.13

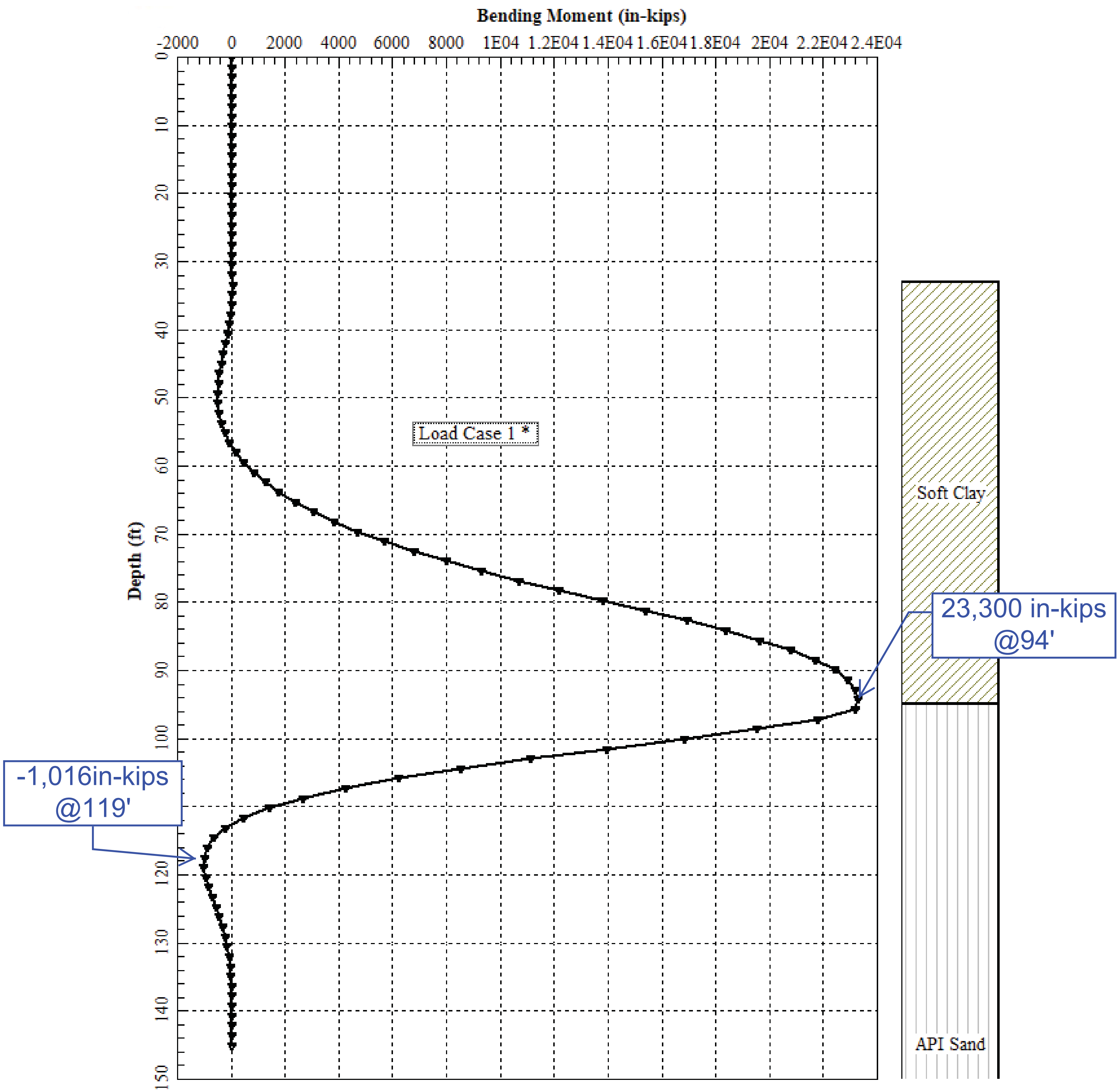
Section	Shoreside-24" Diameter											
Lower Bound												
Material	Depth Below Grade (ft.)	Elevation (MLLW ft.)	P0 (lbs/in)	Y0 (in)	P1 (lbs/in)	Y1 (in)	P2 (lbs/in)	Y2 (in)	P3 (lbs/in)	Y3 (in)	P4 (lbs/in)	Y4 (in)
Artificial Fill (Non-liquefiable)	0.1	12.4	0	0	10	0.14	13	0.25	14	0.46	14	0.57
Artificial Fill (Non-liquefiable)	4.9	7.6	0	0	1583	0.22	2124	0.38	2351	0.60	2405	0.87
Artificial Fill (Liquefiable)	5.1	7.4	0	0	34	0.20	80	0.41	153	0.68	255	1.07
Artificial Fill (Liquefiable)	9.9	2.6	0	0	37	0.13	85	0.26	157	0.44	255	0.69
YBM	10.1	2.4	0	0	221	0.36	397	2.07	662	9.60	662	10.20
YBM	91.9	-79.4	0	0	706	0.36	1270	2.07	2117	9.60	2117	10.20
San Antonio	92.1	-79.6	0	0	17078	0.27	23884	0.55	25898	1.02	25945	1.09
San Antonio	100.0	-87.5	0	0	19437	0.28	27183	0.57	29475	1.06	29528	1.13

