

MEMO

From: Bud Brown, President, ECO-ANALYSTS, INC.

To: Peter Tischbein, Project Manager, U.S. Army Corps of Engineers

cc: Jay Clement, Project Manager, U.S. Army Corps of Engineers
Shawn Mahaney, Project Manager, U.S. Army Corps of Engineers
Audra Caler-Bell, Acting City Manager, City of Rockland
Matt Ripley, Harbormaster, City of Rockland

Date: August 9, 2016

RE: Grain Size Results and Discussion for the Rockland Fish Pier

Good Afternoon Pete,

As you, Jay, Shawn and I discussed, we have systematically sampled the east side of the Rockland Fish Pier to determine how much of the volumes there are sands. The City of Rockland had been dumping snow, along with road sand, salt, and other debris there for many years, a practice only recently ended. Those sands have accumulated to depths of as much as 16 feet at the upper (north) end of the area in question. We were unable to sample to that depth because the sand wouldn't remain in the corer so we are unsure if that depth is accurate. We did find that there was a refusal layer of marine clay at elevation -9 feet at the outer sites, indicating that the area had been dredged to that depth at some point in the past.

The attached Plan shows the seven (7) sites we sampled for Grain Size. Also attached is Table One from the Corps' website which defines sieve sizes and particle types. Our Table One summarizes the results. Individual site results with graphs are attached at the end. The percentage of fines is 1.5% or less at Sites One through Four, 8.3% and 12.8% at Sites Five and Six respectively, but is 50% at Site Seven, the outermost site.

Tables Two and Three are taken from the Sample Analysis Plan (SAP) Request and show volume calculations. Table Four Summarizes and Compares the Areas and Volumes on the two sides of the Pier. Note that the Suitability Determination we received incorrectly states that the compositing was based upon Grain Size results we had submitted. We never submitted any for this Project. We did submit Grain Size results for the SAP Request for the Biddeford Pool Yacht Club in the same time frame which may have caused some confusion.

Table Five provides a summary of how much of the entire project volumes would be sand versus fines so the more contaminated fines could be covered with sands as we discussed. I'm unsure of the cut-off amount of fines that would make the materials unsuitable as cover. I've tried to contact Norm but to no avail. If 8.3% fines is acceptable, then 20% of the material could serve as cover. If 12.8% is acceptable, then 29% of the material could serve as cover. Thanks for your consideration.

