Harbor Island West Marina Redevelopment Project

Volume 2 - Final Mitigated Negative Declaration Appendices

UPD #MND-2013-80, SCH# 2019129019

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Appendix A
Air Quality and Greenhouse Gas Calculations

Construction

Schedule

Phase	Code	Start Date	End Date	Working Days	2019	2020
Waterside - Demo docks	HBIW_1	1/1/2019	12/31/2019	262	262	
Waterside - Install docks	HBIW_2	1/1/2019	12/31/2019	262	262	
Landside - Building Demo I	HBIW_3	9/2/2019	10/2/2019	23	23	
Landside - Parking Lot Demo I	HBIW_4	9/2/2019	12/31/2019	88	88	
Landside - Landscape Demo I	HBIW_5	12/2/2019	12/31/2019	23	23	
Landside - Building Construction I	HBIW_6	9/2/2019	10/2/2019	23	23	
Landside - Parking Lot Paving I	HBIW_7	10/2/2019	12/31/2019	66	66	
Landside - Parking Lot Demo II	HBIW_8	1/2/2020	2/1/2020	22		22
Landside - Building Demo II	HBIW_9	1/2/2020	3/2/2020	43		43
Landside - Landscape Demo II	HBIW_10	12/1/2020	12/31/2020	23		23
Landside - Building Construction II	HBIW_11	1/2/2020	3/2/2020	43		43
Landside - Landscape Install	HBIW_12	3/3/2020	1/31/2020	239		239
Landside - Parking Lot Paving II	HBIW_13	12/1/2020	12/31/2020	23		23

Offroad Equipment

Code	Year	Days	Equip	#/day	hrs/day	HP	LF	g/hp-hr (CalEEMod)									Pounds per day						Metric tons per day			
								ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	CO2e
HBIW_2	2019	262	Bore/Drill Rigs	1	8	221	0.503	0.1	1.9	1.1	0.1	0.0	0.0	475.8	0.2	0.0	0.3	3.7	2.1	0.1	0.1	0.0	0.42	0.0	0.0	0.4
HBIW_2	2019	262	Cranes	1	8	231	0.288	0.4	5.1	1.9	0.2	0.2	0.0	483.5	0.2	0.0	0.5	6.0	2.3	0.3	0.2	0.0	0.3	0.0	0.0	0.3
HBIW_3	2019	23	Excavators	1	8	158	0.382	0.2	2.5	3.1	0.1	0.1	0.0	482.7	0.2	0.0	0.3	2.7	3.3	0.1	0.1	0.0	0.2	0.0	0.0	0.2
HBIW_3	2019	23	Graders	1	8	187	0.409	0.6	6.0	3.7	0.3	0.3	0.0	489.0	0.2	0.0	0.8	8.1	4.9	0.5	0.4	0.0	0.3	0.0	0.0	0.3
HBIW_3	2019	23	Skid Steer Loaders	1	8	65	0.369	0.2	2.7	3.3	0.1	0.1	0.0	482.4	0.2	0.0	0.1	1.1	1.4	0.1	0.0	0.0	0.1	0.0	0.0	0.1
HBIW_4	2019	88	Excavators	1	8	158	0.382	0.2	2.5	3.1	0.1	0.1	0.0	482.7	0.2	0.0	0.3	2.7	3.3	0.1	0.1	0.0	0.2	0.0	0.0	0.2
HBIW_4	2019	88	Skid Steer Loaders	1	8	65	0.369	0.2	2.7	3.3	0.1	0.1	0.0	482.4	0.2	0.0	0.1	1.1	1.4	0.1	0.0	0.0	0.1	0.0	0.0	0.1
HBIW_4	2019	88	Tractors/Loaders/Backhoes	1	7	97	0.369	0.4	3.7	3.6	0.2	0.2	0.0	485.9	0.2	0.0	0.2	2.0	2.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_4	2019	88	Other Construction Equipment	1	8	172	0.415	0.4	4.4	3.3	0.2	0.2	0.0	480.5	0.2	0.0	0.5	5.6	4.1	0.3	0.3	0.0	0.3	0.0	0.0	0.3
HBIW_4	2019	88	Tractors/Loaders/Backhoes	1	8	97	0.369	0.4	3.7	3.6	0.2	0.2	0.0	485.9	0.2	0.0	0.2	2.3	2.3	0.2	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_6	2019	23	Air Compressors	2	6	78	0.48	0.5	3.7	3.7	0.3	0.3	0.0	568.3	0.0	0.0	0.5	3.7	3.7	0.3	0.3	0.0	0.3	0.0	0.0	0.3
HBIW_6	2019	23	Tractors/Loaders/Backhoes	1	8	97	0.369	0.4	3.7	3.6	0.2	0.2	0.0	485.9	0.2	0.0	0.2	2.3	2.3	0.2	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_7	2019	66	Graders	1	8	187	0.409	0.6	6.0	3.7	0.3	0.3	0.0	489.0	0.2	0.0	0.8	8.1	4.9	0.5	0.4	0.0	0.3	0.0	0.0	0.3
HBIW_7	2019	66	Pavers	1	8	130	0.415	0.5	4.7	3.6	0.3	0.3	0.0	480.3	0.2	0.0	0.5	4.4	3.4	0.3	0.3	0.0	0.2	0.0	0.0	0.2
HBIW_7	2019	66	Paving Equipment	1	8	132	0.355	0.4	4.0	3.6	0.3	0.3	0.0	484.4	0.2	0.0	0.4	3.3	3.0	0.2	0.2	0.0	0.2	0.0	0.0	0.2
HBIW_7	2019	66	Plate Compactors	1	8	8	0.43	0.7	4.1	3.5	0.2	0.2	0.0	568.3	0.1	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HBIW_7	2019	66	Rollers	1	6	80	0.375	0.4	4.2	3.6	0.3	0.3	0.0	484.3	0.2	0.0	0.2	1.7	1.4	0.1	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_7	2019	66	Rubber Tired Loaders	2	8	203	0.362	0.3	3.7	1.3	0.1	0.1	0.0	480.1	0.2	0.0	0.8	9.7	3.4	0.3	0.3	0.0	0.6	0.0	0.0	0.6
HBIW_8	2020	22	Excavators	1	8	158	0.382	0.2	2.3	3.1	0.1	0.1	0.0	472.3	0.2	0.0	0.2	2.4	3.3	0.1	0.1	0.0	0.2	0.0	0.0	0.2
HBIW_8	2020	22	Skid Steer Loaders	2	8	65	0.369	0.2	2.5	3.3	0.1	0.1	0.0	471.9	0.2	0.0	0.2	2.1	2.8	0.1	0.1	0.0	0.2	0.0	0.0	0.2
HBIW_8	2020	22	Tractors/Loaders/Backhoes	1	8	97	0.369	0.3	3.3	3.6	0.2	0.2	0.0	475.2	0.2	0.0	0.2	2.1	2.3	0.1	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_9	2020	43	Excavators	2	8	158	0.382	0.2	2.3	3.1	0.1	0.1	0.0	472.3	0.2	0.0	0.5	4.8	6.6	0.2	0.2	0.0	0.5	0.0	0.0	0.5
HBIW_9	2020	43	Graders	1	8	187	0.409	0.6	5.5	3.6	0.3	0.3	0.0	478.0	0.2	0.0	0.8	7.5	4.9	0.4	0.4	0.0	0.3	0.0	0.0	0.3
HBIW_9	2020	43	Skid Steer Loaders	2	8	65	0.369	0.2	2.5	3.3	0.1	0.1	0.0	471.9	0.2	0.0	0.2	2.1	2.8	0.1	0.1	0.0	0.2	0.0	0.0	0.2
HBIW_10	2020	23	Other Construction Equipment	1	8	172	0.415	0.4	4.1	3.2	0.2	0.2	0.0	470.0	0.2	0.0	0.5	5.2	4.1	0.3	0.3	0.0	0.3	0.0	0.0	0.3
HBIW_10	2020	23	Tractors/Loaders/Backhoes	1	8	97	0.369	0.3	3.3	3.6	0.2	0.2	0.0	475.2	0.2	0.0	0.2	2.1	2.3	0.1	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_11	2020	43	Aerial Lifts	2	8	63	0.308	0.2	3.0	3.1	0.0	0.0	0.0	525.1	0.2	0.0	0.1	2.0	2.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2
HBIW_11	2020	43	Air Compressors	4	6	78	0.48	0.5	3.4	3.7	0.2	0.2	0.0	568.3	0.0	0.0	1.0	6.7	7.3	0.4	0.4	0.0	0.5	0.0	0.0	0.5
HBIW_11	2020	43	Cranes	1	8	231	0.288	0.4	4.6	1.8	0.2	0.2	0.0	472.9	0.2	0.0	0.5	5.4	2.1	0.2	0.2	0.0	0.3	0.0	0.0	0.3
HBIW_11	2020	43	Forklifts	2	8	89	0.201	0.5	4.1	3.8	0.3	0.3	0.0	471.5	0.2	0.0	0.3	2.6	2.4	0.2	0.2	0.0	0.1	0.0	0.0	0.1
HBIW_12	2020	239	Cranes	0	0	231	0.288	0.4	4.6	1.8	0.2	0.2	0.0	472.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HBIW_13	2020	23	Graders	1	8	187	0.409	0.6	5.5	3.6	0.3	0.3	0.0	478.0	0.2	0.0	0.8	7.5	4.9	0.4	0.4	0.0	0.3	0.0	0.0	0.3
HBIW_13	2020	23	Pavers	2	8	130	0.415	0.5	4.4	3.6	0.3	0.3	0.0	469.9	0.2	0.0	0.9	8.4	6.9	0.6	0.6	0.0	0.4	0.0	0.0	0.4
HBIW_13	2020	23	Paving Equipment	1	6	132	0.355	0.4	3.8	3.6	0.3	0.2	0.0	473.3	0.2	0.0	0.2	2.3	2.2	0.2	0.1	0.0	0.1	0.0	0.0	0.1
HBIW_13	2020	23	Plate Compactors	1	8	8	0.43	0.7	4.1	3.5	0.2	0.2	0.0	568.3	0.1	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HBIW_13	2020	23	Rollers	2	6	80	0.375	0.4	3.9	3.5	0.2	0.2	0.0	473.9	0.2	0.0	0.3	3.1	2.8	0.2	0.2	0.0	0.2	0.0	0.0	0.2
HBIW_13	2020	23	Rubber Tired Loaders	2	8	203	0.362	0.3	3.4	1.3	0.1	0.1	0.0	469.5	0.2	0.0	0.8	8.9	3.3	0.3	0.3	0.0	0.6	0.0	0.0	0.6

Employee Vehicles

Code	Year	Days	Trips/ Day	Mi/Trip	Running g/mi (EMFAC, AP 42)											Process g/trip (EMFAC)											Pounds per day								Metric tons per day			
					ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	CO2e
HBIW_1	2019	262	24	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.1	0.1	0.6	0.0	0.0	0.5	0.1	0.0	0	0.0	0.0	0
HBIW_2	2019	262	24	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.1	0.1	0.6	0.0	0.0	0.5	0.1	0.0	0	0.0	0.0	0
HBIW_3	2019	23	8	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0	0.0	0.0	0
HBIW_4	2019	88	8	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0	0.0	0.0	0
HBIW_5	2019	23	6	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0	0.0	0.0	0
HBIW_6	2019	23	12	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.1	0.0	0	0.0	0.0	0
HBIW_7	2019	66	6	10.8	0.0	0.1	0.9	0.0	0.0	0.9	0.2	0.0	311	0.0	0.0	1.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0	64	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0	0.0	0.0	0
HBIW_8	2020	22	8	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0	0.0	0.0	0
HBIW_9	2020	43	20	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.0	0.0	0.5	0.0	0.0	0.4	0.1	0.0	0	0.0	0.0	0
HBIW_10	2020	23	12	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.1	0.0	0	0.0	0.0	0
HBIW_11	2020	43	32	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.1	0.1	0.8	0.0	0.0	0.7	0.2	0.0	0	0.0	0.0	0
HBIW_12	2020	239	12	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.1	0.0	0	0.0	0.0	0
HBIW_13	2020	23	8	10.8	0.0	0.1	0.8	0.0	0.0	0.9	0.2	0.0	302	0.0	0.0	0.9	0.3	2.4	0.0	0.0	0.0	0.0	0.0	62	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0	0.0	0.0	0

Trucks

Code	Year	Vehicle	Days	Trip/Day	Mi/Trip	Running g/mi (EMFAC, AP 42)											Process g/trip (EMFAC)											Pounds per day								Metric tons per day			
						ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	PM10 D	PM2.5 D	SO2	CO2	CH4	N2O	CO2e
HBIW_1	2019	Vendor	262	0	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_2	2019	Vendor	262	8	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.1	0.0	0.0	0	0.0	0.0	0
HBIW_3	2019	Vendor	23	0	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_4	2019	Vendor	88	0	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_5	2019	Vendor	23	0	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_6	2019	Vendor	23	1	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_7	2019	Vendor	66	1	7.3	0.3	4.2	0.7	0.1	0.1	1.0	0.3	0.0	1070	0.0	0.2	0.0	1.7	0.2	0.0	0.0	0.0	0.0	0.0	58.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_1	2019	Haul	262	1	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.5	0.1	0.0	0.0	0.1	0.0	0.0	0	0.0	0.0	0
HBIW_2	2019	Haul	262	0	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_3	2019	Haul	23	0	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_4	2019	Haul	88	1	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_5	2019	Haul	23	0	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_6	2019	Haul	23	0	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_7	2019	Haul	66	0	20	0.8	9.0	1.8	0.2	0.2	0.9	0.2	0.0	1910	0.0	0.3	0.4	7.9	3.6	0.0	0.0	0.0	0.0	0.0	713.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_8	2020	Vendor	22	0	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_9	2020	Vendor	43	0	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_10	2020	Vendor	23	0	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_11	2020	Vendor	43	1	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_12	2020	Vendor	239	1	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_13	2020	Vendor	23	1	7.3	0.2	3.5	0.6	0.1	0.1	1.0	0.3	0.0	1050	0.0	0.2	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_8	2020	Haul	22	4	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.1	1.4	0.3	0.0	0.0	0.2	0.0	0.0	0	0.0	0.0	0
HBIW_9	2020	Haul	43	0	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_10	2020	Haul	23	0	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_11	2020	Haul	43	0	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_12	2020	Haul	239	0	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0
HBIW_13	2020	Haul	23	0	20	0.5	7.5	1.3	0.1	0.1	0.9	0.2	0.0	1892	0.0	0.3	0.3	8.5	4.3	0.0	0.0	0.0	0.0	0.0	855.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0

Workboat

Code	Year	Days	#/day	Hr/Day	Engine HP		Prop Engine (g/kw-hr)									Aux Engine (g/kw-hr)									Pounds per day						Metric tons per day			
					Prop	Aux	ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	CO2e
HBIW_2	2019	262	1	8	354	10	0.5	5.0	3.9	0.1	0.1	0.0	588	0.0	0.0	1.7	6.5	5.6	0.5	0.5	0.0	588	0.0	0.0	2.4	21.9	17.1	0.6	0.6	0.0	1	0.0	0.0	1

Earth Moving Calculations

Code	Year	Days	Grading (acres/day)	Cut/fill (cy/day)	Dozing (hour/day)	Emission Factor						Pounds per day	
						PM10 G (lb/acre)	PM2.5 G (lb/acre)	PM10 C/F (lb/ton)	PM2.5 C/F (lb/ton)	PM10 Doz (lb/hr)	PM2.5 Doz (lb/hr)	PM10 D	PM2.5 D
HBIW_5	2019	23	0.01	0	0	0.4	0.045	0.000	0.000	0.3	0.2	0.0	0.0
HBIW_10	2020	23	0.01	0	0	0.4	0.045	0.000	0.000	0.3	0.2	0.0	0.0
HBIW_12	2020	239	0.00	0	0	0.4	0.045	0.000	0.000	0.3	0.2	0.0	0.0

Demolition

Code	Year	Days	Demo (sf/day)	Emission Factor		Pounds per day	
				PM10 (lb/ton)	PM2.5 (lb/ton)	PM10 D	PM2.5 D
HBIW_1	2019	262	557	0.014	0.002	0.4	0.1
HBIW_2	2019	262	0	0.014	0.002	0.0	0.0
HBIW_3	2019	23	43	0.014	0.002	0.0	0.0
HBIW_4	2019	88	581	0.014	0.002	0.4	0.1
HBIW_8	2020	22	3130	0.014	0.002	2.0	0.3
HBIW_9	2020	43	512	0.014	0.002	0.3	0.0

Coating

Code	Year	Days	Coated (sf/day)	Emission Factor	Pounds
				ROG (lbs per sf)	ROG
HBIW_6	2019	23	0	0.0005	0.0
HBIW_11	2020	43	882	0.0005	0.4

Paving

Code	Year	Days	Paved (sf/day)	Emission Factor	Pounds per day
				ROG (lbs per acre)	ROG
HBIW_7	2019	66	1,303	2.6	0.1
HBIW_13	2020	23	1,303	2.6	0.1

Operation

Harbor Island West Existing Conditions
San Diego County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Health Club	22.00	1000sqft	0.51	22,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2018
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Project Characteristics - CO2e emission factor from SDG&E
Vehicle Trips - Trip rate based on memo from traffic engineers
Energy Use - Consumption based on existing uitlity bills

Table Name	Column Name	Default Value	New Value
tblEnergyUse	LightingElect	2.83	16.20
tblEnergyUse	NT24E	4.27	24.44
tblEnergyUse	NT24NG	7.25	70.03
tblEnergyUse	T24E	1.21	6.93
tblEnergyUse	T24NG	4.31	41.63
tblProjectCharacteristics	CH4IntensityFactor	0.029	0
tblProjectCharacteristics	CO2IntensityFactor	720.49	533.52
tblProjectCharacteristics	N2OIntensityFactor	0.006	0
tblVehicleTrips	ST_TR	20.87	112.73
tblVehicleTrips	SU_TR	26.73	112.73
tblVehicleTrips	WD_TR	32.93	112.73

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.1114	0	2.00E-04	0		0	0		0	0	0	3.90E-04	3.90E-04	0	0	4.20E-04
Energy	0.0133	0.1204	0.1012	7.20E-04		9.15E-03	9.15E-03		9.15E-03	9.15E-03	0	384.3568	384.3568	2.51E-03	2.40E-03	385.1359
Mobile	0.8098	3.1528	8.2271	0.0213	1.6153	0.0259	1.6413	0.4327	0.0244	0.4571	0	1,954.03	1,954.03	0.125	0	1,957.15
Waste						0	0		0	0	25.4551	0	25.4551	1.5044	0	63.0639
Water						0	0		0	0	0.4128	6.2442	6.657	0.0424	1.00E-03	8.0152
Total	**0.9345**	**3.2732**	**8.3285**	**0.022**	**1.6153**	**0.0351**	**1.6504**	**0.4327**	**0.0336**	**0.4663**	**25.8679**	**2,344.63**	**2,370.50**	**1.6743**	**3.40E-03**	**2,413.37**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,479.99	2,479.99	2479.99	4,284,603	4,284,603
Total	2,479.99	2,479.99	2,479.99	4,284,603	4,284,603

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Health Club	0.574135	0.045525	0.189369	0.116519	0.019283	0.005646	0.014833	0.022073	0.001871	0.002173	0.006385	0.000739	0.001452

5.0 Energy Detail

Historical Energy Use: N

5.2 Energy by Land Use - NaturalGas

	NaturalGa	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Health Club	2.4566e+0	0.0133	0.1204	0.1012	7.2000e-		9.1500e-	9.1500e-		9.1500e-	9.1500e-	0.0000	131.0935	131.0935	2.5100e-	2.4000e-	131.8726

Total		**0.0133**	**0.1204**	**0.1012**	**7.2000e-**		**9.1500e-**	**9.1500e-**		**9.1500e-**	**9.1500e-**	**0.0000**	**131.0935**	**131.0935**	**2.5100e-**	**2.4000e-**	**131.8726**

5.3 Energy by Land Use - Electricity

	Electricity	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Health Club	1.04654e+	253.2633	0.0000	0.0000	253.2633
Total		**253.2633**	**0.0000**	**0.0000**	**253.2633**

6.0 Area Detail

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural	0.0255					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer	0.0859					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	2.0000e-	0.0000	2.0000e-	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	3.9000e-	3.9000e-	0.0000	0.0000	4.2000e-
Total	**0.1114**	**0.0000**	**2.0000e-**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**3.9000e-**	**3.9000e-**	**0.0000**	**0.0000**	**4.2000e-**

7.0 Water Detail

	Indoor/Out	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Health Club	1.30115 /	6.6570	0.0424	1.0000e-	8.0152
Total		**6.6570**	**0.0424**	**1.0000e-**	**8.0152**

8.0 Waste Detail

	Waste	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Health Club	125.4	25.4551	1.5044	0.0000	63.0639
Total		**25.4551**	**1.5044**	**0.0000**	**63.0639**

Harbor Island West Existing Conditions
San Diego County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Health Club	22.00	1000sqft	0.51	22,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2018
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Project Characteristics - CO2e emission factor from SDG&E
Vehicle Trips - Trip rate based on memo from traffic engineers
Energy Use - Consumption based on existing uitlity bills

Table Name	Column Name	Default Value	New Value
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tblEnergyUse	NT24NG	7.25	70.03
tblEnergyUse	T24E	1.21	6.93
tblEnergyUse	T24NG	4.31	41.63
tblProjectCharacteristics	CH4IntensityFactor	0.029	0
tblProjectCharacteristics	CO2IntensityFactor	720.49	533.52
tblProjectCharacteristics	N2OIntensityFactor	0.006	0
tblVehicleTrips	ST_TR	20.87	112.73
tblVehicleTrips	SU_TR	26.73	112.73
tblVehicleTrips	WD_TR	32.93	112.73

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.6107	2.00E-05	2.28E-03	0		1.00E-05	1.00E-05		1.00E-05	1.00E-05		4.81E-03	4.81E-03	1.00E-05		5.15E-03
Energy	0.0726	0.6598	0.5543	3.96E-03		0.0502	0.0502		0.0502	0.0502		791.8131	791.8131	0.0152	0.0145	796.5184
Mobile	4.7036	16.8262	45.2392	0.1222	9.0887	0.1417	9.2304	2.4299	0.1335	2.5634		12,367.76	12,367.76	0.7555		12,386.65
Total	**5.3869**	**17.4861**	**45.7957**	**0.1261**	**9.0887**	**0.1919**	**9.2806**	**2.4299**	**0.1837**	**2.6136**		**13,159.58**	**13,159.58**	**0.7707**	**0.0145**	**13,183.18**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,479.99	2,479.99	2479.99	4,284,603	4,284,603
Total	2,479.99	2,479.99	2,479.99	4,284,603	4,284,603

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Health Club	0.574135	0.045525	0.189369	0.116519	0.019283	0.005646	0.014833	0.022073	0.001871	0.002173	0.006385	0.000739	0.001452

5.0 Energy Detail

Historical Energy Use: N

	NaturalGa	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Health Club	6.73041	0.0726	0.6598	0.5543	3.9600e-		0.0502	0.0502		0.0502	0.0502		791.8131	791.8131	0.0152	0.0145	796.5184
Total		**0.0726**	**0.6598**	**0.5543**	**3.9600e-**		**0.0502**	**0.0502**		**0.0502**	**0.0502**		**791.8131**	**791.8131**	**0.0152**	**0.0145**	**796.5184**

6.0 Area Detail

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural	0.1397					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer	0.4708					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	2.2000e-	2.0000e-	2.2800e-	0.0000		1.0000e-	1.0000e-		1.0000e-	1.0000e-		4.8100e-	4.8100e-	1.0000e-		5.1500e-
Total	**0.6107**	**2.0000e-**	**2.2800e-**	**0.0000**		**1.0000e-**	**1.0000e-**		**1.0000e-**	**1.0000e-**		**4.8100e-**	**4.8100e-**	**1.0000e-**		**5.1500e-**

Harbor Island West With Project
San Diego County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Parking Lot	380.00	Space	3.42	116,000.00	0
Health Club	15.68	1000sqft	0.36	15,682.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2021
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Project Characteristics - CO2e emission factor from SDG&E
Land Use - From PD
Vehicle Trips - Trip rate based on memo from traffic engineers
Energy Use - Consumption based on 48% improvement over existing

Table Name	Column Name	Default Value	New Value
tblEnergyUse	LightingElect	2.83	8.31
tblEnergyUse	LightingElect	0.35	0.00
tblEnergyUse	NT24E	4.27	12.53
tblEnergyUse	NT24NG	7.25	51.58
tblEnergyUse	T24E	1.21	3.55
tblEnergyUse	T24NG	4.31	30.66
tblLandUse	LandUseSquareFeet	152,000.00	116,000.00
tblLandUse	LandUseSquareFeet	15,680.00	15,682.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0

tblProjectCharacteristics	CO2IntensityFactor	720.49	533.52
tblProjectCharacteristics	N2OIntensityFactor	0.006	0
tblVehicleTrips	ST_TR	20.87	153.81
tblVehicleTrips	SU_TR	26.73	153.81
tblVehicleTrips	WD_TR	32.93	153.81

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.0913	3.00E-05	3.65E-03	0		1.00E-05	1.00E-05		1.00E-05	1.00E-05	0	7.07E-03	7.07E-03	2.00E-05	0	7.54E-03
Energy	6.95E-03	0.0632	0.0531	3.80E-04		4.80E-03	4.80E-03		4.80E-03	4.80E-03	0	161.3965	161.3965	1.32E-03	1.26E-03	161.8055
Mobile	0.6115	2.5	6.2037	0.019	1.5702	0.0166	1.5869	0.4205	0.0156	0.4361	0	1,750.07	1,750.07	0.1011	0	1,752.59
Waste						0	0		0	0	18.1433	0	18.1433	1.0722	0	44.9493
Water						0	0		0	0	0.2942	4.4504	4.7446	0.0302	7.10E-04	5.7127
Total	**0.7097**	**2.5633**	**6.2604**	**0.0194**	**1.5702**	**0.0215**	**1.5917**	**0.4205**	**0.0204**	**0.4409**	**18.4375**	**1,915.92**	**1,934.36**	**1.2049**	**1.97E-03**	**1,965.07**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,411.69	2,411.69	2411.69	4,166,600	4,166,600
Parking Lot	0.00	0.00	0.00		
Total	2,411.69	2,411.69	2,411.69	4,166,600	4,166,600

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9
Parking Lot	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
Health Club	0.593936	0.041843	0.182569	0.108325	0.016436	0.005513	0.015940	0.023523	0.001912	0.001972	0.006090	0.000748	0.001193
Parking Lot	0.593936	0.041843	0.182569	0.108325	0.016436	0.005513	0.015940	0.023523	0.001912	0.001972	0.006090	0.000748	0.001193

5.0 Energy Detail

Historical Energy Use: N

5.2 Energy by Land Use - NaturalGas

	NaturalGa	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Health Club	1.2897e+0	6.9500e-	0.0632	0.0531	3.8000e-		4.8000e-	4.8000e-		4.8000e-	4.8000e-	0.0000	68.8233	68.8233	1.3200e-	1.2600e-	69.2323
Parking Lot	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		**6.9500e-**	**0.0632**	**0.0531**	**3.8000e-**		**4.8000e-**	**4.8000e-**		**4.8000e-**	**4.8000e-**	**0.0000**	**68.8233**	**68.8233**	**1.3200e-**	**1.2600e-**	**69.2323**

5.3 Energy by Land Use - Electricity

	Electricity	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Health Club	382533	92.5732	0.0000	0.0000	92.5732
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Total		**92.5732**	**0.0000**	**0.0000**	**92.5732**

6.0 Area Detail

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural	0.0222					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer	0.0687					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.4000e-	3.0000e-	3.6500e-	0.0000		1.0000e-	1.0000e-		1.0000e-	1.0000e-	0.0000	7.0700e-	7.0700e-	2.0000e-	0.0000	7.5400e-
Total	**0.0913**	**3.0000e-**	**3.6500e-**	**0.0000**		**1.0000e-**	**1.0000e-**		**1.0000e-**	**1.0000e-**	**0.0000**	**7.0700e-**	**7.0700e-**	**2.0000e-**	**0.0000**	**7.5400e-**

7.0 Water Detail

	Indoor/Out	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Health Club	0.927365 /	4.7446	0.0302	7.1000e-	5.7127
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**4.7446**	**0.0302**	**7.1000e-**	**5.7127**

8.0 Waste Detail

	Waste	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Health Club	89.38	18.1433	1.0722	0.0000	44.9493
Parking Lot	0	0.0000	0.0000	0.0000	0.0000

Total		**18.1433**	**1.0722**	**0.0000**	**44.9493**

Harbor Island West With Project
San Diego County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Parking Lot	380.00	Space	3.42	116,000.00	0
Health Club	15.68	1000sqft	0.36	15,682.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2021
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Project Characteristics - CO2e emission factor from SDG&E
Land Use - From PD
Vehicle Trips - Trip rate based on memo from traffic engineers
Energy Use - Consumption based on 48% improvement over existing

Table Name	Column Name	Default Value	New Value
tblEnergyUse	LightingElect	2.83	8.31
tblEnergyUse	LightingElect	0.35	0.00
tblEnergyUse	NT24E	4.27	12.53
tblEnergyUse	NT24NG	7.25	51.58
tblEnergyUse	T24E	1.21	3.55
tblEnergyUse	T24NG	4.31	30.66
tblLandUse	LandUseSquareFeet	152,000.00	116,000.00
tblLandUse	LandUseSquareFeet	15,680.00	15,682.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0

tblProjectCharacteristics	CO2IntensityFactor	720.49	533.52
tblProjectCharacteristics	N2OIntensityFactor	0.006	0
tblVehicleTrips	ST_TR	20.87	153.81
tblVehicleTrips	SU_TR	26.73	153.81
tblVehicleTrips	WD_TR	32.93	153.81

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.5021	3.70E-04	0.0406	0		1.50E-04	1.50E-04		1.50E-04	1.50E-04		0.0866	0.0866	2.30E-04		0.0923
Energy	0.0381	0.3464	0.291	2.08E-03		0.0263	0.0263		0.0263	0.0263		415.697	415.697	7.97E-03	7.62E-03	418.1673
Mobile	3.5693	13.4078	34.2783	0.1089	8.835	0.0911	8.9262	2.3614	0.0852	2.4465		11,070.37	11,070.37	0.6108		11,085.64
Total	**4.1095**	**13.7545**	**34.6098**	**0.111**	**8.835**	**0.1176**	**8.9527**	**2.3614**	**0.1116**	**2.473**		**11,486.16**	**11,486.16**	**0.619**	**7.62E-03**	**11,503.90**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,411.69	2,411.69	2411.69	4,166,600	4,166,600
Parking Lot	0.00	0.00	0.00		
Total	2,411.69	2,411.69	2,411.69	4,166,600	4,166,600

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9
Parking Lot	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
Health Club	0.593936	0.041843	0.182569	0.108325	0.016436	0.005513	0.015940	0.023523	0.001912	0.001972	0.006090	0.000748	0.001193
Parking Lot	0.593936	0.041843	0.182569	0.108325	0.016436	0.005513	0.015940	0.023523	0.001912	0.001972	0.006090	0.000748	0.001193

5.0 Energy Detail

Historical Energy Use: N

	NaturalGa	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Health Club	3.53342	0.0381	0.3464	0.2910	2.0800e-		0.0263	0.0263		0.0263	0.0263		415.6970	415.6970	7.9700e-	7.6200e-	418.1673
Parking Lot	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
Total		**0.0381**	**0.3464**	**0.2910**	**2.0800e-**		**0.0263**	**0.0263**		**0.0263**	**0.0263**		**415.6970**	**415.6970**	**7.9700e-**	**7.6200e-**	**418.1673**

6.0 Area Detail

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural	0.1217					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer	0.3767					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.7900e-	3.7000e-	0.0406	0.0000		1.5000e-	1.5000e-		1.5000e-	1.5000e-		0.0866	0.0866	2.3000e-		0.0923
Total	**0.5021**	**3.7000e-**	**0.0406**	**0.0000**		**1.5000e-**	**1.5000e-**		**1.5000e-**	**1.5000e-**		**0.0866**	**0.0866**	**2.3000e-**		**0.0923**

Harbor Island West Existing Conditions Phase I Trips
San Diego County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Health Club	1.00	1000sqft	0.02	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2018
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Vehicle Trips - Trip rate based on memo from traffic engineers.

Table Name	Column Name	Default Value	New Value
tblVehicleTrips	ST_TR	20.87	2,480.00
tblVehicleTrips	SU_TR	26.73	2,480.00
tblVehicleTrips	WD_TR	32.93	2,480.00

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0	0	0	0		0	0		0	0		0	0	0	0	0
Energy	0	0	0	0		0	0		0	0		0	0	0	0	0
Mobile	4.7036	16.8263	45.2393	0.1222	9.0887	0.1417	9.2304	2.4299	0.1335	2.5634		12,367.79	12,367.794	0.7555		12,386.681

Total	**4.7036**	**16.8263**	**45.2393**	**0.1222**	**9.0887**	**0.1417**	**9.2304**	**2.4299**	**0.1335**	**2.5634**		**12,367.79**	**12,367.794**	**0.7555**	**0**	**12,386.681**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,480.00	2,480.00	2480.00	4,284,613	4,284,613
Total	2,480.00	2,480.00	2,480.00	4,284,613	4,284,613

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Health Club	0.574135	0.045525	0.189369	0.116519	0.019283	0.005646	0.014833	0.022073	0.001871	0.002173	0.006385	0.000739	0.001452

Harbor Island West Phase I Trips
San Diego County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Health Club	1.00	1000sqft	0.02	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	40
Climate Zone	13			**Operational Year**	2020
Utility Company	San Diego Gas & Electric				
CO2 Intensity	533.52	**CH4 Intensity**	0	**N2O Intensity**	0

1.3 User Entered Comments & Non-Default Data

Vehicle Trips - Trip rate based on memo from traffic engineers

Table Name	Column Name	Default Value	New Value
tblVehicleTrips	ST_TR	20.87	2,412.00
tblVehicleTrips	SU_TR	26.73	2,412.00
tblVehicleTrips	WD_TR	32.93	2,412.00

2.0 Emissions Summary

2.2 Overall Operational

	ROG	NOx	CO	SO2	Fugitive	Exhaust	PM10	Fugitive	Exhaust	PM2.5	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0	0	0	0		0.0000	0.0000		0.0000	0.0000		0	0	0.0000		0
Energy	0	0	0	0		0	0		0	0		0	0	0	0	0
Mobile	3.8488	14.3987	36.7835	0.1123	8.8367	0.1101	8.9468	2.3620	0.1033	2.4652		11,393.91	11,393.910	0.6452		11,410.038

Total	**3.8488**	**14.3987**	**36.7835**	**0.1123**	**8.8367**	**0.1101**	**8.9468**	**2.3620**	**0.1033**	**2.4652**		**11,393.91**	**11,393.910**	**0.6452**	**0**	**11,410.038**

4.0 Operational Detail - Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Health Club	2,412.00	2,412.00	2412.00	4,167,132	4,167,132
Total	2,412.00	2,412.00	2,412.00	4,167,132	4,167,132

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-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Health Club	0.588316	0.042913	0.184449	0.110793	0.017294	0.005558	0.015534	0.023021	0.001902	0.002024	0.006181	0.000745	0.001271

Recreational Boating, 2018

Boat	Pounds per Boat per Day								
	ROG	NOX	CO	PM10	PM2.5	SOx	CO2	CH4	N2O
Outboards, 25hp	0.137	0.006	0.219	0.006	0.004	0.000	0.801	0.000	0.000
Outboards, 50hp	0.343	0.024	0.651	0.019	0.014	0.000	2.685	0.000	0.000
Inboard/sterndrive, 120hp	0.021	0.069	0.031	0.002	0.001	0.000	3.887	0.000	0.000

Slip Range			Pounds per Day						Metric Tons Per Year			
	Vessel	Counts	ROG	NOX	CO	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
12 – 20 feet	Outboards, 25hp	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.000	0.000	0
21 – 25 feet	Outboards, 25hp	96	13.1	0.6	21.0	0.5	0.4	0.0	13	0.001	0.000	13
26 – 30 feet	Outboards, 25hp	111	15.2	0.7	24.3	0.6	0.5	0.0	15	0.001	0.000	15
31 – 35 feet	Outboards, 25hp	231	31.5	1.5	50.5	1.3	1.0	0.0	31	0.002	0.001	31
36 – 40 feet	Outboards, 25hp	106	14.5	0.7	23.2	0.6	0.4	0.0	14	0.001	0.000	14
41 – 45 feet	Outboards, 25hp	9	1.2	0.1	2.0	0.0	0.0	0.0	1	0.000	0.000	1
46 – 50 feet	Outboards, 50hp	44	15.1	1.1	28.6	0.8	0.6	0.0	20	0.001	0.000	20
Greater than 51 feet	Inboard/sterndrive, 120hp	23	0.5	1.6	0.7	0.0	0.0	0.0	15	0.000	0.001	15

Recreational Boating, 2020/2021

Boat	Pounds per Boat per Day								
	ROG	NOX	CO	PM10	PM2.5	SOx	CO2	CH4	N2O
Outboards, 25hp	0.132	0.006	0.221	0.005	0.004	0.000	0.811	0.000	0.000
Outboards, 50hp	0.322	0.024	0.641	0.018	0.014	0.000	2.705	0.000	0.000
Inboard/sterndrive, 120hp	0.021	0.069	0.031	0.002	0.001	0.000	3.888	0.000	0.000

Slip Range			Pounds per Day						Metric Tons Per Year			
	Vessel	Counts	ROG	NOX	CO	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
12 – 20 feet	Outboards, 25hp	57	7.5	0.4	12.6	0.3	0.2	0.0	8	0.001	0.000	8
21 – 25 feet	Outboards, 25hp	106	13.9	0.7	23.4	0.5	0.4	0.0	14	0.001	0.000	14
26 – 30 feet	Outboards, 25hp	55	7.2	0.4	12.2	0.3	0.2	0.0	7	0.001	0.000	7
31 – 35 feet	Outboards, 25hp	174	22.9	1.1	38.5	0.9	0.7	0.0	23	0.002	0.001	24
36 – 40 feet	Outboards, 25hp	73	9.6	0.5	16.1	0.4	0.3	0.0	10	0.001	0.000	10
41 – 45 feet	Outboards, 25hp	28	3.7	0.2	6.2	0.1	0.1	0.0	4	0.000	0.000	4
46 – 50 feet	Outboards, 50hp	44	14.2	1.1	28.2	0.8	0.6	0.0	20	0.001	0.000	20
Greater than 51 feet	Inboard/sterndrive, 120hp	66	1.4	4.5	2.0	0.1	0.1	0.0	42	0.000	0.002	43

Appendix B
Eelgrass Resources Report

MARINE TAXONOMIC SERVICES, LTD.

Harbor Island West Marina Updated Baseline Eelgrass Resources Report

Prepared for

Charlie Richmond
ICF International
525 B St. #1700
San Diego, CA 92101

Prepared by

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April 2, 2018 (Revised December 10, 2018)

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Harbor Island West Marina Updated Baseline Eelgrass Resources Report

April 2, 2018 (Revised December 10, 2018)

Introduction

Marine Taxonomic Services (MTS) was contracted by ICF International to provide an updated baseline eelgrass (*Zostera marina*) inventory at Harbor Island West Marina in San Diego, California. MTS has completed the survey of the eelgrass resources at Harbor Island West Marina and has prepared the following report on the findings. The survey was intended to support the environmental planning associated with proposed construction activities. As such the results of the inventory are discussed relative to potential impacts associated with planned construction activities at the marina.

Harbor Island West Marina is located in the northern portion of San Diego Bay along the northwestern shore of Harbor Island (Figure 1). The Harbor Island West Marina Renovation Project (Project) entails demolishing and replacing all existing buildings and structures as well as replacing landscaping, reconfiguring hardscape, modernizing utilities, modernizing lighting, renovating the parking lot, adding a public promenade, and improving view corridors. On the water, the docks will be replaced and slightly reconfigured. The replacement docks will follow the existing layout except that two extension dock/headwalks will be consolidated into a single dock/headwalk. This will reduce the current 11 dock/headwallks to 10 docks/headwalks and will reduce the over water coverage of the docks from 13,564 square meters (146,000 square feet) to 13,006 square meters (140,000 square feet). The number of slips will be reduced from 620 to 603 with adjustments made to the distribution of dock sizes within the marina.

Methods

A bathymetric survey was performed as part of the original baseline survey on November 29, 2014. Those data are still considered valid. The methods are reported below to maintain the completeness of this updated report. MTS staff Robert Mooney, Kees Schipper, and Angelica Lopez performed side-scan sonar and SCUBA-based surveys on March 26, 2018 to update the eelgrass distribution data. The side-scan sonar survey was performed to get a complete view of the seafloor for eelgrass mapping. The SCUBA survey was performed to visually verify the sonar record and provide independent transect-based coverage estimates.

Bathymetric Survey

The bathymetric survey was performed by using a survey-grade fathometer operating at 50 kHz. The fathometer data was integrated to the vessels differential GPS system via a laptop computer running Hypack hydrographic surveying software. Two transects were navigated

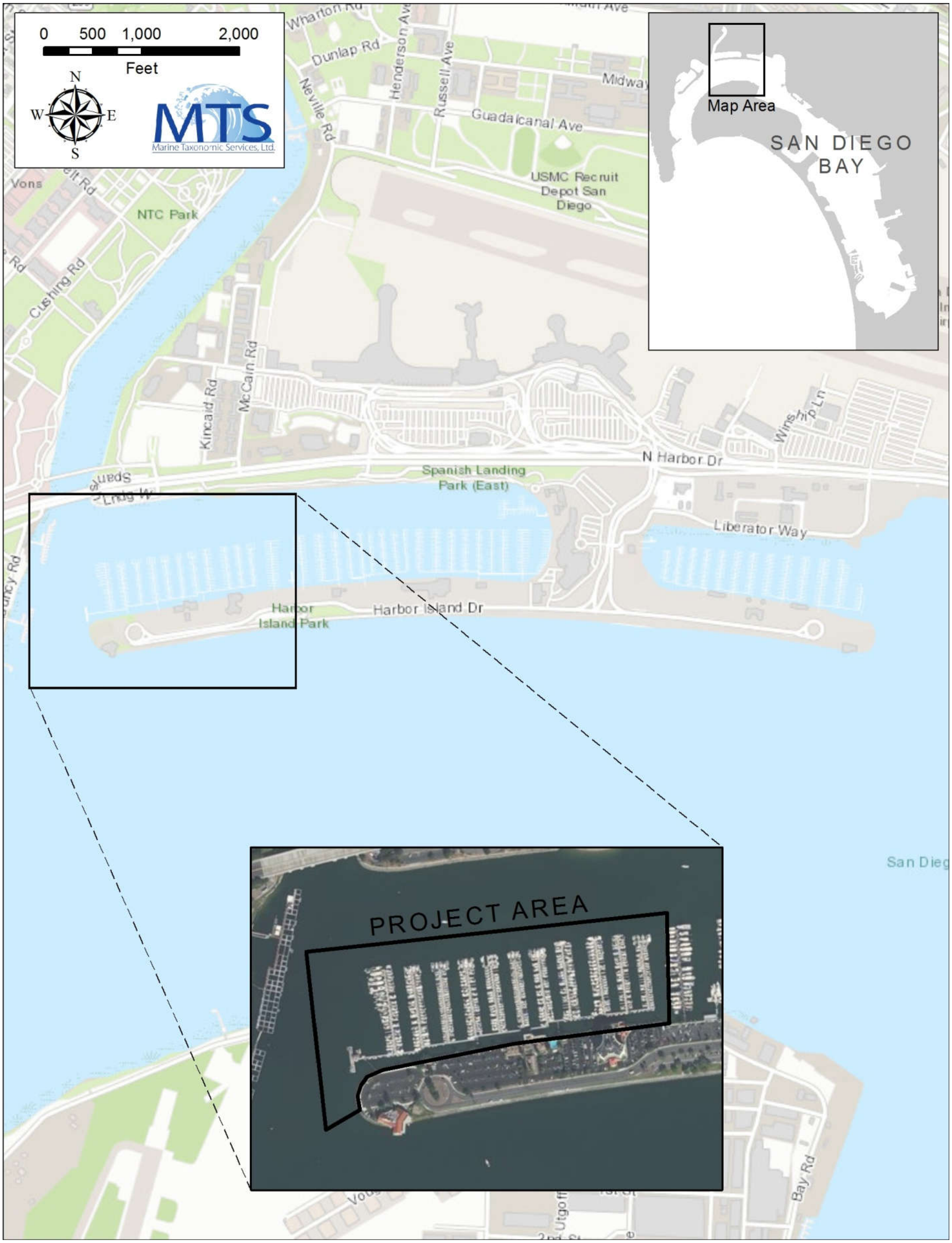

Figure 1. Vicinity map showing location of the Harbor Island West Marina within San Diego Bay.

along each fairway and a series of transects were performed around the perimeter of the marina. The data were post-processed in Hypack to produce a grid of interpolated data that were corrected for changing tidal elevations during the survey. The grid data were then processed and smoothed in ArcMap to produce depth contours.

SCUBA and Transect Surveys

The SCUBA surveys were implemented to visually verify the sonar data, provide an independent means of estimating eelgrass coverage, provide additional mapping support in areas where sonar data could not be adequately obtained, and provide eelgrass density data. The visual verification and coverage information were obtained by placing 100-meter transect lines on the seafloor running up the middle of every other fairway (refer to Figure 2). The diver swam each transect and noted where each transect intercepted eelgrass beds. In addition to the intercept data, the diver used the transects to randomly place a 1/16 square meter quadrat within eelgrass beds. The quadrat data were used to calculate eelgrass density by using the diver's counts of leaf shoots within each quadrat.

The diver transects were subsequently plotted in ArcMap. The transect data were used to calculate a percent cover of eelgrass for each transect. The data were also used to help refine the side-scan sonar digitizing. If eelgrass was found by a diver that was not digitized, the GIS Specialist would inspect the sonar record. If the sonar record showed a return in that region, the eelgrass boundary was refined and similar returns in that area were also be used to refine the eelgrass boundaries. If there was no sonar return that could be justified to represent eelgrass, no attempt was made to draw additional eelgrass patches. The two methods are sampling techniques and so variation with sampling error is considered a valid result.

Side-Scan Sonar Survey

To detect and map any eelgrass present, a side-scan sonar survey was performed by navigating a small vessel along a series of transects through the study site. The vessel was fitted with a pole-mounted side-scan sonar operating at 450 kHz. The sonar was set to scan 30 meters on both the port and starboard channels for a total scanning swath of 60 meters. Two survey transects were navigated down each of the marina fairways with the vessel biased to the left and right of center. This allowed for complete coverage of each fairway while providing for overlapping data to provide redundancy within the sonar record. Similarly transects were navigated around the perimeter of the marina with significant overlap to ensure the survey area was thoroughly covered. In areas where vessels could not be navigated, diver data were used to map eelgrass resources. The survey boundary is provided in Figure 2.

Following the field surveys, the collected side-scan sonar files were geographically registered using the vessel's navigation data collected during the survey. The side-scan files were then compiled to create a contiguous view of the seafloor across the entirety of the study site. The boundaries of the eelgrass present were then digitized from the compiled data set using ESRI ArcMap software and plotted on a geographically registered image of the project area.

Figure 2. Position of diver transects performed to validate sonar and assess eelgrass condition.

Results

Bathymetric Survey

The bathymetric survey results show that the survey area ranges from intertidal to -17-feet Mean Lower Low Water (MLLW). From simple observation of the contour lines, the toe of the shoreline rip-rap occurs at approximately -1-foot MLLW. Most of the slips occur over water in the -10 to -11-feet MLLW range.

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The diver transect survey revealed that estimates of eelgrass cover within the marina ranged from a low of 13% at the eastern end of the marina to a high of 66% at the westernmost fairway that was sampled along transect number F2 (Table 1). The general trend was for increasing eelgrass cover moving from east to west.

Table 1. The below table provides the position of the SCUBA-based diver transects and the associated percent cover of eelgrass along each transect.

	Transect Start Coordinates		Transect End Coordinates		
Transect	Latitude	Longitude	Latitude	Longitude	Cover
F1	32.725429	-117.213679	32.726270	-117.213857	49%
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F5	32.726890	-117.209725	32.725996	-117.209664	35%
F6	32.726877	-117.208778	32.725967	-117.208661	13%

Eelgrass density within the marina was generally low across the survey area. Eelgrass beds in shallow water along shore typically had shorter blades than patches observed in deeper water. Eelgrass density within the marina was 59.5 ± 44.7 (mean ± 1 sd) leaf shoots per square meter. A total of 155 quadrats (n=155) were sampled to determine the leaf shoot density estimate. The relatively high variability given the number of sampled quadrats was due to high variability among quadrats sampled in shallow water along the shore. There were many areas near shore where eelgrass was short in stature and occurred in low density.

Side-Scan Sonar Surveys

The side-scan sonar mapping resulted in identification of 15,256 square meters of eelgrass within the survey area (Figure 3). Eelgrass is generally spread across the survey area as clusters of individual patches. All fairways within the marina had eelgrass; however, eelgrass occurrence as observed by SCUBA and sonar was lowest in the easternmost fairway and the area between Harbor Island West and the neighboring Marina Cortez to the east.

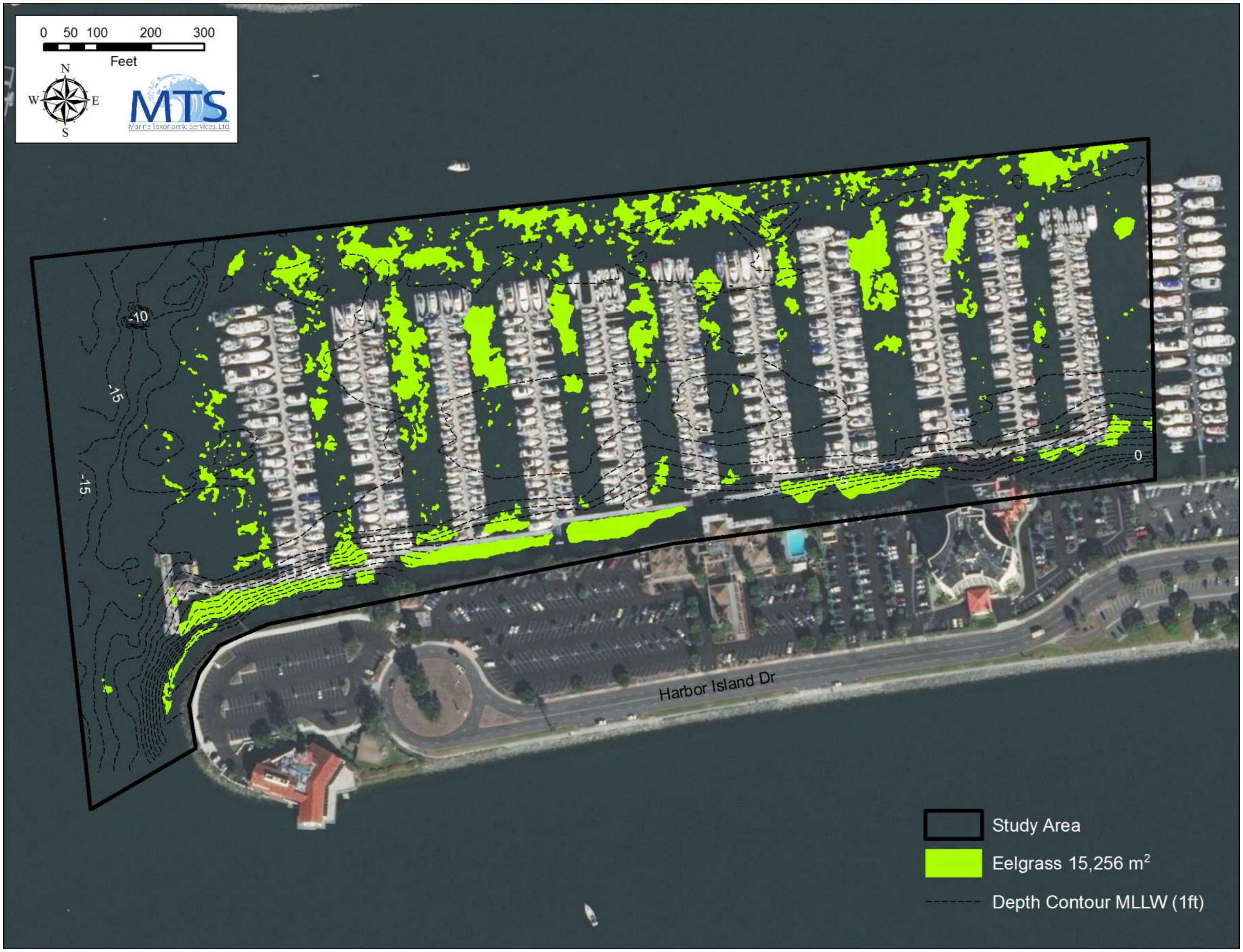

Figure 3. **The above figure shows the distribution of eelgrass resources within the Harbor Island West eelgrass survey area.**

Eelgrass Impact Analysis

The eelgrass map and bathymetric map data were analyzed to determine the potential for impacts to eelgrass resources within the survey area. For the purpose of the analysis, the existing and proposed dock layouts were used to create a mask. The dock masks were then used to clip the bathymetry and the eelgrass data. The eelgrass and bathymetry that remained outside the mask provided the unshaded eelgrass and bathymetric depth distribution. The proportion of eelgrass within each unshaded 1-foot depth category provides the percent cover of eelgrass habitat within each depth category. Only areas that were both surveyed for eelgrass and had associated depth data were included in the analysis. Some areas were mapped by SCUBA for eelgrass but could not be accessed by the survey vessel when the bathymetry survey was performed.

The potential habitat lost or gained is simply the difference between each of the depth categories before and after implementation of the dock plan. In cases where a greater amount of a depth category is shaded after construction, potential habitat is lost and a negative number results. If a depth category has less shading after construction, the value is positive. The expected eelgrass change is calculated by multiplying the potential habitat lost or gained by the percent eelgrass cover observed in each unshaded depth category. This assumes that where dock structures are removed, eelgrass will recruit to those unshaded areas in a manner similar to that observed for those depth categories prior to construction.

It is important to point out that the dock masks were created by using the perimeter of the current and proposed dock layouts with an assumption that areas within boat slips were covered. This is different from the area of the docks themselves as presented in other planning documents for the Project. This is basically assuming all slips are filled with vessels prior to and after construction regardless of the current vacancy status. The existing combined dock and slip area was calculated to be 41,244 square meters (443,947 square feet). The proposed dock and slip area measures 39,779 square meters (428,178 square feet). The existing dock and slip area where there was also bathymetry such that it could be included in the eelgrass impact model was 39,763 square meters (428,005 square feet). The proposed dock and slip area with bathymetry included in the analysis was 39,593 square meters (426,176 square feet).

The results of the eelgrass impact analysis show that the reconfiguration of the marina facilities will directly cover 177 square meters (1,905 square feet) of eelgrass (Figure 4 and Table 2). This represents all of the eelgrass mapped within the eastternmost fairway as that fairway will be covered by the new dock arrangement. It also includes minor amounts of eelgrass at the westernmost dock/headwalk where some of the western boat slips are increasing in length (Figure 4).

Figure 4. The above figure shows the existing and proposed dock footprint masks as used to support the impact analysis. The insets show where most of the 177 square meters of eelgrass will be covered due to dock reconfiguration.

Table 2. The below table provides the distribution of habitats and eelgrass by depth and whether or not they are covered by marina facilities. The three columns at right are calculated using the other fields. The percent cover of eelgrass habitat is the proportion of unshaded bottom within each depth classification that is vegetated by eelgrass. The potential loss/gain is the amount of unshaded potential eelgrass habitat that will be lost or gained when the existing docks are replaced by the current docks. The expected eelgrass loss/gain multiplies the percent eelgrass cover by the amount of potential eelgrass loss/gain within each depth classification to determine the expected loss or gain of eelgrass after the Project is implemented. All values represent areas in square meters.

Depth Range (ft MLLW)	Bathymetric Distribution	Existing Dock Cover	Proposed Dock Cover	Eelgrass Distribution	Existing Dock Over Eelgrass	Proposed Dock Over Eelgrass	Bathymetric Distribution Unshaded	Eelgrass Unshaded	Habitat % Eelgrass Cover	Potential Loss/Gain	Expected Eelgrass Loss/Gain
-17 to -16	478	0	0	0	0	0	478	0	0.0%	0	0.0
-16 to -15	1525	0	0	0	0	0	1525	0	0.0%	0	0.0
-15 to -14	2340	0	0	0	0	0	2340	0	0.0%	0	0.0
-14 to -13	3934	2	2	2	0	0	3932	2	0.1%	0	0.0
-13 to -12	6076	960	959	116	0	0	5116	116	2.3%	1	0.0
-12 to -11	38387	11136	11303	4205	4	12	27251	4201	15.4%	-167	-25.7
-11 to -10	52255	21143	20831	6528	18	167	31112	6510	20.9%	312	65.3
-10 to -9	5034	2385	2418	145	13	17	2649	132	5.0%	-33	-1.6
-9 to -8	2706	1323	1331	291	2	5	1383	289	20.9%	-8	-1.7
-8 to -7	2466	1087	1149	432	24	25	1379	408	29.6%	-62	-18.3
-7 to -6	2273	977	976	444	7	12	1296	437	33.7%	1	0.3
-6 to -5	1682	344	264	765	12	18	1338	753	56.3%	80	45.0
-5 to -4	1400	182	142	586	8	8	1218	578	47.5%	40	19.0
-4 to -3	1353	114	108	509	2	2	1239	507	40.9%	6	2.5
-3 to -2	4990	76	73	660	2	1	4914	658	13.4%	3	0.4
-2 to -1	3366	33	36	379	2	4	3333	377	11.3%	-3	-0.3
-1 to 0	592	1	1	76	0	0	591	76	12.9%	0	0.0
0 to 1	292	0	0	0	0	0	292	0	0.0%	0	0.0
1 to 2	297	0	0	0	0	0	297	0	0.0%	0	0.0
2 to 3	185	0	0	0	0	0	185	0	0.0%	0	0.0
3 to 4	13	0	0	0	0	0	13	0	0.0%	0	0.0
Totals	**131644**	**39763**	**39593**	**15138**	**94**	**271**	**91881**	**15044**	**NA**	**170**	**84.8**

Note: Existing and proposed dock cover includes slip space and is not the same as dock coverage only values provided in text and in other project documents.

The impact analysis also shows that the Project will provide for greater potential eelgrass habitat area after implementation due to a reduction of 557 square meters (6,000 square feet) of over water dock coverage (170 square meters [1,830 square feet] reduction of dock and slip coverage) (Table 2). Based on model predictions, the Project will result in a net increase of 85 square meters (915 square feet) of eelgrass above that currently mapped within the Project area. This increase is due to the reduction in shading over areas with depths suitable to support eelgrass.

Discussion

The results of this survey show that there are considerable eelgrass resources within and around the Harbor Island West Marina. The patterns of eelgrass occurrence observed are generally similar to two recent mapping efforts (M&A 2012, MTS 2015). However, both the current effort and MTS (2015) identified more eelgrass between the marina and shore relative to M&A (2012). The differences within these shallow, nearshore areas are likely due to a lower level of visual verification in the M&A (2012) study. Increases between MTS 2015 and the current study seem to be due to expansion of eelgrass beds as there are increases throughout the survey area. Eelgrass densities have been highly variable in all recent mapping efforts indicating that eelgrass vigor ranges throughout the survey area.

The results of the impact analysis show that 177 square meters of eelgrass will be directly impacted by the reconfiguration of the docks. These impacts occur in the easternmost fairway where the two docks/headwalks at the eastern end of the marina are being replaced by a single dock/headwalk and at slips of the westernmost dock/headwalk where there are slight increases to slip lengths. The amount of total eelgrass, the amount of eelgrass impacted, and the amount of predicted eelgrass recover is significantly higher than that noted during the MTS (2015) survey. It was pointed out in the MTS (2015) discussion of results that transect survey results predicted that there was slightly more eelgrass in the eastern fairway than mapped via sonar and that future surveys might detect more eelgrass under favorable conditions. Given the expansive eelgrass growth across the marina it appears conditions have been favorable for eelgrass growth since the prior survey.

While the new configuration covers 177 square meters of eelgrass, the results of the impact analysis indicate that the Project will provide a surplus of potential eelgrass habitat relative to the existing condition. As shown in the impact analysis, multiplication of the area made available by the proportion of eelgrass cover observed in each of the bathymetric depth categories indicates that a net increase of 85 square meters of eelgrass can be expected to grow within the areas where the decreased dock footprint results in reduced bottom shading.

The impact analysis shows that the Project is self-mitigating with regards to eelgrass cover. Although there will be 177 square meters of current eelgrass coverage lost, there will be a net increase over the current coverage of 85 square meters. This means the project will result in production of 262 square meters (2,820 square feet) of eelgrass in areas that will be made available by the Project. This equates to a ratio of 1.48:1 of created eelgrass for lost eelgrass.

This is in excess of the 1.2:1 eelgrass mitigation ratio specified in the California Eelgrass Mitigation Policy.

Given the Project provides a net increase in potential eelgrass habitat and therefore a long-term benefit to the resource, it is reasonable to expect favorable review of the Project by NOAA Fisheries. However, it is suggested that a small restoration effort be performed to ensure rapid eelgrass colonization in appropriate areas and to ensure that the Project does not result in a reduction of eelgrass resources. This would simply mean planting approximately 300 square meters worth of eelgrass in areas where shading is removed and depths are suitable for eelgrass growth.

In addition to the potential for direct impacts to eelgrass associated with reconfiguration of the dock layout, there is a potential for direct and indirect impacts associated with construction techniques. Construction elements that can cause direct impact include shading from support vessels (e.g. barges), bottom scour from propeller wash from construction vessels and bottom contact from the use of spuds. Indirect impacts can also occur from increases in turbidity. Turbidity decreases the light available to the eelgrass beds as more light is attenuated through the water column than would be otherwise. Additionally, as particulates settle from the turbid water column they can land of eelgrass blades and reduce the ability of the plant to photosynthesize. The extent of turbidity related impacts is dependent upon the extent and duration of the elevated turbidity.

The potential direct and indirect eelgrass impacts associated with bottom contact, scour, and turbidity mentioned above can be readily avoided through contractor training, provision of eelgrass maps, and use of silt curtains during pile jetting and driving. The map data can be used by construction personnel so that direct and indirect impacts associated with construction activities would be avoided. Silt curtains would minimize the spread of particulates through the water column and minimize the potential for indirect impacts.

References

Marine Taxonomic Services, Ltd. [MTS]. 2015. Harbor Island West Marina Baseline Eelgrass Resource Report. Prepared for ICF International. January 7, 2015 (revised January 2, 2017).

Merkel & Associates, Inc. [M&A]. Baseline eelgrass report for the Harbor Island West Marina Redevelopment Project, San Diego Bay, California. Letter Report. April 23, 2012.

Appendix B1

Harbor Island West Marina Updated Eelgrass Resources and Impact Report

MARINE TAXONOMIC SERVICES, LTD.

Harbor Island West Marina Updated Eelgrass Resources and Impact Report

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January 28, 2022

Prepared for:

Charlie Richmond
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Prepared By:

Marine Taxonomic Services, Ltd.

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Marine Taxonomic Services Ltd. 2022. Harbor Island West Marina Updated Eelgrass Resources and Impact Report. Prepared for ICF International. January 28, 2022.

Robert Mooney, PhD
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Participating Marine Taxonomic Services Ltd. Team Members;

Project Manager – Robert Mooney, PhD
Biologist and Report Draft – Grace Teller, MSc

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January 28, 2022

1 Introduction

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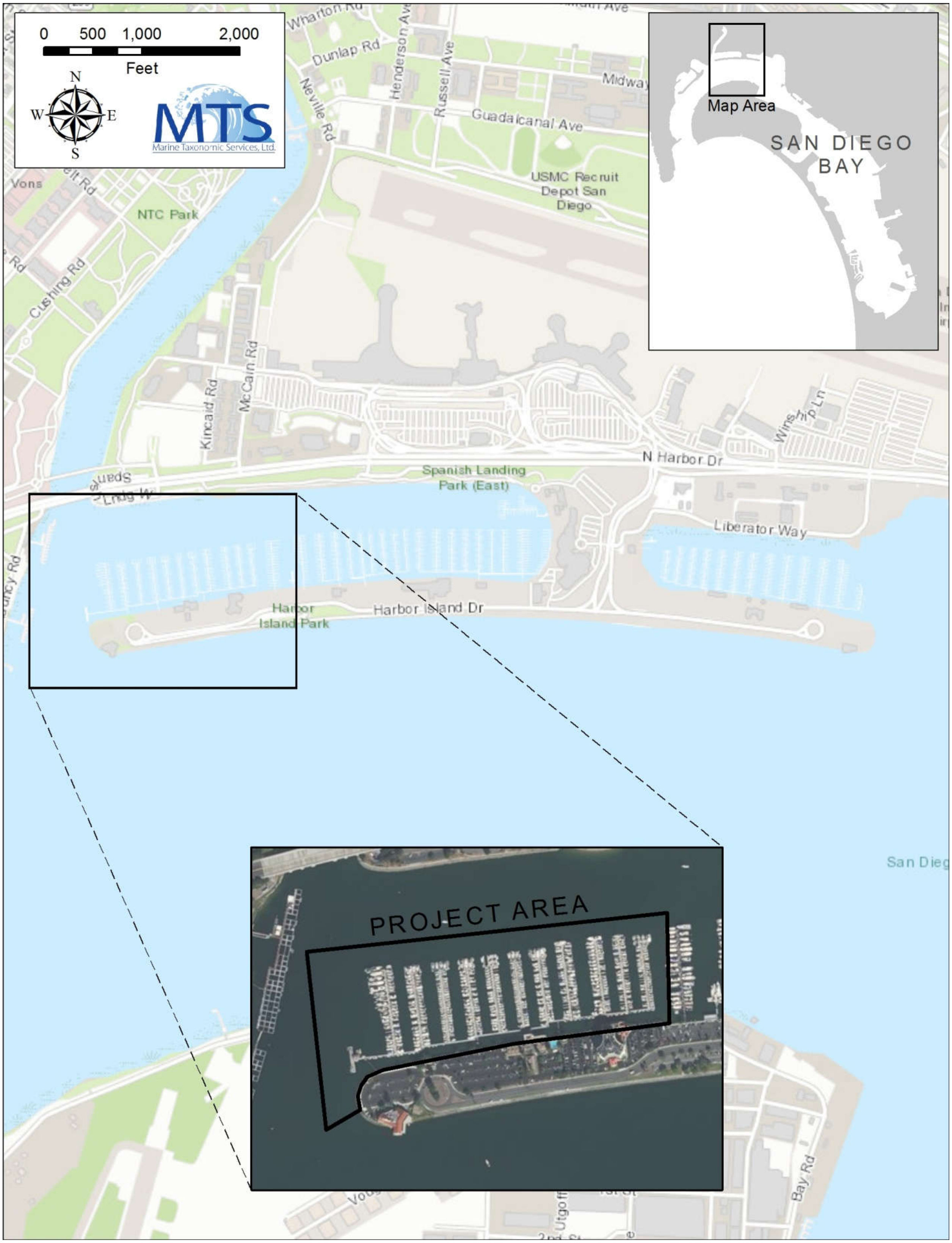

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Figure 2. Position of diver transects performed to validate sonar and assess eelgrass condition.

3 Results

3-1 Bathymetric Survey

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The potential habitat lost or gained is simply the difference between each of the depth categories before and after implementation of the dock plan. In cases where a greater amount of a depth category is shaded after construction, potential habitat is lost and a negative number results. If a depth category has less shading after construction, the value is positive. The expected eelgrass change is calculated by multiplying the potential habitat lost or gained by the percent eelgrass cover observed in each unshaded depth category. This assumes that where dock structures are removed, eelgrass will recruit to those unshaded areas in a manner similar to that observed for those depth categories prior to construction.

It is important to point out that the dock masks were created by using the perimeter of the current and proposed dock layouts with an assumption that areas within boat slips were covered. This is different from the area of the docks themselves as presented in other planning documents for the Project. This is basically assuming all slips are filled with vessels prior to and after construction regardless of the current vacancy status. The existing combined dock and slip area was calculated to be 41,244 square meters (443,947 square feet). The proposed dock and slip area measures 47,366 square meters (509,843 square feet). The existing dock and slip area where there was also bathymetry such that it could be included in the eelgrass impact model was 39,763 square meters (428,005 square feet). The proposed dock and slip area with bathymetry included in the analysis was 47,361 square meters (509,790 square feet).

The results of the eelgrass impact analysis show that the reconfiguration of the marina facilities will directly cover 4,543 square meters (48,900 square feet) of eelgrass (Figure 4 and Table 2). Eelgrass impacts represent eelgrass covered throughout the mapped area due to the shift in placement of main dock walkways and fingers over areas that are currently fairways supporting eelgrass in the current dock layout (Figure 4).

The impact analysis also shows that the Project will reduce the potential eelgrass habitat after implementation due to an increase of 7,598 square meters (81,784 square feet) of over water dock coverage and slip coverage. Based on model predictions, the Project will result in a net decrease of 1,267 square meters (13,638 square feet) of eelgrass beyond what is currently mapped within the Project area. This decrease is due to the increase in shading over areas with depths suitable to support eelgrass (Table 2).

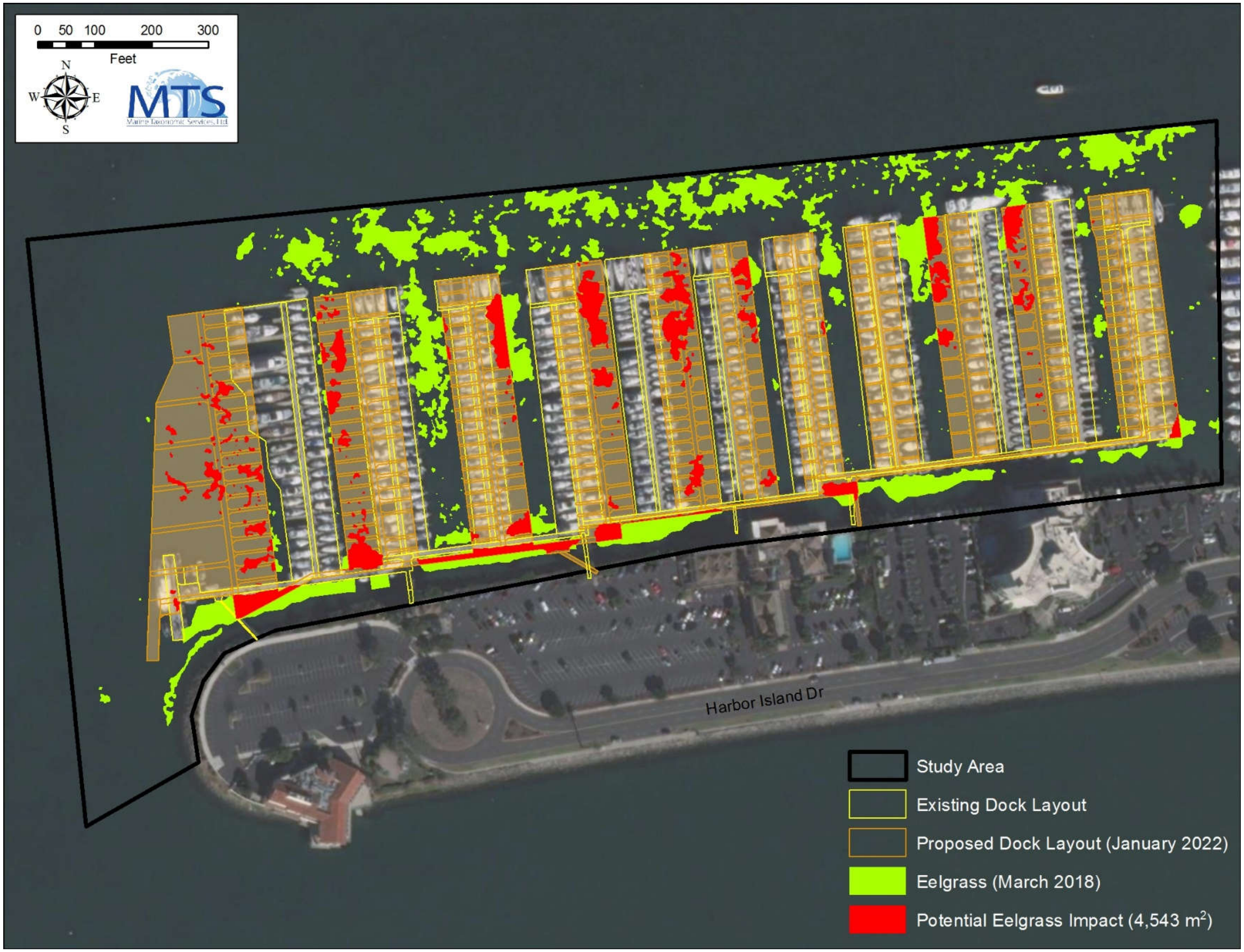

Figure 4. The above figure shows the existing and proposed dock footprint masks as used to support the impact analysis. The insets show where most of the 4,543 square meters of eelgrass will be covered due to dock reconfiguration.

Table 2. The below table provides the distribution of habitats and eelgrass by depth and whether or not they are covered by marina facilities. The three columns at right are calculated using the other fields. The percent cover of eelgrass habitat is the proportion of unshaded bottom within each depth classification that is vegetated by eelgrass. The potential loss/gain is the amount of unshaded potential eelgrass habitat that will be lost or gained when the existing docks are replaced by the current docks. The expected eelgrass loss/gain multiplies the percent eelgrass cover by the amount of potential eelgrass loss/gain within each depth classification to determine the expected loss or gain of eelgrass after the Project is implemented. All values represent areas in square meters.

Depth Range (ft MLLW)	Bathymetric Distribution	Existing Dock Cover	Proposed Dock Cover	Eelgrass Distribution	Existing Dock Over Eelgrass	Proposed Dock Over Eelgrass	Bathymetric Distribution Unshaded	Eelgrass Unshaded	Habitat % Eelgrass Cover	Potential Loss/Gain	Expected Eelgrass Loss/Gain
-17 to -16	478						478	0	0.0%	0	0.0
-16 to -15	1525						1525	0	0.0%	0	0.0
-15 to -14	2340						2340	0	0.0%	0	0.0
-14 to -13	3934	2	161	2			3932	2	0.1%	-159	-0.1
-13 to -12	6076	960	1963	116		99	5116	116	2.3%	-1003	-22.7
-12 to -11	38387	11136	15220	4205	4	1010	27251	4201	15.4%	-4084	-629.5
-11 to -10	52255	21143	22450	6528	18	2077	31112	6510	20.9%	-1307	-273.5
-10 to -9	5034	2385	2601	145	13	87	2649	132	5.0%	-216	-10.7
-9 to -8	2706	1323	1331	291	2	149	1383	289	20.9%	-8	-1.6
-8 to -7	2466	1087	1177	432	24	201	1379	408	29.6%	-90	-26.6
-7 to -6	2273	977	1110	444	7	198	1296	437	33.7%	-133	-44.7
-6 to -5	1682	344	686	765	12	310	1338	753	56.3%	-342	-192.7
-5 to -4	1400	182	313	586	8	148	1218	578	47.5%	-131	-62.1
-4 to -3	1353	114	69	509	2	52	1239	507	40.9%	45	18.5
-3 to -2	4990	76	140	660	2	87	4914	658	13.4%	-64	-8.6
-2 to -1	3366	33	134	379	2	115	3333	377	11.3%	-101	-11.4
-1 to 0	592	1	8	76		8	591	76	12.9%	-7	-0.9
0 to 1	292						292	0	0.0%	0	0.0
1 to 2	297						297	0	0.0%	0	0.0
2 to 3	185						185	0	0.0%	0	0.0
3 to 4	13						13	0	0.0%	0	0.0
Totals	131644	39763	47361	15138	94	4543	91881	15044	NA	-7598	-1267

Note: Existing and proposed dock cover includes slip space and is not the same as dock coverage only values provided in text and in other project documents.

4 Discussion

The results of this survey show that there are considerable eelgrass resources within and around the Harbor Island West Marina. The patterns of eelgrass occurrence observed are generally similar to two recent mapping efforts (M&A 2012, MTS 2015). However, both the MTS 2018 and MTS 2015 efforts identified more eelgrass between the marina and shore relative to M&A (2012). The differences within these shallow, nearshore areas are likely due to a lower level of visual verification in the M&A (2012) study. Increases between MTS 2015 and the MTS 2018 survey seem to be due to expansion of eelgrass beds as there are increases throughout the survey area. Eelgrass densities were highly variable in all recent mapping efforts indicating that eelgrass vigor ranges throughout the survey area.

The results of the impact analysis show that 4,543 square meters of eelgrass will be directly impacted by the reconfiguration of the docks. These impacts occur throughout the Project area where docks/headwalks are replacing fairways currently supporting eelgrass. The amount of total eelgrass, the amount of eelgrass impacted, and the amount of predicted eelgrass recover is significantly higher than that noted during the MTS (2015) survey. It was pointed out in the MTS (2015) discussion of results that transect survey results predicted that there was slightly more eelgrass in the eastern fairway than mapped via sonar and that future surveys might detect more eelgrass under favorable conditions. Given the expansive eelgrass growth across the marina it appears conditions were favorable for eelgrass growth between the MTS (2015) and MTS (2018) surveys.

While the new configuration covers 4,543 square meters of eelgrass, the results of the impact analysis indicate that the Project will result in a net decrease of potential eelgrass habitat relative to the existing condition. As shown in the impact analysis, multiplication of the area made available by the proportion of eelgrass cover observed in each of the bathymetric depth categories indicates that a net decrease of 1,267 square meters of eelgrass from increased bottom shading.

The impact analysis shows that the Project would result in a net decrease of eelgrass cover. While there will be 4,543 square meters of current eelgrass coverage lost, the positioning of the proposed dock structure is estimated to provide 3,276 square meters of unvegetated seafloor for eelgrass establishment. Overall, there will be a net decrease of eelgrass compared to current coverage of 1,267 square meters. This means that the Project would likely need to mitigate for the loss of 4,543 square meters of eelgrass. The California Eelgrass Mitigation Policy requires an eelgrass mitigation ratio of 1.2:1 which would result in establishment of 5,452 square meters of eelgrass. Given the estimated 3,276 square meters of available seafloor for transplanting eelgrass within the Project area a total of 2,176 square meters of eelgrass would need to be transplanted outside the Project area to comply with the mitigation requirement. Alternately, site modifications could be made within the Project area to increase the potential for successful eelgrass establishment within the leasehold.

Ultimately, the actual amount of impact will have to be determined through a series of eelgrass surveys performed before and after construction. However, mitigation will need to begin as soon as possible within the construction schedule to avoid penalties associated with the delay of eelgrass restoration as defined in the CEMP. This means the Project needs to plan conservatively for eelgrass restoration and identify suitable sites for restoration or alter the marina plans in ways that allow for a higher probability of successfully establishing the eelgrass required to mitigate for impacts.

In addition to the potential for direct impacts to eelgrass associated with reconfiguration of the dock layout, there is a potential for direct and indirect impacts associated with construction techniques. Construction elements that can cause direct impact include shading from support vessels (e.g. barges), bottom scour from propeller wash from construction vessels and bottom contact from the use of spuds. Indirect impacts can also occur from increases in turbidity. Turbidity decreases the light available to the eelgrass beds as more light is attenuated through the water column than would be otherwise. Additionally, as particulates settle from the turbid water column, they can land of eelgrass blades and reduce the ability of the plant to photosynthesize. The extent of turbidity related impacts is dependent upon the extent and duration of the elevated turbidity.

The potential direct and indirect eelgrass impacts associated with bottom contact, scour, and turbidity mentioned above can be readily avoided through contractor training, provision of eelgrass maps, and use of silt curtains during pile jetting and driving. The map data can be used by construction personnel so that direct and indirect impacts associated with construction activities would be avoided. Silt curtains would minimize the spread of particulates through the water column and minimize the potential for indirect impacts.

5 References

Marine Taxonomic Services, Ltd. [MTS]. 2015. Harbor Island West Marina Baseline Eelgrass Resource Report. Prepared for ICF International. January 7, 2015 (revised January 2, 2017).

Marine Taxonomic Services, Ltd. [MTS]. 2018. Harbor Island West Marina Updated Baseline Eelgrass Resources Report. Prepared for ICF International. April 2, 2018 (revised December 10, 2018).

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Appendix B2
Eelgrass Mitigation Plan

MARINE TAXONOMIC SERVICES, LTD.

Harbor Island West Marina Redevelopment Project Eelgrass Mitigation Plan

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December 7, 2022

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Marine Taxonomic Services Ltd. 2022. Harbor Island West Marina Redevelopment Project Eelgrass Mitigation Plan. Prepared for Adam Gale, Anchor QEA, LLC. December 7, 2022.

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Harbor Island West Marina Redevelopment Project Eelgrass Mitigation Plan

December 7, 2022

1 Introduction

Marine Taxonomic Services, Ltd. (MTS) was contracted by Anchor QEA to perform an analysis of eelgrass impacts and develop an eelgrass mitigation plan in support of the Harbor Island West Marina Redevelopment Project (HIWMRP). This document provides an eelgrass mitigation plan to meet that need. The mitigation plan is developed within the appropriate regulatory framework to provide a plan that incorporates MTS' current understanding of the HIWRP relative to eelgrass resources. This plan is provided in good faith that it meets the intent and criteria associated with the California Eelgrass Mitigation Policy (CEMP) (National Marine Fisheries Service [NMFS] 2014) while being sensitive to the HIWMRP needs and limitations imposed by the surrounding environment.

This document provides a mitigation plan to account for impacts to eelgrass due to construction of the new HIWMRP dock layout. It includes details on the location, methods, and timing for creating new eelgrass habitat as part of the proposed mitigation. Additionally, the plan includes a five-year monitoring plan to assess the establishment of the eelgrass habitat that is created to ensure that the minimum coverage and density obligations are met per the CEMP. The acceptance of this plan as appropriate mitigation for the HIWMRP is ultimately at the discretion of the NMFS and the California Department of Fish and Wildlife though the consultation process during project permitting. The provision of this document to the HIWMRP proponents does not guarantee that regulatory agencies will accept the proposed mitigation plan.

1-1 Location

Harbor Island West Marina is located in the northern portion of San Diego Bay along the northwestern shore of Harbor Island (Figure 1).

1-2 Description of Project Site and Proposed Actions

Harbor Island West Marina is a marina used to berth privately owned vessels within San Diego Unified Port District (District) jurisdiction. The current vessel docks are beyond their useful life such that replacement is necessary. The HIWMRP entails demolishing and replacing all existing buildings and structures as well as replacing landscaping, reconfiguring hardscape, modernizing utilities, modernizing lighting, renovating the parking lot, adding a public promenade, and improving view corridors. On the water, the docks will be replaced and reconfigured. The replacement and reconfiguration of the dock structures will reduce dock coverage from 13,564 square meters (146,000 square feet) to 12,934 square meters (139,218 square feet). The number of slips will be increased from 620 to 623 with adjustments made to

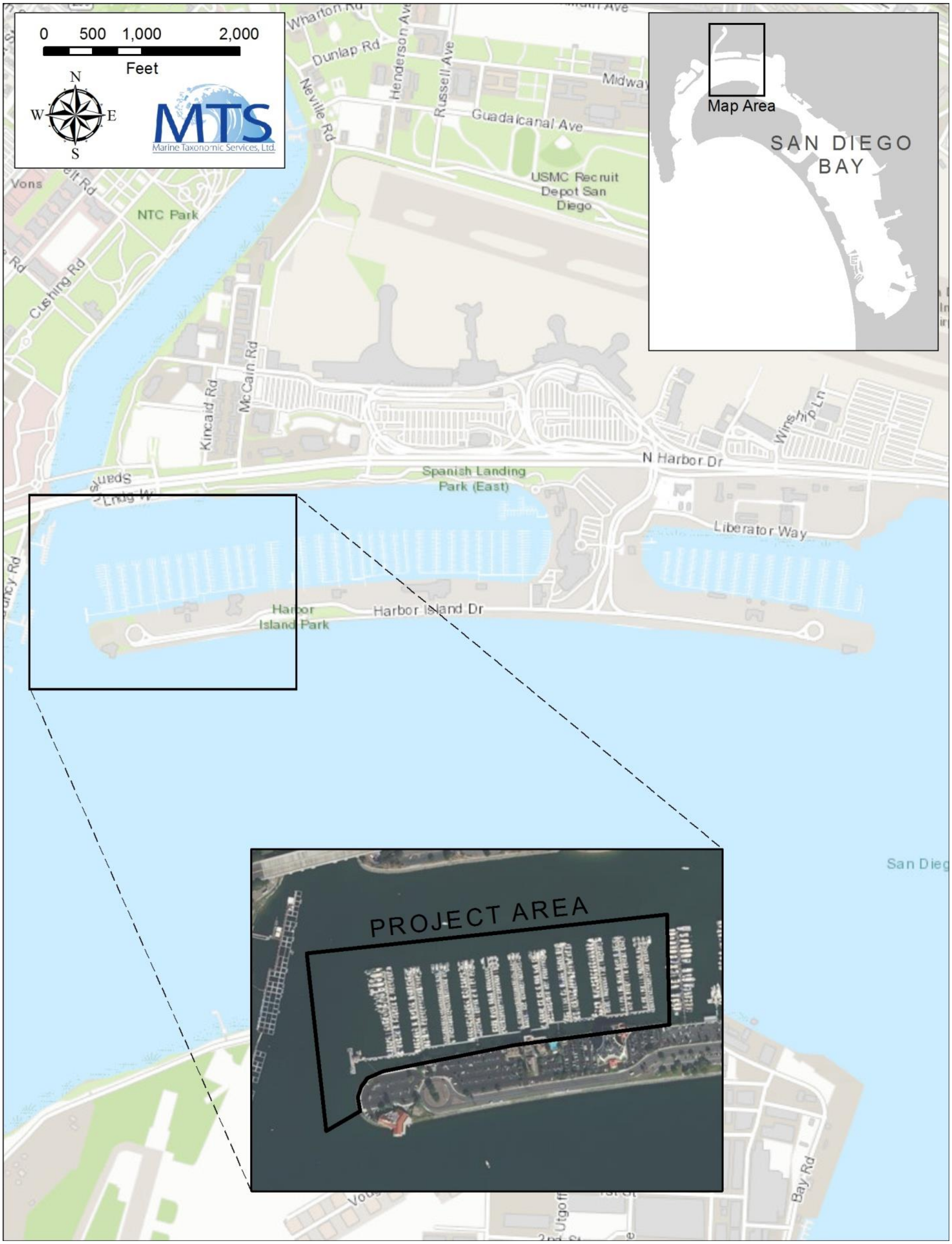

Figure 1. Vicinity map showing location of Harbor Island West Marina in northern San Diego Bay, San Diego, California.

the distribution of slip sizes within the marina. The HIWMRP plans as developed by Bellingham Marine Industries, Inc. are included as Appendix A.

2 Eelgrass Occurrence and Projected Impacts

2-1 Results of Preliminary Eelgrass Survey

A baseline eelgrass inventory was performed by MTS on March 26, 2018. The eelgrass survey identified eelgrass beds growing within and adjacent to the existing docks (MTS 2018). The side-scan sonar mapping resulted in identification of 15,256 square meters of eelgrass within the survey area (Figure 2). Eelgrass was generally spread across the survey area as clusters of individual patches. All fairways within the marina had eelgrass; however, eelgrass occurrence as observed by SCUBA and sonar was lowest in the easternmost fairway and the area between Harbor Island West and the neighboring Marina Cortez to the east. The methods and detailed results of the baseline eelgrass survey can be found in MTS (2018).

2-2 Description of Projected Eelgrass Impacts

An impact analysis was performed by MTS (2022). The primary anticipated impact to eelgrass resources will result from the direct shading of eelgrass vegetated areas by the docks (Figure 3). The results of the eelgrass impact analysis show that the reconfiguration of the marina facilities will directly cover 4,543 square meters (48,900 square feet) of the eelgrass as mapped in MTS (2018). Eelgrass impacts represent eelgrass covered throughout the mapped area due to the shift in placement of main dock walkways and fingers over areas that are currently fairways supporting eelgrass (Figure 3). It should be noted that the impact analysis looked at coverage by docks with an assumed 100% occupancy by vessels. This means the analysis considered the impacts of the docks as well as the operational impacts of the docks being occupied by vessels.