APPENDIX H

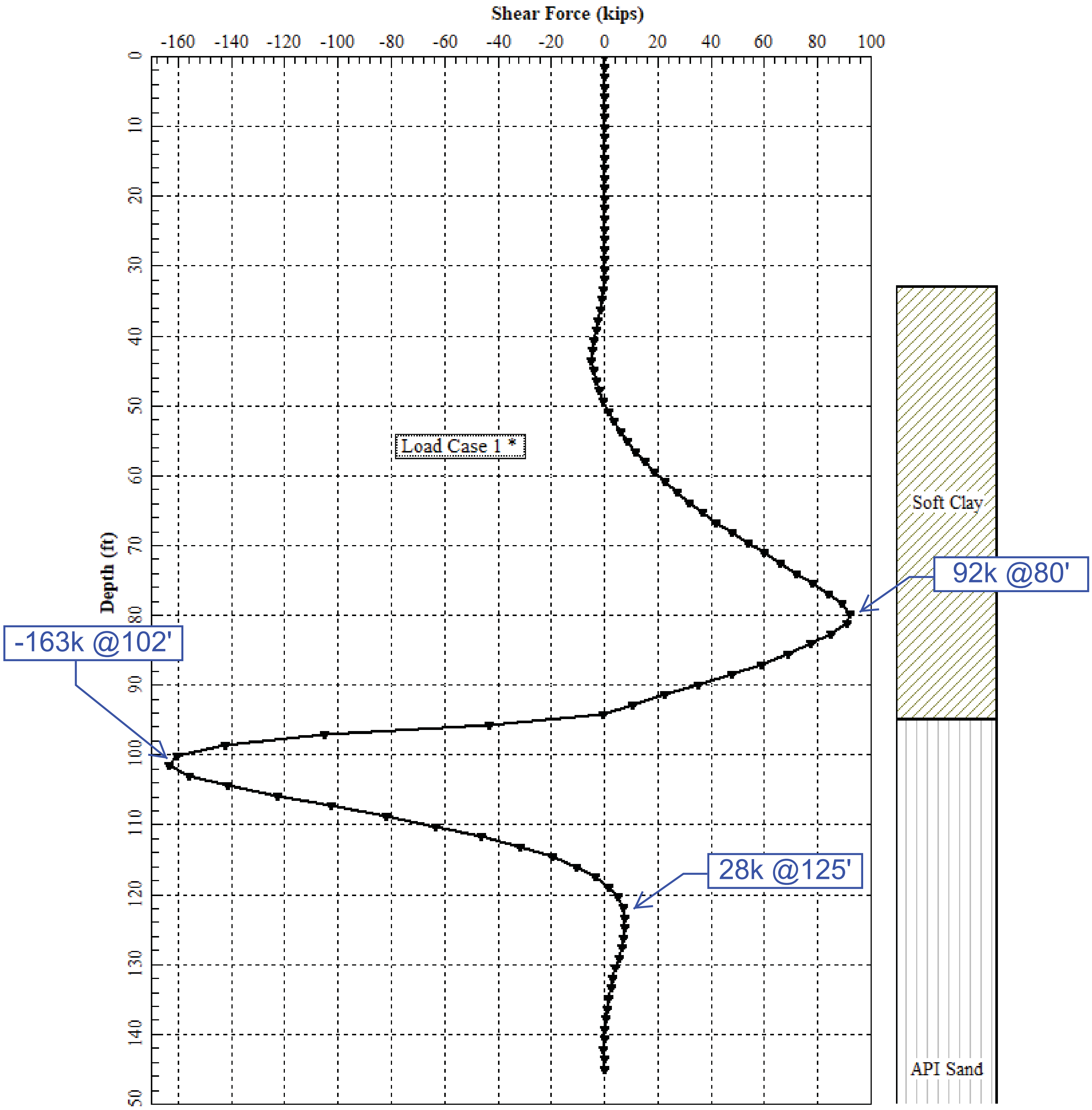
LATERAL PILE ANALYSIS: RESPONSE

Monopile response under lateral soil movement



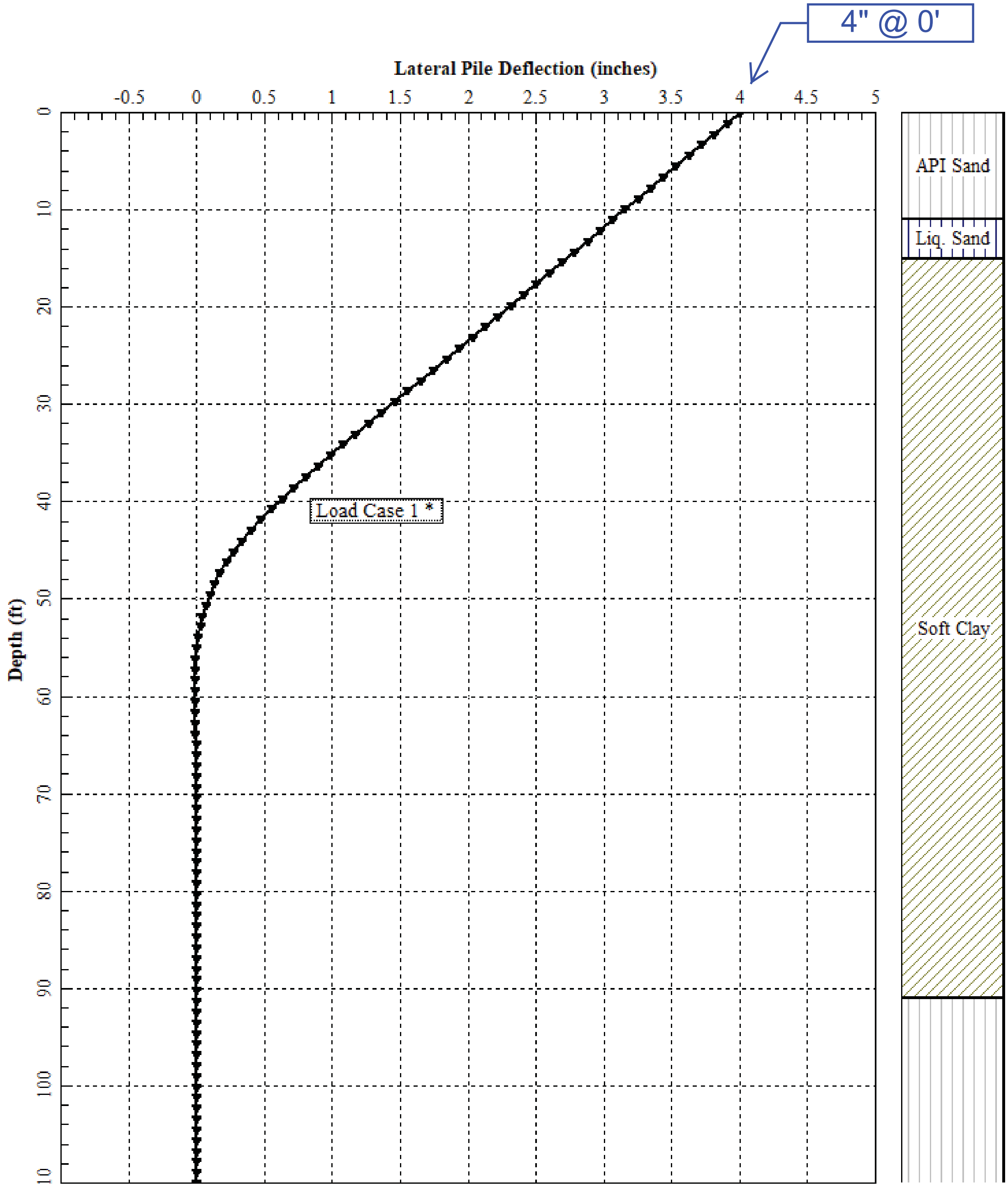


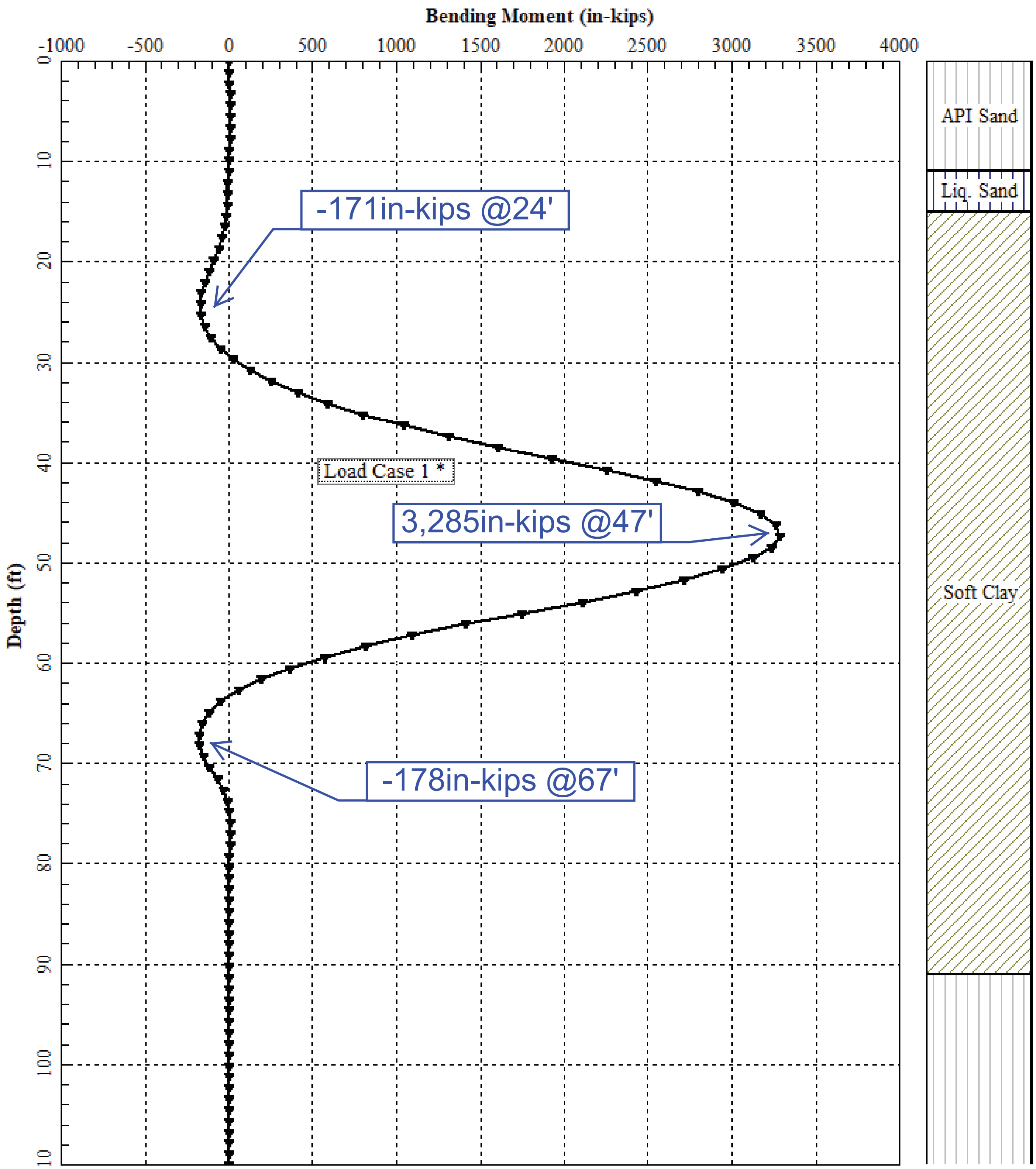
Bending Moment (in-kips)
-2000
0
2000
4000
6000
8000
1E04
1.2E04
1.4E04
1.6E04
1.8E04
2E04
2.2E04
2.4E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Load Case 1 *
Soft Clay
API Sand
23,300 in-kips @94'
-1,016in-kips @119'



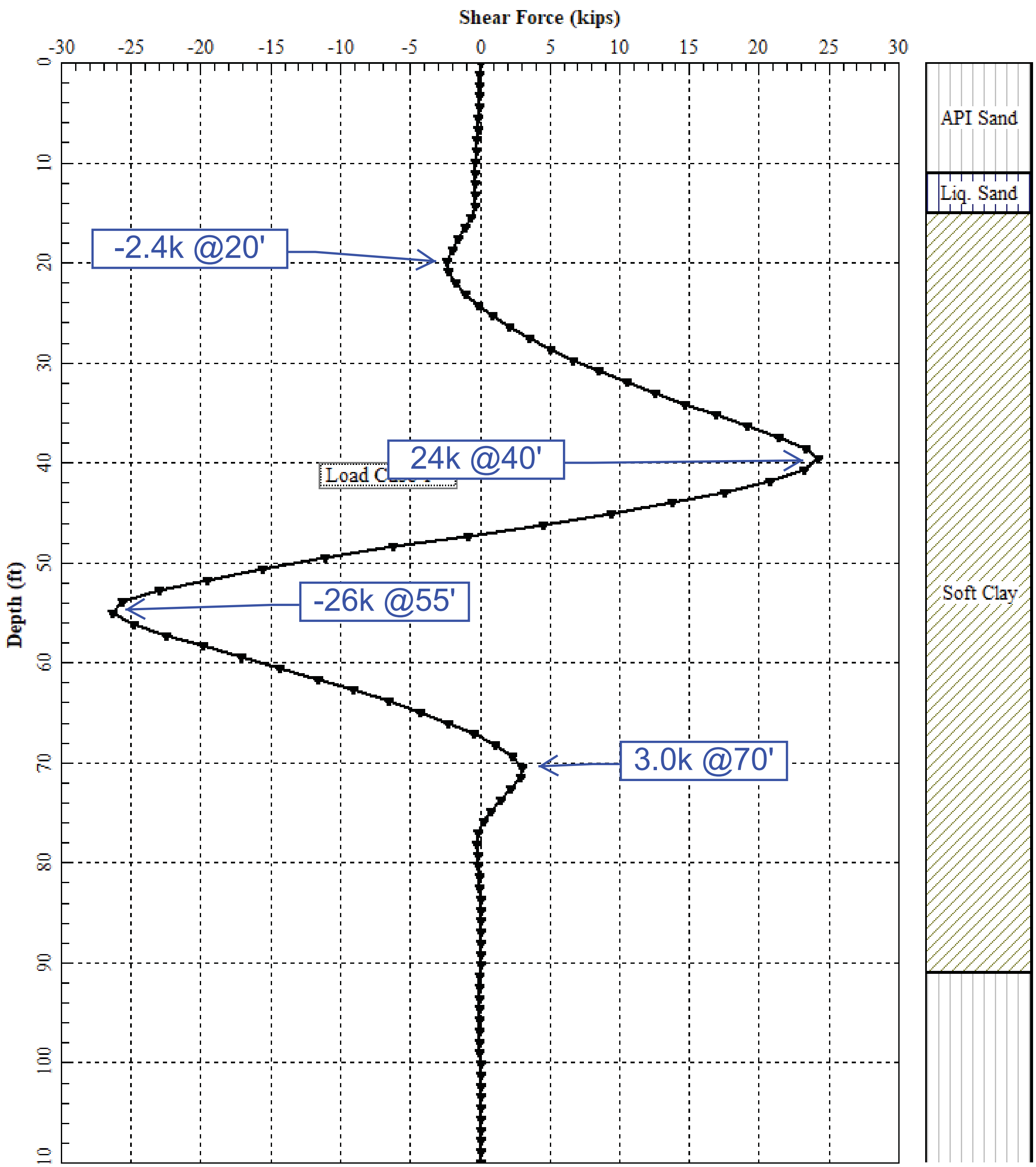
Shear Force (kips)
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Load Case 1 *
Soft Clay
API Sand
92k @80'
-163k @102'
28k @125'