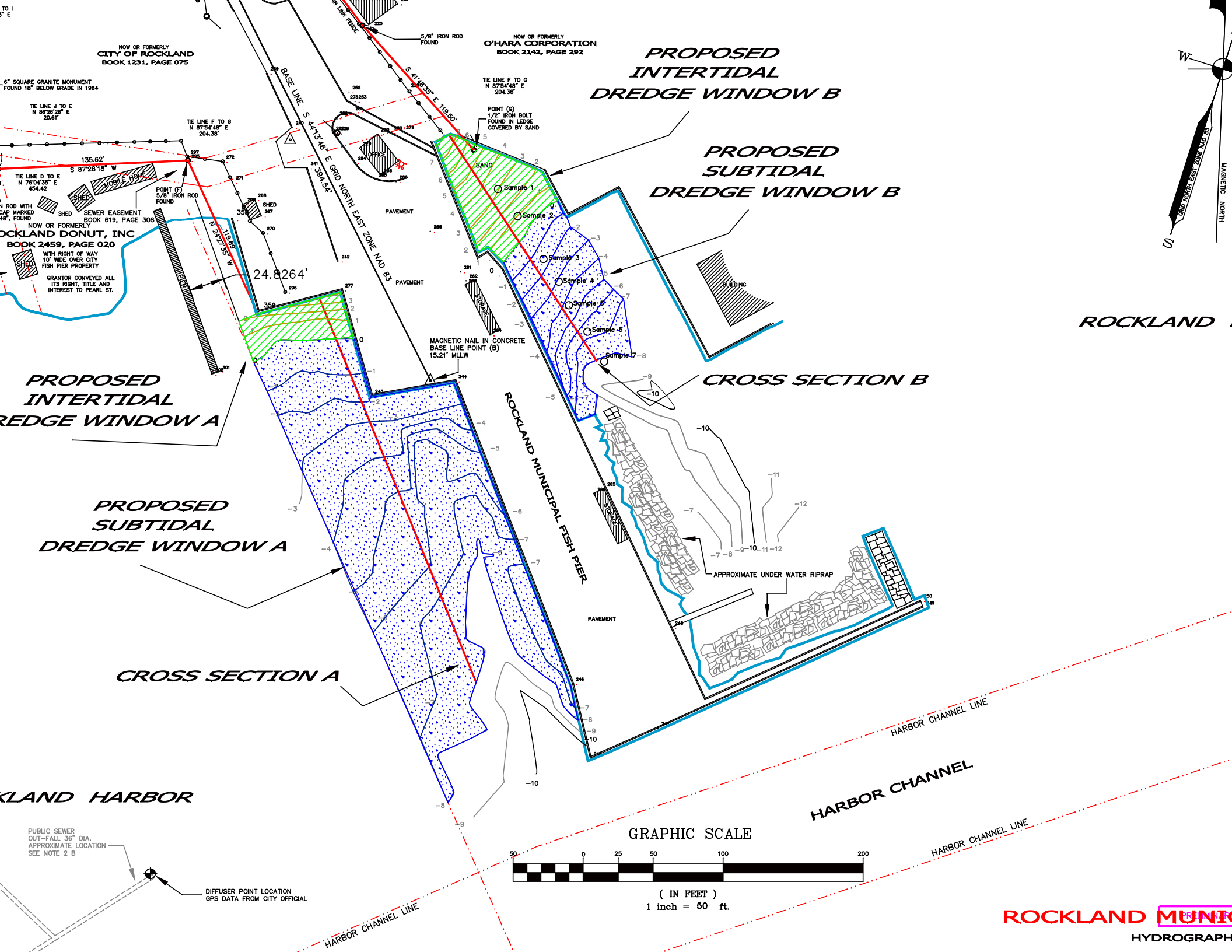


TABLE 1. Parameters used for the physical characterization of sediments

<u>Parameter</u>	<u>Method</u>	<u>Measure/Quantitation limit</u>
Grain Size Distribution	Plumb, 1981; ASTM, 1998a	
Gravel (> 4.75mm)		Retained on No. 4 Sieve
Coarse Sand (2.0 - 4.75mm)		Passing through No. 4 and retained on No. 10 Sieve
Medium Sand (0.425 - 2.0mm)		Passing through No. 10 and retained on No. 40 Sieve
Fine Sand (0.075 - 0.425mm)		Passing through No. 40 and retained on No. 200 Sieve
Silt (0.005 - 0.075mm)		As determined by Hydrometer, Pipette or Coulter Counter
Clay (< 0.005mm)		As determined by Hydrometer, Pipette or Coulter Counter
Percent Moisture	Plumb, 1981; APHA, 1995	1.0%
Total Organic Carbon	Plumb, 1981; EPA, 1992; PSEP, 1986	0.1 %

Table One. Rockland Fish Pier Grain Size Analysis

		----- U.S. Standard Sieve (in.) -----													
		3	2	1.5	1	3/4	1/2	3/8	#4	#10	#20	#40	#60	#100	#200
		----- Particle Size (mm) -----													
		76.2	50.8	37.5	25.4	19.1	12.7	9.5	4.76	2	0.84	0.42	0.25	0.149	0.074
		----- Gravel -----						Coarse Sand		Medium Sand		Fine Sand		Fines	
Site	Contour														
One	+3	100.0%	100.0%	100.0%	100.0%	100.0%	99.0%	98.5%	97.8%	96.8%	94.5%	70.1%	19.2%	4.8%	0.5%
Two	+1	100.0%	100.0%	100.0%	100.0%	100.0%	97.8%	96.4%	89.1%	75.4%	51.8%	26.5%	6.5%	2.6%	0.6%
Three	-1 to -2	100.0%	100.0%	100.0%	100.0%	100.0%	98.2%	97.3%	90.9%	78.5%	55.1%	37.8%	31.4%	13.4%	1.5%
Four	-3	100.0%	100.0%	100.0%	100.0%	100.0%	98.5%	98.5%	96.6%	92.3%	77.0%	34.6%	9.0%	2.3%	0.9%
Five	-4 to -5	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	97.3%	94.8%	84.5%	69.7%	56.7%	43.3%	25.8%	8.3%
Six	-6 to -7	100.0%	100.0%	100.0%	100.0%	100.0%	98.8%	97.3%	87.3%	72.5%	59.4%	48.3%	37.2%	25.2%	12.8%
Seven	-8 to -9	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.0%	98.5%	97.1%	95.0%	92.3%	88.5%	79.2%	50.0%
Median		100.0%	100.0%	100.0%	100.0%	100.0%	98.8%	97.3%	94.8%	84.5%	69.7%	48.3%	31.4%	13.4%	1.5%
Mean		100.0%	100.0%	100.0%	100.0%	100.0%	98.9%	97.8%	93.6%	85.3%	71.8%	52.3%	33.6%	21.9%	10.7%
Max		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.0%	98.5%	97.1%	95.0%	92.3%	88.5%	79.2%	50.0%
Min		100.0%	100.0%	100.0%	100.0%	100.0%	97.8%	96.4%	87.3%	72.5%	51.8%	26.5%	6.5%	2.3%	0.5%
S.D.		0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.9%	4.1%	9.5%	16.6%	21.2%	25.8%	25.2%	16.7%