Figure 2. Results of eelgrass mapping performed in March 2018. Adapted from MTS (2018).

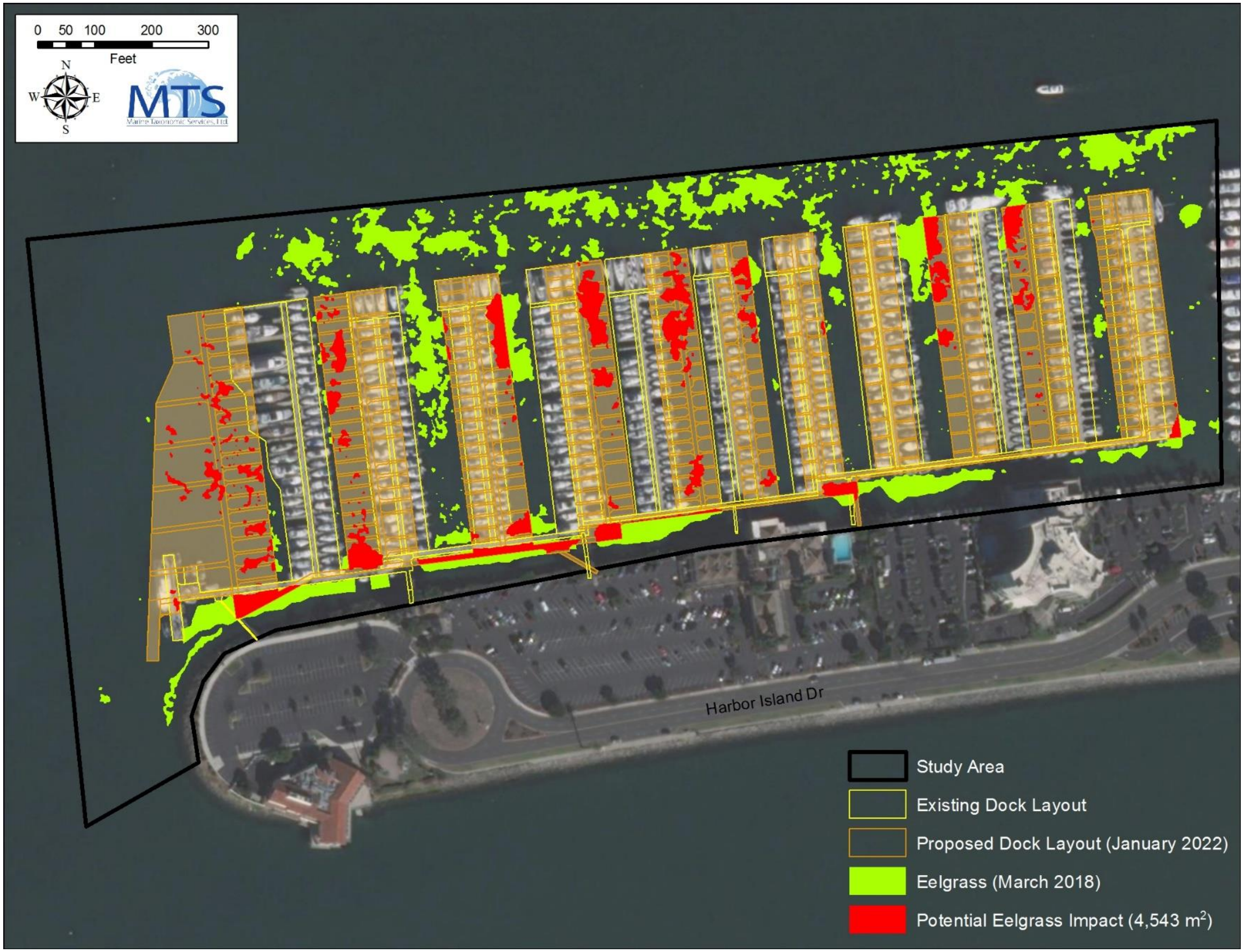

Figure 3. The above figure shows the existing and proposed dock footprint masks as used to support the impact analysis performed by MTS (2022). The potential eelgrass impact (red) shows where the 4,543 square meters of eelgrass will be covered due to dock reconfiguration.

3 Mitigation

Under the proposed Project, impacts to eelgrass habitat from the marina reconfiguration with 100% occupancy by vessels are currently estimated at 4,543 square meters. Most of the pile driving will occur in areas where the docks are moved such that pile driving is not likely to have additional impacts to eelgrass. If there are unforeseen additional impacts to eelgrass, the proposed mitigation takes a conservative approach to restoration and provides significant eelgrass planting above the requirements. To address the potential for unforeseen construction related impacts to eelgrass, measures will be taken during construction to avoid and minimize impacts to eelgrass habitat to the maximum extent practical. The construction contractor will be educated on the eelgrass presence prior to construction, silt curtains will be placed to minimize spread of turbidity during pile driving, and the contractor will be instructed to not direct propeller wash toward eelgrass vegetated areas and to not stage barges or docks over eelgrass vegetated areas. These measures are required by the HIWMRP's mitigation, monitoring and reporting program and Coastal Development Permit.

Any direct loss or significant indirect impacts to eelgrass habitat (as determined by surveys described in Section 6-1) would be mitigated in-kind in accordance with the provisions of the CEMP (NMFS 2014). The CEMP requires that mitigation be provided for losses to eelgrass beds directly or indirectly damaged by Project construction. For each square meter of eelgrass adversely impacted, 1.2 square meters of new eelgrass habitat must be created. This mitigation plan takes a conservative approach such that enough restoration area exists on site to mitigate the known impacts while also having additional space to mitigate unforeseen impacts.

Based on the currently known potential for direct impacts of 4,543 square meters, the CEMP requires the successful establishment of 5,452 square meters of eelgrass at the 1.2:1 mitigation ratio to mitigate for the permanent impacts to eelgrass associated with the new HIWMRP dock layout. The CEMP recommends a conservative planning approach with a minimum transplant ratio of 1.38:1 to account for the fact that not all planting area will successfully support eelgrass. The recommended eelgrass transplant starting area at the 1.38:1 ratio is 6,269 square meters (Table 1).

Table 1. Summary table of the existing eelgrass, eelgrass impacts, and mitigation planning elements for the eelgrass mitigation requirements associated with impacts to eelgrass at the HIWMRP site.

	METRIC	EXISTING EELGRASS	IMPACTED EELGRASS	REQUIRED MITIGATION	RECOMMENDED TRANSPLANT STARTING AREA	TOTAL MITIGATION AREA
Direct + Indirect Operational Impacts	SQUARE METERS	15,256	4,543	5,452	6,269	30,410

3-1 Mitigation Site

Eelgrass mitigation space has been identified within the HIWMRP water lease area. The proposed mitigation site is comprised of all of the fairways that will exist as part of the new marina layout (Figure 4). These areas currently support eelgrass where they are part of existing fairways. The conditions under the current docks where docks will be removed are similar and therefore the new fairways are expected to support eelgrass. The mitigation approach will be to plant eelgrass throughout the proposed mitigation site to bolster eelgrass presence. The mitigation site provides 30,410 square meters of eelgrass planting area. The mitigation site proposed is more than enough to accommodate the mitigation need based on the current estimate of impacts from construction and operation of the marina. Any eelgrass existing within the boundary of the mitigation site at the beginning of the transplant will be excluded from mitigation site planting area such that it is not included in the determination of success per the milestones noted within the CEMP.

The mitigation site was chosen to capitalize on areas that are currently shaded but where removal of dock structures will allow sunlight to reach the bottom. By transplanting eelgrass within the proposed mitigation site, the HIWMRP may meet project related mitigation requirements. In the event the site fails to support enough eelgrass cover to meet the mitigation requirements, supplemental planting and additional adaptive management strategies may be employed in conformance with the CEMP and as outlined in Section 6 below.

3-2 Donor Site

The donor eelgrass material to support this effort will come from eelgrass beds salvaged from within the project footprint and from eelgrass beds located north of the HIWMRP area. (Figure 5). It is anticipated that the marina construction will occur in phases. Once a set of docks are demolished and a future fairway is opened, divers will harvest eelgrass from an area within the HIWMRP area where eelgrass will be impacted by future dock cover. In the event that there is not enough material within the HIWMRP or phasing makes it difficult to obtain an appropriate amount of eelgrass at the time of transplant, the donor beds to the north of the HIWMRP will be utilized.

The project will require 133,360 eelgrass turions. This estimate is based on the need for 16,670 bare root eelgrass bundles of 8 turions each. Fairways 1-3 would be planted with one bare root bundle per square meter of available planting area. This will require 12,091 bare root bundles composed of up to 96,728 turions. The remaining fairways will be planted at a ratio of one bare root bundle per four square meters of available planting area. This will require an additional 4,579 bare root bundles and 36,632 turions.

It is anticipated that most of the 4,543 square meters of eelgrass to be impacted can be salvaged. Given the estimate from the baseline eelgrass survey (MTS 2018) of 51 turions per square meter, it is possible that up to 231,693 turions could be salvaged. This is more than enough to meet the requirements of the transplant but assumes a high rate of recovery of suitable material and that

Fairway	Total Area (sq m)	2018 Eelgrass (sq m)	Available Seafloor (sq m)
1	5,822	136	5,686
2	4,308	1,106	3,202
3	3,759	556	3,203
4	3,194	0	3,194
5	1,856	0	1,856
6	2,077	99	1,978
7	2,319	251	2,068
8	2,454	490	1,964
9	2,454	39	2,415
10	2,979	140	2,839
11	2,104	99	2,005
TOTALS	33,326	2,916	30,410

Figure 4. Eelgrass transplant mitigation site as composed of the seafloor in the 11 proposed fairways within the HIWMRP. The available seafloor within each fairway is the anticipated un-vegetated portion of each proposed fairway.

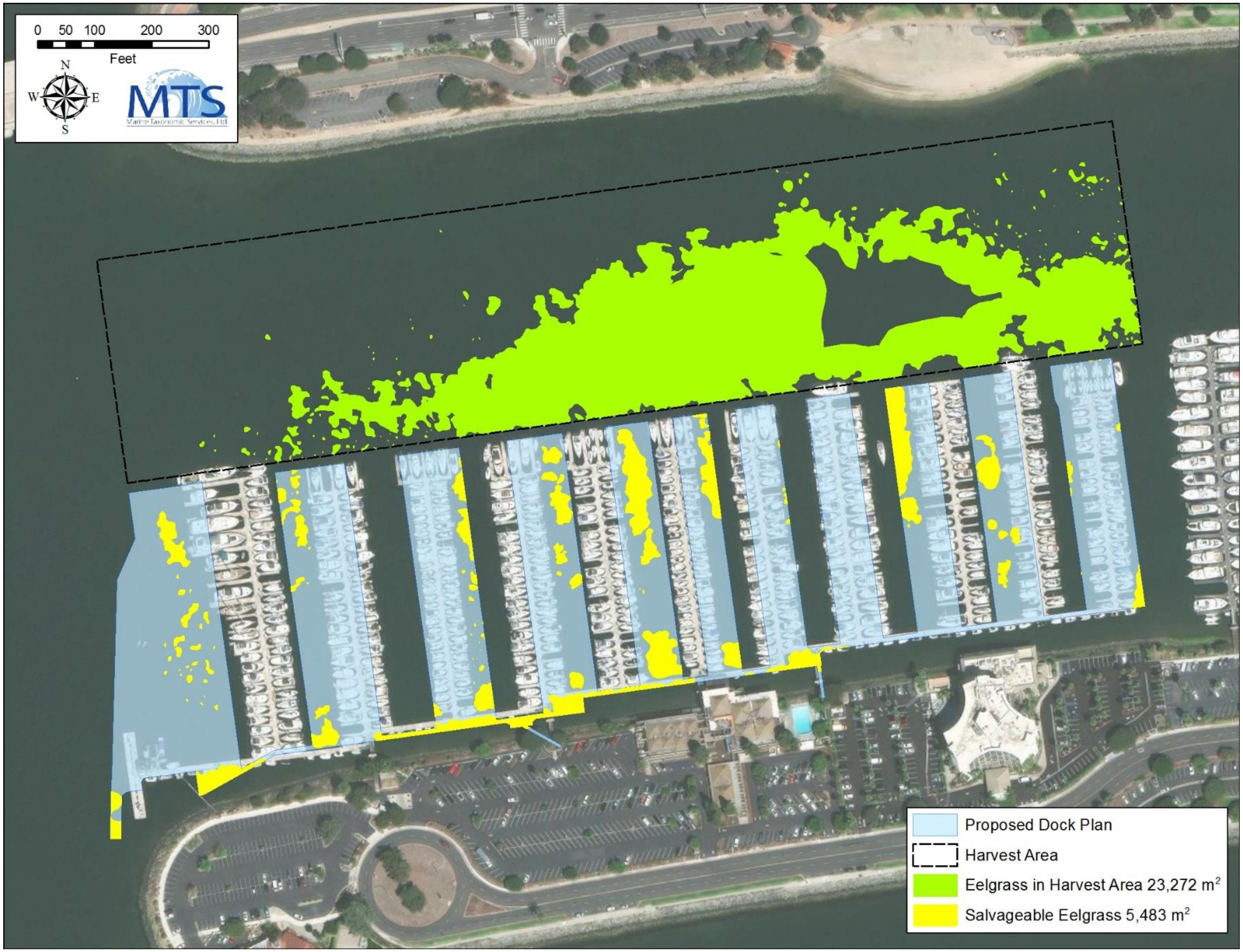

Figure 5. The above figure shows the areas where eelgrass will be impacted and will be available to support salvage efforts as well as the proposed harvest area where additional eelgrass may be harvested as necessary to support the mitigation effort. Harvest area eelgrass data from NAVFACSW (2020).

all of the impacted eelgrass can be harvested. It's likely that some of the impacted eelgrass will not be available for salvage due to timing and other logistical reasons.

If eelgrass is harvested from the harvest area eelgrass beds, it will be harvested in an evenly spaced manner and will be thinned without leaving any noticeable bare patches (refer to Section 4-1). Eelgrass will only be harvested from available salvage areas and the designated donor site (Figure 5). The donor site was selected based on the following factors:

1. Proximity to the mitigation site allows for logistical suitability, including similar oceanographic conditions for the transplant material, similar environmental conditions between donor and mitigation site, ease of access and diver safety.
2. Appropriate size and eelgrass density of the donor bed to provide transplant material while minimizing impacts to the donor bed.
3. Appropriate genetic profile for eelgrass growing in the region.
4. Prevention of the spread of invasive species.
5. Long-term persistence and recovery potential of the donor bed.

4 Proposed Mitigation Methods

4-1 Eelgrass Donor Harvest Methods

Donor material will be harvested by first removing loose sediment around the rhizome and then removing the rhizome using a hand raking method. Care will be taken when removing rhizomes to avoid tearing or ripping them to preserve as much rhizome material as possible. This method minimizes disturbance to surrounding eelgrass and substrate. Divers will perform donor collection in a systematic fashion collecting no more than 10% of eelgrass from any localized portion of the donor bed. Collected rhizomes will be loosely placed in mesh bags for processing at the surface. Donor material will be considered viable if there are a minimum of three internodal segments per rhizome. Higher numbers of internodal segments are preferred for improved transplant success.

In the case of eelgrass collected from impact areas as salvage, divers will remove as much eelgrass as possible to minimize the need for collection from the donor site. Divers will remove eelgrass with similar methods to ensure that as much rhizome is kept intact as possible.

Once on the surface, donor material will be stored in floating mesh bags in the ocean prior to preparation and in a flow-through seawater system during processing. Material will be stored no longer than 24 hours from harvesting to transplant unit preparation. Once prepared, transplant units will be stored in open water no longer than 24 hours prior to planting.

4-2 Eelgrass Transplant Methods

Eelgrass harvested from the donor site will be bundled into transplant units comprised of approximately eight turions each. This bundling method has a high success rate in achieving self-sustaining eelgrass habitat post-transplanting (Merkel 1988). Transplant units will be installed by hand digging a hole approximately the size of the unit and placing the unit with the rhizomes approximately two inches below the surface. The unit will then be anchored to the substrate using biodegradable stakes and the hole will be backfilled. Divers will conduct planting on a monumented grid system, accessing the planting area from the marina. The grid layout will provide for ease of tracking and quality control of planting. Transplant units will be spaced 1 m on centers (one unit per square meter) in proposed fairways 1-3 (refer to Figure 4). The remaining fairways will be planted with one eelgrass bundle per every 4 square meters.

5 Schedule

5-1 Construction Schedule

The HIWMRP is currently seeking permits from regulatory agencies. Permits for the marina construction may be obtained by May 2024.

5-2 Mitigation Timing

Mitigation will begin upon receipt of state, federal, and local permits and authorizations (including California Department of Fish and Wildlife (CDFW) Letter of Permission for eelgrass harvest) for the Project. The eelgrass transplant shall be initiated as soon as the first section of the marina is demolished that clears space for one or more fairways. Additional proposed fairways will be planted within 30 days of the removal of marina facilities that currently cover those areas. Eelgrass planting will only occur between the months of April and September. This timing will avoid harvesting eelgrass too soon after winter when the rhizomes might not have appropriate starch storage to support the transplant units. It will also avoid planting too late in the season such that newly planted material would go into the winter season without an appropriate period to establish roots.

Based on the current estimated construction start and end dates, mitigation activities could commence as early as July 2024.

6 Mitigation Monitoring and Performance

6-1 Pre-Impact and Post-Impact Assessment Surveys

To assess impacts from the HIWMRP, pre- and post-construction eelgrass surveys will be conducted in accordance with the CEMP. The pre- and post-construction surveys will be conducted during the active growing season (March through October) to accurately assess both vegetated and un-vegetated eelgrass habitat, as defined by the CEMP. Reports of all surveys will be provided to the appropriate regulatory agencies and the District within 30 days of survey completion. Additional post-construction surveys will be conducted in both the Project site and reference areas 12 and 24 months after construction if required by Project permits, to determine the occurrence and extent of any significant indirect impacts attributable to the Project. Any significant indirect impacts identified by these surveys would be mitigated.

Within the donor site, pre- and post-harvest surveys will be conducted within 30 days prior to harvesting, and again within 30 days following harvest, to document the efficacy of harvest methods relative to protection of harvest beds. SCUBA surveys will be conducted along transects within the eelgrass donor site. The donor site surveys will document percent cover along transects and turion density within quadrats randomly placed along transects. This information will be included in the post-transplant report (Year 0).

6-2 Eelgrass Mitigation Monitoring Surveys

Once the planting effort has concluded, monitoring of the mitigation site will be conducted for 60 months (5 years) to document the success of the mitigation as outlined in the CEMP. Monitoring surveys will begin immediately after transplanting has been completed at intervals of 0, 6, 12, 24-, 36-, 48-, and 60-months post-transplant. The monitoring program will assess the aerial extent, percent cover, and density of eelgrass in the mitigation site using the same methods proposed for the pre- and post-construction surveys. Monitoring dates will be scheduled during the active eelgrass growing season to collect information on growth and survival.

Additional monitoring after the fifth year may be necessary if the aerial extent and density of eelgrass in the mitigation site does not meet the mitigation performance milestones. The reference area will be monitored in concert with the mitigation site to account for any natural fluctuations in the aerial extent and density of eelgrass in the area.

6-3 Mitigation Performance Milestones

Criteria for transplanting success will be determined based on the mitigation performance milestones as specified in the CEMP and outlined in Table 2 below.

Table 2. Mitigation performance milestones for eelgrass transplanting (CEMP, NMFS 2014).

Monitoring Date (post transplanting)	Performance Milestones
Month 0	Confirmation of full coverage distribution of planting units over the initial mitigation site.
Month 6	Persistence and growth of eelgrass in the initial mitigation site 50% survival of initial planting units and well distributed coverage Monitoring date should be flexible to fall within active growing season
Month 12	40% eelgrass coverage in the initial mitigation site 20% density of adjacent reference areas No less than 1.2 times the area of the impact site
Month 24	85% eelgrass coverage in the initial mitigation site 70% density of reference areas No less than 1.2 times the area of the impact site
Month 36	100% eelgrass coverage in the initial mitigation site 85% density of reference areas No less than 1.2 times the area of the impact site
Month 48	100% eelgrass coverage in the initial mitigation site 85% density of reference areas No less than 1.2 times the area of the impact site
Month 60	100% eelgrass coverage in the initial mitigation site 85% density of reference areas No less than 1.2 times the area of the impact site

6-4 Mitigation Contingency/Adaptive Management

If the eelgrass transplanting fails to meet the established success criteria in the initial mitigation site, supplemental mitigation may be required in consultation with CDFW and NMFS. Supplemental transplants could occur in any areas within the marina that failed to establish. Any supplemental transplant would occur at the point within Table 3 where a failure to meet the performance criteria occurred.

If the site cannot support the necessary eelgrass within the designated areas as they will exist following construction, site modification may be necessary to establish eelgrass within the HIWMRP area. This could include importing fill to raise the seafloor elevation in specific locations enough to increase the carrying capacity of the marina relative to eelgrass. Alternately, the HIWMRP proponents could propose out of kind mitigation such as purchase of credits in a suitable mitigation bank or provision of funds to an in lieu fee program if one exists at the time it is required. Any actions taken to obtain credit for impacts to eelgrass beyond the actions described in this mitigation plan would be subject to consultation with regulatory agencies including but not limited to NMFS, CDFW, and U.S. Fish and Wildlife Service.

7 Mitigation Coordination and Schedule

7-1 Letter of Permission and Notifications

Prior to the beginning of the eelgrass transplant work, a letter of permission to harvest and plant eelgrass will be obtained from the CDFW. Also, prior to the beginning of the eelgrass transplant work, a scientific collecting permit will be obtained to account for the harvesting of eelgrass within the donor site in accordance with this mitigation plan. A minimum five-day notification and a preliminary transplanting schedule will be given to CDFW prior to commencement of the transplant work.

7-2 Monitoring Reports

Monitoring reports shall be provided to the resource agencies (CDFW, NMFS) and the District within 30 days after the completion of each required monitoring period and shall include spatial data. Per the CEMP (NMFS 2014), these reports will include: a description of the action, action party, mitigation consultants, relevant points of contact, and relevant permits; the size of permitted impacted estimates, location of activities, actual eelgrass impacts, and eelgrass mitigation needs; a detailed description of eelgrass habitat survey methods, donor harvest methods, and transplant methods; and mitigation performance milestone progress. The initial monitoring report (0 months) will document any variances from the mitigation plan, sources of donor materials, and the full area of planting. The final monitoring report will include an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met.

7-3 Notification of Completion

If mitigation performance milestones (refer to Table 2) have been met once the final monitoring event has been completed, a Notice of Completion will be forwarded along with the final

Monitoring Report. At that point, implementation of the Mitigation Plan will be considered complete.

8 References

Marine Taxonomic Services, Ltd. [MTS]. 2018. Harbor Island West Marina Updated Baseline Eelgrass Resources Report. Prepared for ICF International. April 2, 2018 (revised December 10, 2018).

Marine Taxonomic Services, Ltd. [MTS]. 2022. Harbor Island West Marina Updated Eelgrass Resources Impact Report. Prepared for ICF International. January 28, 2022.

Merkel, K.W. 1988. Growth and survival of transplanted eelgrass: The importance of planting unit size and spacing. In: Proceedings of the California Eelgrass Symposium. Chula Vista, CA.

National Marine Fisheries Service [NMFS], National Oceanic and Atmospheric Administration (NOAA), 2014. California Eelgrass Mitigation Policy and Implementation Guidelines. NOAA Fisheries, West Coast Region, Long Beach, CA.

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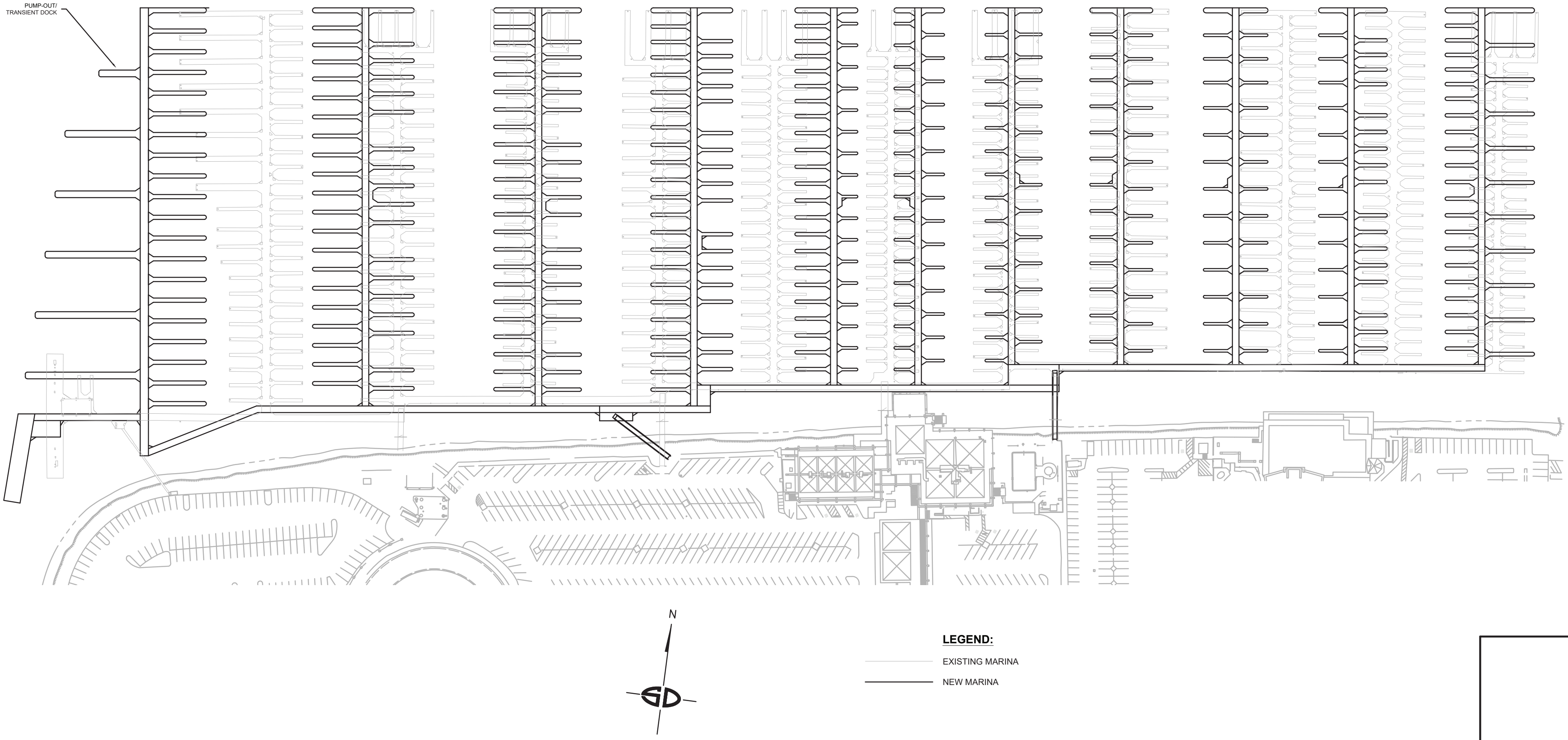
Appendix A: Project Plans



NO.	DATE	DESCRIPTION	BY

REVISIONS

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SITE IMPROVEMENT PLAN

ACCEPTED BY: ______________________
CITY ENGINEER R.C.E. EXP. DATE

ACCEPTED BY: ______________________
CITY ENGINEER R.C.E. EXP. DATE

PROJECT NUMBER: 11-3-651
ENGINEER / DESIGNER:
PROJECT MANAGER:
CHECKED BY:

SCALE: NTS
DRAWN BY: DD
DATE: 8-31-21
SHEET NO.:
DRAWING: ENL1

HARBOR ISLAND WEST

SAN DIEGO, CA

EXISTING & NEW OVERLAY LAYOUT #4
REV. 2-2021

Appendix C
Marine Biological Resources Technical Report

MARINE TAXONOMIC SERVICES, LTD.

Harbor Island West Marina Marine Biological Resources Report

Prepared for

Charlie Richmond
ICF International
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Prepared by

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April 2, 2018 (Revised September 2, 2019)

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Marine Biological
Resources Report

April 2, 2018 (Revised September 2, 2019)

Introduction

Marine Taxonomic Services (MTS) was contracted by ICF International to provide a marine biological survey and essential fish habitat assessment at Harbor Island West Marina in San Diego, California. MTS has previously completed the survey and analysis of the resources at Harbor Island West Marina and has prepared a report on the findings. This report updates that effort by providing additional analyses relative to acoustic effects of pile driving on marine mammals, sea turtles, and fishes. This report is intended to support the environmental planning associated with proposed construction activities. As such the results are discussed relative to potential impacts associated with planned construction activities at the marina.

Harbor Island West Marina is located in the northern portion of San Diego Bay along the northwestern shore of Harbor Island (Figure 1). The Harbor Island West Marina Renovation Project (Project) entails demolishing and replacing all existing buildings and structures as well as replacing landscaping, reconfiguring hardscape, modernizing utilities, modernizing lighting, renovating the parking lot, adding a public promenade, and improving view corridors. On the water, the docks will be replaced and slightly reconfigured. The replacement docks will follow the existing layout except that two-extension dock/headwalks will be consolidated into a single dock/headwalk. This will reduce the current 11 dock/headwallks to 10 docks/headwalks and will reduce the over water coverage of the docks from 146,000 square feet to 140,000 square feet. The number of slips will be reduced from 620 to 603 with adjustments made to the distribution of slip sizes within the marina.

Methods

MTS staff Robert Mooney performed a side-scan sonar survey of the marina on March 26, 2018. The side-scan sonar survey was performed to detect and map any eelgrass (*Zostera marina*) present, the sonar survey was performed by navigating a small vessel along a series of transects through the study area. The vessel was fitted with a pole-mounted side-scan sonar operating at 450 kHz. The sonar was set to scan 30 meters on both the port and starboard channels for a total scanning swath of 60 meters. Survey transects were navigated such that adjacent sonar swaths overlapped, providing complete bottom coverage within the marina study area.

Figure 1. Aerial image showing location of the Harbor Island West Marina (black polygon) within San Diego Bay.

Following the field surveys, the collected side-scan sonar files were geographically registered using the vessel's navigation data collected during the survey. The side-scan files were then compiled to create a contiguous view of the seafloor across the entirety of the study site. The boundaries of the eelgrass present were then digitized from the compiled data set using ESRI ArcView software and plotted on a geographically registered image of the project area.

On March 26, 2018, MTS staff Angelica Lopez and Kees Schipper further inspected the survey area using SCUBA. Each of the habitat types in the marina was surveyed to characterize it and document the dominant flora and fauna present. Notes were made on the occurrence or potential for occurrence of sensitive species that could be impacted by the proposed project.

To determine the potential for noise from pile driving to impact sensitive species, an analysis of potential noise levels was performed. The analysis used the compendium of pile driving noise data from Buchler et al. (2015) to establish potential noise levels at the source of pile driving. The potential for generated noise to cause Level A (injury) and Level B (behavioral) Harassment of marine mammals was then evaluated by calculating isopleths over which noise would attenuate to thresholds established by NOAA (NMFS 2016a and NMFS 2016b). Isopleth calculations for Level A Harassment were performed using the NOAA companion spreadsheet for NMFS (2016a); the isopleths for Level B Harassment were calculated with direct application of the practical spreading loss model (refer to MTS and ICF 2016). Analysis of potential impacts to fish used the NOAA developed spreadsheet and associated thresholds for injury and behavioral effects on fishes[1].

Results

Marine Habitats

The natural and man-made habitats surveyed within the study site were unvegetated soft bottom, vegetated soft bottom, docks and pilings, riprap, and open water. Each is discussed below.

Unvegetated Soft Bottom

The majority of the marina is loosely consolidated soft bottom, ranging in depth from intertidal to -17-feet Mean Lower Low Water (MLLW). The intertidal portions are mostly shoreline rip-rap while the soft bottom habitats start at approximately -1-foot MLLW (low intertidal). Shallow shoreline areas typically have greater content of fine sands that quickly give way to mud as one moves to deeper water. Most of the approximately 13.6-hectare survey area is unvegetated soft bottom. The primary vegetation present was eelgrass growing over approximately 1.5 hectares and leaving approximately 12.1 hectares of unvegetated soft bottom within the surveyed area.

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[1] *https://www.wsdot.wa.gov/NR/rdonlyres/1C4DD9F8.../BA_NMFSpileDrivCalcs.xls*

Unvegetated soft bottom with invertebrate burrows.

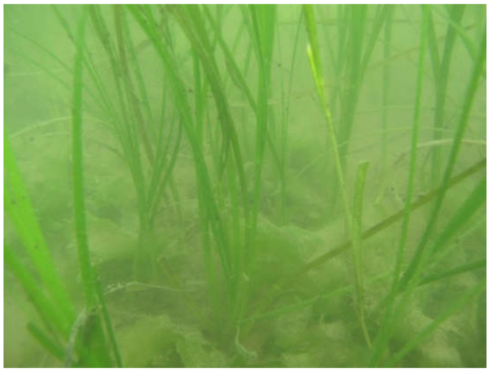
The most common invertebrates observed were the tube-dwelling anemone (*Pachycerianthus fimbriatus*) and sea pens (*Sylatula elongata*). Additionally, the mud showed evidence of numerous burrowing invertebrates, likely including bivalves, burrowing anemones, and amphipods. During the 2014 survey (MTS 2015), a core of mud representative of the unvegetated soft bottom habitat was collected and processed through a sieve. Inspection of the macrofauna retained by the sieve revealed a variety of infaunal polychaetes and a jackknife clam (*Tagelus californianus*). Additionally, the exotic colonial bryozoan, *Zoobotryon verticillatum* was found in occasional clumps over soft bottom.

Common motile invertebrates observed on the mud bottom included spiny lobster (*Panulirus interruptus*), California aglaja (*Navanax inermis*), and cloudy bubble snails (*Bulla gouldiana*). The observed lobsters were associated with debris items.

Fish species observed over unvegetated soft bottom included numerous round stingrays (*Urobatis halleri*). Fleeing flatfish were observed that were difficult to identify but likely included diamond turbot (*Hypsopsetta guttulata*) and California halibut (*Paralichthys californicus*). Barred sand bass (*Paralabrax nebulifer*) and spotted sand bass (*Paralabrax maculatofaciatus*) were also observed over unvegetated soft bottom.

Vegetated Soft Bottom

Eelgrass occurs in a portion of the un-shaded soft bottom habitat across much of the marina. Mapping of the side-scan sonar record identified 15,256 square meters of eelgrass patches within the study site, growing at depths ranging from approximately -1 to -13-feet MLLW (Figure 2). Eelgrass density varied across the survey area. The average eelgrass density was 59.5 ± 44.7 (mean ± 1 sd) leaf shoots per square meter. A total of 155 quadrats (n=155) were sampled to determine the leaf shoot density estimate. The eelgrass was generally observed to be healthy with a minimal epiphyte load and was not flowering at the time of the survey. Eelgrass growing in shallow water along shore was typically shorter (less than 30 centimeters tall) relative to eelgrass in deeper water that was typically greater than 40 centimeters in length.



Eelgrass with the green alga Ulva lactuca.

Frequently intermixed with the eelgrass were loose clumps of a Gracilarioid red alga (Family Gracilariaceae). This alga is frequently found in eelgrass beds in southern California, at times in such abundance as to smother the eelgrass. The green alga, *Ulva lactuca* was also occasionally observed intermixed with eelgrass.

Figure 2. The above figure shows the distribution of eelgrass resources within the Harbor Island West eelgrass survey area.

Fish observed within the eelgrass included a few round stingrays, barred sand bass, spotted sand bass, and a Pacific seahorse (*Hippocampus ingens*).

The most common invertebrate observed within eelgrass was the tube-dwelling anemone. The soft-bottom associated with eelgrass was generally similar to unvegetated areas with evidence of numerous burrowing invertebrates, likely including bivalves, burrowing anemones, and amphipods. Common motile invertebrates observed included the California aglaja and cloudy bubble snails.

Docks and Piles

A large portion of the study site is covered by floating docks and their associated piles. The upper reaches of the piles (0 to -6-feet MLLW) were generally colonized by a fouling community dominated by barnacles (*Balanus glandula* and *Chthamalus* sp.), tunicates (*Styela clava, Ciona* sp. *Botrylloides* spp*.,* and others), sponges, oysters (*Ostrea lurida*), the soft bryozoan *Zoobotryon verticillatum,* encrusting bryozoans (*Eurystomella* sp.), hydroids, and the green algas *Ulva intestinalis*, and *Ulva lactuca*. Sponges were the primary fauna on the piles below -6-ft MLLW.

Fish observed around the piles included giant kelpfish, kelp bass (*Paralabrax clathratus*), and barred sand bass. Schools of topsmelt (*Atherinops affinis*) were observed nearby while inspecting the docks.

The sides of the dock floats were fouled by similar flora and fauna as the piles. Dominant algal species were *Ulva lactuca*, *Mazzaella splendens*, and the exotic kelp *Undaria pinnatifida*.

Riprap

The riprap revetment along the marina shoreline supported a limited amount of hard bottom intertidal marine life. Occasional barnacles, limpets, and the green alga *Ulva intestinalis* colonized the riprap. Near the tow of the rip-rap the exotic alga *Sargassum muticum* occurred at low density as interspersed individuals. The crevices formed by the rocks likely provide shelter to small fish, though none were seen during the survey. Spiny lobsters were observed associated with the rip-rap particularly in areas associated with wharf piles.

Open Water

Schools of topsmelt were observed in the open water around and between the boat docks. It is likely that other schooling bait fish frequent the open waters of the marina, including slough anchovy (*Anchoa delicatissima*) and deepbody anchovy (*Anchoa compressa*) (Pondella and Williams 2009). These fish are important prey items for sea birds that can be expected to forage in the marina, including brown pelicans (*Pelecanus occidentalis californicus*), double-crested cormorants (*Phalacrocorax auritus*), grebes, loons, and terns. While pelicans loons, and terns were not observed during the survey, double-crested cormorants, and western grebes (*Aechmophorus occidentalis*) were observed.

Sensitive Species

Protected, rare, threatened, or endangered species that may occur within Harbor Island West Marina include east Pacific green sea turtle (*Chelonia mydas*) (Federal Threatened), California least tern (CLT; *Sternula antillarum browni*) (State Endangered and Federal Endangered), California brown pelican (California Department of Fish and Wildlife Fully Protected). Mammals protected under the Marine Mammal Protection Act and likely to occur within the marina include the harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus californianus*). None of the above species were observed during the survey, though their likelihood of occurrence is as follows.

Individuals from the green sea turtle population that live in San Diego Bay are typically observed in south San Diego Bay. They could potentially enter the marina when migrating but such an occurrence would be a rare event. CLT are seasonally present in San Diego Bay, from April to September. The marina is located approximately 1.5 miles from each of two nesting site in north San Diego Bay and it is likely that CLT could forage within the marina during nesting season. Year-long, baywide avian surveys identified CLT across the water at Spanish Landing in 2006 and 2009 (TDI 2009, 2011). California brown pelicans do not nest in San Diego Bay, but frequently loaf and forage in marina habitats. During the 2006 and 2009 baywide avian surveys, California brown pelicans were observed a total of 15 and 14 times, respectively (TDI 2009, 2011). Harbor seals and California sea lions do not breed in San Diego Bay, but forage there year-round and may occasionally enter the marina.

Essential Fish Habitat Assessment

The following assessment of Essential Fish Habitat (EFH) for Harbor Island West Marina is provided in accordance with the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act (MSA) (Code of Federal Regulations (CFR) Title 50, Chapter VI, Part 600). The amendments require the delineation of “essential fish habitat” for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH and respond in writing to the NMFS’s recommendations.

The MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” For the purpose of interpreting the definition of essential fish habitat: “waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle. A healthy ecosystem is defined under the MSA as, “an ecosystem where ecological productive capacity is maintained, diversity of the flora and fauna is preserved, and the ecosystem retains the ability to regulate itself”.

The purpose of this EFH assessment is to comprehensively identify and analyze EFH occurring within the Harbor Island West Marina, so that federal agencies can best determine whether or not the proposed Project would adversely affect designated EFH, and identify possible conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH. The MSA requires consultation for all federal agency actions that may adversely affect EFH. EFH consultation with NMFS is required by federal agencies undertaking, permitting, or funding activities that may adversely affect EFH, regardless of its location. Under Section 305(b)(4) of the MSA, NMFS is required to provide EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. As such, the following EFH assessment, which includes an analysis of species managed by the Pacific Fishery Management Council (PFMC) that are known to utilize EFH within the Project area, and an analysis of potential HAPCs within the Project area, will provide all of the information necessary for NMFS to conduct any future EFH consultations for the proposed Project.

NMFS Managed Ichthyofauna Present in San Diego Bay

To adequately address EFH at the project site, fish species managed by the PFMC that are known to either occur within the Project area, have historically occurred within the Project area, or depend upon those marine habitats that are known to occur within the Project area, were identified. This was accomplished through a thorough review of the latest PFMC's Fishery Management Plans (PFMC 2019 and 2016), a thorough analysis of the range and habitat requirements of PFMC managed fish species (McCain 2003, Love et al. 2002, Henderson and Mooney 2001, and PFMC 2005), running an analysis of the latest EFH mapping GIS software regularly maintained and updated by NOAA Fisheries (NOAA Fisheries 2019), and by evaluating fish species identified during the most recent fisheries inventories conducted throughout San Diego Bay in 2016 (Williams et al. 2016).

In all, 100 species of marine fishes, and one species of marine invertebrate were identified to contain EFH within Harbor Island West Marina (NOAA Fisheries 2019). Of these species identified, 96 are currently managed under the Pacific Coast Groundfish FMP, and 5 are managed under the Coastal Pelagic Species FMP (PFMC 2019 and 2016). Thorough analyses of the range and habitat requirements of each of these species suggests that 57 of the 101 species identified to contain EFH within Harbor Island West Marina have the greatest likelihood to occur within the Project area based on species-specific habitat requirements. This subset of marine species that maintain the strongest affinities for bays and harbors in Southern California are listed below in Table 1.

Table 1. PFMC-managed coastal pelagic fish species and pacific coast groundfish species with habitat requirements in San Diego Bay.

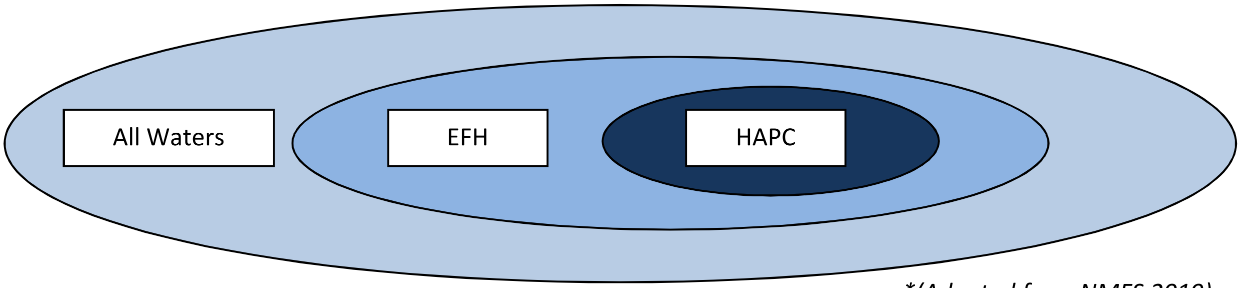
Common Name	Species Name
Coastal Pelagic Species FMP	
Jack Mackerel	*Trachurus symmetricus*
Market Squid	*Loligo opalescens*
Northern Anchovy*	***Engraulis mordax***
Pacific Mackerel	*Scomber japonicas*
Pacific Sardine*	***Sardinops sagax***
Pacific Coast Groundfish FMP	

Aurora Rockfish	*Sebastes aurora*
Bank Rockfish	*Sebastes rufus*
Blue Rockfish	*Sebastes mystinus*
Boccaccio	*Sebastes paucispinis*
Big Skate	*Raja binoculata*
Brown Rockfish	*Sebastes auriculatus*
Cabezon	*Scorpaenichthys marmoratus*
Calico Rockfish	*Sebastes dallii*
California Scorpionfish*	***Scorpaena guttata***
California Skate	*Raja inornate*
Canary Rockfish	*Sebastes pinniger*
Chilipepper Rockfish	*Sebastes phillipsi*
Cowcod	*Sebastes levis*
Curlfin Sole	*Pleuronichthys decurrens*
Dark Blotched Rockfish	*Sebastes crameri*
Dover Sole	*Microstomus pacificus*
English Sole	*Parophrys vetulus*
Finescale Codling	*Antimora microlepis*
Gopher Rockfish	*Sebastes carnatus*
Grass Rockfish	*Sebastes rastrelliger*
Green-Spotted Rockfish	*Sebastes chlorostictus*
Honeycomb Rockfish	*Sebastes umbrosus*
Kelp Greenling	*Hexagrammos decagrammus*
Kelp Rockfish	*Sebastes atrovirens*
Leopard Shark	*Triakis semifasciata*
Lingcod	*Ophiodon elongatus*
Longnose Skate	*Raja rhina*
Longspine Thornyhead	*Sebastes altivelis*
Mexican Rockfish	*Sebastes madonaldi*
Olive Rockfish*	***Sebastes serranoides***
Pacific Cod	*Gadus macrocephalus*
Pacific Ocean Perch	*Sebastes alutus*
Pacific Sanddab	*Citharichthys sordidus*
Pacific Whiting	*Merluccius productus*
Petrale Sole	*Eopsetta jordanni*
Ratfish	*Hydrolagus colliei*
Rex Sole	*Glyptocephalus zachirus*
Rock Sloe	*Lepidopsetta bilineata*
Rougheye Rockfish	*Sebastes aleutianus*
Sablefish	*Anoplopoma fimbria*
Sand Sloe	*Psettichthys melanostictus*
Sharpchin Rockfish	*Sebastes zacentrus*
Shortbelly Rockfish	*Sebastes jordani*
Shortspine Thornyhead	*Sebastes alascanus*
Soupfin Shark	*Galeorhinus zyopterus*
Spiny Dogfish	*Squalus suckleyi*
Splitnose Rockfish	*Sebastes diploproa*
Starry Flounder	*Platichthys stellatus*
Stripetail Rockfish	*Sebastes saxicola*
Treefish	*Sebastes serriceps*
Widow Rockfish	*Sebastes entomelas*
Yellowtail Rockfish	*Sebastes flavidus*

***Indicate species caught during San Diego Bay Fisheries Inventories in 2016 (Williams et al. 2016).**

Habitat Areas of Particular Concern

While 100% of the Project area falls within designated EFH for the two FMPs identified above, Habitat Areas of Particular Concern (HAPC) are also designated within Harbor Island West Marina. HAPCs are a discreet subset of EFH (as illustrated below*) that are distinguished by characteristics including their high ecological value and vulnerability to anthropogenic stressors.



**(Adapted from NMFS 2019)*

Areas within designated EFH can also be designated as a HAPC based on one or more of the following characteristics: 1) The importance of the ecological function provided by the habitat, 2) Its sensitivity to human-induced environmental degradation, 3) The extent of threats posed by development of the habitat, or 4) The rarity of the habitat type (NMFS 2019). HAPCs are considered high priority areas for conservation, management, or research because they are rare, sensitive, stressed by development, or important to ecosystem function (NMFS 2019). The HAPC designation does not necessarily mean additional protections or restrictions upon an area, but they help to prioritize and focus conservation efforts (NMFS 2019). Although these habitats are particularly important for healthy fish populations, other EFH areas that provide suitable habitat functions are also necessary to support and maintain sustainable fisheries and a healthy ecosystem (NMFS 2019). Current HAPC types are estuaries, canopy kelp, seagrass, and rocky reefs.

Seagrass habitat is present in Harbor Island West Marina and is a designated as HAPC by the National Marine Fisheries Service (PFMC 2016). The seagrass present at the marina is known as eelgrass (*Zostera marina*). Mooney and Woodfield (2009) summarized eelgrass functions and contributions to ecological processes:

> Eelgrass plays many important roles in estuarine systems. It clarifies water through sediment trapping and stabilization (de Boer 2007). It also provides the benefits of nutrient transformation and water oxygenation (Yarbro and Carlson 2008). Eelgrass serves as a primary producer in detritus-based food webs (Thresher et al. 1992) and is further directly grazed upon by invertebrates, fish, and birds (Valentine and Heck 1999), thus contributing to eco-system health at multiple trophic levels. Additionally, it provides physical structure in the form of habitat to the community and supports epiphytic plants and animals, which are in turn grazed upon by other invertebrates, fish, and birds. Eelgrass is also a nursery

area for many commercially and recreationally important finfish and shellfish (Heck et al. 2003), including both those that are resident within the bays and estuaries, as well as oceanic species that enter the estuaries to breed or spawn. Among recreationally important species, sand basses and lobster make use of eelgrass beds as habitat. Besides providing important habitat for fish, eelgrass and associated invertebrates provide important food resources, supporting migratory birds during critical life stages, including migratory periods.

Analysis of Pile Driving Noise

The MMPA of 1972 states that "take" ("to hunt, harass, capture, kill, or collect") any marine mammal or attempt to do so is prohibited. In 1994, amendments were made to this act that defined two levels of harassment, labeled "Level A" and "Level B". For marine mammals, Level A harassment is defined as, "any act of pursuit, torment, or annoyance which has the potential to injure..." Level B harassment is defined as the potential to disturb by, "causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

According to NMFS, extreme sound levels can cause harassment to marine mammals and other wildlife species (e.g. fish and sea turtles). The sound level thresholds for Level A harassment for marine mammals was updated in July 2016 and provides different thresholds based on the auditory ranges of different types of marine mammals (NMFS 2016a). The thresholds are provided in Table 2. The thresholds were developed using dual metrics of cumulative sound exposure level for a 24-hour accumulation period (L_E) and peak sound level (L_{pk}) for impulsive sounds (e.g. impact pile driving), and only L_E for non-impulsive sounds (e.g. vibratory pile driving). The thresholds for Level B harassment are based on older guidelines and are 160 decibels root mean square (dB RMS) for impulsive noise and 120 dB RMS for unattenuated noise (Table 2). The RMS accounts for variable sound levels over time and provides a measure of the sound magnitude. To calculate the RMS, each point over the calculation period is squared, the average taken, and then the square root of the average is taken. For impact pile driving, RMS is calculated over the period of the pulse that contains 90% of the acoustical energy (Department of the Navy 2013). Only impulsive sounds due to impact pile driving are analyzed for this Project because vibratory methods are not proposed.

The analysis of in-water noise used L_{PK}, RMS, and single-strike sound exposure level values of 185 decibels (dB), 166 dB, and 155 dB, respectively. These values were determined to be the potential worst-case sound energy levels associated with driving 18-inch concrete piles after review of Buchler et al. (2015). The project will use jetting with impact driving for final setting of 12-inch, 14-inch, and 18-inch piles. The calculation of isopleths used assumptions of 12 strikes per pile and installation of 10 piles per day.

Table 2. NMFS thresholds and calculated isopleths to thresholds for Level A harassment of marine mammals for each of the marine mammal hearing groups. Isopleths are in meters and thresholds are in dB.

Hearing Group	**Low-Frequency Cetaceans**	**Mid-Frequency Cetaceans**	**High-Frequency Cetaceans**	**Phocid Pinnipeds**	**Otariid Pinnipeds**
L_{E} Threshold	183	185	155	185	203
PTS Isopleth to L_{E} Threshold	3.3	0.1	3.9	1.8	0.1
L_{PK} Threshold	219	230	202	218	232
PTS Isopleth to L_{PK} Threshold	0.0	0.0	0.0	0.0	0.0

Level A Harassment (physical injury) has a low likelihood of occurrence as a result of the Project given the projected sound pressure levels from pile-driving activities. Anticipated L_{PK} at the source of pile driving for this project are estimated up to 185 dB (i.e., with use of an impact hammer to drive 18-inch piles) (Buchler et al. 2015). This is below Level A thresholds established by NOAA for low-frequency cetaceans (219 dB), mid-frequency cetaceans (230 dB), high-frequency cetaceans (202 dB), phocid pinnipeds (218 dB), and otariid pinnipeds (232 dB). Thus, the potential for L_{PK} noise levels that would harm marine mammals is negligible.

In addition to L_{PK} thresholds, recent NOAA guidance (NMFS 2016a) regarding Level A Harassment of marine mammals includes thresholds for L_{E}. The worst case calculated L_{E} at source would be above the threshold for all marine mammals. However, the threshold exceedance would be so low that the sound levels would attenuate to the thresholds within minimal isopleth distances. Based on an assumption of 12 strikes per pile for 18-inch concrete piles, the mid-frequency cetaceans and otariid pinniped isopleths are 0.1 meter from source. Phocid pinnipeds are 1.8 meters from source. The isopleths for low-frequency cetaceans and high-frequency cetaceans are 3.3 and 3.9 meters from source, respectively. Given such narrow isopleths within which noise levels can exceed thresholds for cumulative exposure, the potential for noise level impacts, as measured by L_{E}, is negligible.

The recent NOAA guidance for noise level impacts on marine mammals addresses only Level A Harassment (NMFS 2016a). A determination of Level B Harassment (behavioral) relies on previous guidance established by NOAA (NMFS 2016b). Level B Harassment could occur if marine mammals are exposed to in-water sound levels greater than 160 dB RMS. Impact driving of 18-inch concrete piles is anticipated to produce noise levels of 166 dB RMS (Buchler et al. 2015). The isopleth where sound is attenuated from 166 dB rms to 160 dB rms is 25 meters, based on the practical spreading loss model (Table 3). However, there are data showing higher noise levels for driving of smaller (16-inch) piles. Buchler et al. (2015) provide data showing 173 dB RMS at source for driving of 16-inch concrete piles. The isopleth to attenuate sound from 173 dB RMS to 160 dB

RMS is 74 meters based on the practical spreading loss model (Table 3). Therefore, there is minor potential for Level B Harassment of marine mammals and green sea turtles.

Taking a conservative approach, an isopleth of 74 meters would be sufficient to monitor marine mammals during construction. In-air sound attenuates faster that in-water sound and sound levels are generally lower in air. Therefore, monitoring marine mammals within 74 meters of source in air or in water would be sufficient to protect marine mammals. This standard is also protective of green sea turtles.

Table 3. The below table provides the Level B harassment isopleths as calculated using the anticipated sound levels from driving piles using NMFS guidance and the practical spreading loss model.

Pile Size / Type	**Driving Method**	**Level B Influence Isopleth Distance**[1]
16" Concrete	Impact	74 m
18" Concrete	Impact	25 m

[1] 160 dB_{RMS} used as threshold for Level B harassment.

The results of noise analysis relative to fishes used the same worst-case scenarios and assumptions as those used for marine mammals. Applying the NOAA thresholds for physical injury and behavioral modification for fishes, allowed calculation of isopleths within which injury or behavioral modification may occur. L_{PK} sound levels are not anticipated to result in physical injury to fishes given that L_{PK} levels are anticipated to be lower than the threshold for injury based on peak sound levels (Table 4). L_E sound exposure levels are also expected to be too low based on 12 strikes per pile and 10 piles per day to cause physical injury to fishes. RMS levels for behavioral modification of fish based on the worst-case scenario (166 dB RMS) are above the 150 dB RMS threshold established by NOAA. Calculation of the behavioral modification isopleth using the practical spreading loss model requires a 117-meter isopleth to reduce RMS levels from 166 to 150 dB. Thus, behavioral modification may occur for all fish occurring within 117 meters of pile driving (Table 4).

Table 3. NMFS thresholds and calculated isopleths to thresholds for physical injury and behavioral effects in fishes. Physical injury for all fishes can occur if peak sound levels are above 206 dB or if cumulative sound exposure levels exceed 187 dB for fish ≥ 2 grams or 183 dB for fish < 2 grams. Behavioral modification is assumed to occur for all fish at above 150 dB RMS.

	Onset of Physical Injury			**Behavior**
	All Fish	**Fish ≥ 2 g**	**Fish < 2 g**	**All Fish**
Threshold	206 dB (L_{pk})	187 dB (L_E)	183 dB (L_E)	150 dB (rms)
Isopleth	0 m	0 m	0 m	117 m

Discussion

The biological communities present in Harbor Island West Marina are typical of the inner reaches of bays and harbors in the region and are not notably diverse, unique, or sensitive. The proposed changes to the dock layout pose no major biological constraints to marina improvements.

However, the following are biological and permitting issues to consider for general planning purposes.

The presence of eelgrass poses the greatest constraint to development activities. Eelgrass creates a unique marine habitat that serves many important functions in the bay environment, and is therefore given special status under the Clean Water Act, 1972 (as amended), Section 404(b)(10). The project has been determined to have impacts to eelgrass anticipated at approximately 177 square meters (1,905 square feet [MTS 2018]). However, the impact assessment identified that due to a reduction of 557 square meters (6,000 square feet) of vessel dock area, the Project would provide additional potential eelgrass habitat. That increased habitat potential could be used as part of a mitigation strategy to restore eelgrass resources on site. The increased habitat potential is expected to provide a net gain of 85 square meters (915 square feet) of eelgrass above that currently present. That means the project will result in eelgrass growth that will replace the 177 square meters of impact plus an additional 85 square meters. This represents a 1.48:1 ratio of impacted to expected growth.

To avoid any additional eelgrass restoration commitments, the Project should seek to avoid impacting eelgrass during construction. Indirect impacts may arise due to disturbance by construction vessels, pile installation, or increased turbidity. To avoid these impacts, Project implementation should minimize shading associated with staging of vessels or dock structures. Construction crews should incorporate techniques that avoid suspension of sediments that could reduce light penetration or settle on eelgrass directly.

Due to the known presence of eelgrass within the marina, state and federal permits will require pre- and post-construction eelgrass surveys be performed, whether or not impacts are anticipated. Surveys and any mitigation must be performed in accordance with the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014). If impacts cannot be avoided, the permitee will be required to prepare and implement an Eelgrass Mitigation Plan per the CEMP, which involves a compensatory restoration of lost eelgrass at a 1.2:1 ratio (or 1:1 for impacts less than 10 square meters) and a five-year monitoring and reporting program. However, given that the Project will result in a net production of eelgrass and potential eelgrass habitat, it is possible that NOAA Fisheries will allow for a 2-year monitoring period prior to assessing impacts. Under that scenario it is likely that any eelgrass lost due to dock realignment will be offset by new growth.

The eelgrass data presented in this report were collected as part of a broad program to characterize the marina habitats. As such, it should be used for planning and permitting purposes; not as a surrogate for a pre-construction eelgrass survey. The project's pre-construction eelgrass survey should make use of extensive diver transect data to ensure mapping accuracy.

Another biological constraint to consider is a potential impact to CLT from turbidity generated by Project activities such as pile jetting and pile driving. This arises from concerns that elevated turbidity reduces visibility in the water and could impair foraging terns, which view prey fish from above and dive to catch them in surface waters. Most projects with such elements are required utilize best management practices to mitigate turbidity.

An additional concern raised regionally by resource agencies reviewing proposed projects is the loss of open water for foraging by CLT and other piscivorous birds. Given that the dock reconfiguration proposed, this Project will have an overall decrease (4,500 square feet) in over water cover and therefore should be looked upon as favorable to piscivorous birds.

It is not anticipated that the other sensitive species noted above would be significantly impacted by the marina improvements or construction activities.

In addition to the potential impacts noted above, the EFH assessment identified designated EFH habitat for 101 species of marine fish and invertebrates managed under the PFMC Coastal Pelagic and Pacific Coast Groundfish FMPs within Harbor Island West Marina. Furthermore, both estuarine and seagrass HAPCs occur within the Project area and could be impacted by potential project activities. The presence and potential to impact eelgrass, a HAPC was noted above.

With regard to potential impacts to EFH and the coastal pelagic and pacific coast groundfish species managed under the Coastal Pelagic and Pacific Coast Groundfish FMPs, the coastal pelagic species that both occur, and have the potential to occur in San Diego Bay, are generally open water schooling species that would only occasionally be found in a marina environment in San Diego Bay. Fish species managed under the Pacific Coast Groundfish FMP occur in low numbers in San Diego Bay and are not likely to be common within the Project area. More importantly, none of the proposed Project construction activities are expected to negatively alter the ecological roles and processes currently occurring within the Project area that are characteristic of designated EFH for coastal pelagic species and pacific coast groundfish. As such, any potential impacts to the role(s) that waters and substrate within the Project area play for these species regarding habitat for spawning, breeding, feeding, or growth to maturity, are expected to be negligible.

With regard to potential impacts to seagrass HAPC within the Project area, any potential impacts are expected to range from negligible to beneficial. The completed Project will result in the reduction of overwater coverage by Harbor Island West Marina by 6,000 square feet and will pose a negligible impact to eelgrass beds already present with the implementation of best management practices that are protocol for such dock renovation/replacement projects. As such, the removal of shading and increase eelgrass habitat is only expected to benefit/improve seagrass HAPC already present within Harbor Island West Marina, with other potential impacts to seagrass HAPC being negligible, as other ecological roles and processes characteristic of the HAPC will not be altered by the proposed Project.

The results of acoustic analysis of potential pile driving sounds indicates marine mammals, sea turtles, and fish will not be harmed due to pile driving generated sounds. The analysis indicates that there is the potential to cause behavioral modification to marine mammals, green sea turtles, and fishes. The behavioral isopleths are generally small (less than 74 meters for marine mammals and sea turtles, and 117 meters for fishes). These impacts are minimal and can be mitigated by use of soft-start techniques during pile driving to allow animals to flee the work area as well as a biological observer to ensure no sensitive species are harmed.

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Appendix D
Geotechnical Investigation—Landside

GEOTECHNICAL INVESTIGATION
LANDSIDE IMPROVEMENTS
HARBOR ISLAND WEST MARINA
SAN DIEGO, CALIFORNIA

Prepared for
HARBOR ISLAND WEST MARINA
San Diego, California

Prepared by
TERRACOSTA CONSULTING GROUP, INC.
San Diego, California

Project No. 2769A
January 28, 2015

TerraCosta
Consulting Group

Geotechnical Engineering
Coastal Engineering
Maritime Engineering

Project No. 2769A
January 28, 2015

Mr. Eric G. Leslie, Director of Marina Operations
HARBOR ISLAND WEST MARINA
2040 Harbor Island Drive
San Diego, California 92101

GEOTECHNICAL INVESTIGATION
LANDSIDE IMPROVEMENTS
HARBOR ISLAND WEST MARINA
SAN DIEGO, CALIFORNIA

Dear Mr. Leslie:

In accordance with your request, TerraCosta Consulting Group, Inc. (TCG) is pleased to submit the following report of geotechnical investigation for the subject project, performed in general accordance with our Proposal No. 14123 dated October 15, 2014 in support of the proposed landside improvements for the Harbor Island West Marina located at 2040 Harbor Island Drive in San Diego, California.

The accompanying report presents the results of our review of available reports, plans, and literature, our field investigation, and our conclusions and recommendations pertaining to the geotechnical aspects of the proposed site development.

We appreciate the opportunity to be of service and trust this information meets your needs. If you have any questions or require additional information, please give us a call.

Very truly yours,

TERRACOSTA CONSULTING GROUP, INC.

Braven R Smillie

Matthew W. Eckert, Director of Engineering
R.C.E. 45171, R.G.E. 2316

Braven R. Smillie, Principal Geologist
R.G. 402, C.E.G. 207

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HARBOR ISLAND WEST MARINA, LANDSIDE IMPROVEMENTS GEOTECHNICAL INVESTIGATION

EXECUTIVE SUMMARY

Harbor Island was constructed in the early 1960s by hydraulically dredging relatively clean sands, and then hydraulically pumping and depositing these sands in the current configuration of Harbor Island. These hydraulically placed sands were placed up to about the mean high tide line, and mechanically placed fill soils then imported and placed up to the existing ground surface, with typically about 10 to 12 feet of mechanically placed fills comprising the near-surface soils of Harbor Island. The near-surface fills, hydraulic fills, and natural bay deposits are in turn underlain by the Quaternary-age Bay Point Formation, which was generally encountered near elevation -13 feet MLLW during the earlier Harbor Island West Marina study, and also encountered at elevation -13.5 feet in Boring B-4 during the current study. In one of the offshore borings, specifically Boring B-5 adjacent to the revetted marina slope just offshore of the Harbor Island West pool area, the Bay Point Formation was locally encountered much deeper near elevation -22 feet, with the recent landside Boring B-1 encountering the Bay Point Formation near elevation -27.5 feet. As with other areas in the bay, we anticipate that this was a locally incised drainage channel associated with past flood flows from the San Diego River entering into the bay, now resulting in this locally deeper deposit of loose bay deposits overlain by loose hydraulic fills.

Given this depositional environment, the relatively loose hydraulic fills and granular bay deposits are highly susceptible to liquefaction, with the entirety of Harbor Island at significant risk from liquefaction and its associated lateral spreading during a severe seismic event.

While the Uniform Building Code and the more recently adopted California Building Code (CBC) have required consideration of site seismicity and liquefaction potential, becoming progressively more stringent over time, the 2013 CBC, for the first time, required that potentially liquefiable sites be assessed and mitigated for soil liquefaction resulting from the Maximum Considered Earthquake (MCE), which has a probability of exceedance of 2 percent in a 50-year period, or roughly equivalent to the 2,000-year design event. In contrast, the 2010 CBC required the assessment and mitigation of liquefaction resulting from a probabilistic seismic hazard having a 10% probability of exceedance in a 50-year period, or roughly equivalent to a 400-year design event.

The entirety of Harbor Island has been considered susceptible to liquefaction dating back to the 1970s. However, importantly, the 2013 CBC raised the requirements for mitigation and design to a significantly more severe design event than that used for all of the other structures on Harbor Island.

What this means for the current project is that under the code-specified MCE, site liquefaction and lateral spreading of the margins of the island into the bay must be accounted for in design. Mitigation of liquefaction and soil strength loss can be accommodated through ground improvement, typically stone columns or deep soil mixing; through the use of a robust deep foundation system capable of resisting the seismically induced liquefied lateral loads applied to the deep foundation system; or a rigid structural mat foundation stiff and strong enough to accommodate the anticipated MCE design level settlements and lateral movements without collapse of the structure. All three alternatives are discussed in this report.

GEOTECHNICAL INVESTIGATION
LANDSIDE IMPROVEMENTS
HARBOR ISLAND WEST MARINA
SAN DIEGO, CALIFORNIA

1 INTRODUCTION, PROJECT DESCRIPTION, AND SCOPE OF WORK

1.1 Introduction

TerraCosta Consulting Group, Inc. (TCG) is pleased to present the following report of our geotechnical investigation for the proposed landside improvements at the Harbor Island West Marina located on Harbor Island in San Diego Bay in San Diego, California. This report includes the results of our geotechnical and geologic studies and our recommendations for the landside improvements for the marina.

Harbor Island is a man-made island located just south of the northern boundary of San Diego Bay near the San Diego International Airport (Lindbergh Field). Please refer to the Vicinity Map (Figure 1) and Site Plan (Figure 2). More specifically, the project site is located at approximately 32 degrees 43 minutes and 20 seconds north latitude, and 117 degrees 12 minutes and 38 seconds west longitude.

1.2 Project Description

Based on our review of the conceptual design for the marina, we understand that currently proposed landside improvements for the Harbor Island West Marina include the following:

- Demolition of two existing two-story buildings, an existing one-story building, an existing restroom facility, a trash enclosure, and existing pavement;
- Minor regrading of the parking lot area, including modifications to egress and exits to the property;
- Reconstruction of the parking lot, including new landscape islands and possible permeable pavement areas for site infiltration;
- Construction of new trash enclosures and restrooms;

- Construction of three two-story buildings with two covered courtyards;
- Renovation of an existing overlook; and
- Construction of a bayfront promenade and other site pedestrian walkways.

Figure 3 illustrates the current conceptual site development plan. It is important to note that the exact composition of improvements may change during the planning and review process.

1.3 Scope of Work

In order to address the project geologic and geotechnical issues, and to provide input for the environmental reports required for the project, we performed the following scope of work.

1. Field Investigation - To investigate subsurface soil conditions, we drilled, logged, and sampled four geotechnical test borings ranging in depth from 12 to 48 feet.

2. Laboratory Testing - To characterize site soils, we performed laboratory testing on selected samples obtained from our field investigation.

3. Engineering Analyses - We performed engineering analyses to address the following issues:

    a. The potential for seismically induced liquefaction and lateral spreading;

    b. Structural foundation loads imposed by buildings (perimeter wall footings and column foundations) and ancillary structures, such as retaining walls, buried utilities, concrete flatwork, and asphalt pavements;

    c. Site preparation and earthwork operations; and

    d. Regional and local faulting, seismicity, and geologic hazards, as well as seismic design parameter requirements.

4. Report Preparation - We prepared this report to provide our findings and recommendations.

2 PREVIOUS STUDIES

To assist in our preparation for this project, we reviewed our in-house files and available literature. We also reviewed the conceptual design package prepared by SPAL Miller Hall that was submitted to the San Diego Unified Port District for comment. Lastly, we reviewed the following three studies:

- Carol Liana Forrest's 1982 Master's Thesis titled, "The Liquefaction Potential of Harbor Island."
- TerraCosta Consulting Group's December 10, 2012, draft letter-report prepared for Bellingham Marine Industries, Inc. titled, "Guide Pile and Approach Pier/Gangway, Foundation Criteria, Harbor Island West Marina, San Diego, California."
- TerraCosta Consulting Group's December 11, 2012, draft letter-report prepared for Bellingham Marine Industries, Inc. titled, "Addendum to Guide Pile Foundation Criteria, Evaluation of Existing 12-Inch Square Guide Piles, Harbor Island West Marina, San Diego, California."

3 FIELD AND LABORATORY INVESTIGATION

3.1 Field Investigation

On December 4, 2014, we performed our field investigation, which included a site reconnaissance; and drilling, sampling, and logging of four 6-inch-diameter exploratory test borings ranging from depths of 12 to 48 feet. The approximate locations of our test borings are shown on the Site Plan / Boring Location Map (Figure 2).

Samples were obtained from the test borings using both a 2-inch O.D. Standard Penetration Test (SPT) sampler and a 3-inch O.D. "California Sampler." The samplers were advanced by driving them into the soil ahead of the auger using a 140-pound hammer falling 30 inches.

Samples obtained from the borings were sealed in the field to preserve in-situ moisture, and transported to the laboratory for additional inspection and testing. The drilling operations were observed, and the borings logged and classified, by a geologist from our firm.

Field logs of the materials encountered in the test borings were prepared based on visual examination of the materials, and on the action of the drilling and sampling equipment. The descriptions on the logs are based on our field observations, sample inspection, and laboratory test results. A Key to Excavation Logs is presented in Appendix A as Figure A-1, and final logs of the test borings are presented as Figures A-2 through A-5.

3.2 **Laboratory Testing**

Representative soil samples obtained during our field exploration program were tested in the laboratory to verify field classifications and to provide data for geotechnical input to the design of project structures. The results of our laboratory tests are presented in Appendix B.

4 **SITE CONDITIONS AND GEOLOGY**

4.1 **Regional and Geomorphic Setting**

The site is located in San Diego Bay at the westerly edge of the approximately 10-mile-wide terraced coastal plain, which bounds the Peninsular Ranges geomorphic province of California.

The Peninsular Ranges are a northwest/southeast-oriented complex of tectonically related blocks separated by generally parallel fault zones (Norris and Webb, 1990). Geomorphically, this province is known for its long, low mountain ranges separated by deep alluviated valleys. Geologically, the Peninsular Ranges province extends from the southerly end of the Los Angeles Basin in the north and to the south through Baja California. The general tectonic setting is illustrated on the Regional Fault Map (Figure 4).

Offshore from Southern California is an area known as the Continental Borderland. While this area is not officially designated as a geomorphic province, many of those who study the area consider it a separate province due to its geomorphic complexity. The Continental Borderland is composed of elevated blocks and ridges, which form islands and banks separated by deep, often enclosed, basins (Legg and Kennedy, 1991). The Continental Borderland extends from the Santa Barbara Basin to the north, south along the coastline into Mexico and offshore approximately 160 miles out to the Patton Escarpment.

4.2 Local Geologic Setting

The topography for most of the San Diego coastal metropolitan area consists of uplifted ancient sea floors and shore platforms that have become the present-day westerly sloping coastal terraces, which are in turn incised by westerly and southwesterly flowing streams and rivers (Abbott, 1999).

Over the last million years, the San Diego region has risen at an average rate of about 5.5 inches per 1,000 years (Abbott, 1999). In the last 80,000 years, the rate of uplift has increased to nearly 12 inches per 1,000 years northwest of the Rose Canyon fault zone, and approximately 18 inches per 1,000 years southwest of the Rose Canyon fault zone. The Rose Canyon system has been suggested to have right-slip (lateral) displacement and is believed to represent a portion of the motion between the North American and Pacific Tectonic Plates.

Conversely, these tectonic forces have also caused down-dropping of the region within San Diego Bay. Following the Rose Canyon fault zone southerly from downtown San Diego, tectonic forces spread across three major faults (and quite possibly other faults) that underlie San Diego Bay. These faults (the Silver Strand, Coronado, and Spanish Bight Faults) are believed to transfer tectonic forces to the Descanso Fault, which lies offshore of Point Loma extending southerly into Mexico. Structurally, the right step, which occurs between the Rose Canyon and the Descanso fault zones, creates a releasing bend that causes the rocks underlying the bay to be stretched and down-dropped to accommodate the movement caused by these tectonic forces. Typical movements along the faults that underlie the bay are observed to experience a significant vertical or normal component to their movement.

From the standpoint of the overall geologic structure, San Diego Bay (located at the southerly end of the Rose Canyon system) is a down-dropped faulted trough (graben) lying just west of a stable hinterland-coastal plain. Bedrock to the east of the zone has been slightly deformed as opposed to that on the west side of this zone, which has experienced extensive faulting and displacement locally. Faults on the east side of the bay (i.e., La Nacion-Sweetwater Faults) display down-to-the-west normal displacement, while many of the unnamed faults on Point Loma display down-to-the-east normal displacement. The normal faults that parallel the bay to the east are likely a result of subsidence and compaction along the margin of the Pliocene-age San Diego Embayment.

4.3 Site Geology

The project site lies within an area of reclaimed estuarine and low-lying tidelands located south and east of Loma Portal at the north end of San Diego Bay. Historically, prior to the early 1900s, the San Diego River periodically overflowed its banks and reestablished a new course southerly into San Diego Bay (Figure 5).

In the early 1900s, the Army Corps of Engineers created a levee system to prevent flooding and to direct the San Diego River to the west into False Bay (currently Mission Bay). Over the next decades, the low-lying lands in the general San Diego Bay area were developed into what is currently the San Diego International Airport, Harbor Island, Shelter Island, and a few remaining tidelands.

Beginning in 1961, the Harbor Department of San Diego began a major dredging operation of the bay. Dredged material from this operation was used to create Harbor Island. Most of the man-placed fills are of hydraulic origin and generally consist of relatively clean sands placed over relatively granular bay deposits. All of these near-surface overburden soils are underlain at depth by relatively competent Pleistocene-age marine and non-marine terrace deposits.

The local surface geology of the site and adjacent areas, as presented on the State of California’s 30 degree by 60 degree geology map of San Diego (Kennedy and Tang, 2005), is shown on Figure 6. Previous representations of local geologic conditions, as presented by Kennedy in 1975, are shown on Figure 7.

4.4 Site Conditions

The Harbor Island West Marina is comprised of eleven floating docks and various landside improvements, consisting of several buildings and shops and paved parking. The existing structures include two single-story and two two-story wood-framed structures. The two-story structures are located immediately adjacent to the north-facing descending bayfront slope. One single-story structure is located at the western end of the property immediately adjacent to the north-facing descending bayfront slope; the other single-story building is located south of the two two-story buildings. Lastly, the majority of the landward portion of the property is covered with asphalt pavement.

Elevations across the site range from approximately 12 to 15 feet MLLW. The estimated ground surface along the top of the north-facing descending bayfront slope of Harbor Island is near elevation +15 feet MLLW. From the bayfront slope, the site slopes gently downward and to the south toward Harbor Island Drive, to an approximate elevation of +12 feet MLLW, where site parking transitions into an ascending slope to the northern limits of Harbor Island Drive at an approximate elevation of +14 feet MLLW.

4.5 **Subsurface Conditions**

Within the landward portion (Harbor Island proper) of the marina, subsurface conditions encountered by our onshore borings were comprised of both mechanically and hydraulically placed fill soils underlain by bay deposits, in turn underlain by relatively competent Pleistocene-age marine and non-marine terrace deposits commonly referred to as the Bay Point Formation. According to Forrest's review of several sites on Harbor Island, an average subsurface soil profile consisted of fill soils that extended from surface grades down to an elevation of -9 feet, bay deposits that extended to an elevation of -19 feet MLLW, and Pleistocene-age marine and non-marine terrace deposits that extended to the depths explored. At the Harbor Island West Marina site, the contact between fill and bay deposits ranged from -7 to -20 feet MLLW, and the contact between the bay deposits and the Pleistocene-age marine and non-marine deposits ranged between elevations -13.5 feet and -27.5 feet MLLW.

Within the bayward portion of the marina, the subsurface soil conditions encountered by our offshore borings and vane shear tests typically consist of 6 to 12 inches of near-surface, fine-grained, colloidal flock exhibiting essentially no shear strength. The bay-floor colloidal flock is underlain by variable thickness (typically 1- to 2-feet thick) bay deposits consisting of very loose to medium dense fine sands, and locally very soft to soft silts and clays. Weathered Bay Point formational terrace deposits were generally encountered below elevation -13 feet and the less weathered (more competent) Bay Point Formation below -20 feet.

All of the offshore borings drilled for the marina project (see Figure 2), with the exception of Boring B-5, encountered weathered Bay Point Formation terrace deposits near elevation -13 feet, suggesting a relatively uniform depositional environment. In offshore Boring B-5, terrace deposits were encountered near elevation -22 feet, which we interpreted to be an older incised channel associated with past flows of the San Diego River into San Diego Bay. The more recent onshore borings also reflect this locally incised channel with Boring B-1 immediately bayward of the offshore Boring B-5 encountering the weathered Bay Point Formation near elevation -27.5 feet, while the onshore Boring B-4 again encountered weathered Bay Point Formation soils near elevation -13.5 feet. Thus, it would appear that under at least the eastern portion of the proposed improvements, a deeper incised alluvial channel exists, which is now predominantly filled with loose liquefiable soils.

The individual soil units encountered within the project limits are described in more detail below:

Offshore Recent Bay Deposits: The recent bay deposits consist of a relatively thin layer of colloidal flock underlain by very loose and soft, gray, very fine- to medium-grained sands and silt.

Offshore Bay Point Formation: The offshore Bay Point Formation was generally encountered below -13 feet MLLW. The upper 5 to 10 feet of this soil unit is generally weathered, becoming more competent below -20 to -25 feet MLLW. The Bay Point Formation typically consists of old paralic deposits of late to middle Pleistocene age and is mostly poorly sorted, interfingered, beach estuarine and colluvial deposits comprised of siltstones and sandstones and occasional clays.

Fill Deposits: Artificial, or man-placed, fill soils encountered within the project area consist of sands, sands with silt, and silty and clayey sands. These fill soils appeared to have been mechanically placed to a depth just above the groundwater table, and hydraulically placed below the groundwater table. The hydraulically placed fill soils were comprised primarily of sands with fines contents less than 6 percent and contained relatively abundant shell fragments. Sample penetration resistances within the mechanically placed soils range from 6 to 37 blows per foot, and sample penetration resistances within the hydraulically placed soils range from 2 to 7 blows per foot.

Onshore Bay Deposits: The onshore bay deposits are comprised of gray saturated silty sands. Sample penetration resistances within the onshore bay deposits ranged from 3 to 21. In addition, these bay deposits have fines contents that range from 10 to 19 percent.

> *Onshore Bay Point Formation*: The onshore Bay Point Formation was encountered below -14 feet MLLW in Boring B-4 and -28 feet in Boring B-1. The soils encountered in our borings are comprised of gray silty sands and mottled red-brown clayey and silty sands with sample penetration resistances ranging from 21 to 40.

Generalized geologic and geotechnical cross-sections have been prepared to illustrate the subsurface conditions at the site. These cross-sections are presented as Figures 8 through 11.

4.6 Groundwater

Groundwater levels at the site can be expected to vary in response to tidal fluctuations. Groundwater highs will likely approach tidal highs in the bay, and groundwater lows may drop slightly below mean sea level. From a construction standpoint, any excavations approaching the upper margins of the tidal zone should be expected to experience severe caving.

5 GEOLOGIC HAZARDS

5.1 Introduction

In general, a project may be exposed to risks associated with various geologic hazards. Many of those hazards are related to the actions of earthquakes and faulting. In addition to geologic hazards associated with earthquakes and faulting, other potential geologic hazards exist that could impact a given project, such as landslides, expansive soils, collapsible soils, corrosive soils, and high or perched groundwater. A brief description of the various geologic hazards and their impact on the project site is presented below.

5.2 Faulting and Seismicity

5.2.1 *Regional Faulting Seismicity*

Movement between the North American and Pacific Plates makes Southern California one of the more seismically active regions in the United States. Strain, caused by movement between the North American Plate and the Pacific Plate, is spread across a 150+ mile wide zone between the San Andreas fault zone, approximately 100 miles east of San Diego, out to and beyond the San Clemente fault zone located approximately 50 miles west of San Diego.

Nearing the end of the Miocene, approximately 5.5 million years ago, the boundary between the North American and Pacific Plates moved eastward to its present-day position in the Gulf of California (Abbott, 1999). The resultant extension and stretching of the North American continental crust formed a rift between the two plates, creating the Gulf of California, which continues opening through the present day. The San Andreas, San Jacinto, Elsinore, Rose Canyon/Newport-Inglewood, and San Clemente fault zones are just a few of the resultant strain features (faults) created by this tectonic movement (Figure 4.) Today, there is an estimated 22 to 24 inches per year of relative plate motion between the North American and Pacific Plates spread across the faults within this 150+ mile wide zone, of which the Rose Canyon fault zone is estimated to contribute 0.06 inch/year (±0.02 inch). It is this context within which the local tectonics of San Diego is situated.

5.2.2 *Local Tectonics*

Of the major active fault systems in Southern California, the Rose Canyon/Newport-Inglewood fault zone has impacted the local San Diego region the most. In addition, the La Nacion fault zone to the east of the project and the Descanso Fault offshore to the west have contributed to the local tectonic state of the project site. Together with other offshore fault zones, these faults have contributed to the formation of San Diego Bay. South of La Jolla, the Rose Canyon fault zone changes its orientation from a northwest/southeast trend to a more north/south trend, creating a left bend in the fault zone. This left bend locally creates a locking mechanism within the predominantly right lateral Rose Canyon fault zone. The compressional forces within this zone have caused folding, uplift, and tilting of the overlying sedimentary rocks, thus creating Mount Soledad and the down-dropped Mission Bay area. To the south in San Diego Bay, the Rose Canyon fault zone separates into a “horsetail splay,” spreading movement across the Silver Strand, Coronado, and Spanish Bight Faults (as well as several smaller faults) as it trends offshore toward the Descanso Fault. The Descanso Fault lies offshore from Point Loma, where it extends southerly toward the Agua Blanca fault zone in northern Baja (Legg and Kennedy, 1991). This right step, between the Descanso and Rose Canyon fault zones, creates a releasing bend, causing the rocks to be stretched and down-dropped. In response, the rocks have not deformed elastically, but instead have responded with brittle fault failure (Abbott, 1999). The easterly boundary of this releasing bend is formed by the La Nacion fault zone, which generally consists of normal faults that down-drop to the west.

5.2.3 *Local Faults*

The Harbor Island West Marina project is located along the northerly margin of San Diego Bay and west of the active Rose Canyon fault zone. As described above, when the Rose Canyon fault zone is followed southerly, it appears to terminate in San Diego Bay. From there, the fault movement appears to be transferred to the northerly trending Silver Strand, Coronado, and Spanish Bight Faults that continue offshore toward the Descanso Fault. Based on our review of the State of California Earthquake Fault Zone Map for the Point Loma Quadrangle, the earthquake fault zone boundary for the Spanish Bight Fault (the closest active fault to the Harbor Island West project site) is located approximately 1.8 kilometers to the east/southeast (Figure 12).

5.2.4 *Historical Seismicity*

The historical seismicity of the site can be illustrated from searches of both the California Geological Survey (CGS) database of historical earthquakes and the earthquake database contained in the computer program EQSEARCH. The CGS database contains historical earthquake events from 1800 to 1999 above a minimum magnitude of 5.5, and permits searches for historical earthquakes within a 31 mile radius of the subject site. The database within EQSEARCH contains historical earthquake events between 1800 and 2010 for earthquake magnitudes above 4 for a user-defined search radius (typically on the order of 100 miles from the site). In addition, EQSEARCH permits an estimation of peak ground acceleration (PGA) using common attenuation relationships to help characterize the relative importance that a given historical event may have at a site. For our purposes, we employed a search radius of 100 miles and used Boore, et al., 1997 attenuation relationships for a NEHRP Soil Type D (Vs30m of approximately 820 ft/s).

From our search of the CGS database, four historical earthquakes were identified:

- May 25, 1803, event located at latitude 32.8 degrees north and longitude 117.1 degrees west. This earthquake had a reported magnitude of 5.5 and was located approximately 13.5 kilometers from the site;

- May 27, 1862, event located at latitude 32.55 degrees north and longitude 117.15 degrees west. This earthquake had a reported magnitude of 6.2 and was located approximately 20 kilometers from the site;
- June 25, 1863, event located at latitude 32.4 degrees north and longitude 117.1 degrees west. This earthquake had a reported magnitude of 5.8 and was located approximately 37.3 kilometers from the site; and
- October 23, 1984, event located at latitude 32.8 degrees north and longitude 116.8 degrees west. This earthquake had a reported magnitude of 6.1 and was located approximately 39.4 kilometers from the site.

The results of the EQSEARCH are presented in Appendix C. In general, results of the search are similar to the California Geological Society. However, several of the reported distances of the faults to the site depend on the database searched. The EQSEARCH database reports the May 27, 1862, earthquake occurring closer to the site than the California Geological Society database. This results in a higher estimation of PGA. This is especially true with the event that corresponds to a PGA of 0.38g, which, according to the CGS database, is located approximately 20 kilometers from the site versus the 2.6 kilometers in the EQSEARCH database. Regardless of distance measures, the site has likely experienced historic ground accelerations greater than 0.1g within its lifetime.

5.3 Geologic Hazards Associated with Earthquakes

5.3.1 *General*

Geologic hazards generally associated with earthquakes include ground rupture, ground shaking, tsunamis, seiches, seismic-induced flooding, liquefaction, seismic-induced ground settlement, and seismic-induced slope instability. With respect to these hazards, we have the following comments.

5.3.2 *Ground Rupture*

Our review of the CGS Earthquake Fault Zone Map for the Point Loma Quadrangle (see Figure 12), the Fault Activity Map of California and Adjacent Areas, Bulletin 200 (see Figure 7), and the Geologic Map of the San Diego 30-Minute by 60-Minute Quadrangle (see Figure 6) did not indicate that any active faults trend toward or traverse the site. The nearest active fault is the Spanish Bight segment of the Rose Canyon Fault, located approximately 1.8 kilometers to the east of the site (see Figure 12). Thus, based on our review of these maps, it is our opinion that ground rupture due to faulting is not a hazard for this project.

5.3.3 *Ground Shaking*

As the proposed project is located in an earthquake-prone area, we consider the risk associated with ground shaking at this site to be very high. As such, the project improvements will be required to satisfy, at a minimum, the prescribed California Building Code (CBC) requirements (see Sections 1613 and 1803.5.8 of the CBC).

Code requirements for ground shaking focus on two issues, with the most common issue pertaining to the imparting of inertial forces into buildings and structures. For this issue, ground shaking is oftentimes characterized in terms of a design response spectrum. The second issue (of equal significance) is the stability of the ground during ground shaking. For this second issue, analyses pertaining to slope instability, liquefaction, lateral spreading, and seismic-induced ground settlement are commonly performed.

In past building codes, the design earthquake considered for both assessing ground stability and building design was based upon the same level of earthquake. However, the 2013 Building Code considers different design earthquakes for different analyses. For example, when assessing liquefaction and soil strength loss, CBC Section 1803.5.12 states that the evaluation to be carried out using site peak ground acceleration, earthquake magnitude, and source characteristics consistent with the maximum considered earthquake (MCE). This is roughly equivalent to the 2,000 year design event. For the assessment of building effects due to earthquake loading, is to be generally assessed using a response spectra based on the design level earthquake, which is taken as two-thirds of the response spectra ordinates based on a response spectra corresponding to the MCE, or roughly equivalent to the 400-year design event.