Shore-side pile response under lateral soil movement



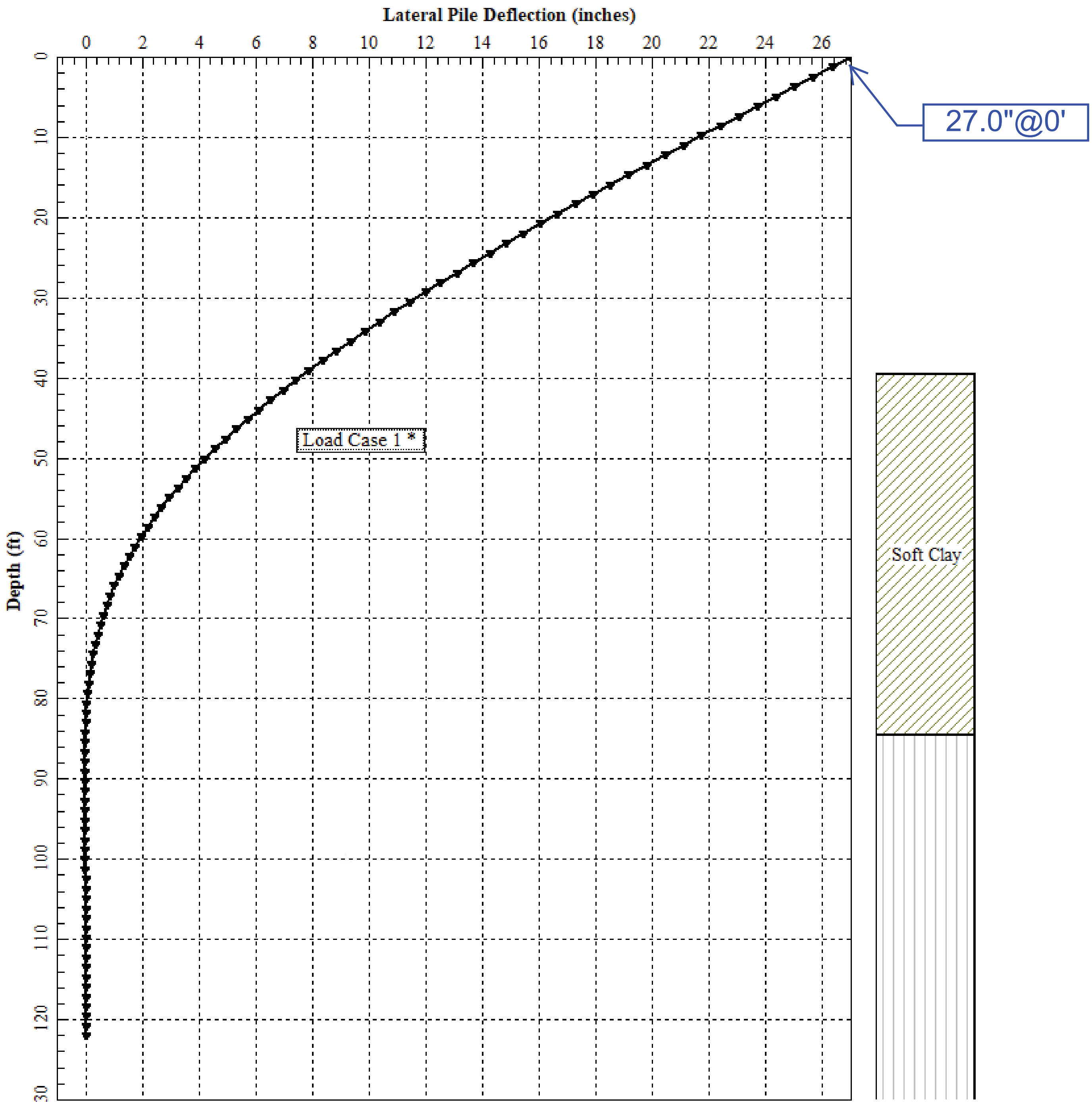


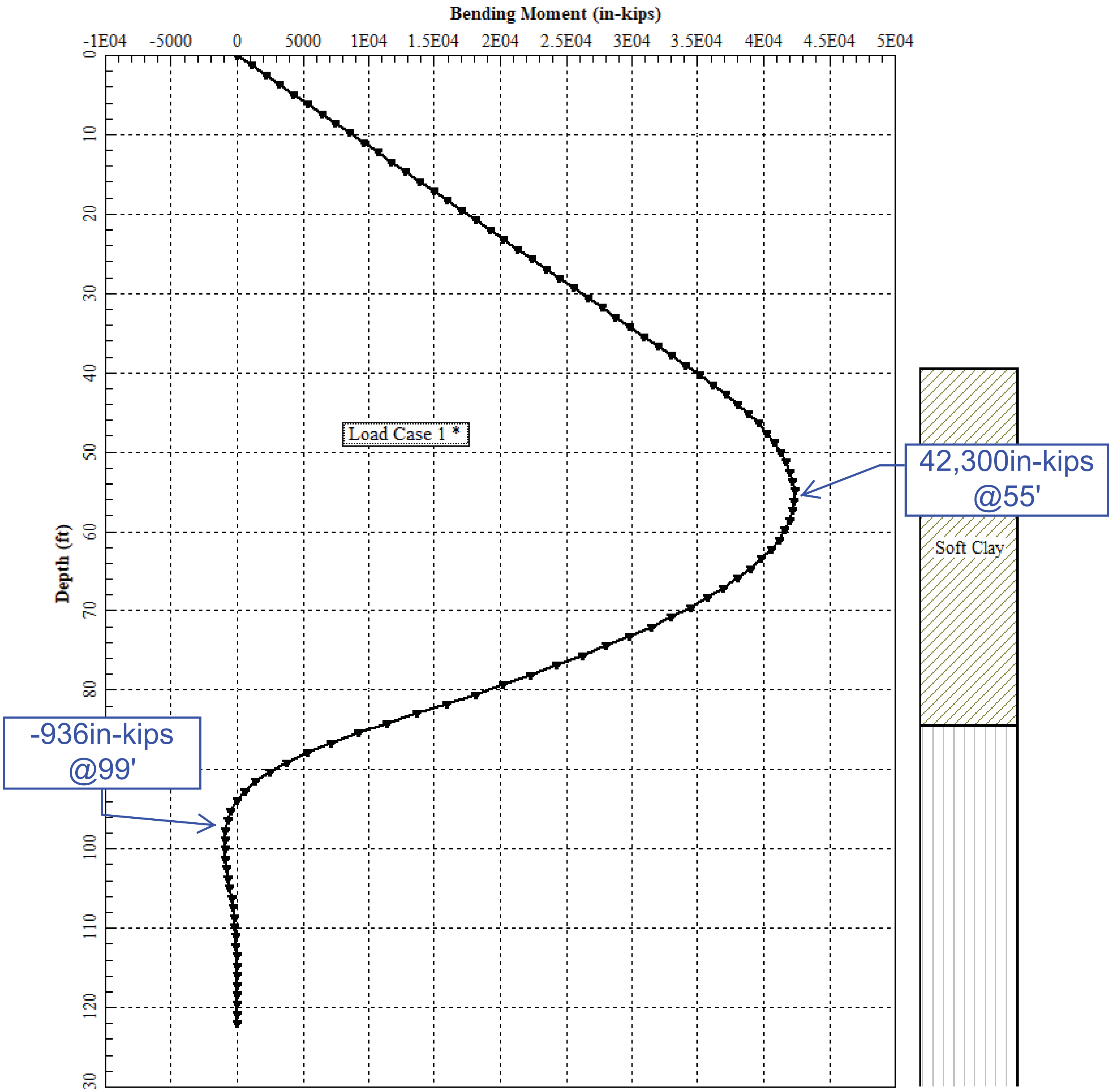
Bending Moment (in-kips)
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
-171in-kips @24'
Load Case 1 *
3,285in-kips @47'
-178in-kips @67'
API Sand
Liq. Sand
Soft Clay



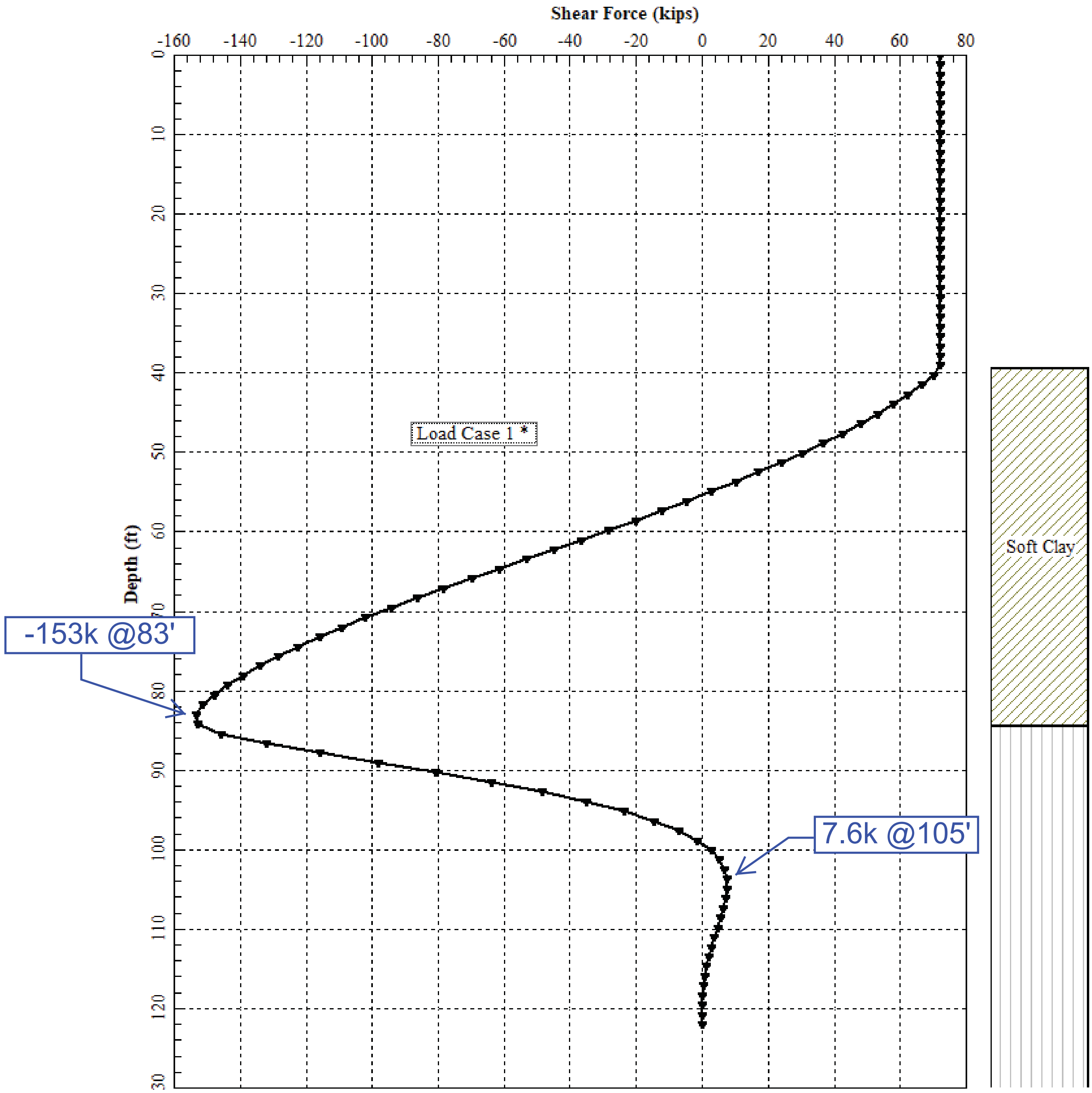
Shear Force (kips)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
-2.4k @20'
24k @40'
-26k @55'
3.0k @70'
API Sand
Liq. Sand
Soft Clay