Table Two Rockland Fish Pier Dredge Volume Calculations for East Side

Depth Contour (ft)	Area (sq. ft.)	Volume (cu. ft.) in Each Layer																Layer Volume		Cumulative Volume
		8 to 7	7 to 6	6 to 5	5 to 4	4 to 3	3 to 2	2 to 1	1 to 0	0 to -1	-1 to -2	-2 to -3	-3 to -4	-4 to -5	-5 to -6	-6 to -7	-7 to -8	(cu. ft.)	(cu. yds.)	(cu. yds.)
7 to 8	140	70																70	3	3
6 to 7	226	140	113															253	9	12
5 to 6	360	140	226	180														546	20	32
4 to 5	536	140	226	360	268													994	37	69
3 to 4	679	140	226	360	536	340												1,602	59	128
2 to 3	790	140	226	360	536	679	395											2,336	87	215
1 to 2	718	140	226	360	536	679	790	359										3,090	114	329
0 to 1	714	140	226	360	536	679	790	718	357									3,806	141	470
0 to -1	745	140	226	360	536	679	790	718	714	373								4,536	168	638
-1 to -2	794	140	226	360	536	679	790	718	714	745	397							5,305	196	835
-2 to -3	855	140	226	360	536	679	790	718	714	745	794	428						6,130	227	1,062
-3 to -4	964	140	226	360	536	679	790	718	714	745	794	855	482					7,039	261	1,322
-4 to -5	834	140	226	360	536	679	790	718	714	745	794	855	964	417				7,938	294	1,616
-5 to -6	754	140	226	360	536	679	790	718	714	745	794	855	964	834	377			8,732	323	1,940
-6 to -7	840	140	226	360	536	679	790	718	714	745	794	855	964	834	754	420		9,529	353	2,293
-7 to -8	1,162	140	226	360	536	679	790	718	714	745	794	855	964	834	754	840	581	10,530	390	2,683
overdig	11,111																	10,530	390	3,073