Design parameters for the assessment of ground shaking are discussed and presented in Section 7.5 of this report.

5.3.4 *Tsunamis and Seiches*

Tsunamis and seiches are considered likely hazards at this project site. A review of the State of California Tsunami Inundation Map for Emergency Planning (2009) indicates that the site will be affected by tsunamis caused by both local and distant sources (Figure 13).

In addition, recent tsunamis generated by distant sources (the 2010 Chilean earthquake and the 2011 Honshu, Japan, earthquake) caused damage within San Diego Bay as a result of rapid changes in water surface elevations as the tsunami waves passed into and out of the bay.

5.3.5 *Liquefaction*

Three key ingredients are required for liquefaction to occur: liquefaction-susceptible soils, sufficiently high groundwater, and strong shaking. Liquefaction is the phenomena associated with ground shaking that results in the increase of pore pressures within the soil. As the pore pressure increases, the shear strength of the soil is reduced. If the pore pressure is sufficiently increased, the soil takes on a “liquid like” behavior. Consequences commonly associated with soil liquefaction include ground settlements, surface manifestations (sand boils), loss of strength, and possible lateral ground movement typically referred to as lateral spreading, ground oscillations and lurching, and possible ground failure.

Soils susceptible to liquefaction generally consist of loose to medium dense sands and non-plastic silt deposits below the groundwater table. The soil deposits underlying the site are comprised of loose to medium dense fills, including hydraulically placed fills comprised of sands with varying amounts of silts, bay deposits, and Quaternary-age deposits, all of which exist below the water table.

In general, the results of our liquefaction assessment for the MCE event indicates that the fill soils below the groundwater table and bay deposits are liquefiable, whereas the denser and more clayey weathered strata of the terrace deposits and Bay Point Formation soils are not liquefiable.

As described above, potential liquefaction impacts associated with the MCE event include seismic-induced ground settlement, ground lurching, surface manifestations such as sand boils and surface cracking, and lateral spreading. Liquefaction-induced vertical ground displacements are estimated to be on average approximately 9 inches and expected to range from 4 to 18 inches.

In addition, liquefaction of the saturated fill soils and bay deposits results in a reduction in soil strengths, such that the stability of the bayfront descending slope and areas adjacent to the top of the slope will likely fail due to the reduced soil strengths. A more detailed discussion of the liquefaction-induced slope failure is presented in Section 5.3.7.

5.3.6 *Lateral Spreading and Flow Failure*

Lateral spreading is a phenomenon related to liquefaction that is characterized by accumulated incremental lateral or horizontal displacements that occur during earthquake shaking. During liquefaction, the strength of the soil decreases to a residual undrained shear strength primarily due to the increase in pore pressures in the soil. The residual undrained strength is oftentimes related to the Standard Penetration Test resistance of the soil, and is generally expressed as either an undrained strength or the ratio of undrained strength to initial effective overburden pressure prior to liquefaction. Lateral spreading is oftentimes distinguished from flow failures on the basis of a comparison of the shear stress acting on the soil during static conditions to the cyclic-induced shear stress on the soils generated during an earthquake.

When the static-induced shear stress exceeds the residual undrained strength of the liquefied soil, flow of the soil mass occurs and the phenomenon is commonly referred to as flow failure. However, when the static shear stress is less than the shear strength of the liquefied soil, ground failure is related to the phenomenon known as cyclic mobility, which results from the development of incremental deformations that are driven by both cyclic and static shear stresses. The magnitude of lateral spreading displacements is related to the number and magnitude of stress impulses that exceed the soil strength. The magnitude of lateral movement varies between negligible and significant. These types of deformations are commonly referred to as lateral spreading and can occur on very gentle to virtually flat ground near or adjacent to a free face.

Estimating lateral displacements due to lateral spreading is an imprecise exercise and estimates vary widely. For this site and for the code-specified earthquake scenarios, we estimate that lateral displacements will be on the order of 6 to 22 feet near the top of the bayfront descending slope. In addition, lateral displacements are expected to extend landward from the bayfront slope in a diminishing manner. Given that Harbor Island is approximately 320-feet wide at the location of the Harbor Island West Marina, one would anticipate that lateral spreading effects will affect the majority of Harbor Island, with ground cracking associated with differential lateral displacements occurring across Harbor Island.

5.3.7 *Seismic-Induced Slope Instability*

For this project, there is one primary slope of interest; that being, the bayfront descending slope located along the northern shore of Harbor Island. This slope is a composite slope with inclinations varying from the 1.5:1 to 10:1 (horizontal to vertical). Beginning at the top of the slope near elevation +15 feet MLLW, the slope descends at an inclination of approximately 1.5:1, down to elevation +2 feet MLLW, where the inclination flattens to 3:1 as the slope continues to descend to elevation -2 feet MLLW, where the inclination flattens to 10:1 as the slope continues to descend to elevation -10 feet MLLW.

The slope, which is comprised of fill soils, is underlain by both bay deposits and the Bay Point Formation. From approximate elevation +3 feet to elevation -13 feet (locally -22 feet), the slope is comprised and underlain by liquefiable fill and bay deposit soils, which are anticipated to lose significant strength as the result of liquefaction. Consequently, this slope is prone to seismic instability (both lateral spreading and slope failure).

As discussed above, the effects of lateral spreading are anticipated to extend landward several hundred feet from the top of the slope. In addition, the underlying foundation soils supporting the slope are expected to fail in a bearing capacity manner. This bearing capacity-like failure is estimated to extend approximately 140 feet landward from the top of the slope where the computed seismic factor of safety against failure is approximately 1. It is important to note that the estimated width of Harbor Island near the Harbor Island West Marina is on the order of 320 feet. As such, the potential seismic-induced ground failure extends practically to the middle of Harbor Island. Assuming that the other half of Harbor Island is similar to the half where Harbor Island West Marina is located, the implication is that under the 2,000 year design event, the majority of Harbor Island will experience significant ground damage during the code-specified earthquake event.

Given that a significant portion of the site is expected to experience ground displacement, the CBC requires that areas of the site where buildings are proposed will need to be remediated in order to preclude, or at least mitigate, the effects of liquefaction. As such, during the code-specified seismic event for liquefaction, the bayfront descending slope and the area adjacent to the slope (not having been remediated) will still be susceptible to seismic-induced movements. These movements are a function of the strength of the slope soils. For the condition where the soils do not liquefy, we estimate that the slope and the area adjacent to the top of the slope could be displaced by upwards of 4 inches during the MCE level seismic event. Such displacements can be reduced to less than 1 inch, provided the soils in question have been sufficiently strengthened.

5.4 Landslides

A review of Bulletin 200 and the geology map of the Point Loma Quadrangle (Figure 7), as well as review of reports by others, indicates that no landslides are mapped on or adjacent to the site. As such, it is our opinion that the risk associated with landslides at the site is negligible.

5.5 Slope Stability

As described above in Section 5.3.7, the primary slope of interest for this project is the bayfront descending slope located along the northern shore of Harbor Island. This slope is a composite slope with inclinations that vary from 1.5:1 to 10:1 (horizontal to vertical).

From our analyses, the static factor of safety against failure of this slope varies with distance from the top of the slope. The slope has a minimum computed factor of safety just greater than 1 for failure surfaces intersecting the ground surface approximately 11 feet from the top of slope. The factor of safety increases to the code-required minimum of 1.5 at a distance of 20 feet from the top of the slope face.

5.6 Collapsible Soils

No collapsible soils were reported in the literature reviewed or encountered during our site investigation. As such, it is our opinion that the potential for collapsible soils is low.

5.7 Expansive Soils

Our test borings did not encounter any expansive soils within the proposed grading depths. As such, it is our opinion that the potential for soil movement (swell-shrink) related damage to the development from on-site soils is low to negligible.

5.8 Corrosive Soils

In general, marine environments are very corrosive by nature. Soils (and conditions) should be considered moderately to severely corrosive.

5.9 Groundwater

Groundwater was encountered in the onshore borings at a depth of approximately 12 feet (elevation +4 feet MLLW) at the time of our investigation. The depth to groundwater is directly related to the level of water within the bay and, as such, is expected to vary with tides. As such, any given groundwater elevation is expected to be transitory and to oscillate between an upper and lower bound. Discounting perching horizons and contributions from rainfall and irrigation, we estimate that the groundwater table elevation will vary between a maximum groundwater table elevation corresponding to the Highest Observed Water Level (HOWL), highest recorded tide elevation record in the bay at +8.14 feet MLLW, and a minimum groundwater table elevation corresponding to the lowest tide at -2.2 feet MLLW for current sea level conditions. However, over time, this highest groundwater elevation is likely to rise given sea level rise. Sea level rise has been estimated at 0.25 to 2.2 feet over the next 50 years (IPCC, 2007). If one assumes that the maximum sea level rise is 2.25 feet, the groundwater table elevation is anticipated to fluctuate between -2.2 feet and about 10.3 feet MLLW.

6 DISCUSSION

6.1 Site Development

The proposed project consists of the demolition of existing site improvements, including parking, landscaping, and several existing structures, and the construction of proposed improvements, which includes minor adjustments to site grades, new pavement, new landscaping, and new buildings.

Constraints to the proposed project include stability of the existing bayfront descending slope, stability of foundation soils under code-specified earthquake conditions, and foundation capacity of on-site soils.

Of the constraints for the proposed project, the key issue or concern is the anticipated performance of site soils during the code-specified earthquake event. As stated in Section 5.3 of this report, the proposed development is located on soils that are susceptible to liquefaction, lateral spreading, and seismic-induced slope instability, which under the design event are anticipated to result in ground failure, excessive ground settlement, and lateral ground displacements during the code-specified earthquake event. Also, as mentioned in Section 5.3, given that the width of Harbor Island near the Harbor Island West Marina is on the order of 320 feet, the extent of seismic-induced ground instability, including ground failure, ground cracking, sand boils, ground settlement and lateral displacements, is anticipated to affect the majority, if not all, of Harbor Island. As such, mitigation of the seismic-induced impacts for new structures is required given current code requirements.

Given the technologies and methods of construction available within the area and the industry, it is our opinion that all the geologic hazards for this project can be mitigated to a level that would permit new development within code requirements.

6.2 Site Remediation and Mitigation

There are two general areas of the site that require remediation and mitigation: the static stability of the existing bayfront slope and ground failure issues associated code-specified earthquake events.

6.2.1 *Mitigation of Static Slope Stability of Bayfront Slope*

Our analyses indicate that areas adjacent to the top of the existing bayfront descending slope have computed factors of safety against slope failure less than the common industry standard of 1.5. Our analyses show that the area from the top of the slope to 20 feet beyond the top of the slope has a computed factor of safety less than 1.5 and greater than 1. **As such, locating new structure a distance greater than 20 feet will mitigate concerns of placing new structures near slopes of marginal safety.**

6.2.2 *Mitigation of Seismic-Induced Site Hazards*

According to Sections 1803.5.11 and 1803.5.12 of the 2013 Edition of the CBC, structures need to consider the potential for liquefaction and lateral spreading and their impact on the proposed development. As part of this assessment, mitigation measures pertaining to the potential seismic impacts are to be considered as part of the design process for the structures. Such mitigation measures typically include ground stabilization, appropriate foundation systems, and/or other structural systems that can accommodate the anticipated displacements and forces. As we understand the code requirements, the primary focus of seismic mitigation is to mitigate and address life and safety concerns more so than maintaining building performance. As such, it is our opinion that a mitigation measure that prevents building collapse but does not prohibit building damage satisfies code requirements.

It is important to note that, in general, all existing structures and buildings on Harbor Island are at risk to significant impacts associated with ground failure and vertical and lateral soil movements. As such, existing structures will likely be significantly damaged during the code-specified earthquake scenario and, depending upon the foundation system of a given structure, may also experience structural collapse.

That said, it is our understanding that code requirements for mitigation pertain to protecting the life and safety of occupants in the proposed new structures. As such, the selection of the type and extent of mitigation depends on a variety of factors, which includes prevention of structural collapse, protecting the life and safety of occupants, desired condition and end-use of the structure after the occurrence of the code-specified earthquake, cost of mitigation, and cost of repair.

As outlined in the CBC, mitigation measures may include prevention of liquefaction and lateral spreading by improving the ground, selecting foundation systems that can accommodate the anticipated seismically induced ground movements and forces, or a combination of measures that includes some amount of ground stabilization in conjunction with a compatible foundation system.

Oftentimes, the first mitigation strategy considered is remediating site soils to preclude site liquefaction, lateral spreading, and seismically induced slope instability and ground failure. To this end, mitigation methods employed for ground modification and stabilization include the following:

- Soil compaction;
- Deep dynamic compaction;
- Vibro-compaction and vibro-replacement with stone columns;
- Compaction grouting;
- Deep soil mixing;
- Jet grouting; and/or
- Chemical grouting.

Brief descriptions of the ground improvement methods and their advantages and disadvantages are presented in Table 1.

In addition to mitigating the liquefaction and lateral spreading impacts by using ground improvements, the selection and design of the foundation system for the structure or improvement may be a viable alternative. Table 2 summarizes several foundation systems that might be appropriate, pending their ability to accommodate the anticipated liquefaction and lateral spreading-induced ground movements without structural collapse.

The selection of an appropriate strategy for mitigating liquefaction and lateral spreading impacts is oftentimes an iterative process where several alternatives are considered, with the more cost-effective solution selected. These cost-benefit analyses typically consider ground improvement costs, building construction costs, and repair costs. However, given the site soils and anticipated site performance, it is our opinion that, of the potential options available for consideration, the alternatives presented in Table 3 are likely the most feasible. Lastly, to help facilitate this process, we have provided preliminary design criteria for the alternatives presented in Table 3. These criteria are presented in Section 7 of this report.

7 RECOMMENDATIONS

7.1 Site Preparation

Site preparation for this project is anticipated to consist of:

- Minor regrading and placement of limited amounts of new fill soils;
- Remediation of ground instability associated with liquefaction, lateral spreading, and seismically induced instability within and adjacent to new building areas by either ground improvement, the use of deep foundations with grade beams and structural floors, or the use of mat foundations;
- Preparation of subgrade soils for other structures and facilities, pavement, and flatwork; and
- Utility installation and trench backfilling.

Recommendations for site preparation and earthwork operations are presented below. Recommendations for ground improvement alternatives are presented in Section 7.2. Recommendations for deep foundations with grade beams and structural floors are presented in Section 7.3. Recommendations for mat foundations are presented in Section 7.4.

7.1.1 *Site Preparation and Earthwork Operations*

7.1.1.1 **Site Preparation Beneath Sidewalks, Flatwork, and Buildings**

We recommend that, where improvements consisting of sidewalks, flatwork, pavements, and buildings are to be placed, the site be excavated to a minimum depth of 1 foot below existing grade or finish grade, whichever is deeper, and then scarified to a minimum depth of 8 inches, watered, and properly recompacted to a minimum of 95 percent relative compaction, in accordance with ASTM D 1557. Any loose zones encountered during compaction of the final subgrade should be overexcavated and properly recompacted to 95 percent in order to provide the recommended subgrade density.

7.1.1.2 **Site Preparation for Remaining Areas**

We recommend that, as a minimum, the existing ground surface or finish grade, whichever is deeper, be scarified to a depth of 8 inches, moistened as needed, and recompacted to a relative compaction of 92 percent.

7.1.1.3 **Site Preparation and Remediation Within Ground Improvement Areas**

The near-surface soils in the area of ground improvement will be highly disturbed during installation. As such, within the areas of ground improvement, we recommend that the site be excavated to a depth of 4 feet (1 foot below the top of treatment). The contractor is to then place a minimum of 18 inches of 1/2-inch crushed rock or gravel. The crushed rock or gravel shall comply with Section 200-1.2 - Crushed Rock and Rock Dust of the Standard Specifications for Public Works Construction. A non-woven filter fabric shall be placed on top of the 18-inch crushed rock layer. The non-woven filter fabric shall be Mirafi N-140 or equivalent. The contractor shall then place fill materials and recompact the soil to finish grade to a relative compaction of 95 percent.

7.1.1.4 **General Site Preparation and Earthwork**

Where new fill is to be placed in areas underlying buildings or structures, we recommend that new fill be compacted to 95 percent relative compaction. For areas not underlying buildings, sidewalks, flatwork, and pavements, we recommend placing new fill at a minimum relative compaction of 92 percent.

All fill should be placed at a moisture content between optimum moisture, as determined by the latest approved version of ASTM D 1557, and 2 percent above optimum.

For utility trench backfill, we recommend that the soils within the pipe zone be compacted to the minimum specified relative compaction per the utility designer. Soils used as backfill above the pipe zone shall be compacted to a minimum relative compaction of 92 percent.

We recommend that the existing hydraulic fill sands be compacted by a combination of vibration using a vibratory roller, compactor, and/or heavy track equipment.

Except for as noted above, all site preparation and grading should be performed under the observation of the geotechnical engineer and in accordance with Section 300, “Earthwork,” of the Standard Specifications for Public Works Construction.

7.2 Ground Improvement Implementation

As discussed above, Sections 1803.5.11 and 1803.5.12 of the 2013 Edition of the CBC require that effects associated with liquefaction , lateral spreading, and seismically induced slope and ground instability be mitigated. This mitigation may be achieved by ground improvements, foundation design, or a combination of both. As the project is still in the planning stages, the selection of the most viable mitigation strategy will require an alternatives evaluation of potentially viable methods. As such, preliminary design guidelines and criteria for two ground improvement methods are presented below. Final design recommendations can be provided once a mitigation strategy has been selected.

As discussed in Section 6.2 of this report, it is our opinion that the two most likely candidates for ground improvement are stone columns installed by vibro-replacement with wick drains and deep-soil-mixing. Preliminary recommendations for use in the evaluation of these two options are presented below.

7.2.1 *Ground Modification via Wick Drains and Stone Columns Installed by Vibro-Replacement*

1. We recommend that the wick drain and stone column system be designed by a design-build contracting team.
2. We recommend that the ground improvements consist of vibro-replaced stone columns installed within the limits of the proposed building footprint, and that the area of treatment extend horizontally a minimum distance of 30 feet from the edge of the building footprint. It is important to note that site improvements and facilities located outside of the ground improvement treatment area will be subjected to significant seismically induced ground movements, as described in previous sections of this report.

3. We recommend that the stone column improvements extend vertically from 3 feet below grade to an elevation corresponding to 5 feet below the contact of the Bay Point Formation. For preliminary planning purposes, the elevation of the Bay Point Formation contact may be taken as elevation -30 feet.

4. In addition, we recommend that liquefiable soils be improved to a condition such that the post-treated soils have a minimum normalized clean sand CPT tip resistance of 190. The normalized clean sand CPT tip resistance is to be computed using methods outlined by Robertson and Wride (1998). We anticipate that this will require a replacement area ratio ranging from 10 to 20 percent. Our estimates suggest a replacement area ratio of 15 percent. We anticipate that this would require the placement of stone columns on a 7- to 8-foot grid.

5. As the silt content of the bay deposits is significant and likely resistant to densification, wick drains may be required in conjunction with the stone column. The design of the wick drain system should mitigate liquefaction within the underlying bay deposits.

6. The near-surface soils in the area of ground improvement will be highly disturbed during installation. As such, within the areas of ground improvement, we recommend that the site be excavated to a depth of 4 feet below grade (1 foot below the top of treatment). The contractor shall then place a minimum of 18 inches of 1/2-inch crushed rock or gravel. The crushed rock or gravel shall comply with Section 200-1.2 - Crushed Rock and Rock Dust of the Standard Specifications for Public Works Construction (“Greenbook”). A non-woven filter fabric shall be placed on top of the 18-inch crushed rock layer. The non-woven filter fabric shall be Mirafi N-140 or equivalent. The contractor shall then recompact the soil to finish grade to a relative compaction of 95 percent in accordance with ASTM Test Designation D 1557.

7. As the buildings will likely be located near the bayfront, the treated ground will be subjected to lateral loading associated with the seismically induced ground movements discussed in Section 5.3 of this report. As such, the ground improved area will act as a buttress to non-treated soils located inland from the bayfront edge. Thus, the area of treatment may need to be enlarged and modified in order that the treated soils remain stable, with limited lateral

movements due to soil loads imposed on the treated area due to the behavior of the non-treated areas. As such, the treated area needs to be designed to accommodate the following two lateral load design cases:

a. Case 1 assumes a passive pressure loading of the upper soils equal to 480 pcf. The soils generating the passive loading are to be taken from the ground surface to an elevation equal to +3 feet MLLW. Below elevation +3 feet MLLW, the soils are assumed to be liquefied with a lateral pressure equal to 120 pcf. The zone of liquefied soils is to extend to a minimum elevation of -30 feet MLLW. Below elevation -30 feet MLLW, an active soil pressure of 20 pcf is to be assumed.

b. Case 2 assumes a lateral soil loading of 120 pcf acting against the soil-cement buttress from the ground surface to a minimum elevation of -30 feet. Below elevation -20 feet MLLW, an active soil pressure of 20 pcf is to be assumed. In addition, an equivalent hydro-dynamic loading of the liquefied soil is to be applied. This loading can be estimated by Westergaard’s equation using an equivalent fluid unit weight of 120 pcf.

8. A base seismic coefficient of 0.53 is to be used in the design. This value may be modified depending upon the allowable displacement assumed for the design.

9. A sliding coefficient of 0.6 may be assumed along the bottom of the sliding mass. For passive pressures within the Bay Point Formation, we recommend an unfactored passive pressure of 160 pcf.

10. Lastly, as the buildings will likely be located near the descending bayfront slope, the ground improved areas for the buildings will need to be designed in order to maintain global stability near the bayfront slope. As such, the treated area is to be designed such that seismically induced displacements associated with ground instability, including global slope stability near the descending bayfront slope, are less than 0.5 inch. For design purposes, the horizontal seismic coefficient is to be taken as 0.53.

7.2.2 *Ground Modification via Deep Soil Mixing*

1. We recommend that, as a minimum, the deep soil mixing treatment area should include the limits of building footprints, and a minimum distance of 25 feet beyond the building footprints. The actual limits, including embedment, will depend on global stability requirements for overturning and sliding of the treated area. It is important to note that site improvements and facilities located outside of the ground improvement treatment area will be subjected to significant seismically induced ground movements, as described in previous sections of this report.

2. We recommend that the area of treatment be designed by a design-build contracting team.

3. The soils within the treatment area can either be fully-mixed and augmented by the creation of soil-cement soils generated by the deep-soil-mixing process, or may be partially augmented by the creation of interlocking soil-cement-mixed-columns. The interlocking soil-cement-mixed column cells shall be designed to maintain structural integrity and limited lateral displacements associated with anticipated seismically induced loads. In addition, if the interconnected cell concept is adopted, we recommend that the outside perimeter of the treated area be comprised of soil column elements such that columns overlap to create a continuously treated soil mass. This continuously treated soil mass should have a minimum width of 15 feet, as measured from the outside edge of the treated area. The configuration of columns within the interior portion of the soil-cement mixed mass should result in a coherent and interlocked treated area. The layout and pattern of interlocking columns within the interior of the buttress is at the discretion of the design-build contractor. Regardless of the layout, the treated area is to function as a coherent mass.

4. The strength of the soil-cement mix should be determined by the design-build contractor to prevent shear failure of the soil-cement mixed soil. However, we recommend, as a minimum, that the soil-cement mixed soil has an unconfined compressive strength of 400 psi.

5. We recommend that the soil-cement treatment area extend to a minimum of 5 feet below the contact of the Bay Point Formation. Deeper embedment may

be needed to accommodate sliding requirements. For preliminary planning purposes, the elevation of the Bay Point Formation contact may be taken as elevation of -30 feet. The elevation of the top of treatment should be at an elevation of +5 feet.

6. Recommendations provided for stone columns, specifically Section 7.2.1, Items 6 through 9, will also apply for the deep soil mixing alternative.

7.3 Foundation Design

7.3.1 *Deep Foundations Used for Ground Instability Remediation*

As indicated above, one potential alternative for mitigating the effects of ground instability associated with liquefaction, lateral spreading, and seismically induced slope/ground instability is the use of foundation systems that can accommodate the ground displacements. For this site, one such system is either driven piles or cast-in-drilled-hole (CIDH) shafts tied together with grade beams. These deep foundation elements help to isolate the building from the anticipated ground movement. However, key to the design is the need to accommodate the imposed lateral soil loading on the piles. The grade beams are necessary to tie the piles together and thus help to provide additional lateral restraint to the imposed loads.

We recommend the following design parameters for preliminary design and planning assessment of the viability of the use of a deep foundation and grade beam system:

1. Piles or CIDH shafts are to be tied structurally together by grade beams in order to provide additional fixity to the pile and shaft system.

2. Piles or CIDH shafts are to be designed to accommodate building loads, lateral loads due to ground displacement, and down-drag loads due to the reconsolidating of liquefiable soils. To this end, the following design loads, in addition to building loads, are to be considered in the design of the pile or shaft foundation system:

    a. Down-drag loads of 1 ksf skin friction for that portion of the pile or shaft that extends from the bottom of the grade beam to elevation -30 feet MLLW.

    b. Lateral soil loads of 480 pcf for the perimeter piles located landward of the top of the descending bayfront slope for those portions of the grade beam and pile/shaft foundation system that extend from the ground surface to elevation +3 feet MLLW.

c. Linearly increasing lateral soil pressure acting over the length of each pile/shaft beginning at elevation +3 feet MLLW at a magnitude of 400 psf, and extending to an elevation of -30 feet MLLW at a magnitude of 900 psf.

3. The pile/shaft foundations are to be embedded a minimum of 4 times T, where T is equal to the square root of the modulus of elasticity of the pile/shaft (E), times the moment of the inertia of the pile/shaft (I), divided by the stiffness of the soil (f). The stiffness of the soil (f) is 25 pci.

4. For analyses using point of fixity calculations, the point of fixity may be taken as 1.8 times T, as determined in Item 3, above.

5. The axial capacities of pile/shafts are to be determined using an ultimate skin friction of 1 ksf and an ultimate bearing capacity of 25 ksf.

7.3.2 *Foundations for Buildings Founded on Improved Ground*

For those buildings located on improved ground in accordance with Section 7.1.1:

- We recommend that buildings be supported on a combination of continuous strip footings, spread or pad footings, and grade beams.

- We recommend that the foundation elements be designed for an allowable bearing pressure of 2,000 psf or less. The allowable bearing pressure may be increased by one-third for seismic and/or wind loads. We estimate that for foundations designed to these bearing pressures, total settlements due to building loads will be less than 1 inch, and differential settlements will be less than or equal to 1/2 inch.

- We recommend that foundation elements have a minimum embedment depth of 24 inches.

- Foundations shall be designed in accordance with Chapter 18 of the CBC, and shall specifically address the requirements of seismic ties for footings as presented in Section 1809.13 of the CBC.

To provide resistance for design lateral loads, we recommend that an allowable friction coefficient of 0.45 be used between the concrete mat foundation and the underlying recompacted sandy subgrade soils. If, for some reason, additional lateral resistance is required, interior shear keys can be added when located a minimum of three times the depth of the shear key in from the perimeter edge of the mat foundation. Passive pressures, if used, should be limited to an equivalent fluid pressure of 300 pcf.

7.4 Mat Foundation Recommendations

7.4.1 *Static Design*

We recommend that all mat foundations be designed by a registered civil or structural engineer experienced in mat foundation design. We recommend a subgrade modulus of 100 pci that has been adjusted for foundation size. We recommend that maximum allowable contact stresses be limited to 2,000 psf. This value should not be increased for any transient loads, including seismic and wind loads. The settlement associated with a bearing pressure of 2,000 psf is 0.5 inch. The estimated settlement of the mat foundation may be pro-rated as a function of bearing pressure. Differential settlements of mat foundations are a function of mat loading and relative mat stiffness. We recommend that the mat be designed to limit the differential settlements to 0.25 times the total settlement, or less.

To provide resistance for design lateral loads, we recommend that an allowable friction coefficient of 0.45 be used between the concrete mat foundation and the underlying recompacted sandy subgrade soils. If, for some reason, additional lateral resistance is required, interior shear keys can be added when located a minimum of three times the depth of the shear key in from the perimeter edge of the mat foundation. Passive pressures, if used, should be limited to an equivalent fluid pressure of 300 pcf.

7.4.2 *Seismic Design Assuming Liquefaction and Lateral Spreading*

The design approach presented below for mat foundations is to:

1. Design the mat foundation to span areas beneath the slab that can lose bearing support due to differential settlements associated with lateral spreading and liquefaction;

2. Design deepened footings within the mat foundation systems to resist passive pressures on the footing sides generated potentially by the lateral displacement of the ground due to lateral spreading;

3. Design the mat foundation to resist forces exerted on the mat foundations assuming sliding of the mat foundation due to lateral displacement of the ground associated with lateral spreading;

4. Design the mat foundation system so that it can undergo rigid-body-like rotations associated with one end of the mat moving or rotating downward relative to the other end of the mat; and

5. Design the mat foundation system stiffness to limit differential settlements within the mat after adjustments for rigid-body-like rotations that can be transmitted into the building superstructure that limit angular distortions into the building superstructure so as to maintain life and safety concerns.

To this end, we provide the following:

1. We recommend that the buildings be founded on a structural mat foundation designed to support the structure in question and span over areas where potential ground loss may occur, namely under and around the buildings. We anticipate that portions of the mat foundation may become unsupported. To estimate the loss of support, we recommend that the lateral distance subject to loss of support be determined as follows:

   - For building footprint dimensions less than 30 feet, the lateral distance subject to loss of support should be taken as one-third (0.33 times) the dimension of the building; and

   - For building footprint dimensions greater than 30 feet, the lateral distance subject to loss of support should be taken as one-quarter (0.25 times) the dimension of the building, with the following restrictions: the minimum is 7.5 feet and the maximum is 15 feet.

2. To accommodate potential lateral movement of the structure, we recommend that:

   - Footings that extend below grade be designed to resist lateral earth passive pressures equal to 500 pcf.

   - For interior footings, the effective depth of the footing is to be taken as the difference between the actual footing embedment and the projected depth of embedment of the adjacent footing below the intersection of the height of the footing in question, projected back along a 2:1 (horizontal to vertical) plane. For example, assuming two footings are spaced 3 feet apart and both are embedded to a depth of 2 feet, the effective embedment of the footing in question would be equal to 2 feet (its embedment) minus 0.5 foot, or an effective height of 1.5 feet. The 0.5-foot height was determined by first computing the projected height of the footing in question onto the adjacent footing, and then subtracting the footing height from this projected height. If the resulting number is negative, the adjacent footing does not interfere with the footing in question. Therefore, the projected height of the footing is 1.5 feet (3 feet divided by 2). The height of the adjacent footing is 2 feet. Hence, the height of the adjacent footing interfering with the footing in question is 0.5 foot, or 2 feet minus 1.5 feet. Therefore, the effective height of the footing in question is 2 feet minus 0.5 foot.

   - Footings and slabs designed to resist potential sliding of the structure must be designed to resist a lateral load that is equal to the weight of the structure. In other words, the axial capacity or longitudinal capacity of the slabs-on-ground or footings are to be designed to accommodate a horizontal force taken to be equivalent to the weight of the structure.

3. In addition, we recommend that the foundation system be designed to accommodate the foundation gradients across the mat, which can approach the magnitude of total seismic settlements that are estimated to be on average approximately 9 inches and expected to range from 4 to 18 inches;

4. We recommend that the stiffness of the mat foundation be sufficient to limit angular distortions transmitted into the superstructure of the building to levels deemed safe for the structure as it pertains to life and safety concerns of the occupants; and

5. Lastly, we recommend that utility connections into the buildings, including but not limited to water, electric and gas, be designed to accommodate lateral displacements on the order of several feet. Such accommodations may include, but are not limited to, flexible connections and automatic shut-off valves.

7.5 Seismic Design Parameters per CBC

The CBC states that a site-specific seismic response analysis be performed for any site that is considered liquefiable. However, based on ASCE Standard ASCE/SEI 7-05, if the proposed structures have a fundamental period of vibration equal to or less than 0.5 second, site-specific analysis is not required and response spectra can be determined using the equivalent site class for non-liquefiable soil. As such, we have treated the site as a non-liquefiable site having Site Class D.

For structures that are to be designed for earthquake loads per Section 1613 and 1613A of the 2013 CBC, we have provided the following recommended site coefficients for proposed improvements that have a fundamental period of vibration equal to or less than 0.5 second (approximate location: 32.7222 degrees latitude, -117.210 degrees longitude).

CBC Seismic Design Parameters	
F_A	1.018
F_V	1.539
S_S	1.205
S_1	0.461
S_{MS}	1.226
S_{M1}	0.709
S_{DS}	0.818
S_{D1}	0.473

7.6 Concrete Flatwork and Walkways

We recommend that areas to receive concrete flatwork and walkways be prepared in general accordance with Section 301-1 of the Standard Specifications for Public Works Construction. We recommend that subgrade soils be scarified to a minimum depth of 6 inches, and compacted to a minimum relative compaction of 95 percent. Additional subgrade preparation may be necessary in those areas where flatwork and walkways may be subject to vehicle loading and should be evaluated on a case-by-case basis.

7.7 Soil Corrosivity

The results of corrosivity testing of the near-surface soils indicate a soil pH of 7.0 and 40 years to perforation for a 16-gauge metal culvert. Test results are included in Appendix B.

7.8 Excavations

We recommend that all trenching operations for the proposed pipeline comply with OSHA and CALOSHA requirements. As such, trench excavations for the pipeline will generally need to be either shored or sloped back. Trench shields may be used in lieu of shoring or sloping the excavations, provided CALOSHA and OSHA regulations are followed.

For preliminary design and cost estimating purposes, we anticipate that the majority of the excavations will be within OSHA Type C soils. We recommend that excavation conditions be verified in the field, and that modifications be made to any trench excavation support systems, as needed, based upon the actual exposed conditions in the field. We recommend that the designated “competent person” determine the need for, and method for, trench stabilization as stated in the OSHA and CALOSHA requirements.

For shoring systems that are cantilevered, we recommend that shoring systems be designed for an equivalent lateral earth pressure of 40 pcf, with area surcharge loads included at 0.33 times the surface pressure. A minimum surcharge surface load of 260 psf should be used for an additional uniform lateral pressure of 86 psf. If heavy equipment is to be used near and adjacent to the trench, additional surcharge loads need to be considered in the design of the shoring system. Heavy construction equipment and materials should be kept away from the trench excavation. We recommend that such loads be kept a minimum distance of two times the depth of the excavation.

We recommend that shoring systems that are internally restrained be designed for a uniform lateral earth pressure of 30H psf, where H is the depth of the excavation in feet. Area surcharge loads shall be included in the design of the shoring and shall be 0.5 times the surface pressure. A minimum surcharge surface load of 260 psf should be used for an additional uniform lateral pressure of 120 psf. If heavy equipment is to be used near and adjacent to the trench, additional surcharge loads need to be considered in the design of the shoring system. Heavy construction equipment and materials should be kept away from the trench excavation. We recommend that such loads be kept a minimum distance of two times the depth of the excavation.

7.8.1 *Pavements*

As no information concerning frequency of traffic loading was provided, we have provided the following pavement for a conventional asphalt concrete section over a crushed aggregate base section on the basis of a typical Caltrans Traffic Index of 5. If anticipated traffic conditions or patterns include frequent heavy trucks, such as trash trucks, additional recommendations may be needed.

We recommend 3 inches of asphalt concrete overlying 4 inches of compacted crushed aggregate base material having a minimum R-value of 79 or CBR of 80. In addition, we recommend that the subgrade soils be compacted to a relative compaction of 95 percent of the maximum dry density, as determined by ASTM D 1557. The crushed aggregate base is to be compacted to a minimum relative compaction of 95 percent of its maximum dry density, as determined by ASTM D 1557. Subgrade soils should not be pumping when pavement is placed.

8 **LIMITATIONS**

Coastal and geotechnical engineering, as well as the other earth sciences, are characterized by uncertainty. Professional judgments presented herein are based partly on our evaluation of the technical information gathered, partly on our understanding of the proposed construction, and partly on our general experience. Our engineering work and judgments rendered meet the current professional standards. We do not guarantee the performance of the project in any respect.

We have investigated only a small portion of the pertinent soil and geologic conditions at the subject site. The opinions and conclusions made herein were based on the assumption that the soil and geologic conditions do not deviate appreciably from those encountered during our field investigation. We recommend that a soil engineer from our office observe construction to assist in identifying soil conditions that may be significantly different from those assumed in our design. Additional recommendations may be required at that time.

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TABLE 1
SUMMARY OF GROUND MODIFICATION TECHNIQUES

Method	Means of Ground Modification(1)				Applicable Soils(2)		
	Densification	Soil Reinforcement	Soil Modification	Pore Pressure Dissipation	Sands	Sands with Significant Fines	Fines
Deep Dynamic Compaction	X				X		
Vibro-Compaction	X				X		
Vibro-Replacement with stone columns	X	X			X		X(3)
Deep Soil Mixing		X	X		X	X	X
Compaction Grouting	X	X			X		X
Jet Grouting		X			X	X	X
Vibro-Compaction with stone columns and wick drains	X	X		X	X	X	
Wick and gravel drains				X	X		
Chemical grout injection			X		X		

NOTES:

(1) The “means of ground modification” depends upon the properties of the soil being modified. Densification pertains to physically changing the density of the soil, and thereby increasing its strength and reducing its liquefaction potential. Soil reinforcement pertains to adding structural element to the soil mass, thereby strengthening the soil and, as such, augmenting the liquefaction resistance of the soil. Oftentimes, soil reinforcement is achieved by inserting a cement or soil-cement column within the soil mass. It is these elements that provide resistance to seismic loading. Soil modification pertains to changing the soil composition, and thereby transforming the soil into a new soil. In deep soil-mixing, a soil-cement composite is created by blending and mixing cement into the soil. In chemical grout injection, a cement is injected into the pore space of the soil to create a cement-soil composite.

(2) The applicability of soil refers to the type of soils that are considered suitable for a particular ground improvement technique. Sands have high permeabilities and, as such, are easy to compact and densify by vibration and other means. Sands with significant fines have lower permeabilities and, as such, are not easy to densify by compactive means. As such, if densification is desired, the drainage of the silty sand soil needs to be improved. One common means for this is through the use of wick drains. As such, the amount of fines and types of fines will have a significant impact on the type of ground modification that will be effective. In fine-grained soils, the only viable ground modification treatment is likely to be reinforcement.

(3) Stone columns may be applicable in fine soils if the concern is the improvement of the vertical support-carrying capacity of the soil. Its applicability is generally limited to vertical support in fine-grained soils.

TABLE 2
SUMMARY OF FOUNDATION ALTERNATIVES TO MITIGATE LIQUEFACTION, LATERAL SPREADING, AND SEISMIC-INDUCED GROUND INSTABILITY

Method	Description of Mitigation Strategy	Applicable Ground Movement		
		Ground Settlement	Limited Lateral Ground Displacement	Ground Failure and Instability
Mat Foundations	Create a rigid foundation to reduce transferring differential ground movements into the superstructure of the building(1)	X	X	
Driven Piles	Isolate building from ground movement(2)	X	X	X
CIDH Shafts	Isolate building from ground movement(3)	X	X	X

Notes:

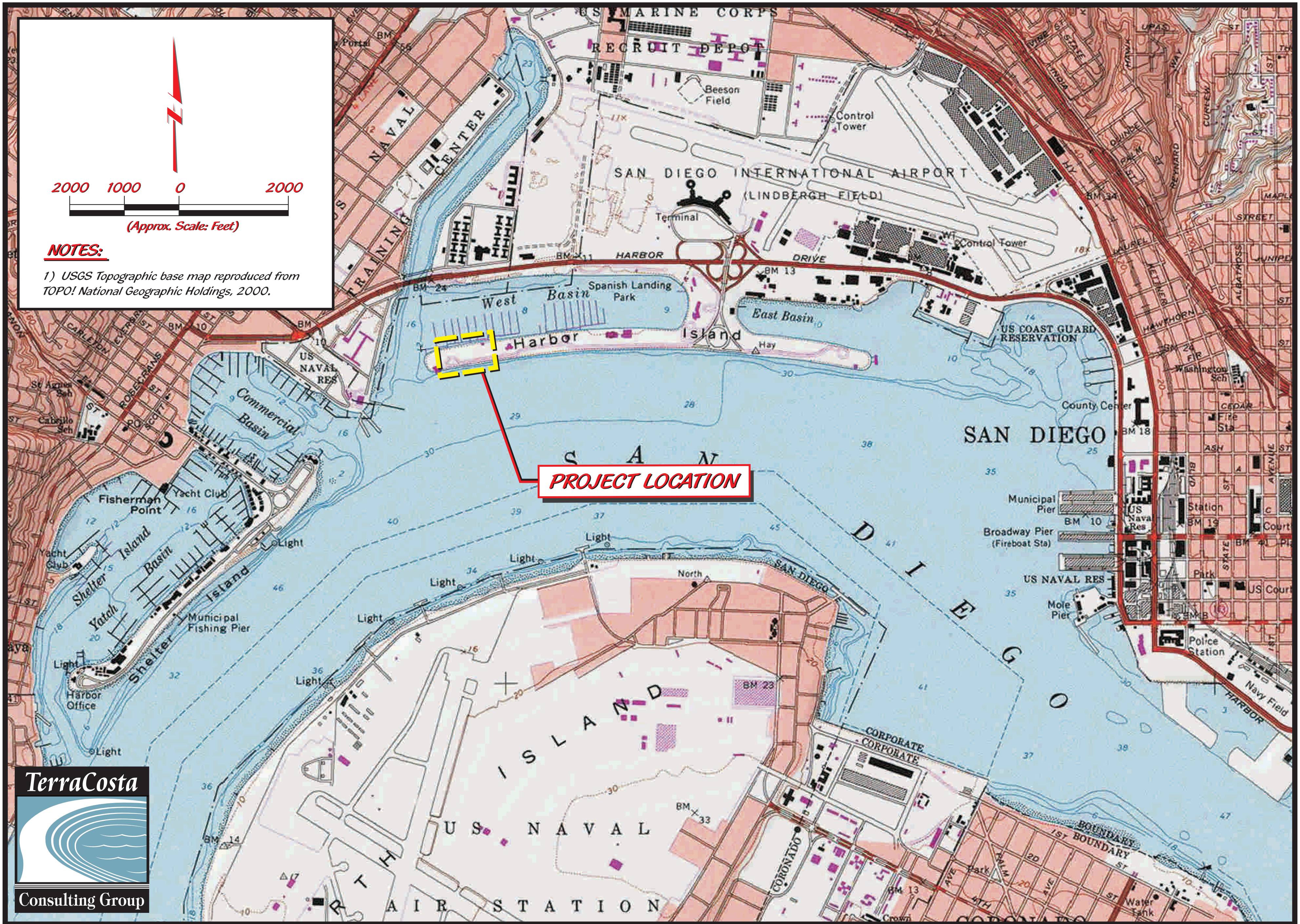
(1) The use of a mat foundation is intended to provide a rigid foundation system that will mitigate the transferring of differential ground movements into the superstructure of the building. As such, the mat will need to be designed to be stiff enough to limit distortion into the structure. It is important to note that buildings founded on mat foundations will undergo rigid body movements and, as such, the functional capacity of a building may be impaired after an earthquake due to significant tilt of the rigid structure due to differential ground settlement. As such, repairs will likely be needed to restore the building to service. The goal of this approach is to prevent structural collapse. As such, this method is applicable when ground movements are such that the movement of the building and mat is acceptable. This system may not be applicable for extreme lateral ground movements and areas where ground instability is anticipated. Lastly, besides designing the mat to accommodate differential settlements, the mat foundation may need to be designed to hold together when the mat moves, as well as when portions of the mat become unsupported due to ground movements.

(2) The strategy for using driven piles is to isolate the building from the ground movements. As such, the pile foundation will likely need to be held together through the use of grade beams, with the first story of the building consisting of a structural floor founded on the grade beams. In addition, given the types of ground movement anticipated, lateral soil loads applied as the result of lateral spreading and ground failure will need to be accommodated. As such, additional piles will likely be required to accommodate the imposed lateral loads. With driven piles, assuming the soils are predominantly sandy, one benefit is the possibility of using closely spaced piles to densify the soils. This densification may have the added benefit of reducing the liquefaction potential of the soils. Any pile foundation system will also need to be designed for down-drag loads due to seismically induced ground settlements.

(3) The strategy for using CIDH shafts is similar to that for driven piles, with the possible exception of the potential benefit of soil densification.

TABLE 3
SUMMARY OF APPLICABLE SEISMIC-INDUCED GROUND MITIGATION METHODS FOR HARBOR ISLAND WEST MARINA LAND IMPROVEMENTS

Method	Type of Mitigation	Applicable	Not Applicable
Deep Dynamic Compaction	Ground Improvement		X
Vibro-Compaction	Ground Improvement		X
Vibro-Replacement with Stone Columns	Ground Improvement		X
Deep Soil Mixing	Ground Improvement	X	
Compaction Grouting	Ground Improvement		X
Jet Grouting	Ground Improvement	X	
Vibro-Compaction with Stone Columns and Wick Drains	Ground Improvement	X	
Wick and Gravel Drains	Ground Improvement		X
Chemical Grout Injection	Ground Improvement		X
Mat Foundations	Structural	X	
Driven Piles	Structural	X	
CIDH Shafts	Structural	X	



NOTES:

1) USGS Topographic base map reproduced from TOPO! National Geographic Holdings, 2000.

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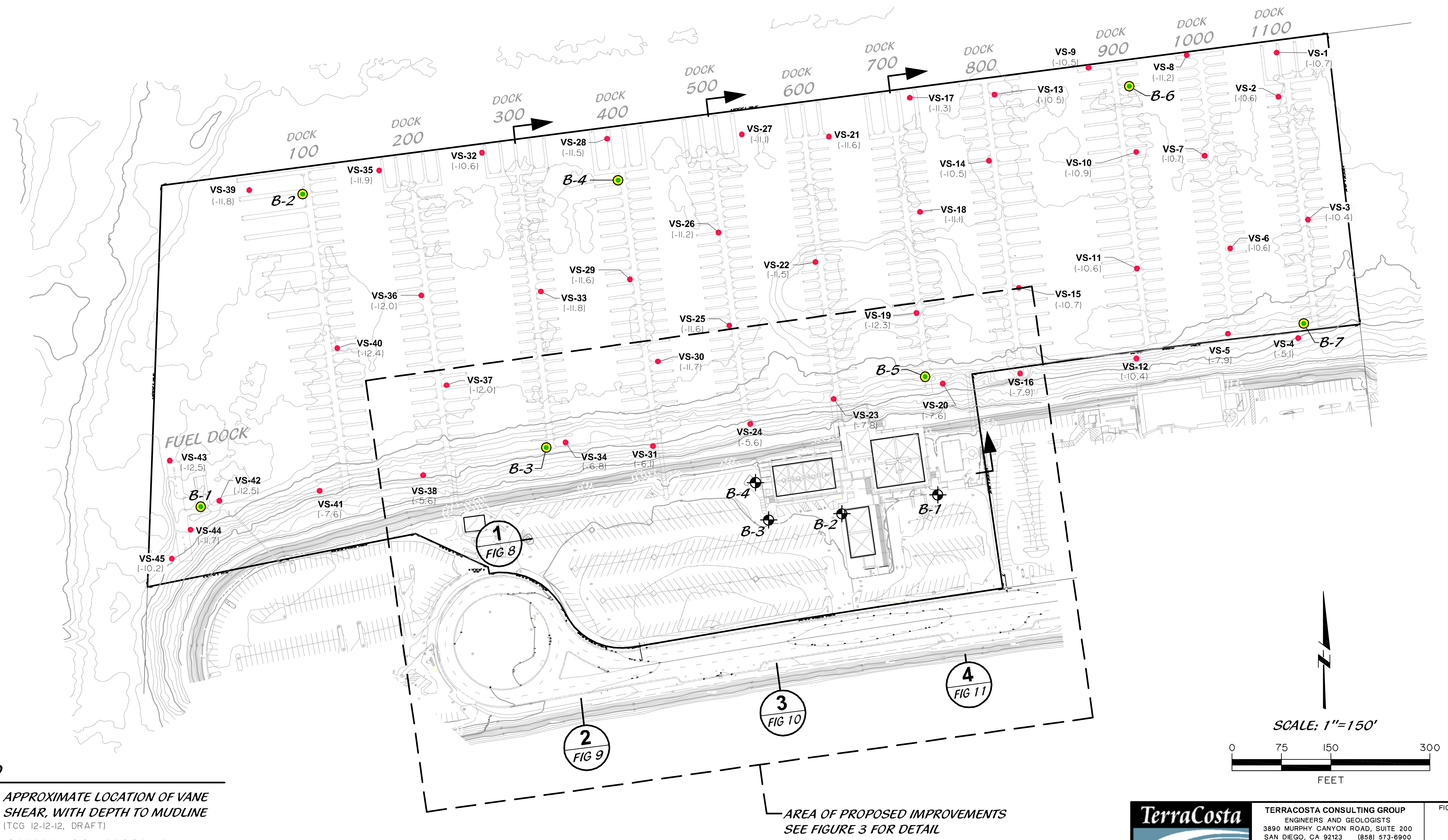
Project: Harbor Island West Marina *Project No. 2769A* *Figure 1*



LEGEND

● VS-45 (-10.2)	APPROXIMATE LOCATION OF VANE SHEAR, WITH DEPTH TO MUDLINE (TCG 12-12-12, DRAFT)
◉ B-7	APPROXIMATE LOCATION OF WATERSIDE BORING (TCG 12-12-12, DRAFT)
⊕ B-4	APPROXIMATE LOCATION OF LANDSIDE BORING

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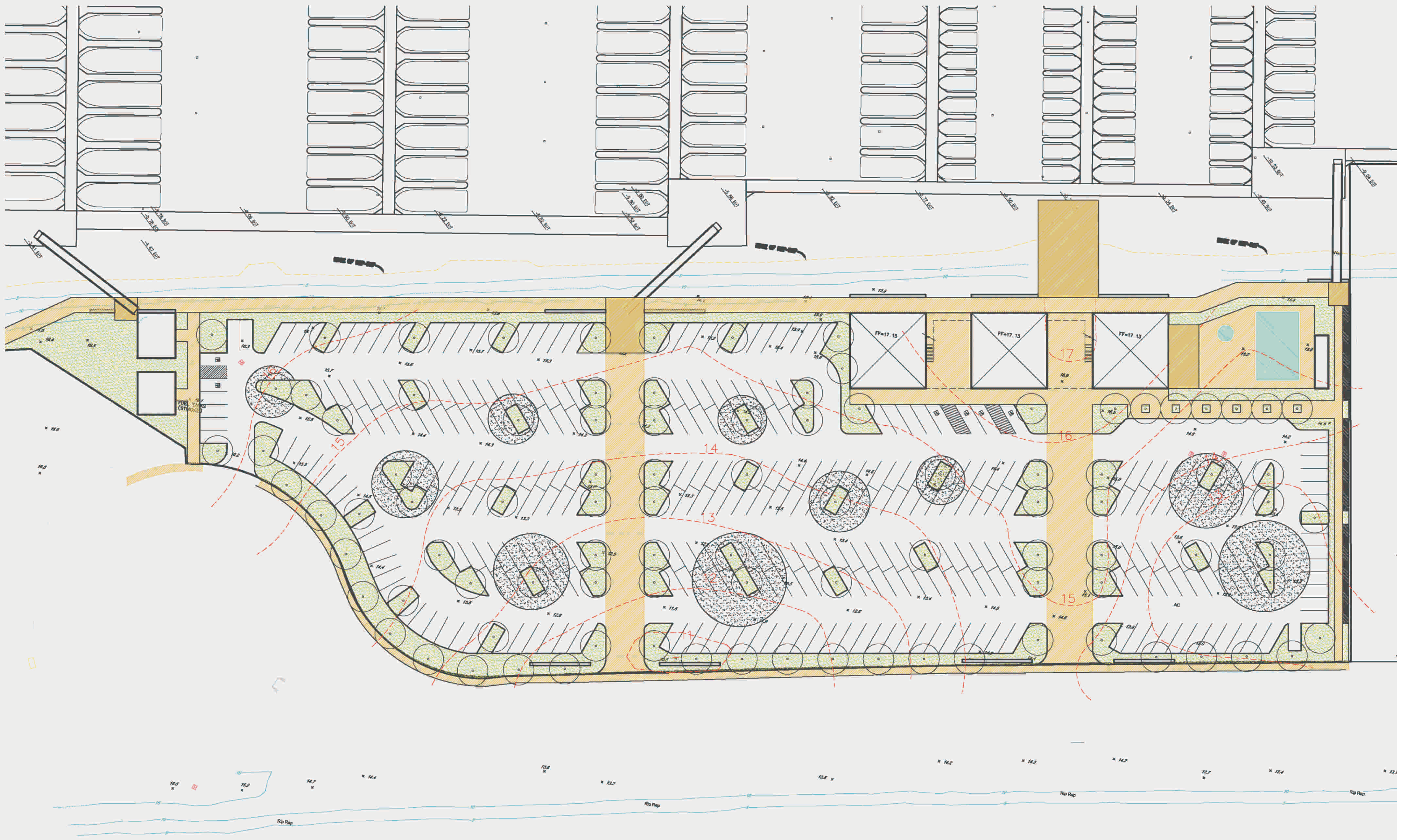
FIGURE NUMBER
2

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

SITE PLAN / BORING LOCATION MAP



LEGEND				
	EXISTING PARKING STALLS:	335 (6 HC)	STALLS 18'X8.5'	AISLES 18'-29' WIDE
	PROPOSED PARKING STALLS:	331 (6 HC)	STALLS 18'X8.5'	AISLES 18' WIDE

Harbor Island West Marina

San Diego • Beauchamp Realty, Inc • 15 August, 2012

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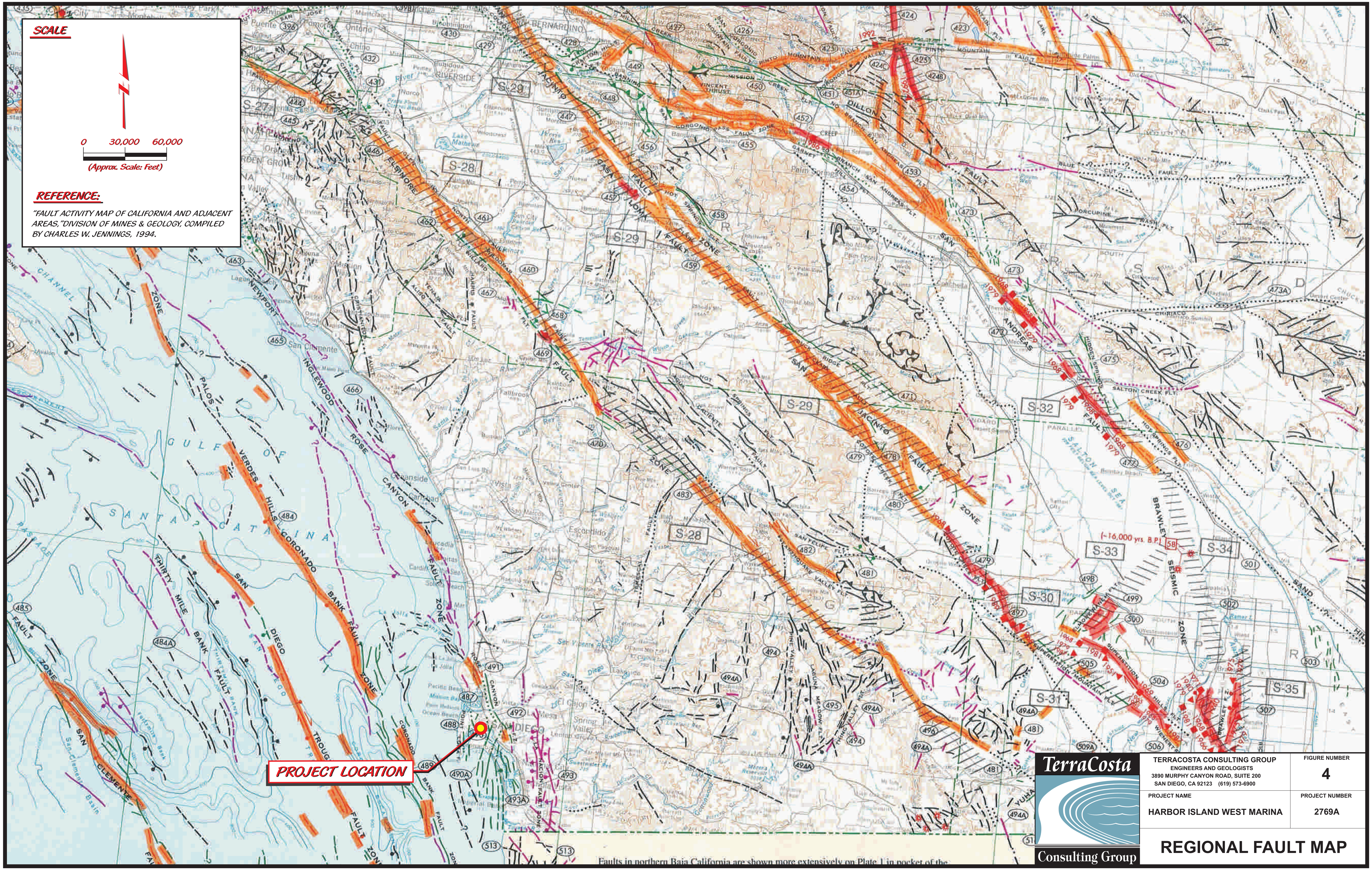
FIGURE NUMBER
3

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

PROPOSED SITE IMPROVEMENTS



REFERENCE:

"FAULT ACTIVITY MAP OF CALIFORNIA AND ADJACENT AREAS," DIVISION OF MINES & GEOLOGY, COMPILED BY CHARLES W. JENNINGS, 1994.

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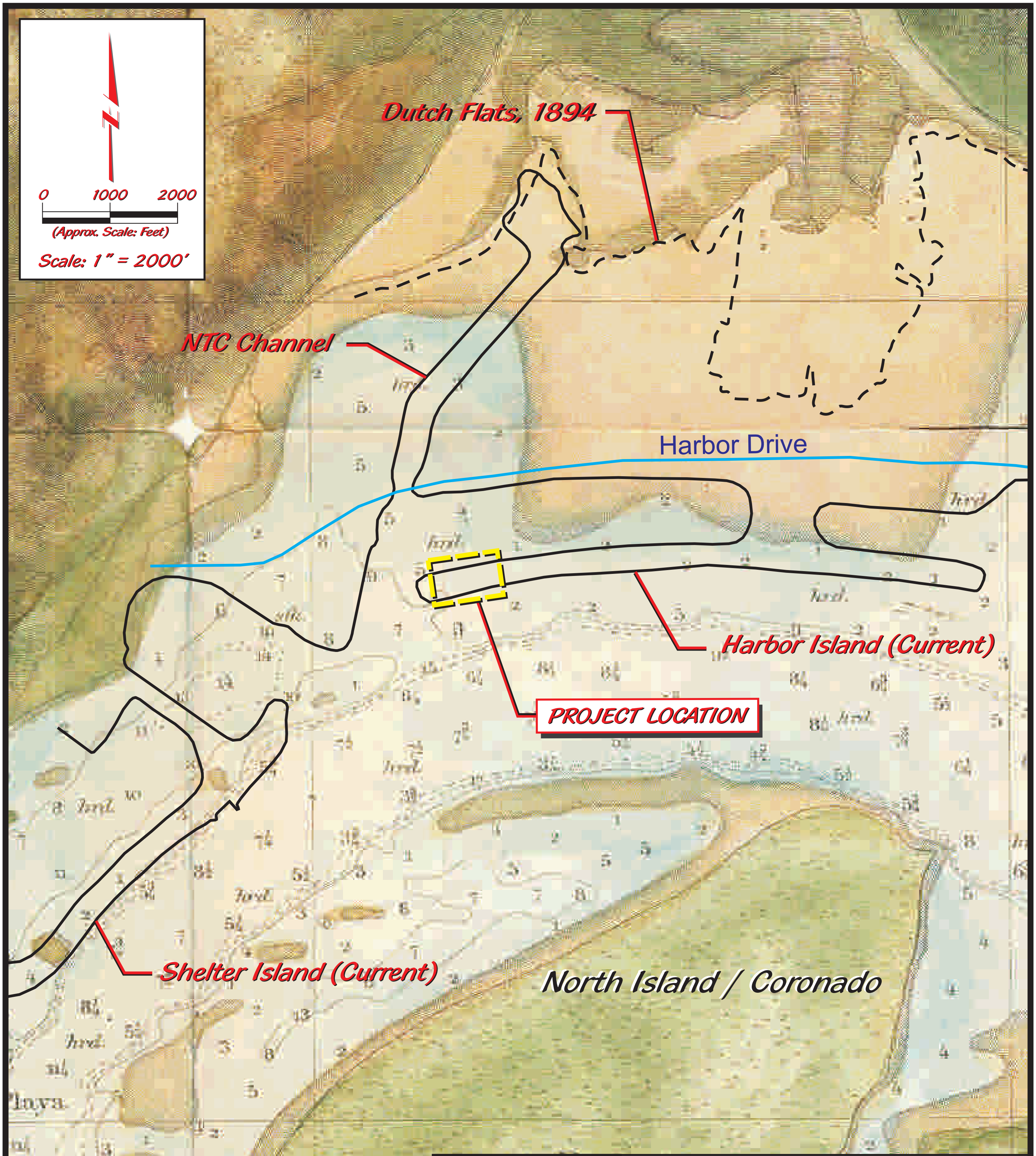
FIGURE NUMBER
4

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

REGIONAL FAULT MAP



This chart was prepared under the supervision of A. D. Bache for inclusion in the 1857 edition of the *Report of the Superintendent of the United States Coast Survey*. The triangulation for this chart was accomplished by R. D. Cutts, the topography by A. M. Harrison, and the hydrology by a party under the command of James Alden.

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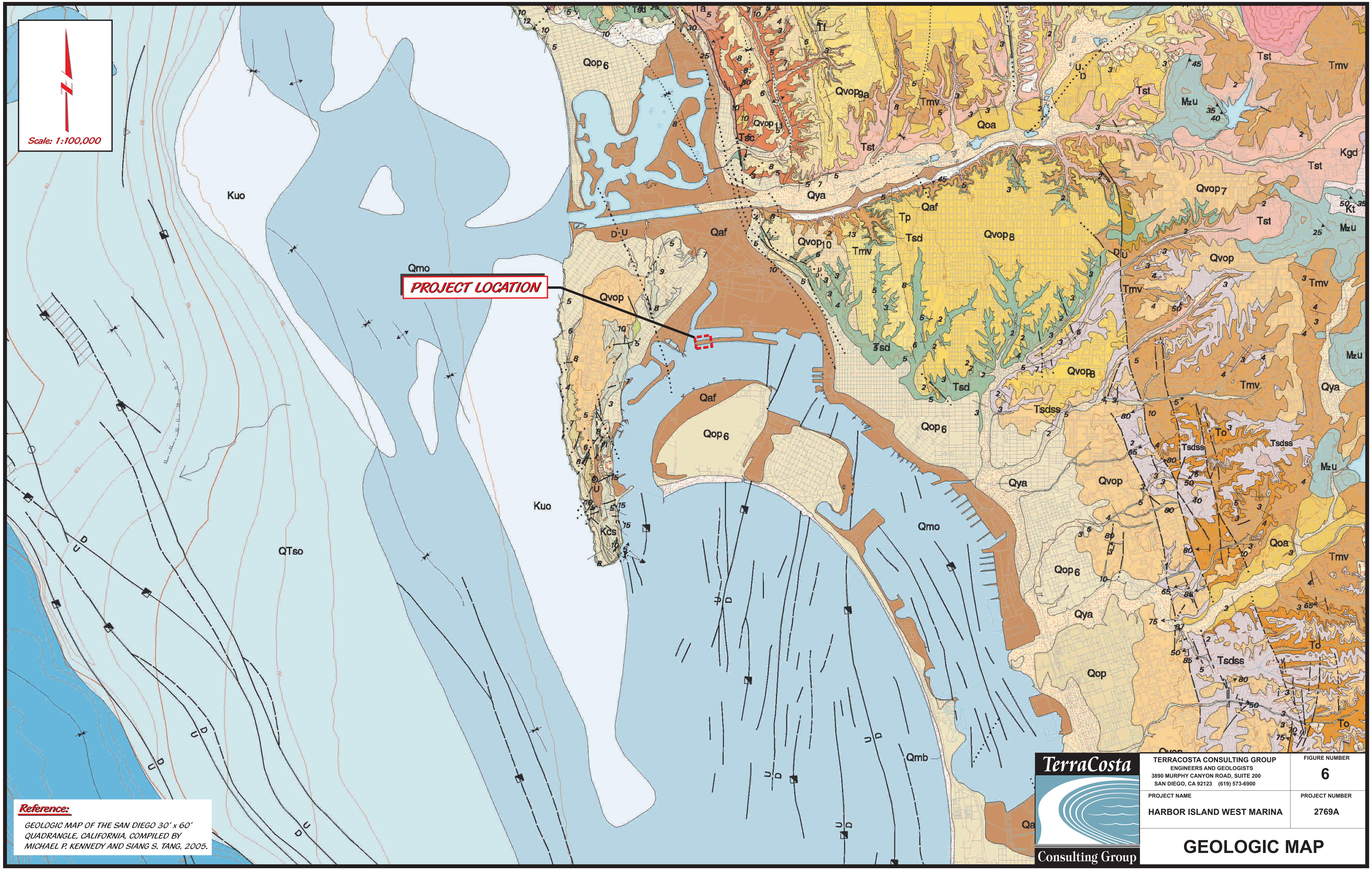
FIGURE NUMBER	5
PROJECT NAME	PROJECT NUMBER
HARBOR ISLAND WEST MARINA	2769A

SAN DIEGO BAY, 1857



Reference:
GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA, COMPILED BY MICHAEL P. KENNEDY AND SIANG S. TANG, 2005.

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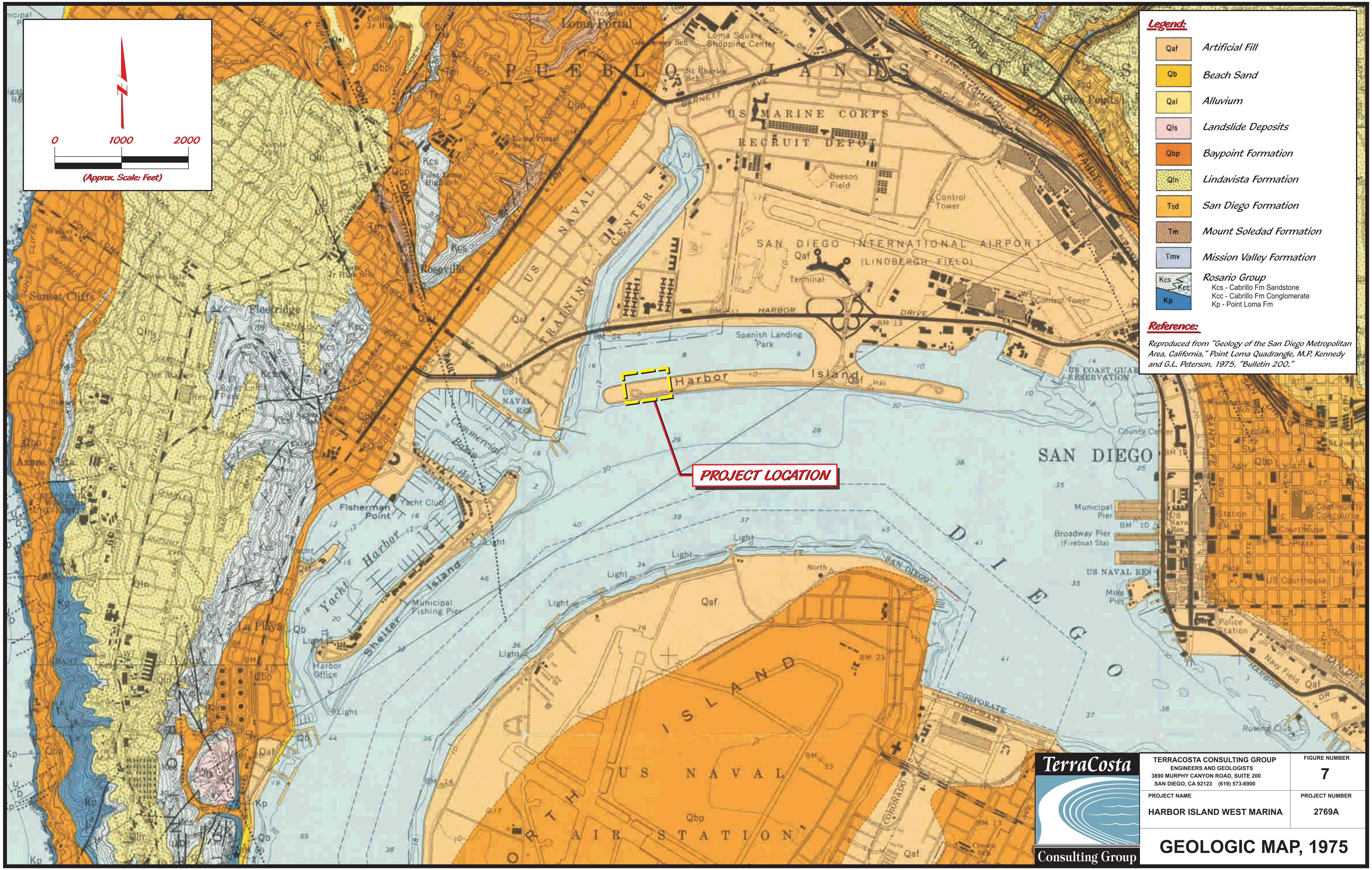
FIGURE NUMBER
6

PROJECT NAME	PROJECT NUMBER
HARBOR ISLAND WEST MARINA	2769A

GEOLOGIC MAP



Legend:

Qaf	Artificial Fill
Qb	Beach Sand
Qal	Alluvium
Qls	Landslide Deposits
Qbp	Baypoint Formation
Qln	Lindavista Formation
Tsd	San Diego Formation
Tm	Mount Soledad Formation
Tmv	Mission Valley Formation
Kcs Kcc Kp	*Rosario Group* Kcs - Cabrillo Fm Sandstone Kcc - Cabrillo Fm Conglomerate Kp - Point Loma Fm

Reference:

Reproduced from "Geology of the San Diego Metropolitan Area, California," Point Loma Quadrangle, M.P. Kennedy and G.L. Peterson, 1975, "Bulletin 200."

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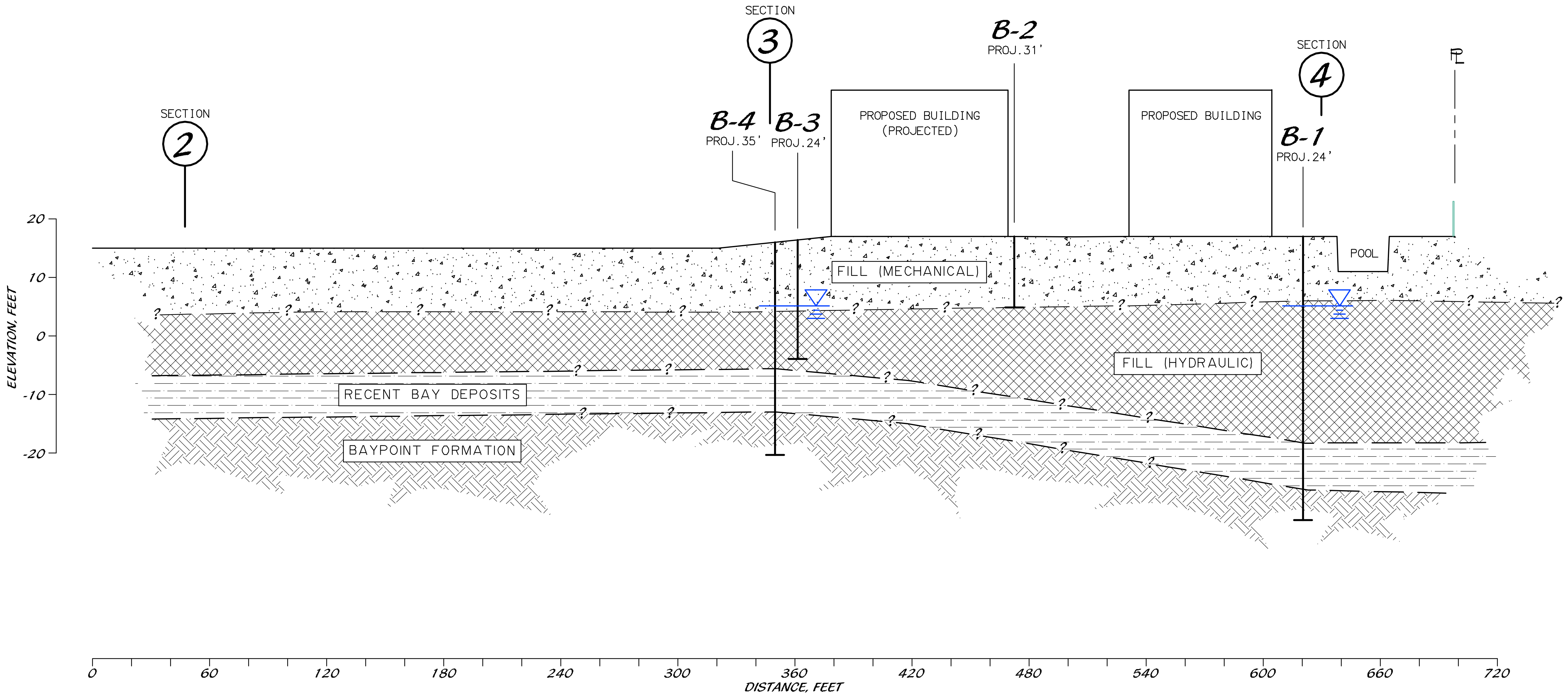
FIGURE NUMBER
7

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

GEOLOGIC MAP, 1975



CROSS SECTION 1
FIG 2

SCALE: 1"=60' (HORIZ.)
1"=20' (VERT.)

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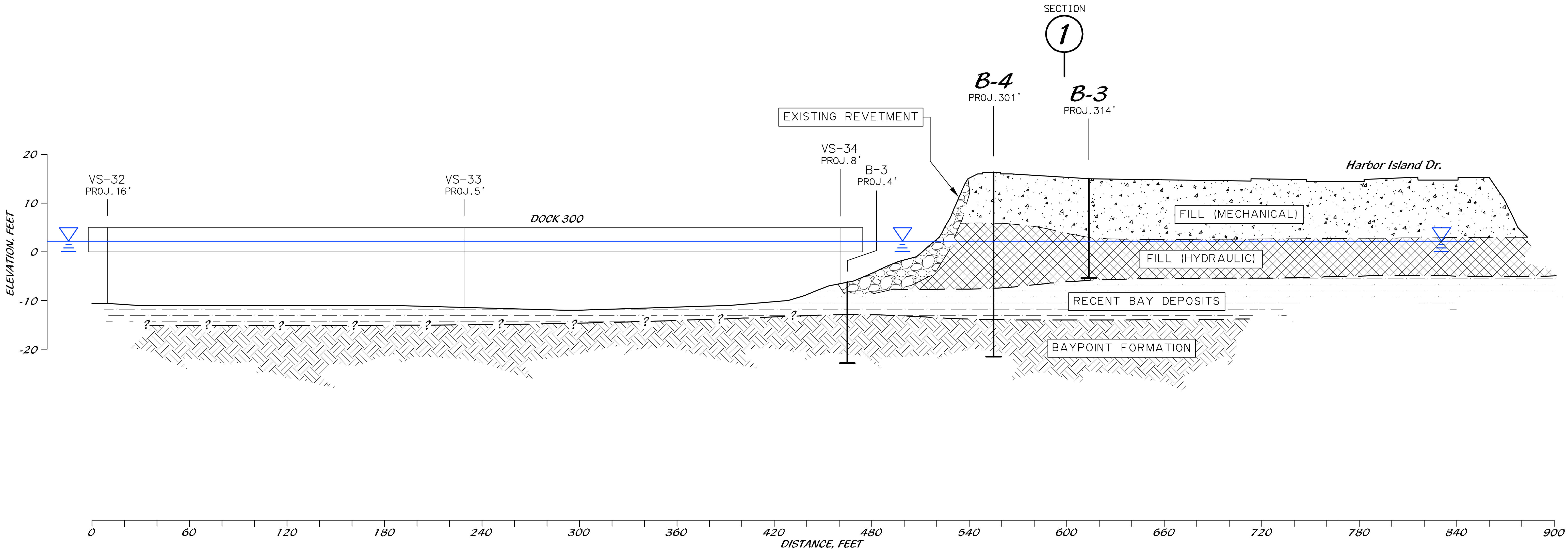
FIGURE NUMBER
8

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

GENERALIZED GEOLOGIC SECTION



CROSS SECTION 2
FIG 2

SCALE: 1"=60' (HORIZ.)
1"=20' (VERT.)

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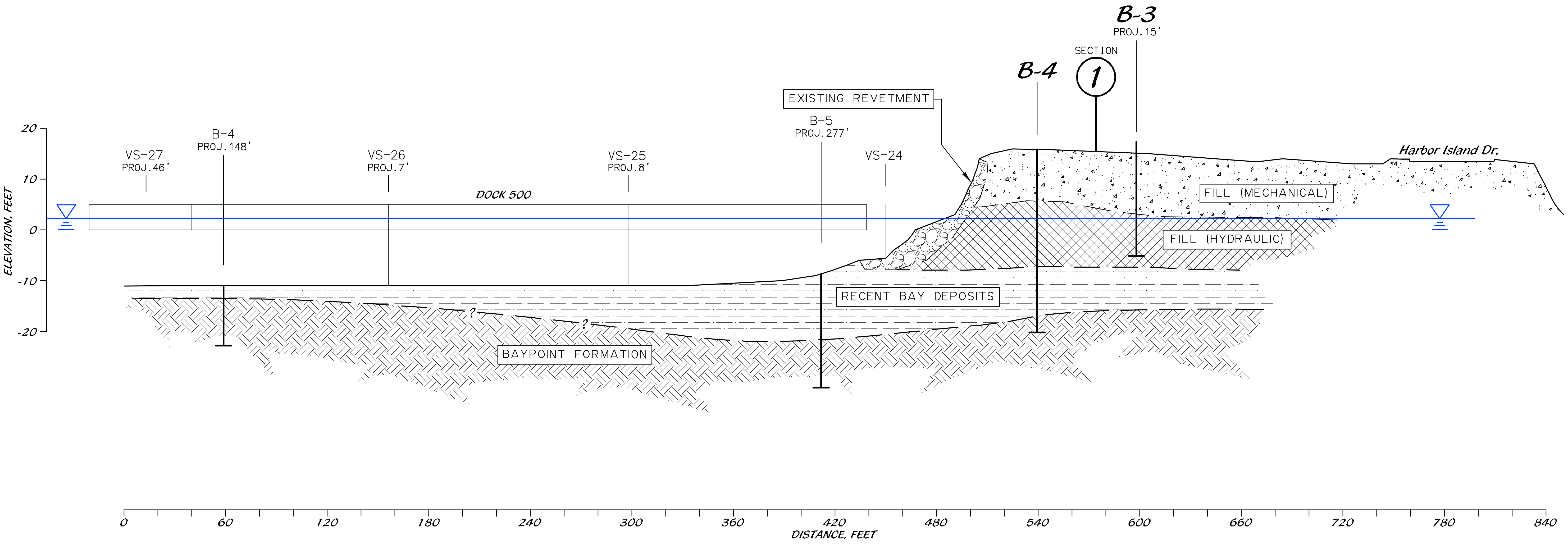
FIGURE NUMBER
9

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

GENERALIZED GEOLOGIC SECTION



CROSS SECTION 3
FIG 2

SCALE: 1"=60' (HORIZ.)
1"=20' (VERT.)

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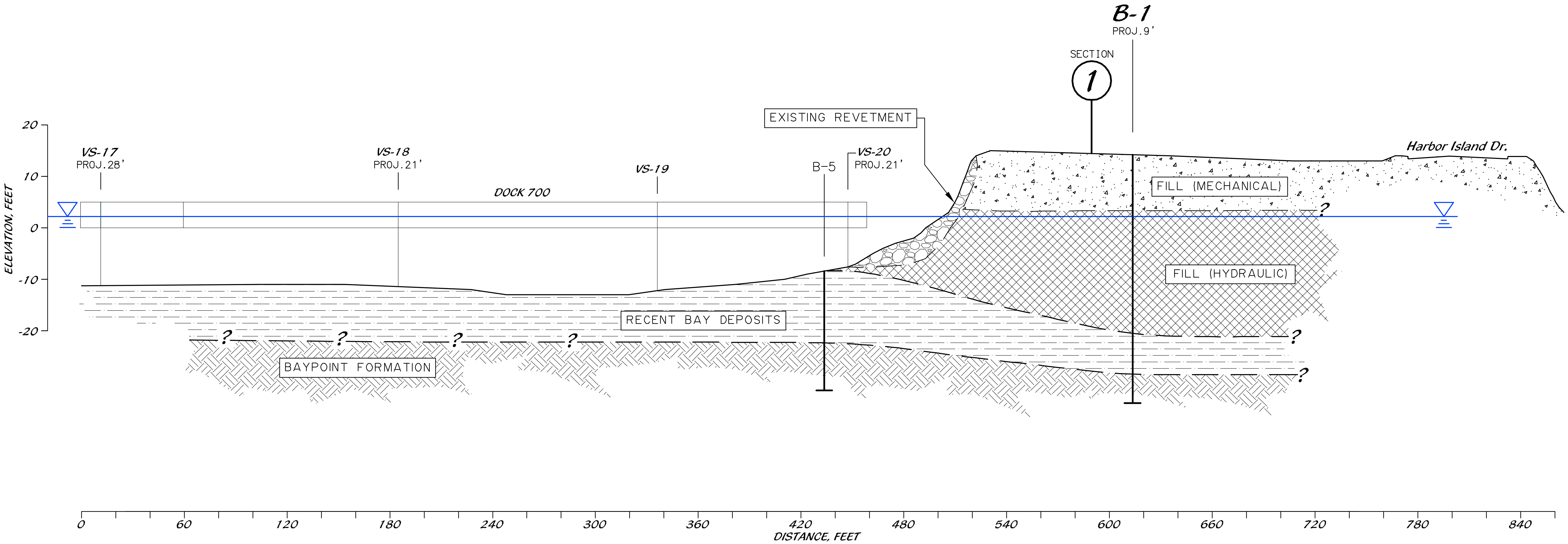
FIGURE NUMBER	10
PROJECT NAME	HARBOR ISLAND WEST MARINA
PROJECT NUMBER	2769A

GENERALIZED GEOLOGIC SECTION



CROSS SECTION 4

FIG 2

SCALE: 1"=60' (HORIZ.)
1"=20' (VERT.)

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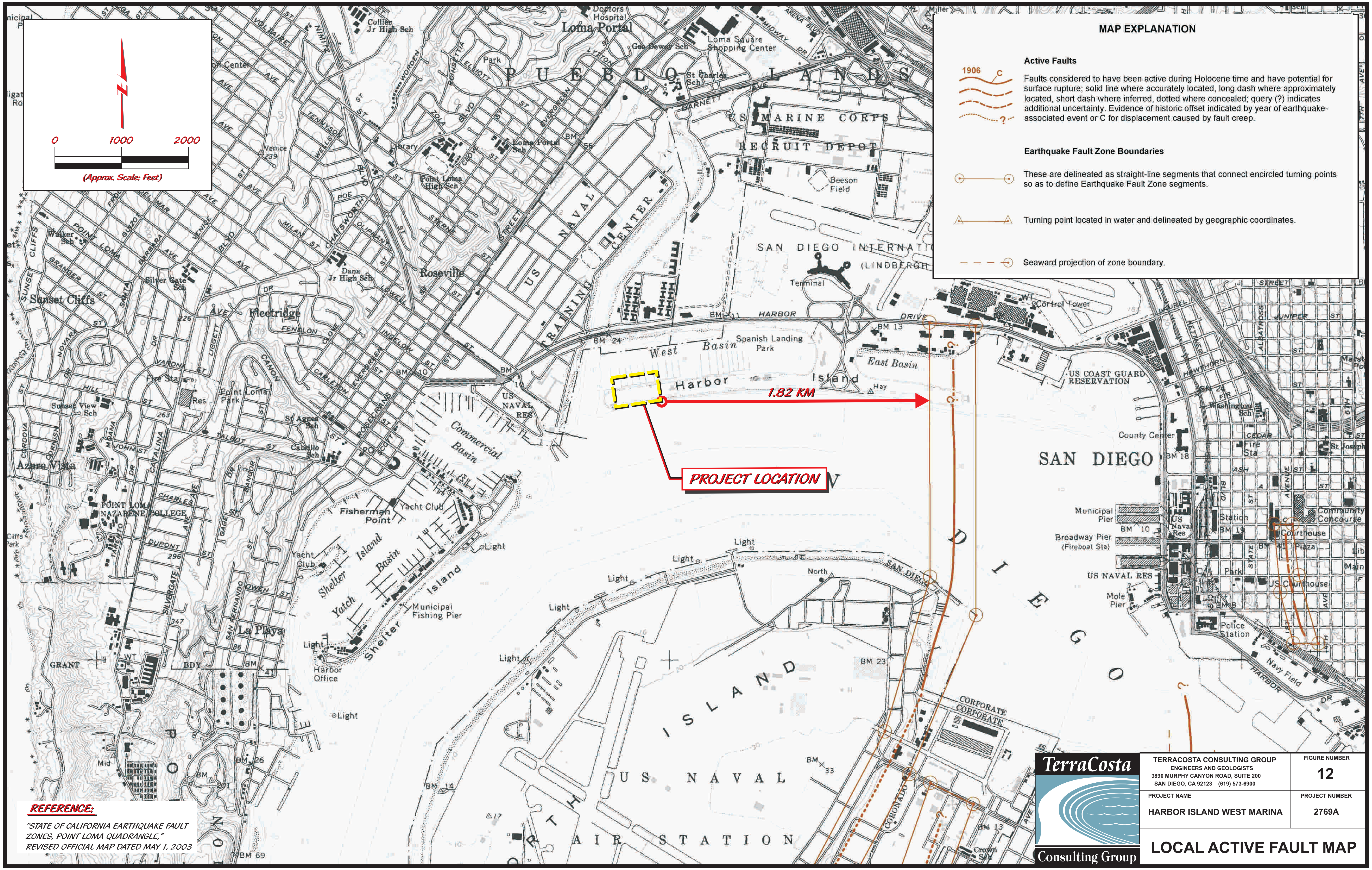
FIGURE NUMBER	**11**
PROJECT NAME **HARBOR ISLAND WEST MARINA**	PROJECT NUMBER **2769A**

GENERALIZED GEOLOGIC SECTION



MAP EXPLANATION

Active Faults

Faults considered to have been active during Holocene time and have potential for surface rupture; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

Earthquake Fault Zone Boundaries

These are delineated as straight-line segments that connect encircled turning points so as to define Earthquake Fault Zone segments.

Turning point located in water and delineated by geographic coordinates.

Seaward projection of zone boundary.