Float pile response under lateral loading

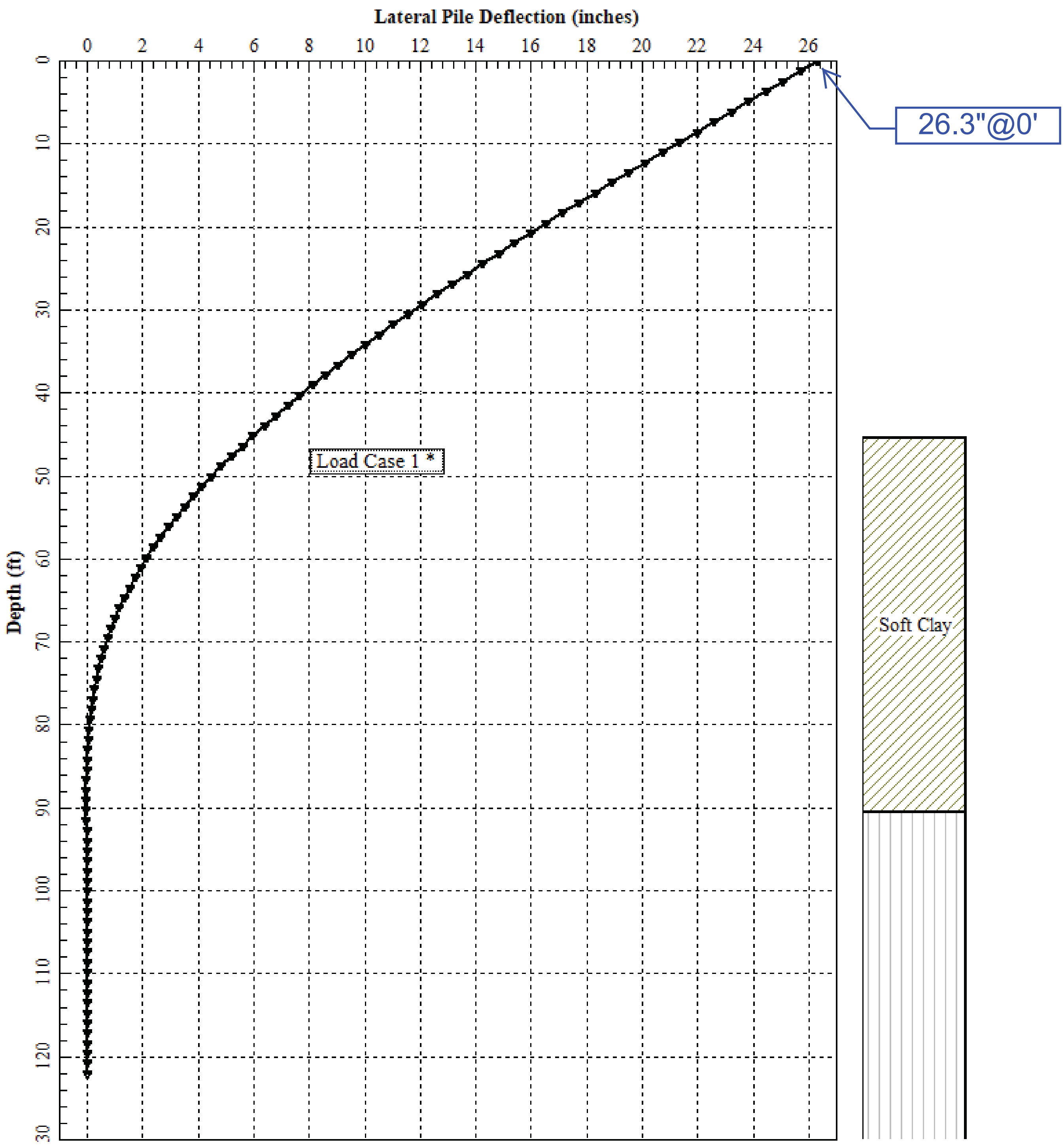


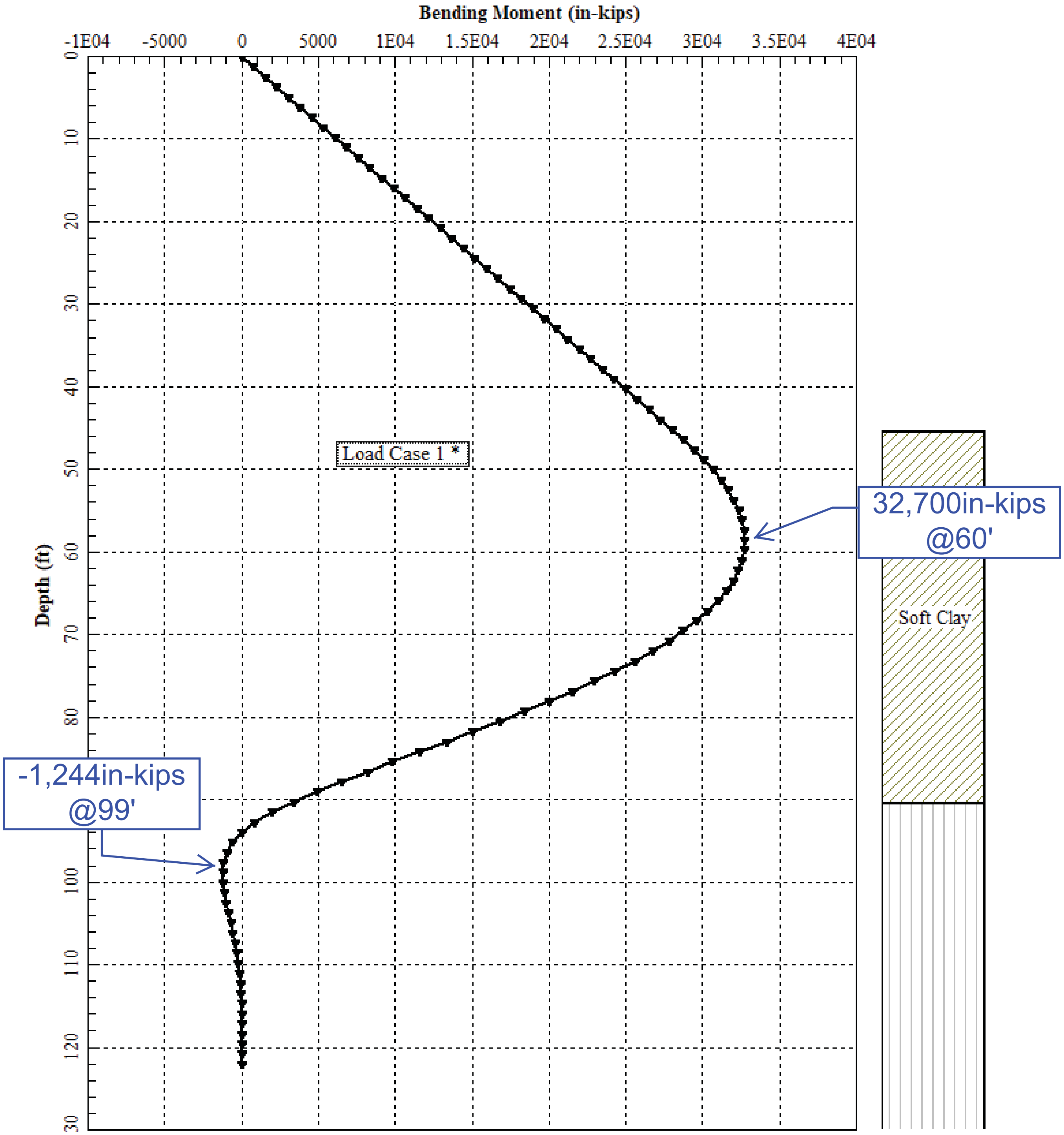


Bending Moment (in-kips)
-1E04
-5000
0
5000
1E04
1.5E04
2E04
2.5E04
3E04
3.5E04
4E04
4.5E04
5E04
Depth (ft)
0
10
20
30
40
50
60
70
80
100
110
120
130
Load Case 1 *
42,300in-kips @55'
-936in-kips @99'
Soft Clay