REFERENCE:

"STATE OF CALIFORNIA EARTHQUAKE FAULT ZONES, POINT LOMA QUADRANGLE," REVISED OFFICIAL MAP DATED MAY 1, 2003

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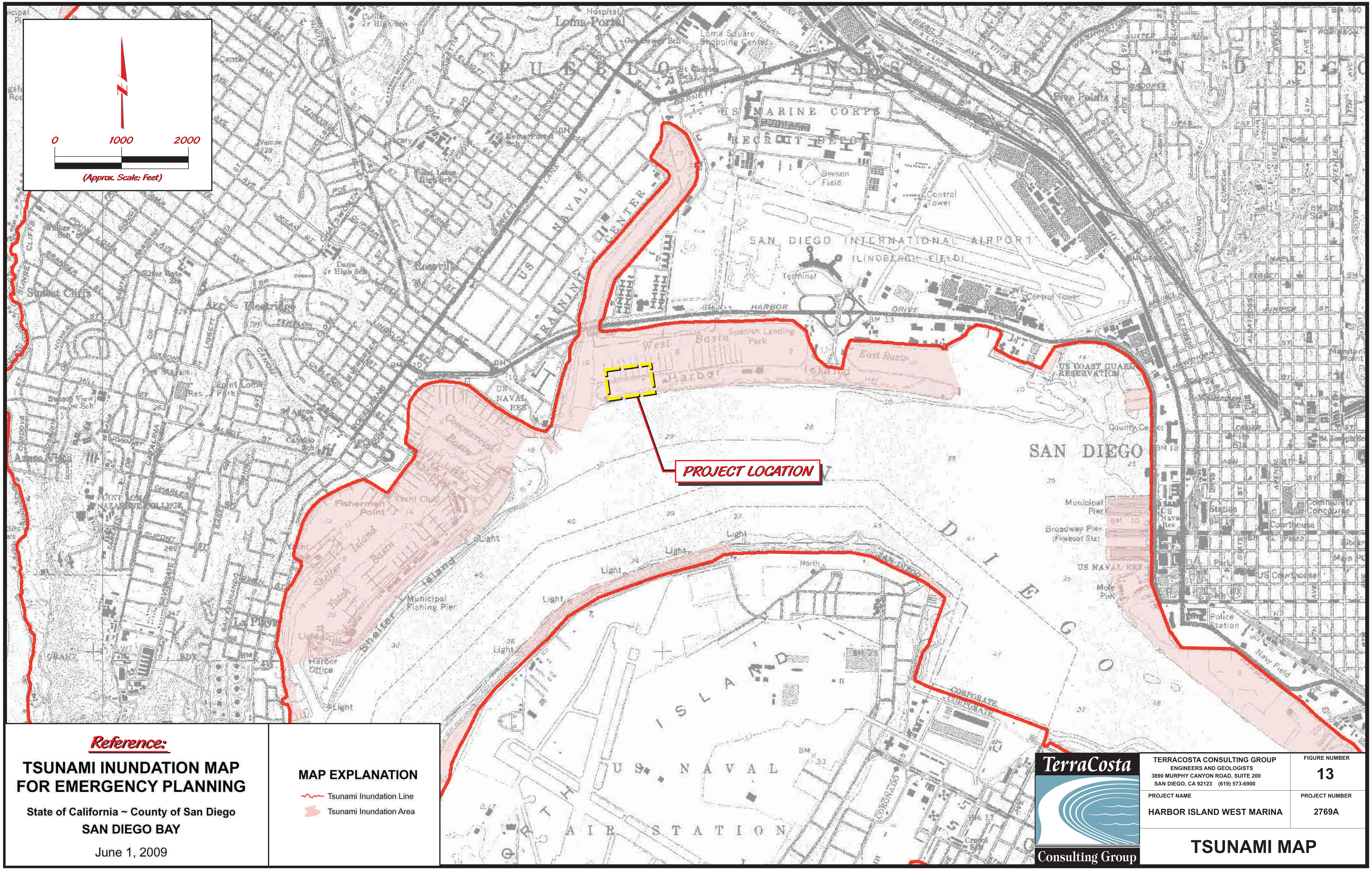
FIGURE NUMBER	PROJECT NAME	PROJECT NUMBER
12	HARBOR ISLAND WEST MARINA	2769A

LOCAL ACTIVE FAULT MAP



Reference:

TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

State of California ~ County of San Diego
SAN DIEGO BAY
June 1, 2009

MAP EXPLANATION

〰 Tsunami Inundation Line
▨ Tsunami Inundation Area

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FIGURE NUMBER
13

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769A

TSUNAMI MAP

APPENDIX A

LOGS OF EXCAVATIONS

LOG OF TEST BORING

PROJECT NAME: HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER: 2769A
BORING: **LEGEND**
SITE LOCATION: Harbor Island, San Diego
START: 12/4/2014
FINISH: 12/4/2014
SHEET NO.: 1 of 2
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: G. Spaulding
CHECKED BY:
DRILLING EQUIPMENT: Marl M5
BORING DIA. (in): 6
TOTAL DEPTH (ft): 40
GROUND ELEV (ft):
DEPTH/*ELEV.* GROUND WATER (ft): ▼ n/a
SAMPLING METHOD: SPT/Cal
NOTES:

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
5									
10									
		C	1						
		S	2						
		B	3						
15									

KEY TO EXCAVATION LOGS

▼ WATER TABLE MEASURED AT TIME OF DRILLING

OTHER TESTS

CC	Confined Compression	ppm	parts per million of VOCs*
CL	Chloride Content	R	Resistivity
CS	Consolidation	RV	R-Value
DS	Direct Shear	SA	Sieve Analysis
EI	Expansion Index	SE	Sand Equivalent
GS	Grain Size Analysis	SF	Sulfate
LC	Laboratory Compaction	SG	Specific Gravity
pH	Hydrogen Ion	SW	Swell
PI	Plasticity Index		

PENETRATION RESISTANCE (BLOWS/ft)

Number of blows required to advance the sampler 1 foot.

California Sampler blow counts can be converted to equivalent SPT blow counts by using an end-area conversion factor of 0.67 when using a 140-pound hammer and a 30-inch drop.

SAMPLE TYPE

C ("California Sampler") - An 18-inch-long, 2-1/2-inch I.D., 3-inch O.D., thick-walled sampler. The sampler is lined with eighteen 2-3/8-inch I.D. brass rings. Relatively undisturbed, intact soil samples are retained in the brass rings.

S ("SPT") - a.k.a. Standard Penetration Test, an 18-inch-long, 2-inch O.D., 1-3/8-inch I.D. drive sampler.

B ("Bulk") - a.k.a. Bulk Sack Sample, a disturbed, but representative sample obtained from a specific depth interval placed in a large plastic bag.

NOTES ON FIELD INVESTIGATION

Borings were advanced using a truck-mounted Marl M5 drill rig with a 6-inch hollow-stem auger.

(CONTINUED)

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FIGURE A-1 a

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE	**PROJECT NUMBER** 2769A	**BORING** **LEGEND**		
SITE LOCATION Harbor Island, San Diego	**START** 12/4/2014	**FINISH** 12/4/2014	**SHEET NO.** 2 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 6	**TOTAL DEPTH (ft)** 40	**GROUND ELEV (ft)**	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a
SAMPLING METHOD SPT/Cal	**NOTES**			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
25									
30									
35									

KEY TO EXCAVATION LOGS

(CONTINUED)

NOTES ON FIELD INVESTIGATION (Continued)

Standard Penetration Tests (SPT) and California Samplers were used to obtain soil samples. The SPT and California Samplers were driven into the soil at the bottom of the borings with a 140-pound hammer falling 30 inches. When the samplers were withdrawn from the boring, the samples were removed, visually classified, sealed in plastic containers, and taken to the laboratory for detailed inspection.

Free groundwater was encountered in the borings as shown on the logs.

Classifications are based upon the Unified Soil Classification System and include color, moisture, and consistency. Field descritpions have been modified to reflect results of laboratory inspection where deemed appropriate.

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FIGURE A-1 b

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE	**PROJECT NUMBER** 2769A	**BORING** **B-1**		
SITE LOCATION Harbor Island, San Diego	**START** 12/4/2014	**FINISH** 12/4/2014	**SHEET NO.** 1 of 3	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 6	**TOTAL DEPTH (ft)** 47.5	**GROUND ELEV (ft)** 14.5	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ 12.5 / *2.0*
SAMPLING METHOD SPT/Cal	**NOTES** Boring sealed with bentonite 5' to 47.5'			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									6" AC
									FILL **Interbedded Silty SAND (SM)**, red-brown to tan, damp, with shell fragments
		B	1						
	10								
5									
		C	2	21					
	5								
10									
		S	3	19					HYDRAULIC FILL **SAND with Silt (SP-SM)**, medium dense to loose, gray, wet, interbedded with shell fragments
								▼	
		S	4	19			GS		
	0								
15									
		S	5	6			SA		
		S	6	6			GS		
	-5								

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FIGURE A-2 a

LOG OF TEST BORING

PROJECT NAME	HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER	2769A
BORING	**B-1**
SITE LOCATION	Harbor Island, San Diego
START	12/4/2014
FINISH	12/4/2014
SHEET NO.	2 of 3
DRILLING COMPANY	Pacific Drilling
DRILLING METHOD	Hollow Stem Auger
LOGGED BY	G. Spaulding
CHECKED BY	
DRILLING EQUIPMENT	Marl M5
BORING DIA. (in)	6
TOTAL DEPTH (ft)	47.5
GROUND ELEV (ft)	14.5
DEPTH/*ELEV.* GROUND WATER (ft)	▼ 12.5 / *2.0*
SAMPLING METHOD	SPT/Cal
NOTES	Boring sealed with bentonite 5' to 47.5'

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									Fine SAND with Silt (SP-SM), loose to very loose, gray, saturated, interbedded with shell fragments
		S	7	5			SA		
		S	8	4			GS		
	-10								
25									
		S	9	2			SA		
		S	10	2					
	-15								
30									
		S	11	4			SA		
		S	12	6			SA		
	-20								
35									<u>RECENT BAY DEPOSITS</u> **Very Fine SAND (SP/SM) to SILT (ML)**, very loose, gray, saturated, interbedded
		S	13	3		27.8	GS PI		
		S	14	3		21.7	GS PI		
	-25								

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FIGURE A-2 b

LOG OF TEST BORING

PROJECT NAME	HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER	2769A
BORING	**B-1**
SITE LOCATION	Harbor Island, San Diego
START	12/4/2014
FINISH	12/4/2014
SHEET NO.	3 of 3
DRILLING COMPANY	Pacific Drilling
DRILLING METHOD	Hollow Stem Auger
LOGGED BY	G. Spaulding
CHECKED BY	
DRILLING EQUIPMENT	Marl M5
BORING DIA. (in)	6
TOTAL DEPTH (ft)	47.5
GROUND ELEV (ft)	14.5
DEPTH/*ELEV.* GROUND WATER (ft)	▼ 12.5 / *2.0*
SAMPLING METHOD	SPT/Cal
NOTES	Boring sealed with bentonite 5' to 47.5'

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	15	21					- Becomes medium dense
		S	16	39			GS		WEATHERED BAY POINT FORMATION **Silty SAND (SM)**, medium dense to dense, gray, wet, with shell fragments
45	-30	S	17	24		14.9	GS PI		BAY POINT FORMATION **Clayey SAND (SC)**, medium dense, mottled red-brown/gray, moist
									Boring terminated at depth of 47.5 feet. *Groundwater encountered at depth of 12.5 feet at time of excavation (varies with tides).*
50	-35								
55	-40								
	-45								

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FIGURE A-2 c

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER 2769A
BORING **B-2**
SITE LOCATION Harbor Island, San Diego
START 12/4/2014
FINISH 12/4/2014
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Hollow Stem Auger
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT Marl M5
BORING DIA. (in) 6
TOTAL DEPTH (ft) 12
GROUND ELEV (ft) 16
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 12.0 / *4.0*
SAMPLING METHOD SPT/Cal
NOTES Boring sealed with benotnite 5' to 12'±

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									5" AC / 6" CLASS 3 BASE
	15								FILL **Silty SAND (SM)**, gray-brown to light brown, damp
		B	1						
5		S	2	27					
	10	C	3	37					
10		S	4	14					
	5	S	5	17					
								▼	*Boring terminated at depth of 12 feet.* *Groundwanter encountered at 12 feet at time of excavation (varies with tides).*
15									
	0								

TCG_METRIC_LOG(3) 2769A.GPJ GDCLOGMT.GDT 1/14/15

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FIGURE A-3

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE		PROJECT NUMBER 2769A		BORING **B-3**	
SITE LOCATION Harbor Island, San Diego		START 12/4/2014	FINISH 12/4/2014	SHEET NO. 1 of 2	
DRILLING COMPANY Pacific Drilling	DRILLING METHOD Hollow Stem Auger		LOGGED BY G. Spaulding	CHECKED BY	
DRILLING EQUIPMENT Marl M5	BORING DIA. (in) 6	TOTAL DEPTH (ft) 20	GROUND ELEV (ft) 15	DEPTH/*ELEV.* GROUND WATER (ft) ▼ 11.5 / *3.5*	
SAMPLING METHOD SPT	NOTES Boring sealed with bentonite 5' to 20'				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									5" AC
									FILL **Interbedded Silty SAND (SM) and Fine to Medium Fine SAND (SP)**, gray to gray-brown, damp, with shell fragments
5	10	S	1	13					
		S	2	11					
10	5								
		S	3	18				▼	
									HYDRAULIC FILL **Interbedded Silty SAND (SM)**, loose, gray-brown, saturated with shell fragments
		S	4	7					
15	0								
		S	5	5					

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FIGURE A-4 a

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER 2769A
BORING **B-3**
SITE LOCATION Harbor Island, San Diego
START 12/4/2014
FINISH 12/4/2014
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Hollow Stem Auger
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT Marl M5
BORING DIA. (in) 6
TOTAL DEPTH (ft) 20
GROUND ELEV (ft) 15
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 11.5 / *3.5*
SAMPLING METHOD SPT
NOTES Boring sealed with bentonite 5' to 20'

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									Boring terminated at depth of 20 feet. *Groundwater encountered at depth of 11.5 feet at time of excavation (varies with tides).*
25	-10								
30	-15								
35	-20								

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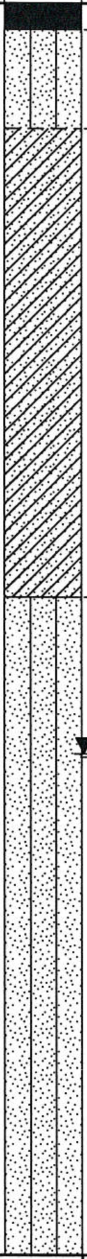
FIGURE A-4 b

TCG_METRIC_LOG(3) 2769A.GPJ GDCLOGMT.GDT 1/14/15

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER 2769A
BORING **B-4**
SITE LOCATION Harbor Island, San Diego
START 12/4/2014
FINISH 12/4/2014
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Hollow Stem Auger
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT Marl M5
BORING DIA. (in) 6
TOTAL DEPTH (ft) 36.5
GROUND ELEV (ft) 16
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 12.0 / *4.0*
SAMPLING METHOD SPT
NOTES Boring sealed with bentonite 4' to 36.5'



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									5" AC
	15								FILL **Silty Fine SAND (SM)**, gray, damp
		S	1	11					
									Silty to Clayey SAND (SC), red-brown, damp, with trace gravel
5									
	10	S	2	6					
									HYDRAULIC FILL **Silty Fine SAND (SM)**, loose, gray, moist to wet, with trace of shell fragments
10									
	5	S	3	8					
								▼	
15									
	0	S	4	7					

TerraCosta Consulting Group, Inc.
3890 Murphy Canyon Road, Suite 200
San Diego, California 92123

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-5 a

LOG OF TEST BORING

PROJECT NAME: HARBOR ISLAND WEST MARINA - LANDSIDE
PROJECT NUMBER: 2769A
BORING: **B-4**
SITE LOCATION: Harbor Island, San Diego
START: 12/4/2014
FINISH: 12/4/2014
SHEET NO.: 2 of 2
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: G. Spaulding
CHECKED BY:
DRILLING EQUIPMENT: Marl M5
BORING DIA. (in): 6
TOTAL DEPTH (ft): 36.5
GROUND ELEV (ft): 16
DEPTH/*ELEV.* GROUND WATER (ft): ▼ 12.0 / *4.0*
SAMPLING METHOD: SPT
NOTES: Boring sealed with bentonite 4' to 36.5'

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-5	S	5	4					
									RECENT BAY DEPOSITS **Silty Fine SAND (SM)**, loose, dark gray, saturated
25									
	-10	S	6	3			SA		
									BAY POINT FORMATION **Silty to Clayey SAND (SM/SC)**, medium dense, mottled red-brown, moist
30									
	-15	S	7	21		21.8	GS PI		
35									
	-20	S	8	40			SA		
									Boring terminated at depth of 36.5 feet. *Groundwater encountered at depth of 12.0 feet at time of excavation (varies with tides).*

FIGURE A-5 b

APPENDIX B

LABORATORY TEST RESULTS

amec

9177 Sky Park Ct. San Diego, CA. 92123

PHYSICAL PROPERTIES OF SOILS

PROJECT: #2769A Harbor Island	LAB NO.: 28891-28905 (page 1 of 1)	PROJECT NO.: 5014-09-0006.48
West Marina	SAMPLED BY: G. Spaulding	DATE: 12/04/14
	SUBMITTED BY: G. Spaulding	DATE: 12/05/14
	AUTHORIZED BY: M. Eckert	DATE: 12/05/14
	REVIEWED BY: L. Collins	REPORT DATE: 12/17/14

Sample I.D.	Depth (ft.)	Liquid Limit/ Plastic Limit/PI ASTM D 4318	R- Value CTM301	Percent Passing #200 Sieve ASTM D 1140	Dry Density (pcf)	Moisture Content (%), as received ASTM D 2216
B1-4 (#28891)	12.5’	*	*	5.8	*	*
B1-5 (#28892)	15’	*	*	5.8	*	*
B1-6 (#28893)	17.5’	*	*	2.0	*	*
B1-7 (#28894)	20’	*	*	4.1	*	*
B1-8 (#28895)	22.5’	*	*	3.7	*	*
B1-9 (#28896)	25’	*	*	4.7	*	*
B1-11 (#28897)	30’	*	*	6.1	*	*
B1-12 (#28898)	32.5’	*	*	5.1	*	*
B1-13 (#28899)	35’	NV/NP	*	19.4	*	27.8
B1-14 (#28900)	37.5’	NV/NP	*	10.4	*	21.7
B1-16 (#28901)	42.5’	*	*	15.8	*	*
B1-17 (#28902)	45’	30.8/18.2/12.6	*	35.0	*	14.9
B4-6 (#28903)	25’	*	*	18.3	*	*
B4-7 (#28904)	30’	NV/NP	*	11.5	*	21.8
B4-8 (#28905)	35’	*	*	13.1	*	*

*Indicates test not requested

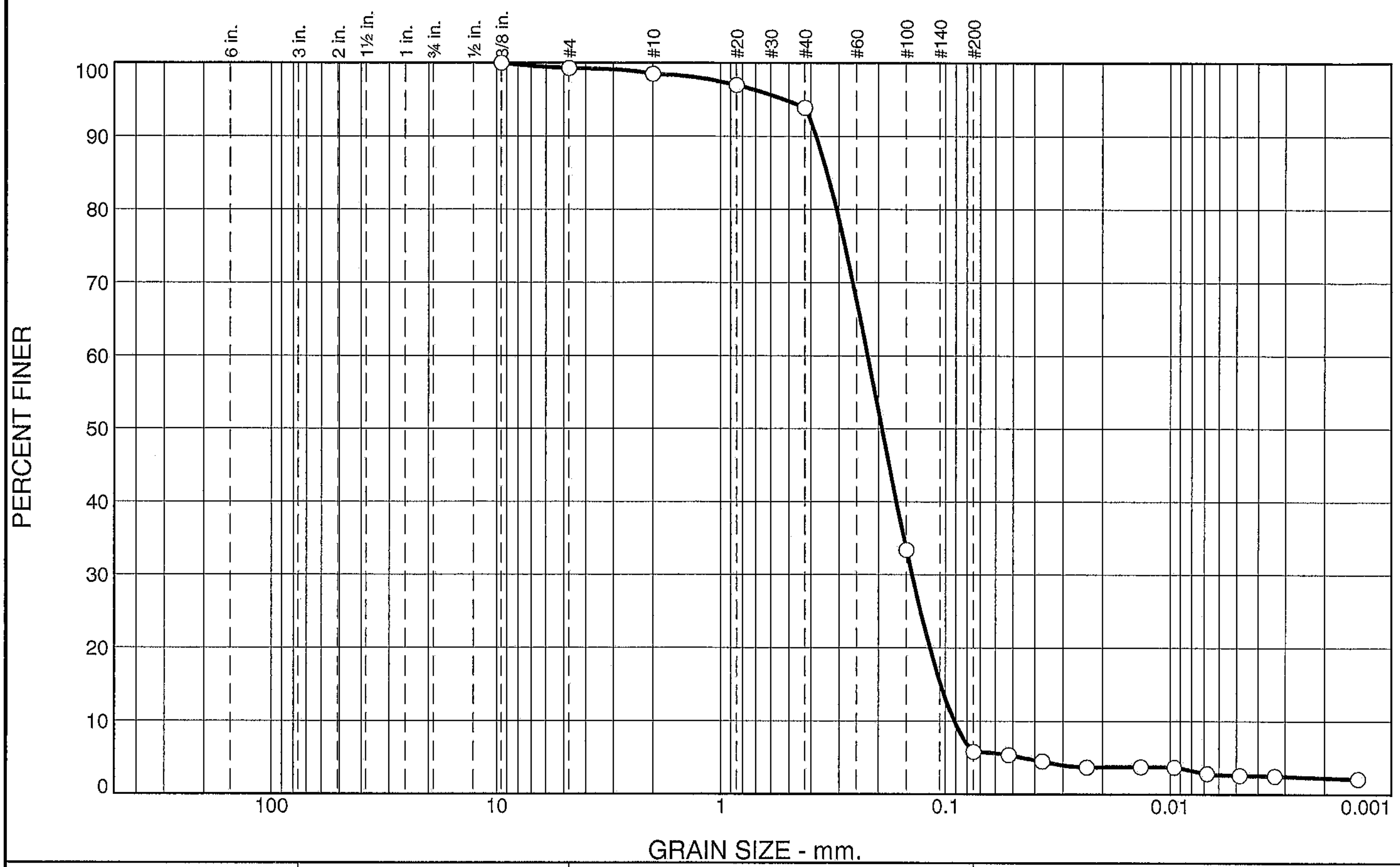
TerraCosta Consulting Inc./ G. Spaulding

AMEC E&I, Inc.

Reviewed By:________________________

Rick Larson, CE#39226
Senior Principal Engineer

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.8	4.6	88.1	3.5	2.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.3		
#10	98.5		
#20	97.0		
#40	93.9		
#100	33.4		
#200	5.8		

* (no specification provided)

Material Description

Poorly Graded Sand w/ Silt, SP-SM (#28891)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3784 D_{85}= 0.3380 D_{60}= 0.2235
D_{50}= 0.1930 D_{30}= 0.1418 D_{15}= 0.1055
D_{10}= 0.0917 C_u= 2.44 C_c= 0.98

Classification

USCS= SP-SM AASHTO=

Remarks

Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay

Sample Number: B1-4 **Depth:** 12.5'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28891

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 12.5' **Sample Number:** B1-4
Material Description: Poorly Graded Sand w/ Silt, SP-SM (#28891)
Date: 12/12/14
USCS Classification: SP-SM
Testing Remarks: Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	99.3
#10	98.5
#20	97.0
#40	93.9
#100	33.4
#200	5.8

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 98.5
Weight of hydrometer sample =56.63
Hygroscopic moisture correction:
Moist weight and tare = 36.63
Dry weight and tare = 36.63
Tare weight = 26.03
Hygroscopic moisture = 0.0%
Table of composite correction values:

Temp., deg. C:	18.6	20.2	21.7	22.3	23.2
Comp. corr.:	-6.0	-5.5	-5.0	-5.0	-5.0

Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - .164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	20.5	8.5	3.1	0.0136	8.5	14.9	0.0523	5.4
2.00	20.5	8.0	2.6	0.0136	8.0	15.0	0.0371	4.5
5.00	20.6	7.5	2.1	0.0135	7.5	15.1	0.0235	3.7
15.00	20.7	7.5	2.2	0.0135	7.5	15.1	0.0136	3.8
30.00	20.6	7.5	2.1	0.0135	7.5	15.1	0.0096	3.7
60.00	20.6	7.0	1.6	0.0135	7.0	15.1	0.0068	2.8
120.00	20.2	7.0	1.5	0.0136	7.0	15.1	0.0048	2.6
250.00	20.0	7.0	1.4	0.0136	7.0	15.1	0.0034	2.5
1440.00	19.3	7.0	1.2	0.0138	7.0	15.1	0.0014	2.1

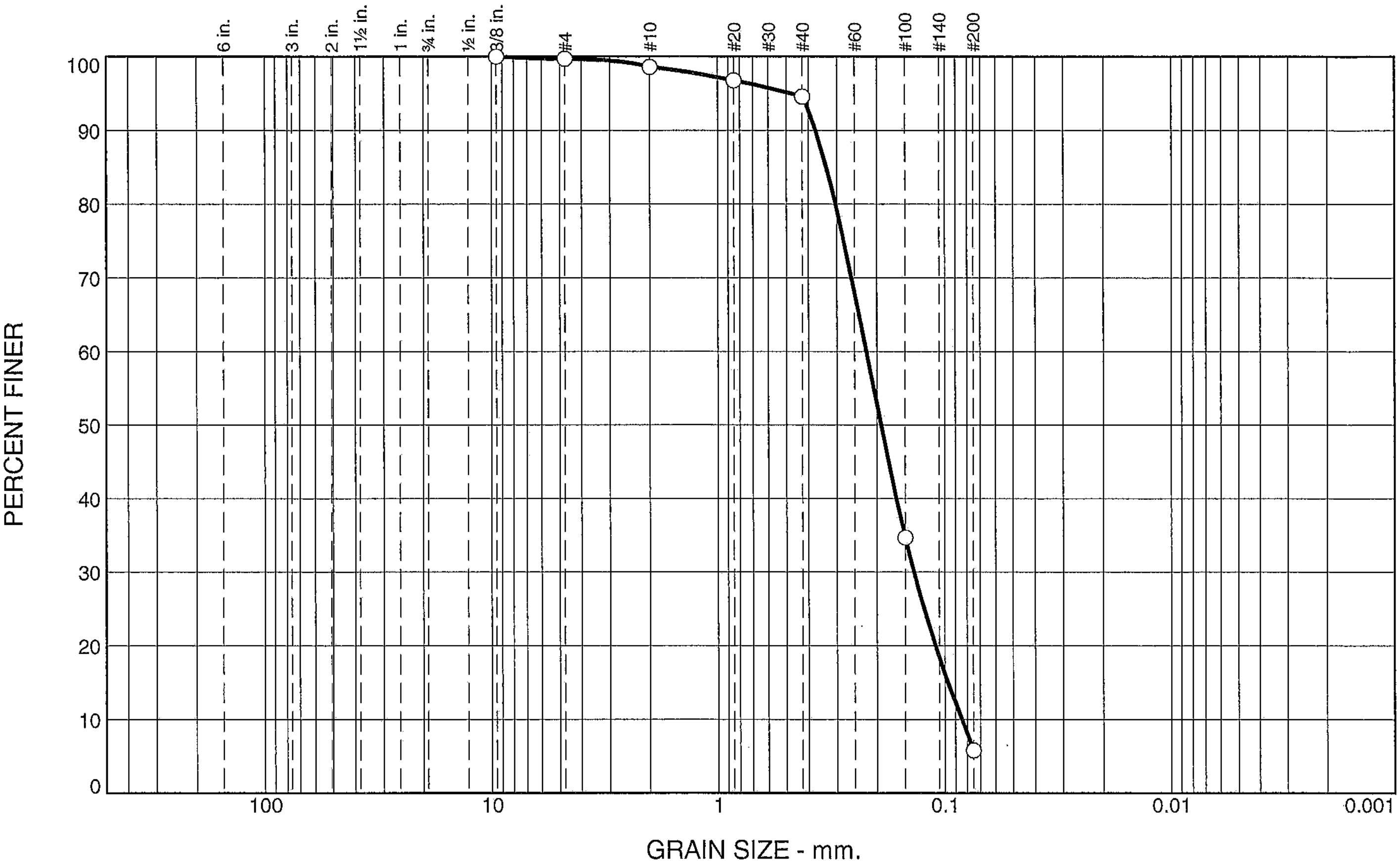
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.7	0.7	0.8	4.6	88.1	93.5	3.5	2.3	5.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0917	0.1055	0.1179	0.1418	0.1930	0.2235	0.3072	0.3380	0.3784	0.5225

Fineness Modulus	C_u	C_c
0.96	2.44	0.98

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.1	4.0	88.8	5.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.7		
#10	98.6		
#20	96.8		
#40	94.6		
#100	34.7		
#200	5.8		

* (no specification provided)

Material Description

Poorly Graded Sand w/ Silt, SP-SM (#28892)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3723 D_{85}= 0.3342 D_{60}= 0.2226
D_{50}= 0.1918 D_{30}= 0.1374 D_{15}= 0.0972
D_{10}= 0.0847 C_u= 2.63 C_c= 1.00

Classification

USCS= AASHTO=

Remarks

Sample Number: B1-5 **Depth:** 15'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28892

Tested By: Valles/Sancha **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 15' **Sample Number:** B1-5
Material Description: Poorly Graded Sand w/ Silt, SP-SM (#28892)
Date: 12/12/14
Tested by: Valles/Sancha **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	99.7
#10	98.6
#20	96.8
#40	94.6
#100	34.7
#200	5.8

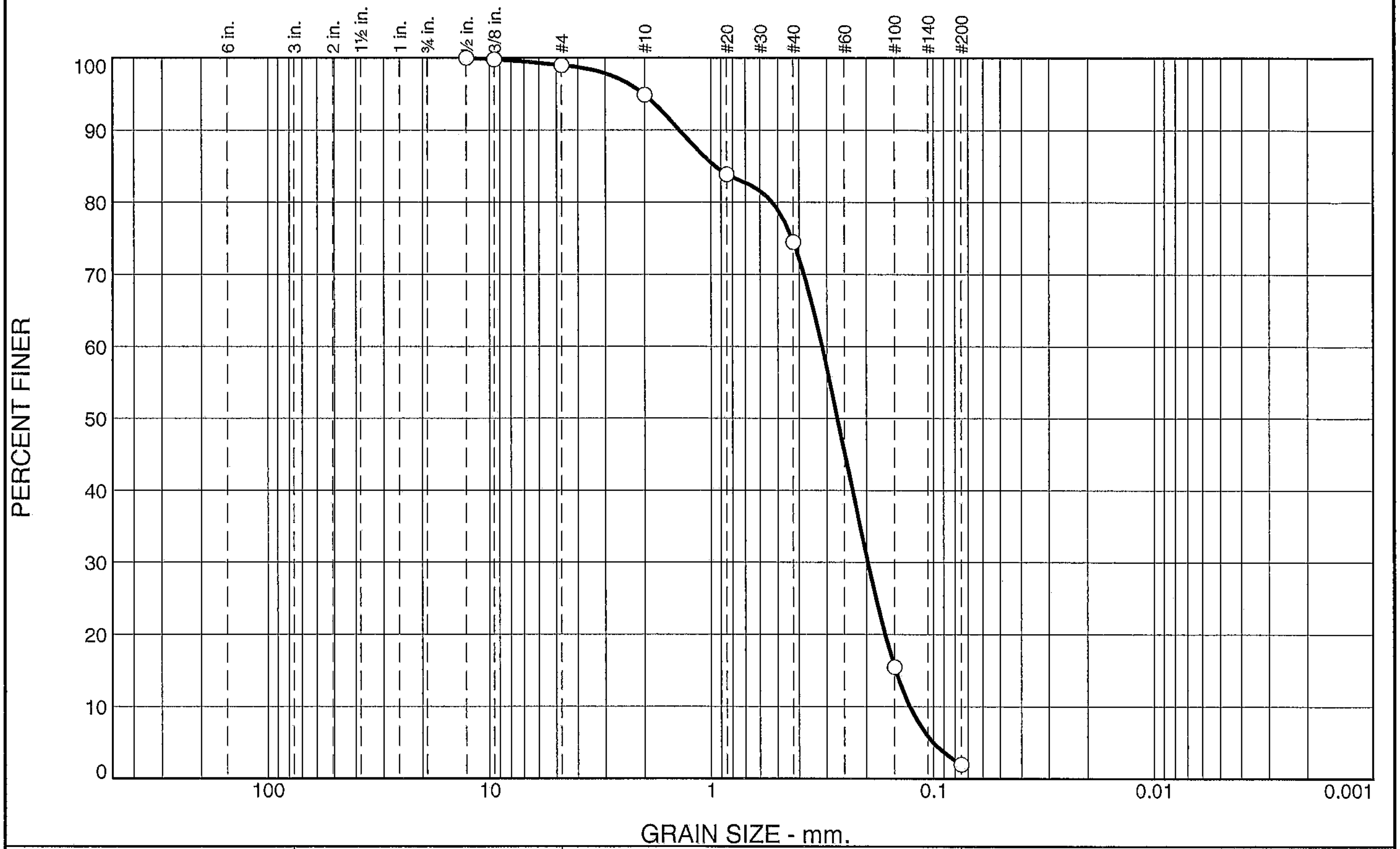
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.3	0.3	1.1	4.0	88.8	93.9			5.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0847	0.0972	0.1104	0.1374	0.1918	0.2226	0.3047	0.3342	0.3723	0.4753

Fineness Modulus	C_u	C_c
0.94	2.63	1.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	4.1	20.4	72.5	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	99.8		
#4	99.0		
#10	94.9		
#20	83.9		
#40	74.5		
#100	15.5		
#200	2.0		

* (no specification provided)

Material Description

Poorly Graded Sand, SP (#28893)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.3915 D_{85}= 0.9579 D_{60}= 0.3158
D_{50}= 0.2691 D_{30}= 0.1974 D_{15}= 0.1482
D_{10}= 0.1281 C_u= 2.47 C_c= 0.96

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B1-6 **Depth:** 17.5'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project No: 5014-09-0006. **Figure** #28893

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 17.5' **Sample Number:** B1-6
Material Description: Poorly Graded Sand, SP (#28893)
Date: 12/12/14
USCS Classification: SP
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	99.8
#4	99.0
#10	94.9
#20	83.9
#40	74.5
#100	15.5
#200	2.0

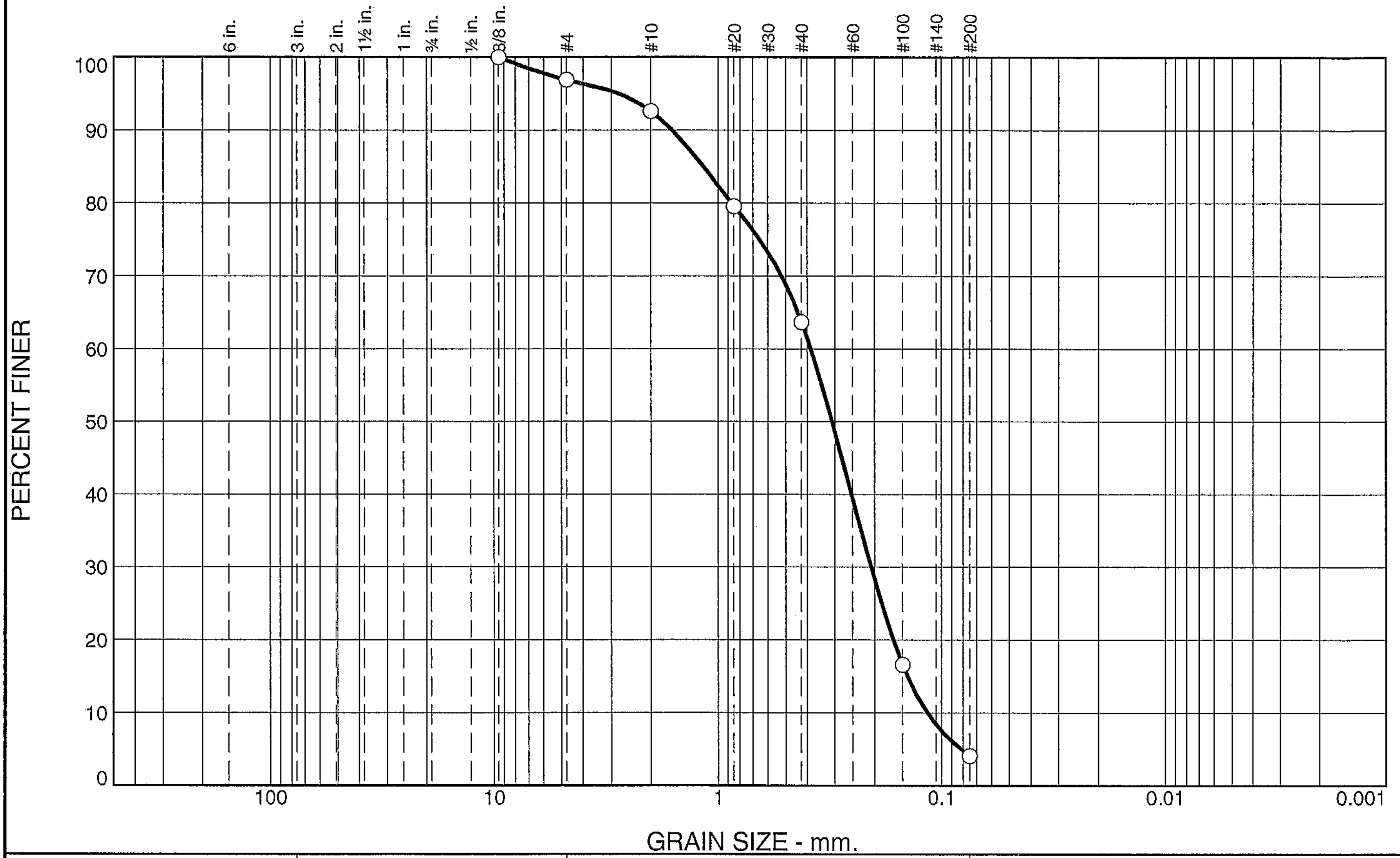
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.0	1.0	4.1	20.4	72.5	97.0			2.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1281	0.1482	0.1653	0.1974	0.2691	0.3158	0.5290	0.9579	1.3915	2.0185

Fineness Modulus	C_u	C_c
1.63	2.47	0.96

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	4.3	28.9	59.6	4.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	96.9		
#10	92.6		
#20	79.6		
#40	63.7		
#100	16.6		
#200	4.1		

* (no specification provided)

Material Description

Poorly Graded Sand, SP (#28894)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.6099	D_{85}= 1.1654	D_{60}= 0.3863
D_{50}= 0.3099	D_{30}= 0.2074	D_{15}= 0.1425
D_{10}= 0.1160	C_u= 3.33	C_c= 0.96

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B1-7 **Depth:** 20'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project No: 5014-09-0006. **Figure** #28894

Tested By: Valles/Sancha **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 20' **Sample Number:** B1-7
Material Description: Poorly Graded Sand, SP (#28894)
Date: 12/12/14
USCS Classification: SP
Tested by: Valles/Sancha **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	96.9
#10	92.6
#20	79.6
#40	63.7
#100	16.6
#200	4.1

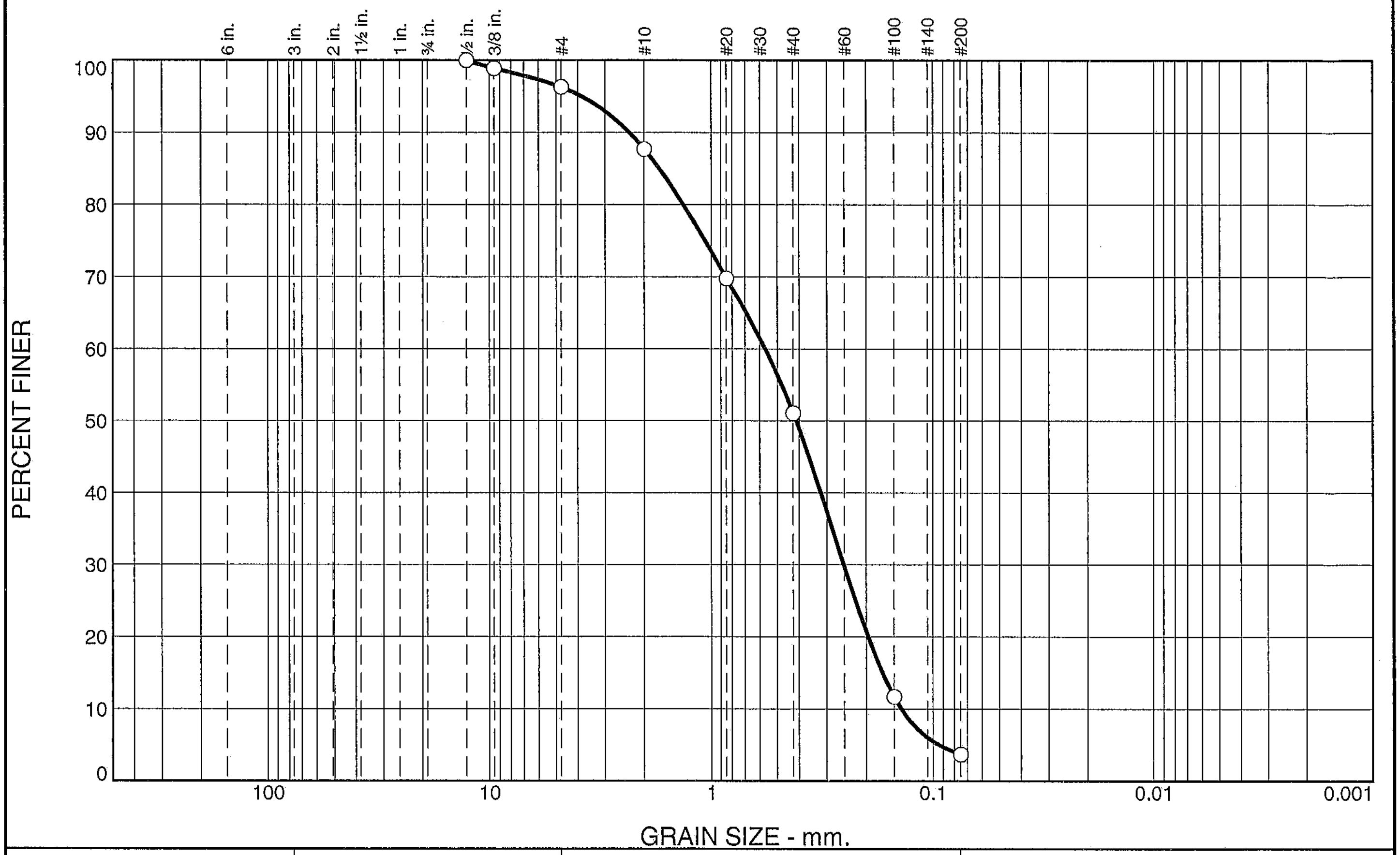
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	3.1	3.1	4.3	28.9	59.6	92.8			4.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1160	0.1425	0.1649	0.2074	0.3099	0.3863	0.8702	1.1654	1.6099	2.7805

Fineness Modulus	C_u	C_c
1.86	3.33	0.96

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.7	8.6	36.6	47.4	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	98.9		
#4	96.3		
#10	87.7		
#20	69.8		
#40	51.1		
#100	11.7		
#200	3.7		

* (no specification provided)

Material Description

Poorly Graded Sand, SP (#28895)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.3367 D_{85}= 1.7120 D_{60}= 0.5680
D_{50}= 0.4121 D_{30}= 0.2524 D_{15}= 0.1690
D_{10}= 0.1391 C_u= 4.08 C_c= 0.81

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B1-8 **Depth:** 22.5'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project No: 5014-09-0006. **Figure** #28895

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 22.5' **Sample Number:** B1-8
Material Description: Poorly Graded Sand, SP (#28895)
Date: 12/12/14
USCS Classification: SP
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	98.9
#4	96.3
#10	87.7
#20	69.8
#40	51.1
#100	11.7
#200	3.7

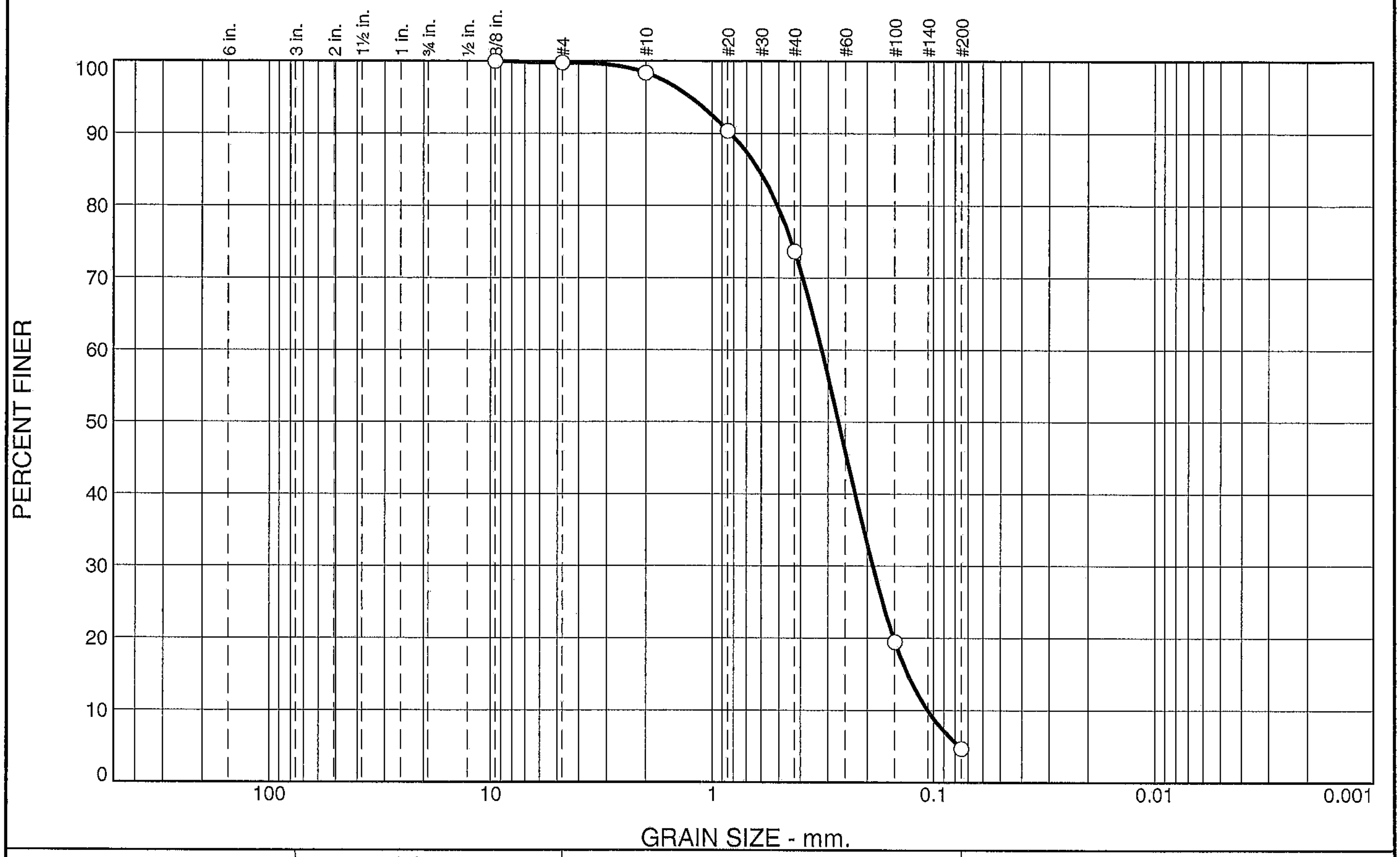
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	3.7	3.7	8.6	36.6	47.4	92.6			3.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1391	0.1690	0.1960	0.2524	0.4121	0.5680	1.3347	1.7120	2.3367	3.8382

Fineness Modulus	C_u	C_c
2.27	4.08	0.81

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	1.4	24.7	69.0	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.8		
#10	98.4		
#20	90.4		
#40	73.7		
#100	19.5		
#200	4.7		

* (no specification provided)

Material Description

Poorly Graded Sand, SP (#28896)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.8260 D_{85}= 0.6175 D_{60}= 0.3211

D_{50}= 0.2693 D_{30}= 0.1888 D_{15}= 0.1313

D_{10}= 0.1067 C_u= 3.01 C_c= 1.04

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B1-9 **Depth:** 25.0'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.

Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28896

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 25.0' **Sample Number:** B1-9
Material Description: Poorly Graded Sand, SP (#28896)
Date: 12/12/14
USCS Classification: SP
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	99.8
#10	98.4
#20	90.4
#40	73.7
#100	19.5
#200	4.7

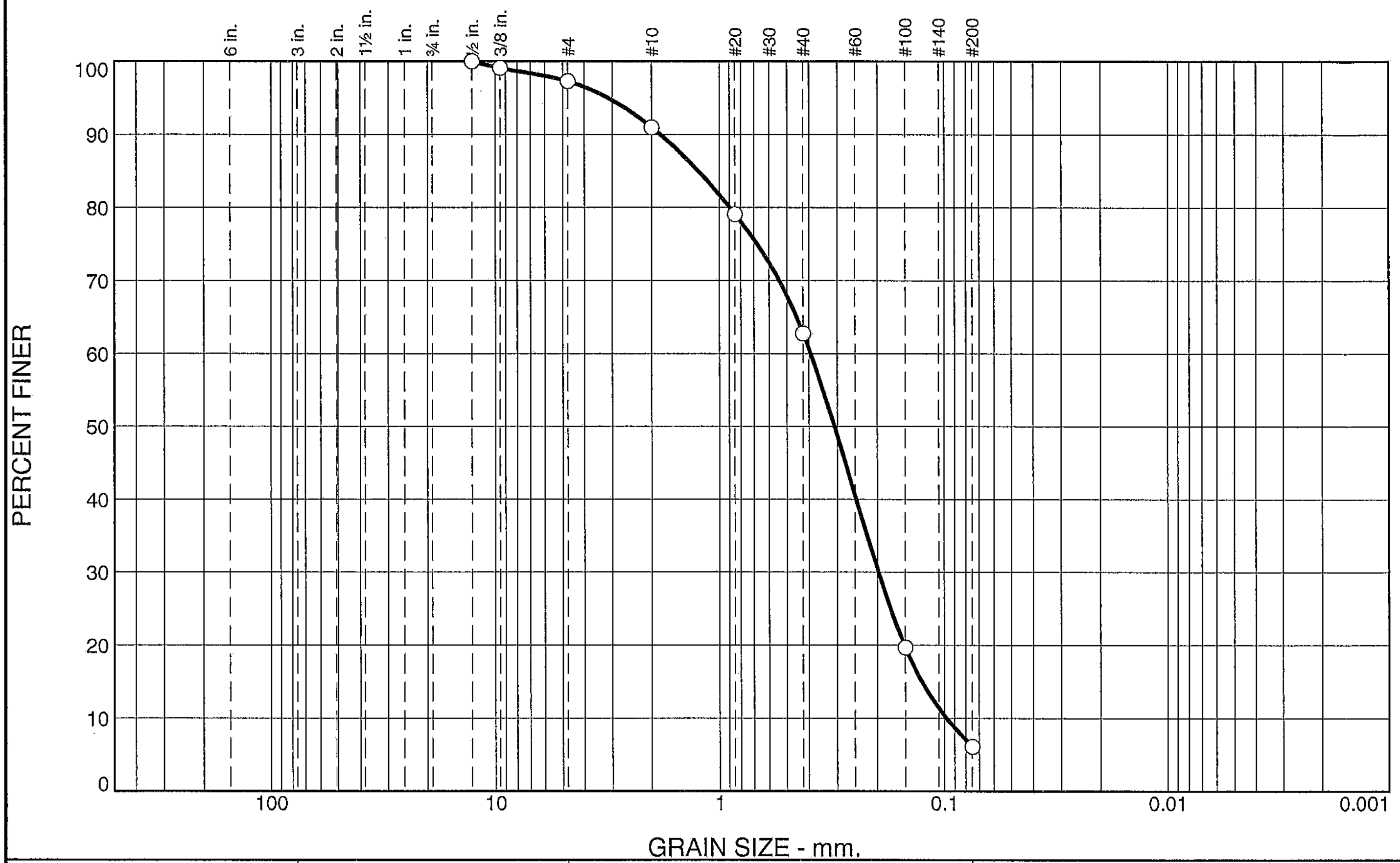
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.2	0.2	1.4	24.7	69.0	95.1			4.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1067	0.1313	0.1519	0.1888	0.2693	0.3211	0.5077	0.6175	0.8260	1.2541

Fineness Modulus	C_u	C_c
1.47	3.01	1.04

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	6.3	28.2	56.7	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	99.1		
#4	97.3		
#10	91.0		
#20	79.1		
#40	62.8		
#100	19.7		
#200	6.1		

* (no specification provided)

Material Description

Poorly Graded Sand w/ Silt, SP-SM (#28897)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.8274	D_{85}= 1.2403	D_{60}= 0.3934
D_{50}= 0.3092	D_{30}= 0.1977	D_{15}= 0.1264
D_{10}= 0.0980	C_u= 4.02	C_c= 1.01

Classification

USCS= SP-SM AASHTO=

Remarks

Sample Number: B1-11 **Depth:** 30.0'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28897

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 30.0' **Sample Number:** B1-11
Material Description: Poorly Graded Sand w/ Silt, SP-SM (#28897)
Date: 12/12/14
USCS Classification: SP-SM
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	99.1
#4	97.3
#10	91.0
#20	79.1
#40	62.8
#100	19.7
#200	6.1

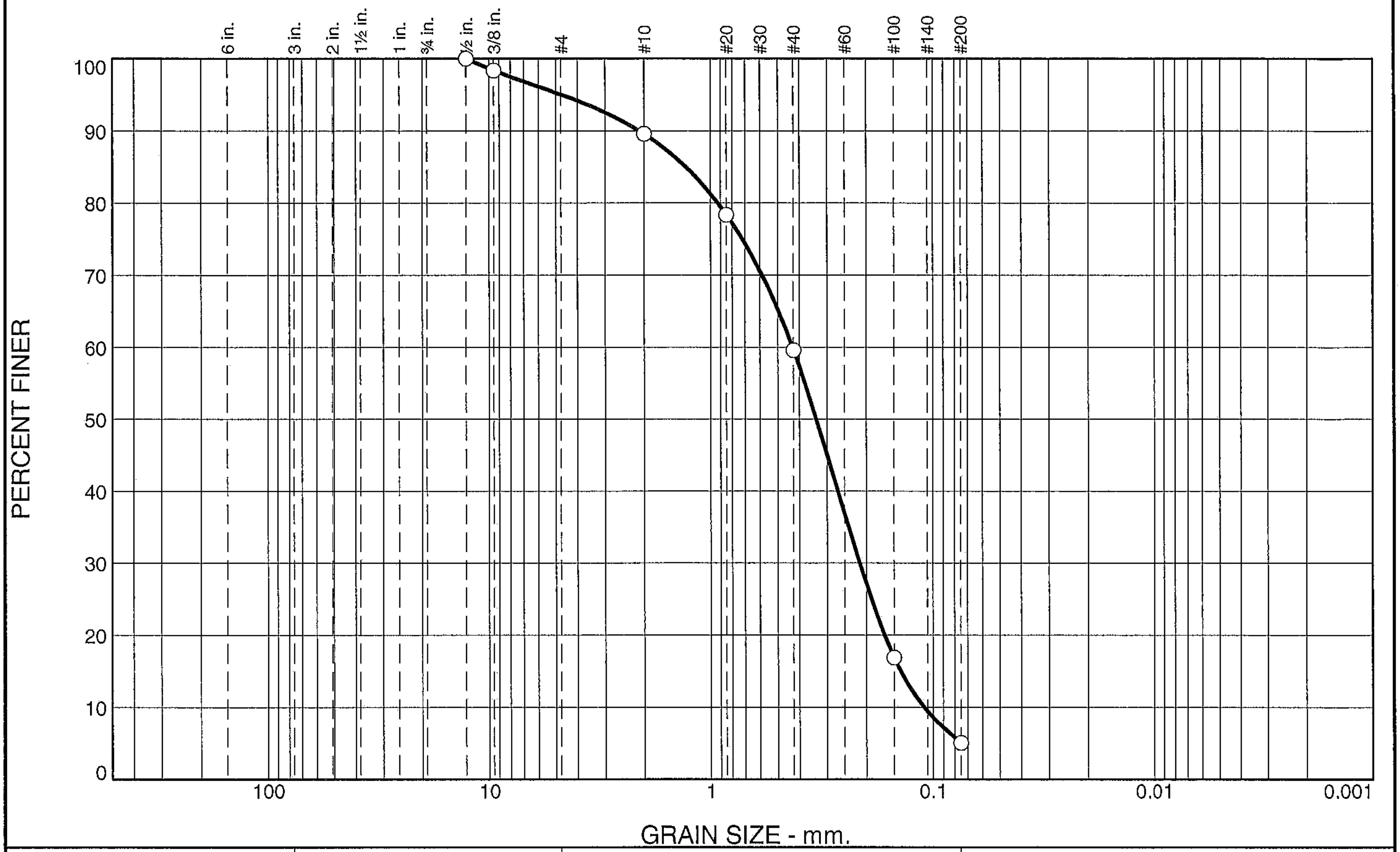
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.7	2.7	6.3	28.2	56.7	91.2			6.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0980	0.1264	0.1514	0.1977	0.3092	0.3934	0.8971	1.2403	1.8274	3.1300

Fineness Modulus	C_u	C_c
1.86	4.02	1.01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.9	5.5	30.0	54.5	5.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	98.4		
#10	89.6		
#20	78.4		
#40	59.6		
#100	16.9		
#200	5.1		

* (no specification provided)

Material Description

Poorly Graded Sand w/ Silt, SP-SM (#28898)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.0970 D_{85}= 1.2927 D_{60}= 0.4296
D_{50}= 0.3362 D_{30}= 0.2144 D_{15}= 0.1399
D_{10}= 0.1099 C_u= 3.91 C_c= 0.97

Classification

USCS= SP-SM AASHTO=

Remarks

Sample Number: B1-12 **Depth:** 32.5'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28898

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 32.5' **Sample Number:** B1-12
Material Description: Poorly Graded Sand w/ Silt, SP-SM (#28898)
Date: 12/12/14
USCS Classification: SP-SM
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	98.4
#10	89.6
#20	78.4
#40	59.6
#100	16.9
#200	5.1

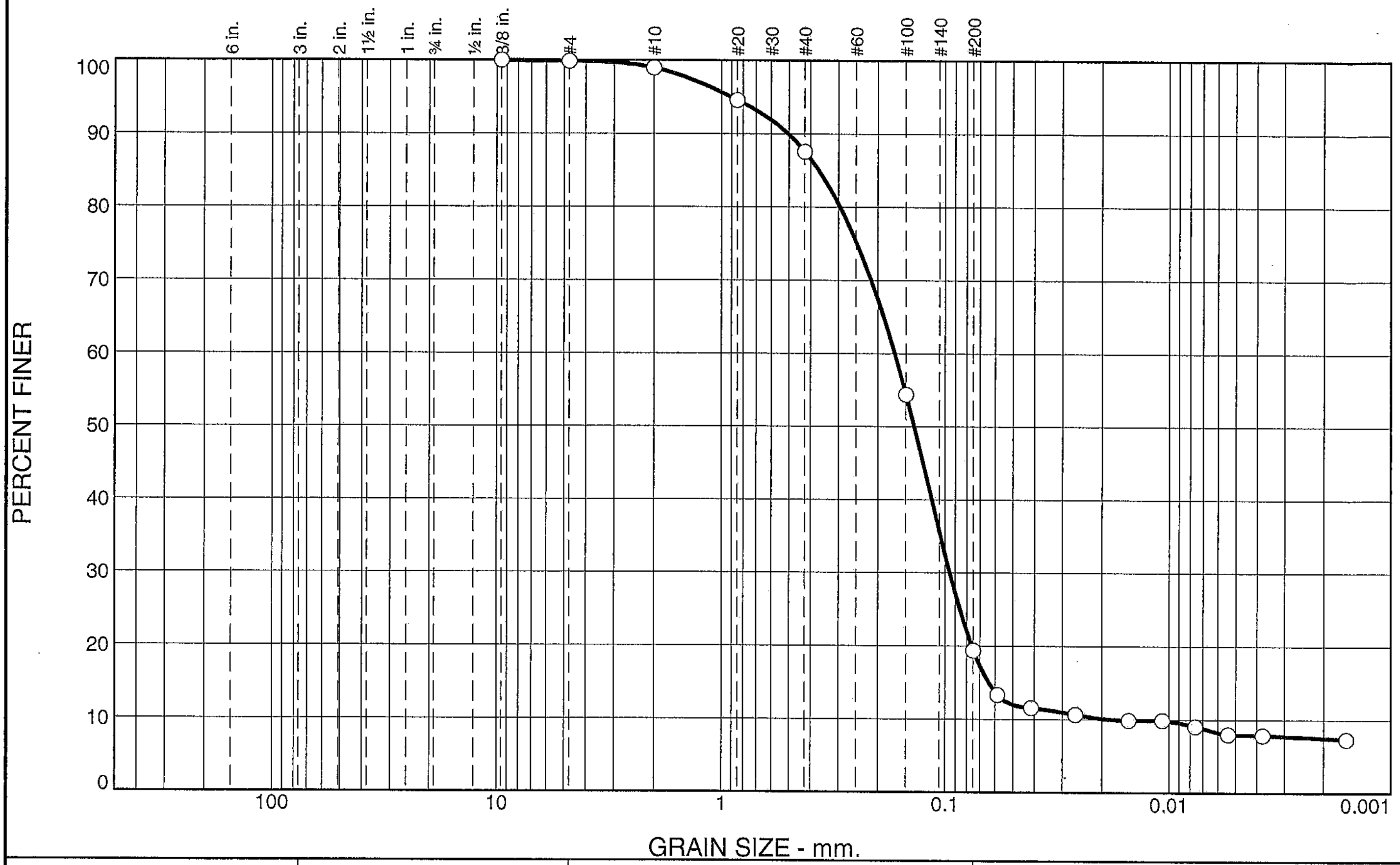
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	4.9	4.9	5.5	30.0	54.5	90.0			5.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1099	0.1399	0.1655	0.2144	0.3362	0.4296	0.9279	1.2927	2.0970	4.6878

Fineness Modulus	C_u	C_c
1.99	3.91	0.97

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.9	11.4	68.2	14.8	4.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.9		
#10	99.0		
#20	94.6		
#40	87.6		
#100	54.4		
#200	19.4		

* (no specification provided)

Material Description

Silty Sand, SM (#28899)

Atterberg Limits

PL= NP   LL= NV   PI= NP

Coefficients

D_{90}= 0.5017 D_{85}= 0.3692 D_{60}= 0.1692
D_{50}= 0.1373 D_{30}= 0.0939 D_{15}= 0.0670
D_{10}= 0.0462 C_u= 3.67 C_c= 1.13

Classification

USCS= SM   AASHTO= A-2-4(0)

Remarks

Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay

Sample Number: B1-13   **Depth:** 35.0'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006.   **Figure** #28899

Tested By: R. Valles   **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 35.0'
Sample Number: B1-13
Material Description: Silty Sand, SM (#28899)
Date: 12/12/14
PL: NP
LL: NV
PI: NP
USCS Classification: SM
AASHTO Classification: A-2-4(0)
Testing Remarks: Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay
Tested by: R. Valles
Checked by: L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375	100.0
#4	99.9
#10	99.0
#20	94.6
#40	87.6
#100	54.4
#200	19.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.0
Weight of hydrometer sample =57.38
Hygroscopic moisture correction:
Moist weight and tare = 37.23
Dry weight and tare = 37.16
Tare weight = 27.04
Hygroscopic moisture = 0.7%

Table of composite correction values:

Temp., deg. C:	18.6	20.2	21.7	22.3	23.2
Comp. corr.:	-5.0	-5.5	-5.0	-5.0	-5.0

Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 20.4 - .13 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	20.7	13.0	7.7	0.0135	13.0	18.7	0.0585	13.3
2.00	20.7	12.0	6.7	0.0135	12.0	18.8	0.0415	11.6
5.00	20.6	11.5	6.1	0.0135	11.5	18.9	0.0263	10.7
15.00	20.8	11.0	5.7	0.0135	11.0	19.0	0.0152	9.9
30.00	20.8	11.0	5.7	0.0135	11.0	19.0	0.0107	9.9
60.00	20.9	10.5	5.2	0.0135	10.5	19.0	0.0076	9.1
120.00	20.5	10.0	4.6	0.0136	10.0	19.1	0.0054	8.0
250.00	20.1	10.0	4.5	0.0136	10.0	19.1	0.0038	7.9
1440.00	19.5	9.5	4.2	0.0137	9.5	19.2	0.0016	7.3

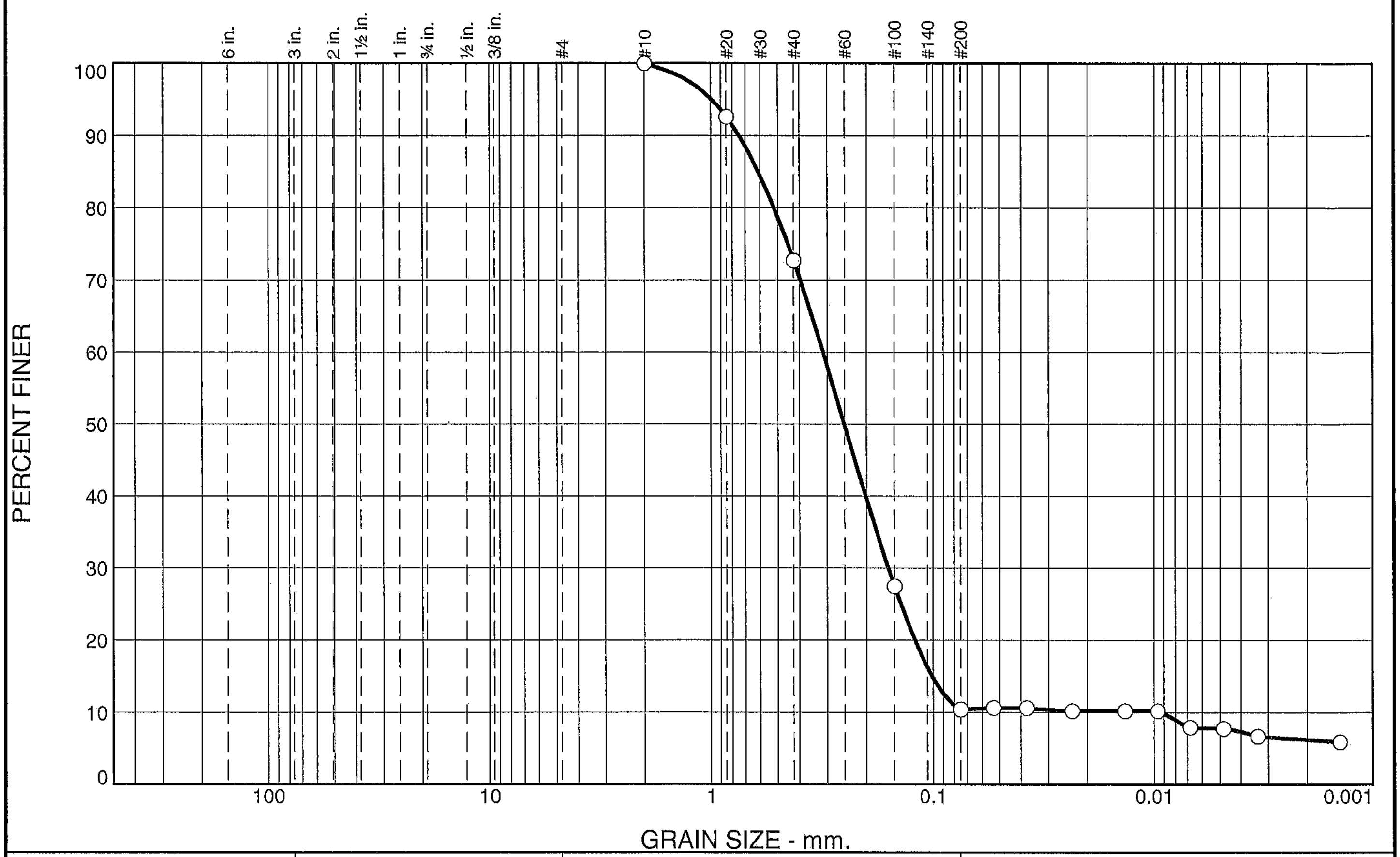
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.1	0.1	0.9	11.4	68.2	80.5	14.8	4.6	19.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0462	0.0670	0.0761	0.0939	0.1373	0.1692	0.2983	0.3692	0.5017	0.9037

Fineness Modulus	C_u	C_c
0.78	3.67	1.13

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	27.3	62.3	4.2	6.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	92.6		
#40	72.7		
#100	27.5		
#200	10.4		

* (no specification provided)

Material Description

Poorly Graded Silty Sand, SP-SM (#28900)

Atterberg Limits

PL= NP
LL= NV
PI= NP

Coefficients

D_{90}= 0.7469
D_{85}= 0.6128
D_{60}= 0.3141
D_{50}= 0.2519
D_{30}= 0.1598
D_{15}= 0.1014
D_{10}= 0.0093
C_u= 33.94
C_c= 8.78

Classification

USCS= SP-SM
AASHTO= A-3

Remarks

Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay

Sample Number: B1-14 **Depth:** 37.5'

Date: 12/15/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28900

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 37.5' **Sample Number:** B1-14
Material Description: Poorly Graded Silty Sand, SP-SM (#28900)
Date: 12/15/14 **PL:** NP **LL:** NV **PI:** NP
USCS Classification: SP-SM **AASHTO Classification:** A-3
Testing Remarks: Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
#10	100.0
#20	92.6
#40	72.7
#100	27.5
#200	10.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =20.65
Hygroscopic moisture correction:
Moist weight and tare = 35.06
Dry weight and tare = 35.05
Tare weight = 29.37
Hygroscopic moisture = 0.2%
Table of composite correction values:

Temp., deg. C:	18.6	20.2	21.7	22.3	23.2
Comp. corr.:	-6.0	-5.5	-5.0	-5.0	-5.0

Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - .164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.2	8.0	2.2	0.0138	8.0	15.0	0.0533	10.6
2.00	19.2	8.0	2.2	0.0138	8.0	15.0	0.0377	10.6
5.00	20.5	7.5	2.1	0.0136	7.5	15.1	0.0235	10.2
15.00	20.5	7.5	2.1	0.0136	7.5	15.1	0.0136	10.2
30.00	20.5	7.5	2.1	0.0136	7.5	15.1	0.0096	10.2
60.00	20.6	7.0	1.6	0.0135	7.0	15.1	0.0068	7.9
120.00	20.5	7.0	1.6	0.0136	7.0	15.1	0.0048	7.8
250.00	19.8	7.0	1.4	0.0137	7.0	15.1	0.0034	6.7
1440.00	19.3	7.0	1.2	0.0138	7.0	15.1	0.0014	5.9

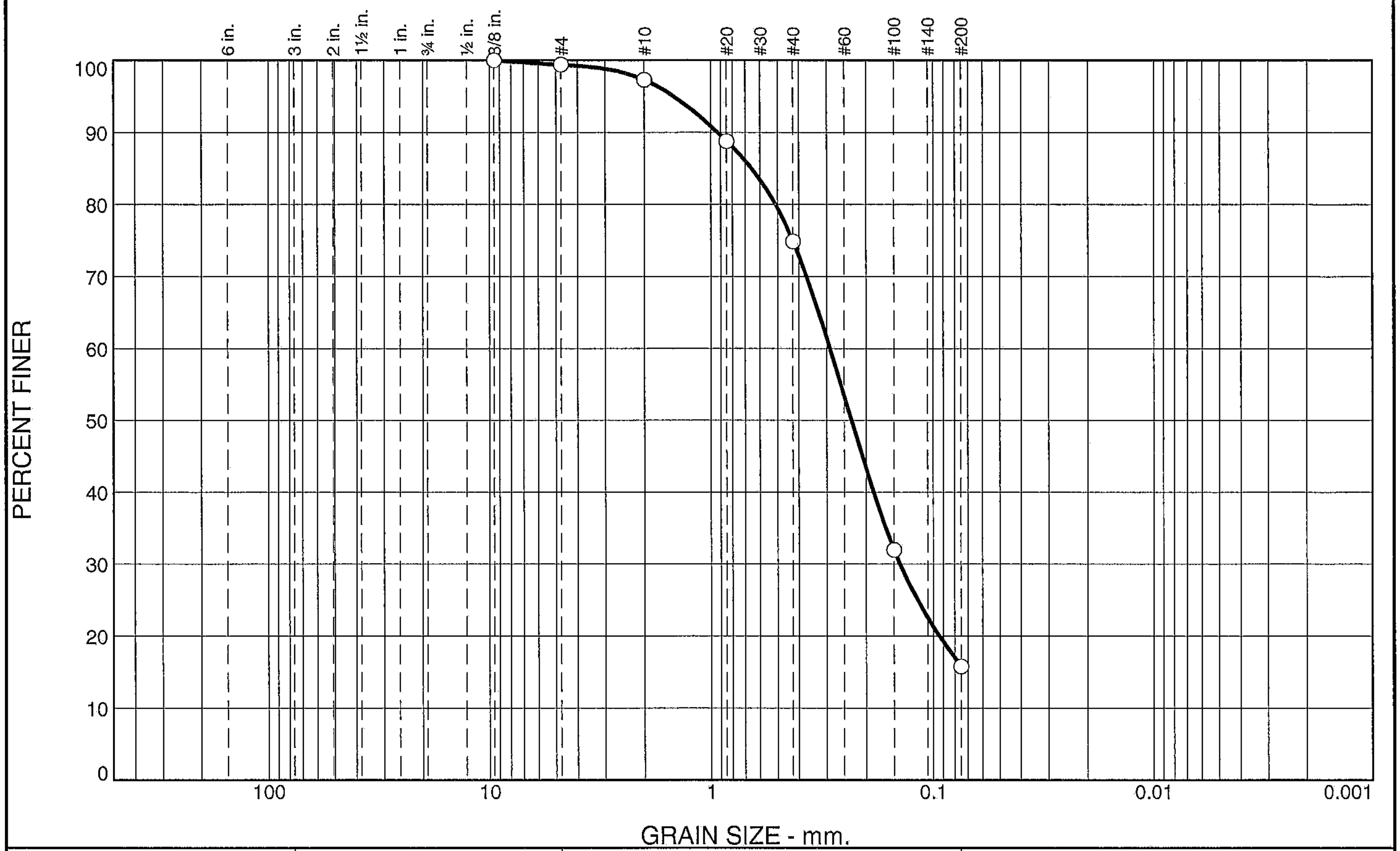
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	27.3	62.3	89.6	4.2	6.2	10.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0093	0.1014	0.1214	0.1598	0.2519	0.3141	0.5207	0.6128	0.7469	0.9909

Fineness Modulus	C_u	C_c
1.33	33.94	8.78

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	2.1	22.4	59.1	15.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.4		
#10	97.3		
#20	88.8		
#40	74.9		
#100	32.0		
#200	15.8		

* (no specification provided)

Material Description

Silty Sand, SM (#28901)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.9330 D_{85}= 0.6547 D_{60}= 0.2906
D_{50}= 0.2327 D_{30}= 0.1411 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: B1-16 **Depth:** 42.5'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28901

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 42.5' **Sample Number:** B1-16
Material Description: Silty Sand, SM (#28901)
Date: 12/12/14
USCS Classification: SM
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	99.4
#10	97.3
#20	88.8
#40	74.9
#100	32.0
#200	15.8

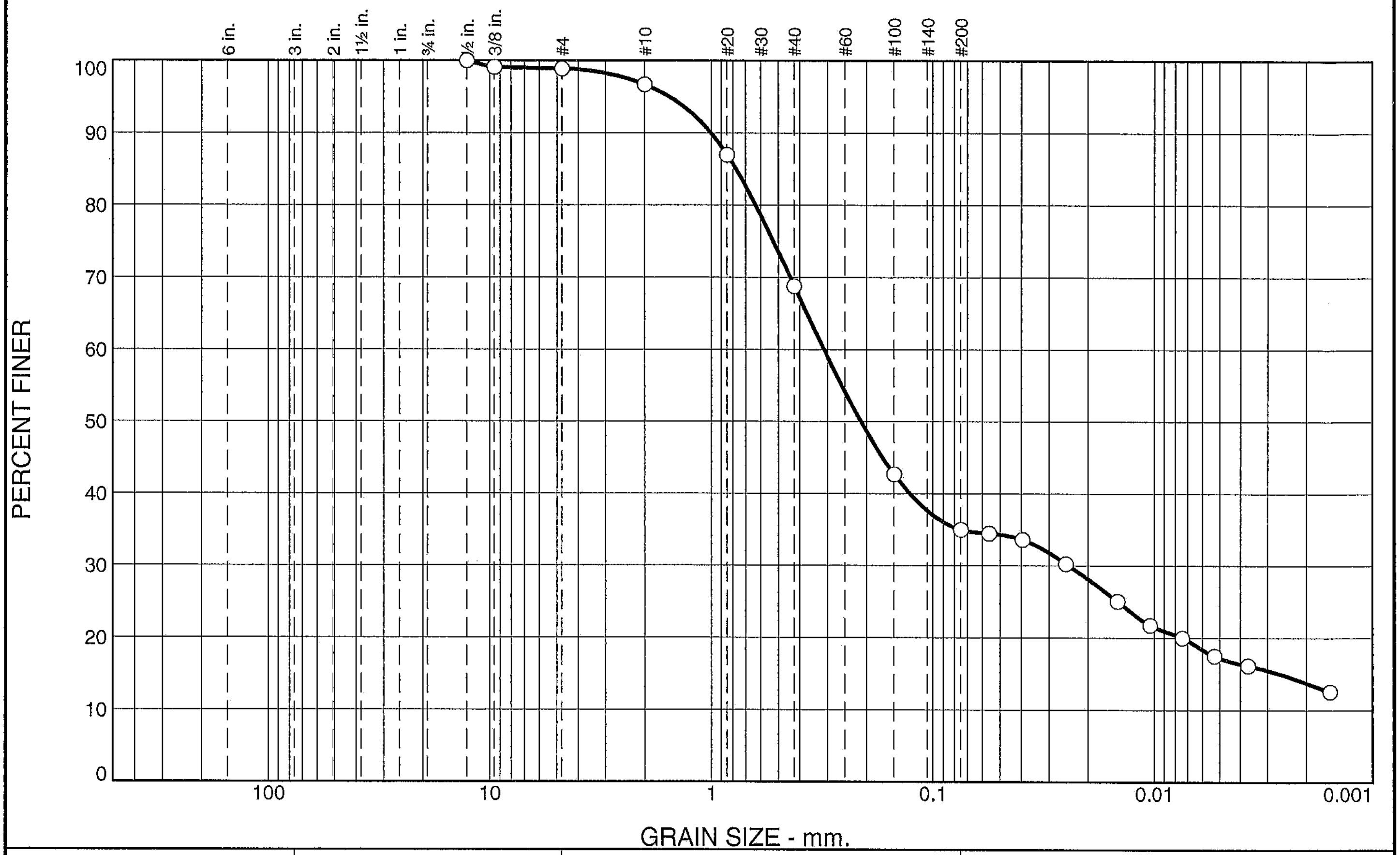
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.6	0.6	2.1	22.4	59.1	83.6			15.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0939	0.1411	0.2327	0.2906	0.5103	0.6547	0.9330	1.4715

Fineness Modulus
1.33

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	2.2	27.9	33.8	21.3	13.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	99.1		
#4	98.9		
#10	96.7		
#20	87.0		
#40	68.8		
#100	42.7		
#200	35.0		

* (no specification provided)

Material Description

Silty Sand, SC (#28902)

Atterberg Limits

PL= 18.2 LL= 30.8 PI= 12.6

Coefficients

D_{90}= 1.0041 D_{85}= 0.7741 D_{60}= 0.3120
D_{50}= 0.2120 D_{30}= 0.0245 D_{15}= 0.0026
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay

Sample Number: B1-17 **Depth:** 45.0'

Date: 12/12/14

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28902

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 45.0' **Sample Number:** B1-17
Material Description: Silty Sand, SC (#28902)
Date: 12/12/14 **PL:** 18.2 **LL:** 30.8 **PI:** 12.6
USCS Classification: SC **AASHTO Classification:** A-2-6(1)
Testing Remarks: Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	99.1
#4	98.9
#10	96.7
#20	87.0
#40	68.8
#100	42.7
#200	35.0

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 96.7
Weight of hydrometer sample =57.88
Hygroscopic moisture correction:
Moist weight and tare = 35.37
Dry weight and tare = 35.14
Tare weight = 25.39
Hygroscopic moisture = 2.4%
Table of composite correction values:

Temp., deg. C:	18.6	20.2	21.7	22.3	23.2
Comp. corr.:	-6.0	-5.5	-5.0	-5.0	-5.0

Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 20.4 - .13 x **Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	20.7	25.5	20.2	0.0135	25.5	17.1	0.0559	34.5
2.00	20.7	25.0	19.7	0.0135	25.0	17.1	0.0396	33.6
5.00	20.8	23.0	17.7	0.0135	23.0	17.4	0.0252	30.3
15.00	20.7	20.0	14.7	0.0135	20.0	17.8	0.0147	25.1
30.00	20.9	18.0	12.7	0.0135	18.0	18.1	0.0105	21.8
60.00	20.8	17.0	11.7	0.0135	17.0	18.2	0.0074	20.0
120.00	20.9	15.5	10.2	0.0135	15.5	18.4	0.0053	17.5
250.00	20.1	15.0	9.5	0.0136	15.0	18.4	0.0037	16.2
1440.00	19.7	13.0	7.3	0.0137	13.0	18.7	0.0016	12.6

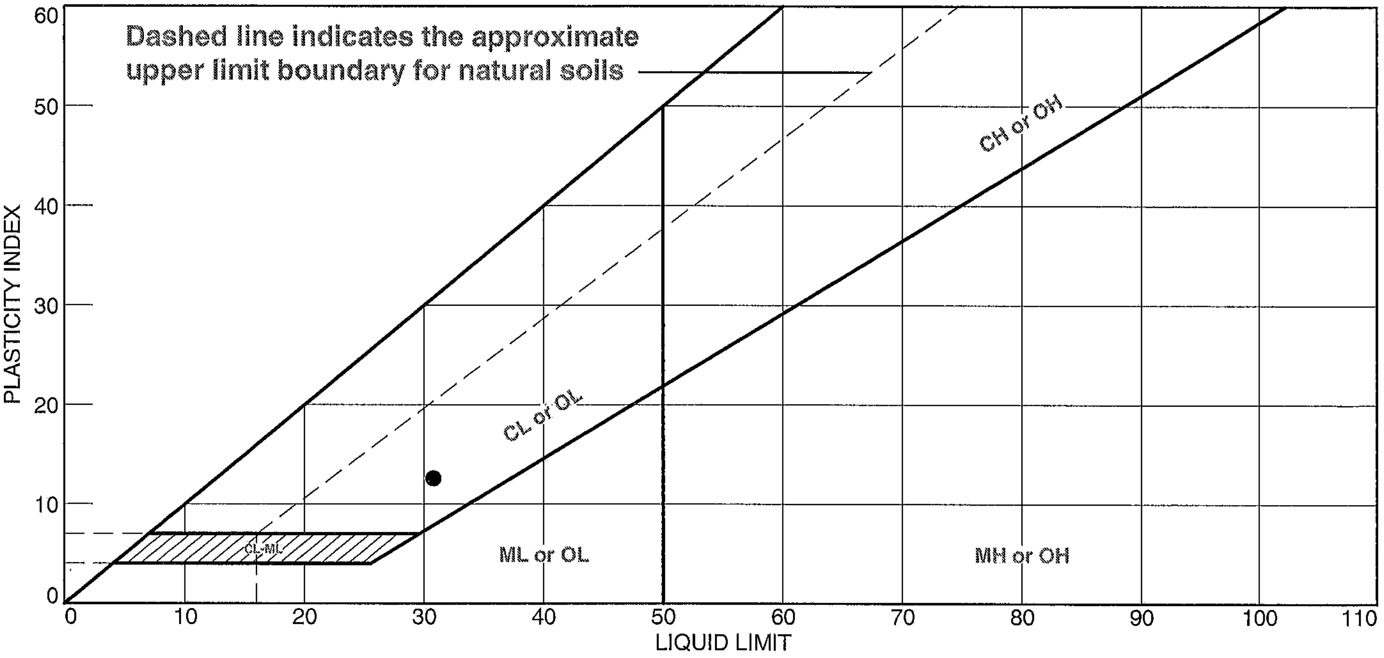
Fractional Components

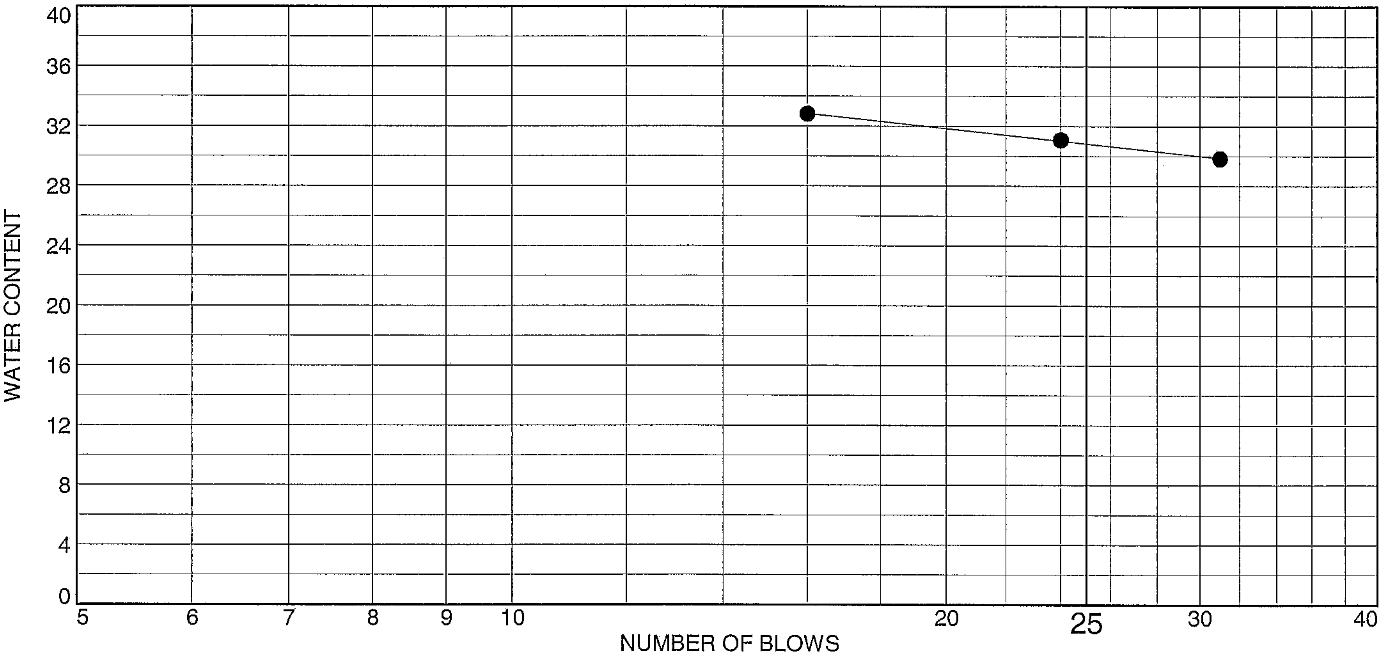
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.1	1.1	2.2	27.9	33.8	63.9	21.3	13.7	35.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0026	0.0074	0.0245	0.2120	0.3120	0.6318	0.7741	1.0041	1.5433

Fineness Modulus
1.32

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand, SC (#28902)	30.8	18.2	12.6	68.8	35.0	SC

Project No. 5014-09- **Client:** TerraCosta Consulting Group, Inc.