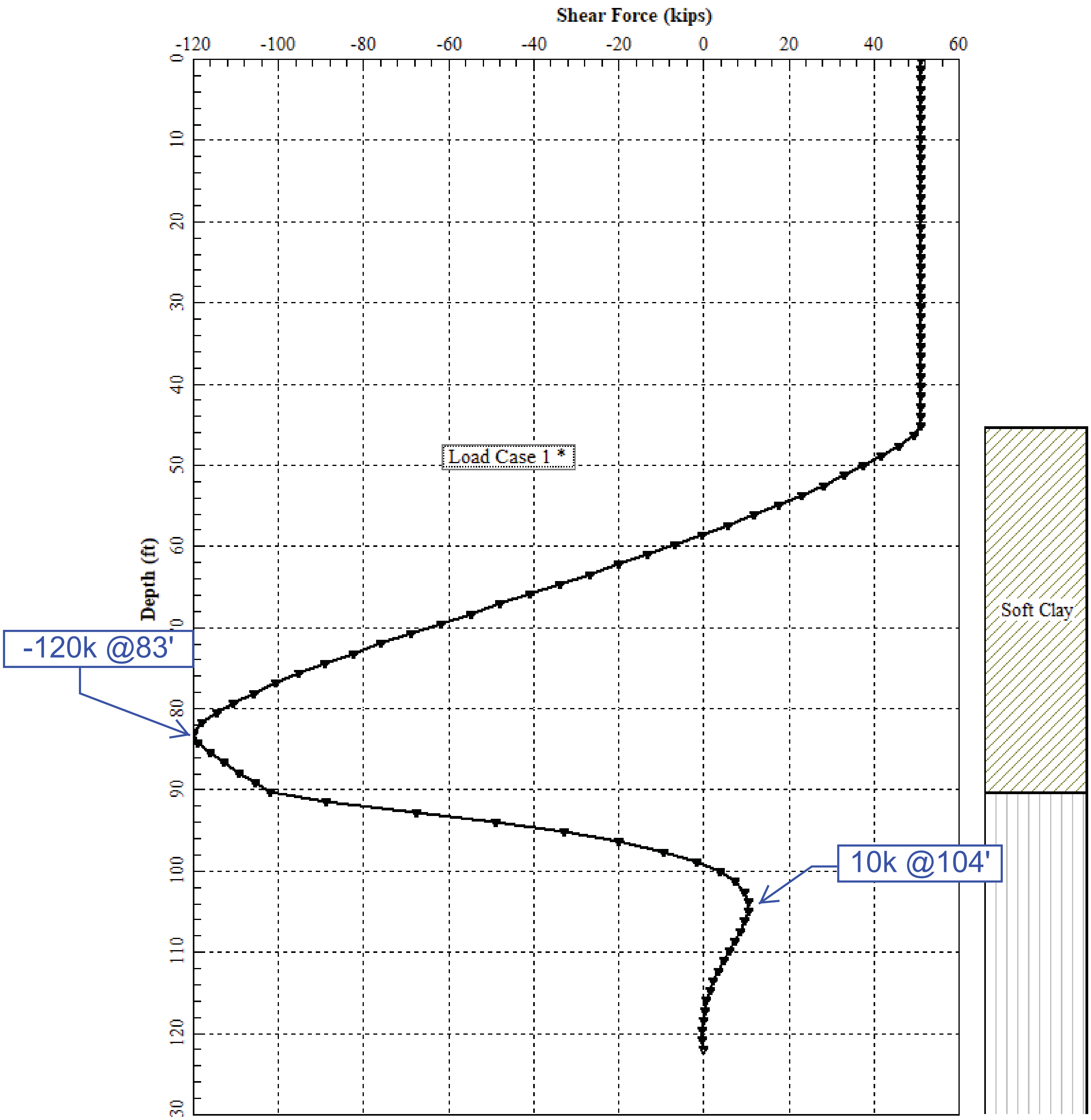

Shear Force (kips)
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
80
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Load Case 1 *
-153k @83'
7.6k @105'
Soft Clay

Donut pile response under lateral loading





Bending Moment (in-kips)
-1E04
-5000
0
5000
1E04
1.5E04
2E04
2.5E04
3E04
3.5E04
4E04
Depth (ft)
0
10
20
30
40
50
60
70
80
100
110
120
130
Load Case 1 *
32,700in-kips
@60'
-1,244in-kips
@99'
Soft Clay


Shear Force (kips)
-120
-100
-80
-60
-40
-20
0
20
40
60
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Load Case 1 *
-120k @83'
10k @104'
Soft Clay

ENGEO

Expect Excellence

Appendix E

Hydroacoustic Assessment

ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT PROJECT HYDROACOUSTIC ASSESSMENT

Alameda, California

November 1, 2022

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I&R Job No.: 22-105

EXECUTIVE SUMMARY

This report summarizes the results of an acoustic assessment performed to evaluate the effects of construction activity noise on aquatic species. The construction activities for the refurbishment of the Alameda Main Street (AMS) Ferry Terminal includes replacement of the terminal bridge and foundation, gangway replacement, float demolition and replacement, and utility upgrades. The purpose of this assessment is to predict construction noise levels that may occur during the project so that permitting regulatory agencies can address concerns and answer questions raised about the potential project effects on sensitive habitat and aquatic species. The assessment focuses on predicting underwater noise levels from pile-driving activities. Because the design and construction details are preliminary at this time, an analysis that predicts conditions that are expected to cause reasonably worst-case acoustic conditions were analyzed. Under this worst-case scenario, piles would be driven using both vibratory and impact hammers. Note that impact pile driving would only occur if vibratory driving were not able to install piles to their tip elevation. Results of this assessment are summarized as follows:

- **48-inch-diameter steel pipe pile (Monopile)**: Impact pile driving of these piles in water could cause acoustic impacts at distances extending out to 4,200 meters (m) and 1,010 m for the root-mean-square (RMS) (150 decibel [dB] re 1 micropascal [µPa]) and Cumulative sound exposure level (SEL) (187 dB re 1µPa^2-sec) respectively for the adopted fish thresholds. Note that sounds would travel further to the west. Distances where sound levels exceed the marine mammal thresholds could extend out to about 997 m for the Level A Injury Zone for Pinnipeds while extending out to about 4,200 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 158 m for the RMS (150 dB re 1µPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to the mouth of the Middle Harbor at 4,200 m for the marine mammal thresholds. Use of attenuation methods (e.g., air bubble curtains), would reduce these distances.

- **36-inch steel pipe pile (guide piles & donut fender piles)**: Impact driving of these piles in water could result in sounds above thresholds extending out to the mouth of the Middle harbor at 4,200 m and 1,166 m for the RMS (150 dB re 1µPa) and Cumulative SEL (187 dB re 1µPa^2-sec) respectively for the adopted fish thresholds. Distances where sound levels exceed the marine mammal thresholds could extend out to about 1,311 m for the Level A Injury Zone for Pinnipeds while extending out to about 1,848 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 117 m for the RMS (150 dB re 1µPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to 4,200 m for the marine mammal thresholds. Use of attenuation methods (e.g., air bubble curtains), would reduce these distances.

- **24-inch steel pipe pile:** These piles would be driven on land, which could result in impact distances extending out to 736 m and 64 m for the RMS (150 dB re 1µPa) and Cumulative

SEL (187 dB re 1μPa^2-sec) respectively for the adopted fish thresholds. Distances where sound levels exceed the marine mammal thresholds could extend out to about 63 m for the Level A Injury Zone for Pinnipeds while extending out to about 158 m for the Level B Harassment Zones. Vibratory driving of these piles would result in impact distances extending out to 5 m for the RMS (150 dB re 1μPa) adopted fish threshold, while resulting in Level B Harassment Zones of extending out to 541 m for the marine mammal thresholds.

Note, the maximum anticipated distances to various fish and marine mammal thresholds calculated for each type of pile using NMFS guidelines, are constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the edge of the shipping channel ~ 4,200 m to the west of the ferry terminal site and ~1,700 m to the east. Substantial noise from piling activity is not anticipated to propagate past these bends. The computed distances for vibratory driving using the standard attenuation rate (15 Log of the distance) are 11.6 to 15.8 km, which extend beyond the harbor mouth. However, measurements in the Bay have shown greater attenuation rates of 18 Log of the distance that reduce this distance to 3.6 to 4.6 km. Given this higher attenuation rate and the narrow channel that sound would propagate, sounds above the threshold would not extend beyond the Middle Harbor.

Attachment A depicts the areas where sound effects above thresholds are predicted.

INTRODUCTION

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) is proposing the Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (project) to support WETA ferry operations within the Oakland Inner Harbor.

The project site is located at 2990 Main Street in Alameda (City), California and includes the existing AMS Ferry Terminal, which consists of a trestle, steel float structure, aluminum gangway, and bridge structure. The site is designated under the General and Maritime Industry land use and zoned as General Industrial (M-2). Much of the project site is within the Oakland Inner Harbor, with a portion of the bridge structure extending onto the landside of the City. The landside of the project site consists of various bay rocks, rip-rap, and dirt/sand. The project site is accessible by vehicle via Main Street and by ferry within the Oakland Inner Harbor. The project is within a developed area of the City and is bounded by the Oakland Inner Harbor to the north, industrial uses to the east, the San Francisco Bay Trail, AMS Ferry Terminal parking lot, and residential uses to the south, as well as the Main Street Dog Park and undeveloped land uses to the east.

Project elements would include replacement of the existing bridge walkway and foundation, and replacement of the gangway, float, guide piles, and upgrades to utilities at the project site. All project features would be compliant with Americans with Disabilities Act (ADA) standards. These details rely on project plans and are further described, below.

Terminal Bridge and Foundation Replacement. Project activities would involve demolishment of existing bridge/walkway and bridge foundation and replacement with a new aluminum truss bridge. Onshore and landside support would be installed and would consist of a 48-inch (in) monopile and two 24-in pipe piles with cap beams, respectively.

Gangway Replacement. The project would include removal of the existing 60-foot gangway and replacement with an 80-foot covered aluminum gangway.

Float Demolition/Replacement. The existing terminal float would be removed and replaced-in-kind with a new steel float. Ramps that had been previously installed on the float would be removed, protected in place, and reused once the new float is installed. Float ramps would be shifted to the west to provide additional room for a longer gangway. The four (4) existing 30-foot guide piles would be removed and replaced with four (4) new 36-in guide piles. To achieve a more safe, efficient berthing capacity and enable ingress and egress in a timely manner, float demolition/replacement activities would also involve installation of two (2) new 36-in steel pipe piles and two (2) 72-in donut fender piles.

Utility Upgrades. Utility upgrades associated with the project would involve replacement of existing razor equipment, installation of electrical service for replacement lighting, ramp controls, and outlets and a new potable water line. The new potable water line will connect to an existing line at the Ferry Terminal restroom facility. The new line will be used for intermittent terminal cleaning activities as needed. No other utility improvements are planned. The bridge, gangway, and float structures are designed to accommodate additional conduit related to an electric shorepower system that is to be constructed in the future as part of a separate project. The shorepower system will allow for charging of electric ferry vessels that will berth at AMS Ferry Terminal.

Overall, the footprint of the project site is expected to increase the AMS Ferry Terminal shade area by approximately 830 square feet. No changes in operational demand (i.e., an increase in ferry users) are anticipated, and no physical impacts beyond the project boundaries (see Figure 2) are anticipated as part of the project. Vehicular and pedestrian access to the AMS Ferry Terminal is not anticipated to change.

The water depth at the project site varies between 14-in to 28-in mean lower low water (MLLW). Most construction activities will occur above or at the waterline. The only elements that will extend below the mudline are the new piles that will have a maximum tip elevation of approximately 110-in MLLW.

This study is an assessment of potential underwater noise levels generated by planned construction activities involved with the refurbishment of the AMS Ferry Terminal. The study was requested in order to aid regulatory biologists in assessing underwater sound impacts on fish and marine species that may be present in the area when construction occurs. This assessment is based on information provided by project designers consisting of a location map, draft layout sheets, estimated pile-driving data, a review of potential construction activities to be conducted at the site, a review of related studies, the modeling, and a semi-quantitative analysis of underwater noise levels. This study assesses the sound levels associated with potential pile-driving activities that could affect aquatic species. This study does not address environmental impacts associated with the project.