Project: #2769A Harbor Island West Marina

Sample Number: B1-17 **Depth:** 45.0'

Remarks:

Figure #28902

Tested By: R. Valles **Checked By:** L. Collins

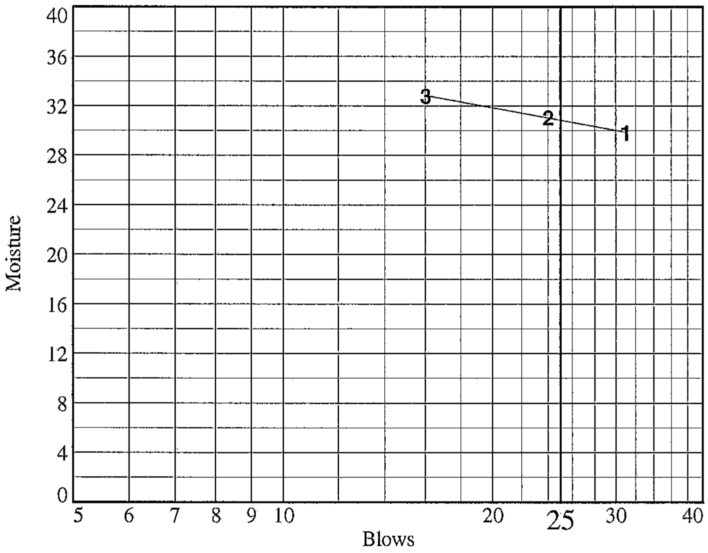
LIQUID AND PLASTIC LIMIT TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 45.0' **Sample Number:** B1-17
Material Description: Silty Sand, SC (#28902)
%<#40: 68.8 **%<#200:** 35.0 **USCS:** SC **AASHTO:** A-2-6(1)
Tested by: R. Valles **Checked by:** L. Collins

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	39.86	37.19	38.22			
Dry+Tare	35.50	33.41	33.95			
Tare	20.89	21.25	20.94			
# Blows	31	24	16			
Moisture	29.8	31.1	32.8			

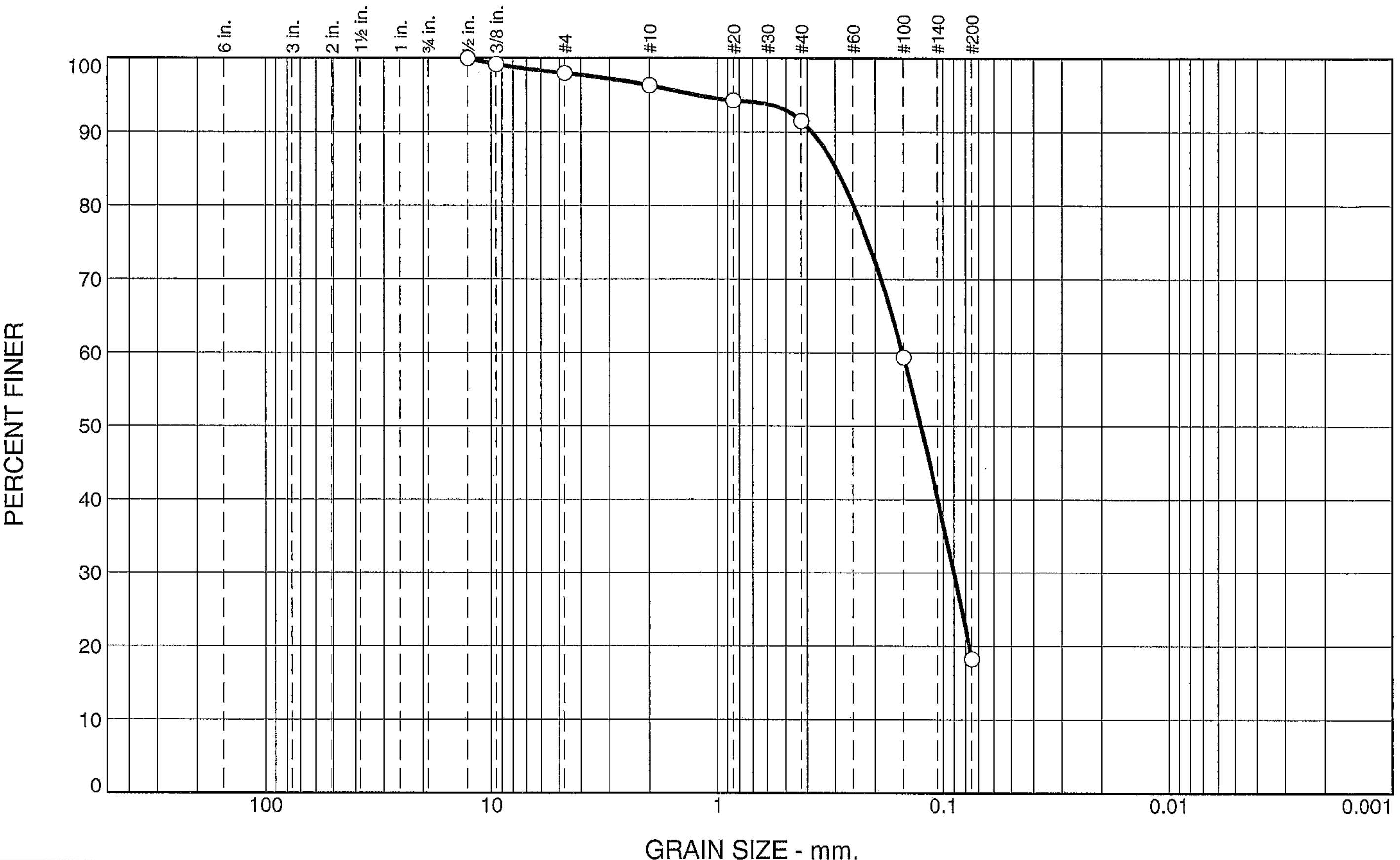


Liquid Limit= 30.8
Plastic Limit= 18.2
Plasticity Index= 12.6

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	30.26	30.14			
Dry+Tare	28.83	28.73			
Tare	20.86	21.09			
Moisture	17.9	18.5			

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	1.7	4.8	73.2	18.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5"	100.0		
0.375"	99.2		
#4	98.0		
#10	96.3		
#20	94.3		
#40	91.5		
#100	59.4		
#200	18.3		

* (no specification provided)

Material Description

Silty Sand, SM (#28903)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3809 D_{85}= 0.2972 D_{60}= 0.1518
D_{50}= 0.1258 D_{30}= 0.0902 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: B4-6 **Depth:** 25.0'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28903

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 25.0' **Sample Number:** B4-6
Material Description: Silty Sand, SM (#28903)
Date: 12/12/14
USCS Classification: SM
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.5"	100.0
0.375"	99.2
#4	98.0
#10	96.3
#20	94.3
#40	91.5
#100	59.4
#200	18.3

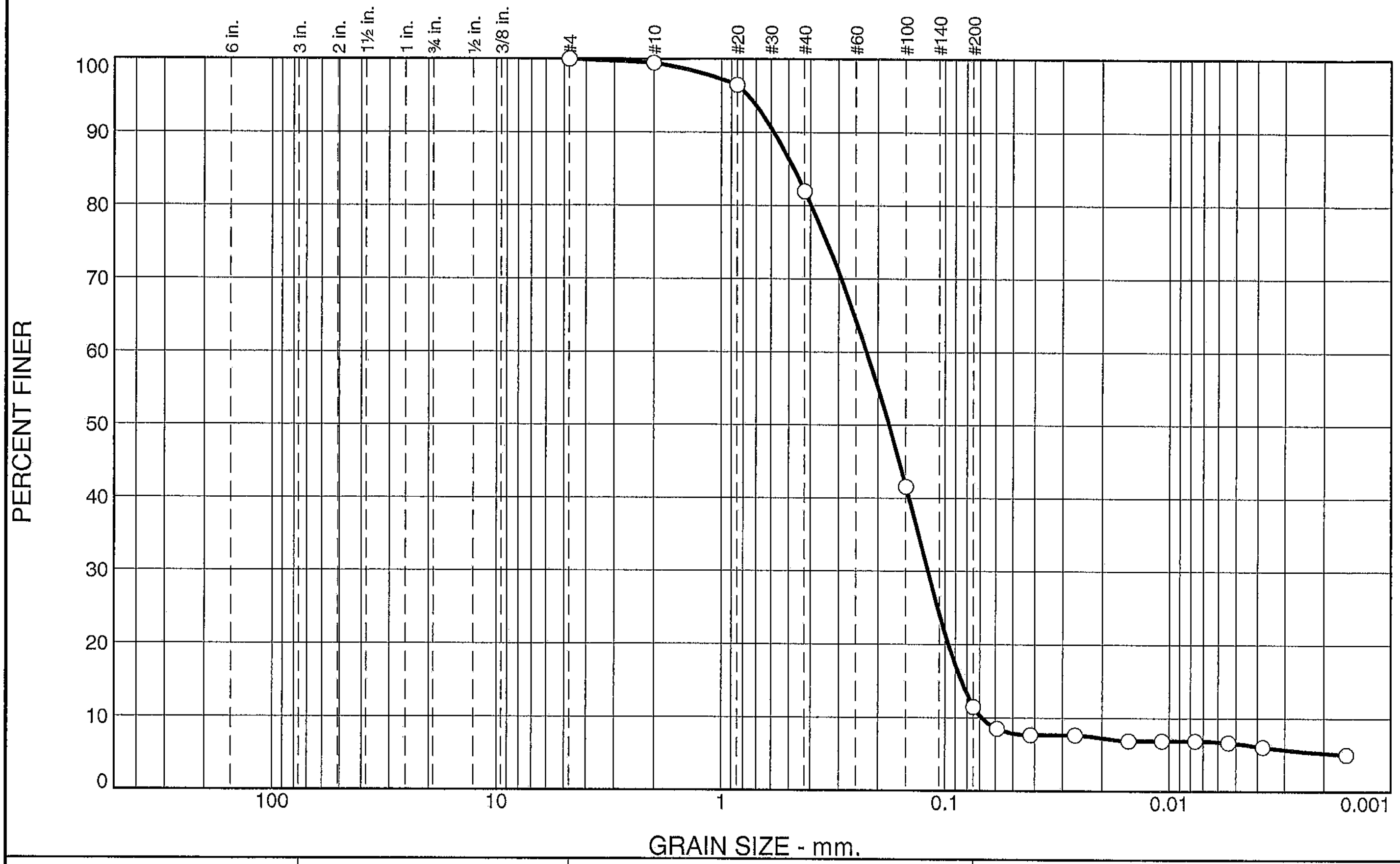
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.0	2.0	1.7	4.8	73.2	79.7			18.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0770	0.0902	0.1258	0.1518	0.2486	0.2972	0.3809	1.2326

Fineness Modulus
0.73

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	17.5	70.5	6.2	5.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#20	96.5		
#40	82.0		
#100	41.6		
#200	11.5		

* (no specification provided)

Material Description

Silty Sand, SM (#28904)

Atterberg Limits

PL= NP
LL= NV
PI= NP

Coefficients

D_{90}= 0.5820
D_{85}= 0.4739
D_{60}= 0.2249
D_{50}= 0.1787
D_{30}= 0.1196
D_{15}= 0.0850
D_{10}= 0.0690
C_u= 3.26
C_c= 0.92

Classification

USCS= SP-SM
AASHTO= A-2-4(0)

Remarks

Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay

Sample Number: B4-7 **Depth:** 30.0'

Date: 12/12/14

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28904

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 30.0' **Sample Number:** B4-7
Material Description: Silty Sand, SM (#28904)
Date: 12/12/14 **PL:** NP **LL:** NV **PI:** NP
USCS Classification: SP-SM **AASHTO Classification:** A-2-4(0)
Testing Remarks: Assumed specific gravity of 2.65 used for hydrometer calculations and soil particles smaller than 0.002mm have been classified as clay
Tested by: R. Valles **Checked by:** L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
#4	100.0
#10	99.5
#20	96.5
#40	82.0
#100	41.6
#200	11.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.5
Weight of hydrometer sample =57.15
Hygroscopic moisture correction:
Moist weight and tare = 36.89
Dry weight and tare = 36.84
Tare weight = 26.81
Hygroscopic moisture = 0.5%
Table of composite correction values:

Temp., deg. C:	18.6	20.2	21.0	22.3	23.2
Comp. corr.:	-6.0	-5.5	-5.0	-5.0	-5.0

Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 20.4 - .13 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	20.8	10.0	4.9	0.0135	10.0	19.1	0.0590	8.5
2.00	20.8	9.5	4.4	0.0135	9.5	19.2	0.0418	7.7
5.00	20.8	9.5	4.4	0.0135	9.5	19.2	0.0265	7.7
15.00	20.9	9.0	3.9	0.0135	9.0	19.2	0.0153	6.9
30.00	20.9	9.0	3.9	0.0135	9.0	19.2	0.0108	6.9
60.00	20.9	9.0	3.9	0.0135	9.0	19.2	0.0076	6.9
120.00	20.7	9.0	3.8	0.0135	9.0	19.2	0.0054	6.7
250.00	20.1	9.0	3.5	0.0136	9.0	19.2	0.0038	6.1
1440.00	19.8	8.5	2.9	0.0137	8.5	19.3	0.0016	5.0

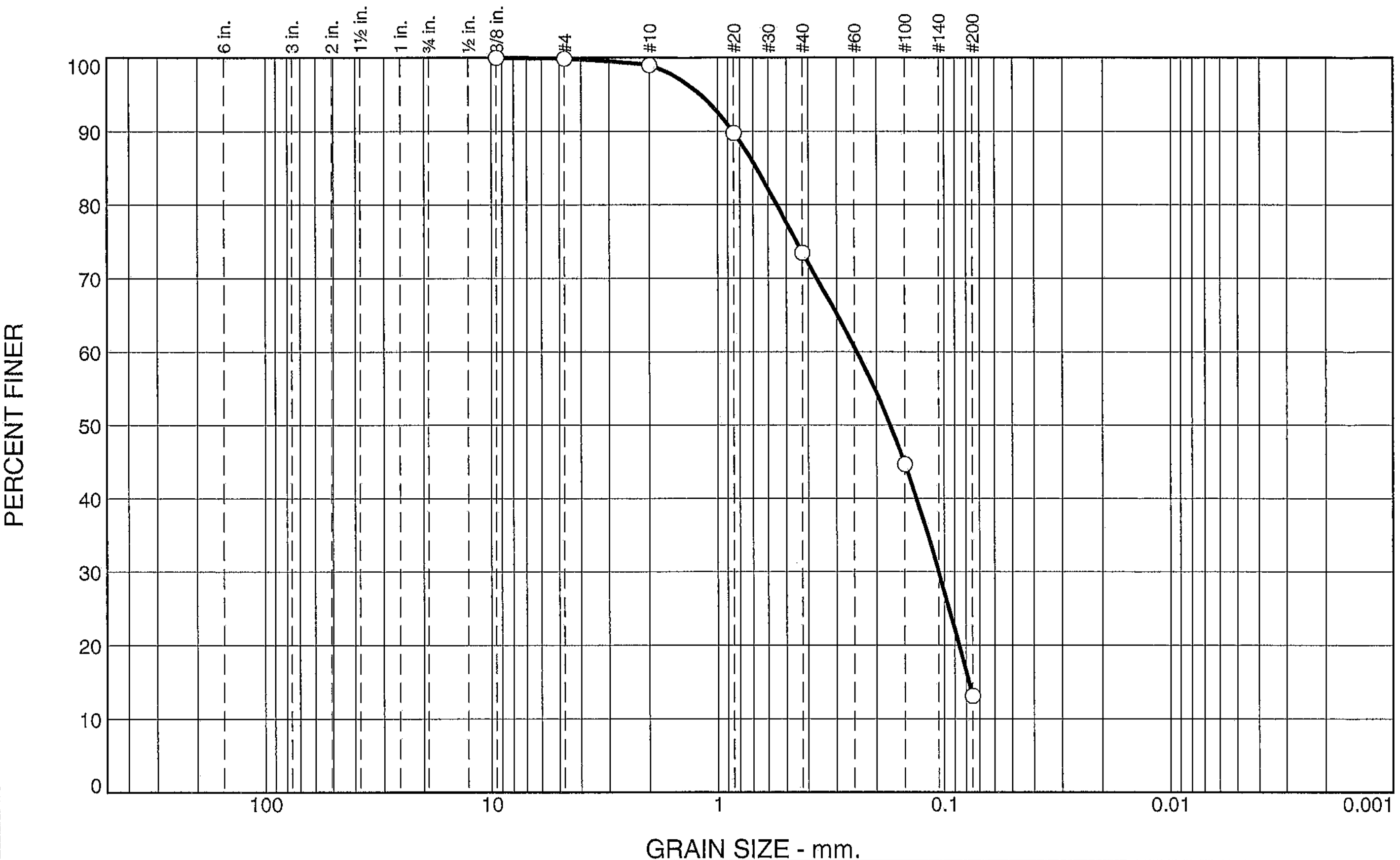
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.5	17.5	70.5	88.5	6.2	5.3	11.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0690	0.0850	0.0968	0.1196	0.1787	0.2249	0.3968	0.4739	0.5820	0.7606

Fineness Modulus	C_u	C_c
0.99	3.26	0.92

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.9	25.5	60.4	13.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.9		
#10	99.0		
#20	89.8		
#40	73.5		
#100	44.7		
#200	13.1		

* (no specification provided)

Material Description

Silty Sand, SM (#28905)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.8590 D_{85}= 0.6782 D_{60}= 0.2444
D_{50}= 0.1741 D_{30}= 0.1063 D_{15}= 0.0779
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: B4-8 **Depth:** 35.0'

Date: 12/12/14

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina

Project No: 5014-09-0006. **Figure** #28905

Tested By: R. Valles **Checked By:** L. Collins

GRAIN SIZE DISTRIBUTION TEST DATA

12/16/2014

Client: TerraCosta Consulting Group, Inc.
Project: #2769A Harbor Island West Marina
Project Number: 5014-09-0006.
Depth: 35.0'
Sample Number: B4-8
Material Description: Silty Sand, SM (#28905)
Date: 12/12/14
USCS Classification: SM
Tested by: R. Valles
Checked by: L. Collins

Sieve Test Data

Sieve Opening Size	Percent Finer
0.375"	100.0
#4	99.9
#10	99.0
#20	89.8
#40	73.5
#100	44.7
#200	13.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.1	0.1	0.9	25.5	60.4	86.8			13.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0779	0.0863	0.1063	0.1741	0.2444	0.5515	0.6782	0.8590	1.1929

Fineness Modulus
1.14

APPENDIX C

EQSEARCH RESULTS

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                           *                       *
                           *    E Q S E A R C H    *
                           *                       *
                           *     Version 3.00      *
                           *                       *
                           *************************

                                 ESTIMATION OF
                            PEAK ACCELERATION FROM
                        CALIFORNIA EARTHQUAKE CATALOGS


JOB NUMBER: 0042-0000
                                                     DATE: 01-13-2015

JOB NAME: Harbor Island West Marina

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT


MAGNITUDE RANGE:
   MINIMUM MAGNITUDE:  4.00
   MAXIMUM MAGNITUDE:  9.00

SITE COORDINATES:
   SITE LATITUDE:  32.7222
   SITE LONGITUDE:  117.2106

SEARCH DATES:
           START DATE:   1800
           END DATE:   2000

SEARCH RADIUS:
           100.0 mi
           160.9 km

ATTENUATION RELATION:   3) Boore et al. (1997) Horiz. - NEHRP D (250)
   UNCERTAINTY (M=Median, S=Sigma): M       Number of Sigmas:  0.0
   ASSUMED SOURCE TYPE:  DS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
   SCOND:   0  Depth Source:  A
   Basement Depth:  5.00 km     Campbell SSR:        Campbell SHR:
   COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km):  0.0
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                         EARTHQUAKE SEARCH RESULTS
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-------------------------------------------------------------------------------
    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+------+---+-----------
MGI |32.7000|117.2000|04/19/1906| 028 0.0|  0.0| 4.30| 0.167 |VIII|  1.6(  2.6)
MGI |32.7000|117.2000|09/08/1915| 742 0.0|  0.0| 4.00| 0.143 |VIII|  1.6(  2.6)
DMG |32.7000|117.2000|05/27/1862|20 0 0.0|  0.0| 5.90| 0.388 |  X |  1.6(  2.6)
MGI |32.7000|117.2000|05/20/1920|1330 0.0|  0.0| 4.00| 0.143 |VIII|  1.6(  2.6)
T-A |32.6700|117.1700|04/15/1865| 840 0.0|  0.0| 4.30| 0.126 |VIII|  4.3(  6.9)
T-A |32.6700|117.1700|05/24/1865| 0 0 0.0|  0.0| 5.00| 0.182 |VIII|  4.3(  6.9)
T-A |32.6700|117.1700|12/00/1856| 0 0 0.0|  0.0| 5.00| 0.182 |VIII|  4.3(  6.9)
T-A |32.6700|117.1700|10/21/1862| 0 0 0.0|  0.0| 5.00| 0.182 |VIII|  4.3(  6.9)
T-A |32.6700|117.1700|01/25/1863|1020 0.0|  0.0| 4.30| 0.126 |VIII|  4.3(  6.9)
PAS |32.6790|117.1510|06/18/1985| 32228.7|  5.7| 4.00| 0.104 | VII|  4.6(  7.3)
PAS |32.6150|117.1520|10/29/1986| 23815.3| 14.6| 4.10| 0.078 | VII|  8.1( 13.1)
MGI |32.8000|117.1000|05/25/1803| 0 0 0.0|  0.0| 5.00| 0.124 | VII|  8.4( 13.5)
PAS |32.6270|117.3770|06/29/1983| 8 836.4|  5.0| 4.60| 0.079 | VII| 11.7( 18.8)
DMG |32.8500|117.4830|02/23/1943| 92112.0|  0.0| 4.00| 0.042 | VI | 18.1( 29.1)
DMG |33.0000|117.3000|11/22/1800|2130 0.0|  0.0| 6.50| 0.146 |VIII| 19.9( 32.0)
DMG |33.0000|117.0000|03/03/1906|2025 0.0|  0.0| 4.50| 0.046 | VI | 22.7( 36.6)
MGI |33.0000|117.0000|12/29/1914|10 0 0.0|  0.0| 4.00| 0.035 |  V | 22.7( 36.6)
MGI |33.0000|117.0000|09/21/1856| 730 0.0|  0.0| 5.00| 0.060 | VI | 22.7( 36.6)
DMG |32.8000|116.8000|10/23/1894|23 3 0.0|  0.0| 5.70| 0.082 | VII| 24.4( 39.3)
MGI |32.8000|116.8000|08/14/1927|1448 0.0|  0.0| 4.60| 0.046 | VI | 24.4( 39.3)
MGI |32.7000|116.7000|03/21/1918|2325 0.0|  0.0| 4.00| 0.029 |  V | 29.7( 47.8)
GSP |33.0700|116.8000|12/04/1991|071057.5| 15.0| 4.20| 0.029 |  V | 33.8( 54.4)
PAS |32.9470|117.7360|01/15/1989|153955.2|  6.0| 4.20| 0.029 |  V | 34.2( 55.0)
PAS |32.3020|116.8810|08/19/1978| 931 5.7| 19.8| 4.10| 0.027 |  V | 34.8( 56.0)
MGI |33.2000|117.0000|07/20/1923| 7 0 0.0|  0.0| 4.00| 0.025 |  V | 35.2( 56.6)
MGI |33.1000|116.8000|06/22/1918| 557 0.0|  0.0| 4.00| 0.025 |  V | 35.3( 56.8)
DMG |32.5830|117.8000|04/19/1939| 741 0.0|  0.0| 4.50| 0.033 |  V | 35.6( 57.3)
DMG |32.7170|117.8330|11/06/1950|205546.0|  0.0| 4.40| 0.031 |  V | 36.2( 58.2)
DMG |32.8000|117.8330|01/24/1942|214148.0|  0.0| 4.00| 0.025 |  V | 36.5( 58.8)
T-A |32.2500|117.5000|01/13/1877|20 0 0.0|  0.0| 5.00| 0.041 |  V | 36.7( 59.1)
PAS |32.9450|117.8060|09/07/1984|11 313.4|  6.0| 4.30| 0.028 |  V | 37.8( 60.8)
PAS |32.9700|117.8030|07/14/1986| 03246.2| 10.0| 4.00| 0.024 | IV | 38.4( 61.8)
GSP |32.9700|117.8100|04/04/1990|085439.3|  6.0| 4.00| 0.023 | IV | 38.7( 62.4)
PAS |32.9450|117.8310|07/29/1986| 81741.8| 10.0| 4.10| 0.025 |  V | 39.1( 63.0)
DMG |33.2670|117.0170|06/07/1935|1633 0.0|  0.0| 4.00| 0.023 | IV | 39.2( 63.2)
PAS |32.9330|117.8410|07/29/1986| 81741.6| 10.0| 4.30| 0.027 |  V | 39.4( 63.3)
GSP |32.9850|117.8180|06/21/1995|211736.2|  6.0| 4.30| 0.027 |  V | 39.6( 63.8)
MGI |33.0000|116.6000|06/11/1917| 354 0.0|  0.0| 4.00| 0.023 | IV | 40.3( 64.8)
PAS |32.7590|117.9060|10/18/1976|172753.1| 13.8| 4.20| 0.025 |  V | 40.5( 65.1)
USG |33.0170|117.8170|07/16/1986|1247 3.7| 10.0| 4.11| 0.024 |  V | 40.6( 65.4)
USG |33.0170|117.8170|07/14/1986| 11112.6| 10.0| 4.12| 0.024 |  V | 40.6( 65.4)
PAS |32.7140|117.9100|10/18/1976|172652.6| 15.1| 4.20| 0.025 |  V | 40.6( 65.4)
PAS |32.9860|117.8440|10/01/1986|201218.6|  6.0| 4.00| 0.022 | IV | 41.0( 66.0)
PAS |32.9900|117.8490|07/13/1986|14 133.0| 12.0| 4.60| 0.031 |  V | 41.4( 66.6)
PAS |32.9710|117.8700|07/13/1986|1347 8.2|  6.0| 5.30| 0.044 | VI | 41.9( 67.5)
MGI |32.6000|116.5000|05/03/1918| 425 0.0|  0.0| 4.00| 0.022 | IV | 42.2( 67.8)
DMG |33.1000|116.6330|02/08/1952|174028.0|  0.0| 4.00| 0.022 | IV | 42.4( 68.3)
DMG |33.2000|116.7200|05/12/1930|172548.5|  0.0| 4.20| 0.024 | IV | 43.5( 70.1)
MGI |33.1000|116.6000|05/28/1917|1017 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|03/04/1915|1250 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|05/11/1915|1145 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|08/10/1921|19 6 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|02/05/1922|1915 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
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                         EARTHQUAKE SEARCH RESULTS
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-------------------------------------------------------------------------------
    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
MGI |33.1000|116.6000|02/16/1915|1330 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|08/10/1921|2151 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|08/19/1917| 710 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
MGI |33.1000|116.6000|02/09/1920| 220 0.0|  0.0| 4.00| 0.021 | IV | 44.0( 70.7)
DMG |33.2000|116.7000|01/01/1920| 235 0.0|  0.0| 5.00| 0.036 |  V | 44.3( 71.3)
PAS |32.7560|117.9880|01/12/1975|212214.8| 15.3| 4.80| 0.032 |  V | 45.2( 72.7)
DMG |32.0830|117.0000|05/10/1948| 34925.0|  0.0| 4.00| 0.021 | IV | 45.8( 73.7)
DMG |32.1670|117.6670|10/29/1935|1017 0.0|  0.0| 4.50| 0.026 |  V | 46.7( 75.1)
DMG |33.1500|116.5830|12/02/1935| 319 0.0|  0.0| 4.00| 0.020 | IV | 46.8( 75.4)
PAS |32.6250|118.0090|07/11/1981|215029.4|  5.0| 4.30| 0.024 | IV | 46.9( 75.4)
PAS |33.0330|117.9440|02/22/1983| 21830.4| 10.0| 4.30| 0.023 | IV | 47.6( 76.6)
DMG |33.1100|116.5230|01/24/1957|205449.9|  3.9| 4.60| 0.027 |  V | 48.0( 77.3)
MGI |33.2000|116.6000|10/12/1920|1748 0.0|  0.0| 5.30| 0.039 |  V | 48.4( 77.8)
DMG |32.1130|116.7850|04/23/1968|131825.4| 10.0| 4.20| 0.022 | IV | 48.8( 78.6)
DMG |33.0020|116.4360|07/02/1957| 65638.5| 12.8| 4.10| 0.021 | IV | 48.9( 78.7)
DMG |33.0000|116.4330|06/04/1940|1035 8.3|  0.0| 5.10| 0.035 |  V | 49.0( 78.9)
GSP |32.7260|118.0680|12/27/2000|002714.1|  6.0| 4.10| 0.020 | IV | 49.8( 80.1)
DMG |32.6800|116.3540|01/21/1970|1124 0.4|  8.0| 4.10| 0.020 | IV | 49.9( 80.2)
PAS |33.1380|116.5010|10/10/1984|212258.9| 11.6| 4.50| 0.025 |  V | 50.1( 80.7)
DMG |32.6800|118.0770|10/28/1973|22 0 2.7|  8.0| 4.50| 0.025 |  V | 50.4( 81.1)
DMG |32.0000|117.0670|06/23/1939|2048 0.0|  0.0| 4.50| 0.025 |  V | 50.6( 81.4)
DMG |32.9670|116.3830|10/31/1942|15 758.0|  0.0| 4.00| 0.019 | IV | 50.9( 81.9)
DMG |32.3330|116.4670|01/13/1935| 224 0.0|  0.0| 4.00| 0.019 | IV | 50.9( 82.0)
DMG |33.1000|116.4500|11/23/1953|1339 7.0|  0.0| 4.30| 0.022 | IV | 51.2( 82.4)
DMG |32.0000|117.0000|04/27/1942|112754.0|  0.0| 4.00| 0.019 | IV | 51.4( 82.6)
DMG |32.0000|117.0000|02/11/1949| 95725.0|  0.0| 4.00| 0.019 | IV | 51.4( 82.6)
DMG |33.1670|116.5000|06/23/1932| 22552.7|  0.0| 4.00| 0.019 | IV | 51.4( 82.7)
DMG |33.1670|116.5000|06/23/1932| 23037.1|  0.0| 4.00| 0.019 | IV | 51.4( 82.7)
DMG |33.0970|116.4440|08/18/1959|215221.3| 17.3| 4.30| 0.022 | IV | 51.4( 82.7)
GSP |32.6810|118.1090|06/20/1997|043540.5|  6.0| 4.70| 0.027 |  V | 52.3( 84.1)
DMG |32.5290|118.0820|05/26/1973|234633.3|  8.0| 4.30| 0.022 | IV | 52.4( 84.3)
DMG |32.6000|116.3170|06/15/1946|194653.0|  0.0| 4.80| 0.028 |  V | 52.6( 84.7)
DMG |32.0000|117.5000|05/03/1939| 828 0.0|  0.0| 4.00| 0.019 | IV | 52.6( 84.7)
DMG |32.0000|117.5000|06/24/1939|1627 0.0|  0.0| 5.00| 0.031 |  V | 52.6( 84.7)
DMG |32.0000|117.5000|06/25/1939| 1 9 0.0|  0.0| 4.00| 0.019 | IV | 52.6( 84.7)
DMG |32.0000|117.5000|05/03/1939|2358 0.0|  0.0| 4.50| 0.024 |  V | 52.6( 84.7)
DMG |32.0000|117.5000|05/01/1939|2353 0.0|  0.0| 5.00| 0.031 |  V | 52.6( 84.7)
DMG |32.0000|117.5000|05/01/1939|2357 0.0|  0.0| 4.50| 0.024 |  V | 52.6( 84.7)
DMG |32.2000|116.5500|11/06/1949|23 510.0|  0.0| 4.00| 0.019 | IV | 52.7( 84.9)
DMG |32.2000|116.5500|11/05/1949| 43524.0|  0.0| 5.10| 0.033 |  V | 52.7( 84.9)
DMG |32.2000|116.5500|11/04/1949|204238.0|  0.0| 5.70| 0.045 | VI | 52.7( 84.9)
DMG |32.2000|116.5500|11/11/1949|1354 0.0|  0.0| 4.20| 0.021 | IV | 52.7( 84.9)
DMG |32.2000|116.5500|11/05/1949|20 2 7.0|  0.0| 4.00| 0.019 | IV | 52.7( 84.9)
DMG |33.1670|116.4670|08/01/1960|193930.0|  0.0| 4.20| 0.021 | IV | 52.9( 85.1)
DMG |32.7000|116.3000|02/24/1892| 720 0.0|  0.0| 6.70| 0.077 | VII| 52.9( 85.2)
DMG |31.9920|116.9270|04/10/1968|104237.8| 10.0| 4.50| 0.024 |  V | 53.1( 85.4)
DMG |33.1170|116.4170|10/21/1940| 64933.0|  0.0| 4.50| 0.024 | IV | 53.5( 86.0)
DMG |33.1170|116.4170|06/04/1940|103656.0|  0.0| 4.00| 0.018 | IV | 53.5( 86.0)
DMG |33.4540|116.8980|07/29/1936|142252.8| 10.0| 4.00| 0.018 | IV | 53.7( 86.4)
DMG |33.4560|116.8960|06/16/1938| 55916.9| 10.0| 4.00| 0.018 | IV | 53.8( 86.6)
DMG |33.0380|116.3610|02/26/1957|211652.2|  0.0| 4.10| 0.019 | IV | 53.9( 86.7)
GSP |32.6850|118.1380|06/20/1997|053855.0|  6.0| 4.20| 0.020 | IV | 53.9( 86.8)
GSP |33.1100|116.4000|04/01/1984|071702.3| 11.0| 4.00| 0.018 | IV | 54.1( 87.0)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+---------+-----+-----+-------+----+----------
T-A |33.5000|117.0700|12/29/1880| 7 0 0.0|  0.0| 4.30| 0.021 | IV | 54.3( 87.4)
DMG |32.0830|116.6670|10/12/1938|1231 0.0|  0.0| 4.00| 0.018 | IV | 54.3( 87.4)
DMG |32.0830|116.6670|09/27/1934|2140 0.0|  0.0| 4.00| 0.018 | IV | 54.3( 87.4)
DMG |32.0830|116.6670|11/25/1934| 818 0.0|  0.0| 5.00| 0.031 |  V | 54.3( 87.4)
GSP |32.6260|118.1510|06/20/1997|080413.6|  6.0| 4.60| 0.025 |  V | 55.1( 88.6)
DMG |33.5000|117.0000|08/08/1925|1013 0.0|  0.0| 4.50| 0.023 | IV | 55.1( 88.6)
DMG |33.1670|116.4170|12/05/1939|173352.0|  0.0| 4.00| 0.018 | IV | 55.3( 89.0)
DMG |33.1670|116.4170|07/10/1938|18 6 0.0|  0.0| 4.00| 0.018 | IV | 55.3( 89.0)
DMG |33.1670|116.4170|10/14/1935|1550 0.0|  0.0| 4.00| 0.018 | IV | 55.3( 89.0)
DMG |31.9540|117.5060|09/29/1972|141341.2|  8.0| 4.30| 0.021 | IV | 55.8( 89.7)
DMG |32.1000|116.6000|01/07/1950| 93735.0|  0.0| 4.00| 0.018 | IV | 55.8( 89.8)
DMG |32.7180|118.1720|04/28/1938| 6 728.0| 10.0| 4.50| 0.023 | IV | 55.8( 89.9)
DMG |32.9610|116.2900|08/25/1971|23 033.0|  8.0| 4.00| 0.018 | IV | 55.9( 89.9)
DMG |32.9230|116.2720|10/14/1969|131842.7| 10.0| 4.50| 0.023 | IV | 56.2( 90.4)
DMG |33.5000|116.9170|11/04/1935| 355 0.0|  0.0| 4.50| 0.023 | IV | 56.3( 90.6)
DMG |32.9520|116.2790|09/13/1973|173039.8|  8.0| 4.80| 0.027 |  V | 56.3( 90.6)
PAS |32.9050|116.2610|12/25/1975| 71852.3|  3.6| 4.00| 0.018 | IV | 56.5( 91.0)
PAS |33.4200|116.6980|06/05/1978|16 3 3.9| 11.9| 4.40| 0.022 | IV | 56.6( 91.0)
DMG |33.1210|116.3490|05/25/1971|10 252.9|  8.0| 4.10| 0.018 | IV | 57.0( 91.8)
DMG |32.0830|117.8330|09/13/1940|144548.0|  0.0| 4.50| 0.023 | IV | 57.1( 91.9)
DMG |31.9390|116.8930|04/10/1968|1055 3.2| 10.0| 4.30| 0.020 | IV | 57.2( 92.0)
DMG |33.0530|116.3060|04/02/1967|201538.6|  1.0| 4.30| 0.020 | IV | 57.2( 92.1)
DMG |32.7500|118.2000|06/25/1939| 149 0.0|  0.0| 4.50| 0.023 | IV | 57.5( 92.5)
DMG |33.1830|116.3830|10/14/1949| 02925.0|  0.0| 4.10| 0.018 | IV | 57.5( 92.6)
DMG |32.9900|116.2680|11/08/1958|132044.1|  2.4| 4.10| 0.018 | IV | 57.7( 92.9)
DMG |32.9500|116.2500|11/14/1951|2355 3.0|  0.0| 4.10| 0.018 | IV | 57.9( 93.2)
DMG |32.0000|116.7000|12/02/1929|1124 0.0|  0.0| 4.50| 0.022 | IV | 58.1( 93.5)
DMG |33.4880|116.7770|06/12/1959|11 313.0|  5.7| 4.00| 0.017 | IV | 58.5( 94.2)
MGI |33.5000|116.8000|06/02/1917| 435 0.0|  0.0| 4.00| 0.017 | IV | 58.7( 94.5)
MGI |33.5000|116.8000|03/30/1918|16 5 0.0|  0.0| 4.60| 0.023 | IV | 58.7( 94.5)
MGI |33.5000|116.8000|05/31/1917| 435 0.0|  0.0| 4.00| 0.017 | IV | 58.7( 94.5)
MGI |33.5000|116.8000|11/26/1916|17 5 0.0|  0.0| 4.00| 0.017 | IV | 58.7( 94.5)
DMG |33.4500|116.6830|04/25/1955| 25515.0|  0.0| 4.00| 0.017 | IV | 58.8( 94.6)
MGI |32.8000|116.2000|07/23/1929|1155 0.0|  0.0| 4.30| 0.020 | IV | 58.9( 94.8)
DMG |32.8170|116.2000|11/22/1953| 81138.0|  0.0| 4.10| 0.018 | IV | 59.0( 95.0)
DMG |33.0430|116.2600|08/22/1961|231933.6| 12.1| 4.40| 0.021 | IV | 59.4( 95.6)
DMG |32.1000|116.5000|01/08/1937|1246 0.0|  0.0| 4.00| 0.017 | IV | 59.7( 96.0)
DMG |33.4000|116.5670|02/04/1953| 43616.0|  0.0| 4.30| 0.020 | IV | 59.8( 96.2)
DMG |31.9700|116.6980|04/23/1968|132234.8| 10.0| 4.00| 0.017 | IV | 59.9( 96.4)
DMG |32.1670|116.4170|09/17/1950|194330.0|  0.0| 4.50| 0.022 | IV | 60.1( 96.7)
DMG |33.2670|116.4000|06/06/1940|2321 4.0|  0.0| 4.00| 0.017 | IV | 60.1( 96.8)
DMG |33.4830|116.7000|12/28/1948|125341.0|  0.0| 4.00| 0.017 | IV | 60.3( 97.0)
GSG |31.8490|117.1980|01/29/1995|160231.5| 12.0| 4.40| 0.021 | IV | 60.3( 97.0)
GSP |32.8220|116.1750|05/24/1992|122225.8| 12.0| 4.10| 0.018 | IV | 60.5( 97.4)
DMG |33.0330|116.2330|09/20/1961| 5 410.0|  0.0| 4.00| 0.017 | IV | 60.6( 97.5)
DMG |33.0190|116.2250|08/20/1969|152957.2|  0.6| 4.00| 0.017 | IV | 60.7( 97.7)
DMG |33.4170|116.5670|12/22/1950| 2 536.0|  0.0| 4.00| 0.017 | IV | 60.7( 97.7)
DMG |33.0500|116.2380|08/23/1961| 1 047.8| 11.9| 4.70| 0.024 |  V | 60.8( 97.8)
DMG |33.0210|116.2230|01/13/1963| 23938.9| 13.0| 4.20| 0.018 | IV | 60.9( 98.0)
DMG |32.8670|118.2500|02/13/1952|151337.0|  0.0| 4.70| 0.024 | IV | 61.1( 98.4)
DMG |32.5330|116.1830|02/22/1939|1030 0.0|  0.0| 4.00| 0.016 | IV | 61.2( 98.4)
DMG |32.5330|116.1830|11/12/1939|1849 0.0|  0.0| 4.00| 0.016 | IV | 61.2( 98.4)
DMG |33.4670|116.6330|02/20/1934|1035 0.0|  0.0| 4.00| 0.016 | IV | 61.3( 98.7)
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    |       |        |          |  TIME  |     |      | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+-----------
GSP |32.5880|116.1670|03/13/1999|133120.4|  6.0| 4.30| 0.019 | IV | 61.4( 98.8)
GSP |32.5920|116.1650|02/19/1999|030832.2|  3.0| 4.20| 0.018 | IV | 61.4( 98.9)
GSP |32.5930|116.1630|04/07/1999|062640.1|  8.0| 4.00| 0.016 | IV | 61.5( 99.0)
GSP |32.5870|116.1630|04/18/1999|155301.1|  7.0| 4.20| 0.018 | IV | 61.6( 99.1)
DMG |33.3330|116.4330|02/12/1954| 94428.0|  0.0| 4.50| 0.021 | IV | 61.7( 99.3)
DMG |33.2000|116.3000|05/12/1930| 414 0.0|  0.0| 4.00| 0.016 | IV | 62.2(100.1)
DMG |33.4000|116.5000|10/11/1918| 4 0 0.0|  0.0| 4.00| 0.016 | IV | 62.3(100.2)
PAS |33.0580|116.2110|03/22/1982| 85328.6|  4.6| 4.50| 0.021 | IV | 62.4(100.4)
DMG |33.3680|116.4440|03/25/1937|232026.7| 10.0| 4.00| 0.016 | IV | 62.9(101.2)
DMG |33.4670|116.5830|03/26/1937|2124 0.0|  0.0| 4.00| 0.016 | IV | 62.9(101.3)
DMG |33.4670|116.5830|03/27/1937| 742 0.0|  0.0| 4.50| 0.021 | IV | 62.9(101.3)
DMG |33.4670|116.5830|03/27/1937| 528 0.0|  0.0| 4.00| 0.016 | IV | 62.9(101.3)
DMG |33.4670|116.5830|01/04/1938| 029 0.0|  0.0| 4.50| 0.021 | IV | 62.9(101.3)
DMG |31.8110|117.1310|12/22/1964|205433.2|  2.3| 5.60| 0.037 |  V | 63.1(101.5)
DMG |33.2830|116.3500|04/13/1949| 75336.0|  0.0| 4.10| 0.017 | IV | 63.1(101.5)
DMG |32.9500|116.1500|10/25/1942|185939.0|  0.0| 4.00| 0.016 | IV | 63.5(102.2)
DMG |33.4200|116.4900|03/29/1937|17 316.8| 10.0| 4.00| 0.016 | IV | 63.7(102.5)
DMG |33.5080|116.6310|08/11/1967| 05711.4| 10.7| 4.10| 0.017 | IV | 63.8(102.6)
DMG |32.8940|116.1190|09/16/1961|194939.4| 18.5| 4.40| 0.020 | IV | 64.4(103.7)
DMG |33.2910|116.3170|03/19/1966|142156.0| 10.9| 4.00| 0.016 | IV | 65.0(104.5)
DMG |33.5060|116.5850|05/21/1967|144234.4| 19.4| 4.70| 0.023 | IV | 65.1(104.8)
DMG |32.6000|116.1000|12/24/1941| 73012.0|  0.0| 4.50| 0.020 | IV | 65.1(104.8)
PAS |31.7940|117.4100|03/31/1979|213656.7|  5.0| 4.70| 0.023 | IV | 65.1(104.8)
DMG |33.2350|116.2660|04/09/1968| 93833.0|  5.2| 4.00| 0.016 | IV | 65.2(104.9)
DMG |33.5330|116.6330|09/21/1942| 7 754.0|  0.0| 4.00| 0.016 | IV | 65.2(104.9)
USG |32.7700|118.3340|06/16/1985|1027 0.7|  5.0| 4.14| 0.017 | IV | 65.3(105.1)
DMG |33.2000|116.2330|04/05/1942| 92039.0|  0.0| 4.00| 0.016 | IV | 65.5(105.5)
PAS |33.5580|116.6670|06/15/1982|234921.3| 12.2| 4.80| 0.024 | IV | 65.7(105.7)
DMG |33.3430|116.3460|04/28/1969|232042.9| 20.0| 5.80| 0.040 |  V | 65.9(106.0)
DMG |33.3000|116.3000|01/04/1940| 8 711.0|  0.0| 4.00| 0.016 | IV | 66.1(106.4)
DMG |32.3340|116.1700|08/24/1963|204749.5|  4.8| 4.10| 0.016 | IV | 66.2(106.6)
PAS |33.4840|116.5130|08/11/1976|152455.5| 15.4| 4.30| 0.018 | IV | 66.3(106.7)
DMG |33.4170|116.4170|01/02/1943|141118.0|  0.0| 4.50| 0.020 | IV | 66.4(106.9)
DMG |33.5450|117.8070|10/27/1969|1316 2.3|  6.5| 4.50| 0.020 | IV | 66.5(106.9)
DMG |32.8170|118.3500|12/26/1951| 04654.0|  0.0| 5.90| 0.042 | VI | 66.5(107.0)
DMG |32.0250|116.4240|08/20/1961| 42843.0| 12.6| 4.60| 0.021 | IV | 66.5(107.0)
DMG |33.3150|116.3050|04/09/1968|1831 3.8| 12.6| 4.70| 0.022 | IV | 66.5(107.0)
DMG |33.4260|116.4210|03/25/1937|20 4 8.3| 10.0| 4.00| 0.015 | IV | 66.7(107.3)
DMG |33.4830|116.5000|02/15/1951|104759.0|  0.0| 4.80| 0.024 | IV | 66.7(107.3)
DMG |33.4830|116.5000|02/15/1951|104957.0|  0.0| 4.80| 0.024 | IV | 66.7(107.3)
PAS |33.5200|116.5580|08/02/1975| 014 7.7| 13.4| 4.70| 0.022 | IV | 66.8(107.4)
DMG |33.2000|116.2000|05/28/1892|1115 0.0|  0.0| 6.30| 0.052 | VI | 67.2(108.1)
PAS |33.5010|116.5130|02/25/1980|104738.5| 13.6| 5.50| 0.034 |  V | 67.2(108.2)
DMG |32.7860|116.0550|07/04/1938|215945.3| 10.0| 4.00| 0.015 | IV | 67.2(108.2)
DMG |32.7960|116.0550|11/30/1965| 84325.1| 16.4| 4.00| 0.015 | IV | 67.3(108.3)
DMG |33.5340|116.5610|09/23/1956|112441.9| 12.2| 4.30| 0.018 | IV | 67.5(108.6)
DMG |33.3330|116.3000|08/05/1933|2331 0.0|  0.0| 4.40| 0.019 | IV | 67.5(108.6)
DMG |33.3330|116.3000|08/06/1933| 332 0.0|  0.0| 4.70| 0.022 | IV | 67.5(108.6)
PAS |32.2020|116.2290|12/12/1979|213741.0|  5.5| 4.00| 0.015 | IV | 67.5(108.7)
DMG |33.5000|116.5000|09/30/1916| 211 0.0|  0.0| 5.00| 0.026 |  V | 67.6(108.8)
DMG |33.2790|116.2490|01/07/1966|191023.0| -1.7| 4.00| 0.015 | IV | 67.7(108.9)
DMG |31.8590|116.6570|11/15/1972|205117.4|  8.0| 4.00| 0.015 | IV | 67.8(109.1)
DMG |33.7000|117.1000|06/11/1902| 245 0.0|  0.0| 4.50| 0.020 | IV | 67.8(109.1)
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                           EARTHQUAKE SEARCH RESULTS
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    |       |        |           |  TIME   |     |      | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |    DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |           | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+------+-------+----+-----------
PAS |33.4580|116.4340|02/12/1979| 44842.3|  3.9| 4.20| 0.017 | IV | 67.8(109.1)
DMG |33.1670|116.1670|11/16/1937|1057 0.0|  0.0| 4.00| 0.015 | IV | 67.8(109.1)
DMG |33.0020|116.0850|11/21/1964|172559.7|  4.1| 4.20| 0.017 | IV | 68.1(109.6)
GSP |33.3990|116.3540|07/26/1997|031456.0| 11.0| 4.80| 0.023 | IV | 68.1(109.6)
DMG |33.5000|116.4830|02/23/1941|183614.0|  0.0| 4.50| 0.020 | IV | 68.2(109.8)
DMG |33.4670|116.4330|05/12/1939|1925 2.2|  0.0| 4.50| 0.020 | IV | 68.3(109.9)
DMG |33.7000|117.4000|04/11/1910| 757 0.0|  0.0| 5.00| 0.026 |  V | 68.4(110.1)
DMG |33.7000|117.4000|05/13/1910| 620 0.0|  0.0| 5.00| 0.026 |  V | 68.4(110.1)
DMG |33.7000|117.4000|05/15/1910|1547 0.0|  0.0| 6.00| 0.043 | VI | 68.4(110.1)
DMG |32.7170|116.0330|06/01/1959|163536.0|  0.0| 4.60| 0.021 | IV | 68.4(110.1)
PAS |32.0580|116.3370|01/29/1980|1949 3.3|  5.0| 4.40| 0.019 | IV | 68.5(110.3)
GSP |33.6320|116.7190|07/19/1999|220927.5| 14.0| 4.20| 0.017 | IV | 68.9(110.9)
PAS |33.4830|116.4380|07/02/1988| 02658.2| 12.6| 4.00| 0.015 | IV | 69.0(111.0)
DMG |33.2370|116.1900|04/14/1968|125558.7| 10.8| 4.30| 0.018 | IV | 69.0(111.0)
DMG |33.1170|116.1170|06/18/1943|161546.0|  0.0| 4.50| 0.020 | IV | 69.0(111.0)
DMG |32.2000|116.2000|03/03/1957|11 6 3.0|  0.0| 4.40| 0.019 | IV | 69.0(111.1)
DMG |33.6820|117.5530|07/05/1938|18 655.7| 10.0| 4.50| 0.020 | IV | 69.2(111.3)
DMG |33.6500|116.7500|09/05/1950|191956.0|  0.0| 4.80| 0.023 | IV | 69.4(111.6)
GSP |33.6500|116.7400|12/02/1989|231647.8| 14.0| 4.20| 0.017 | IV | 69.6(112.0)
DMG |33.6990|117.5110|05/31/1938| 83455.4| 10.0| 5.50| 0.033 |  V | 69.6(112.1)
DMG |31.8670|116.5710|02/27/1937| 12918.4| 10.0| 5.00| 0.025 |  V | 69.9(112.4)
GSP |33.5100|116.4500|02/18/1990|155259.9|  9.0| 4.10| 0.016 | IV | 69.9(112.6)
DMG |33.3100|116.2240|05/22/1968|132655.4|  7.5| 4.40| 0.018 | IV | 70.1(112.8)
DMG |32.1020|116.2580|05/07/1966| 32657.4| 12.7| 4.50| 0.019 | IV | 70.1(112.8)
DMG |33.7380|117.1870|04/27/1962| 91232.1|  5.7| 4.10| 0.016 | IV | 70.1(112.9)
DMG |33.7100|116.9250|09/23/1963|144152.6| 16.5| 5.00| 0.025 |  V | 70.2(112.9)
DMG |31.9940|116.3700|08/20/1961|125245.9|  8.2| 4.00| 0.015 | IV | 70.2(113.0)
DMG |33.5010|116.4290|02/23/1971| 0 739.2|  8.0| 4.20| 0.016 | IV | 70.2(113.0)
DMG |33.3670|118.1500|04/16/1942| 72833.0|  0.0| 4.00| 0.015 | IV | 70.3(113.1)
DMG |32.7500|116.0000|02/19/1919| 458 0.0|  0.0| 4.50| 0.019 | IV | 70.3(113.2)
DMG |33.1670|116.1170|04/09/1968| 23930.0|  0.0| 4.40| 0.018 | IV | 70.4(113.3)
DMG |33.1670|116.1170|04/09/1968| 233 9.0|  0.0| 4.30| 0.017 | IV | 70.4(113.3)
PAS |33.4600|116.3700|09/07/1984|175730.3| 15.2| 4.10| 0.016 | IV | 70.4(113.3)
DMG |33.3330|116.2360|10/05/1962|1529 2.6| 13.9| 4.10| 0.016 | IV | 70.4(113.3)
DMG |33.4000|116.3000|02/09/1890|12 6 0.0|  0.0| 6.30| 0.050 | VI | 70.5(113.4)
DMG |33.1900|116.1290|04/09/1968| 22859.1| 11.1| 6.40| 0.052 | VI | 70.5(113.4)
DMG |32.0280|116.3230|09/20/1961|1036 2.6| 11.4| 4.20| 0.016 | IV | 70.5(113.5)
DMG |33.3330|116.2330|06/09/1942| 5 633.0|  0.0| 4.00| 0.015 | IV | 70.6(113.6)
DMG |33.7170|117.5070|08/06/1938|22 056.0| 10.0| 4.00| 0.015 | IV | 70.8(113.9)
DMG |33.7170|117.5170|06/19/1935|1117 0.0|  0.0| 4.00| 0.015 | IV | 70.9(114.1)
PAS |33.7010|116.8370|08/22/1979| 2 136.3|  5.0| 4.10| 0.015 | IV | 70.9(114.2)
DMG |32.0320|116.3090|08/27/1963| 121 1.8| 14.6| 4.00| 0.015 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|101957.0|  0.0| 4.50| 0.019 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|101522.0|  0.0| 4.50| 0.019 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|14 057.0|  0.0| 4.10| 0.015 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|10 139.0|  0.0| 4.20| 0.016 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|13 8 4.0|  0.0| 4.30| 0.017 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|102610.0|  0.0| 4.00| 0.015 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/20/1954| 41919.0|  0.0| 4.90| 0.024 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954| 95748.0|  0.0| 4.00| 0.015 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954| 95556.0|  0.0| 5.00| 0.025 |  V | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954| 957 7.0|  0.0| 4.60| 0.020 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|143750.0|  0.0| 4.00| 0.015 | IV | 71.0(114.2)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+-----------
DMG |33.2830|116.1830|04/04/1954| 42920.0|  0.0| 4.10| 0.015 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/20/1954| 6 353.0|  0.0| 4.30| 0.017 | IV | 71.0(114.2)
DMG |33.2830|116.1830|10/26/1944|225410.0|  0.0| 4.20| 0.016 | IV | 71.0(114.2)
DMG |33.2830|116.1830|03/23/1954| 41450.0|  0.0| 5.10| 0.026 |  V | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954| 95429.0|  0.0| 6.20| 0.047 | VI | 71.0(114.2)
DMG |33.2830|116.1830|03/19/1954|102117.0|  0.0| 5.50| 0.032 |  V | 71.0(114.2)
DMG |33.2170|116.1330|08/15/1945|175624.0|  0.0| 5.70| 0.036 |  V | 71.2(114.5)
DMG |33.7250|117.4980|01/03/1956| 02548.9| 13.7| 4.70| 0.021 | IV | 71.2(114.6)
DMG |33.1330|116.0830|10/16/1940|175213.0|  0.0| 4.00| 0.015 | IV | 71.2(114.6)
DMG |33.1330|116.0830|10/06/1940|181953.0|  0.0| 4.00| 0.015 | IV | 71.2(114.6)
DMG |33.1330|116.0830|05/07/1936|1147 0.0|  0.0| 4.50| 0.019 | IV | 71.2(114.6)
DMG |33.1330|116.0830|02/28/1940|1728 7.0|  0.0| 4.50| 0.019 | IV | 71.2(114.6)
DMG |33.7330|117.4670|10/26/1954|162226.0|  0.0| 4.10| 0.015 | IV | 71.3(114.8)
PAS |33.4710|118.0610|02/27/1984|101815.0|  6.0| 4.00| 0.015 | IV | 71.4(114.8)
DMG |33.2000|116.1170|12/28/1950| 52211.0|  0.0| 4.20| 0.016 | IV | 71.4(114.9)
DMG |33.1030|116.0610|04/09/1968|111754.5|  4.8| 4.00| 0.015 | IV | 71.6(115.3)
PAS |33.1360|116.0710|02/29/1984| 2 731.7|  6.6| 4.30| 0.017 | IV | 72.0(115.8)
DMG |33.7500|117.0000|06/06/1918|2232 0.0|  0.0| 5.00| 0.025 |  V | 72.0(115.9)
DMG |33.7500|117.0000|04/21/1918|223225.0|  0.0| 6.80| 0.064 | VI | 72.0(115.9)
DMG |32.9670|116.0000|11/02/1943|1753 5.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|03/26/1943| 62957.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|162654.0|  0.0| 5.00| 0.025 |  V | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|162519.0|  0.0| 5.00| 0.025 |  V | 72.2(116.2)
DMG |32.9670|116.0000|08/20/1944|113310.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|04/07/1943| 34614.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|1638 6.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/29/1942|1556 0.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|03/07/1943|205631.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|02/24/1943| 15831.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/29/1942|162157.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|191028.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/07/1942| 439 6.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/22/1942|113951.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|163439.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/22/1942|125553.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|08/17/1943|155058.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/12/1942| 0 737.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|162213.0|  0.0| 6.50| 0.054 | VI | 72.2(116.2)
DMG |32.9670|116.0000|01/08/1943| 024 3.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/22/1942| 63951.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/30/1942| 53545.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/02/1943|18 134.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/29/1942|173552.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/16/1943|18 9 9.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/02/1943|164759.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/03/1942|101834.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/22/1942|181326.0|  0.0| 5.00| 0.025 |  V | 72.2(116.2)
DMG |32.9670|116.0000|11/03/1942| 5 629.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/02/1943|165716.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|214928.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|04/30/1943|155256.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/02/1943|175041.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |32.9670|116.0000|04/27/1943| 32833.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+---------+--------+-----+-----+-------+----+----------
DMG |32.9670|116.0000|10/26/1942| 434 4.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|10/21/1942|225031.0|  0.0| 4.00| 0.014 | IV | 72.2(116.2)
DMG |32.9670|116.0000|11/02/1942|125942.0|  0.0| 4.50| 0.019 | IV | 72.2(116.2)
DMG |33.7480|117.4790|06/22/1971|104119.0|  8.0| 4.20| 0.016 | IV | 72.5(116.7)
DMG |33.4080|116.2610|03/25/1937|1649 1.8| 10.0| 6.00| 0.041 |  V | 72.5(116.7)
DMG |33.0000|116.0000|05/18/1920| 625 0.0|  0.0| 4.50| 0.019 | IV | 72.8(117.1)
DMG |33.0500|116.0170|08/26/1955| 52322.0|  0.0| 4.30| 0.017 | IV | 72.8(117.2)
DMG |31.7000|116.9000|11/21/1952|192618.0|  0.0| 4.10| 0.015 | IV | 72.9(117.3)
DMG |33.1040|116.0360|04/09/1968| 34810.3|  4.8| 4.70| 0.021 | IV | 73.0(117.5)
DMG |33.1130|116.0370|04/09/1968| 3 353.5|  5.0| 5.20| 0.027 |  V | 73.2(117.8)
DMG |33.0400|116.0050|05/11/1968| 810 4.0|  8.8| 4.20| 0.016 | IV | 73.3(117.9)
DMG |33.3490|116.1880|05/19/1969|144033.0|  8.6| 4.50| 0.019 | IV | 73.3(118.0)
DMG |32.9830|115.9830|05/23/1942|154729.0|  0.0| 5.00| 0.024 |  V | 73.4(118.2)
DMG |33.5670|117.9830|07/07/1937|1112 0.0|  0.0| 4.00| 0.014 | IV | 73.5(118.2)
DMG |33.5670|117.9830|04/17/1934|1833 0.0|  0.0| 4.00| 0.014 | IV | 73.5(118.2)
PAS |33.5080|118.0710|11/20/1988| 53928.7|  6.0| 4.50| 0.019 | IV | 73.6(118.5)
GSP |33.2240|116.0880|07/10/1998|212913.8| 12.0| 4.10| 0.015 | IV | 73.7(118.6)
GSP |33.6200|117.9000|04/07/1989|200730.2| 13.0| 4.50| 0.019 | IV | 73.7(118.6)
DMG |33.5750|117.9830|03/11/1933| 518 4.0|  0.0| 5.20| 0.027 |  V | 73.9(118.9)
DMG |33.2330|116.0860|08/26/1965|133814.0| -2.0| 4.50| 0.019 | IV | 74.1(119.2)
DMG |32.3830|116.0000|01/03/1956|1424 1.0|  0.0| 4.70| 0.021 | IV | 74.2(119.5)
DMG |33.0560|115.9930|04/09/1968| 35836.0|  7.9| 4.30| 0.017 | IV | 74.3(119.5)
DMG |31.9670|116.3000|05/31/1961| 72339.0|  0.0| 4.00| 0.014 | IV | 74.4(119.8)
DMG |33.0480|115.9860|04/16/1968| 33029.9|  8.3| 4.80| 0.022 | IV | 74.5(119.9)
DMG |33.2670|116.1000|01/04/1954|233152.0|  0.0| 4.20| 0.016 | IV | 74.5(119.9)
GSP |32.7270|115.9260|01/13/1999|132056.0|  2.0| 4.40| 0.017 | IV | 74.6(120.1)
DMG |33.1070|116.0070|04/09/1968| 8 038.5|  4.0| 4.00| 0.014 | IV | 74.6(120.1)
DMG |33.5170|118.1000|03/22/1941| 82240.0|  0.0| 4.00| 0.014 | IV | 75.2(121.0)
DMG |33.0830|115.9830|12/15/1937| 958 0.0|  0.0| 4.00| 0.014 | IV | 75.4(121.3)
DMG |33.0830|115.9830|03/02/1934|2130 0.0|  0.0| 4.50| 0.018 | IV | 75.4(121.3)
DMG |33.0830|115.9830|07/13/1940|163923.0|  0.0| 4.00| 0.014 | IV | 75.4(121.3)
DMG |33.0830|115.9830|07/14/1940| 0 144.0|  0.0| 4.00| 0.014 | IV | 75.4(121.3)
DMG |33.0830|115.9830|12/10/1938| 312 0.0|  0.0| 4.00| 0.014 | IV | 75.4(121.3)
DMG |33.8000|117.0000|12/25/1899|1225 0.0|  0.0| 6.40| 0.050 | VI | 75.4(121.3)
DMG |32.7920|115.9140|10/12/1936|135631.8| 10.0| 4.00| 0.014 | IV | 75.4(121.4)
DMG |33.2780|116.0850|08/26/1965|125351.0|  1.0| 4.20| 0.016 | IV | 75.6(121.7)
DMG |33.6170|117.9670|03/11/1933| 154 7.8|  0.0| 6.30| 0.047 | VI | 75.7(121.8)
DMG |32.7640|115.9080|10/12/1936|17 750.1| 10.0| 4.00| 0.014 | IV | 75.7(121.8)
DMG |33.5610|118.0580|01/15/1937|183547.0| 10.0| 4.00| 0.014 | IV | 75.9(122.1)
DMG |33.6000|118.0000|03/11/1933| 231 0.0|  0.0| 4.40| 0.017 | IV | 75.9(122.1)
DMG |33.6000|118.0000|03/11/1933| 217 0.0|  0.0| 4.50| 0.018 | IV | 75.9(122.1)
DMG |33.0390|115.9490|05/06/1968|173147.6|  6.7| 4.00| 0.014 | IV | 76.3(122.9)
DMG |33.6000|118.0170|12/25/1935|1715 0.0|  0.0| 4.50| 0.018 | IV | 76.5(123.0)
GSP |33.2500|116.0500|08/31/1990|033800.0|  8.0| 4.20| 0.015 | IV | 76.5(123.0)
DMG |32.0500|116.1670|02/06/1958|111530.0|  0.0| 4.50| 0.018 | IV | 76.5(123.1)
MGI |33.8000|116.9000|12/18/1920|1726 0.0|  0.0| 4.00| 0.014 | IV | 76.5(123.2)
MGI |33.8000|116.9000|04/29/1918| 2 0 0.0|  0.0| 4.00| 0.014 | IV | 76.5(123.2)
MGI |33.8000|116.9000|06/14/1918|1024 0.0|  0.0| 4.00| 0.014 | IV | 76.5(123.2)
MGI |33.8000|116.9000|04/23/1918|1415 0.0|  0.0| 4.00| 0.014 | IV | 76.5(123.2)
DMG |33.2400|116.0360|04/28/1961| 63021.2| -1.2| 4.20| 0.015 | IV | 76.8(123.7)
DMG |33.3330|116.1000|06/12/1943|192141.0|  0.0| 4.00| 0.014 | IV | 76.9(123.7)
DMG |32.9550|115.9110|04/10/1967| 04717.3|  4.4| 4.00| 0.014 | IV | 77.1(124.0)
DMG |32.0500|116.1500|03/01/1945|111958.0|  0.0| 4.40| 0.017 | IV | 77.3(124.4)
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                            EARTHQUAKE SEARCH RESULTS
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    |       |        |          |   TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |   (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          |  H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
DMG |33.6170|118.0170|10/02/1933|1326 1.0|  0.0| 4.00| 0.014 | III| 77.4(124.5)
DMG |33.6170|118.0170|03/14/1933|19 150.0|  0.0| 5.10| 0.025 |  V | 77.4(124.5)
DMG |33.6170|118.0170|03/15/1933|111332.0|  0.0| 4.90| 0.022 | IV | 77.4(124.5)
DMG |33.8330|117.4000|06/05/1940| 82727.0|  0.0| 4.00| 0.014 | III| 77.5(124.7)
DMG |33.1670|115.9830|07/21/1940| 836 3.0|  0.0| 4.40| 0.017 | IV | 77.5(124.7)
DMG |33.2000|116.0000|08/15/1951|1227 9.0|  0.0| 4.00| 0.014 | III| 77.5(124.7)
DMG |33.8000|117.6000|09/16/1903|1210 0.0|  0.0| 4.00| 0.014 | III| 77.7(125.1)
MGI |33.8000|117.6000|04/22/1918|2115 0.0|  0.0| 5.00| 0.023 | IV | 77.7(125.1)
DMG |32.5000|115.9000|06/25/1941|1715 0.0|  0.0| 4.00| 0.014 | III| 77.7(125.1)
DMG |32.1170|116.0830|07/09/1951| 9 622.0|  0.0| 4.20| 0.015 | IV | 77.9(125.3)
DMG |33.3170|116.0670|09/04/1944|125528.0|  0.0| 4.10| 0.014 | IV | 77.9(125.4)
DMG |33.6170|118.0330|05/21/1938| 944 0.0|  0.0| 4.00| 0.014 | III| 77.9(125.4)
DMG |31.9670|116.2170|02/18/1955|152728.0|  0.0| 4.70| 0.020 | IV | 78.0(125.5)
PAS |31.8640|116.3420|12/09/1984| 8 3 9.0|  6.0| 4.30| 0.016 | IV | 78.0(125.5)
DMG |31.8990|116.2900|06/04/1964|10 341.3| -0.5| 4.10| 0.014 | IV | 78.2(125.9)
DMG |33.2310|116.0040|05/26/1957|155933.6| 15.1| 5.00| 0.023 | IV | 78.2(125.9)
MGI |33.7000|117.9000|07/08/1902| 945 0.0|  0.0| 4.00| 0.014 | III| 78.4(126.1)
DMG |33.2830|116.0330|03/16/1949|18 027.0|  0.0| 4.00| 0.014 | III| 78.4(126.2)
DMG |33.2830|116.0330|03/29/1951|233929.0|  0.0| 4.40| 0.017 | IV | 78.4(126.2)
DMG |33.6590|117.9810|10/20/1961|20 714.5|  6.1| 4.00| 0.014 | III| 78.5(126.4)
DMG |33.6540|117.9940|10/20/1961|194950.5|  4.6| 4.30| 0.016 | IV | 78.7(126.6)
DMG |33.6650|117.9790|10/20/1961|214240.7|  7.2| 4.00| 0.014 | III| 78.8(126.8)
DMG |33.0360|115.9030|10/05/1964| 121 9.5| -2.0| 4.10| 0.014 | IV | 78.9(126.9)
DMG |32.8850|115.8650|10/27/1963|145822.4| -2.0| 4.40| 0.017 | IV | 78.9(127.0)
DMG |31.7500|116.5000|04/29/1935|20 8 0.0|  0.0| 5.00| 0.023 | IV | 78.9(127.0)
DMG |31.7500|116.5000|05/01/1935| 655 0.0|  0.0| 4.00| 0.014 | III| 78.9(127.0)
DMG |31.7500|116.5000|05/01/1935|1823 0.0|  0.0| 4.00| 0.014 | III| 78.9(127.0)
DMG |31.7500|116.5000|05/01/1935| 0 7 0.0|  0.0| 4.50| 0.018 | IV | 78.9(127.0)
DMG |31.7500|116.5000|04/29/1935|2149 0.0|  0.0| 4.00| 0.014 | III| 78.9(127.0)
DMG |31.7500|116.5000|05/01/1935| 352 0.0|  0.0| 4.00| 0.014 | III| 78.9(127.0)
DMG |31.7500|116.5000|05/01/1935|1825 0.0|  0.0| 4.00| 0.014 | III| 78.9(127.0)
DMG |32.7000|115.8500|11/01/1941|142434.0|  0.0| 4.00| 0.014 | III| 79.1(127.2)
DMG |33.2880|116.0180|07/27/1965|14 441.4|  0.6| 4.30| 0.016 | IV | 79.3(127.7)
GSP |33.2100|115.9700|07/19/1991|024136.8|  3.0| 4.00| 0.013 | III| 79.4(127.7)
DMG |32.5000|118.5500|02/24/1948| 81510.0|  0.0| 5.30| 0.027 |  V | 79.4(127.8)
PAS |33.0290|115.8880|11/26/1987|1739 2.0|  1.8| 4.30| 0.016 | IV | 79.6(128.0)
USG |32.6450|115.8440|02/28/1988| 5 259.5|  7.1| 4.21| 0.015 | IV | 79.6(128.1)
PAS |33.0170|115.8810|11/24/1987|185040.3|  0.0| 4.30| 0.016 | IV | 79.7(128.3)
DMG |32.1520|116.0200|02/16/1967|194127.4|  5.3| 4.00| 0.013 | III| 79.8(128.4)
PAS |32.9930|115.8720|11/24/1987|133259.9|  0.0| 4.20| 0.015 | IV | 79.9(128.5)
DMG |33.0330|115.8830|08/27/1945|112520.0|  0.0| 4.00| 0.013 | III| 79.9(128.6)
DMG |31.8330|116.3330|06/26/1932|103222.0|  0.0| 4.00| 0.013 | III| 80.0(128.7)
DMG |31.8330|116.3330|06/27/1932|1016 9.0|  0.0| 4.00| 0.013 | III| 80.0(128.7)
DMG |31.8330|116.3330|06/27/1932| 94643.0|  0.0| 4.00| 0.013 | III| 80.0(128.7)
DMG |31.8330|116.3330|06/27/1932|10 720.0|  0.0| 4.50| 0.017 | IV | 80.0(128.7)
DMG |33.8000|116.7000|08/11/1911|1820 0.0|  0.0| 4.00| 0.013 | III| 80.0(128.8)
DMG |33.8000|116.7000|08/11/1911|2340 0.0|  0.0| 4.50| 0.017 | IV | 80.0(128.8)
DMG |33.6800|117.9930|11/20/1961| 85334.7|  4.4| 4.00| 0.013 | III| 80.1(128.9)
DMG |33.7670|117.8170|08/22/1936| 521 0.0|  0.0| 4.00| 0.013 | III| 80.2(129.0)
DMG |33.6710|118.0120|10/20/1961|223534.2|  5.6| 4.10| 0.014 | IV | 80.2(129.1)
GSP |33.8060|117.7150|03/07/2000|002028.2| 11.0| 4.00| 0.013 | III| 80.3(129.2)
DMG |33.1000|115.9000|04/25/1957|22 5 0.0|  0.0| 4.20| 0.015 | IV | 80.3(129.3)
DMG |33.1000|115.9000|04/25/1957|2248 0.0|  0.0| 4.10| 0.014 | IV | 80.3(129.3)
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                             EARTHQUAKE SEARCH RESULTS
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    |       |        |           |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |    DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |           | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
DMG |33.1000|115.9000|04/25/1957|2249 0.0|  0.0| 4.20| 0.015 | IV | 80.3(129.3)
PAS |32.9320|115.8470|09/05/1982| 52126.6|  4.2| 4.40| 0.016 | IV | 80.4(129.4)
PAS |33.5380|118.2070|05/25/1982|134430.3| 13.7| 4.10| 0.014 | IV | 80.6(129.7)
DMG |33.5000|118.2500|06/18/1920|10 8 0.0|  0.0| 4.50| 0.017 | IV | 80.6(129.7)
DMG |33.6170|118.1170|01/20/1934|2117 0.0|  0.0| 4.50| 0.017 | IV | 81.0(130.3)
DMG |31.5700|117.4880|05/01/1939|202223.3| 10.0| 4.00| 0.013 | III| 81.2(130.7)
DMG |33.0450|115.8630|12/17/1968|225351.2|  8.0| 4.70| 0.019 | IV | 81.2(130.8)
DMG |33.9000|117.2000|12/19/1880| 0 0 0.0|  0.0| 6.00| 0.038 |  V | 81.3(130.9)
DMG |32.0000|116.1000|12/15/1959|152419.0|  0.0| 4.30| 0.015 | IV | 81.7(131.5)
PAS |31.9430|116.1550|08/06/1980| 94622.7|  7.4| 4.00| 0.013 | III| 81.8(131.6)
MGI |33.8000|117.8000|11/09/1926|1535 0.0|  0.0| 4.60| 0.018 | IV | 81.8(131.7)
MGI |33.8000|117.8000|05/20/1917| 945 0.0|  0.0| 4.00| 0.013 | III| 81.8(131.7)
MGI |33.8000|117.8000|11/07/1926|1948 0.0|  0.0| 4.60| 0.018 | IV | 81.8(131.7)
MGI |33.8000|117.8000|11/10/1926|1723 0.0|  0.0| 4.60| 0.018 | IV | 81.8(131.7)
MGI |33.8000|117.8000|05/19/1917| 635 0.0|  0.0| 4.00| 0.013 | III| 81.8(131.7)
MGI |33.8000|117.8000|05/19/1917| 719 0.0|  0.0| 4.00| 0.013 | III| 81.8(131.7)
MGI |33.8000|117.8000|11/04/1926|2238 0.0|  0.0| 4.60| 0.018 | IV | 81.8(131.7)
DMG |33.0530|115.8550|10/05/1964| 12455.5|  0.0| 4.40| 0.016 | IV | 81.8(131.7)
DMG |31.9000|116.2000|08/21/1960|212732.0|  0.0| 4.00| 0.013 | III| 81.9(131.7)
DMG |31.7000|116.5000|01/12/1941|12 8 0.0|  0.0| 4.00| 0.013 | III| 81.9(131.8)
DMG |31.5500|116.9830|09/05/1959| 91744.0|  0.0| 4.00| 0.013 | III| 82.0(132.0)
PAS |33.0130|115.8390|11/24/1987|131556.5|  2.4| 6.00| 0.038 |  V | 82.0(132.0)
DMG |31.7920|116.3340|06/12/1963|221516.9|  8.8| 4.80| 0.020 | IV | 82.1(132.2)
DMG |33.0000|115.8330|01/08/1946|185418.0|  0.0| 5.40| 0.027 |  V | 82.2(132.2)
DMG |33.6830|118.0500|03/11/1933| 658 3.0|  0.0| 5.50| 0.029 |  V | 82.2(132.2)
DMG |33.6830|118.0500|03/11/1933|1250 0.0|  0.0| 4.40| 0.016 | IV | 82.2(132.2)
PAS |31.9370|116.1520|11/07/1984|142326.8|  6.0| 4.00| 0.013 | III| 82.2(132.2)
DMG |33.8000|116.6000|09/10/1931| 436 0.0|  0.0| 4.00| 0.013 | III| 82.3(132.5)
PAS |31.7820|116.3400|07/24/1981|113846.2| 15.0| 4.60| 0.018 | IV | 82.4(132.7)
PAS |33.1330|115.8730|11/24/1987|133355.8|  0.0| 4.00| 0.013 | III| 82.5(132.8)
DMG |32.1000|116.0000|02/03/1960| 83718.0|  0.0| 4.50| 0.017 | IV | 82.6(132.9)
PAS |32.9790|115.8160|11/25/1987|135410.0|  0.6| 4.20| 0.014 | IV | 82.8(133.3)
DMG |33.2670|115.9330|12/30/1960|214025.0|  0.0| 4.00| 0.013 | III| 83.0(133.6)
PAS |32.9960|115.8160|11/27/1987| 11010.5|  6.0| 4.70| 0.019 | IV | 83.1(133.7)
DMG |32.9310|115.7980|01/12/1972|1231 9.6|  0.0| 4.00| 0.013 | III| 83.2(133.9)
PAS |32.9950|115.8130|12/02/1987| 4 3 6.2|  1.7| 4.00| 0.013 | III| 83.2(133.9)
PAS |32.9800|115.8090|11/28/1987| 03910.9|  0.8| 4.20| 0.014 | IV | 83.2(133.9)
DMG |33.0330|115.8210|09/30/1971|224611.3|  8.0| 5.10| 0.023 | IV | 83.4(134.2)
PAS |33.0140|115.8150|11/24/1987|131848.9|  6.0| 4.10| 0.014 | III| 83.4(134.2)
PAS |33.0360|115.8200|11/24/1987| 21435.5|  4.7| 4.50| 0.017 | IV | 83.5(134.4)
DMG |31.7870|116.3000|01/18/1965| 65719.5|  6.3| 4.00| 0.013 | III| 83.6(134.6)
DMG |33.7000|118.0670|03/11/1933| 51022.0|  0.0| 5.10| 0.023 | IV | 83.7(134.7)
DMG |33.7000|118.0670|03/11/1933| 85457.0|  0.0| 5.10| 0.023 | IV | 83.7(134.7)
DMG |33.7000|118.0670|07/20/1940| 4 113.0|  0.0| 4.00| 0.013 | III| 83.7(134.7)
DMG |33.7000|118.0670|02/08/1940|165617.0|  0.0| 4.00| 0.013 | III| 83.7(134.7)
DMG |32.5510|115.7850|01/23/1971|22 736.0|  8.0| 4.10| 0.014 | III| 83.7(134.7)
PAS |33.0330|115.8140|11/24/1987| 22159.6|  4.5| 4.00| 0.013 | III| 83.8(134.8)
PAS |33.0220|115.8080|11/24/1987| 62323.1|  3.4| 4.00| 0.013 | III| 83.9(135.1)
PAS |33.0400|115.8120|11/24/1987| 253 0.7|  3.5| 4.70| 0.019 | IV | 84.0(135.2)
DMG |33.9330|117.3670|10/24/1943| 02921.0|  0.0| 4.00| 0.013 | III| 84.1(135.3)
DMG |33.8540|117.7520|10/04/1961| 22131.6|  4.3| 4.10| 0.014 | III| 84.2(135.4)
DMG |31.8000|116.2670|06/20/1963| 446 8.0|  0.0| 4.00| 0.013 | III| 84.2(135.5)
DMG |31.8000|116.2670|06/11/1963|154948.0|  0.0| 4.00| 0.013 | III| 84.2(135.5)
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                          EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+-----------
DMG |31.8000|116.2670|06/12/1963|221556.0|  0.0| 4.70| 0.019 | IV | 84.2(135.5)
DMG |31.8000|116.2670|06/12/1963| 85536.0|  0.0| 4.00| 0.013 | III| 84.2(135.5)
DMG |33.2830|115.9170|03/28/1952| 11622.0|  0.0| 4.20| 0.014 | IV | 84.3(135.7)
DMG |31.7960|116.2690|06/11/1963|152338.3| -2.0| 5.80| 0.033 |  V | 84.3(135.7)
DMG |33.7500|118.0000|11/16/1934|2126 0.0|  0.0| 4.00| 0.013 | III| 84.3(135.7)
PAS |33.0470|115.8080|11/24/1987|143629.9|  0.0| 4.00| 0.013 | III| 84.4(135.8)
MGI |33.8000|117.9000|05/22/1902| 740 0.0|  0.0| 4.30| 0.015 | IV | 84.4(135.8)
DMG |32.2000|115.9000|05/31/1960|191736.0|  0.0| 4.00| 0.013 | III| 84.4(135.9)
DMG |32.4170|115.8000|05/13/1960|123640.0|  0.0| 4.10| 0.014 | III| 84.7(136.4)
DMG |33.6300|118.2000|09/13/1929|132338.2|  0.0| 4.00| 0.013 | III| 84.8(136.5)
PAS |33.0500|115.8000|11/24/1987| 21647.2|  6.0| 4.00| 0.013 | III| 84.9(136.6)
PAS |33.0480|115.7980|11/24/1987| 21523.2|  5.0| 4.80| 0.019 | IV | 84.9(136.7)
PAS |33.0080|115.7860|11/24/1987|1321 0.2|  6.0| 4.10| 0.013 | III| 84.9(136.7)
DMG |33.6330|118.2000|11/01/1940|20 046.0|  0.0| 4.00| 0.013 | III| 85.0(136.8)
DMG |33.1830|115.8500|04/25/1957|222148.0|  0.0| 4.20| 0.014 | IV | 85.0(136.8)
DMG |33.1830|115.8500|04/25/1957|222412.0|  0.0| 5.10| 0.023 | IV | 85.0(136.8)
DMG |32.8330|115.7500|02/24/1933|1933 0.0|  0.0| 4.50| 0.017 | IV | 85.1(137.0)
PAS |32.9420|115.7630|11/24/1987|133439.9| 14.0| 4.80| 0.019 | IV | 85.3(137.3)
PAS |33.0670|115.7810|11/24/1987| 13248.1|  4.0| 4.20| 0.014 | IV | 86.2(138.8)
PAS |33.0720|115.7820|11/24/1987| 153 3.2|  4.2| 4.00| 0.013 | III| 86.3(138.8)
DMG |32.0000|116.0000|02/07/1930|2323 0.0|  0.0| 4.50| 0.016 | IV | 86.4(139.1)
DMG |32.0000|116.0000|07/19/1954|20 154.0|  0.0| 4.80| 0.019 | IV | 86.4(139.1)
DMG |32.0000|116.0000|07/20/1963| 14518.0|  0.0| 4.20| 0.014 | IV | 86.4(139.1)
DMG |33.5430|118.3400|09/14/1963| 35116.2|  2.2| 4.20| 0.014 | IV | 86.5(139.1)
DMG |33.7330|118.1000|03/11/1933|1350 0.0|  0.0| 4.40| 0.016 | IV | 86.7(139.4)
DMG |33.7330|118.1000|03/11/1933|15 9 0.0|  0.0| 4.40| 0.016 | IV | 86.7(139.4)
DMG |33.7330|118.1000|03/11/1933|1447 0.0|  0.0| 4.40| 0.016 | IV | 86.7(139.4)
DMG |33.9170|116.7500|01/25/1933|1444 0.0|  0.0| 4.00| 0.013 | III| 86.7(139.5)
PAS |33.0820|115.7750|11/24/1987| 15414.5|  4.9| 5.80| 0.032 |  V | 86.8(139.8)
DMG |33.7500|118.0830|03/12/1933|2354 0.0|  0.0| 4.50| 0.016 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 347 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/25/1933|1346 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 323 0.0|  0.0| 5.00| 0.021 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|2232 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 211 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/15/1933| 432 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|2231 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 252 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 616 0.0|  0.0| 4.60| 0.017 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/21/1933| 326 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 034 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 311 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/23/1933| 840 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 3 5 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 2 9 0.0|  0.0| 5.00| 0.021 | IV | 87.0(140.0)
DMG |33.7500|118.0830|04/02/1933| 8 0 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1129 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933|1532 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/19/1933|2123 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1653 0.0|  0.0| 4.80| 0.019 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/23/1933|1831 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 230 0.0|  0.0| 5.10| 0.022 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 837 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+-------+-----+-----+-------+----+-----------
DMG |33.7500|118.0830|03/11/1933|1357 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 6 1 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 436 0.0|  0.0| 4.60| 0.017 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 440 0.0|  0.0| 4.70| 0.018 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933|2128 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1956 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1547 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/15/1933| 540 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 2 5 0.0|  0.0| 4.30| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933| 343 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 027 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|23 5 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 751 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 222 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 546 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 448 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 832 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/20/1933|1358 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/30/1933|1225 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 258 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933|1825 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 3 9 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933|1738 0.0|  0.0| 4.50| 0.016 | IV | 87.0(140.0)
DMG |33.7500|118.0830|04/02/1933|1536 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1045 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 336 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/16/1933|1529 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933| 617 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933|131828.0|  0.0| 5.30| 0.025 |  V | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 439 0.0|  0.0| 4.90| 0.020 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1147 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933|1929 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 227 0.0|  0.0| 4.60| 0.017 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/14/1933|1219 0.0|  0.0| 4.50| 0.016 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 210 0.0|  0.0| 4.60| 0.017 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 2 4 0.0|  0.0| 4.90| 0.020 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/15/1933| 2 8 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/31/1933|1049 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 524 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 555 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|04/01/1933| 642 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|11 0 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 216 0.0|  0.0| 4.80| 0.019 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|2240 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/16/1933|1530 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/18/1933|2052 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 8 8 0.0|  0.0| 4.50| 0.016 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 926 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 759 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/14/1933| 036 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 515 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 910 0.0|  0.0| 5.10| 0.022 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1944 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
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                            EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+---------+-----+-----+-------+----+----------
DMG |33.7500|118.0830|03/12/1933| 835 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1138 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 553 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 259 0.0|  0.0| 4.60| 0.017 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1025 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 339 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/13/1933| 432 0.0|  0.0| 4.70| 0.018 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|1141 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933|15 2 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933|1651 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 257 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 911 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 635 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933|22 0 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/12/1933| 740 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/17/1933|1651 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 611 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 513 0.0|  0.0| 4.70| 0.018 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 618 0.0|  0.0| 4.20| 0.014 | IV | 87.0(140.0)
DMG |33.7500|118.0830|03/14/1933|2242 0.0|  0.0| 4.10| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/16/1933|1456 0.0|  0.0| 4.00| 0.013 | III| 87.0(140.0)
DMG |33.7500|118.0830|03/11/1933| 521 0.0|  0.0| 4.40| 0.015 | IV | 87.0(140.0)
DMG |33.2330|115.8330|06/14/1942|222549.0|  0.0| 4.00| 0.013 | III| 87.2(140.4)
DMG |33.2330|115.8330|06/14/1942|213623.0|  0.0| 4.00| 0.013 | III| 87.2(140.4)
DMG |33.2330|115.8330|06/24/1942|235240.0|  0.0| 4.00| 0.013 | III| 87.2(140.4)
DMG |33.8000|118.0000|10/21/1913| 938 0.0|  0.0| 4.00| 0.013 | III| 87.3(140.4)
DMG |33.9500|116.8500|09/28/1946| 719 9.0|  0.0| 5.00| 0.021 | IV | 87.3(140.5)
DMG |33.9500|117.5830|04/11/1941| 12024.0|  0.0| 4.00| 0.012 | III| 87.4(140.7)
DMG |32.2830|115.8000|09/26/1959| 34050.0|  0.0| 4.30| 0.015 | IV | 87.6(140.9)
DMG |32.9830|115.7330|01/24/1951| 733 7.0|  0.0| 4.00| 0.012 | III| 87.6(140.9)
DMG |32.9830|115.7330|01/24/1951| 717 2.6|  0.0| 5.60| 0.029 |  V | 87.6(140.9)
DMG |32.8560|115.7100|09/18/1936|144032.1| 10.0| 4.50| 0.016 | IV | 87.6(140.9)
DMG |33.9170|116.7000|11/17/1943|112841.0|  0.0| 4.50| 0.016 | IV | 87.6(141.0)
DMG |33.9330|116.7500|08/06/1938| 228 0.0|  0.0| 4.00| 0.012 | III| 87.7(141.2)
DMG |33.9330|116.7500|10/28/1944|183016.0|  0.0| 4.40| 0.015 | IV | 87.7(141.2)
DMG |32.7330|115.7000|04/21/1960|233920.0|  0.0| 4.20| 0.014 | IV | 87.7(141.2)
DMG |31.6670|116.3670|07/17/1959| 72630.0|  0.0| 4.90| 0.020 | IV | 88.0(141.6)
DMG |33.9960|117.2700|02/17/1952|123658.3| 16.0| 4.50| 0.016 | IV | 88.0(141.6)
DMG |32.9500|115.7170|06/14/1953| 41729.9|  0.0| 5.50| 0.027 |  V | 88.1(141.7)
DMG |32.9500|115.7170|06/14/1953| 42958.0|  0.0| 4.80| 0.019 | IV | 88.1(141.7)
DMG |33.9680|116.8820|06/27/1959|162211.1| 13.8| 4.00| 0.012 | III| 88.1(141.7)
DMG |33.2160|115.8080|04/25/1957|215738.7| -0.3| 5.20| 0.023 | IV | 88.1(141.8)
DMG |32.6000|115.7000|12/19/1958|1437 0.0|  0.0| 4.10| 0.013 | III| 88.2(141.9)
DMG |32.6000|115.7000|04/26/1963| 1 342.0|  0.0| 4.00| 0.012 | III| 88.2(141.9)
MGI |33.5000|116.0000|09/30/1916| 425 0.0|  0.0| 4.00| 0.012 | III| 88.2(142.0)
DMG |34.0000|117.2500|07/23/1923| 73026.0|  0.0| 6.25| 0.041 |  V | 88.3(142.0)
DMG |34.0000|117.2500|11/01/1932| 445 0.0|  0.0| 4.00| 0.012 | III| 88.3(142.0)
DMG |34.0000|117.2830|11/07/1939|1852 8.4|  0.0| 4.70| 0.018 | IV | 88.3(142.1)
DMG |32.9000|115.7000|10/02/1928|19 1 0.0|  0.0| 5.00| 0.021 | IV | 88.5(142.4)
DMG |33.7500|118.1330|03/11/1933|11 4 0.0|  0.0| 4.60| 0.017 | IV | 88.7(142.8)
DMG |32.9150|115.6970|05/23/1963| 63635.7|  1.2| 4.30| 0.014 | IV | 88.8(142.9)
MGI |34.0000|117.4000|05/22/1907| 652 0.0|  0.0| 4.60| 0.017 | IV | 88.9(143.1)
T-A |34.0000|117.4200|04/12/1888|1315 0.0|  0.0| 4.30| 0.014 | IV | 89.0(143.3)
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+-----------
T-A |34.0000|117.4200|09/10/1920|1415 0.0|  0.0| 4.30| 0.014 | IV | 89.0(143.3)
DMG |34.0000|117.0000|06/30/1923| 022 0.0|  0.0| 4.50| 0.016 | IV | 89.1(143.3)
DMG |33.1670|115.7670|05/10/1955| 43840.0|  0.0| 4.30| 0.014 | IV | 89.1(143.4)
DMG |31.5000|117.7000|10/12/1940| 34542.0|  0.0| 4.00| 0.012 | III| 89.1(143.4)
DMG |33.7670|118.1170|11/04/1939|2141 0.0|  0.0| 4.00| 0.012 | III| 89.1(143.4)
DMG |33.9500|116.7330|04/26/1942|151023.0|  0.0| 4.00| 0.012 | III| 89.1(143.4)
DMG |33.9670|116.8000|09/07/1945|153424.0|  0.0| 4.30| 0.014 | IV | 89.1(143.5)
DMG |32.3330|115.7500|12/15/1938| 0 2 0.0|  0.0| 4.00| 0.012 | III| 89.2(143.5)
DMG |33.8980|116.5690|11/17/1964|145228.2| 10.3| 4.00| 0.012 | III| 89.2(143.6)
MGI |33.7000|116.2000|08/12/1917|11 0 0.0|  0.0| 4.00| 0.012 | III| 89.2(143.6)
GSG |31.8060|116.1280|03/23/1994|025916.2| 22.0| 5.00| 0.021 | IV | 89.4(143.9)
DMG |33.1750|115.7640|10/28/1963| 81417.1|  0.9| 4.00| 0.012 | III| 89.5(144.0)
PAS |32.9140|115.6840|01/28/1988| 254 2.4|  5.9| 4.70| 0.018 | IV | 89.6(144.1)
GSP |33.9510|117.7090|01/05/1998|181406.5| 11.0| 4.30| 0.014 | IV | 89.6(144.2)
DMG |34.0000|117.5000|07/03/1908|1255 0.0|  0.0| 4.00| 0.012 | III| 89.8(144.5)
MGI |34.0000|117.5000|12/16/1858|10 0 0.0|  0.0| 7.00| 0.060 | VI | 89.8(144.5)
PAS |34.0230|117.2450|10/02/1985|234412.4| 15.2| 4.80| 0.019 | IV | 89.8(144.6)
DMG |34.0170|117.0500|02/19/1940|12 655.7|  0.0| 4.60| 0.017 | IV | 89.9(144.6)
GSP |34.0240|117.2300|03/11/1998|121851.8| 14.0| 4.50| 0.016 | IV | 89.9(144.7)
DMG |33.7500|118.1670|05/16/1933|205855.0|  0.0| 4.00| 0.012 | III| 89.9(144.7)
DMG |32.1330|115.8330|06/10/1961| 21742.0|  0.0| 4.10| 0.013 | III| 90.0(144.8)
DMG |33.9730|116.7690|06/10/1944|111531.9| 10.0| 4.00| 0.012 | III| 90.0(144.9)
MGI |33.7500|116.2500|11/19/1917|1730 0.0|  0.0| 4.00| 0.012 | III| 90.1(144.9)
DMG |33.9760|116.7750|10/17/1965| 94519.0| 17.0| 4.90| 0.020 | IV | 90.1(145.1)
DMG |32.0000|118.5000|07/15/1943|2138 0.0|  0.0| 4.00| 0.012 | III| 90.2(145.2)
DMG |33.7500|118.1830|08/04/1933| 41748.0|  0.0| 4.00| 0.012 | III| 90.5(145.6)
DMG |33.7830|118.1330|10/02/1933| 91017.6|  0.0| 5.40| 0.025 |  V | 90.6(145.7)
DMG |33.7830|118.1330|11/20/1933|1032 0.0|  0.0| 4.00| 0.012 | III| 90.6(145.7)
DMG |33.7830|118.1330|01/13/1940| 749 7.0|  0.0| 4.00| 0.012 | III| 90.6(145.7)
DMG |32.9900|115.6820|11/29/1964|142526.4| 13.8| 4.20| 0.014 | III| 90.6(145.7)
DMG |34.0330|117.3170|09/03/1935| 647 0.0|  0.0| 4.50| 0.016 | IV | 90.7(146.0)
DMG |33.7830|116.2830|03/04/1937|16 4 0.0|  0.0| 4.00| 0.012 | III| 90.7(146.0)
DMG |34.0330|117.3500|04/18/1940|184343.9|  0.0| 4.40| 0.015 | IV | 90.9(146.2)
DMG |31.8000|116.1000|10/10/1953|1849 6.0|  0.0| 5.00| 0.021 | IV | 90.9(146.2)
DMG |33.0380|118.7340|09/13/1937|221439.5| 10.0| 4.00| 0.012 | III| 91.0(146.4)
DMG |33.9760|116.7210|06/12/1944|104534.7| 10.0| 5.10| 0.022 | IV | 91.1(146.5)
DMG |32.5000|115.6670|02/12/1932| 23021.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/22/1959| 631 0.0|  0.0| 4.40| 0.015 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 6 3 0.0|  0.0| 4.60| 0.017 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/20/1958| 0 6 0.0|  0.0| 4.30| 0.014 | IV | 91.1(146.6)
DMG |32.2500|115.7500|02/16/1959| 643 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/18/1959|1813 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/19/1958|1533 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/07/1959|1514 0.0|  0.0| 4.30| 0.014 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/25/1958| 127 0.0|  0.0| 4.60| 0.017 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/02/1958| 957 0.0|  0.0| 4.30| 0.014 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/04/1958| 142 0.0|  0.0| 4.20| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/25/1959| 345 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|02/26/1959| 3 3 0.0|  0.0| 4.50| 0.016 | IV | 91.1(146.6)
DMG |32.2500|115.7500|01/25/1959|10 1 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/22/1959| 023 0.0|  0.0| 4.60| 0.017 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/15/1958| 621 0.0|  0.0| 4.60| 0.017 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/14/1958| 0 7 0.0|  0.0| 4.20| 0.013 | III| 91.1(146.6)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+------+---+----------
DMG |32.2500|115.7500|12/01/1958| 843 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 6 2 0.0|  0.0| 5.50| 0.027 |  V | 91.1(146.6)
DMG |32.2500|115.7500|12/08/1958| 051 0.0|  0.0| 4.40| 0.015 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/08/1958| 052 0.0|  0.0| 4.50| 0.016 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/02/1958|1156 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/09/1959|1835 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/23/1958| 653 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/20/1958| 3 5 0.0|  0.0| 4.50| 0.016 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/06/1958| 324 0.0|  0.0| 4.40| 0.015 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 350 0.0|  0.0| 5.00| 0.021 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/24/1958|2027 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/15/1959| 635 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 331 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 426 0.0|  0.0| 4.80| 0.018 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/02/1958| 054 0.0|  0.0| 4.70| 0.018 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/09/1958|1922 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/18/1959|1933 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/06/1958| 331 0.0|  0.0| 4.50| 0.016 | IV | 91.1(146.6)
DMG |32.2500|115.7500|03/22/1961|151115.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/20/1958| 0 7 0.0|  0.0| 4.70| 0.018 | IV | 91.1(146.6)
DMG |32.2500|115.7500|12/02/1958|1358 0.0|  0.0| 4.20| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/17/1958|1330 0.0|  0.0| 4.30| 0.014 | IV | 91.1(146.6)
DMG |32.2500|115.7500|03/04/1959|1659 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/14/1959| 332 0.0|  0.0| 4.20| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 32118.0|  0.0| 5.80| 0.031 |  V | 91.1(146.6)
DMG |32.2500|115.7500|12/01/1958| 340 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/10/1959|15 2 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
DMG |32.2500|115.7500|12/03/1958|19 6 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/22/1959| 820 0.0|  0.0| 4.10| 0.013 | III| 91.1(146.6)
DMG |32.2500|115.7500|01/22/1959| 739 0.0|  0.0| 4.00| 0.012 | III| 91.1(146.6)
PAS |31.8940|115.9940|03/04/1979|183746.0|  5.0| 4.00| 0.012 | III| 91.2(146.7)
DMG |33.0270|115.6810|05/23/1963|1553 1.8|  0.4| 4.80| 0.018 | IV | 91.2(146.7)
DMG |34.0430|117.2280|04/03/1939| 25044.7| 10.0| 4.00| 0.012 | III| 91.2(146.8)
PAS |33.9760|116.7130|08/06/1984| 81436.6| 14.2| 4.30| 0.014 | IV | 91.2(146.8)
DMG |31.8540|116.0320|07/23/1970|125947.0|  8.0| 4.40| 0.015 | IV | 91.2(146.8)
DMG |33.9590|116.6510|09/23/1949|214440.1| 12.2| 4.00| 0.012 | III| 91.3(146.9)
GSP |34.0470|117.2550|02/21/2000|134943.1| 15.0| 4.50| 0.016 | IV | 91.5(147.3)
DMG |33.8800|116.4370|04/17/1959|1619 0.2| 22.2| 4.20| 0.013 | III| 91.6(147.3)
DMG |33.9810|116.7020|06/12/1944|222119.5| 10.0| 4.20| 0.013 | III| 91.7(147.6)
PAS |33.9790|116.6810|12/16/1988| 553 5.0|  8.1| 4.80| 0.018 | IV | 92.0(148.0)
DMG |33.0080|115.6600|06/17/1965| 74013.5|  8.8| 4.10| 0.013 | III| 92.1(148.2)
PAS |33.0790|115.6800|04/26/1981|124043.4|  6.0| 4.20| 0.013 | III| 92.1(148.2)
GSP |32.6120|115.6280|07/27/1992|204008.8| 15.0| 4.10| 0.013 | III| 92.3(148.5)
DMG |33.9940|116.7120|06/12/1944|111636.0| 10.0| 5.30| 0.024 | IV | 92.4(148.7)
PAS |33.9670|116.6170|07/08/1986|155526.2|  6.0| 4.00| 0.012 | III| 92.5(148.9)
PAS |33.9670|116.6170|07/08/1986|102240.6|  6.0| 4.40| 0.015 | IV | 92.5(148.9)
PAS |32.7880|115.6180|10/15/1979|2355 2.6|  5.0| 4.20| 0.013 | III| 92.6(149.0)
PAS |33.9530|116.5720|10/15/1986| 22847.8|  8.7| 4.70| 0.017 | IV | 92.6(149.0)
MGI |34.0000|117.7000|12/03/1929| 9 5 0.0|  0.0| 4.00| 0.012 | III| 92.6(149.1)
DMG |32.3000|115.7000|02/28/1961|212254.0|  0.0| 4.40| 0.015 | IV | 92.7(149.1)
DMG |34.0140|116.7710|06/10/1944|111150.5| 10.0| 4.50| 0.016 | IV | 92.7(149.2)
DMG |32.7940|115.6150|04/23/1968|1624 9.5|  5.0| 4.10| 0.013 | III| 92.8(149.3)
DMG |33.7830|118.2000|12/27/1939|192849.0|  0.0| 4.70| 0.017 | IV | 92.9(149.5)
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                             EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+-----------
DMG |32.1500|115.7670|06/10/1959|172046.0|  0.0| 4.10| 0.013 | III| 92.9(149.6)
DMG |34.0000|116.7000|08/25/1944| 73025.0|  0.0| 4.20| 0.013 | III| 93.0(149.7)
DMG |32.8830|115.6170|01/16/1946|11 654.0|  0.0| 4.20| 0.013 | III| 93.1(149.9)
DMG |33.6330|118.4000|10/17/1934| 938 0.0|  0.0| 4.00| 0.012 | III| 93.2(149.9)
PAS |33.9890|116.6490|07/17/1986|203515.0|  6.2| 4.00| 0.012 | III| 93.3(150.1)
GSP |32.9750|118.7910|03/04/1992|190627.0|  6.0| 4.20| 0.013 | III| 93.3(150.2)
DMG |32.0330|115.8330|01/28/1932|171749.0|  0.0| 4.50| 0.015 | IV | 93.4(150.2)
DMG |32.0330|115.8330|01/08/1932| 23445.0|  0.0| 4.00| 0.012 | III| 93.4(150.2)
PAS |33.9910|116.6490|07/17/1986|215445.2|  7.4| 4.40| 0.015 | IV | 93.4(150.3)
DMG |32.2670|115.7000|06/11/1960|213656.0|  0.0| 4.50| 0.015 | IV | 93.4(150.3)
DMG |33.2330|115.7170|10/22/1942| 15038.0|  0.0| 5.50| 0.026 |  V | 93.4(150.3)
DMG |33.2330|115.7170|10/26/1942| 615 4.0|  0.0| 4.50| 0.015 | IV | 93.4(150.3)
DMG |33.2330|115.7170|10/26/1942| 3 215.0|  0.0| 4.50| 0.015 | IV | 93.4(150.3)
DMG |33.2330|115.7170|10/26/1942| 34316.0|  0.0| 4.00| 0.012 | III| 93.4(150.3)
PAS |31.7760|116.0660|05/16/1976|232612.9|  5.0| 4.20| 0.013 | III| 93.5(150.4)
DMG |34.0290|116.7870|04/30/1954| 03623.9| 11.1| 4.20| 0.013 | III| 93.5(150.4)
DMG |33.7590|118.2530|08/31/1938| 31814.2| 10.0| 4.50| 0.015 | IV | 93.5(150.5)
DMG |31.8330|116.0000|06/07/1956| 6 4 0.0|  0.0| 4.10| 0.012 | III| 93.6(150.6)
DMG |31.8330|116.0000|04/28/1956| 641 0.0|  0.0| 4.30| 0.014 | IV | 93.6(150.6)
DMG |31.8330|116.0000|05/10/1956|114854.0|  0.0| 5.00| 0.020 | IV | 93.6(150.6)
DMG |33.7830|116.2000|10/31/1943|131210.0|  0.0| 4.50| 0.015 | IV | 93.6(150.7)
PAS |34.0060|117.7390|02/18/1989| 717 4.8|  3.3| 4.30| 0.014 | IV | 93.7(150.8)
PAS |33.0940|115.6550|06/13/1979|194645.9|  6.0| 4.10| 0.012 | III| 93.8(150.9)
T-A |34.0800|117.2500|10/07/1869| 0 0 0.0|  0.0| 4.30| 0.014 | IV | 93.8(150.9)
DMG |33.2840|115.7350|10/27/1963|145023.4| -2.0| 4.00| 0.012 | III| 93.8(151.0)
DMG |31.5680|116.3630|08/13/1967| 8 213.0| 10.0| 4.50| 0.015 | IV | 93.8(151.0)
DMG |31.7090|116.1370|02/16/1967|1738 8.0|  2.8| 4.20| 0.013 | III| 93.9(151.2)
DMG |31.5000|116.5000|10/17/1954|225718.0|  0.0| 5.70| 0.029 |  V | 94.1(151.4)
DMG |31.5000|116.5000|02/18/1939| 557 0.0|  0.0| 4.00| 0.012 | III| 94.1(151.4)
PAS |33.9650|117.8860|01/01/1976|172012.9|  6.2| 4.20| 0.013 | III| 94.2(151.6)
DMG |33.2330|115.7000|08/30/1946|111645.0|  0.0| 4.60| 0.016 | IV | 94.3(151.8)
DMG |32.4500|115.6170|01/31/1939|1616 0.0|  0.0| 4.00| 0.012 | III| 94.6(152.2)
DMG |32.4500|115.6170|06/20/1935| 724 0.0|  0.0| 4.00| 0.012 | III| 94.6(152.2)
DMG |32.4500|115.6170|03/21/1939|1351 0.0|  0.0| 4.00| 0.012 | III| 94.6(152.2)
DMG |32.4500|115.6170|04/17/1938| 347 0.0|  0.0| 4.00| 0.012 | III| 94.6(152.2)
DMG |32.4500|115.6170|03/25/1939| 259 0.0|  0.0| 4.00| 0.012 | III| 94.6(152.2)
PAS |32.6630|115.5830|10/31/1980|125536.7|  3.6| 4.40| 0.015 | IV | 94.7(152.3)
DMG |33.7830|118.2500|11/14/1941| 84136.3|  0.0| 5.40| 0.025 |  V | 94.7(152.4)
PAS |33.9980|116.6060|07/08/1986| 92044.5| 11.7| 5.60| 0.027 |  V | 94.7(152.5)
PAS |33.9870|116.5690|07/09/1986| 01232.1|  6.0| 4.40| 0.014 | IV | 94.8(152.6)
DMG |32.5000|115.6000|12/08/1933| 437 0.0|  0.0| 4.00| 0.012 | III| 94.9(152.7)
DMG |32.1590|115.7240|01/19/1972| 15942.8|  8.0| 4.00| 0.012 | III| 94.9(152.8)
GSP |34.0850|116.9890|06/30/1992|214900.3|  3.0| 4.40| 0.014 | IV | 95.0(152.8)
PAS |32.0880|115.7650|04/13/1984| 32835.6|  6.0| 4.10| 0.012 | III| 95.0(152.8)
DMG |33.0560|115.6200|06/16/1965| 242 6.1| -0.5| 4.40| 0.014 | IV | 95.1(153.0)
DMG |32.2000|115.7000|10/16/1954| 8 518.0|  0.0| 4.00| 0.012 | III| 95.1(153.0)
DMG |32.8830|115.5830|04/13/1938|1929 0.0|  0.0| 4.50| 0.015 | IV | 95.1(153.0)
DMG |33.6630|118.4130|01/08/1967| 738 5.3| 17.7| 4.00| 0.012 | III| 95.1(153.1)
PAS |33.0980|115.6320|04/26/1981|12 928.4|  3.8| 5.70| 0.029 |  V | 95.1(153.1)
PAS |32.8390|115.5780|10/15/1979|232552.6|  8.1| 4.00| 0.012 | III| 95.1(153.1)
MGI |34.1000|117.2000|04/23/1923|2113 0.0|  0.0| 4.00| 0.012 | III| 95.1(153.1)
DMG |32.2670|115.6670|05/17/1959|1257 0.0|  0.0| 4.00| 0.012 | III| 95.2(153.2)
PAS |33.0990|115.6300|04/26/1981|12 557.4|  4.2| 4.00| 0.012 | III| 95.2(153.3)
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                       EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+--------+-----+-----+-------+----+----------
MGI |34.1000|117.3000|11/22/1911| 257 0.0|  0.0| 4.00| 0.012 | III| 95.3(153.3)
MGI |34.1000|117.3000|07/15/1905|2041 0.0|  0.0| 5.30| 0.023 | IV | 95.3(153.3)
MGI |34.1000|117.3000|12/27/1901|11 0 0.0|  0.0| 4.60| 0.016 | IV | 95.3(153.3)
DMG |34.1000|117.3000|02/16/1931|1327 0.0|  0.0| 4.00| 0.012 | III| 95.3(153.3)
DMG |33.8170|118.2170|10/22/1941| 65718.5|  0.0| 4.90| 0.019 | IV | 95.3(153.4)
PAS |33.1100|115.6270|04/25/1981| 21155.3|  4.8| 4.10| 0.012 | III| 95.6(153.9)
DMG |32.2500|115.6670|04/29/1932|165233.0|  0.0| 4.00| 0.012 | III| 95.6(153.9)
DMG |31.6250|116.2110|06/10/1969| 34132.7| -2.0| 5.00| 0.020 | IV | 95.7(153.9)
PAS |32.9040|115.5760|10/17/1979|191438.4| 15.9| 4.10| 0.012 | III| 95.7(154.0)
GSP |34.0970|116.9960|12/05/1997|170438.9|  4.0| 4.10| 0.012 | III| 95.7(154.0)
PAS |33.1030|115.6220|11/04/1976|133127.7|  3.7| 4.20| 0.013 | III| 95.8(154.1)
DMG |33.9330|116.4000|12/10/1948|204257.0|  0.0| 4.40| 0.014 | IV | 95.8(154.1)
PAS |33.1030|115.6210|11/04/1976|1139 8.4|  0.9| 4.10| 0.012 | III| 95.8(154.2)
PAS |34.0310|116.6570|07/08/1986| 92412.8|  6.0| 4.40| 0.014 | IV | 95.8(154.2)
DMG |33.0120|115.5920|04/11/1965| 04646.1| -2.0| 4.10| 0.012 | III| 96.0(154.4)
DMG |33.6320|118.4670|01/08/1967| 73730.4| 11.4| 4.00| 0.012 | III| 96.0(154.5)
PAS |33.1090|115.6190|11/04/1976|114940.4|  2.2| 4.10| 0.012 | III| 96.0(154.5)
DMG |33.9000|118.1000|07/08/1929|1646 6.7| 13.0| 4.70| 0.017 | IV | 96.2(154.7)
DMG |33.9330|116.3830|12/04/1948|234317.0|  0.0| 6.50| 0.043 | VI | 96.3(154.9)
PAS |32.9070|115.5660|10/16/1979|114655.3| 11.4| 4.80| 0.018 | IV | 96.3(154.9)
PAS |33.1170|115.6150|04/26/1976| 64637.5| 14.8| 4.00| 0.012 | III| 96.4(155.1)
DMG |32.1500|115.7000|09/26/1959| 75316.0|  0.0| 4.10| 0.012 | III| 96.5(155.3)
DMG |33.9670|116.4500|12/11/1948|161220.0|  0.0| 4.50| 0.015 | IV | 96.5(155.3)
GSP |33.8760|116.2670|06/29/1992|160142.8|  1.0| 5.20| 0.022 | IV | 96.5(155.3)
GSP |33.9450|116.3990|07/05/1992|054938.2|  3.0| 4.00| 0.012 | III| 96.5(155.4)
DMG |34.1180|117.3410|09/22/1951| 82239.1| 11.9| 4.30| 0.014 | III| 96.7(155.6)
T-A |33.5000|115.8200|05/00/1868| 0 0 0.0|  0.0| 6.30| 0.039 |  V | 96.7(155.6)
DMG |33.9330|116.3670|12/05/1948| 0 721.0|  0.0| 4.90| 0.019 | IV | 96.7(155.7)
PAS |33.0010|115.5760|10/16/1979| 74947.2|  8.5| 4.00| 0.012 | III| 96.7(155.7)
DMG |34.1120|117.4260|03/19/1937| 12338.4| 10.0| 4.00| 0.012 | III| 96.8(155.7)
DMG |33.0370|115.5840|06/17/1965| 73020.9| -1.3| 4.30| 0.014 | III| 96.8(155.8)
DMG |33.1310|115.6110|10/27/1963|181250.7|  7.8| 4.20| 0.013 | III| 96.9(155.9)
GSP |33.0300|115.5800|03/24/1989|231648.0|  6.0| 4.00| 0.012 | III| 96.9(156.0)
DMG |33.9630|116.4250|01/13/1950| 5 719.4|  5.9| 4.10| 0.012 | III| 96.9(156.0)
DMG |33.9670|116.4330|12/05/1948| 04235.0|  0.0| 4.60| 0.016 | IV | 96.9(156.0)
DMG |33.2670|115.6670|08/10/1951|1130 8.0|  0.0| 4.40| 0.014 | IV | 97.0(156.1)
DMG |34.1000|116.8830|10/24/1935|1527 0.0|  0.0| 4.00| 0.012 | III| 97.0(156.1)
DMG |34.1000|116.8830|10/24/1935|1451 0.0|  0.0| 4.50| 0.015 | IV | 97.0(156.1)
DMG |34.1000|116.8830|10/24/1935|1452 0.0|  0.0| 4.50| 0.015 | IV | 97.0(156.1)
DMG |32.4170|115.5830|01/03/1936|14 7 0.0|  0.0| 4.00| 0.012 | III| 97.0(156.1)
DMG |32.9820|115.5660|05/23/1963| 9 6 4.7| 25.4| 4.60| 0.016 | IV | 97.1(156.2)
DMG |33.0190|115.5730|06/17/1965| 743 5.0| -2.0| 4.20| 0.013 | III| 97.1(156.3)
DMG |33.2000|115.6330|10/27/1963|145245.2| -2.0| 4.10| 0.012 | III| 97.2(156.4)
GSP |33.9460|116.3790|04/24/1992|123605.7| 10.0| 4.10| 0.012 | III| 97.2(156.4)
PAS |32.9500|115.5570|10/16/1979| 33934.3| 12.1| 4.50| 0.015 | IV | 97.2(156.4)
DMG |33.9330|116.3500|12/05/1948| 04032.0|  0.0| 4.40| 0.014 | IV | 97.2(156.5)
DMG |34.1270|117.3380|02/23/1936|222042.7| 10.0| 4.50| 0.015 | IV | 97.3(156.5)
GSP |34.1200|116.9980|06/29/1992|144126.0|  4.0| 4.40| 0.014 | IV | 97.3(156.6)
DMG |32.1830|115.6670|09/21/1959| 11753.0|  0.0| 4.30| 0.013 | III| 97.3(156.6)
GSP |34.1120|116.9200|10/01/1998|181816.0|  4.0| 4.70| 0.017 | IV | 97.4(156.8)
DMG |34.1160|117.4750|06/28/1960|20 048.0| 12.0| 4.10| 0.012 | III| 97.4(156.8)
DMG |33.8000|118.3000|11/03/1931|16 5 0.0|  0.0| 4.00| 0.011 | III| 97.4(156.8)
MGI |33.8000|118.3000|12/31/1928|1045 0.0|  0.0| 4.00| 0.011 | III| 97.4(156.8)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
GSP |33.9020|116.2840|07/24/1992|181436.2|  9.0| 5.00| 0.019 | IV | 97.4(156.8)
GSP |33.9050|116.2880|05/07/1995|110333.0| 10.0| 4.80| 0.018 | IV | 97.5(156.9)
DMG |33.8670|118.2000|11/13/1933|2128 0.0|  0.0| 4.00| 0.011 | III| 97.5(156.9)
PAS |33.1170|115.5950|11/04/1976|141250.2|  5.0| 4.40| 0.014 | IV | 97.5(156.9)
DMG |32.3540|115.5930|03/17/1972| 029 1.2|  8.0| 4.50| 0.015 | IV | 97.5(156.9)
PAS |33.1180|115.5950|11/04/1976| 62110.7|  5.0| 4.10| 0.012 | III| 97.5(157.0)
PAS |33.1230|115.5960|11/04/1976| 54820.9|  5.0| 4.20| 0.013 | III| 97.6(157.0)
PAS |33.1180|115.5900|11/04/1976| 635 3.5|  4.5| 4.10| 0.012 | III| 97.8(157.4)
GSP |33.7300|116.0200|12/18/1989|062704.5| 10.0| 4.20| 0.013 | III| 97.8(157.4)
GSP |33.9400|116.3410|05/04/1992|011602.6|  6.0| 4.00| 0.011 | III| 97.9(157.6)
PAS |33.1810|115.6110|03/07/1989| 02458.2|  2.8| 4.10| 0.012 | III| 97.9(157.6)
GSP |34.1210|116.9280|08/16/1998|133440.2|  6.0| 4.70| 0.017 | IV | 97.9(157.6)
PAS |32.9270|115.5400|10/16/1979| 54910.2| 10.4| 5.10| 0.020 | IV | 98.0(157.6)
PAS |32.9450|115.5430|10/16/1979| 31625.4|  7.2| 4.10| 0.012 | III| 98.0(157.6)
DMG |32.5830|115.5330|04/02/1947|151539.0|  0.0| 4.20| 0.013 | III| 98.0(157.7)
PAS |32.9280|115.5390|10/16/1979| 61948.7|  9.2| 5.10| 0.020 | IV | 98.0(157.7)
DMG |34.1240|117.4800|05/15/1955|17 326.0|  7.6| 4.00| 0.011 | III| 98.0(157.7)
DMG |34.1000|116.8000|10/24/1935|1448 7.6|  0.0| 5.10| 0.020 | IV | 98.0(157.8)
PAS |32.9600|115.5440|10/16/1979| 31047.1|  9.4| 4.50| 0.015 | IV | 98.1(157.8)
DMG |33.8670|118.2170|06/19/1944| 0 333.0|  0.0| 4.50| 0.015 | IV | 98.1(157.8)
DMG |33.8670|118.2170|06/19/1944| 3 6 7.0|  0.0| 4.40| 0.014 | IV | 98.1(157.8)
DMG |34.0000|116.4670|12/05/1948| 05057.0|  0.0| 4.40| 0.014 | IV | 98.1(157.9)
DMG |34.0000|116.4670|12/06/1948| 246 8.0|  0.0| 4.30| 0.013 | III| 98.1(157.9)
PAS |33.0140|115.5550|10/16/1979| 65842.8|  9.1| 5.50| 0.025 |  V | 98.1(157.9)
DMG |34.1320|117.4260|04/15/1965|20 833.3|  5.5| 4.50| 0.015 | IV | 98.1(157.9)
DMG |34.1400|117.3390|02/26/1936| 93327.6| 10.0| 4.00| 0.011 | III| 98.2(158.0)
PAS |32.9130|115.5340|10/16/1979| 6 439.0|  8.0| 4.00| 0.011 | III| 98.2(158.0)
DMG |32.3000|115.6000|01/07/1960|175130.0|  0.0| 4.10| 0.012 | III| 98.2(158.0)
DMG |34.0170|116.5000|07/25/1947| 15647.0|  0.0| 4.60| 0.016 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/30/1947| 52217.0|  0.0| 4.20| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|08/01/1947|17 137.0|  0.0| 4.10| 0.012 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/25/1947| 75730.0|  0.0| 4.20| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/26/1947| 24941.0|  0.0| 5.10| 0.020 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/24/1947|225426.0|  0.0| 4.90| 0.018 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/25/1947| 61949.0|  0.0| 5.20| 0.021 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/29/1947|163615.0|  0.0| 4.20| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/25/1947|161453.0|  0.0| 4.50| 0.015 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/26/1947|231351.0|  0.0| 4.10| 0.012 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/25/1947| 04631.0|  0.0| 5.00| 0.019 | IV | 98.3(158.3)
DMG |34.0170|116.5000|07/24/1947|221046.0|  0.0| 5.50| 0.025 |  V | 98.3(158.3)
DMG |34.0170|116.5000|08/08/1947| 64745.0|  0.0| 4.00| 0.011 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/26/1947| 12415.0|  0.0| 4.20| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/24/1947|225341.0|  0.0| 4.30| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/25/1947| 51752.0|  0.0| 4.30| 0.013 | III| 98.3(158.3)
DMG |34.0170|116.5000|07/26/1947|23 425.0|  0.0| 4.50| 0.015 | IV | 98.3(158.3)
USG |34.1390|117.3860|02/21/1987|231530.1|  2.6| 4.07| 0.012 | III| 98.3(158.3)
GSP |33.1920|115.6080|12/31/1997|122245.1| 10.0| 4.10| 0.012 | III| 98.3(158.3)
DMG |33.9960|117.9750|06/15/1967| 458 5.5| 10.0| 4.10| 0.012 | III| 98.4(158.3)
PAS |32.8920|115.5260|01/12/1980|2011 6.4|  5.0| 4.10| 0.012 | III| 98.5(158.4)
PAS |32.9090|115.5280|10/16/1979| 1 013.9|  4.8| 4.60| 0.016 | IV | 98.5(158.5)
PAS |34.1350|117.4480|01/08/1983| 71930.4|  4.6| 4.10| 0.012 | III| 98.5(158.5)
DMG |34.1330|116.9500|06/10/1938|1440 0.0|  0.0| 4.00| 0.011 | III| 98.6(158.6)
GSG |33.9430|116.3250|04/23/1992|052316.2|  5.0| 4.00| 0.011 | III| 98.6(158.6)
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                         EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME   |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC)  |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec | (km)| MAG.|   g   |INT.|  mi  [km]
----+-------+--------+----------+---------+-----+-----+-------+----+-----------
PAS |32.9320|115.5300|10/16/1979| 61346.5|  8.0| 4.10| 0.012 | III| 98.6(158.6)
PAS |33.1820|115.5990|03/06/1989|221647.6|  1.0| 4.30| 0.013 | III| 98.6(158.7)
DMG |34.1270|117.5210|12/27/1938|10 928.6| 10.0| 4.00| 0.011 | III| 98.6(158.7)
DMG |33.9670|118.0500|01/30/1941| 13446.9|  0.0| 4.10| 0.012 | III| 98.6(158.7)
GSP |33.9470|116.3300|09/09/1992|125045.1|  5.0| 4.30| 0.013 | III| 98.6(158.7)
GSP |33.9510|116.3380|05/18/1992|154418.0|  7.0| 4.90| 0.018 | IV | 98.6(158.7)
DMG |33.7710|116.0500|09/02/1956| 24637.0| 14.1| 4.20| 0.013 | III| 98.7(158.8)
GSP |33.9330|116.3020|04/27/1992|031119.3|  0.0| 4.20| 0.013 | III| 98.7(158.8)
DMG |32.9670|115.5330|02/13/1951|174634.0|  0.0| 4.10| 0.012 | III| 98.8(158.9)
DMG |32.9670|115.5330|02/13/1951|1716 0.0|  0.0| 4.20| 0.013 | III| 98.8(158.9)
PDP |33.9370|116.3060|07/25/1992|043160.0|  5.0| 4.90| 0.018 | IV | 98.8(159.0)
DMG |33.9580|116.3460|01/08/1952| 63427.4| 11.4| 4.40| 0.014 | IV | 98.8(159.0)
GSP |33.9430|116.3150|05/06/1992|023843.3|  7.0| 4.50| 0.015 | IV | 98.9(159.1)
PAS |33.9850|116.4020|02/15/1985|232626.6|  2.3| 4.00| 0.011 | III| 98.9(159.1)
PAS |33.1820|115.5940|03/07/1989| 74344.1|  0.5| 4.20| 0.013 | III| 98.9(159.1)
DMG |33.8500|118.2670|03/11/1933|1425 0.0|  0.0| 5.00| 0.019 | IV | 98.9(159.1)
DMG |33.8500|118.2670|03/11/1933| 629 0.0|  0.0| 4.40| 0.014 | IV | 98.9(159.1)
PAS |32.8990|115.5190|10/16/1979| 72324.2|  9.0| 4.20| 0.013 | III| 98.9(159.2)
PAS |32.9260|115.5230|10/16/1979| 11421.3|  9.6| 4.30| 0.013 | III| 98.9(159.2)
DMG |34.1000|117.6830|01/18/1934| 214 0.0|  0.0| 4.00| 0.011 | III| 98.9(159.2)
DMG |34.1000|117.6830|01/09/1934|1410 0.0|  0.0| 4.50| 0.015 | IV | 98.9(159.2)
DMG |33.2000|115.6000|11/12/1942|175612.0|  0.0| 4.00| 0.011 | III| 99.0(159.3)
PAS |32.9470|115.5250|10/16/1979| 139 3.3|  2.0| 4.00| 0.011 | III| 99.0(159.3)
DMG |32.2620|115.6000|07/13/1967| 94253.4| 10.0| 4.10| 0.012 | III| 99.0(159.4)
DMG |33.1170|115.5670|07/28/1950|1624 0.0|  0.0| 4.00| 0.011 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|1727 0.0|  0.0| 4.70| 0.016 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|2113 0.0|  0.0| 4.10| 0.012 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|1730 0.0|  0.0| 4.10| 0.012 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/29/1950|1714 0.0|  0.0| 4.30| 0.013 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/27/1950| 954 0.0|  0.0| 4.10| 0.012 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|1949 0.0|  0.0| 4.20| 0.013 | III| 99.1(159.4)
DMG |33.1170|115.5670|08/14/1950|1916 0.0|  0.0| 4.70| 0.016 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/29/1950| 017 0.0|  0.0| 4.50| 0.015 | IV | 99.1(159.4)
DMG |33.1170|115.5670|08/01/1950| 83720.0|  0.0| 4.70| 0.016 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/27/1950|12 2 0.0|  0.0| 4.20| 0.013 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/29/1950|143632.0|  0.0| 5.50| 0.025 |  V | 99.1(159.4)
DMG |33.1170|115.5670|07/29/1950|1843 0.0|  0.0| 4.70| 0.016 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|1840 0.0|  0.0| 4.00| 0.011 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|1817 0.0|  0.0| 4.20| 0.013 | III| 99.1(159.4)
DMG |33.1170|115.5670|07/27/1950|2251 0.0|  0.0| 4.50| 0.015 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/27/1950|112926.0|  0.0| 4.80| 0.017 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/29/1950|15 9 0.0|  0.0| 4.50| 0.015 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950| 325 0.0|  0.0| 4.70| 0.016 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|175812.0|  0.0| 4.80| 0.017 | IV | 99.1(159.4)
DMG |33.1170|115.5670|07/28/1950|175048.0|  0.0| 5.40| 0.024 | IV | 99.1(159.4)
GSP |33.9420|116.3040|05/04/1992|161949.7| 12.0| 4.80| 0.017 | IV | 99.1(159.5)
DMG |33.0000|115.5330|10/25/1955|174942.0|  0.0| 4.30| 0.013 | III| 99.2(159.6)
MGI |34.0000|118.0000|05/05/1929| 1 7 0.0|  0.0| 4.60| 0.016 | IV | 99.3(159.8)
MGI |34.0000|118.0000|12/25/1903|1745 0.0|  0.0| 5.00| 0.019 | IV | 99.3(159.8)
MGI |34.0000|118.0000|05/05/1929| 735 0.0|  0.0| 4.00| 0.011 | III| 99.3(159.8)
MGI |33.9000|118.2000|10/08/1927|1914 0.0|  0.0| 4.60| 0.016 | IV | 99.4(159.9)
DMG |32.7330|115.5000|05/19/1940| 43640.9|  0.0| 6.70| 0.047 | VI | 99.4(159.9)
DMG |33.9170|116.2500|08/15/1946|19 1 8.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
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                            EARTHQUAKE SEARCH RESULTS
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    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG.  |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST   |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
PAS |31.8900|115.8210|05/08/1985|234020.8|  6.0| 5.00| 0.019 | IV | 99.4(159.9)
MGI |32.7000|115.5000|01/01/1927|1010 0.0|  0.0| 4.60| 0.016 | IV | 99.4(159.9)
MGI |32.7000|115.5000|01/16/1927|19 5 0.0|  0.0| 4.60| 0.016 | IV | 99.4(159.9)
MGI |32.7000|115.5000|10/14/1918|12 5 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|01/13/1927|1048 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|12/09/1926| 548 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|11/03/1916| 555 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|12/08/1917| 945 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|06/08/1917| 031 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|01/01/1927|13 0 0.0|  0.0| 5.30| 0.022 | IV | 99.4(159.9)
MGI |32.7000|115.5000|01/01/1927| 9 5 0.0|  0.0| 4.60| 0.016 | IV | 99.4(159.9)
MGI |32.7000|115.5000|12/07/1916|1855 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|09/23/1928|1744 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|01/02/1927|16 0 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|05/02/1918|1712 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|10/01/1919|2350 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|12/07/1916|2045 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|07/16/1927| 155 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
MGI |32.7000|115.5000|11/17/1921|1958 0.0|  0.0| 4.00| 0.011 | III| 99.4(159.9)
PAS |32.9030|115.5110|10/21/1977|132424.6| 15.5| 4.20| 0.013 | III| 99.4(160.0)
PAS |32.9580|115.5200|10/16/1979| 02214.2| 10.0| 4.20| 0.013 | III| 99.4(160.0)
PAS |32.8730|115.5070|10/16/1979|12 145.6| 14.4| 4.00| 0.011 | III| 99.4(160.0)
DMG |34.1400|117.5150|01/01/1965| 8 418.0|  5.9| 4.40| 0.014 | IV | 99.4(160.0)
GSP |33.9510|116.3110|04/26/1992|062608.0|  0.0| 4.20| 0.013 | III| 99.4(160.0)
PAS |32.9340|115.5150|10/16/1979| 61160.0| 11.0| 4.00| 0.011 | III| 99.5(160.0)
T-A |32.6700|115.5000|01/02/1927|10 0 0.0|  0.0| 4.30| 0.013 | III| 99.5(160.0)
T-A |32.6700|115.5000|01/06/1927|1637 0.0|  0.0| 4.30| 0.013 | III| 99.5(160.0)
MGI |32.8000|115.5000|08/19/1915| 4 0 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
MGI |32.8000|115.5000|07/03/1915|2345 0.0|  0.0| 4.60| 0.016 | IV | 99.5(160.1)
DMG |32.8000|115.5000|06/23/1915| 456 0.0|  0.0| 6.25| 0.037 |  V | 99.5(160.1)
MGI |32.8000|115.5000|07/04/1915| 5 0 0.0|  0.0| 4.60| 0.016 | IV | 99.5(160.1)
MGI |32.8000|115.5000|08/18/1915|2240 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
MGI |32.8000|115.5000|02/12/1927| 858 0.0|  0.0| 4.60| 0.016 | IV | 99.5(160.1)
MGI |32.8000|115.5000|08/20/1915| 4 0 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
MGI |32.8000|115.5000|06/18/1917| 6 0 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
MGI |32.8000|115.5000|07/04/1915| 045 0.0|  0.0| 4.60| 0.016 | IV | 99.5(160.1)
DMG |32.8000|115.5000|06/23/1915| 359 0.0|  0.0| 6.25| 0.037 |  V | 99.5(160.1)
MGI |32.8000|115.5000|08/19/1915|2240 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
DMG |32.6670|115.5000|10/09/1932|2345 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
DMG |32.6670|115.5000|10/09/1932|2251 0.0|  0.0| 4.50| 0.015 | IV | 99.5(160.1)
DMG |32.6670|115.5000|10/10/1932| 129 0.0|  0.0| 4.00| 0.011 | III| 99.5(160.1)
GSP |33.9530|116.3140|11/27/1996|014243.8|  6.0| 4.10| 0.012 | III| 99.5(160.1)
DMG |33.7450|115.9970|09/01/1956| 55752.8| 15.1| 4.00| 0.011 | III| 99.5(160.1)
PAS |32.9390|115.5150|10/16/1979| 93641.1|  9.9| 4.00| 0.011 | III| 99.5(160.1)
PAS |32.8860|115.5070|10/20/1977|102935.9|  4.9| 4.00| 0.011 | III| 99.5(160.1)
DMG |31.8000|115.9000|01/18/1956|195724.0|  0.0| 4.10| 0.012 | III| 99.5(160.2)
DMG |31.7830|115.9170|12/22/1956| 518 0.0|  0.0| 4.50| 0.015 | IV | 99.5(160.2)
DMG |34.1000|116.7000|02/07/1889| 520 0.0|  0.0| 5.30| 0.022 | IV | 99.6(160.2)
PAS |34.1510|116.9720|11/20/1978| 655 9.5|  6.1| 4.30| 0.013 | III| 99.6(160.3)
GSG |31.9010|115.8070|03/20/1996|050309.4|  5.0| 4.00| 0.011 | III| 99.6(160.3)
GSP |32.8850|115.5050|06/14/2000|214918.7|  4.0| 4.50| 0.015 | IV | 99.6(160.3)
GSP |33.9570|116.3170|04/23/1992|022529.9| 11.0| 4.60| 0.015 | IV | 99.6(160.3)
PAS |32.8800|115.5040|10/30/1977| 53014.1|  4.5| 4.00| 0.011 | III| 99.6(160.3)
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-------------------------------------------------------------------------------
    |       |        |          |  TIME  |     |     | SITE  |SITE|  APPROX.
FILE|  LAT. |  LONG. |   DATE   |  (UTC) |DEPTH|QUAKE|  ACC. | MM |  DISTANCE
CODE| NORTH |  WEST  |          | H M Sec| (km)| MAG.|   g   |INT.|  mi  [km]
----+------+-------+---------+-------+----+----+------+---+-----------
PAS |32.8930|115.5050|10/21/1977| 61236.2|  5.9| 4.30| 0.013 | III| 99.7(160.4)
PAS |31.6840|116.0250|05/21/1983|204140.9|  5.0| 4.00| 0.011 | III| 99.7(160.4)
DMG |34.0650|116.5740|08/26/1959| 53250.2| 16.7| 4.30| 0.013 | III| 99.7(160.5)
GSP |33.9610|116.3180|04/23/1992|045023.0| 12.0| 6.10| 0.034 |  V | 99.8(160.7)
GSP |32.8960|115.5020|06/14/2000|190020.4|  5.0| 4.20| 0.013 | III| 99.9(160.7)
DMG |34.1170|116.7500|08/22/1942|125913.0|  0.0| 4.00| 0.011 | III| 99.9(160.8)
DMG |31.7000|116.0000|08/11/1955|174618.0|  0.0| 4.80| 0.017 | IV | 99.9(160.8)
PAS |31.9230|115.7830|06/24/1984|12 8 7.0|  6.0| 4.10| 0.012 | III| 99.9(160.8)
PAS |32.9090|115.5020|10/22/1977|183042.7|  5.0| 4.00| 0.011 | III|100.0(160.9)