UNDERWATER SOUNDS FROM PILE-DRIVING ACTIVITIES

Fundamentals of Underwater Noise

Impact pile driving can produce high underwater sound levels. When a pile-driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, the ground, and the air. Sound pressure pulse as a function of time is referred to as the waveform. In terms of acoustics, these sounds are described by the peak pressure, the root-mean-square (RMS) pressure, and the sound exposure level (SEL). The peak pressure is the highest absolute value of the measured waveform and can be a negative or positive pressure peak. For pile-driving pulses, RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that comprises that portion of the waveform containing the sound energy (Richardson et al. 1995; ISO 18406:2017(E).). The pulse RMS has been approximated in the field for pile-driving sounds by measuring the signal with a precision sound level meter set to the "impulse" RMS setting and is typically used to assess impacts to marine mammals. Another measure of the pressure waveform that can be used to describe the pulse is the sound energy itself. The total sound energy in the pulse is referred to in many ways, most commonly as the "total energy flux" (Finerran 2002). The "total energy flux" is equivalent to the un-weighted SEL for a plane wave propagating in a free field, a common unit of sound energy used in airborne acoustics to describe short-duration events. The unit used is decibels (dB) re 1 micropascal $(\mu Pa)^2$-second (sec). In this report, peak pressure levels are expressed as the absolute maximum pressure of a pulse in dB re 1 μPa; however, in other literature, peak pressure levels can take varying forms, such as pascals or pounds per square inch. The total sound energy in an impulse accumulates over the duration of that pulse and the duration of a pile driving event. Figure 1 illustrates the acoustical characteristics of an underwater pile-driving pulse. Table 1 includes the definitions of terms commonly used to describe underwater sounds.

The variation of instantaneous pressure over the duration of a sound event is referred to as the waveform. The waveform can provide an indication of rise time or the rapidity with which pressure fluctuates with time; however, rise time differences are not clearly apparent for pile-driving sounds because of the numerous rapid fluctuations that are characteristic of this impulse type. A plot showing the accumulation of sound energy over the duration of the pulse (or at least the portion of time during which much of the energy accumulates) illustrates the differences in source strength and rise time. An example of the underwater acoustical characteristics of a typical pile-driving pulse is shown on Figure 1.

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile-driving pulse or many pulses, such as pile driving for one pile or for one day of pile driving. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL associated with the driving of a pile can be estimated using the single-strike SEL value and the number of pile strikes through the following equation:

$$SEL_{cumulative} = SEL_{single-strike} + 10log(\#of\ pile\ strikes)$$

For example, if a single-strike SEL for a pile is 165 dB, and it takes 1,000 strikes to drive the pile, the cumulative SEL is 195 dBA (165 dB + 30 dB = 195 dB), where 10 * $Log_{10}(1000)$ = 30.

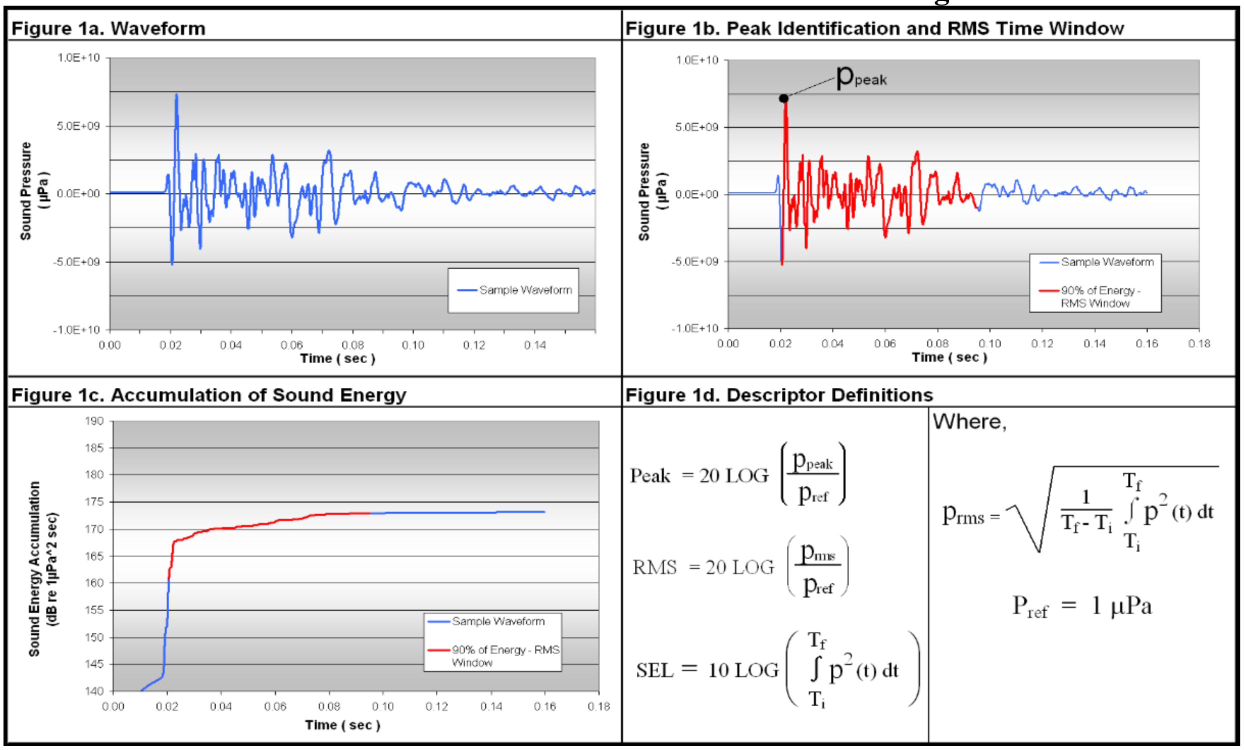
TABLE 1 Definition of Underwater Acoustical Terms

Term	Definition
Peak Sound Pressure, unweighted (dB)	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a dB (referenced to a pressure of 1 μPa) but can also be expressed in units of pressure, such as μPa or pounds per square inch.
RMS Sound Pressure Level, (NMFS Criterion) dB re 1 μPa	The squared root of the average of the squared pressures over the time that comprises that portion of the waveform containing 90 percent of the sound energy for one pile-driving impulse.[1] This measure is typically used to assess acoustical impacts on marine mammals.

[1] The underwater sound measurement results obtained during a Pile Installation Demonstration Project indicated that most pile-driving impulses occurred over a 50- to 100-msec period. Most of the energy was contained in the first 30 to 50 msec. Analysis of that underwater acoustic data for various pile strikes at various distances demonstrated that the acoustic signal measured using the standard "impulse exponential-time-weighting" (35-msec rise time) correlated to the RMS (impulse) used by NMFS.
Notes: msec = millisecond(s)
NMFS = National Marine Fisheries Service

SEL, dB re 1 μPa^2-sec	Proportionally equivalent to the time integral of the squared pressure and is described in this report in terms of dB re 1 μPa^2-sec over the duration of the impulse. Similar to the unweighted SEL standardized in airborne acoustics to study noise from single events.
Cumulative SEL	Measure of the total energy received through a pile-driving event (here defined as pile driving that occurs within a day).
Waveforms, μPa over time	A graphical plot illustrating the time history of positive and negative sound pressures of individual pile strikes shown as a plot of μPa over time (i.e., seconds).
Frequency Spectra, dB over frequency range	A graphical plot illustrating the distribution of sound pressure vs. frequency for a waveform; dimension in RMS pressure and defined frequency bandwidth.

FIGURE 1 Underwater Acoustical Characteristics of a Pile-driving Pulse



Underwater Sound Thresholds

<u>Fish</u>

In 2008, NOAA's NMFS; U.S. Fish and Wildlife Service; California, Oregon, and Washington Departments of Transportation; California Department of Fish and Game; and the U.S. Federal Highway Administration agreed in principle to interim criteria to protect fish from pile-driving activities. The agreed-upon criteria are presented in Table 2.

TABLE 2 Adopted Fish Criteria

Interim Criteria for Injury	Sound Levels Agreed-upon in Principle
Peak	206 dB re 1 µPa (for all sizes of fish)
Cumulative SEL	187 dB re 1 µPa^2-sec – for fish size of 2 grams or greater[a] 183 dB re 1 µPa^2-sec – for fish size of less than 2 grams[a]

[a] Applies to pile strikes of 150 dB SEL (single strike) or greater.

The adopted criteria listed in Table 2 are for pulse-type sounds (e.g., impact pile driving) and do not address sound from vibratory driving. The SEL criteria are not applied to vibratory driving sounds. The in-water areas with project sound levels above 150 dB RMS are considered by NMFS to be acoustically affected given possible behavioral changes in fish; however, these levels are not anticipated to trigger any mitigation requirements (Caltrans 2020).

Marine Mammals

Under the Marine Mammal Protection Act, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild” (NMFS 2018). Level B harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering” (NMFS 2018).

Table 3 outlines the current adopted Level A and Level B (behavioral harassment) criteria. The application of the 120-dB RMS threshold for vibratory pile driving can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. For continuous sounds, NMFS Northwest Region has provided guidance for reporting RMS sound pressure levels. RMS levels are based on a time-constant of 10 seconds; RMS levels should be averaged across the entire event. For impact pile driving, the overall RMS level should be characterized by integrating sound for each acoustic pulse across 90 percent of the acoustic energy in each pulse and averaging all the RMS levels for all pulses.

NMFS has provided marine mammal acoustic technical guidance for predicting the onset of permanent threshold shift (PTS) and temporary threshold shifts in marine mammal hearing from sound sources (NMFS 2018). For this project location, the functional hearing groups are expected to be limited to phocid pinnipeds (harbor seals), and otariid pinnipeds (California sea lions). For impact pile driving, the majority of the acoustic energy is confined to frequencies below 2 kilohertz (kHz), and there is very little energy above 20 kHz. Similarly, much of the acoustic energy for vibratory driving is in the frequency range below 2.5 kHz. The underwater acoustic criteria for phocid and otariid pinnipeds are provided in Table 3. Table 4 lists the functional hearing groups and their hearing ranges as defined by the NMFS guidance (NMFS 2018).