*******************************************************************************
-END OF SEARCH-   1016 EARTHQUAKES FOUND WITHIN THE SPECIFIED SEARCH AREA.

TIME PERIOD OF SEARCH:   1800  TO  2000

LENGTH OF SEARCH TIME:   201  years

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 1.6 MILES (2.7 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.0

LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.388 g

COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
  a-value=  4.010
  b-value=  0.839
  beta-value=  1.931


------------------------------------
TABLE OF MAGNITUDES AND EXCEEDANCES:
------------------------------------

  Earthquake | Number of Times | Cumulative
   Magnitude |    Exceeded     | No. / Year
  -----------+-----------------+-----------
     4.0     |      1016       |   5.05473
     4.5     |       336       |   1.67164
     5.0     |       116       |   0.57711
     5.5     |        46       |   0.22886
     6.0     |        22       |   0.10945
     6.5     |         7       |   0.03483
     7.0     |         1       |   0.00498
```

Appendix E
Geotechnical Investigation—Marine

TerraCosta
Consulting Group

Geotechnical Engineering
Coastal Engineering
Maritime Engineering

Project No. 2769
December 10, 2012

DRAFT

Mr. Eric Noegel
BELLINGHAM MARINE INDUSTRIES, INC.
1205 Business Park Drive
Dixon, California 95620-4303

GUIDE PILE AND APPROACH PIER/GANGWAY FOUNDATION DESIGN CRITERIA
HARBOR ISLAND WEST MARINA
SAN DIEGO, CALIFORNIA

Dear Mr. Noegel:

TerraCosta Consulting Group, Inc. (TCG) is pleased to provide guide pile and approach pier/gangway foundation design criteria for the proposed replacement and associated upgrades for the Harbor Island West Marina, which comprises about the westerly quarter of Harbor Island at the northerly end of San Diego Bay. The project site is generally located at 32.726° north latitude, 117.211° west longitude (Figure 1).

Proposed improvements include the installation of new docks and guide piles, the reconfiguration of the existing marina to improve its use and capacity, and the construction of two ADA-compliant approach piers and gangways to service the facility. This report provides recommendations for laterally loaded guide piles, as well as recommendations for axially loaded approach piers to support the ADA-compliant gangways.

To aid in our understanding of the project, we have discussed the proposed new layout and construction with you and Craig Funston of Redpoint Structures, and received a preliminary design package prepared by Redpoint Structures, including a proposed marina layout with pile and mudline elevations. We also reviewed pertinent technical documents from our files, including three reports of field investigations prepared by our firm for the Harbor Cove Marina [Sunroad Marina] (May 22, 1986), the NTC Marina (April 4, 1988), and the NTC Onshore Marina Building (February 22, 1990). A list of documents reviewed is included in the References section at the end of this letter-report.

FIELD INVESTIGATION

Our field investigation, conducted between January 30 and February 6, 2012, included the drilling of seven test borings and 45 vane shear tests, all performed from the existing floating docks of the marina and fuel pier.

The test borings, drilled by the wash-boring method using a small tripod drill rig, ranged in depth from 11.5 feet to 25.5 feet below the bay floor mudline at the locations indicated on Figure 2. Samples were obtained from the test borings using a 2-inch I.D. Standard Penetration Sampler. The samplers were generally advanced 18 inches by driving with a 140-pound hammer falling 30 inches, at approximately 5-foot intervals. Disturbed samples were obtained from the test borings, sealed, and transported to the laboratory for more detailed inspection and testing. Drilling operations were supervised, and the borings sampled and logged, by the undersigned Project Geologist, Gregory Spaulding.

Field logs of the borings were prepared based on visual examination of the soils encountered and the action of the drilling equipment. A Key to Excavation Logs is presented in Appendix A as Figure A-1. Final logs of the test borings are presented on Figures A-2 through A-8. The descriptions on the logs are based on our field logs, sample inspections, and the results of laboratory testing.

A total of 45 field vane shear tests were conducted (from the deck of the fuel dock, as well as from all eleven floating marina docks) at the locations indicated on Figure 2 to evaluate variations in near-surface soil strengths. A summary of the relevant data obtained from field vane shear testing is presented in Table 1.

LABORATORY TESTING

Representative samples of the soils observed during our field exploration were inspected and tested in the laboratory to verify field classifications and to aid in developing pile design input. Laboratory test results are presented in Appendix B.

GEOLOGIC AND SUBSURFACE SOIL CONDITIONS

Geologic Conditions

The historical site conditions generally consist of reclaimed estuarine and low-lying tidelands located southerly and easterly of Loma Portal at the northerly end of San Diego Bay. Historically, prior to the early 1900s, the San Diego River would periodically overflow its banks and reestablish a new course southerly into San Diego Bay (Figure 3). In the early 1900s, the Army Corps of Engineers created a levee system to prevent flooding and to direct the San Diego River to the west into False Bay (currently Mission Bay). Over the next decades, the low-lying lands were developed into what is now the San Diego International Airport, Marine Corps Recruit Depot, U.S. Naval Training Center, Harbor Island, Shelter Island, and the remaining tidelands that surround the America's Cup Harbor. Most of the man-placed fills are of hydraulic origin and generally consist of relatively clean sands placed over relatively granular bay deposits. All of these near-surface overburden soils are underlain at depth by relatively competent Pleistocene age marine and non-marine terrace deposits.

Subsurface Soil Conditions

Subsurface soil conditions encountered in our offshore borings and vane shear testing typically consisted of 6 to 12 inches of near-surface fine-grained colloidal flock, exhibiting essentially no shear strength, underlain by variable thickness (typically 1 to 2 feet thick) bay deposits consisting of very loose to medium dense, fine sands, and locally very soft to soft silts and clays. The underlying weathered Bay Point formational terrace deposits were generally encountered near elevation -13 feet, with the more competent Bay Point Formation below -20 feet. These soils are described in more detail below.

Recent Bay Deposits: The recent bay deposits consist of a relatively thin layer of colloidal flock underlain by very loose and soft, gray, very fine- to medium-grained sands and silt.

Bay Point Formation: The Bay Point Formation was generally encountered below -13 feet MLLW. The upper 5 to 10 feet are generally weathered, becoming more competent below -20 to -25 feet MLLW. The Bay Point Formation generally consists of old paralic deposits of late to middle Pleistocene age and is mostly poorly sorted, interfingered, beach estuarine and colluvial deposits comprised of siltstones and sandstones and occasional clays.

FAULTING AND SEISMICITY

The site is located in a seismically-active region of Southern California that is subject to significant hazards from moderate to large earthquakes. Ground shaking and surface rupture have occurred in this region in very recent times. Although there are many active fault zones throughout the Southern California region, potential earthquakes from two fault zones are most likely to affect the site: the Rose Canyon fault zone and the Coronado Banks fault zone. The nearest of these, the Rose Canyon fault zone, trends northwest-southeast, and is located approximately 2 miles northeasterly of the site. The Coronado Banks fault zone is 11.9 miles west-southwest of the site. Neither of these faults is known to have produced a moderate to large earthquake since European settlement. It is speculated that a damaging earthquake in 1862 may have originated on one of these faults.

Liquefaction

Liquefaction is a potential hazard in any water-saturated sandy soils. Since most of the fill soils and underlying embayment deposits are predominantly composed of sands, they should be considered to be susceptible to seismically-induced liquefaction. Spontaneous liquefaction develops within sandy soils when they are subjected to rapid buildup of pore pressure, such as that caused by seismic shock, and the result of this condition could be massive mobilization of the slopes surrounding Harbor Island, and the failure (settlement) of any non-pile-supported structural foundations, including the approach piers supporting the ADA-compliant gangways.

APPROACH PIER FOUNDATIONS

The two new approach piers may be supported on either a large gravity mat foundation enabling the approach pier to cantilever out over the rock revetment, on axially-loaded piles deriving their support from the dense formational soils at depth, or a combination of the two.

Gravity Mat Foundation

We recommend that a mat foundation alternative, if desired, be designed for a maximum soil bearing pressure of 2,500 psf (dead plus live loads), with no increase for wind or seismic forces. The mat foundation should extend a minimum of 2 feet below existing grade and the bottom toe of this mat foundation should be located a minimum of 5 feet from the outside face of the existing revetment.

For the gravity mat foundation alternative, with maximum cantilevered induced toe pressures of 2,500 psf, settlement along the outboard toe of the mat should be assumed to be 3/4 inch and zero at its heel, resulting in an angular rotation of 3/4 inch/mat footing length.

Lateral Resistance

Lateral loads may be resisted by passive resistance of the soil equal to a fluid pressure of 350 pounds per cubic foot, or by soil friction, assuming a friction coefficient of 0.4. If passive pressure is to be used in combination with soil friction, the friction value should be reduced to 0.25. The top 1 foot of soil providing passive resistance to lateral loads should not be used for lateral resistance, unless protected by pavement. Moreover, passive resistance should not be used to resist loads acting normal to the slope face in the direction of the slope face.

Pile-Supported Approach Pier Foundations

A pile-supported approach pier alternate minimizes differential settlements, and can be designed to resist lateral loads associated with liquefaction-induced slope movement in the event of a large magnitude earthquake. We suggest that, if this alternate is considered, pile foundations for the approach piers should be designed to have a tip elevation of –35 feet MLLW. This provides a minimum 10+ feet of penetration into competent formational terrace deposits. For this condition, we recommend an allowable design load of 20 tons. We estimate settlements for piles driven to –35 feet and loaded to 20 tons will be on the order of 1/2 inch.

GUIDE PILE DESIGN CONSIDERATIONS

As we understand, a variety of guide piles are currently being considered for use at the marina, including 14-, 16-, and 20-inch-diameter pre-stressed concrete piles, 12-, 14-, 18-, and 20-inch square pre-stressed concrete piles, and 12-, 14-, 18-, and 20-inch-diameter round fiberglass piles.

In order to evaluate the structural requirements and load deformation characteristics of the proposed guide piles, we have used the elastic theory approach developed by Matlock and Reese (1962). A condensed version of this approach is outlined in the NAVFAC Design Manual DM-7.02, Chapter 5, Section 7. A copy of this design section is included with our calculation package. We have also used a coefficient of variation of soil modulus of 15 pci as being representative of the near-surface weathered Bay Point Formation soils and the overlying medium dense alluvial sediments. For this condition, we have assumed a design bay floor elevation of -13 feet MLLW, with all piles jetted down to 2 feet above the design tip elevation.

Ultimate lateral load capacity was also evaluated using the approach developed by Broms (1965), which follows the general approach developed by Matlock and Reese.

We have used a roller assembly design load elevation of +8.5 feet, MLLW, as specified in the structural calculation package by Redpoint Structures. For this loading condition, we have calculated guide pile deflections for the above-referenced 11 pile types assuming jetting down to within 2 feet of design tip, and then driven the last 2 feet to redensify the jetted soils. Figures 4a, 4b, and 4c graphically depict the relationship between roller deflection and load application for the 11 pile types. As indicated in the attached calculation package, we have used a design cantilever length of 21.5 feet.

When using the Matlock and Reese solution, in order to minimize guide pile deflections and account for variabilities in subsurface soil conditions, we recommend a minimum embedment depth on the order of 3.5T or $3.5(EI/f)^{1/5}$. The recommended minimum embedment depth for the 11 pile types is also summarized in Figures 4a and 4b.

WINDS AND WAVES

Although the Harbor Island West Marina is reasonably well protected from wind-generated waves, the fuel dock and westerly most row of slips is exposed to wind-driven waves from the south through the main harbor entrance, in part reflected off Shelter Island. The longest unobstructed fetch is through a relatively narrow corridor of approach from about 200 to 220 degrees originating from Ballast Point. Storms originating from the south primarily result from tropical storms, with several storm events each season generating winds of 30+ knots developing wind waves of 2 to 3 feet, with periods of 3 to 4 seconds. This loading condition results in more severe cyclic loading for the fuel dock and westerly most boat slips, and tends to reduce the soil modulus over the course of time, resulting in slightly higher deflections, which for the fuel pier and westerly docks we would anticipate a 10 to 15 percent increase in calculated deflections over those presented in Figures 4a and 4b. Although we anticipate a reduction in soil modulus associated with this high cyclic loading and an associated 10 to 15 percent increase in laterally loaded deflections, given the relatively competent near-surface terrace deposits that underlie the marina, we do not recommend any additional embedment depth for these westerly most guide piles.

CONSTRUCTION ASPECTS

Subsurface data obtained from our borings suggests the presence of highly weathered near-surface Bay Point formational soils and less weathered formational soils at depth, which will require pre-jetting of both guide piles and the axially loaded approach pier piles to reach the required design tip elevation. To maximize the lateral load capacity and minimize the deformation in response to lateral loads, jetting should be terminated approximately 2 feet from the design tip elevation and the last 2 feet driven to aid in redensifying the soils disturbed by jetting. We recommend that jetting for the axially loaded approach pier piles be stopped at elevation -30 feet and driven the final 5 feet, with axial capacities determined using a dynamic pile driving formula such as the

Engineering News Record (ENR) formula. We would suggest the use of a minimum 50,000 foot-pound capacity pile hammer to achieve design tip elevations within the underlying terrace deposits.

The jetting of piles should be done using internal jet pipes, and jet volumes and velocities should be limited to the minimum flow needed to advance the piles. In this regard, it is important to recognize that excessive jetting will tend to enlarge the hole and significantly reduce the lateral load capacity of the soil. The proper jetting technique is to use a low-volume, low-pressure flow of water through the internal jet pipe while repeatedly lifting and dropping the pile to displace the formational soils beyond the pile tip and expel the sands up the annulus of the jetted hole without excessively disturbing the surrounding dense formational soils. The proper jetting technique essentially allows the lifting and repeated dropping of the pile to redensify the formational soils as the pile is advanced into the dense underlying formational soils.

We trust this information meets your current requirements. Please do not hesitate to contact us if you have any questions or require additional information.

Very truly yours,

TERRACOSTA CONSULTING GROUP, INC.

Walter F. Crampton, Principal Engineer
R.C.E. 23792, R.G.E. 245

Gregory A. Spaulding, Project Geologist
C.E.G. 1863, C.H.G. 351, P.G. 5892

WFC/GAS/jg
Attachments

REFERENCES

Broms, B.B., 1965, "Design of Laterally Loaded Piles," in *Journal of the Soil Mechanics and Foundations Division*, American Society of Civil Engineers, Vol. 91, No. SM3, May 1965, pp. 79-99.

Matlock, H., and L.C. Reese, 1962, "Generalized Solutions for Laterally Loaded Piles," in *Transactions of the American Society of Civil Engineers*, Vol. 127, Part 1, Paper No. 3370, pp. 1220-1251.

TerraCosta Consulting Group (formerly Group Delta Consultants-San Diego), May 22, 1986, Geotechnical Investigation and Design Criteria for Harbor Cove Marina, San Diego, California. Project No. 6S333A.

TerraCosta Consulting Group (formerly Group Delta Consultants-San Diego), February 22, 1990, Additional Geotechnical Investigation, Onshore Marina Building, Naval Training Center, San Diego, California. Project No. 1154.

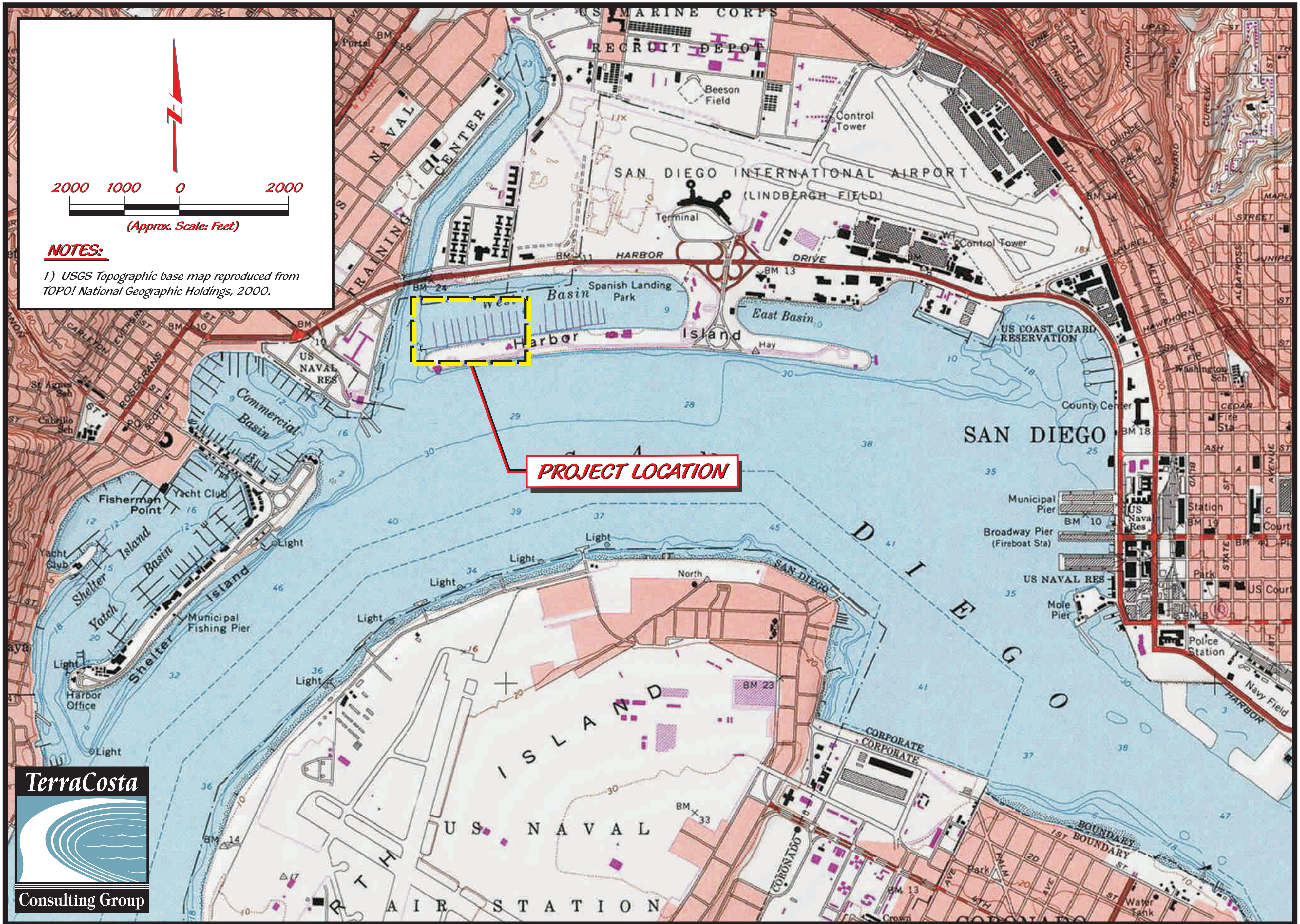
TerraCosta Consulting Group (formerly Group Delta Consultants-San Diego), April 4, 1988, Geotechnical Investigation, NTC Marina, San Diego, California. Project No. 1154.

U.S. Department of the Navy, Naval Facilities Engineering Command, 1986, Foundations and Earth Structures, NAVFAC DM 7.02.

Harbor Island West Marina (Project No. 2769) Date of Vane Shear Testing: 2/6/12

Vane Shear Number	Location	Time	Depth to Mudline (feet)	Tide Height (MLLW) (feet)	Bottom Elevation (feet)	Vane Shear Reading 20 x 40 mm vane (kPa)										
						(@ 1 foot)	(@ 2 feet)	(@ 3 feet)	(@ 4 feet)	(@ 5 feet)	(@ 6 feet)	(@ 7 feet)	(@ 8 feet)	(@ 9 feet)	(@ 10feet)	Refusal @ x feet
1	1100 Dock End	10:30	14.9	4.25	-10.7	10	12	*sandy bottom*								2.2
2	1100 Dock End	10:55	14.2	3.57	-10.6	14	24	*clayey bottom*								2.0
3	1100 Dock Middle	11:02	13.8	3.37	-10.4	12	76	*very soft first foot then sandy @ 2'*								2.0
4	1100 Dock Main Walk	11:07	8.3	3.22	-5.1	12	40	70	*sandy @ 2'*							3.2
5	1000 Dock Main Walk	11:12	11.0	3.08	-7.9	4	24	26	64	62	*very soft; sandy @ 2'*					5.0
6	1000 Dock Middle	11:20	13.4	2.85	-10.6	8	51	84	*very soft; sandy @ 2'*							3.0
7	1000 Dock Middle	11:25	13.4	2.70	-10.7	4	33	50	*very soft; sandy @ 2'*							3.5
8	1000 Dock End	11:31	13.7	2.53	-11.2	22	31	78	*6" soft; sandy @ 2.5'*							3.0
9	900 Dock End	11:42	12.7	2.21	-10.5	10	62	*soft; 1' sand; refusal below 2.5'*								2.5
10	900 Dock Middle	11:46	13.0	2.09	-10.9	18										1.5
11	900 Dock Middle	11:59	12.3	1.73	-10.6	15										1.7
12	900 Dock Main Walk	12:05	12.0	1.56	-10.4	14	10	20	78 @ 3.5	*very soft*						3.5
13	800 Dock End	12:12	11.9	1.37	-10.5	26	34	*sandy base*								2.5
14	800 Dock Middle	12:19	11.7	1.18	-10.5	24	50	92	*soft bottom w/shells; sandy @ 1.5'*							3.0
15	800 Dock Middle	12:24	11.7	1.05	-10.7	13	*sandy after 1'*									1.0
16	800 Dock Main Walk	12:27	8.9	0.97	-7.9	22	16	70	50	42	60	68	60	44	117	10.0
17	700 Dock End	12:41	11.9	0.62	-11.3	24	26	102	*sandy bottom; soft @ 2'*							3.0
18	700 Dock Middle	12:45	11.6	0.53	-11.1	10	44	50	*sandy @ 1'*							3.0
19	700 Dock Middle	12:50	12.7	0.41	-12.3	6	8	66	*sandy @ 2'+*							3.5
20	700 Dock Main Walk	12:54	7.9	0.32	-7.6	18	54	68	64	88	40	38	46	30		10.0
21	600 Dock End	1:40	11.0	-0.55	-11.6	38	62									2.5
22	600 Dock Middle	1:45	10.8	-0.65	-11.5	10	50									2.5
23	600 Dock Main Walk	1:49	7.1	-0.67	-7.8	23	45	78	42	102	78					6.0
24	500 Dock Main Walk	1:55	4.9	-0.74	-5.6	16	44	56	38	50	62	66				7.0
25	500 Dock Middle	2:03	10.8	-0.83	-11.6	10	58									3.0
26	500 Dock Middle	2:09	10.3	-0.89	-11.2	14	47	100								3.0
27	500 Dock End	2:13	10.2	-0.94	-11.1	22	28	108								3.6
28	400 Dock End	2:21	10.5	-0.98	-11.5	52	14	88	*sandy @ top*							3.5
29	400 Dock Middle	2:26	10.6	-1.01	-11.6	8	57	80	130+							4.0
30	400 Dock Middle	2:30	10.7	-1.02	-11.7	12	98	92								3.6
31	400 Dock Main Walk	2:35	5.0	-1.05	-6.1	27	26	38	32	24	94	130+	*sandy @ top*			7.0
32	300 Dock End	2:43	9.5	-1.06	-10.6	17	130+									2.0
33	300 Dock Middle	2:47	10.7	-1.07	-11.8	16	42	85								3.6
34	300 Dock Main Walk	2:53	5.7	-1.07	-6.8	18	25	130+	60	65	106	130+	*3' crunchy*			7.0
35	200 Dock End	3:04	10.8	-1.05	-11.9	22	54	130+								2.8
36	200 Dock Middle	3:09	11.0	-1.03	-12.0	11										1.5
37	200 Dock Middle	3:13	11.0	-1.01	-12.0	24										1.5
38	200 Dock Main Walk	3:17	4.6	-0.99	-5.6	40	21	26	55	36	130+	106	*shell or gravel*			7.0
39	100 Dock End	3:27	10.9	-0.92	-11.8	28										1.5
40	100 Dock Middle	3:32	11.5	-0.88	-12.4	27	130+									2.0
41	100 Dock Main Walk	3:37	6.8	-0.84	-7.6	*	48	42	68	120						5.0
42	Fuel Dock	3:42	11.7	-0.79	-12.5	24	40	104	130+							4.0
43	Fuel Dock	3:46	11.8	-0.74	-12.5	40	130+	*crunchy*								2.0
44	Fuel Dock	3:50	11.0	-0.70	-11.7	25	*	16	130+	*crunchy*						4.0
45	Fuel Dock	3:55	9.6	-0.64	-10.2	130+										6.0

* no reading taken



NOTES:

1) USGS Topographic base map reproduced from TOPO! National Geographic Holdings, 2000.

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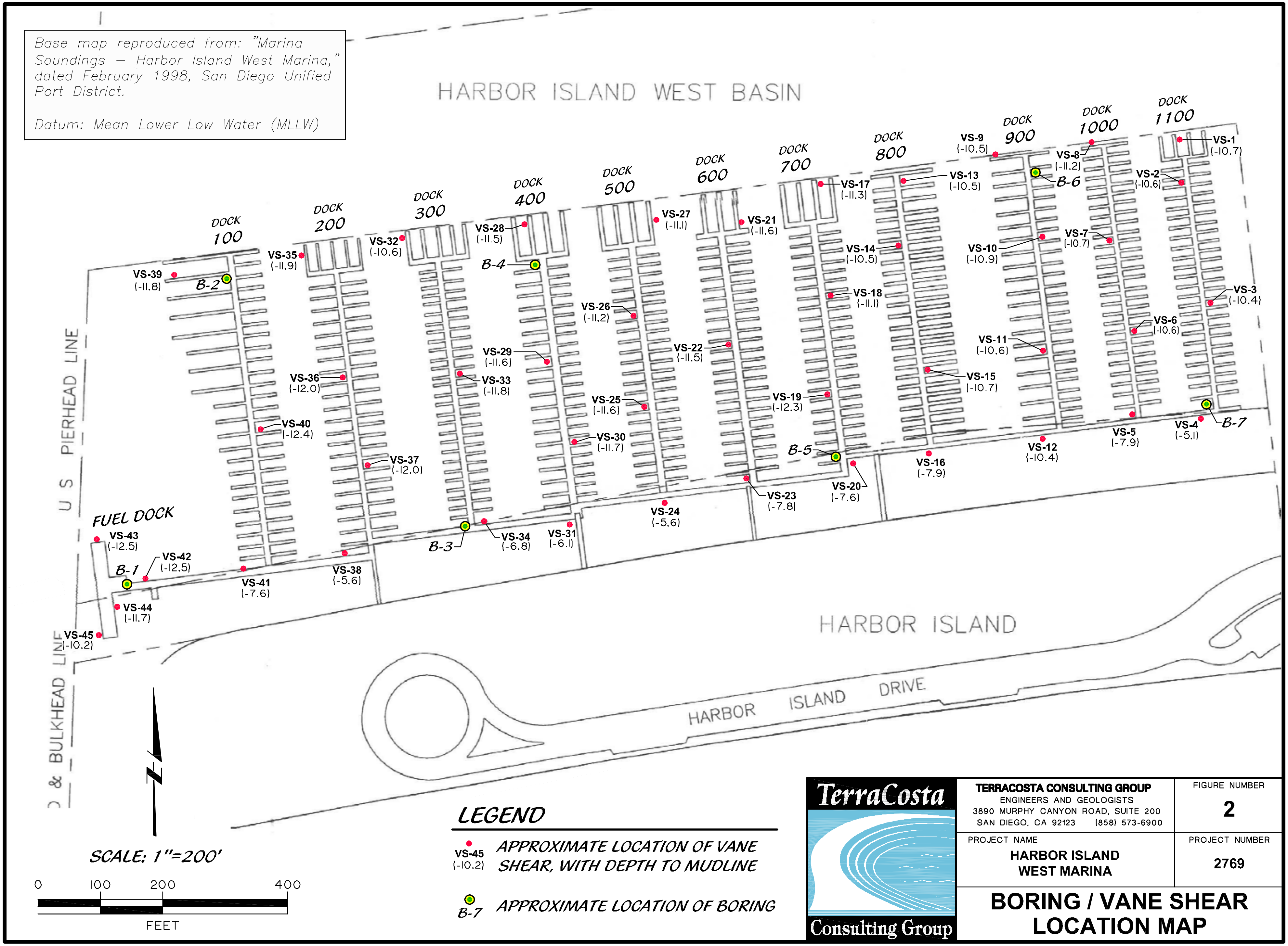
Project: Harbor Island West Marina   Project No. 2769   Figure 1



Base map reproduced from: "Marina Soundings — Harbor Island West Marina," dated February 1998, San Diego Unified Port District.

Datum: Mean Lower Low Water (MLLW)

LEGEND

● VS-45 (-10.2) APPROXIMATE LOCATION OF VANE SHEAR, WITH DEPTH TO MUDLINE

◉ B-7 APPROXIMATE LOCATION OF BORING

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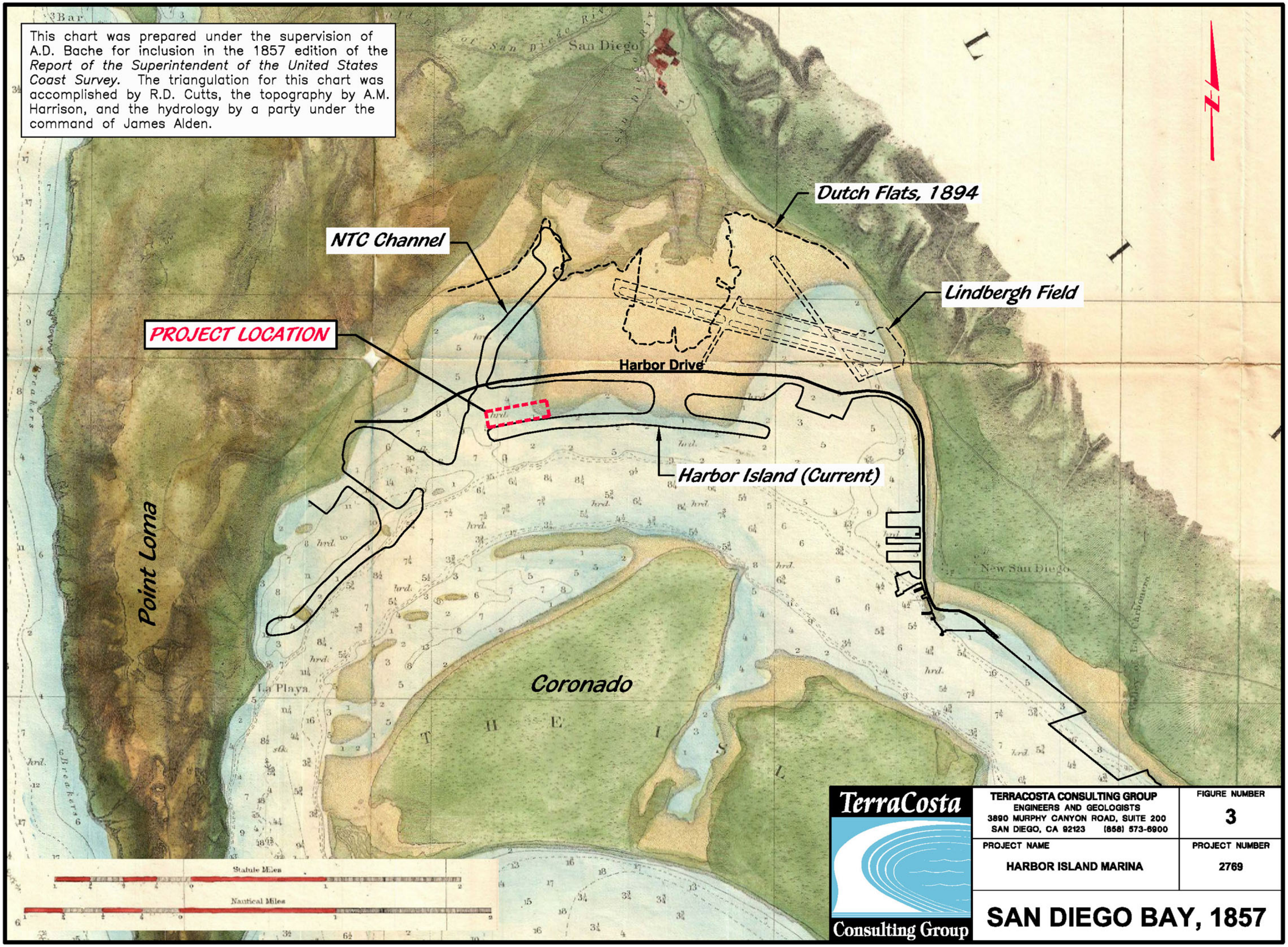
FIGURE NUMBER
2

PROJECT NAME
HARBOR ISLAND WEST MARINA

PROJECT NUMBER
2769

BORING / VANE SHEAR LOCATION MAP



This chart was prepared under the supervision of A.D. Bache for inclusion in the 1857 edition of the *Report of the Superintendent of the United States Coast Survey.* The triangulation for this chart was accomplished by R.D. Cutts, the topography by A.M. Harrison, and the hydrology by a party under the command of James Alden.

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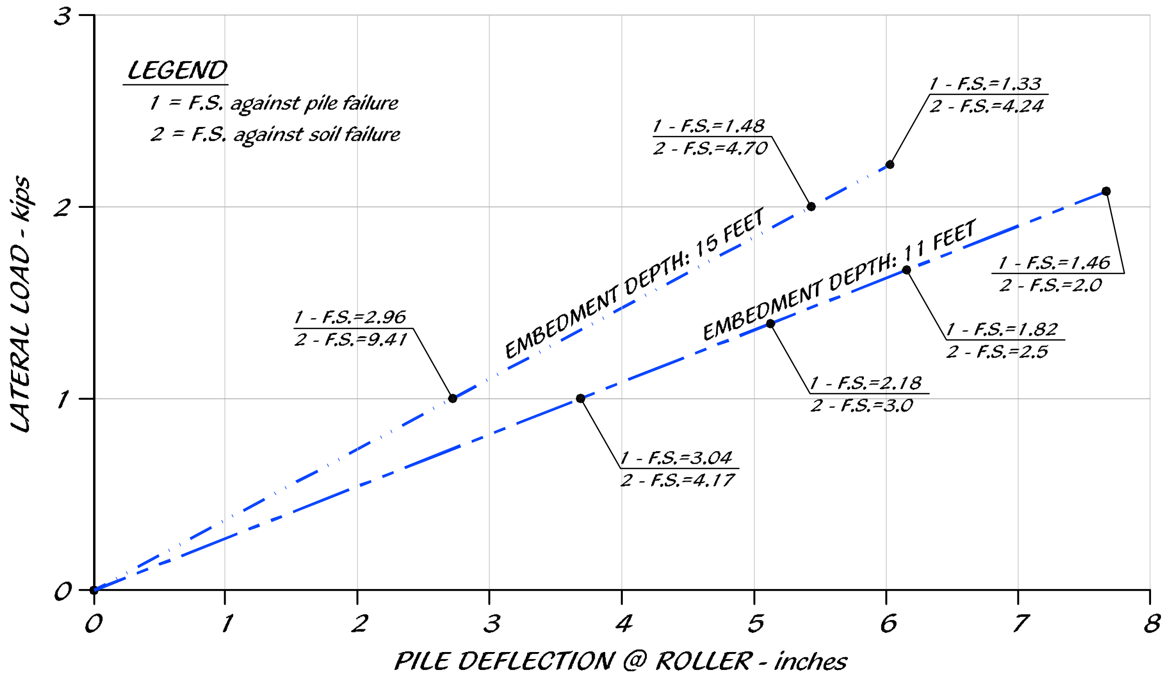
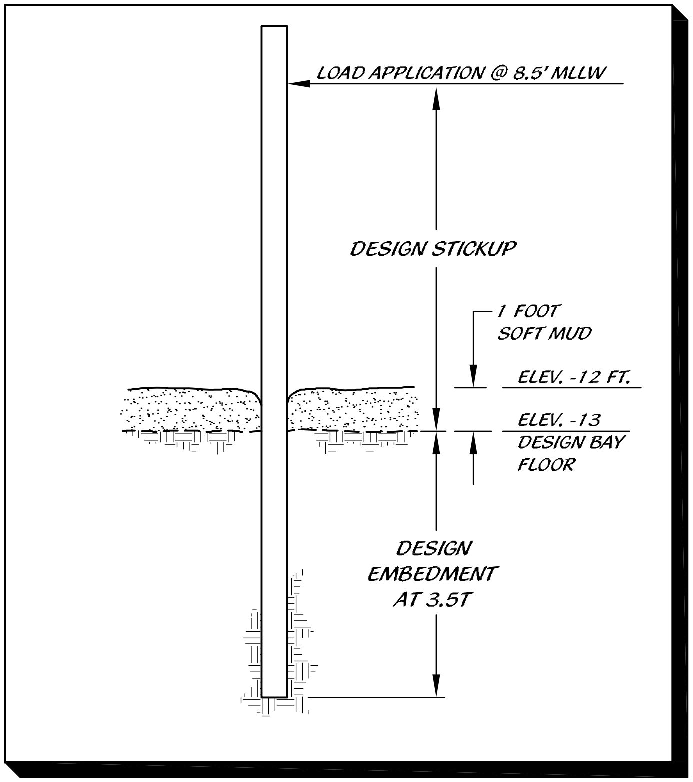
FIGURE NUMBER	3
PROJECT NAME	HARBOR ISLAND MARINA
PROJECT NUMBER	2769

SAN DIEGO BAY, 1857

ROLLER DEFLECTION VS. DESIGN LATERAL LOAD





Pile Size (Inches)	Pile Type	Design Embedment Depth, feet	Design Tip Elevation (feet, MLLW)	Design L/T	Max. Load & Deflection, kips (inches)
12	Square, Conc	15	-28	3.5	2.22k (6.03")
12	Square, Conc	11	-24	2.6	1.67k (6.13") *

* MAX. LOAD BASED ON A
F.S. = 2.5 AGAINST SOIL FAILURE

NOTE:

ASSUMES: M yield 12" SQUARE = 67.7 k-ft

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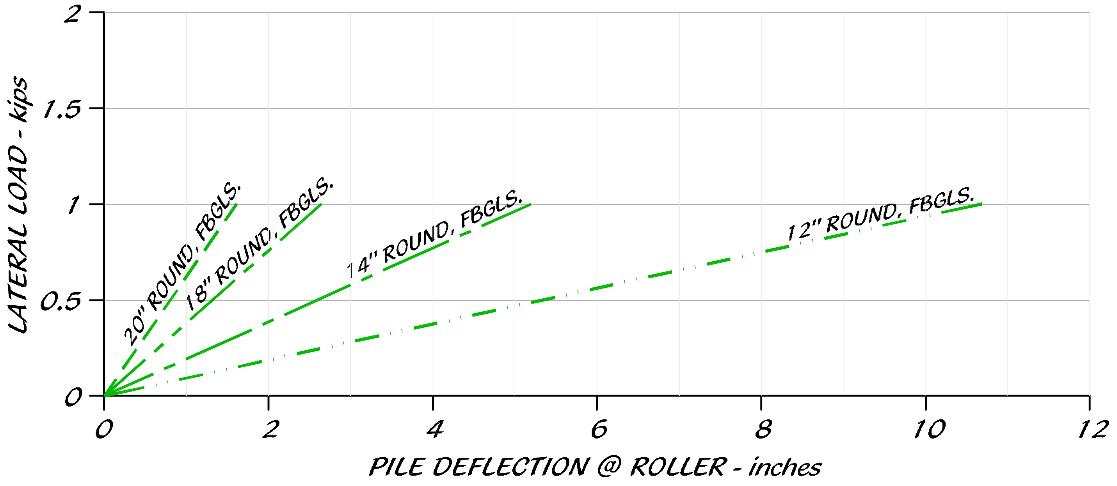
FIGURE NUMBER
4A

PROJECT NAME
HARBOR ISLAND MARINA

PROJECT NUMBER
2769

ROLLER DEFLECTION -
CONCRETE PILES

ROLLER DEFLECTION VS. DESIGN LATERAL LOAD



Pile Size (Inches)	Pile Type	Design Embedment Depth, feet	Design Tip Elevation (feet, MLLW)	Deflection (inches) for a 1.00 kip load @ Elev. +8.5'
12	Rnd, Fbrgls	11	-24	10.68"
14	Rnd, Fbrgls	13	-26	5.09"
18	Rnd, Fbrgls	15	-28	2.64"
20	Rnd, Fbrgls	17	-30	1.61"

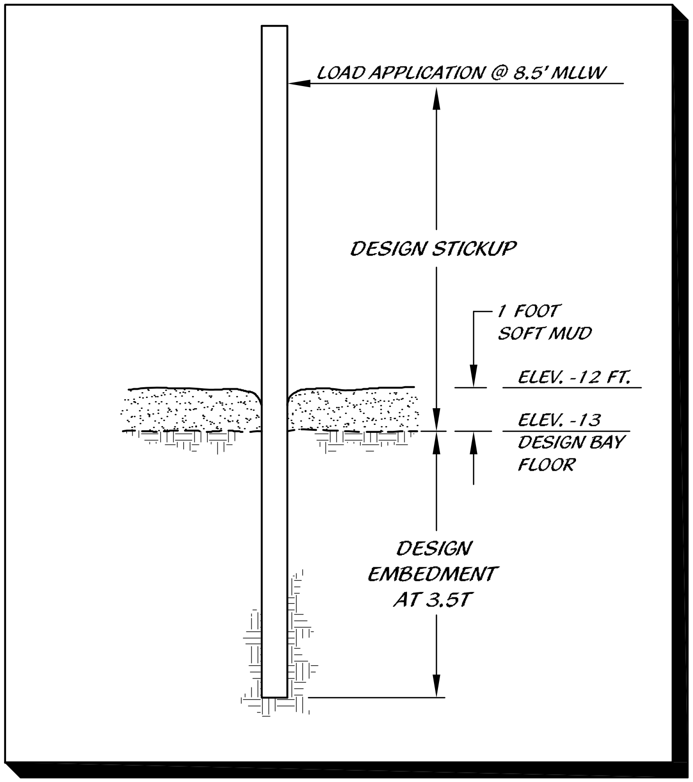


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FIGURE NUMBER
4B

PROJECT NAME
HARBOR ISLAND MARINA

PROJECT NUMBER
2769

**ROLLER DEFLECTION -
FIBERGLASS PILES**

ROLLER DEFLECTION VS. DESIGN LATERAL LOAD

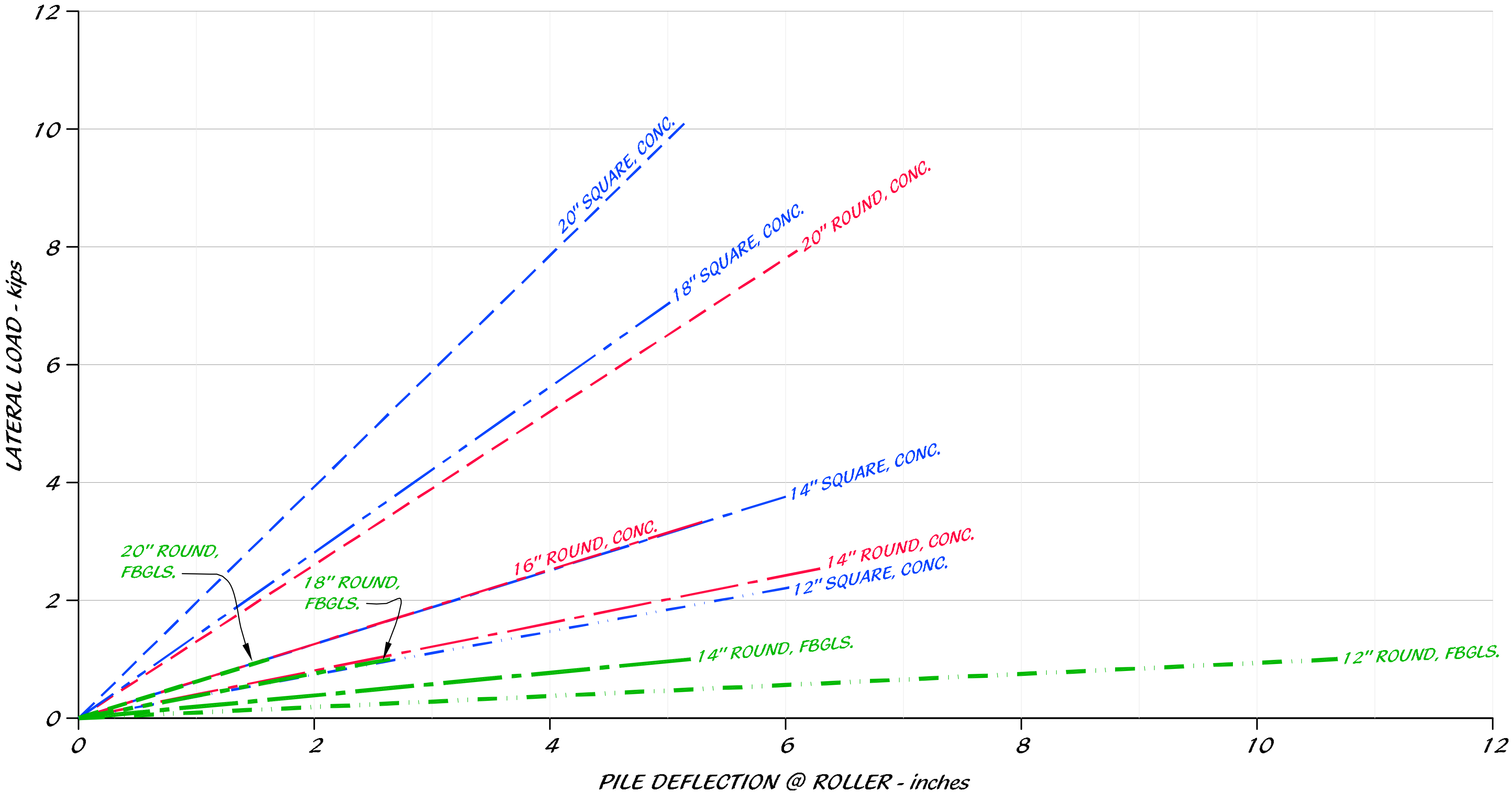

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FIGURE NUMBER
4C

PROJECT NAME
HARBOR ISLAND MARINA

PROJECT NUMBER
2769

ROLLER DEFLECTION - CONCRETE VS. FIBERGLASS PILES

APPENDIX A

BORING LOGS

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA
PROJECT NUMBER 2769
BORING LEGEND
SITE LOCATION Harbor Island, San Diego, CA
START 1/30/2012
FINISH 2/2/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Wash Boring
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT TriPod
BORING DIA. (in) 3
TOTAL DEPTH (ft) 20
GROUND ELEV (ft)
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_
SAMPLING METHOD SPT
NOTES

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
5									
		S	1						
10									
15									

KEY TO EXCAVATION LOGS

▼ WATER TABLE MEASURED AT TIME OF DRILLING

OTHER TESTS

GS Grain Size Analysis

PENETRATION RESISTANCE (BLOWS/ft)

Number of blows required to advance the sampler 1 foot.

SAMPLE TYPE

S ("SPT") - a.k.a. Standard Penetration Test, an 18-inch-long, 2-inch O.D., 1-3/8-inch I.D. drive sampler.

NOTES ON FIELD INVESTIGATION

Borings were advanced using a limited-access TriPod drill rig. Holes were advanced by jetting a 3-inch-diameter casing down to the desired sample depth.

Once the desired sample depth was reached, a Standard Penetration Test (SPT) Sampler was used to obtain soil samples. The SPT Sampler was driven into the soil at the bottom of the borings with a 140-pound hammer falling 30 inches. When the sampler was withdrawn from the boring, the sample was removed, visually classified, sealed in plastic containers, and taken to the laboratory for detailed inspection.

Classifications are based upon the Unified Soil Classification System and include color, moisture, and consistency. Field descriptions have been modified to reflect results of laboratory inspection where deemed appropriate.

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FIGURE A-1

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA

PROJECT NUMBER 2769

BORING B-1

SITE LOCATION Harbor Island, San Diego, CA

START 1/30/2012

FINISH 1/30/2012

SHEET NO. 1 of 1

DRILLING COMPANY Pacific Drilling

DRILLING METHOD Wash Boring

LOGGED BY G. Spaulding

CHECKED BY

DRILLING EQUIPMENT TriPod

BORING DIA. (In) 3

TOTAL DEPTH (ft) 15.5

GROUND ELEV (ft) -12.10

DEPTH/*ELEV.* GROUND WATER (ft) ⯀ n/a_

SAMPLING METHOD SPT

NOTES

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	1	PUSH					**MUD LINE** RECENT BAY DEPOSITS **Silty Fine SAND (SM)**, very loose, gray, wet, with shell fragments
	-15								
									WEATHERED BAY POINT FORMATION **Find Sandy SILT (ML)**, medium dense, olive to olive-brown, wet, micaceous
5		S	2	15			GS		
	-20								
									Silty SAND (SP-SM), grades to medium dense, olive-gray, wet, micaceous
10		S	3	16					
									BAY POINT FORMATION **SAND to Silty SAND (SP/SM)**, dense, interbedded gray-brown / olive-gray, wet, micaceous
	-25								
15		S	4	35					
									Hole sanding in. *Boring terminated at depth of 15.5 feet due to refusal.*
	-30								

TCG_METRIC_LOG(3) 2769.GPJ GDCLOGMT.GDT 8/17/12

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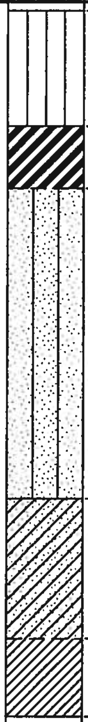
FIGURE A-2

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA	**PROJECT NUMBER** 2769	**BORING** **B-2**	
SITE LOCATION Harbor Island, San Diego, CA	**START** 1/31/2012	**FINISH** 1/31/2012	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Wash Boring	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT TriPod	**BORING DIA. (In)** 3	**TOTAL DEPTH (ft)** 11.5	**GROUND ELEV (ft)** -11.25
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a	**SAMPLING METHOD** SPT	**NOTES**	



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									MUD LINE
		S	1	PUSH					RECENT BAY DEPOSITS **Clayey SILT (ML)**, very soft, dark gray, wet, with shell fragments
									WEATHERED BAY POINT FORMATION Hard clay lense
									Silty SAND (SM), medium dense, gray-brown to olive-gray, wet, micaceous
	-15								
5									
		S	2	19					
									BAY POINT FORMATION Becomes **Clayey SAND (SC)**
	-20								
10									
									Silty CLAY (CL), very stiff, red-brown, moist
		S	3	22					
									Boring terminated at depth of 11.5 feet due to refusal.
	-25								
15									
	-30								

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FIGURE A-3

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA			**PROJECT NUMBER** 2769		**BORING** **B-3**	
SITE LOCATION Harbor Island, San Diego, CA		**START** 1/31/2012	**FINISH** 1/31/2012		**SHEET NO.** 1 of 1	
DRILLING COMPANY Pacific Drilling		**DRILLING METHOD** Wash Boring		**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT TriPod	**BORING DIA. (in)** 3	**TOTAL DEPTH (ft)** 16.5	**GROUND ELEV (ft)** -6	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_		
SAMPLING METHOD SPT	**NOTES**					

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	1	PUSH					**MUD LINE** RECENT BAY DEPOSITS **Clayey SILT (ML)**, very loose, dark olive-gray to gray, wet, with shell fragments
									Interbedded **Silty Fine SAND (SP-SM) to Fine Sandy SILT (ML)**, loose, dark gray, wet, with shell fragments
	-10								
5									
		S	2	7					
									BAY POINT FORMATION **Silty SAND (SM)**, medium dense to dense, gray-brown to brown, with occasional shell fragments
	-15								
10									
		S	3	17					
	-20								
15									
		S	4	46					
									Boring terminated at depth of 16.5 feet due to refusal.
	-25								

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FIGURE A-4

LOG OF TEST BORING

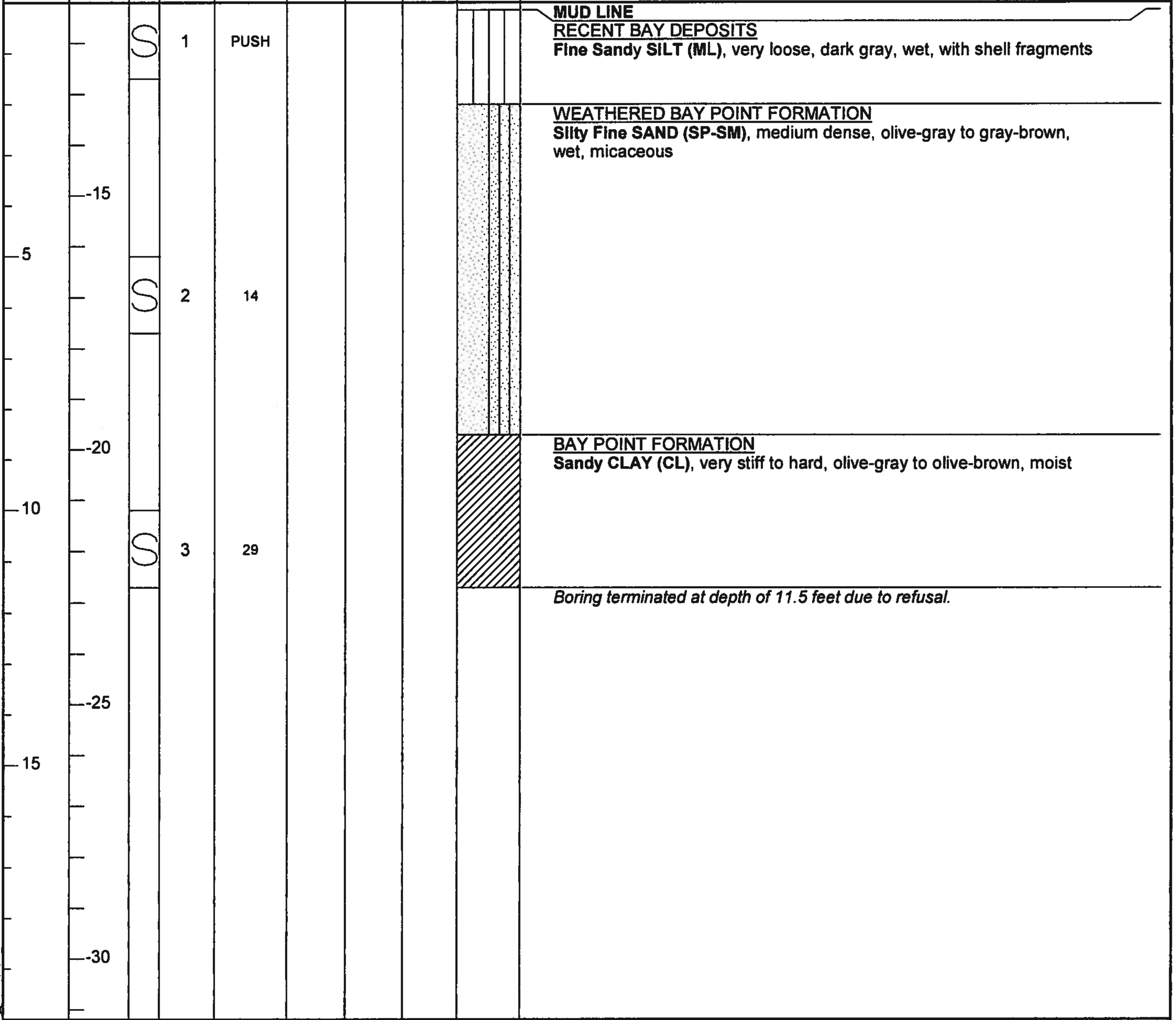
PROJECT NAME	PROJECT NUMBER	BORING
HARBOR ISLAND WEST MARINA	2769	**B-4**

SITE LOCATION	START	FINISH	SHEET NO.
Harbor Island, San Diego, CA	1/31/2012	1/31/2012	1 of 1

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Pacific Drilling	Wash Boring	G. Spaulding	

DRILLING EQUIPMENT	BORING DIA. (In)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUND WATER (ft)
TriPod	3	11.5	-11.2	▼ n/a_

SAMPLING METHOD	NOTES
SPT	



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									MUD LINE
		S	1	PUSH					RECENT BAY DEPOSITS **Fine Sandy SILT (ML)**, very loose, dark gray, wet, with shell fragments
									WEATHERED BAY POINT FORMATION **Silty Fine SAND (SP-SM)**, medium dense, olive-gray to gray-brown, wet, micaceous
		S	2	14					
									BAY POINT FORMATION **Sandy CLAY (CL)**, very stiff to hard, olive-gray to olive-brown, moist
		S	3	29					
									Boring terminated at depth of 11.5 feet due to refusal.

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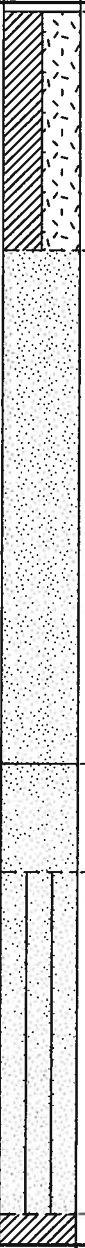
FIGURE A-5

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA
PROJECT NUMBER 2769
BORING B-5
SITE LOCATION Harbor Island, San Diego, CA
START 2/1/2012
FINISH 2/1/2012
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Wash Boring
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT TriPod
BORING DIA. (In) 3
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -9.3
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_
SAMPLING METHOD SPT
NOTES



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								MUD LINE
	-10							RECENT BAY DEPOSITS **Silty CLAY (CL) to Fine Sandy SILT (ML)**, very soft, gray, wet, with shell fragments
		S	1	PUSH				
								Fine SAND (SP), very loose to loose, gray, wet, micaceous
5								
	-15							
		S	2	3			GS	
10								
	-20							- Clay lense from 9.75 to 10.25 feet
		S	3	4				
								BAY POINT FORMATION Becomes coarse **SAND (SP)**, brown
								Silty SAND (SM), dense, interbedded, mottled olive-gray / gray-brown / yellow-brown, wet
15								
	-25							
		S	4	40				
								Silty to Fine Sandy CLAY (CL), very stiff to hard, red-brown, moist

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FIGURE A-6 a

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA	**PROJECT NUMBER** 2769	**BORING** **B-5**	
SITE LOCATION Harbor Island, San Diego, CA	**START** 2/1/2012	**FINISH** 2/1/2012	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Wash Boring	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT TriPod	**BORING DIA. (In)** 3	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** -9.3
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES**		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-30		5	35				▨	**Coarse Clayey SAND (SC)**, dense, red-brown, moist *Boring terminated at depth of 21.5 feet due to refusal.*
25	-35								
30	-40								
35	-45								

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FIGURE A-6 b

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA	**PROJECT NUMBER** 2769	**BORING** **B-6**	
SITE LOCATION Harbor Island, San Diego, CA	**START** 2/2/2012	**FINISH** 2/2/2012	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Wash Boring	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT TriPod	**BORING DIA. (In)** 3	**TOTAL DEPTH (ft)** 16.5	**GROUND ELEV (ft)** -10.6
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES**		

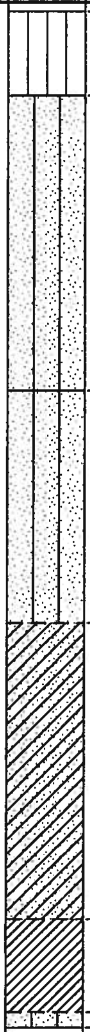
DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	1	PUSH					**MUD LINE** RECENT BAY DEPOSITS **Fine Sandy SILT (ML)**, very loose, dark gray, wet
									WEATHERED BAY POINT FORMATION **Silty Fine SAND (SM)**, loose to medium dense, gray to olive-gray, wet, with occasional shell fragments
	-15								
5									
		S	2	17					BAY POINT FORMATION **Silty SAND (SM)**, medium dense, mottled olive-brown, wet
	-20								
10									Becomes **Clayey SAND (SC)**, medium dense, interbedded olive-gray to olive-brown, moist
		S	3	25					
	-25								
15									**Silty to Fine Sandy CLAY (CL)**, very stiff, olive to olive-gray, moist
		S	4	30					
									Silty Fine SAND (SM), very dense, gray, moist, micaceous *Boring terminated at depth of 16.5 feet due to refusal.*
	-30								

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FIGURE A-7

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA
PROJECT NUMBER 2769
BORING B-7
SITE LOCATION Harbor Island, San Diego, CA
START 2/2/2012
FINISH 2/2/2012
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Wash Boring
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT TriPod
BORING DIA. (In) 3
TOTAL DEPTH (ft) 25.5
GROUND ELEV (ft) -7.20
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_
SAMPLING METHOD SPT
NOTES

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									MUD LINE <u>RECENT BAY DEPOSITS</u> **Clayey Silt / Silty CLAY (ML/CL)**, very soft, gray, wet
		S	1	PUSH					
	-10								**Silty Fine SAND (SP-SM)**, loose, gray, wet, micaceous, with occasional shell fragments
5		S	2	6			GS		
	-15								<u>WEATHERED BAY POINT FORMATION</u> **Silty Fine SAND (SP-SM)**, medium dense, gray to olive-gray, wet, micaceous
10		S	3	23					
	-20								<u>BAY POINT FORMATION</u> **Silty SAND (SM)**, medium dense, mottled olive-gray, wet
15		S	4	35					
	-25								
		S	5	37					

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FIGURE A-8 a

LOG OF TEST BORING

PROJECT NAME HARBOR ISLAND WEST MARINA	**PROJECT NUMBER** 2769	**BORING** B-7	
SITE LOCATION Harbor Island, San Diego, CA	**START** 2/2/2012	**FINISH** 2/2/2012	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Wash Boring	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT TriPod	**BORING DIA. (in)** 3	**TOTAL DEPTH (ft)** 25.5	**GROUND ELEV (ft)** -7.20
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES**		

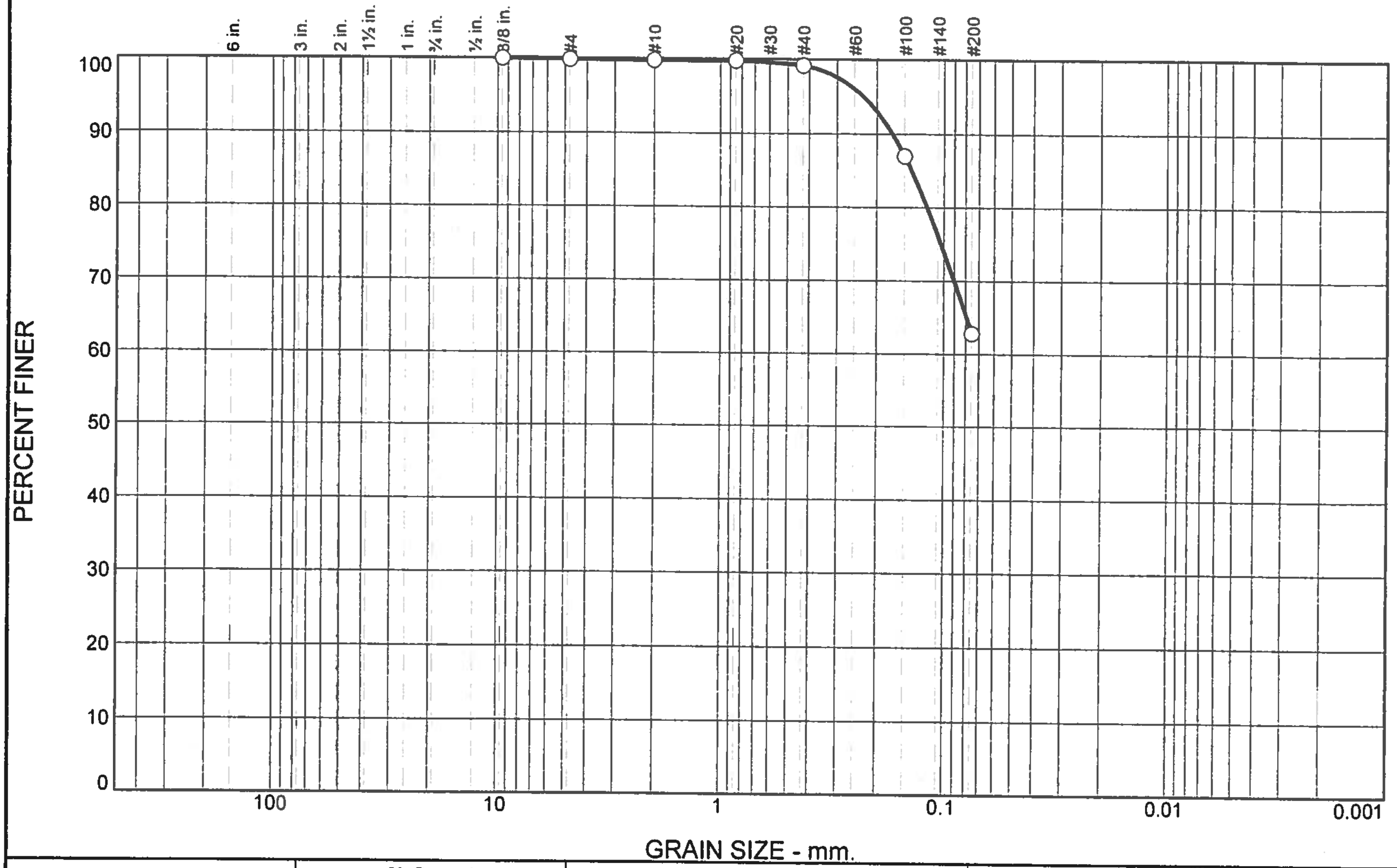
DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S						▨	
	-30							▨	**Silty SAND (SM)**, very dense, mottled gray, moist, micaceous
25		S	6	75				▨	
									Hole sanding in. *Boring terminated at depth of 25.5 feet due to refusal.*
	-35								
30									
	-40								
35									
	-45								

FIGURE A-8 b

APPENDIX B

LABORATORY TEST RESULTS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	0.6	36.4	62.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.9		
#10	99.8		
#20	99.8		
#40	99.2		
#100	87.0		
#200	62.8		

* (no specification provided)

Material Description

Sandy Silt, ML (Lab #26673)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1701 D_{85}= 0.1395 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Sample Number: B1-2 **Depth:** 4.0'

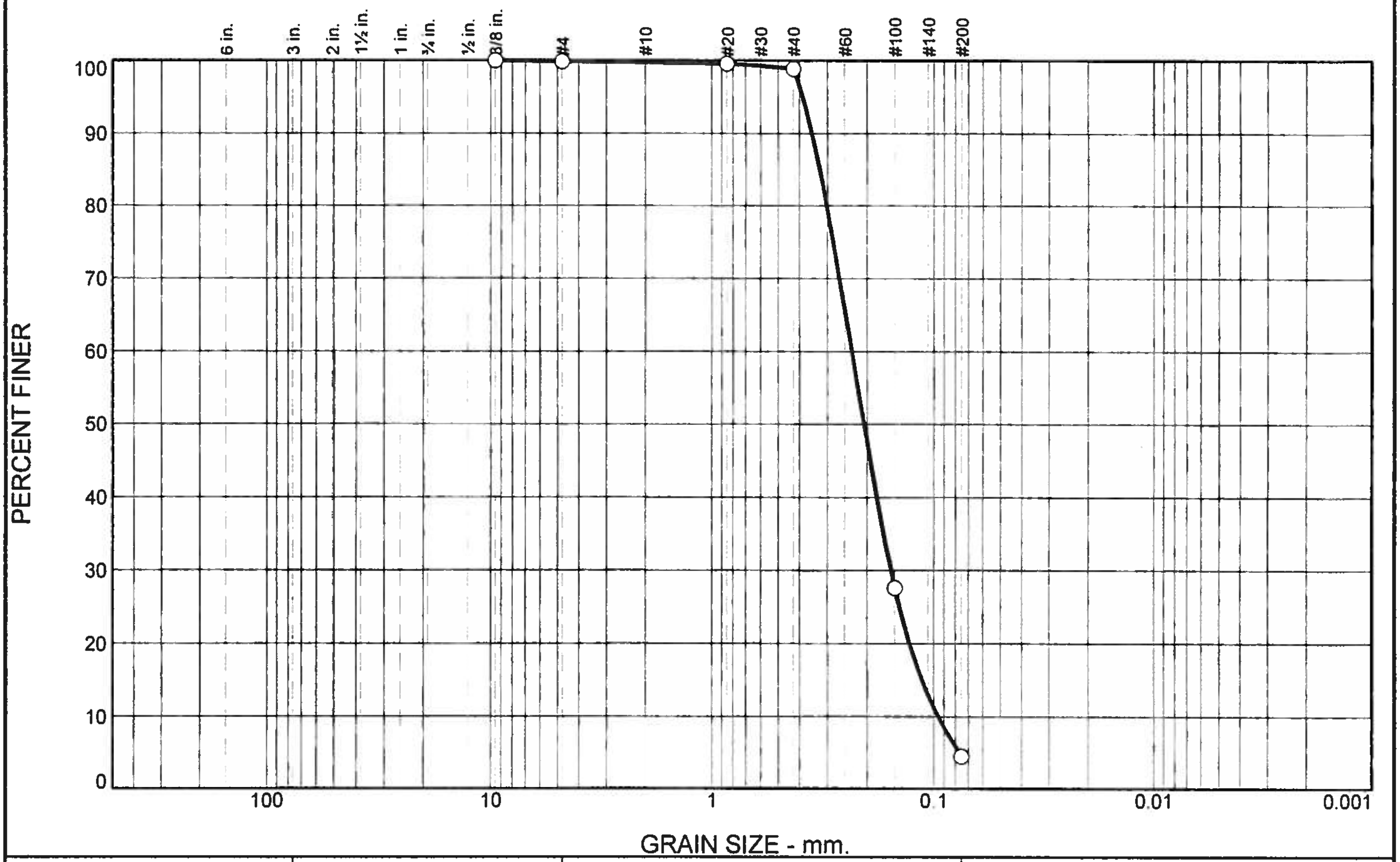
Date: 2/16/12

Client: TerraCosta Consutling Group, Inc.
Project: #2769, Harbor Island West

Project No: 5014-09-0006.29 **Figure** #26673

Tested By: E. Guttierrez **Checked By:** L. Collins

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	0.9	94.4	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375"	100.0		
#4	99.9		
#20	99.6		
#40	98.9		
#100	27.6		
#200	4.5		

* (no specification provided)

Material Description

Poorly Graded Sand, SP (Lab #26674)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3514 D_{85}= 0.3243 D_{60}= 0.2331
D_{50}= 0.2059 D_{30}= 0.1561 D_{15}= 0.1134
D_{10}= 0.0958 C_u= 2.43 C_c= 1.09

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B5-2 **Depth:** 6.0'

Date: 2/16/12

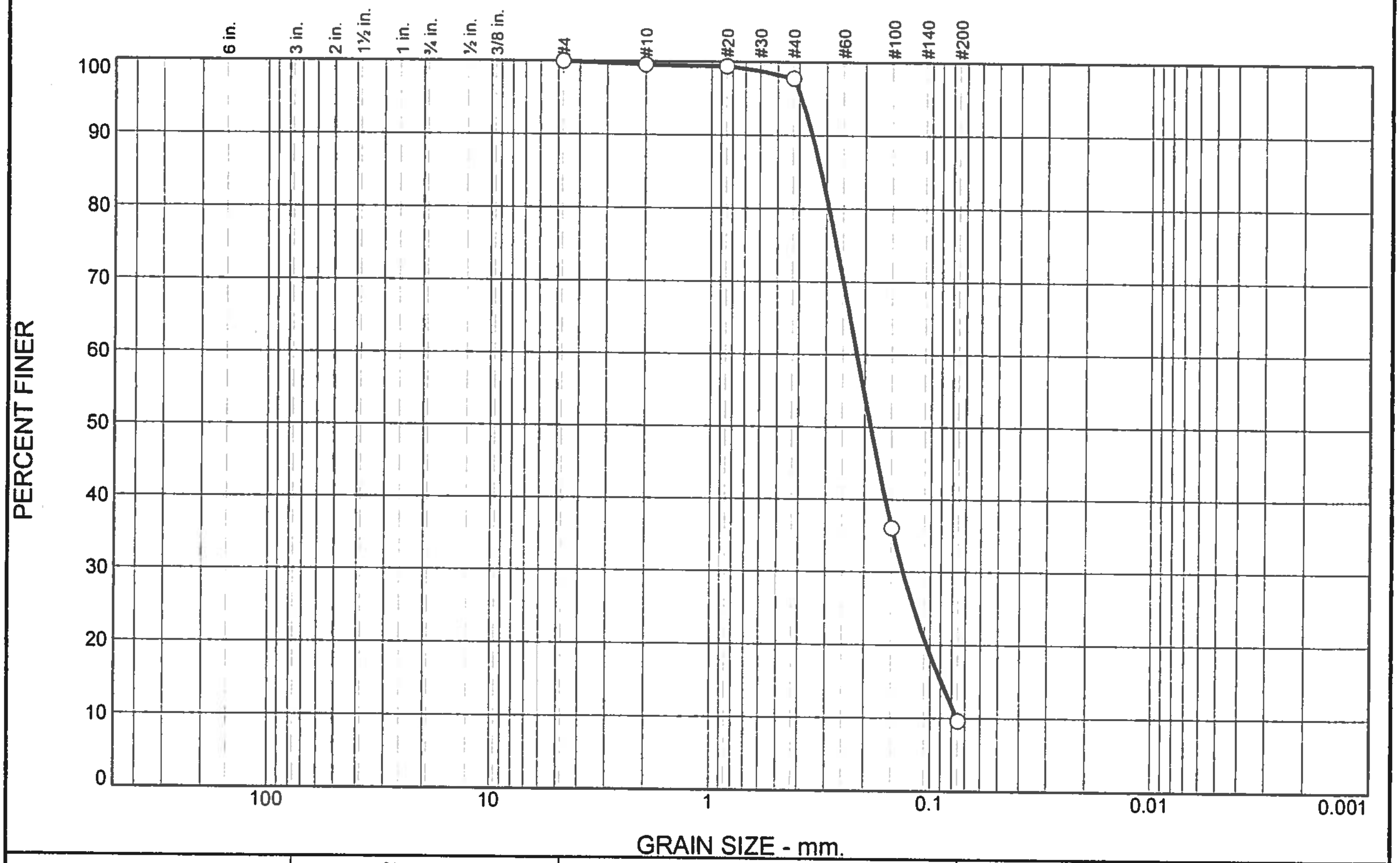
amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769, Harbor Island West

Project No: 5014-09-0006.29 **Figure** #26674

Tested By: R. Valles **Checked By:** L. Collins

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	1.8	88.2	9.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#20	99.4		
#40	97.8		
#100	36.1		
#200	9.6		

* (no specification provided)

Material Description

Poorly Graded Sand w/Silt, SP-SM (Lab #26675)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3490 D_{85}= 0.3177 D_{60}= 0.2170
D_{50}= 0.1877 D_{30}= 0.1332 D_{15}= 0.0897
D_{10}= 0.0760 C_u= 2.86 C_c= 1.07

Classification

USCS= SP-SM AASHTO=

Remarks

Sample Number: B7-2 **Depth:** 4.0'

Date: 2/16/12

amec

Client: TerraCosta Consulting Group, Inc.
Project: #2769, Harbor Island West
Project No: 5014-09-0006.29 **Figure** #26675

Tested By: R. Valles **Checked By:** L. Collins

Appendix F
Noise Modeling and Calculations

FIELD NOISE MEASUREMENT DATA

PROJECT: Harbor Island West Marina PROJ. #: 498.14

SITE IDENTIFICATION: Lincoln Military Housing Park ST-1 OBSERVER(S): Jonathan Higginson

ADDRESS:

START DATE / TIME: 12/10/14 END DATE / TIME: 12/10/14

METEROLOGICAL CONDITIONS:

TEMP: 66 °F HUMIDITY: 70 %R.H. WIND: **CALM [✓ LIGHT] MODERATE VARIABLE**

WINDSPEED: 5 MPH DIR: **N NE E SE S [✓ SW] W NW STEADY GUSTY**

SKY: **SUNNY CLEAR OVRCST [✓ PRTLY CLOUDY] FOG RAIN OTHER:**

ACOUSTIC MEASUREMENTS:

INSTRUMENT: LD-LxT1 TYPE: [✓ 1] **2** SERIAL #: 0004005

CALIBRATOR: LD-CAL200 SERIAL #: 6645

CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.95 dBA SPL WINDSCREEN ✓

SETTINGS: **[✓ A-WEIGHTED] [✓ SLOW] FAST FRONTAL RANDOM [✓ ANSI] OTHER:**

REC #	START	END	L_{eq}	L_{max}	L_{min}	$L_{\cancel{90}}$ 1.67	$L_{\cancel{50}}$ 8.33	L_{10}	OTHER: L_{25}	(TYPE?) L_{50}	L_{90}
004	1:38PM	1:54PM	59.2	71.0	45.7	67.7	62.8	62.3	59.7	56.3	51.4

COMMENTS:

SOURCE INFO AND TRAFFIC COUNTS:

PRIMARY NOISE SOURCE: **TRAFFIC [✓ AIRCRAFT] RAIL INDUSTRIAL AMBIENT OTHER:** Helicopters

ROADWAY TYPE:

TRAFFIC COUNT DURATION: ____-MIN

	SPEED				#2 COUNT		SPEED	
	NB / EB	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**
AUTOS:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER SOURCES: **DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:**

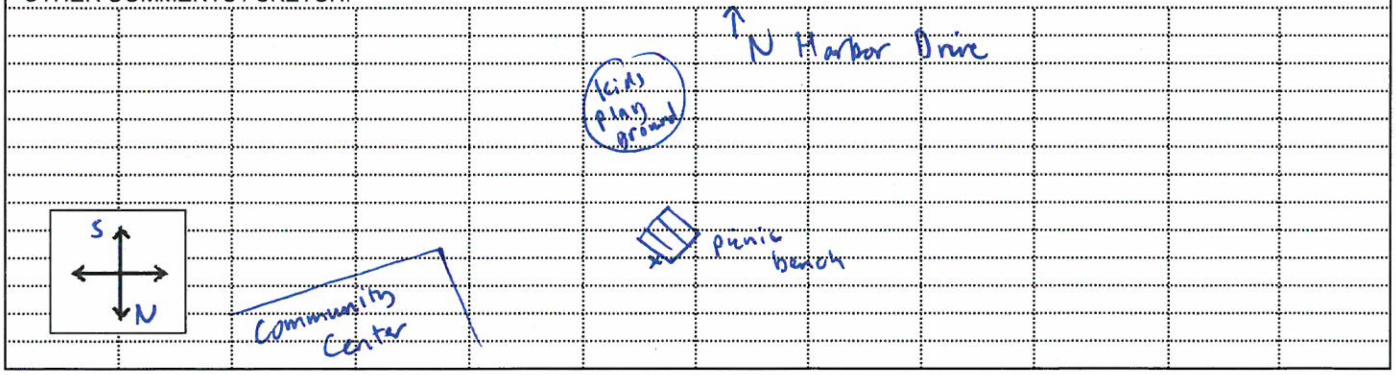
Traffic on N Harbor Drive. Occasional activity at kids playground.

DESCRIPTION / SKETCH:

TERRAIN: **HARD SOFT [✓ MIXED] FLAT OTHER:** Lawn, concrete, trees, shrubs

PHOTOS:

OTHER COMMENTS / SKETCH:



File: LxT_Data.004 "The Village at NTC"

FIELD NOISE MEASUREMENT DATA

PROJECT: Harbor Island West Marina PROJ. #: 498.14

SITE IDENTIFICATION: Spanish Landing Park ST-2 OBSERVER(S): Jonathan Higginson
ADDRESS:
START DATE / TIME: 12/10/14 12:24 AM END DATE / TIME: 12/10/14

METEROLOGICAL CONDITIONS:
TEMP: 66 °F HUMIDITY: 736 %R.H. WIND: **CALM LIGHT MODERATE [✓ VARIABLE]**
WINDSPEED: 5 MPH DIR: **N NE E SE [✓ S SW] W NW** **STEADY GUSTY**
SKY: **SUNNY CLEAR OVRCST [✓ PRTLY CLOUDY] FOG RAIN OTHER:**

ACOUSTIC MEASUREMENTS:
INSTRUMENT: LD-LxT1 TYPE: [✓ 1] **2** SERIAL #: 0004005
CALIBRATOR: LD-CAL200 SERIAL #: 6645
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.93 dBA SPL WINDSCREEN ✓

SETTINGS: **[✓ A-WEIGHTED] [✓ SLOW] FAST FRONTAL RANDOM ANSI OTHER:**

REC #	START	END	L_{eq}	L_{max}	L_{min}	$L_{\cancel{90}}$ 1.67	$L_{\cancel{50}}$ 8.33	L_{10}	OTHER: L_{25}	(TYPE?) L_{50}	L_{90}
003	PM 12:24	12:43pm	63.4	75.9	53.4	71.9	68.0	67.3	63.4	59.6	55.4

COMMENTS:

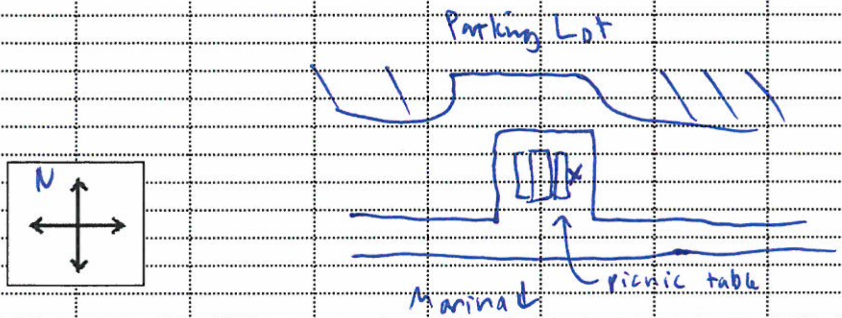
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: **[✓ TRAFFIC] AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:**
ROADWAY TYPE:
TRAFFIC COUNT DURATION: ____-MIN

	SPEED				#2 COUNT		SPEED	
	NB / EB	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**
AUTOS:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER SOURCES: **[✓ DIST. AIRCRAFT] / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL**
DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:
Park activities, marina activities

DESCRIPTION / SKETCH:
TERRAIN: **HARD SOFT [✓ MIXED] FLAT OTHER:** Concrete/asphalt, lawn, water
PHOTOS:
OTHER COMMENTS / SKETCH:



File = LxT_Data.003

FIELD NOISE MEASUREMENT DATA

PROJECT: Harbor Island West Marina PROJ. # 498.14

SITE IDENTIFICATION: Hilton Hotel ST-3 OBSERVER(S): Jonathan Higginson
ADDRESS:
START DATE / TIME: 12/10/14 11:35AM END DATE / TIME: 12/10/14 11:52AM

METEROLOGICAL CONDITIONS:
TEMP: 66 °F HUMIDITY: 70 %R.H. WIND: [✓ **CALM**] **LIGHT** **MODERATE** **VARIABLE**
WINDSPEED: [illegible] MPH DIR: **N** **NE** **E** **SE** **S** **SW** **W** **NW** **STEADY** **GUSTY**
SKY: **SUNNY** **CLEAR** **OVRCST** [✓ **PRTLY CLOUDY**] **FOG** **RAIN** **OTHER:**

ACOUSTIC MEASUREMENTS:
INSTRUMENT: LD-LXT1 TYPE: [✓ 1] 2 SERIAL #: 0004005
CALIBRATOR: LD-CAL200 SERIAL #: 6645
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.09 dBA SPL WINDSCREEN ✓

SETTINGS: [✓ **A-WEIGHTED**] [✓ **SLOW**] **FAST** **FRONTAL** **RANDOM** [✓ **ANSI**] **OTHER:**

REC #	**START**	**END**	L_{eq}	L_{max}	L_{min}	$L_{\cancel{90}}$ 1.67	$L_{\cancel{50}}$ 8.33	$L_{\cancel{10}}$ 10	**OTHER:** L_{25}	**(TYPE?)** L_{50}	L_{90}
002	11:35	11:52	56.7	69.4	48.2	67.1	61.2	57.2	54.0	51.7	49.9

COMMENTS:

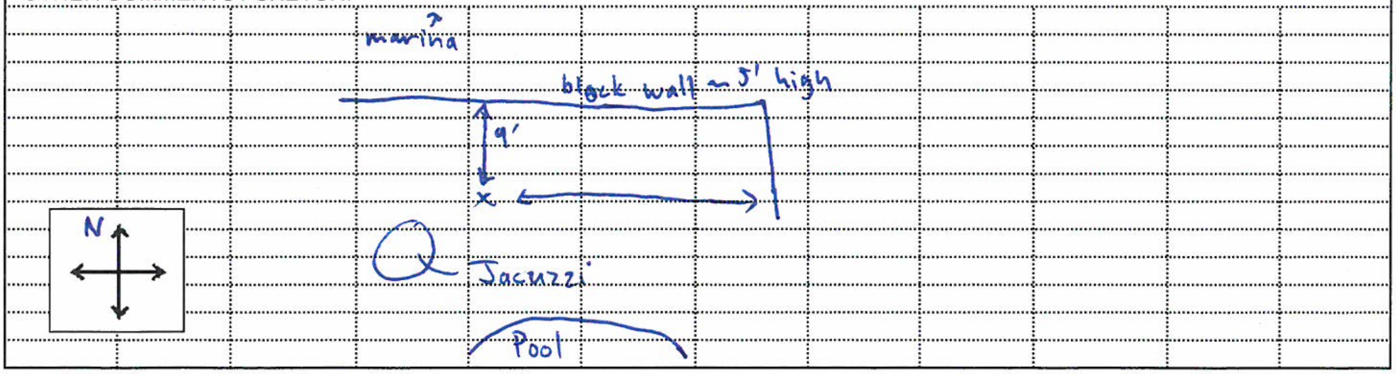
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: **TRAFFIC** [✓ **AIRCRAFT**] **RAIL** **INDUSTRIAL** **AMBIENT** **OTHER:** Helicopter
ROADWAY TYPE:
TRAFFIC COUNT DURATION: _____-MIN SPEED #2 COUNT SPEED

	NB / EB	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**
AUTOS:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER SOURCES: [✓ **DIST. AIRCRAFT**] / **RUSTLING LEAVES** / **DIST. BARKING DOGS** / [✓ **BIRDS**] / **DIST. INDUSTRIAL**
DIST. CHILDREN PLAYING / **DIST. TRAFFIC** / **DIST. LANDSCAPING ACTIVITIES** / **OTHER:**
Occasional marina / boat activities. Hotel staff talking near restaurant / hotel

DESCRIPTION / SKETCH:
TERRAIN: **HARD** **SOFT** [✓ **MIXED**] **FLAT** **OTHER:** Concrete, water
PHOTOS:
OTHER COMMENTS / SKETCH:



File = LxT_Data.002

FIELD NOISE MEASUREMENT DATA

PROJECT: Harbor Island West Marina PROJ. # 498.14

SITE IDENTIFICATION: Harbor Island Park ST-4 OBSERVER(S): Jonathan Higginson
ADDRESS:
START DATE / TIME: 12/10/14 11:01 AM END DATE / TIME: 12/10/14 11:21 AM

METEROLOGICAL CONDITIONS:
TEMP: 64 °F HUMIDITY: 75 %R.H. WIND: [✓ **CALM**] **LIGHT MODERATE VARIABLE**
WINDSPEED: ____ MPH DIR: **N NE E SE S SW W NW** **STEADY GUSTY**
SKY: **SUNNY CLEAR OVRCST** [✓ **PRTLY CLOUDY**] **FOG RAIN** **OTHER:**

ACOUSTIC MEASUREMENTS:
INSTRUMENT: LD-LXT1 TYPE: [✓ 1] 2 SERIAL #: 0004005
CALIBRATOR: LD-CAL200 SERIAL #: 6645
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.9 dBA SPL WINDSCREEN L

SETTINGS: [✓ **A-WEIGHTED**] [✓ **SLOW**] **FAST FRONTAL RANDOM** [✓ **ANSI**] **OTHER:** ______

REC #	START	END	L_{eq}	L_{max}	L_{min}	L~~90~~ 1.67	L~~50~~ 8.33	L_{10}	OTHER: L25	(TYPE?) L50	L90
001	11:01	11:21	60.9	72.8	53.2	68.3	63.1	62.6	61.0	59.5	56.1

COMMENTS:

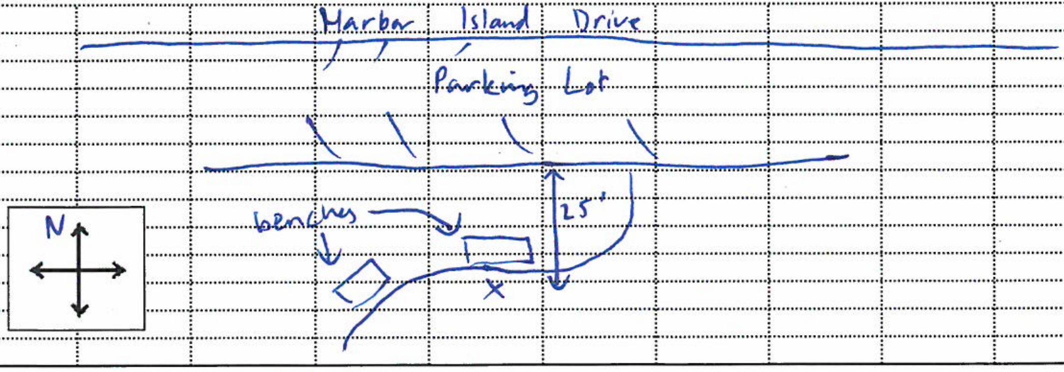
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: **TRAFFIC** [✓ **AIRCRAFT**] **RAIL INDUSTRIAL AMBIENT OTHER:** Helicopters
ROADWAY TYPE:
TRAFFIC COUNT DURATION: ____-MIN

	SPEED				#2 COUNT		SPEED	
	NB / EB	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**	**NB / EB**	**SB / WB**
AUTOS:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER SOURCES: **DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL / DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:**
Sporadic vehicle traffic on Harbor Island Drive

DESCRIPTION / SKETCH:
TERRAIN: **HARD SOFT** [✓ **MIXED**] **FLAT OTHER:** Lawn, concrete/asphalt, water
PHOTOS:
OTHER COMMENTS / SKETCH:



File = LxT_Data.001

Photograph 1. ST-1, Camera Facing Northeast

Photograph 2. ST-2, Camera Facing Southeast

Photograph 3. ST-1, Camera Facing Southwest

Photograph 4. ST-1, Camera Facing Northwest

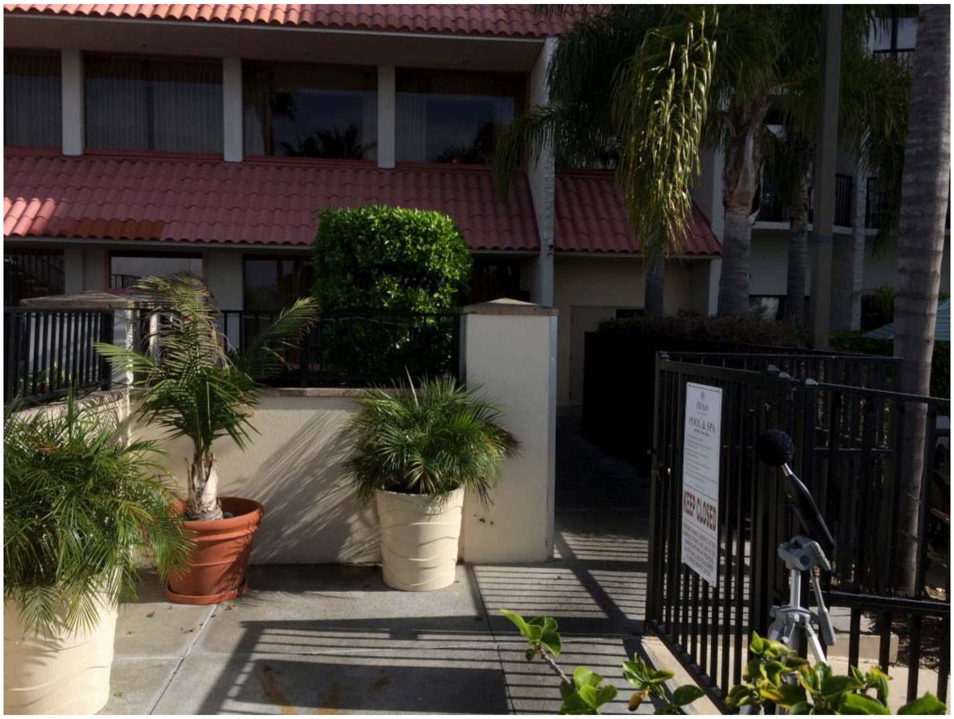
Photograph 5. ST-2, Camera Facing North

Photograph 6. ST-2, Camera Facing East

Photograph 7. ST-2, Camera Facing South

Photograph 8. ST-2, Camera Facing West

Photograph 9. ST-3, Camera Facing North



Photograph 10. ST-3, Camera Facing East

Photograph 11. ST-3, Camera Facing South

Photograph 12. ST-3, Camera Facing West

Photograph 13. ST-4, Camera Facing North

Photograph 14. ST-4, Camera Facing East

Photograph 15. ST-4, Camera Facing South

Photograph 16. ST-4, Camera Facing West

This spreadsheet calculates traffic noise levels based on TNM Version 2.5 Lookup Tables.

**** Type in yellow cells only.**

Traffic Data:

● Enter ADT Traffic

○ Enter Loudest-hour Traffic

Units:

○ Metric

● English

Calculate

Noise Increase Calculation

Construction Traffic:	48.6 dB CNEL
Baseline Traffic:	61.7 dB CNEL
Combined Traffic:	61.9 dB CNEL
Increase:	0.2 dB

Link	Roadway	Segment Location	Hard or Soft Ground (H or S)	BARRIER			Total Daily Traffic Volumes (ADT)	Traffic Mix		Vehicle Speed	Sound Levels at Receiver Locations			
				Present 1=yes	Height min. 7 ft. max. 32 ft.	Distance 35 ft. or 100 ft.		Number #	Description	mph max. 80	Distance feet, min. 33 max. 1000	dB Ldn	dB CNEL	dBA Leq1h (loudest hour)
1	Peak Construction Traffic	N/A	H				121	13	Construction Traffic	35	50	47.6	48.6	47.3
2	Existing Harbor Island Drive	Western Terminus to Harbor Island Dr	H				5,222	10	County of Orange, Arterials	35	50	61.1	61.7	60.2
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														

Table 1. Construction Noise Analysis, Phase I, at "The Village" Military Housing

Equipment		Typical Level @ 50', dBA^1	Usage Factor^{1,2}	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
39	Pneumatic Tools	85.2	0.5	1	8	1650	hard	0	50.1
70	Workboat (estimated)	73	0.1	1	8	1650	hard	0	30.9
12	Crane	80.6	0.16	2	8	1650	hard	0	43.5
35	Pile-driver (Impact)	101.3	0.2	1	1.6	1650	hard	0	55.2
29	Loader (Front End Loader)	79.1	0.4	1	8	2200	hard	0	40.5
18	Excavator	80.7	0.4	1	8	2200	hard	0	42.1
2	Backhoe	77.6	0.4	1	8	2200	hard	0	39.0
34	Paver	77.2	0.5	1	8	2200	hard	0	39.6
44	Roller	80	0.2	1	8	2200	hard	0	38.4
23	Grader	85	0.4	1	8	2200	hard	0	46.4
9	Compactor	83.2	0.2	1	8	2200	hard	0	41.6
71	Bobcat (estimated)	77.6	0.4	1	8	2200	hard	0	39.0
72	Striper (estimated)	77.2	0.5	1	8	2200	hard	0	39.6
2	Backhoe	77.6	0.4	1	8	2200	hard	0	39.0
10	Compressor, Air	77.7	0.4	1	8	2200	hard	0	39.1
47	Saw, Chain	83.7	0.2	2	8	2200	hard	0	45.1
39	Pneumatic Tools	85.2	0.5	2	8	2200	hard	0	50.6
40	Pumps	80.9	0.5	1	6.4	1650	hard	0	44.8
	Combined Equipment								***58.9***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***59.2***

1. Obtained or estimated from:
FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
"Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
"Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971

2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 2. Construction Noise Analysis, Phase I, at Spanish Landing Park

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
39	Pneumatic Tools	85.2	0.5	1	8	600	hard	0	58.8
70	Workboat (estimated)	73	0.1	1	8	600	hard	0	39.7
12	Crane	80.6	0.16	2	8	600	hard	0	52.3
35	Pile-driver (Impact)	101.3	0.2	1	1.6	600	hard	0	64.0
29	Loader (Front End Loader)	79.1	0.4	1	8	1270	hard	0	45.3
18	Excavator	80.7	0.4	1	8	1270	hard	0	46.9
2	Backhoe	77.6	0.4	1	8	1270	hard	0	43.8
34	Paver	77.2	0.5	1	8	1270	hard	0	44.3
44	Roller	80	0.2	1	8	1270	hard	0	43.2
23	Grader	85	0.4	1	8	1270	hard	0	51.2
9	Compactor	83.2	0.2	1	8	1270	hard	0	46.4
71	Bobcat (estimated)	77.6	0.4	1	8	1270	hard	0	43.8
72	Striper (estimated)	77.2	0.5	1	8	1270	hard	0	44.3
2	Backhoe	77.6	0.4	1	8	1270	hard	0	43.8
10	Compressor, Air	77.7	0.4	1	8	1270	hard	0	43.9
47	Saw, Chain	83.7	0.2	2	8	1270	hard	0	49.9
39	Pneumatic Tools	85.2	0.5	2	8	1270	hard	0	55.3
40	Pumps	80.9	0.5	1	6.4	600	hard	0	53.6
	Combined Equipment								***66.6***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***66.6***

1. Obtained or estimated from:
FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
"Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
"Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 3. Construction Noise Analysis, Phase I, at Hilton Hotel

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
39	Pneumatic Tools	85.2	0.5	1	8	60	hard	0	78.8
70	Workboat (estimated)	73	0.1	1	8	60	hard	0	59.7
12	Crane	80.6	0.16	2	8	60	hard	0	72.3
35	Pile-driver (Impact)	101.3	0.2	1	1.6	60	hard	0	84.0
29	Loader (Front End Loader)	79.1	0.4	1	8	805	hard	0	49.2
18	Excavator	80.7	0.4	1	8	805	hard	0	50.8
2	Backhoe	77.6	0.4	1	8	805	hard	0	47.7
34	Paver	77.2	0.5	1	8	805	hard	0	48.3
44	Roller	80	0.2	1	8	805	hard	0	47.1
23	Grader	85	0.4	1	8	805	hard	0	55.1
9	Compactor	83.2	0.2	1	8	805	hard	0	50.3
71	Bobcat (estimated)	77.6	0.4	1	8	805	hard	0	47.7
72	Striper (estimated)	77.2	0.5	1	8	805	hard	0	48.3
2	Backhoe	77.6	0.4	1	8	805	hard	0	47.7
10	Compressor, Air	77.7	0.4	1	8	805	hard	0	47.8
47	Saw, Chain	83.7	0.2	2	8	805	hard	0	53.8
39	Pneumatic Tools	85.2	0.5	2	8	805	hard	0	59.3
40	Pumps	80.9	0.5	1	6.4	60	hard	0	73.6
	Combined Equipment								***85.7***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***85.7***

1. Obtained or estimated from:
   FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
   "Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
   "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 4. Construction Noise Analysis, Phase I, at Harbor Island Park

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
39	Pneumatic Tools	85.2	0.5	1	8	400	hard	0	62.4
70	Workboat (estimated)	73	0.1	1	8	400	hard	0	43.2
12	Crane	80.6	0.16	2	8	400	hard	0	55.8
35	Pile-driver (Impact)	101.3	0.2	1	1.6	400	hard	0	67.5
29	Loader (Front End Loader)	79.1	0.4	1	8	1180	hard	0	45.9
18	Excavator	80.7	0.4	1	8	1180	hard	0	47.5
2	Backhoe	77.6	0.4	1	8	1180	hard	0	44.4
34	Paver	77.2	0.5	1	8	1180	hard	0	45.0
44	Roller	80	0.2	1	8	1180	hard	0	43.8
23	Grader	85	0.4	1	8	1180	hard	0	51.8
9	Compactor	83.2	0.2	1	8	1180	hard	0	47.0
71	Bobcat (estimated)	77.6	0.4	1	8	1180	hard	0	44.4
72	Striper (estimated)	77.2	0.5	1	8	1180	hard	0	45.0
2	Backhoe	77.6	0.4	1	8	1180	hard	0	44.4
10	Compressor, Air	77.7	0.4	1	8	1180	hard	0	44.5
47	Saw, Chain	83.7	0.2	2	8	1180	hard	0	50.5
39	Pneumatic Tools	85.2	0.5	2	8	1180	hard	0	56.0
40	Pumps	80.9	0.5	1	6.4	400	hard	0	57.1
	Combined Equipment								***69.7***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***69.7***

1. Obtained or estimated from:
   FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
   "Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
   "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 5. Construction Noise Analysis, Phase 2, at "The Village" Military Housing

Equipment		**Typical Level @ 50', dBA[1]**	**Usage Factor[1,2]**	**Number of Units**	**Hours Per Day**	**Distance to Receiver, ft.**	**Hard or Soft Site?**	**Barrier Attenuation, dB**	**Leq(h), dBA**
Item No.	**Description**								
2	Backhoe	77.6	0.4	1	8	2655	hard	0	37.4
73	Wood Chipper,	88	0.2	1	8	2655	hard	0	44.7
29	Loader (Front End Loader)	79.1	0.4	2	8	2655	hard	0	41.9
18	Excavator	80.7	0.4	1	8	2655	hard	0	40.5
2	Backhoe	77.6	0.4	1	8	2655	hard	0	37.4
18	Excavator	80.7	0.4	2	8	2655	hard	0	43.5
29	Loader (Front End Loader)	79.1	0.4	2	8	2655	hard	0	41.9
23	Grader	85	0.4	1	8	2655	hard	0	44.8
61	Truck, Dump	76.5	0.4	1	8	2655	hard	0	36.3
	Combined Equipment								***51.4***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***52.8***

1. Obtained or estimated from:
   FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
   "Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
   "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 6. Construction Noise Analysis, Phase 2, at Spanish Landing Park

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
2	Backhoe	77.6	0.4	1	8	1240	hard	0	44.0
73	Wood Chipper,	88	0.2	1	8	1240	hard	0	51.4
29	Loader (Front End Loader)	79.1	0.4	2	8	1240	hard	0	48.5
18	Excavator	80.7	0.4	1	8	1240	hard	0	47.1
2	Backhoe	77.6	0.4	1	8	1240	hard	0	44.0
18	Excavator	80.7	0.4	2	8	1240	hard	0	50.1
29	Loader (Front End Loader)	79.1	0.4	2	8	1240	hard	0	48.5
23	Grader	85	0.4	1	8	1240	hard	0	51.4
61	Truck, Dump	76.5	0.4	1	8	1240	hard	0	42.9
	Combined Equipment								***58.0***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***58.4***

1. Obtained or estimated from:
FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
"Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
"Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 7. Construction Noise Analysis, Phase 2, at Hilton Hotel

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
2	Backhoe	77.6	0.4	1	8	125	hard	0	63.9
73	Wood Chipper,	88	0.2	1	8	125	hard	0	71.3
29	Loader (Front End Loader)	79.1	0.4	2	8	125	hard	0	68.4
18	Excavator	80.7	0.4	1	8	125	hard	0	67.0
2	Backhoe	77.6	0.4	1	8	125	hard	0	63.9
18	Excavator	80.7	0.4	2	8	125	hard	0	70.0
29	Loader (Front End Loader)	79.1	0.4	2	8	125	hard	0	68.4
23	Grader	85	0.4	1	8	125	hard	0	71.3
61	Truck, Dump	76.5	0.4	1	8	125	hard	0	62.8
	Combined Equipment								***78.0***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***78.0***

1. Obtained or estimated from:
   FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
   "Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
   "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 8. Construction Noise Analysis, Phase 2, at Harbor Island Park

Equipment		Typical Level @ 50', dBA[1]	Usage Factor[1,2]	Number of Units	Hours Per Day	Distance to Receiver, ft.	Hard or Soft Site?	Barrier Attenuation, dB	Leq(h), dBA
Item No.	Description								
2	Backhoe	77.6	0.4	1	8	660	hard	0	49.4
73	Wood Chipper,	88	0.2	1	8	660	hard	0	56.8
29	Loader (Front End Loader)	79.1	0.4	2	8	660	hard	0	54.0
18	Excavator	80.7	0.4	1	8	660	hard	0	52.5
2	Backhoe	77.6	0.4	1	8	660	hard	0	49.4
18	Excavator	80.7	0.4	2	8	660	hard	0	55.6
29	Loader (Front End Loader)	79.1	0.4	2	8	660	hard	0	54.0
23	Grader	85	0.4	1	8	660	hard	0	56.8
61	Truck, Dump	76.5	0.4	1	8	660	hard	0	48.3
	Combined Equipment								***63.5***
	Average Hourly Construction Traffic								***47.0***
	Estimated Total Construction Noise								***63.6***

1. Obtained or estimated from:
FHWA Roadway Construction Noise Model (RCNM), Version 1.1, December 8, 2008; and/or
"Transit Noise and Vibration Impact Assessment", FTA, (FTA-VA-90-1003-06), May 2006; and/or
"Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances;" BBN/EPA, December 31, 1971
2. Usage Factor = percentage of time equipment is operating in noisiest mode while in use

Table 9. Construction Noise Analysis, Noise Increases

	Receptor 1: "The Village" Military Housing	Receptor 2: Spanish Landing Park West	Receptor 3: Hilton Hotel	Receptor 3: Harbor Island Park
Measured existing noise level (L_{eq}), dBA	59.2	63.4	56.7	60.9
Project construction noise levels (L_{eq}), dBA				
Phase 1	59.2	66.6	85.7	69.7
Phase 2	52.8	58.4	78.0	63.6
Combined noise levels (L_{eq}), dBA				
Phase 1	62.2	68.3	85.7	70.2
Phase 2	60.1	64.6	78.0	65.5
Increase due to project, dB				
Phase 1	3.0	4.9	29.0	9.3
Phase 2	0.9	1.2	21.3	4.6

Construction Vibration Analysis, PPV

Vibration attenuation constant (n):	1.1
Vibration Source Data	
Equipment Item	**Reference PPV at 25 feet, in/s** [a]
Impact Pile Driver	0.650
Large bulldozer[b]	0.089
Small bulldozer[c]	0.003

Perceptibility Criteria, PPV, in/sec (continuous/frequent intermittent sources)	
Barely perceptible	0.01
Distinctly perceptible	0.04
Strongly perceptible	0.1
Severe	0.4

[a] Obtained from "Transportation and Construction Vibration Guidance Manual", Caltrans 2013

[b] Considered representative of any full size/large excavator, dozer, backhoe, etc.

[c] Considered representative of any small excavator, dozer, backhoe, skid steer, etc.

Receiver #	**Distance from construction source (Feet)**		**Vibration PPV Level (in/sec) at Receptor Location**		**PPV Threshold for Potential Building Damage (in/sec)**	**Exceeds Threshold?**	**Human Response**
	Waterside Sources	**Landside Sources**	**Waterside Sources**	**Landside Sources**			
The Village on the Naval Training Center (Lincoln Military Housing)	1,650	2,000	0.006	0.001	0.5	No	Below barely perceptible
Spanish Landing Park West	600	1,000	0.020	0.002	N/A	No	Barely perceptible
Hilton Hotel	50	25	0.303	0.089	0.5	No	Strongly perceptible
Harbor Island Park	400	400	0.031	0.004	N/A	No	Barely perceptible
Tom Ham’s Lighthouse Restaurant	300	270	0.042	0.006	0.5	No	Distinctly perceptible

Appendix G
Traffic Technical Memorandum

MEMORANDUM

TO: Elyssa Figari, ICF

FROM: Dale Domingo; Chen Ryan Associates

DATE: December 17, 2018

RE: Harbor Island West Marina Redevelopment Project – Technical Memorandum

The purpose of this Technical Memorandum is to identify and document potential transportation impacts related to the construction activities of the Harbor Island West Marina Redevelopment Project (proposed project), as well as to recommend mitigation measures, as necessary, for any identified transportation related impacts associated with the proposed project.

PROPOSED PROJECT

The proposed Harbor Island West Marina Redevelopment Project encompasses the replacement and redevelopment of several elements comprising the Harbor Island West Marina (HIWM), an existing marina facility that provides services and amenities to the boating community and waterfront access opportunities to the public. The purpose of the proposed Project is to replace the existing aged dock structure, existing landside buildings, and infrastructure to accommodate a wider range of vessel sizes, to create more slip opportunities for entry level boaters, and to ensure the HIWM's long-term operation.

In summary, the Project would include the following:

1. Demolition of 23,000 square feet of existing building space and reconstruction of approximately 15,682 square feet of new building space;
2. Demolition of the existing paved parking lot (120,000 square feet of pavement) and construction of a new paved parking lot (approximately 116,000 square feet);
3. Removal of 15,000 square feet of landscaping with installation of approximately 18,000 square feet of new landscaping;
4. Construction of a new public 12-foot-wide promenade and replacement of an existing 6,000 square foot viewing deck with a new 6,000 square foot public viewing deck;
5. Modernizing utilities and site lighting; and
6. Demolition of 146,000 square feet of existing docks (including 620 boat slips) and construction of 140,000 square feet of new docks (including 603 boat slips).

The project site is located at 2040 Harbor Island Drive, San Diego, CA 92101.

PROJECT STUDY AREA

This Technical Memorandum was performed in accordance with the requirements of the City of San Diego Traffic Impact Study Manual requirements. The City of San Diego Traffic Impact Study Manual requires that the defined study area include all freeway segments, roadway segments, and intersections where the proposed project would add 50 or more peak hour trips in either direction.

Study Roadway Segments

Based on the project trip assignment, the following four (4) key study area roadway segments were analyzed:

North Harbor Drive between:

- Terminal 2/Spanish Landing to Harbor Island Drive
- Harbor Island Drive to Winship Lane

Harbor Island Drive between:

- North Harbor Drive to Harbor Island Drive Southern Terminus
- Western Terminus to Harbor Island Drive

Freeway Segments

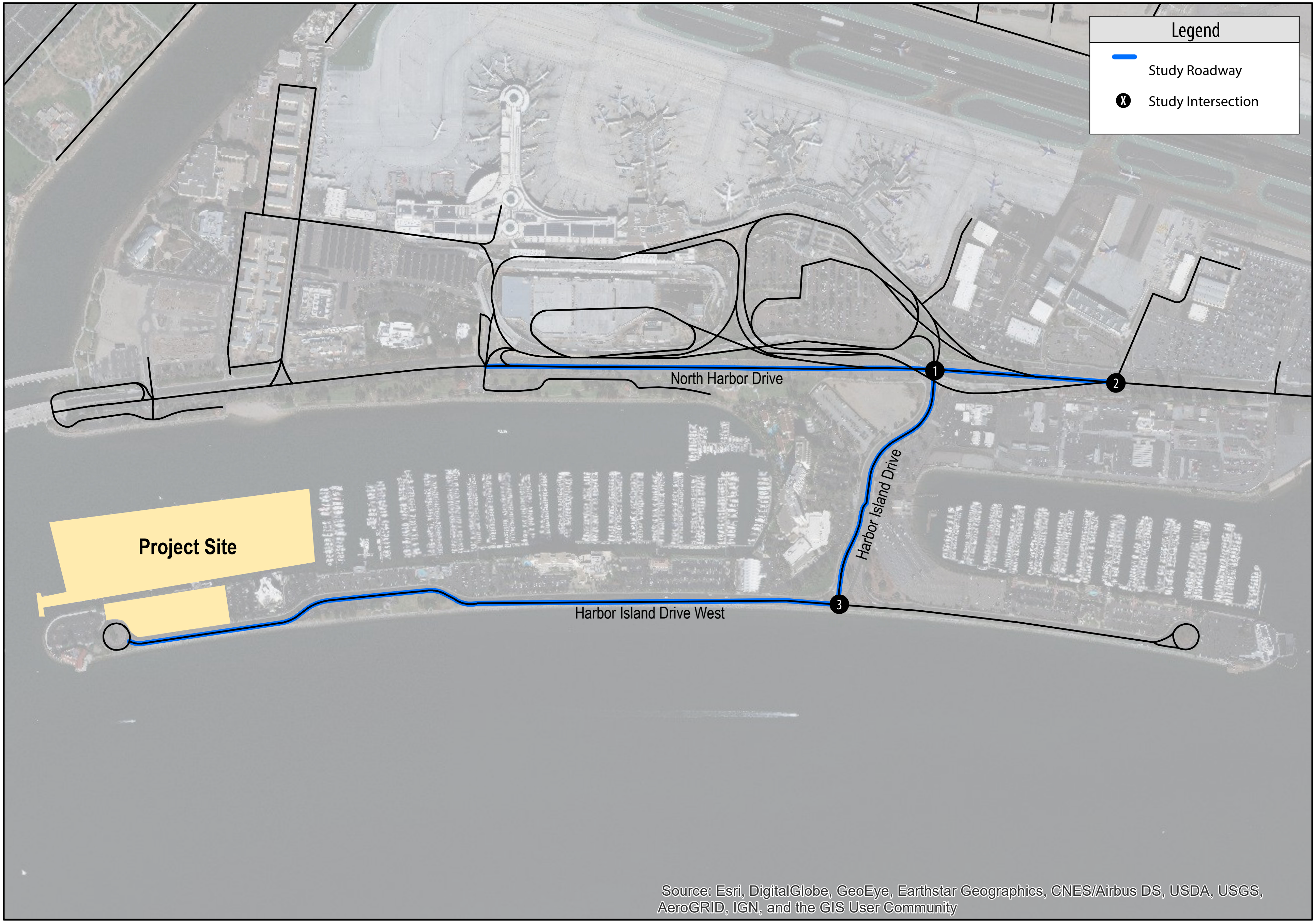
Based on the project trip assignment, no freeway segments will be analyzed for this Technical Memorandum.

Study Intersections

Based on the project trip assignment, the following three (3) key study area intersections were analyzed:

1. Harbor Island Drive & Airport Terminal Road / North Harbor Drive
2. North Harbor Drive / Winship Lane
3. Harbor Island Drive (West) & Harbor Island Drive (East) / Harbor Island Drive

Figure 1 displays the project study area.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Harbor Island West Marina
Redevelopment Project

CHEN RYAN

Figure 1
Project Study Area

ANALYSIS METHODOLOGY

This technical memorandum was performed in accordance with the requirements of the City of San Diego *Traffic Impact Study Manual*, and the Port District's California Environmental Quality Act (CEQA) project review process. Detailed information on roadway segment and intersection analysis methodologies, standards, and thresholds are discussed in the following sections.

Level of Service Definition

Level of Service (LOS) is a quantitative measure describing operational conditions within a traffic stream, and the motorist's and/or passengers' perception of operations. A LOS definition generally describes these conditions in terms of such factors as delay, speed, travel time, freedom to maneuver, interruptions in traffic flow, queuing, comfort, and convenience. **Table 2.1** describes generalized definitions of the various LOS categories (A through F) as applied to roadway operations.

TABLE 2.1
LOS DEFINITIONS

LOS Category	Definition of Operation
A	This LOS represents a completely free-flow condition, where the operation of vehicles is virtually unaffected by the presence of other vehicles and only constrained by the geometric features of the highway and by driver preferences.