TABLE 3 Underwater Acoustic Criteria for Pinnipeds

Species	Underwater Noise Thresholds (dB re 1 µPa)				
	Vibratory Pile-driving Disturbance Threshold (*Level B Harassment*)	Impact Pile-driving Disturbance Threshold (*Level B Harassment*)	Marine Mammal Hearing Group (see Table 4)	PTS SEL_{cum} Threshold Peak – dB re 1 µPa SEL_{cum} – dB re 1 μPa^2-sec	
				Impulsive (*Impact Pile Driving*)	Non-Impulsive (*Vibratory Pile Driving*)
Pinnipeds	120 dB RMS	160 dB RMS	Phocid	218 dB Peak 185 dB SEL_{cum}	201 dB SEL_{cum}
			Otariid	232 dB Peak 203 dB SEL_{cum}	219 dB SEL_{cum}

TABLE 4 Definition of Marine Mammal Hearing Group for Pinnipeds

Marine Mammal Hearing Groups	
Functional Hearing Group	**Functional Hearing Range**
Phocid Pinnipeds – true seals, including harbor seals	50 Hz to 86 kHz
Otariid Pinnipeds – sea lions and fur seals	60 Hz to 39 kHz

Note: Hz = hertz

PROJECT UNDERWATER SOUND-GENERATING ACTIVITIES

The primary type of activity that has the potential to elevate underwater noise levels is the installation of piles using an impact pile driver. For this project however, vibratory driving is expected to be used for majority of the pile installation with the possibility of using an impact hammer if piles hit refusal prior to the required tip elevation. Pile installation activities for the project include installation of a single (1) 48-inch steel pipe monopile in water for the terminal bridge along with two (2) 24-inch steel pipe piles with concrete cap beams on land. The project also involves installation of four (4) 36-inch guide piles and two (2) 36-inch donut fender piles in water for the terminal float.

Pile driving in the water causes sound energy to radiate directly into the water by vibrating the pile between the surface of the water and the riverbed, and indirectly as a result of ground-borne vibration at the riverbed. Airborne sound does not make a substantial contribution to underwater sound levels because of the attenuation of sound at the air/water interface. Pile driving on land would generate low-frequency ground-borne vibration that could cause localized sound pressures in the water that are radiated from the streambed. A minimum water depth is required to allow sound to propagate. For pile-driving sounds, the minimum depth is 1 m (3 feet). Pile-driving activities conducted on land near water bodies have been found to transmit low-frequency sound into the water. The mechanisms for transmitting this sound into the water are complex and difficult, if not impossible, to predict.

Table 5 summarizes the proposed pile-driving activities, the number of piles anticipated per day, and the duration of the pile driving activity for vibratory driving.

TABLE 5 Pile-driving Activities for the Proposed Project

New Structure	Pile Type	Pile Location	Duration/Estimated Blows per Pile[1]	Piles per Day
Terminal Bridge and Foundation Replacement	48-inch steel pipe	In Water	45 mins vibrate 1,015 strikes impact	1
Terminal Bridge and Foundation Replacement	24-inch steel pipe	On Land	45 mins vibrate 1,015 strikes impact	2
Float Replacement (Guide piles & Donut Fender piles)	36-inch steel pipe	In Water	45 mins vibrate 1,015 strikes impact	6

[1] Impact driving if needed, assumes about 20 to 30 minutes of driving with a total of about 1,015 strikes per pile.

Predicted Underwater Sound Levels from Construction

This assessment predicts underwater sound levels associated with the different piling activities that are anticipated. Piling activities include the impact and/or vibratory installation of steel piles. The prediction of sound levels associated with this activity are based on measurements from similar activities.

The prediction of sound levels from pile-driving activities proposed for this project relies on data collected from other sites with similar conditions. The following studies were identified and used to aid in predicting underwater noise levels and calculating the distances to thresholds for fishes and marine mammals discussed in this report.

Underwater Sound Levels from Project Pile Driving

Data in the following studies were reviewed for the various pile-driving activities summarized in Table 6. The values in Table 6 are for sound levels measured at 10 m (33 feet) from the piles for conditions similar to those that would occur at this project. Detailed information on the measurements that make up these levels below are provided in the references.

TABLE 6 Measured Levels for Pile-driving Activities

Driving Method	Pile Type	Size	Sound Pressure Level in dB re 1 µPa at 10 Meters			Notes
			Peak	RMS	SEL	
Impact	Steel pipe pile on land	24-inch	195	178	166	Assumed 15 dB lower than levels in water using data from Naval Base Kitsap, Bangor, WA
Impact	Steel pipe pile in water	36-inch	211	194	181	Naval Base Kitsap at Bangor Test Pile Program, Bangor, WA
Impact	Steel pipe pile in water	48-inch	215	200	187	Anchorage Port Modernization Program – Test Pile Program (POA 2016)
Vibrate	Steel pipe pile on land	24-inch	185	146	146	Assumed 15 dB lower than levels in water using data from Naval Base Kitsap, Bangor, WA
Vibrate	Steel pipe pile in water	36-inch	200	166	166	Naval Base Kitsap at Bangor Test Pile Program, Bangor, WA
Vibrate	Steel pipe pile in water	48-inch	200	168	168	Anchorage Port Modernization Program – Test Pile Program (POA 2016)

Table 7 shows the predicted sound levels expected at 10-m (33-foot) distances from different pile-driving activities expected from the project. Included are the unattenuated sound levels (peak, RMS, SEL) expected, also at 10 m (33 feet) from the piles. Table 7 also shows expected attenuated levels that correspond to a 5-dB reduction because of different attenuation mechanisms like bubble curtains or isolation casing that may be used during the in-water pile-driving activities. These levels, which have been taken from past projects, provide an estimate of the levels to be expected from the pile-driving activities proposed for the project. Impacts on fishes and marine mammals are then calculated using these levels (both unattenuated and attenuated). No methods are available to further attenuate land-based pile-driving sounds.

TABLE 7 Sound Levels Used for Predicting Underwater Sound Impacts

Driving Method	Pile Type	Size	Sound Pressure Level Measured in dB re 1 µPa at 10 Meters					
			Unattenuated			Attenuated[a]		
			Peak	RMS	SEL	Peak	RMS	SEL
Impact	Steel pipe pile on land	24-inch	195	178	166	Sounds from piles driven on land cannot be further attenuated		
Impact	Steel pipe pile in water	36-inch	211	194	181	206	189	176
Impact	Steel pipe pile in water	48-inch	215	200	187	210	195	182
Vibrate	Steel pipe pile on land	24-inch	185	146	146	Sounds from piles driven on land cannot be further attenuated		
Vibrate	Steel pipe pile in water	36-inch	200	166	166	<5 dB attenuation expected from vibrated piles		
Vibrate	Steel pipe pile in water	48-inch	200	168	168	<5 dB attenuation expected from vibrated piles		

[a] Attenuated condition assumes minimum 5-dB lower sounds.

Predicted Impacts on Fishes

Table 8 shows the anticipated distances (in meters and in feet) to the various adopted interim fish thresholds. Distances are shown for both unattenuated and attenuated piles (5-dB attenuation). Also, when the piles are installed with a vibratory hammer, the cumulative SEL thresholds for fish do not apply, and the 150-dB RMS level provides an estimated zone of possible acoustic effects. The distance to each threshold was computed using the transmission loss coefficient of 15 times the Log_{10} of the distance, as recommended by NMFS when there is no site-specific information for the area. This attenuation rate was used in the computations; however, it should be noted that attenuation rates of 18 times the Log_{10} of the distance were measured during pile driving for the San Francisco-Oakland Bay Bridge East Span project (Caltrans 2020)[2]. Cumulative SEL was further computed by adding 10 times the Log_{10} of the number of impact pile strikes. Impact strikes used in these computations are the sum of the anticipated strikes per pile times the number of piles per day.

Note that sound propagation in the Oakland Inner Harbor is limited by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel boundaries. Substantial sound is not anticipated to travel beyond 4,200 m to the west (out the shipping channel) and 1,700 m east of the project site (where the channel bends). Therefore, the distance for noise impacts from this project is limed to 4,200 m west and 1,700 m east under the worst-case conditions.

[2] Technical Guidance for Assessment of the Hydroacoustic Effects of Pile Driving on Fish, Chapter I.9 San Francisco-Oakland Bay Bridge East Span Replacement Project page I-229

TABLE 8 Distance to Adopted Fish Thresholds for All Piles

Driving Method	Pile Type	Size	Piles per Day	Estimated No. of Strikes per Pile	Condition[a]	Distance to Adopted Fish Thresholds			
						Peak 206 dB[b]	RMS 150 dB[b]	Cumulative SEL 187 dB[c]	Cumulative SEL 183 dB[c]
Impact	Steel pile on land	24-in	2	1,015[e]	Unattenuated	--[d]	736 m *[2,414 ft]*	64 m *[209 ft]*	117 m [383 ft]
Impact	Steel pile in water	36-in	6	1,015[e]	Unattenuated	22 m [71 *ft*]	4,200/1,700[g] m *[13,780/5,577 ft]*	1,166 m [3,825 ft]	1,166 m [3,825 ft]
					Attenuated	10 m [33 *ft*]	3,981/1,700[g] m *[13,061/5,577 ft]*	541 m *[1,775 ft]*	541 m *[1,775 ft]*
Impact	Steel pile in water	48-in	1	1,015[e]	Unattenuated	40 m *[131 ft]*	4,200/1,700[g] m *[13,780/5,577 ft]*[g]	1,010 m *[3,314 ft]*	1,866 m *[6,123 ft]*
					Attenuated	18 m *[61 ft]*	4,200/1,700[g] m *[13,780/5,577 ft]*	469 m *[1,538 ft]*	866 m *[2,842 ft]*
Vibrate	Steel pile on land	24-in	2	--[f]	Unattenuated	--[d]	5 m *[18 ft]*	N/A	N/A
Vibrate	Steel pile in water	36-in	6	--[f]	Unattenuated	--[d]	117 m *[383 ft]*	N/A	N/A
Vibrate	Steel pile in water	48-in	1	--[f]	Unattenuated	--[d]	158 m *[520 ft]*	N/A	N/A

[a] Attenuated condition assumes 5-dB lower sounds.
[b] dB re 1 µPa
[c] dB re 1 µPa²-sec
[d] Within the near-field of the sound source - < 10 meters [33 feet]
[e] Assuming impact hammer usage for 20-30 mins with about 1015 strikes per pile.
[f] Piles vibrated in at 45 minutes each (2,700 sec.).
[g] Constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel, 4,200 m [13,780 ft] west and 1, 700 m [5,577 ft] east.