B	This LOS represents a relatively free-flow condition, although the presence of other vehicles becomes noticeable. Average travel speeds are the same as in LOS A, but drivers have slightly less freedom to maneuver.
C	At this LOS the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream is clearly affected by other vehicles.
D	At this LOS, the ability to maneuver is notably restricted due to traffic congestion, and only minor disruptions can be absorbed without extensive queues forming and the service deteriorating.
E	This LOS represents operations at or near capacity. LOS E is an unstable level, with vehicles operating with minimum spacing for maintaining uniform flow. At LOS E, disruptions cannot be dissipated readily thus causing deterioration down to LOS F.
F	At this LOS, forced or breakdown of traffic flow occurs, although operations appear to be at capacity, queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages.

Source: Highway Capacity Manual 2010

Roadway Segment LOS Standards and Thresholds

Roadway segment LOS standards and thresholds provide the basis for analysis of arterial roadway segment performance. The analysis of roadway segment LOS is based on the functional classification of the roadway, the maximum capacity, roadway geometrics, and existing or forecast Average Daily Traffic (ADT) volumes. Table 2.2 presents the roadway segment capacity and LOS standards utilized to analyze roadways evaluated in this report.

TABLE 2.2
CITY OF SAN DIEGO ROADWAY CLASSIFICATIONS AND LOS STANDARDS

Roadway Classification	LOS A	LOS B	LOS C	LOS D	LOS E
Expressway	30,000	42,000	60,000	70,000	80,000
Primer Arterial	25,000	35,000	50,000	55,000	60,000
Major Arterial (6-lane, divided)	< 20,000	< 28,000	< 40,000	**< 45,000**	< 50,000
Major Arterial (4-lane, divided)	< 15,000	< 21,000	< 30,000	**< 35,000**	< 40,000
Secondary Arterial / Collector (4-lane w/ center lane)	< 10,000	< 14,000	< 20,000	**< 25,000**	< 30,000
Collector (4-lane w/o center lane)	< 5,000	< 10,000	< 13,000	**< 15,000**	< 20,000
Collector (2-lane w/ continuous left-turn lane)	< 5,000	< 10,000	< 13,000	**< 15,000**	< 20,000
Collector (2-lane no fronting property)	< 4,000	< 5,500	< 7,500	**< 9,000**	< 10,000
Collector (2-lane commercial-industrial fronting)	<2,500	< 3,500	< 5,000	**< 6,500**	< 8,000
Collector (2-lane multi-family)	<2,500	< 3,500	< 5000	**< 6,500**	< 8,000
Sub-Collector (2-lane single family)	-	-	2,200	-	**-**

Source: City of San Diego, Traffic Impact Study Manual, July 1998

Note:
Bold numbers indicate the ADT thresholds for acceptable LOS.

These standards are generally used as long-range planning guidelines to determine the functional classification of roadways. The actual capacity of a roadway facility varies according to its physical attributes. Typically, the performance and LOS of a roadway segment is heavily influenced by the ability of its intersections to accommodate peak hour traffic volumes. For the purposes of this traffic analysis, LOS D is considered acceptable for the analyzed roadway segments.

Peak Hour Intersection LOS Standards and Thresholds

This section presents the methodologies used to perform peak hour intersection capacity analysis for signalized intersections. The following assumptions were utilized in conducting all intersection LOS analyses:

- *Pedestrian Calls per Hour:* 10 calls per hour for each pedestrian movement was assumed.
- *Signal Timing:* Based on existing signal timing plans**.**
- *Peak Hour Factor*: Based on existing peak hour count data for existing conditions included in **Appendix A**.

Signalized Intersection Analysis

The analysis of signalized intersections utilized the operational analysis procedures as outlined in the *2010 Highway Capacity Manual (HCM)*. This method defines LOS in terms of delay, or more specifically, average stopped delay per vehicle. Delay is a measure of driver and/or passenger discomfort, frustration, fuel consumption and lost travel time. This technique uses 1,900 vehicles per hour per lane (VPHPL) as the maximum saturation volume of an intersection. This saturation volume is adjusted to account for lane width, on-street parking, pedestrians, traffic composition (i.e., percentage trucks) and shared lane movements (i.e. through and right-turn movements originating from the same lane). The LOS criteria used for this technique are described in **Table 2.3**. The computerized analysis of intersection operations was performed utilizing the *Synchro 10* traffic analysis software.

TABLE 2.3
SIGNALIZED INTERSECTION LOS CRITERIA

Average Stopped Delay Per Vehicle (seconds)	Level of Service (LOS) Characteristics
<10.0	*LOS A* describes operations with very low delay. This occurs when progression is extremely favorable, and most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
10.1 – 20.0	*LOS B* describes operations with generally good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
20.1 – 35.0	*LOS C* describes operations with higher delays, which may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
35.1 – 55.0	*LOS D* describes operations with high delay, resulting from some combination of unfavorable progression, long cycle lengths, or high volumes. The influence of congestion becomes more noticeable, and individual cycle failures are noticeable.
55.1 – 80.0	*LOS E* is considered the limit of acceptable delay. Individual cycle failures are frequent occurrences.
>80.0	*LOS F* describes a condition of excessively high delay, considered unacceptable to most drivers. This condition often occurs when arrival flow rates exceed the LOS D capacity of the intersection. Poor progression and long cycle lengths may also be major contributing causes to such delay.

Source: Highway Capacity Manual 2010

Determination of Significant Impacts

The City of San Diego Traffic Impact Study Manual, defines project impact thresholds by facility type. These thresholds are generally based upon an acceptable increase in the Volume / Capacity (V/C) ratio for roadway and freeway segments, and upon increases in vehicle delays for intersections and ramps.

In the City of San Diego, LOS D is considered acceptable for roadway and intersection operations. A project is considered to have a significant impact if it degrades the operations of a roadway or intersection from an acceptable LOS (D or better) to an unacceptable LOS (E or F), or if it adds additional delay to a facility already operating an unacceptable level. **Table 2.5** summarizes the impact significant thresholds as identified within the City of San Diego's guidelines beyond which mitigation measures are required.

TABLE 2.4
CITY OF SAN DIEGO MEASURE OF SIGNIFICANT PROJECT TRAFFIC IMPACTS

	Allowable Change Due to Impact					
	Freeways		Roadway Segments		Intersections	Ramp Metering
LOS with Project	V/C	Speed (mph)	V/C	Speed (mph)	Delay (sec)	Delay (min.)
E **(or ramp meter delays above 15 min.)**	0.01	1.0	0.02	1.0	2.0	2.0
F **(or ramp meter delays above 15 min.)**	0.005	0.5	0.01	0.5	1.0	1.0

Source: City of San Diego, Significance Determination Thresholds, January 2011

EXISTING CONDITIONS

This section describes key study intersections, existing peak hour intersection traffic volume information and LOS analysis results under Existing conditions.

Existing Roadway Network

Harbor Island Drive is a four-lane east-west undivided roadway. This road provides access to hotels, restaurants, and boat docking sites on the north side, with parallel parking and parking lots available on the south side. Harbor Island Drive has a posted speed limit of 35 miles per hour (mph) with sidewalks provided on both sides of the roadway. Additionally, Harbor Island Drive is designated as a Class III bicycle route.

Within the study area, North Harbor Drive is a six-lane major arterial. It has a posted speed limit of 45 mph and provides direct access to the San Diego International Airport, as well as Harbor Island. Pedestrian sidewalks are provided on both sides of the roadway, as well as a Class II bicycle lane on the south side of the road.

Existing Intersection and Roadway Volumes

Figure 2 shows both the existing ADT volumes for study area roadway segments and the AM/PM peak hour traffic volumes for the key study area intersections. The roadway segment and study area intersection traffic counts were conducted in January and May of 2017. Count worksheets are provided in **Appendix A**.

Existing LOS Analysis

Roadway segment analysis and intersection LOS analysis are discussed separately below.

Roadway Segment Analysis

Table 3.1 displays the LOS analysis results for key study area roadway segments under Existing conditions.

TABLE 3.1
ROADWAY SEGMENT LOS RESULTS
EXISTING CONDITIONS

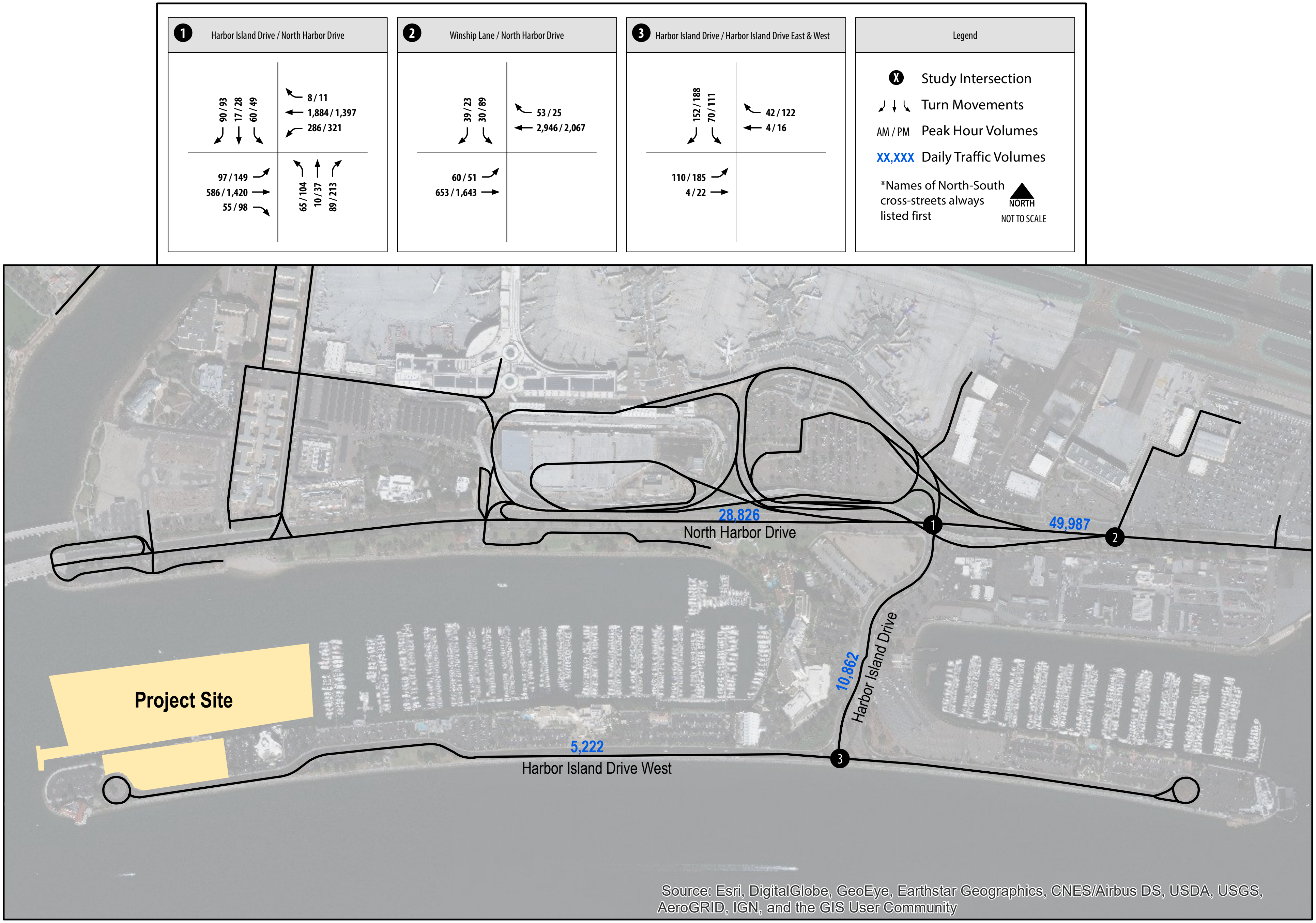
Roadway Segment	Segment	Cross-section	Threshold (LOS E)	ADT	V/C	LOS
N Harbor Dr	Terminal 2/Spanish Landing to Harbor Island Dr	6-Lane Major Arterial	50,000	28,826	0.577	C
	Harbor Island Dr to Winship Ln	6-Lane Major Arterial	50,000	49,987	1.000	**E**
Harbor Island Dr	N Harbor Dr to Harbor Island Drive Southern Terminus	4-Lane Major Arterial	40,000	10,862	0.272	A
	Western Terminus to Harbor Island Dr	4-Lane Collector	15,000	5,222	0.348	B

Source: NDS, Chen Ryan Associates; December 2018

Notes:
V/C = Volume to Capacity Ratio.
Bold letter indicates LOS E or F.

As shown, all key study roadway segments currently operate at LOS D or better with the exception of:

- North Harbor Drive, between Harbor Island Drive and Winship Lane (LOS E)



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Harbor Island West Marina

Redevelopment Project

Figure 2

Traffic Volumes -

Existing Conditions

Intersection Analysis

Table 3.2 displays intersection LOS and average vehicle delay results for the key study area intersections under Existing conditions. LOS calculation worksheets for Existing conditions are provided in **Appendix B**.

TABLE 3.2
PEAK HOUR INTERSECTION LOS RESULTS
EXISTING CONDITIONS

#	Intersection	AM Peak Hour		PM Peak Hour	
		Avg. Delay (sec.)	LOS	Avg. Delay (sec.)	LOS
1	Harbor Island Drive / Airport Terminal Road & N Harbor Drive	51.5	D	36.6	D
2	N Harbor Drive & Winship Lane	6.4	A	5.5	A
3	Harbor Island Drive (West) / Harbor Island Drive (East) & Harbor Island Drive	4.6	A	5.4	A

Source: NDS, Chen Ryan Associates; December 2018

Notes:
Bold letter indicates LOS E or F.

As shown, all key study area intersections currently operate at LOS D or better.

TRIP GENERATION

Project construction is anticipated to begin in Fall 2019 and will occur over a 24-month period over two phases. During this period, debris from existing developments and materials for redevelopment will be hauled to and from the project site. At the peak of project construction, which is estimated to be in December 2019, it is anticipated that 10 hauling trucks will be required to access the project site on a daily basis along with 37 construction employees. **Figure 3** displays the proposed project site plan.

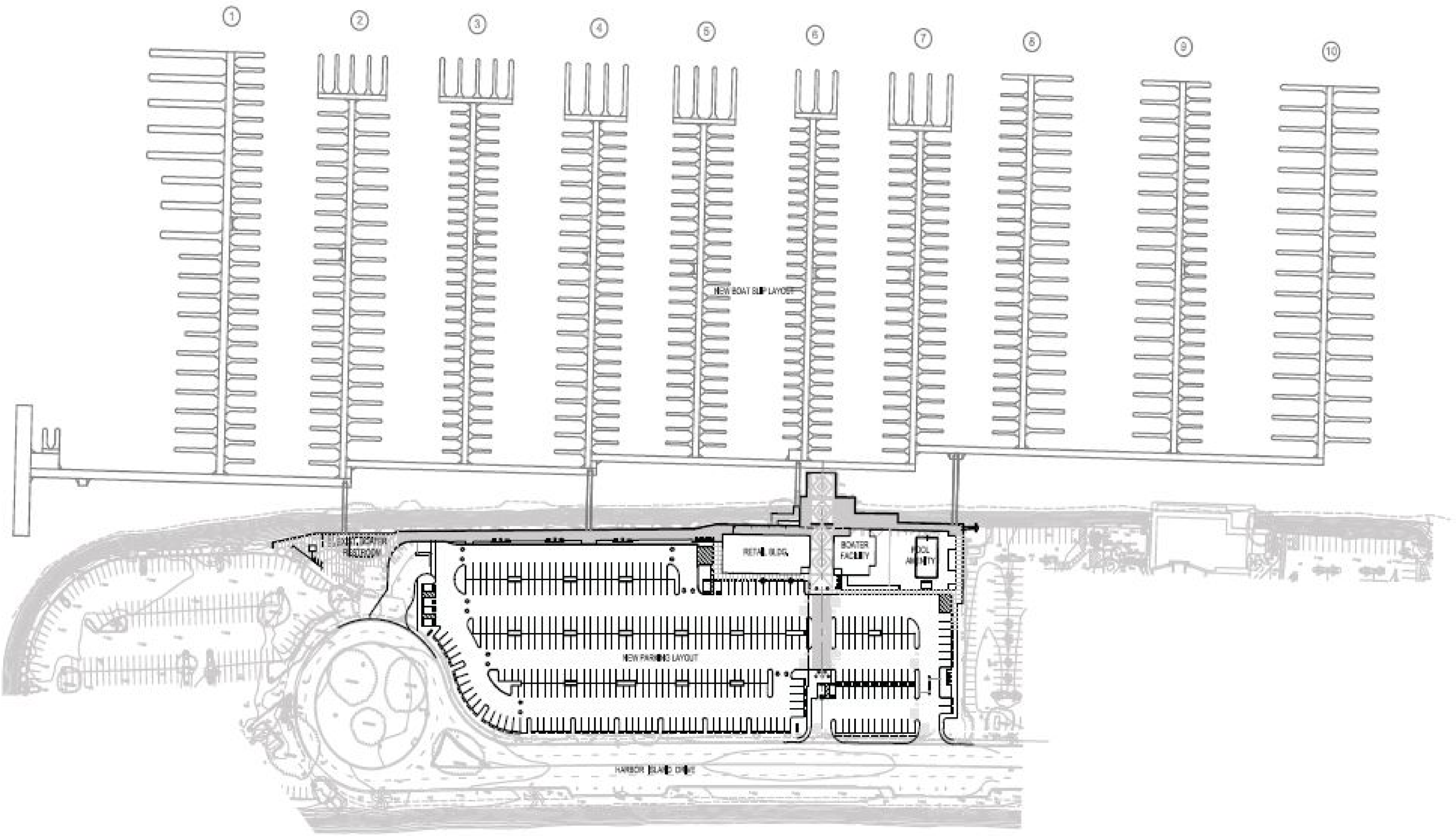
As a worst-case scenario, it was assumed that all construction employees would drive individual vehicles to the project site and would arrive and depart during the AM and PM peak hours, respectively. The daily trip rate per employee is assumed to be three (3) trips per employee to account for a lunch break or off-site errand/meeting. It was also assumed that the hauling trucks would arrive and depart evenly throughout the 8-hour workday. **Table 4.1** displays the assumed vehicle trip generation during the peak of project construction.

TABLE 4.1
PROJECT CONSTRUCTION TRIP GENERATION

Use	Units	Vehicle Conversion Rate	Rate	Daily Vehicle Trips	AM Peak Hour		PM Peak Hour	
					In	Out	In	Out
Construction Employees	37	1	3 / Employee	111	37	0	0	37
Hauling Truck	10	3	2 / Truck	60	3	3	3	3
		Total		**171**	**40**	**3**	**3**	**40**

Source: Chen Ryan Associates; December 2018

As shown, the proposed project construction is anticipated to generate approximately 171 daily trips including 43 trips (40 in / 3 out) during AM Peak Hour and 43 trips (3 in / 40 out) during the PM peak hour.



Harbor Island West Marina

Redevelopment Project

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Figure 3

Project Site Plan

Project Trip Distribution and Assignment

Trip distribution for the Proposed Project was developed based on the project's location in relation to surrounding land uses, distribution of residential population throughout the San Diego Region, and the project's accessibility to freeways. Based upon the assumed project trip distribution, daily and AM/PM peak hour project trips were assigned to the adjacent roadway network per route alternative, as displayed in **Figure 4**.

EXISTING PLUS PROJECT

Existing Plus Project Traffic Volumes

Existing Plus Project traffic volumes were derived by combining the existing traffic volumes (displayed in Figure 3) and the project's trip assignment (displayed in Figures 4-2). Daily roadway and peak hour intersection volumes are displayed in **Figure 5**.

Existing Plus Project Traffic Conditions

Roadway segment analysis and intersection LOS analysis are discussed separately below.

Roadway Segment Analysis

Table 5.1 displays the LOS analysis results for key roadway segments under Existing Plus Project conditions.

TABLE 5.1
ROADWAY SEGMENT LOS RESULTS
EXISTING PLUS PROJECT CONDITIONS

Roadway		Cross-Section	Threshold (LOS E)	Existing	Existing + Project				
				ADT / V/C / LOS	ADT	V/C	LOS	Δ	S?
N Harbor Dr	Terminal 2/Spanish Landing to Harbor Island Dr	6-Lane Major Arterial	50,000	28,826 / 0.577 / C	28,843	0.577	C	0.000	N
	Harbor Island Dr to Winship Ln	6-Lane Major Arterial	50,000	49,987 / 1.000 / **E**	50,141	1.003	F	0.003	N
Harbor Island Dr	N Harbor Dr to Harbor Island Drive Southern Terminus	4-Lane Major Arterial	40,000	10,862 / 0.272 / A	11,033	0.276	A	0.004	N
	Western Terminus to Harbor Island Dr	4-Lane Collector	15,000	5,222 / 0.348 / B	5,393	0.360	B	0.012	N

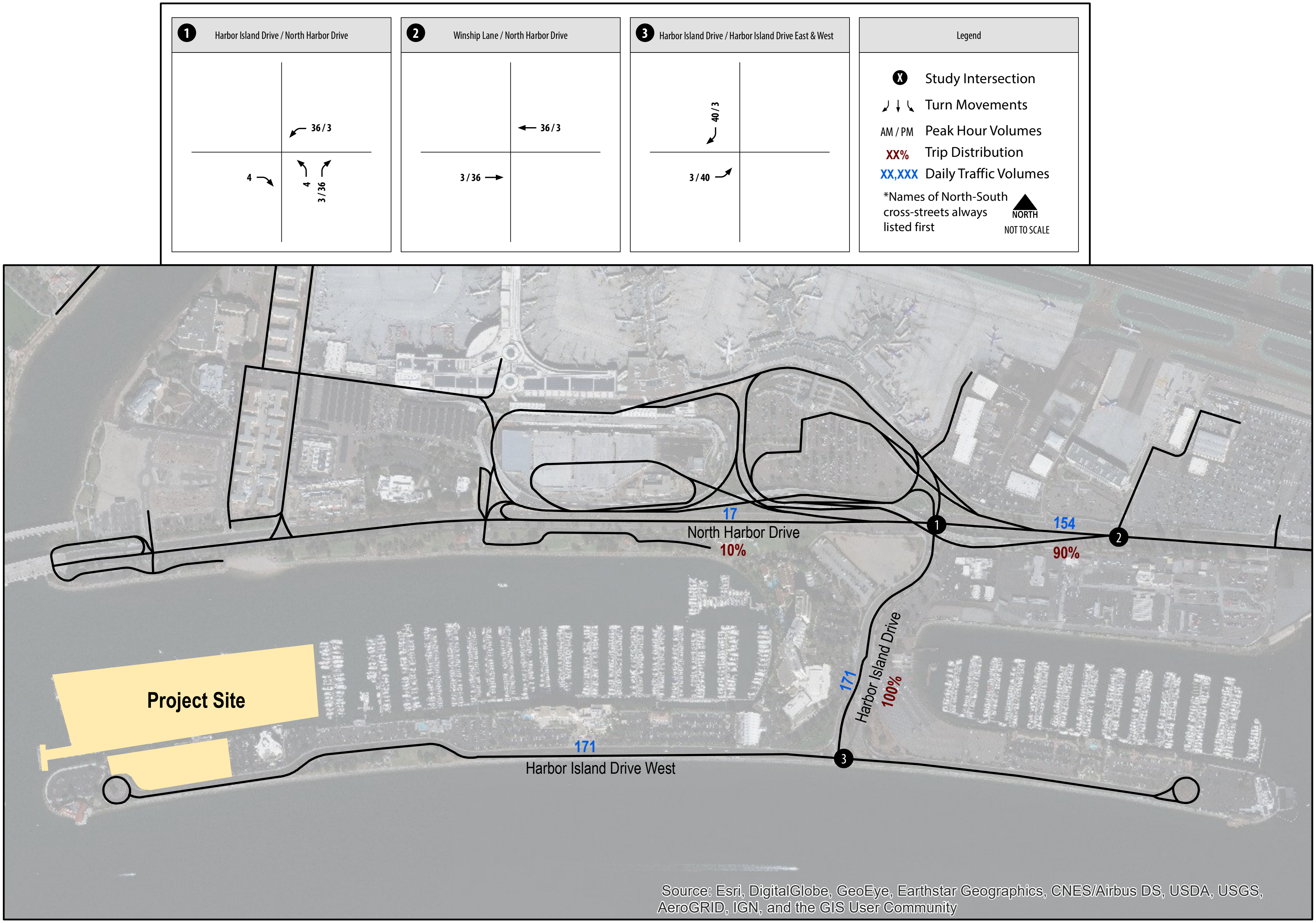
Source: Chen Ryan Associates; December 2018

Notes:
V/C = Volume to Capacity Ratio.
Δ = Change in V/C Ratio.
S? = Indicates if change in V/C ratio is significant.
Bold letter indicates LOS E or F.

As shown in **Table 5.1**, all key study roadway segments would continue to operate at LOS D or better under Existing Plus Project conditions with the exception of:

- North Harbor Drive, between Harbor Island Drive and Winship Lane (LOS F).

Based on the City of San Diego's Significance Criteria, the traffic associated with the proposed project would not cause a significant change in V/C ratio (more than 0.01) under Existing Plus Project conditions. Therefore, a significant project related impact does not exist and mitigation is not required.



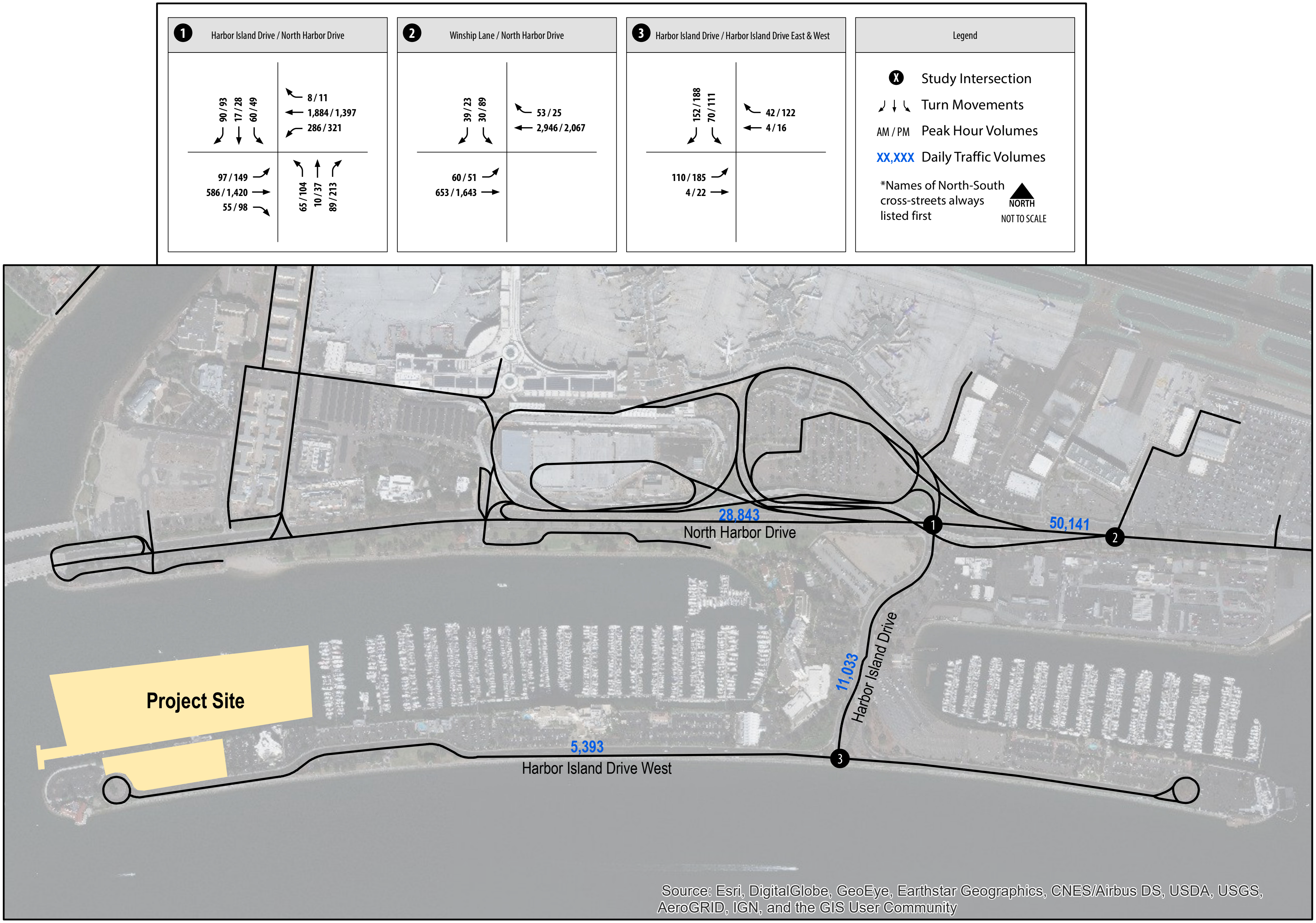
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Harbor Island West Marina Redevelopment Project

CHEN ✚ RYAN

Figure 4

Construction Trip Distribution and Assignment



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Harbor Island West Marina Redevelopment Project

CHEN✚RYAN

Figure 5

Traffic Volumes - Existing Plus Project Conditions

Intersection Analysis

Table 5.2 displays intersection LOS and average vehicle delay results under Existing Plus Project conditions. LOS calculation worksheets for the Existing Plus Project conditions are provided in **Appendix C**.

TABLE 5.2
PEAK HOUR INTERSECTION LOS RESULTS
EXISTING PLUS PROJECT CONDITIONS

#	Intersection	Delay w/o Project (sec.) AM/PM	LOS w/o Project AM/PM	AM Peak Hour		PM Peak Hour		Change in Delay (sec.) AM/PM	Significant Impact?
				Avg. Delay (sec.)	LOS	Avg. Delay (sec.)	LOS		
1	Harbor Island Drive / Airport Terminal Road & N Harbor Drive	51.5 / 36.6	D / D	51.7	D	38.9	D	0.2 / 2.3	N
2	N Harbor Drive & Winship Lane	6.4 / 5.5	A / A	6.4	A	5.4	A	0.0 / -0.1	N
3	Harbor Island Drive (West) / Harbor Island Drive (East) & Harbor Island Drive	4.6 / 5.4	A / A	4.6	A	5.4	A	0.0 / 0.0	N

Source: Chen Ryan Associates; November 2018

Notes:
Bold letter indicates LOS E or F.

As shown in **Table 5.2**, all key study area intersections currently operate at LOS D or better under Existing Plus Project conditions. Therefore, a significant project related impact does not exist and mitigation is not required.

IMPACT SIGNIFICANCE AND MITIGATION

Roadway Segment

Based on the City of San Diego's Significance Criteria, the proposed project would not contribute to a traffic impact for roadway segments within the project study area under Existing Plus Project Construction conditions. Therefore, no mitigation is required.

Intersection

Based on the City of San Diego's Significance Criteria, the proposed project would not contribute to a traffic impact for intersections within the project study area under Existing Plus Project Construction conditions. Therefore, no mitigation is required.

Please feel free to call me if you have any questions regarding the assumptions presented in this memorandum.

Thank you,

Dale Domingo
Chen Ryan Associates, Inc.
(619) 202-0231
ddomingo@chenryanmobility.com

Appendix A
Count Data and Signal Timing Plans

Prepared by NDS/ATD

VOLUME

N Harbor Dr Bet. Terminal 2/Spanish Landing & Harbor Island Dr

Day: Thursday
Date: 5/4/2017

City: San Diego
Project #: CA17_4132_022

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	14,656	14,170	28,826

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
0:00			35		23		58		12:00			223		239		462	
0:15			29		14		43		12:15			195		198		393	
0:30			24		14		38		12:30			219		186		405	
0:45			11	99	11	62	22	161	12:45			250	887	202	825	452	1712
1:00			11		14		25		13:00			259		188		447	
1:15			17		27		44		13:15			206		192		398	
1:30			11		12		23		13:30			233		204		437	
1:45			7	46	10	63	17	109	13:45			220	918	192	776	412	1694
2:00			14		6		20		14:00			226		157		383	
2:15			8		8		16		14:15			229		206		435	
2:30			10		9		19		14:30			220		192		412	
2:45			20	52	8	31	28	83	14:45			296	971	201	756	497	1727
3:00			8		7		15		15:00			288		217		505	
3:15			11		10		21		15:15			275		211		486	
3:30			11		12		23		15:30			336		209		545	
3:45			6	36	13	42	19	78	15:45			357	1256	202	839	559	2095
4:00			12		15		27		16:00			397		180		577	
4:15			19		27		46		16:15			363		206		569	
4:30			29		39		68		16:30			378		192		570	
4:45			60	120	62	143	122	263	16:45			299	1437	237	815	536	2252
5:00			70		74		144		17:00			350		212		562	
5:15			76		117		193		17:15			302		237		539	
5:30			69		112		181		17:30			288		218		506	
5:45			90	305	146	449	236	754	17:45			224	1164	202	869	426	2033
6:00			77		162		239		18:00			255		196		451	
6:15			82		216		298		18:15			222		174		396	
6:30			111		277		388		18:30			194		167		361	
6:45			115	385	283	938	398	1323	18:45			193	864	166	703	359	1567
7:00			112		266		378		19:00			167		152		319	
7:15			147		322		469		19:15			155		185		340	
7:30			164		338		502		19:30			159		124		283	
7:45			152	575	306	1232	458	1807	19:45			192	673	143	604	335	1277
8:00			181		256		437		20:00			159		142		301	
8:15			169		290		459		20:15			184		115		299	
8:30			180		263		443		20:30			164		129		293	
8:45			175	705	251	1060	426	1765	20:45			154	661	126	512	280	1173
9:00			192		216		408		21:00			114		108		222	
9:15			174		204		378		21:15			116		101		217	
9:30			195		199		394		21:30			127		105		232	
9:45			196	757	210	829	406	1586	21:45			102	459	94	408	196	867
10:00			205		176		381		22:00			84		104		188	
10:15			210		180		390		22:15			96		93		189	
10:30			204		155		359		22:30			103		87		190	
10:45			170	789	219	730	389	1519	22:45			101	384	86	370	187	754
11:00			188		208		396		23:00			85		71		156	
11:15			191		218		409		23:15			94		73		167	
11:30			212		220		432		23:30			79		56		135	
11:45			213	804	219	865	432	1669	23:45			51	309	49	249	100	558
TOTALS				4673		6444		**11117**	**TOTALS**				9983		7726		**17709**
SPLIT %				42.0%		58.0%		**38.6%**	**SPLIT %**				56.4%		43.6%		**61.4%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	14,656	14,170	28,826

AM Peak Hour			11:45	7:00	**7:15**	**PM Peak Hour**			15:45	16:45	**15:45**
AM Pk Volume			850	1232	**1866**	**PM Pk Volume**			1495	904	**2275**
Pk Hr Factor			0.953	0.911	**0.929**	**Pk Hr Factor**			0.941	0.954	**0.986**
7 - 9 Volume	0	0	1280	2292	**3572**	**4 - 6 Volume**	0	0	2601	1684	**4285**
7 - 9 Peak Hour			8:00	7:00	**7:15**	**4 - 6 Peak Hour**			16:00	16:45	**16:00**
7 - 9 Pk Volume	0	0	705	1232	**1866**	**4 - 6 Pk Volume**	0	0	1437	904	**2252**
Pk Hr Factor	0.000	0.000	0.974	0.911	**0.929**	**Pk Hr Factor**	0.000	0.000	0.905	0.954	**0.976**

Prepared by NDS/ATD

VOLUME

N Harbor Dr Bet. Harbor Island Dr & Winship Ln

Day: Tuesday
Date: 5/2/2017

City: Port of San Diego
Project #: CA17_4132_023

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	17,117	32,870	49,987

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			81		143		224		**12:00**			186		479		665	
00:15			63		84		147		**12:15**			213		468		681	
00:30			43		59		102		**12:30**			233		483		716	
00:45			40	227	34	320	74	547	**12:45**			240	872	504	1934	744	2806
01:00			36		22		58		**13:00**			284		498		782	
01:15			26		27		53		**13:15**			273		395		668	
01:30			17		16		33		**13:30**			305		371		676	
01:45			10	89	12	77	22	166	**13:45**			284	1146	441	1705	725	2851
02:00			18		10		28		**14:00**			292		328		620	
02:15			20		8		28		**14:15**			291		336		627	
02:30			11		15		26		**14:30**			351		403		754	
02:45			14	63	12	45	26	108	**14:45**			307	1241	359	1426	666	2667
03:00			18		10		28		**15:00**			364		355		719	
03:15			12		15		27		**15:15**			339		356		695	
03:30			13		34		47		**15:30**			420		528		948	
03:45			15	58	64	123	79	181	**15:45**			467	1590	517	1756	984	3346
04:00			18		75		93		**16:00**			393		372		765	
04:15			22		93		115		**16:15**			389		398		787	
04:30			48		189		237		**16:30**			360		406		766	
04:45			45	133	294	651	339	784	**16:45**			397	1539	409	1585	806	3124
05:00			61		365		426		**17:00**			332		462		794	
05:15			70		405		475		**17:15**			305		461		766	
05:30			91		398		489		**17:30**			241		453		694	
05:45			72	294	426	1594	498	1888	**17:45**			250	1128	463	1839	713	2967
06:00			120		409		529		**18:00**			233		411		644	
06:15			109		401		510		**18:15**			234		375		609	
06:30			133		467		600		**18:30**			225		392		617	
06:45			137	499	442	1719	579	2218	**18:45**			233	925	429	1607	662	2532
07:00			127		452		579		**19:00**			203		478		681	
07:15			158		482		640		**19:15**			191		352		543	
07:30			159		504		663		**19:30**			201		406		607	
07:45			189	633	456	1894	645	2527	**19:45**			196	791	450	1686	646	2477
08:00			174		473		647		**20:00**			247		526		773	
08:15			193		464		657		**20:15**			242		365		607	
08:30			180		588		768		**20:30**			186		428		614	
08:45			207	754	481	2006	688	2760	**20:45**			200	875	293	1612	493	2487
09:00			191		539		730		**21:00**			163		298		461	
09:15			190		516		706		**21:15**			203		255		458	
09:30			222		563		785		**21:30**			176		259		435	
09:45			172	775	557	2175	729	2950	**21:45**			153	695	193	1005	346	1700
10:00			211		574		785		**22:00**			164		284		448	
10:15			209		545		754		**22:15**			122		297		419	
10:30			204		568		772		**22:30**			197		270		467	
10:45			228	852	572	2259	800	3111	**22:45**			182	665	238	1089	420	1754
11:00			218		476		694		**23:00**			113		203		316	
11:15			209		502		711		**23:15**			114		233		347	
11:30			233		497		730		**23:30**			82		156		238	
11:45			229	889	552	2027	781	2916	**23:45**			75	384	144	736	219	1120
TOTALS				5266		14890		**20156**	**TOTALS**				11851		17980		**29831**
SPLIT %				26.1%		73.9%		**40.3%**	**SPLIT %**				39.7%		60.3%		**59.7%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	17,117	32,870	49,987

AM Peak Hour			11:00	10:00	**10:00**	**PM Peak Hour**			15:30	12:15	**15:30**
AM Pk Volume			889	2259	**3111**	**PM Pk Volume**			1669	1953	**3484**
Pk Hr Factor			0.954	0.984	**0.972**	**Pk Hr Factor**			0.893	0.969	**0.885**
7 - 9 Volume	0	0	1387	3900	**5287**	**4 - 6 Volume**	0	0	2667	3424	**6091**
7 - 9 Peak Hour			08:00	08:00	**08:00**	**4 - 6 Peak Hour**			16:00	17:00	**16:15**
7 - 9 Pk Volume	0	0	754	2006	**2760**	**4 - 6 Pk Volume**	0	0	1539	1839	**3153**
Pk Hr Factor	0.000	0.000	0.911	0.853	**0.898**	**Pk Hr Factor**	0.000	0.000	0.969	0.993	**0.978**

Prepared by NDS/ATD

VOLUME

Harbor Island Dr Bet. N Harbor Dr & Southern Terminus Of Harbor Island Dr

Day: Tuesday
Date: 1/10/2017

City: San Diego
Project #: CA17_4017_008

DAILY TOTALS	NB	SB	EB	WB	Total
	5,467	5,395	0	0	10,862

AM Period	NB		SB		EB	WB	TOTAL		PM Period	NB		SB		EB	WB	TOTAL	
00:00	23		13				36		12:00	79		87				166	
00:15	17		18				35		12:15	87		61				148	
00:30	26		12				38		12:30	64		82				146	
00:45	15	81	7	50			22	131	12:45	76	306	85	315			161	621
01:00	8		13				21		13:00	130		80				210	
01:15	11		7				18		13:15	115		90				205	
01:30	5		0				5		13:30	121		90				211	
01:45	6	30	7	27			13	57	13:45	102	468	79	339			181	807
02:00	3		3				6		14:00	96		88				184	
02:15	7		6				13		14:15	85		95				180	
02:30	4		3				7		14:30	90		91				181	
02:45	3	17	3	15			6	32	14:45	103	374	79	353			182	727
03:00	5		7				12		15:00	113		94				207	
03:15	5		3				8		15:15	114		82				196	
03:30	5		7				12		15:30	86		107				193	
03:45	4	19	9	26			13	45	15:45	89	402	107	390			196	792
04:00	5		13				18		16:00	92		79				171	
04:15	3		14				17		16:15	74		99				173	
04:30	2		23				25		16:30	83		96				179	
04:45	13	23	18	68			31	91	16:45	108	357	76	350			184	707
05:00	7		12				19		17:00	117		77				194	
05:15	18		28				46		17:15	103		77				180	
05:30	21		27				48		17:30	84		82				166	
05:45	13	59	35	102			48	161	17:45	83	387	83	319			166	706
06:00	29		32				61		18:00	79		89				168	
06:15	13		22				35		18:15	92		89				181	
06:30	38		53				91		18:30	61		72				133	
06:45	36	116	61	168			97	284	18:45	77	309	67	317			144	626
07:00	48		61				109		19:00	68		73				141	
07:15	60		61				121		19:15	56		58				114	
07:30	46		65				111		19:30	65		64				129	
07:45	36	190	64	251			100	441	19:45	61	250	77	272			138	522
08:00	51		77				128		20:00	74		55				129	
08:15	47		67				114		20:15	76		58				134	
08:30	33		62				95		20:30	148		56				204	
08:45	48	179	92	298			140	477	20:45	97	395	57	226			154	621
09:00	52		73				125		21:00	65		50				115	
09:15	60		64				124		21:15	74		56				130	
09:30	58		99				157		21:30	80		43				123	
09:45	62	232	80	316			142	548	21:45	48	267	56	205			104	472
10:00	60		84				144		22:00	60		24				84	
10:15	81		84				165		22:15	56		55				111	
10:30	69		66				135		22:30	73		37				110	
10:45	67	277	89	323			156	600	22:45	48	237	52	168			100	405
11:00	50		84				134		23:00	67		32				99	
11:15	63		101				164		23:15	41		26				67	
11:30	116		114				230		23:30	44		19				63	
11:45	88	317	104	403			192	720	23:45	23	175	17	94			40	269
TOTALS		1540		2047				**3587**	**TOTALS**		3927		3348				**7275**
SPLIT %		42.9%		57.1%				**33.0%**	**SPLIT %**		54.0%		46.0%				**67.0%**

DAILY TOTALS	NB	SB	EB	WB	Total
	5,467	5,395	0	0	10,862

AM Peak Hour	11:30	11:15			**11:15**	**PM Peak Hour**	13:00	15:30			**13:00**
AM Pk Volume	370	406			**752**	**PM Pk Volume**	468	392			**807**
Pk Hr Factor	0.797	0.890			**0.817**	**Pk Hr Factor**	0.900	0.916			**0.956**
7 - 9 Volume	369	549	0	0	**918**	**4 - 6 Volume**	744	669	0	0	**1413**
7 - 9 Peak Hour	07:15	08:00			**08:00**	**4 - 6 Peak Hour**	16:45	16:00			**16:30**
7 - 9 Pk Volume	193	298	0	0	**477**	**4 - 6 Pk Volume**	412	350	0	0	**737**
Pk Hr Factor	0.804	0.810	0.000	0.000	**0.852**	**Pk Hr Factor**	0.880	0.884	0.000	0.000	**0.950**

Prepared by NDS/ATD

VOLUME

Harbor Island Dr Bet. Western Terminus Of Harbor Island Dr & Southern Terminus Of Harbor Island Dr

Day: Tuesday
Date: 1/10/2017

City: San Diego
Project #: CA17_4017_009

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,617	2,605	5,222

AM Period	NB		SB		EB		WB		TOTAL		PM Period	NB		SB		EB		WB		TOTAL	
00:00					12		8		20		12:00					42		40		82	
00:15					8		6		14		12:15					40		27		67	
00:30					6		3		9		12:30					34		39		73	
00:45					1	27	3	20	4	47	12:45					50	166	39	145	89	311
01:00					4		4		8		13:00					70		37		107	
01:15					4		2		6		13:15					70		51		121	
01:30					2		0		2		13:30					57		43		100	
01:45					0	10	2	8	2	18	13:45					56	253	44	175	100	428
02:00					1		1		2		14:00					48		46		94	
02:15					1		2		3		14:15					40		45		85	
02:30					1		3		4		14:30					46		45		91	
02:45					2	5	2	8	4	13	14:45					47	181	40	176	87	357
03:00					5		4		9		15:00					61		46		107	
03:15					2		0		2		15:15					56		38		94	
03:30					3		4		7		15:30					43		50		93	
03:45					2	12	1	9	3	21	15:45					47	207	40	174	87	381
04:00					3		5		8		16:00					42		39		81	
04:15					0		6		6		16:15					41		53		94	
04:30					1		3		4		16:30					39		42		81	
04:45					8	12	14	28	22	40	16:45					56	178	36	170	92	348
05:00					6		7		13		17:00					54		39		93	
05:15					6		15		21		17:15					43		38		81	
05:30					8		13		21		17:30					39		44		83	
05:45					8	28	13	48	21	76	17:45					35	171	52	173	87	344
06:00					13		13		26		18:00					35		53		88	
06:15					4		9		13		18:15					44		52		96	
06:30					18		18		36		18:30					31		30		61	
06:45					18	53	20	60	38	113	18:45					30	140	36	171	66	311
07:00					26		18		44		19:00					23		30		53	
07:15					34		21		55		19:15					29		29		58	
07:30					21		27		48		19:30					34		34		68	
07:45					23	104	26	92	49	196	19:45					23	109	38	131	61	240
08:00					26		37		63		20:00					29		23		52	
08:15					27		27		54		20:15					25		20		45	
08:30					14		28		42		20:30					106		27		133	
08:45					30	97	40	132	70	229	20:45					50	210	32	102	82	312
09:00					27		41		68		21:00					35		25		60	
09:15					29		24		53		21:15					26		32		58	
09:30					26		47		73		21:30					33		20		53	
09:45					35	117	43	155	78	272	21:45					21	115	27	104	48	219
10:00					25		36		61		22:00					21		12		33	
10:15					38		54		92		22:15					13		22		35	
10:30					34		43		77		22:30					28		23		51	
10:45					43	140	52	185	95	325	22:45					14	76	15	72	29	148
11:00					29		48		77		23:00					27		11		38	
11:15					24		60		84		23:15					18		5		23	
11:30					42		69		111		23:30					11		8		19	
11:45					44	139	57	234	101	373	23:45					11	67	9	33	20	100
TOTALS						744		979		**1723**	**TOTALS**						1873		1626		**3499**
SPLIT %						43.2%		56.8%		**33.0%**	**SPLIT %**						53.5%		46.5%		**67.0%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,617	2,605	5,222

	NB	SB	EB	WB	Total		NB	SB	EB	WB	Total
AM Peak Hour			11:30	11:00	**11:15**	**PM Peak Hour**			13:00	17:30	**13:00**
AM Pk Volume			168	234	**378**	**PM Pk Volume**			253	201	**428**
Pk Hr Factor			0.955	0.848	**0.851**	**Pk Hr Factor**			0.904	0.948	**0.884**
7 - 9 Volume	0	0	201	224	**425**	**4 - 6 Volume**	0	0	349	343	**692**
7 - 9 Peak Hour			07:00	08:00	**08:00**	**4 - 6 Peak Hour**			16:30	17:00	**16:15**
7 - 9 Pk Volume	0	0	104	132	**229**	**4 - 6 Pk Volume**	0	0	192	173	**360**
Pk Hr Factor	0.000	0.000	0.765	0.825	**0.818**	**Pk Hr Factor**	0.000	0.000	0.857	0.832	**0.957**

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-008

Day: Tuesday

City: San Diego

Date: 1/10/2017

AM

NS/EW Streets:	Harbour Island Dr			Harbour Island Dr			N Harbor Dr			N Harbor Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	1	1	1.5	1	0.5	1	3	1	2	4	0	
7:00 AM	7	2	32	27	4	20	24	67	7	51	359	1	601
7:15 AM	23	2	28	19	1	21	19	115	10	50	377	3	668
7:30 AM	22	3	26	12	1	22	16	107	14	51	378	0	652
7:45 AM	10	6	20	11	2	24	22	145	15	49	405	1	710
8:00 AM	21	1	26	16	7	23	23	139	14	56	355	1	682
8:15 AM	24	2	19	19	5	24	27	158	12	53	355	2	700
8:30 AM	10	1	24	14	3	19	25	144	14	43	361	1	659
8:45 AM	18	3	25	14	2	18	28	148	20	74	329	0	679
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	135	20	200	132	25	171	184	1023	106	427	2919	9	5351
APPROACH %'s :	38.03%	5.63%	56.34%	40.24%	7.62%	52.13%	14.01%	77.91%	8.07%	12.73%	87.00%	0.27%	

UTURNS			
NB	SB	EB	WB
0	0	7	0
0	0	5	0
0	0	6	0
0	0	7	0
0	0	8	0
0	0	14	0
0	0	8	0
0	0	14	0
NB	SB	EB	WB
0	0	69	0

PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	65	10	89	60	17	90	97	586	55	201	1476	5	2751
PEAK HR FACTOR :		0.854			0.870			0.937			0.924		0.969

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-008

City: San Diego

Day: Tuesday

Date: 1/10/2017

PM

NS/EW Streets:	Harbour Island Dr			Harbour Island Dr			N Harbor Dr			N Harbor Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	1	1	1.5	1	0.5	1	3	1	2	4	0	
4:00 PM	27	12	53	12	7	23	41	394	30	44	264	0	907
4:15 PM	20	7	41	11	7	21	44	418	33	60	247	2	911
4:30 PM	25	9	50	10	9	24	39	377	20	68	260	3	894
4:45 PM	32	9	69	16	5	25	32	296	22	57	228	3	794
5:00 PM	28	8	81	17	6	35	33	299	20	43	266	1	837
5:15 PM	31	5	60	12	5	22	35	291	23	52	325	1	862
5:30 PM	18	6	54	13	11	30	30	272	28	44	270	2	778
5:45 PM	18	7	59	12	4	24	32	207	33	53	209	1	659

UTURNS			
NB	SB	EB	WB
0	0	25	1
0	0	28	0
0	0	13	0
0	0	11	0
0	0	19	0
0	0	19	0
0	1	16	0
0	0	16	0

	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	199	63	467	103	54	204	286	2554	209	421	2069	13	6642
APPROACH %'s :	27.30%	8.64%	64.06%	28.53%	14.96%	56.51%	9.38%	83.77%	6.85%	16.82%	82.66%	0.52%	

NB	SB	EB	WB
0	1	147	1

PEAK HR START TIME :	400 PM												TOTAL
PEAK HR VOL :	104	37	213	49	28	93	156	1485	105	229	999	8	3506
PEAK HR FACTOR :		0.805			0.924			0.882			0.934		0.962

CONTROL : Signalized

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

Harbour Island Dr and N Harbor Dr , San Diego

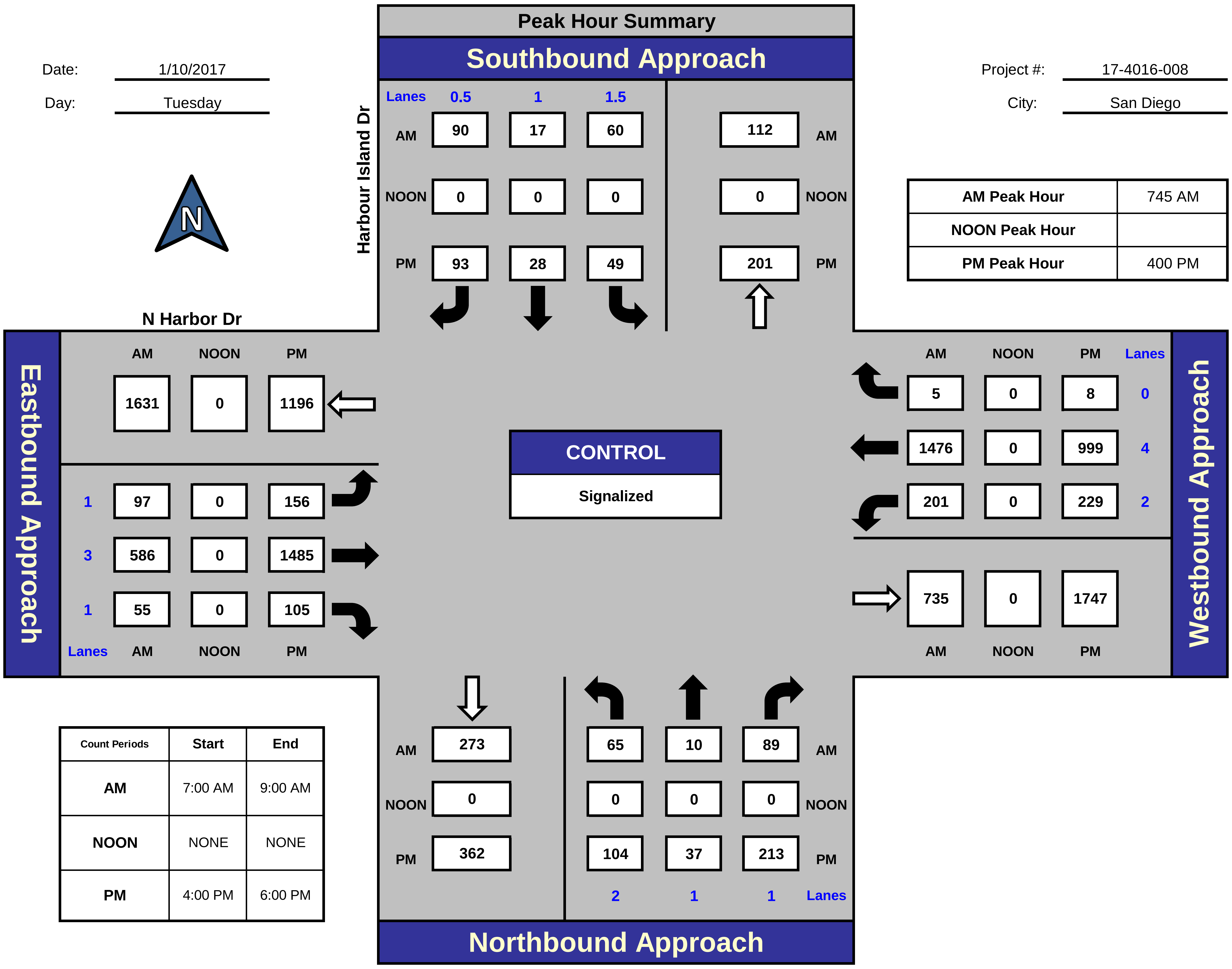
Date: 1/10/2017

Day: Tuesday

Project #: 17-4016-008

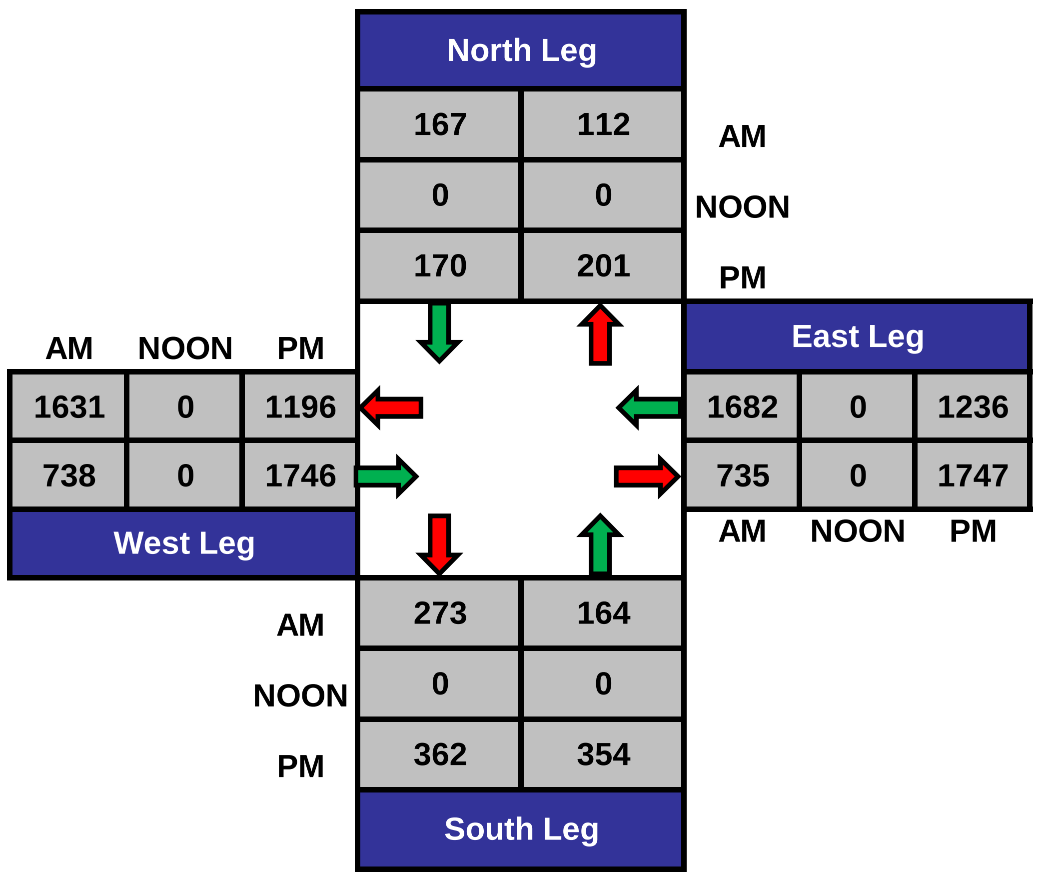
City: San Diego

AM Peak Hour	745 AM
NOON Peak Hour	
PM Peak Hour	400 PM

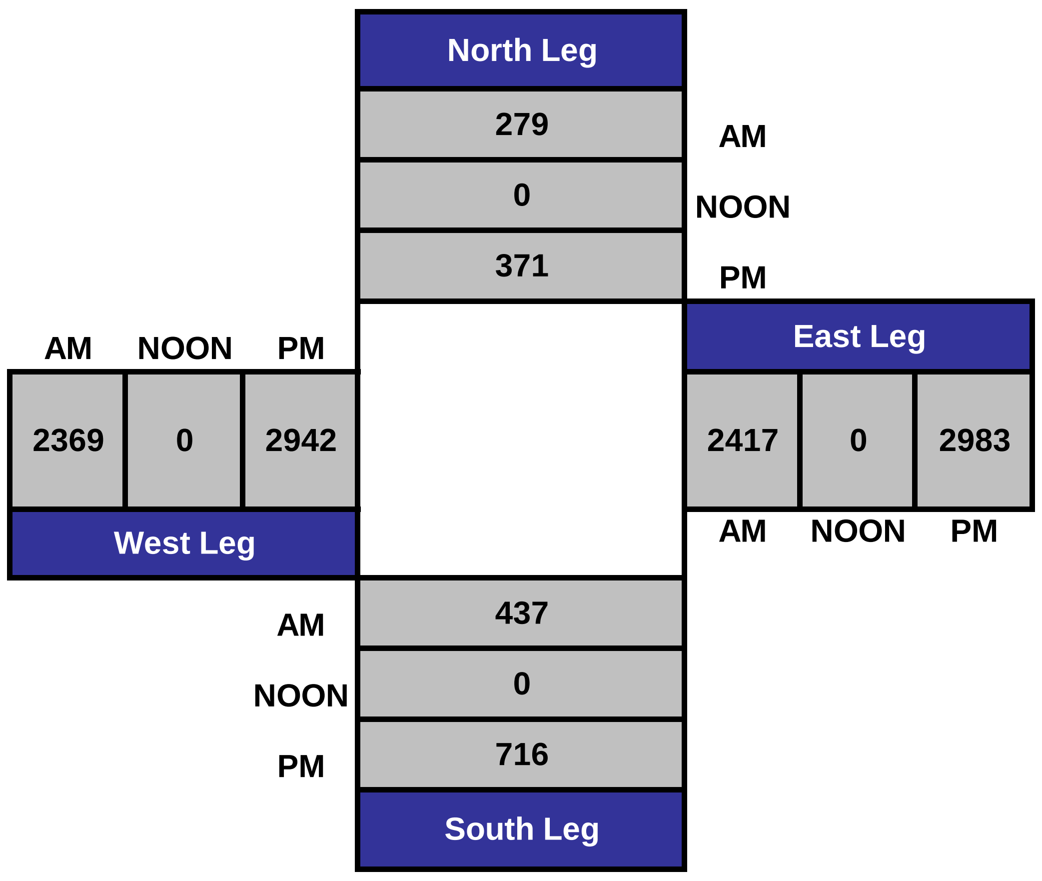


Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON	NONE	NONE
PM	4:00 PM	6:00 PM

Total Ins & Outs



Total Volume Per Leg



Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-009

City: San Diego

Day: Tuesday

Date: 1/10/2017

AM

NS/EW Streets:	Commuter Terminal /Winship Ln			Commuter Terminal /Winship Ln			Harbour Island Dr			Harbour Island Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	1	1	3	0	0	5	1	
7:00 AM	0	0	0	5	0	10	13	104	0	0	604	6	742
7:15 AM	0	0	0	6	0	7	19	131	0	0	560	8	731
7:30 AM	0	0	0	5	0	10	15	146	0	0	626	16	818
7:45 AM	0	0	0	7	0	10	18	145	0	0	619	10	809
8:00 AM	0	0	0	6	0	10	13	181	0	0	609	11	830
8:15 AM	0	0	0	12	0	9	14	181	0	0	533	6	755
8:30 AM	0	0	0	7	0	2	14	145	0	0	586	7	761
8:45 AM	0	0	0	3	0	9	18	188	0	0	568	9	795
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	51	0	67	124	1221	0	0	4705	73	6241
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	43.22%	0.00%	56.78%	9.22%	90.78%	0.00%	0.00%	98.47%	1.53%	
PEAK HR START TIME :	730 AM												TOTAL
PEAK HR VOL :	0	0	0	30	0	39	60	653	0	0	2387	43	3212
PEAK HR FACTOR :		0.000			0.821			0.914			0.946		0.967

CONTROL : Signalized

	UTURNS			
	NB	SB	EB	WB
7:00 AM	0	0	3	0
7:15 AM	0	0	6	0
7:30 AM	0	0	4	0
7:45 AM	0	0	3	0
8:00 AM	0	0	4	0
8:15 AM	0	0	4	0
8:30 AM	0	0	7	0
8:45 AM	0	0	3	0
	NB	SB	EB	WB
TOTAL VOLUMES :	0	0	34	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-009

City: San Diego

Day: Tuesday

Date: 1/10/2017

PM

NS/EW Streets:	Commuter Terminal /Winship Ln			Commuter Terminal /Winship Ln			Harbour Island Dr			Harbour Island Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	1	1	3	0	0	5	1	
4:00 PM	0	0	0	21	0	7	12	438	0	0	396	4	878
4:15 PM	0	0	0	14	0	7	13	451	0	0	447	6	938
4:30 PM	0	0	0	23	0	5	8	447	0	0	432	3	918
4:45 PM	0	0	0	16	0	6	12	379	0	0	459	8	880
5:00 PM	0	0	0	36	0	5	18	366	0	0	452	4	881
5:15 PM	0	0	0	15	0	13	6	356	0	0	493	7	890
5:30 PM	0	0	0	15	0	9	9	333	0	0	411	7	784
5:45 PM	0	0	0	9	0	4	12	281	0	0	375	2	683
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	149	0	56	90	3051	0	0	3465	41	6852
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	72.68%	0.00%	27.32%	2.87%	97.13%	0.00%	0.00%	98.83%	1.17%	
PEAK HR START TIME :	415 PM												TOTAL
PEAK HR VOL :	0	0	0	89	0	23	51	1643	0	0	1790	21	3617
PEAK HR FACTOR :		0.000			0.683			0.913			0.969		0.964

UTURNS				
	NB	SB	EB	WB
4:00 PM	0	0	7	0
4:15 PM	0	0	10	0
4:30 PM	0	0	4	0
4:45 PM	0	0	6	0
5:00 PM	0	0	12	0
5:15 PM	0	0	3	0
5:30 PM	0	0	2	0
5:45 PM	0	0	6	0
	NB	SB	EB	WB
	0	0	50	0

CONTROL : Signalized

ITM Peak Hour Summary

Prepared by:

NDS

National Data & Surveying Services

Commuter Terminal /Winship Ln and Harbour Island Dr , San Diego

Date: 1/10/2017

Day: Tuesday

Project #: 17-4016-009

City: San Diego

AM Peak Hour	730 AM
NOON Peak Hour	
PM Peak Hour	415 PM

Peak Hour Summary

Southbound Approach

Commuter Terminal /Winship Ln

Lanes	1	0	2		
AM	39	0	30	103	AM
NOON	0	0	0	0	NOON
PM	23	0	89	72	PM
	↲	↓	↳	⇧	

Harbour Island Dr

Eastbound Approach

	AM	NOON	PM	
	2426	0	1813	⇦
1	60	0	51	↗
3	653	0	1643	→
0	0	0	0	↘
Lanes	AM	NOON	PM	

CONTROL

Signalized

Westbound Approach

	AM	NOON	PM	Lanes
↖	43	0	21	1
←	2387	0	1790	5
↙	0	0	0	0
⇨	683	0	1732	
	AM	NOON	PM	

	⇩	↰	↑	↱	
AM	0	0	0	0	AM
NOON	0	0	0	0	NOON
PM	0	0	0	0	PM
		0	0	0	Lanes

Northbound Approach

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON	NONE	NONE
PM	4:00 PM	6:00 PM

Total Ins & Outs

North Leg

69	103	AM
0	0	NOON
112	72	PM

West Leg

AM	NOON	PM
2426	0	1813
713	0	1694

East Leg

2430	0	1811
683	0	1732
AM	NOON	PM

South Leg

AM	0	0
NOON	0	0
PM	0	0

Total Volume Per Leg

North Leg

172	AM
0	NOON
184	PM

West Leg

AM	NOON	PM
3139	0	3507

East Leg

3113	0	3543
AM	NOON	PM

South Leg

AM	0
NOON	0
PM	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-014

Day: Tuesday

City: San Diego

Date: 1/10/2017

AM

NS/EW Streets:	Harbour Island Dr			Harbour Island Dr			Harbour Island Dr			Harbour Island Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	1	1	1	1.5	0.5	0	0	1	1	
7:00 AM	0	0	0	33	0	19	21	5	0	0	0	16	94
7:15 AM	0	0	0	30	0	19	33	3	0	0	2	10	97
7:30 AM	0	0	0	25	0	32	25	2	0	0	0	12	96
7:45 AM	0	0	0	24	0	33	24	1	0	0	0	5	87
8:00 AM	0	0	0	19	0	40	24	4	0	0	2	13	102
8:15 AM	0	0	0	11	0	29	31	0	0	0	0	11	82
8:30 AM	0	0	0	19	0	35	19	0	0	0	1	10	84
8:45 AM	0	0	0	21	0	48	36	0	0	0	1	8	114
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	182	0	255	213	15	0	0	6	85	756
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	41.65%	0.00%	58.35%	93.42%	6.58%	0.00%	0.00%	6.59%	93.41%	

UTURNS			
NB	SB	EB	WB
0	0	0	0
0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
NB	SB	EB	WB
0	0	1	0

PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	0	0	0	70	0	152	110	4	0	0	4	42	382
PEAK HR FACTOR :	0.000			0.804			0.792			0.767			0.838

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 17-4016-014

City: San Diego

Day: Tuesday

Date: 1/10/2017

PM

NS/EW Streets:	Harbour Island Dr			Harbour Island Dr			Harbour Island Dr			Harbour Island Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	1	1	1	1.5	0.5	0	0	1	1	
4:00 PM	0	0	0	31	0	43	45	4	0	0	1	23	147
4:15 PM	0	0	0	31	0	57	40	6	0	0	1	23	158
4:30 PM	0	0	0	33	0	40	40	4	0	0	5	28	150
4:45 PM	0	0	0	29	0	38	61	5	0	0	4	23	160
5:00 PM	0	0	0	26	0	44	63	2	0	0	1	36	172
5:15 PM	0	0	0	30	0	42	46	7	0	0	3	29	157
5:30 PM	0	0	0	26	0	45	39	5	0	0	6	28	149
5:45 PM	0	0	0	29	0	57	37	8	0	0	6	29	166
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	235	0	366	371	41	0	0	27	219	1259
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	39.10%	0.00%	60.90%	90.05%	9.95%	0.00%	0.00%	10.98%	89.02%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	0	0	111	0	188	185	22	0	0	16	122	644
PEAK HR FACTOR :		0.000			0.869			0.796			0.932		0.936

UTURNS				
	NB	SB	EB	WB
4:00 PM	0	0	0	0
4:15 PM	0	0	0	0
4:30 PM	0	0	0	0
4:45 PM	0	0	0	0
5:00 PM	0	0	0	0
5:15 PM	0	1	0	0
5:30 PM	0	0	0	0
5:45 PM	0	0	0	0
	NB	SB	EB	WB
	0	1	0	0

CONTROL : Signalized

ITM Peak Hour Summary

Prepared by:

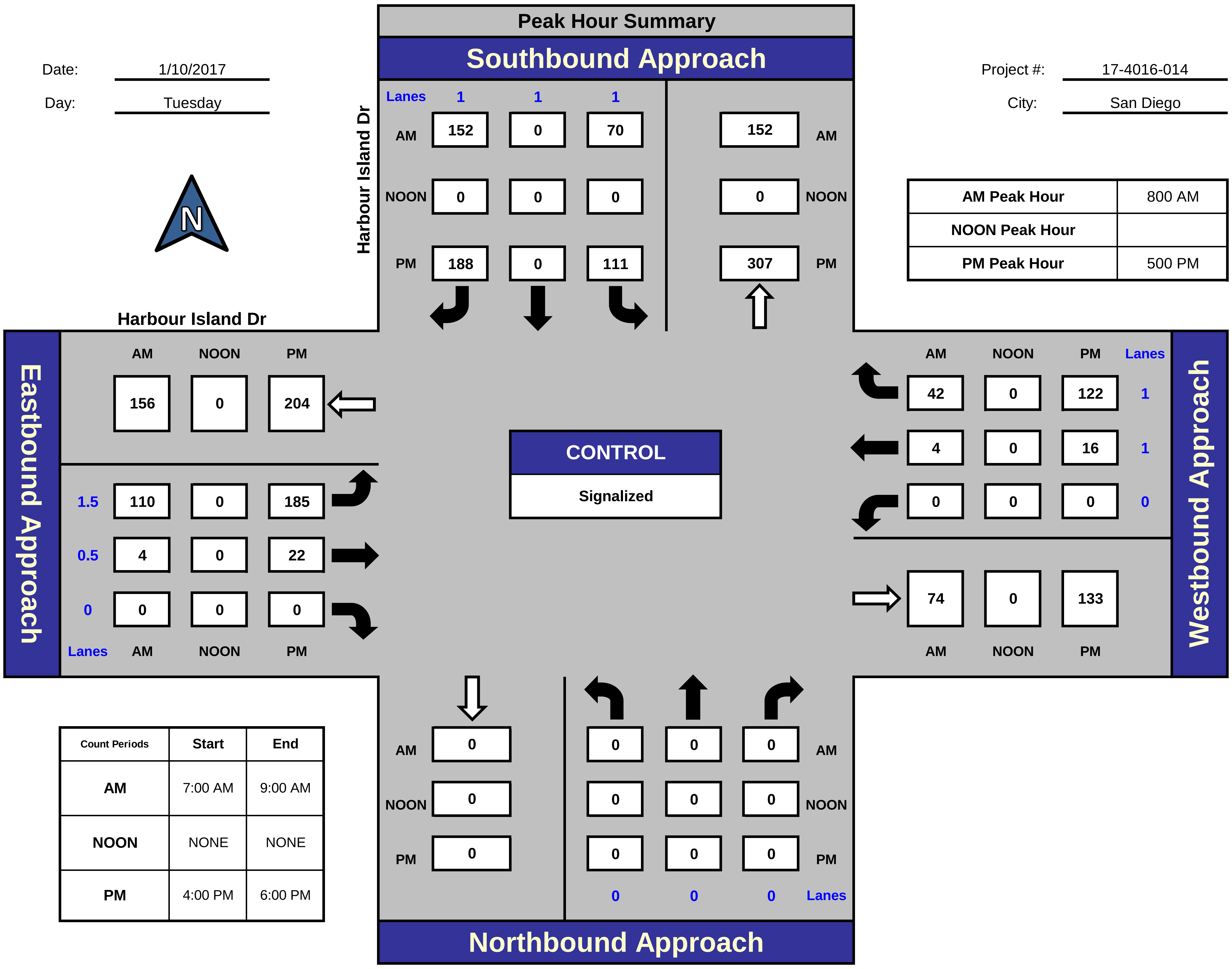
National Data & Surveying Services

Harbour Island Dr and Harbour Island Dr , San Diego

Date: 1/10/2017
Day: Tuesday

Project #: 17-4016-014
City: San Diego

AM Peak Hour	800 AM
NOON Peak Hour	
PM Peak Hour	500 PM



Peak Hour Summary

Southbound Approach

Lanes	1	1	1	
AM	152	0	70	152
NOON	0	0	0	0
PM	188	0	111	307

Eastbound Approach

	AM	NOON	PM
	156	0	204
1.5	110	0	185
0.5	4	0	22
0	0	0	0
Lanes	AM	NOON	PM

Westbound Approach

AM	NOON	PM	Lanes
42	0	122	1
4	0	16	1
0	0	0	0
74	0	133	
AM	NOON	PM	

Northbound Approach

AM	0	0	0	0
NOON	0	0	0	0
PM	0	0	0	0
		0	0	0	Lanes

CONTROL

Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON	NONE	NONE
PM	4:00 PM	6:00 PM

Total Ins & Outs

North Leg

222	152	AM
0	0	NOON
299	307	PM

West Leg

AM	NOON	PM
156	0	204
114	0	207

East Leg

AM	NOON	PM
46	0	138
74	0	133

South Leg

AM	0	0
NOON	0	0
PM	0	0

Total Volume Per Leg

North Leg

374	AM
0	NOON
606	PM

West Leg

AM	NOON	PM
270	0	411

East Leg

AM	NOON	PM
120	0	271

South Leg

AM	0
NOON	0
PM	0

Appendix B

Peak Hour Intersection LOS work Sheets Worksheets –Existing Conditions

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↑	↱	↰↰	↑↑↑↱		↰↰	↑	↱	↰	↰↱	
Traffic Volume (veh/h)	97	586	55	286	1884	8	65	10	89	60	17	90
Future Volume (veh/h)	97	586	55	286	1884	8	65	10	89	60	17	90
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1863	1863	1793	1900	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	103	623	47	311	2048	9	76	12	0	61	32	93
Adj No. of Lanes	1	3	1	2	4	0	2	1	1	1	2	0
Peak Hour Factor	0.94	0.94	0.94	0.92	0.92	0.92	0.85	0.85	0.85	0.87	0.87	0.87
Percent Heavy Veh, %	2	6	2	2	6	6	2	2	2	2	2	2
Cap, veh/h	612	2867	1016	379	2186	10	193	104	89	141	148	126
Arrive On Green	0.35	0.59	0.59	0.04	0.11	0.11	0.06	0.06	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1774	4893	1583	3442	6385	28	3442	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	103	623	47	311	1484	573	76	12	0	61	32	93
Grp Sat Flow(s),veh/h/ln	1774	1631	1583	1721	1542	1788	1721	1863	1583	1774	1863	1583
Q Serve(g_s), s	4.8	7.1	1.3	10.6	37.5	37.5	2.5	0.7	0.0	3.9	1.9	6.8
Cycle Q Clear(g_c), s	4.8	7.1	1.3	10.6	37.5	37.5	2.5	0.7	0.0	3.9	1.9	6.8
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	612	2867	1016	379	1584	612	193	104	89	141	148	126
V/C Ratio(X)	0.17	0.22	0.05	0.82	0.94	0.94	0.39	0.12	0.00	0.43	0.22	0.74
Avail Cap(c_a), veh/h	612	2867	1016	645	1584	612	650	352	299	302	317	270
HCM Platoon Ratio	1.00	1.00	1.00	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.82	0.82	0.82	0.99	0.99	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.9	11.6	7.8	55.7	51.1	51.1	53.8	52.9	0.0	51.8	50.9	53.1
Incr Delay (d2), s/veh	0.0	0.2	0.1	1.4	10.2	20.7	1.3	0.5	0.0	2.1	0.7	8.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	3.2	0.7	5.1	17.6	22.2	1.2	0.4	0.0	2.0	1.0	3.3
LnGrp Delay(d),s/veh	26.9	11.8	7.9	57.1	61.3	71.8	55.1	53.4	0.0	53.9	51.6	61.4
LnGrp LOS	C	B	A	E	E	E	E	D		D	D	E
Approach Vol, veh/h		773			2368			88			186	
Approach Delay, s/veh		13.6			63.3			54.8			57.2	
Approach LOS		B			E			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	17.4	74.8		11.5	46.4	45.8		14.3
Change Period (Y+Rc), s	4.4	5.7		4.9	5.7	* 5.4		4.9
Max Green Setting (Gmax), s	22.1	33.6		22.3	15.6	* 40		20.1
Max Q Clear Time (g_c+I1), s	12.6	9.1		4.5	6.8	39.5		8.8
Green Ext Time (p_c), s	0.4	7.7		0.2	0.1	0.8		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	51.5
HCM 2010 LOS	D

Notes

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑↑↑	↱	↰↰	↱
Traffic Volume (veh/h)	60	653	2946	53	30	39
Future Volume (veh/h)	60	653	2946	53	30	39
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1792	1863	1863	1863
Adj Flow Rate, veh/h	66	718	3101	0	37	39
Adj No. of Lanes	1	3	5	1	2	1
Peak Hour Factor	0.91	0.91	0.95	0.95	0.82	0.82
Percent Heavy Veh, %	2	6	6	2	2	2
Cap, veh/h	86	4279	5726	1249	135	62
Arrive On Green	0.05	0.87	0.79	0.00	0.04	0.04
Sat Flow, veh/h	1774	5055	7600	1583	3442	1583
Grp Volume(v), veh/h	66	718	3101	0	37	39
Grp Sat Flow(s),veh/h/ln	1774	1631	1452	1583	1721	1583
Q Serve(g_s), s	4.3	2.5	18.6	0.0	1.2	2.9
Cycle Q Clear(g_c), s	4.3	2.5	18.6	0.0	1.2	2.9
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	86	4279	5726	1249	135	62
V/C Ratio(X)	0.77	0.17	0.54	0.00	0.27	0.63
Avail Cap(c_a), veh/h	332	4279	5726	1249	720	331
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.97	0.97	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	55.5	1.1	4.6	0.0	55.1	55.8
Incr Delay (d2), s/veh	13.1	0.1	0.4	0.0	1.1	10.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	1.2	7.4	0.0	0.6	2.7
LnGrp Delay(d),s/veh	68.6	1.2	5.0	0.0	56.2	65.9
LnGrp LOS	E	A	A		E	E
Approach Vol, veh/h		784	3101		76	
Approach Delay, s/veh		6.9	5.0		61.1	
Approach LOS		A	A		E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		108.5		9.5	10.1	98.4		
Change Period (Y+Rc), s		5.3		4.9	4.4	5.3		
Max Green Setting (Gmax), s		83.1		24.7	22.1	56.6		
Max Q Clear Time (g_c+I1), s		4.5		4.9	6.3	20.6		
Green Ext Time (p_c), s		14.4		0.2	0.1	35.8		

Intersection Summary			
HCM 2010 Ctrl Delay			6.4
HCM 2010 LOS			A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰↰	↱
Traffic Volume (veh/h)	110	4	4	42	70	152
Future Volume (veh/h)	110	4	4	42	70	152
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	139	5	5	0	88	0
Adj No. of Lanes	1	1	1	1	2	1
Peak Hour Factor	0.79	0.79	0.77	0.77	0.80	0.80
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	0	0	21	18	303	139
Arrive On Green	0.00	0.00	0.01	0.00	0.09	0.00
Sat Flow, veh/h		0	908	1583	3442	1583
Grp Volume(v), veh/h		0.0	5	0	88	0
Grp Sat Flow(s),veh/h/ln			1863	1583	1721	1583
Q Serve(g_s), s			0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s			0.0	0.0	0.2	0.0
Prop In Lane				1.00	1.00	1.00
Lane Grp Cap(c), veh/h			21	18	303	139
V/C Ratio(X)			0.24	0.00	0.29	0.00
Avail Cap(c_a), veh/h			6332	5383	15600	7177
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	0.00
Uniform Delay (d), s/veh			4.4	0.0	3.8	0.0
Incr Delay (d2), s/veh			5.6	0.0	0.5	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			0.0	0.0	0.1	0.0
LnGrp Delay(d),s/veh			10.0	0.0	4.3	0.0
LnGrp LOS			A		A	
Approach Vol, veh/h			5		88	
Approach Delay, s/veh			10.0		4.3	
Approach LOS			A		A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4		6		
Phs Duration (G+Y+Rc), s				4.8		4.0		
Change Period (Y+Rc), s				4.0		4.0		
Max Green Setting (Gmax), s				40.0		30.0		
Max Q Clear Time (g_c+I1), s				2.2		2.0		
Green Ext Time (p_c), s				0.3		0.0		

Intersection Summary	
HCM 2010 Ctrl Delay	4.6
HCM 2010 LOS	A

1: Harbor Island Drive/Airport Terminal Road & N Harbor Drive

PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↑	↱	↰↰	↑↑↑↱		↰↰	↑	↱	↰	↰↱	
Traffic Volume (veh/h)	149	1420	98	321	1397	11	104	37	213	49	28	93
Future Volume (veh/h)	149	1420	98	321	1397	11	104	37	213	49	28	93
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		1.00	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1863	1863	1793	1900	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	169	1614	89	345	1502	11	128	46	0	53	30	91
Adj No. of Lanes	1	3	1	2	4	0	2	1	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.93	0.93	0.93	0.81	0.81	0.81	0.92	0.92	0.92
Percent Heavy Veh, %	2	6	2	2	6	6	2	2	2	2	2	2
Cap, veh/h	748	2825	1006	399	1676	12	201	109	93	146	154	119
Arrive On Green	0.42	0.58	0.58	0.15	0.35	0.35	0.06	0.06	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1774	4893	1582	3442	6364	47	3442	1863	1583	1774	1863	1447
Grp Volume(v), veh/h	169	1614	89	345	1092	421	128	46	0	53	30	91
Grp Sat Flow(s),veh/h/ln	1774	1631	1582	1721	1542	1784	1721	1863	1583	1774	1863	1447
Q Serve(g_s), s	7.3	25.0	2.6	11.7	26.8	26.8	4.4	2.9	0.0	3.4	1.8	7.4
Cycle Q Clear(g_c), s	7.3	25.0	2.6	11.7	26.8	26.8	4.4	2.9	0.0	3.4	1.8	7.4
Prop In Lane	1.00		1.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	748	2825	1006	399	1218	470	201	109	93	146	154	119
V/C Ratio(X)	0.23	0.57	0.09	0.86	0.90	0.90	0.64	0.42	0.00	0.36	0.20	0.76
Avail Cap(c_a), veh/h	748	2825	1006	462	1218	470	1064	576	490	282	296	230
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.92	0.92	0.92	0.96	0.96	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.2	16.0	8.4	49.8	37.4	37.4	55.2	54.5	0.0	52.1	51.3	53.9
Incr Delay (d2), s/veh	0.1	0.8	0.2	11.9	9.8	21.1	3.2	2.5	0.0	1.5	0.6	9.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.6	11.4	1.4	6.2	12.4	15.9	2.2	1.5	0.0	1.7	1.0	3.3
LnGrp Delay(d),s/veh	22.2	16.8	8.6	61.7	47.2	58.5	58.4	57.0	0.0	53.6	52.0	63.5
LnGrp LOS	C	B	A	E	D	E	E	E		D	D	E
Approach Vol, veh/h		1872			1858			174			174	
Approach Delay, s/veh		16.9			52.5			58.1			58.5	
Approach LOS		B			D			E			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	18.3	75.0		11.9	56.3	37.0		14.8
Change Period (Y+Rc), s	4.4	5.7		4.9	5.7	* 5.4		4.9
Max Green Setting (Gmax), s	16.1	27.8		37.1	12.6	* 32		19.1
Max Q Clear Time (g_c+I1), s	13.7	27.0		6.4	9.3	28.8		9.4
Green Ext Time (p_c), s	0.2	0.8		0.7	0.1	2.6		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	36.6
HCM 2010 LOS	D

Notes

2: N Harbor Drive & Winship Lane

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑↑↑	↱	↰↰	↱
Traffic Volume (veh/h)	51	1643	2067	25	89	23
Future Volume (veh/h)	51	1643	2067	25	89	23
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1792	1863	1863	1863
Adj Flow Rate, veh/h	56	1805	2131	0	131	28
Adj No. of Lanes	1	3	5	1	2	1
Peak Hour Factor	0.91	0.91	0.97	0.97	0.68	0.68
Percent Heavy Veh, %	2	6	6	2	2	2
Cap, veh/h	73	4195	5660	1235	198	91
Arrive On Green	0.05	1.00	0.78	0.00	0.06	0.06
Sat Flow, veh/h	1774	5055	7600	1583	3442	1583
Grp Volume(v), veh/h	56	1805	2131	0	131	28
Grp Sat Flow(s),veh/h/ln	1774	1631	1452	1583	1721	1583
Q Serve(g_s), s	3.7	0.0	11.0	0.0	4.5	2.0
Cycle Q Clear(g_c), s	3.7	0.0	11.0	0.0	4.5	2.0
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	73	4195	5660	1235	198	91
V/C Ratio(X)	0.77	0.43	0.38	0.00	0.66	0.31
Avail Cap(c_a), veh/h	312	4195	5660	1235	823	379
HCM Platoon Ratio	1.33	1.33	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.73	0.73	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	56.2	0.0	4.1	0.0	55.4	54.2
Incr Delay (d2), s/veh	11.8	0.2	0.2	0.0	3.7	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.1	4.4	0.0	2.2	1.9
LnGrp Delay(d),s/veh	68.0	0.2	4.3	0.0	59.1	56.1
LnGrp LOS	E	A	A		E	E
Approach Vol, veh/h		1861	2131		159	
Approach Delay, s/veh		2.3	4.3		58.6	
Approach LOS		A	A		E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		108.2		11.8	9.3	98.9		
Change Period (Y+Rc), s		5.3		4.9	4.4	5.3		
Max Green Setting (Gmax), s		81.1		28.7	21.1	55.6		
Max Q Clear Time (g_c+I1), s		2.0		6.5	5.7	13.0		
Green Ext Time (p_c), s		57.3		0.5	0.1	39.1		

Intersection Summary			
HCM 2010 Ctrl Delay			5.5
HCM 2010 LOS			A

	↗	→	←	↖	↘	↙
Movement	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Lane Configurations	↰	↑	↑	↱	↰↰	↱
Traffic Volume (veh/h)	185	22	16	122	111	188
Future Volume (veh/h)	185	22	16	122	111	188
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	231	28	17	0	128	0
Adj No. of Lanes	1	1	1	1	2	1
Peak Hour Factor	0.80	0.80	0.93	0.93	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	0	0	34	29	417	192
Arrive On Green	0.00	0.00	0.02	0.00	0.12	0.00
Sat Flow, veh/h		0	1863	1583	3442	1583
Grp Volume(v), veh/h		0.0	17	0	128	0
Grp Sat Flow(s),veh/h/ln			1863	1583	1721	1583
Q Serve(g_s), s			0.1	0.0	0.3	0.0
Cycle Q Clear(g_c), s			0.1	0.0	0.3	0.0
Prop In Lane				1.00	1.00	1.00
Lane Grp Cap(c), veh/h			34	29	417	192
V/C Ratio(X)			0.49	0.00	0.31	0.00
Avail Cap(c_a), veh/h			6010	5109	14806	6812
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	0.00
Uniform Delay (d), s/veh			4.5	0.0	3.7	0.0
Incr Delay (d2), s/veh			10.5	0.0	0.4	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			0.1	0.0	0.2	0.0
LnGrp Delay(d),s/veh			15.1	0.0	4.1	0.0
LnGrp LOS			B		A	
Approach Vol, veh/h			17		128	
Approach Delay, s/veh			15.1		4.1	
Approach LOS			B		A	

Timer	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Assigned Phs				4		6		
Phs Duration (G+Y+Rc), s				5.1		4.2		
Change Period (Y+Rc), s				4.0		4.0		
Max Green Setting (Gmax), s				40.0		30.0		
Max Q Clear Time (g_c+I1), s				2.3		2.1		
Green Ext Time (p_c), s				0.4		0.0		

Intersection Summary	
HCM 2010 Ctrl Delay	5.4
HCM 2010 LOS	A

Appendix C

Peak Hour Intersection LOS work Sheets Worksheets – Existing Plus Project Conditions

1: Harbor Island Drive/Airport Terminal Road & N Harbor Drive

AM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↑	↱	↰↰	↑↑↑↱		↰↰	↑	↱	↰	↰↱	
Traffic Volume (veh/h)	97	586	59	322	1884	8	65	10	92	60	17	90
Future Volume (veh/h)	97	586	59	322	1884	8	65	10	92	60	17	90
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1863	1863	1793	1900	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	103	623	51	350	2048	9	76	12	0	61	32	93
Adj No. of Lanes	1	3	1	2	4	0	2	1	1	1	2	0
Peak Hour Factor	0.94	0.94	0.94	0.92	0.92	0.92	0.85	0.85	0.85	0.87	0.87	0.87
Percent Heavy Veh, %	2	6	2	2	6	6	2	2	2	2	2	2
Cap, veh/h	612	2810	998	419	2186	10	193	104	89	141	148	126
Arrive On Green	0.35	0.57	0.57	0.04	0.11	0.11	0.06	0.06	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1774	4893	1583	3442	6385	28	3442	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	103	623	51	350	1484	573	76	12	0	61	32	93
Grp Sat Flow(s),veh/h/ln	1774	1631	1583	1721	1542	1788	1721	1863	1583	1774	1863	1583
Q Serve(g_s), s	4.8	7.3	1.5	11.9	37.5	37.5	2.5	0.7	0.0	3.9	1.9	6.8
Cycle Q Clear(g_c), s	4.8	7.3	1.5	11.9	37.5	37.5	2.5	0.7	0.0	3.9	1.9	6.8
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	612	2810	998	419	1584	612	193	104	89	141	148	126
V/C Ratio(X)	0.17	0.22	0.05	0.84	0.94	0.94	0.39	0.12	0.00	0.43	0.22	0.74
Avail Cap(c_a), veh/h	612	2810	998	645	1584	612	650	352	299	302	317	270
HCM Platoon Ratio	1.00	1.00	1.00	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.81	0.81	0.81	0.99	0.99	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.9	12.3	8.3	55.5	51.1	51.1	53.8	52.9	0.0	51.8	50.9	53.1
Incr Delay (d2), s/veh	0.0	0.2	0.1	2.7	10.1	20.6	1.3	0.5	0.0	2.1	0.7	8.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	3.3	0.7	5.8	17.6	22.1	1.2	0.4	0.0	2.0	1.0	3.3
LnGrp Delay(d),s/veh	26.9	12.4	8.4	58.2	61.2	71.7	55.1	53.4	0.0	53.9	51.6	61.4
LnGrp LOS	C	B	A	E	E	E	E	D		D	D	E
Approach Vol, veh/h		777			2407			88			186	
Approach Delay, s/veh		14.1			63.3			54.8			57.2	
Approach LOS		B			E			D			E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	18.8	73.5		11.5	46.4	45.8		14.3				
Change Period (Y+Rc), s	4.4	5.7		4.9	5.7	* 5.4		4.9				
Max Green Setting (Gmax), s	22.1	33.6		22.3	15.6	* 40		20.1				
Max Q Clear Time (g_c+I1), s	13.9	9.3		4.5	6.8	39.5		8.8				
Green Ext Time (p_c), s	0.4	7.7		0.2	0.1	0.8		0.6				
Intersection Summary												
HCM 2010 Ctrl Delay			51.7									
HCM 2010 LOS			D									
Notes												

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑↑↑	↱	↰↰	↱
Traffic Volume (veh/h)	60	656	2982	53	30	39
Future Volume (veh/h)	60	656	2982	53	30	39
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1792	1863	1863	1863
Adj Flow Rate, veh/h	66	721	3139	0	37	39
Adj No. of Lanes	1	3	5	1	2	1
Peak Hour Factor	0.91	0.91	0.95	0.95	0.82	0.82
Percent Heavy Veh, %	2	6	6	2	2	2
Cap, veh/h	86	4279	5726	1249	135	62
Arrive On Green	0.05	0.87	0.79	0.00	0.04	0.04
Sat Flow, veh/h	1774	5055	7600	1583	3442	1583
Grp Volume(v), veh/h	66	721	3139	0	37	39
Grp Sat Flow(s),veh/h/ln	1774	1631	1452	1583	1721	1583
Q Serve(g_s), s	4.3	2.6	19.0	0.0	1.2	2.9
Cycle Q Clear(g_c), s	4.3	2.6	19.0	0.0	1.2	2.9
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	86	4279	5726	1249	135	62
V/C Ratio(X)	0.77	0.17	0.55	0.00	0.27	0.63
Avail Cap(c_a), veh/h	332	4279	5726	1249	720	331
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.97	0.97	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	55.5	1.1	4.6	0.0	55.1	55.8
Incr Delay (d2), s/veh	13.1	0.1	0.4	0.0	1.1	10.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	1.2	7.6	0.0	0.6	2.7
LnGrp Delay(d),s/veh	68.6	1.2	5.0	0.0	56.2	65.9
LnGrp LOS	E	A	A		E	E
Approach Vol, veh/h		787	3139		76	
Approach Delay, s/veh		6.8	5.0		61.1	
Approach LOS		A	A		E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		108.5		9.5	10.1	98.4		
Change Period (Y+Rc), s		5.3		4.9	4.4	5.3		
Max Green Setting (Gmax), s		83.1		24.7	22.1	56.6		
Max Q Clear Time (g_c+I1), s		4.6		4.9	6.3	21.0		
Green Ext Time (p_c), s		14.5		0.2	0.1	35.5		

Intersection Summary			
HCM 2010 Ctrl Delay			6.4
HCM 2010 LOS			A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰↰	↱
Traffic Volume (veh/h)	113	4	4	42	70	192
Future Volume (veh/h)	113	4	4	42	70	192
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	143	5	5	0	88	0
Adj No. of Lanes	1	1	1	1	2	1
Peak Hour Factor	0.79	0.79	0.77	0.77	0.80	0.80
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	0	0	21	18	303	139
Arrive On Green	0.00	0.00	0.01	0.00	0.09	0.00
Sat Flow, veh/h		0	908	1583	3442	1583
Grp Volume(v), veh/h		0.0	5	0	88	0
Grp Sat Flow(s),veh/h/ln			1863	1583	1721	1583
Q Serve(g_s), s			0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s			0.0	0.0	0.2	0.0
Prop In Lane				1.00	1.00	1.00
Lane Grp Cap(c), veh/h			21	18	303	139
V/C Ratio(X)			0.24	0.00	0.29	0.00
Avail Cap(c_a), veh/h			6332	5383	15600	7177
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	0.00
Uniform Delay (d), s/veh			4.4	0.0	3.8	0.0
Incr Delay (d2), s/veh			5.6	0.0	0.5	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			0.0	0.0	0.1	0.0
LnGrp Delay(d),s/veh			10.0	0.0	4.3	0.0
LnGrp LOS			A		A	
Approach Vol, veh/h			5		88	
Approach Delay, s/veh			10.0		4.3	
Approach LOS			A		A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4		6		
Phs Duration (G+Y+Rc), s				4.8		4.0		
Change Period (Y+Rc), s				4.0		4.0		
Max Green Setting (Gmax), s				40.0		30.0		
Max Q Clear Time (g_c+I1), s				2.2		2.0		
Green Ext Time (p_c), s				0.3		0.0		

Intersection Summary	
HCM 2010 Ctrl Delay	4.6
HCM 2010 LOS	A

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↑	↱	↰↰	↑↑↑↱		↰↰	↑	↱	↰	↰↑↱	
Traffic Volume (veh/h)	149	1420	98	324	1397	11	108	37	249	49	28	93
Future Volume (veh/h)	149	1420	98	324	1397	11	108	37	249	49	28	93
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		1.00	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1863	1863	1793	1900	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	169	1614	89	348	1502	11	133	46	0	53	30	91
Adj No. of Lanes	1	3	1	2	4	0	2	1	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.93	0.93	0.93	0.81	0.81	0.81	0.92	0.92	0.92
Percent Heavy Veh, %	2	6	2	2	6	6	2	2	2	2	2	2
Cap, veh/h	745	2810	1004	404	1676	12	207	112	95	146	154	119
Arrive On Green	0.42	0.57	0.57	0.12	0.26	0.26	0.06	0.06	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1774	4893	1582	3442	6364	47	3442	1863	1583	1774	1863	1447
Grp Volume(v), veh/h	169	1614	89	348	1092	421	133	46	0	53	30	91
Grp Sat Flow(s),veh/h/ln	1774	1631	1582	1721	1542	1784	1721	1863	1583	1774	1863	1447
Q Serve(g_s), s	7.3	25.1	2.6	11.9	27.3	27.3	4.5	2.9	0.0	3.4	1.8	7.4
Cycle Q Clear(g_c), s	7.3	25.1	2.6	11.9	27.3	27.3	4.5	2.9	0.0	3.4	1.8	7.4
Prop In Lane	1.00		1.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	745	2810	1004	404	1218	470	207	112	95	146	154	119
V/C Ratio(X)	0.23	0.57	0.09	0.86	0.90	0.90	0.64	0.41	0.00	0.36	0.20	0.76
Avail Cap(c_a), veh/h	745	2810	1004	462	1218	470	1064	576	490	282	296	230
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.92	0.92	0.92	0.94	0.94	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.3	16.2	8.5	52.0	42.6	42.6	55.1	54.4	0.0	52.1	51.3	53.9
Incr Delay (d2), s/veh	0.1	0.9	0.2	11.8	9.8	21.1	3.1	2.3	0.0	1.5	0.6	9.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.6	11.4	1.4	6.3	12.7	16.2	2.3	1.5	0.0	1.7	1.0	3.3
LnGrp Delay(d),s/veh	22.4	17.1	8.7	63.8	52.4	63.7	58.3	56.6	0.0	53.6	52.0	63.5
LnGrp LOS	C	B	A	E	D	E	E	E		D	D	E
Approach Vol, veh/h		1872			1861			179			174	
Approach Delay, s/veh		17.2			57.1			57.9			58.5	
Approach LOS		B			E			E			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	18.5	74.6		12.1	56.1	37.0		14.8
Change Period (Y+Rc), s	4.4	5.7		4.9	5.7	* 5.4		4.9
Max Green Setting (Gmax), s	16.1	27.8		37.1	12.6	* 32		19.1
Max Q Clear Time (g_c+I1), s	13.9	27.1		6.5	9.3	29.3		9.4
Green Ext Time (p_c), s	0.2	0.6		0.7	0.1	2.1		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	38.9
HCM 2010 LOS	D

Notes

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑↑↑	↱	↰↰	↱
Traffic Volume (veh/h)	51	1679	2070	25	89	23
Future Volume (veh/h)	51	1679	2070	25	89	23
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1792	1792	1863	1863	1863
Adj Flow Rate, veh/h	56	1845	2134	0	131	28
Adj No. of Lanes	1	3	5	1	2	1
Peak Hour Factor	0.91	0.91	0.97	0.97	0.68	0.68
Percent Heavy Veh, %	2	6	6	2	2	2
Cap, veh/h	73	4195	5660	1235	198	91
Arrive On Green	0.05	1.00	0.78	0.00	0.06	0.06
Sat Flow, veh/h	1774	5055	7600	1583	3442	1583
Grp Volume(v), veh/h	56	1845	2134	0	131	28
Grp Sat Flow(s),veh/h/ln	1774	1631	1452	1583	1721	1583
Q Serve(g_s), s	3.7	0.0	11.0	0.0	4.5	2.0
Cycle Q Clear(g_c), s	3.7	0.0	11.0	0.0	4.5	2.0
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	73	4195	5660	1235	198	91
V/C Ratio(X)	0.77	0.44	0.38	0.00	0.66	0.31
Avail Cap(c_a), veh/h	312	4195	5660	1235	823	379
HCM Platoon Ratio	1.33	1.33	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.72	0.72	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	56.2	0.0	4.1	0.0	55.4	54.2
Incr Delay (d2), s/veh	11.6	0.2	0.2	0.0	3.7	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.1	4.4	0.0	2.2	1.9
LnGrp Delay(d),s/veh	67.8	0.2	4.3	0.0	59.1	56.1
LnGrp LOS	E	A	A		E	E
Approach Vol, veh/h		1901	2134		159	
Approach Delay, s/veh		2.2	4.3		58.6	
Approach LOS		A	A		E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		108.2		11.8	9.3	98.9		
Change Period (Y+Rc), s		5.3		4.9	4.4	5.3		
Max Green Setting (Gmax), s		81.1		28.7	21.1	55.6		
Max Q Clear Time (g_c+I1), s		2.0		6.5	5.7	13.0		
Green Ext Time (p_c), s		58.8		0.5	0.1	39.1		

Intersection Summary	
HCM 2010 Ctrl Delay	5.4
HCM 2010 LOS	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰↰	↱
Traffic Volume (veh/h)	225	22	16	122	111	191
Future Volume (veh/h)	225	22	16	122	111	191
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	281	28	17	0	128	0
Adj No. of Lanes	1	1	1	1	2	1
Peak Hour Factor	0.80	0.80	0.93	0.93	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	0	0	34	29	417	192
Arrive On Green	0.00	0.00	0.02	0.00	0.12	0.00
Sat Flow, veh/h		0	1863	1583	3442	1583
Grp Volume(v), veh/h		0.0	17	0	128	0
Grp Sat Flow(s),veh/h/ln			1863	1583	1721	1583
Q Serve(g_s), s			0.1	0.0	0.3	0.0
Cycle Q Clear(g_c), s			0.1	0.0	0.3	0.0
Prop In Lane				1.00	1.00	1.00
Lane Grp Cap(c), veh/h			34	29	417	192
V/C Ratio(X)			0.49	0.00	0.31	0.00
Avail Cap(c_a), veh/h			6010	5109	14806	6812
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	0.00
Uniform Delay (d), s/veh			4.5	0.0	3.7	0.0
Incr Delay (d2), s/veh			10.5	0.0	0.4	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			0.1	0.0	0.2	0.0
LnGrp Delay(d),s/veh			15.1	0.0	4.1	0.0
LnGrp LOS			B		A	
Approach Vol, veh/h			17		128	
Approach Delay, s/veh			15.1		4.1	
Approach LOS			B		A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4		6		
Phs Duration (G+Y+Rc), s				5.1		4.2		
Change Period (Y+Rc), s				4.0		4.0		
Max Green Setting (Gmax), s				40.0		30.0		
Max Q Clear Time (g_c+I1), s				2.3		2.1		
Green Ext Time (p_c), s				0.4		0.0		

Intersection Summary	
HCM 2010 Ctrl Delay	5.4
HCM 2010 LOS	A