Predicted Impacts on Marine Mammals

The following threshold distances were computed to assess impacts on pinnipeds:

- Distance to onset PTS isopleth for each hearing group (considered Level A impacts)
    - Unattenuated
    - Attenuated
- Distance for unweighted 120-dB vibratory and 160-dB impulse behavior isopleth (considered Level B impacts)
    - Unattenuated
    - Attenuated

The Companion User Spreadsheet (Version 2.2 [2020]) to the *NMFS Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* was used to predict zones where the onset of PTS to marine mammal hearing could occur. A spreading loss calculation is included in the spreadsheet to predict the distance to the onset PTS from accumulated SEL and peak sound pressure. The spreadsheet incorporates a frequency weighting function that accounts for sensitivity for different hearing groups when computing the accumulated SEL. These are referred to as weighting frequency adjustments. The default weighting frequency adjustments are 2 kHz for impact pile driving and 2.5 kHz for vibratory driving. Because the onset of PTS based on SEL_{cum} is computed as further from the pile than it would be using peak sound pressure computations, the onset of PTS is based on SEL computations; therefore, the onset of PTS based on peak sound levels is not provided in this assessment.

The extent of the Level B Zone was calculated using the 10-meter (33-foot) sound levels and applying a transmission loss coefficient of 15 times the Log_{10} of the distance, as recommended by NMFS when there is no site-specific information for the area. Substantial sound is not expected to propagate outside the Middle Harbor because of the narrow propagation path westward combined with the higher sound attenuation rates that have been measured in the Bay (see Caltrans 2020)[3].

Table 9 presents the anticipated distances to the adopted marine mammal thresholds (Level A and Level B Zones). When the piles are installed with a vibratory hammer, the cumulative SEL thresholds do not apply, and the peak PTS thresholds that apply to marine mammals will not be reached. Distances are shown for both unattenuated and attenuated pile-driving activities expected from the project, for the estimated number of strikes and piles per day proposed.

Attenuation Methods

Air bubble curtains, either confined or un-confined, have been shown to reduce sound pressure levels for pile driving in water by up to about 5 to 20 dB within 300 meters of the pile. However, in accordance with Caltrans guidance, only a 5-dB reduction was used for calculating the distances to the fish and marine mammal thresholds (Caltrans 2020). The amount of attenuation may be more, especially at distant locations from the pile because of the contribution of sound propagating through the bottom substrate. At the Benicia-Martinez Bridge and San Francisco-Oakland Bay Bridge projects (Caltrans 2020), more than 10 dB of sound reduction was obtained using bubble curtains. At the Humboldt Bay Seismic Retrofit Project, reductions of between 12 and 16 dB were achieved using either an unconfined bubble ring or a bubble ring in an isolation casing, with the best results being the unconfined bubble ring (Caltrans 2020).

The design of the specific bubble ring configuration will depend on several factors, such as the depth of water and the water current, and must be designed individually for each project and location within the project. Air bubble curtain systems are used during production pile driving to reduce underwater sound pressures. Typically, a system consists of stacked rings to generate air bubbles throughout the entire water column surrounding the piles, even with currents. A bubble curtain system is generally composed of air compressors, supply lines to deliver the air, distribution manifolds or headers, perforated aeration pipes, and a frame. The frame is used to facilitate transportation and placement of the system, keep the aeration pipes stable, and provide ballast to counteract the buoyancy of the aeration pipes during pile-driving operations. Bubble curtain designs consist of single or multiple concentric layers of perforated aeration pipes (stacked vertically). Pipes in any layer are arranged in a geometric pattern that allows the pile-driving operation to be completely enclosed by bubbles for the full depth of the water column. The lowest layer of perforated aeration pipe is designed to ensure contact with the mud line without sinking

[3] Technical Guidance for Assessment of the Hydroacoustic Effects of Pile Driving on Fish, Chapter I.9 San Francisco-Oakland Bay Bridge East Span Replacement Project page I-229

into the bottom substrates. A proper combination of bubble density and closeness of bubbles to the pile is most effective. Numerous smaller bubbles are more effective because they displace more water between the bubbles. This pattern has to be maintained throughout the water column.

TABLE 9 Distance to the Adopted Marine Mammal Thresholds for Different Pile-driving Activities – Level A and B Zones

Driving Method	Pile Type	Size	Piles per Day	Estimated No. of Strikes per Pile	Condition[a]	Level A Injury Zone Using SEL_{cum} Threshold		Level B Harassment Zone
						Pinnipeds		
						Phocid	Otariid	
Impact	Steel pipe pile on land	24-inch	2	1,015[e]	Unattenuated	63 m *[207 ft]*	--[b]	158 m *[518 ft]*
Impact	Steel pipe pile in water	36-inch	6	1,015[e]	Unattenuated	1,311 m *[4,301 ft]*	96 m *[314 ft]*	1,848/1,700[d] m *[6,061/5,577 ft]*
					Attenuated	609 m *[1,998 ft]*	44 m *[144 ft]*	858 m *[2,815 ft]*
Impact	Steel pipe pile in water	48-inch	1	1,015[e]	Unattenuated	997 m *[3,271 ft]*	73 m *[239 ft]*	4,200/1,700[d] m *[13,780/5,577 ft]*
					Attenuated	463 m *[1,519 ft]*	34 m *[111 ft]*	2,154/1,700[d] m *[7,067/5,577 ft]*
Vibrate	Steel pipe pile on land	24-inch	2	--[c]	Unattenuated	--[b]	--[b]	541 m *[1,775 ft]*
Vibrate	Steel pipe pile in water	36-inch	6	--[c]	Unattenuated	24 m *[78 ft]*	--[b]	4,200/1,700[d] m *[13,780/5,577 ft]*
Vibrate	Steel pipe pile in water	48-inch	1	--[c]	Unattenuated	10 m *[33 ft]*	--[b]	4,200/1,700[d] m *[13,780/5,577 ft]*

[a] Attenuated condition assumes 5-dB lower sounds.
[b] Within the near-field of the sound source - < 10 meters [33 feet]
[c] Piles vibrated in at 45 minutes each.
[d] Constrained by bends in the Oakland Estuary and relatively shallow water bathymetry near the shipping channel, 4,200 m [13,780 ft] west and 1, 700 m [5,577 ft] east.

Illustration of Impacts

Attachment A includes Google Earth maps displaying the extent of both fish injury zones and marine mammal Level A and B Zones around the proposed project site for the piles driven.

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Attachment A

Maps Illustrating the 187-dB Cumulative SELs, 206-dB Peak Adopted Fish Injury Zones and Marine Mammal Level A and B Zones (Source: Google Earth 2022)

Figure A1 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 24-inch Steel pile on Land impact driven

Figure A2 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 36-inch Steel pile impact driven

Figure A3 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 48-inch monopile impact driven

Figure A4 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL$_{cum}$; for 24-inch Steel pile on Land driven using a vibratory hammer

Figure A5 – Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 36-inch Steel pile driven using a vibratory hammer

Figure A6– Fish Injury Zones – 206 dB Peak, 150 dB RMS and 187 SEL_{cum}; for 48-inch monopile driven using a vibratory hammer

Figure A7 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 24-inch Steel pile on Land impact driven

Figure A8 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 36-inch Steel pile impact driven

Figure A9 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 48-inch monopile impact driven

Figure A10 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 24-inch Steel pile on Land driven using a vibratory hammer

Figure A11 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 36-inch Steel pile driven using a vibratory hammer

Figure A12 – Marine Mammal Level A and B Zones – Phocid and Otariid Pinnipeds; for 48-inch monopile driven using a vibratory hammer

Appendix F

Solid Waste Estimates

Total Description	**Volume**
Total CY for Steel Float	34.3
Total CY for Guide Piles	10.0
Total CY for Gangway	40.0
Total CY for Bridge Structure	60.0
Total CY for Bridge Structure Steel Support	5.0
Total CY for Approach Slab	13.0
Total CY for Electrical Mechanical	2.0
Total Overall Cubic Yards	**164.3**

Debris Generation for Permits						
ITEM	QTY.	DIMENSIONS			Volume (CY)	NOTES
		Length	Width	Height		
	EA	FT	FT	FT		
STEEL FLOAT						
Top	1	33.0	112.0	0.031	4.3	Keel is 3/8" thick
Keel	1	33.0	112.0	0.031	4.3	Base is 3/8" thick
Outer Walls						
North/South	2	112.0	0.03	5.9	1.5	Walls are 3/8" thick
East/West	2	33.0	0.03	5.9	1.0	Walls are 3/8" thick
Bulkheads						
North/South	5	111.9	0.03	5.9	3.2	Walls are 3/8" thick
East/West	2	11.0	0.03	5.9	1.0	Walls are 3/8" thick
Structrural Ribs						
Top/Bottom L8	10	111.9	0.04		2.0	Assume L8x4x1/2
Top/Bottom L7	10	111.9	0.04		2.0	Assume L7x4x1/2
Top/Bottom PL on L8/L7	24	111.9	0.50	0.04	3.0	Assume 6" long by 1/2" thick pl
Vertical L6	40	5.3	0.03		1.0	Assume L6x6x1/2"
Vertical L5	60	5.3	0.03		1.0	Assume L5x5x1/2"
Horizontal L5	4	111.9	0.03		1.0	Assume L5x5x1/2"
PL on L5	4	111.9	0.50	0.04	1.0	Assume 6" long by 1/2" thick pl
Fender Bracket	7	12.00	0.11		1.0	Assume W14x82
Guide Pile Brackets	6	24.8		0.5	3.0	Conservative assume .5" thick of steel
Misc. Steel	1	Assume 10% of steel			4.0	
Total CY for Steel Float					**34.3**	
Guide Piles	4	0.6		100.0	10	Cross Sectional Area of piles with assumption of 30" ID with wall thickness of 1"
Total CY for Guide Piles					**10**	
Gangway Upper Frame/Canopy	1	3.5		60.0	8	
Gangway platform	1	12.3		60.0	28	
Gangway lateral/diagonal bracing	1	(assume 10% from gangway and gangway platform)			4	
Total CY for Gangway					**40.0**	
Bridge Upper Frame/Canopy	1	3.5		107.0	14	
Bridge platform	1	10.5		107.0	42	
Bridge lateral/diagonal bracing	1	(assume 5% from gangway and gangway			3	
C12x30	4	13.00	0.06		0.12	
Total CY for Bridge Structure					**60.0**	
HP 14x73 Pile	1	75	0.22		1	
W18x76 Beam	2	56.5	0.15		1	
Concrete Abutment	1	13.00	2.00	3.50	3	
Total CY for Bridge Structure Steel Support					**5.0**	
Approach Slab	1	24.50	10.00	0.5	5	
Approach slab frame/Canopy	1	3.5		60.0	8	
Total CY for Approach Slab					**13.0**	
Electrical/Mechanical	1	303.5	0.50		1.4	Assume full length of all structural elements by 6" x 3"
Total CY for Electrical Mechanical					**2.0**	