Table Three Rockland Fish Pier Dredge Volume Calculations for West Side

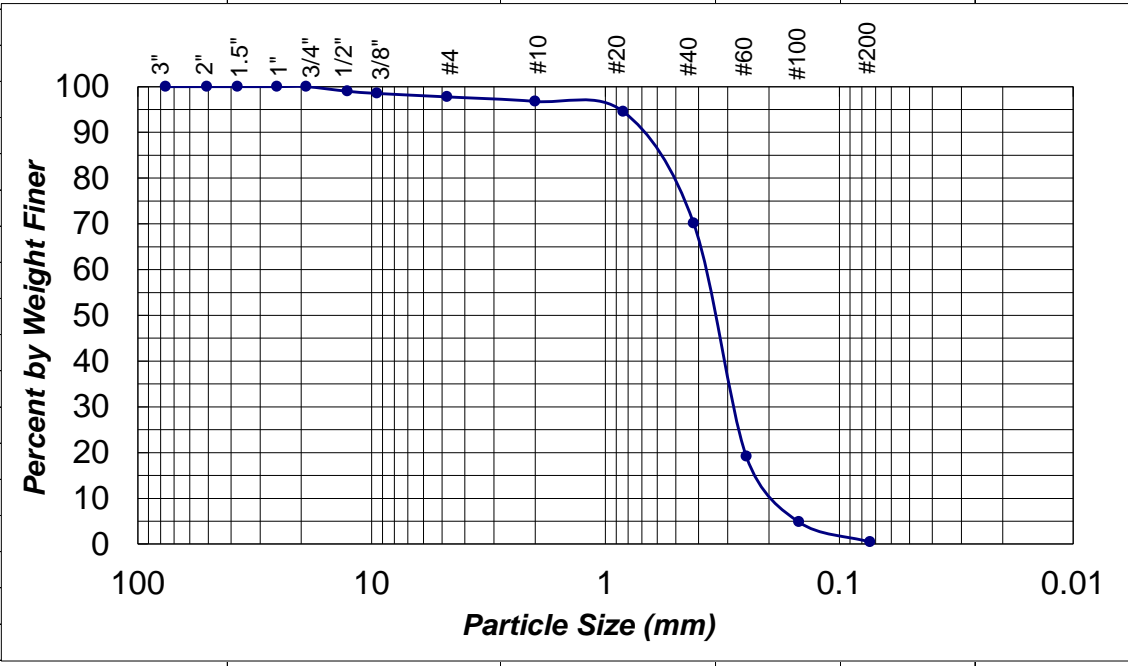
Depth Contour (ft)	Area (sq. ft.)	Volume (cu. ft.) in Each Layer																	Layer Volume		Cumulative Volume (cu. yds.)
		8 to 7	7 to 6	6 to 5	5 to 4	4 to 3	3 to 2	2 to 1	1 to 0	0 to -1	-1 to -2	-2 to -3	-3 to -4	-4 to -5	-5 to -6	-6 to -7	-7 to -8	(cu. ft.)	(cu. yds.)		
7 to 8	0	0																0	0	0	
6 to 7	0	0	0															0	0	0	
5 to 6	0	0	0	0														0	0	0	
4 to 5	0	0	0	0	0													0	0	0	
3 to 4	137	0	0	0	0	69												69	3	3	
2 to 3	288	0	0	0	0	137	144											281	10	13	
1 to 2	563	0	0	0	0	137	288	282										707	26	39	
0 to 1	1,075	0	0	0	0	137	288	563	538									1,526	57	96	
0 to -1	1,864	0	0	0	0	137	288	563	1,075	932								2,995	111	207	
-1 to -2	1,544	0	0	0	0	137	288	563	1,075	1,864	772							4,699	174	381	
-2 to -3	2,713	0	0	0	0	137	288	563	1,075	1,864	1,544	1,357						6,828	253	633	
-3 to -4	3,052	0	0	0	0	137	288	563	1,075	1,864	1,544	2,713	1,526					9,710	360	993	
-4 to -5	3,377	0	0	0	0	137	288	563	1,075	1,864	1,544	2,713	3,052	1,689				12,925	479	1,472	
-5 to -6	4,069	0	0	0	0	137	288	563	1,075	1,864	1,544	2,713	3,052	3,377	2,035			16,648	617	2,088	
-6 to -7	5,657	0	0	0	0	137	288	563	1,075	1,864	1,544	2,713	3,052	3,377	4,069	2,829		21,511	797	2,885	
-7 to -8	6,977	0	0	0	0	137	288	563	1,075	1,864	1,544	2,713	3,052	3,377	4,069	5,657	3,489	27,828	1,031	3,916	
overdig																		27,828	1,031	4,946	

Table Four Rockland Fish Pier East and West Side Dredge Volume Comparisons

Depth Contour (ft)	East Side				West Side				Total Cumulative Volume (cu. yds.)	Percent Total Cumulative Volume East Side	Percent Total Cumulative Volume West Side
	Area (sq. ft.)	Layer Volume (cu. ft.)	Cumulative Volume (cu. yds.)		Area (sq. ft.)	Layer Volume (cu. ft.)	Cumulative Volume (cu. yds.)				
		(cu. yds.)				(cu. yds.)					
7 to 8	140	70	3	3	0	0	0	0	3	100%	0%
6 to 7	226	253	9	12	0	0	0	0	12	100%	0%
5 to 6	360	546	20	32	0	0	0	0	32	100%	0%
4 to 5	536	994	37	69	0	0	0	0	69	100%	0%
3 to 4	679	1,602	59	128	137	69	3	3	131	98%	2%
2 to 3	790	2,336	87	215	288	281	10	13	228	94%	6%
1 to 2	718	3,090	114	329	563	707	26	39	368	89%	11%
0 to 1	714	3,806	141	470	1,075	1,526	57	96	566	83%	17%
0 to -1	745	4,536	168	638	1,864	2,995	111	207	845	76%	24%
-1 to -2	794	5,305	196	835	1,544	4,699	174	381	1,215	69%	31%
-2 to -3	855	6,130	227	1,062	2,713	6,828	253	633	1,695	63%	37%
-3 to -4	964	7,039	261	1,322	3,052	9,710	360	993	2,316	57%	43%
-4 to -5	834	7,938	294	1,616	3,377	12,925	479	1,472	3,088	52%	48%
-5 to -6	754	8,732	323	1,940	4,069	16,648	617	2,088	4,028	48%	52%
-6 to -7	840	9,529	353	2,293	5,657	21,511	797	2,885	5,178	44%	56%
-7 to -8	1,162	10,530	390	2,683	6,977	27,828	1,031	3,916	6,598	41%	59%
overdig	11,111	10,530	390	3,073	31,316	27,828	1,031	4,946	8,019	38%	62%

Grain Size Analysis - ASTM D421

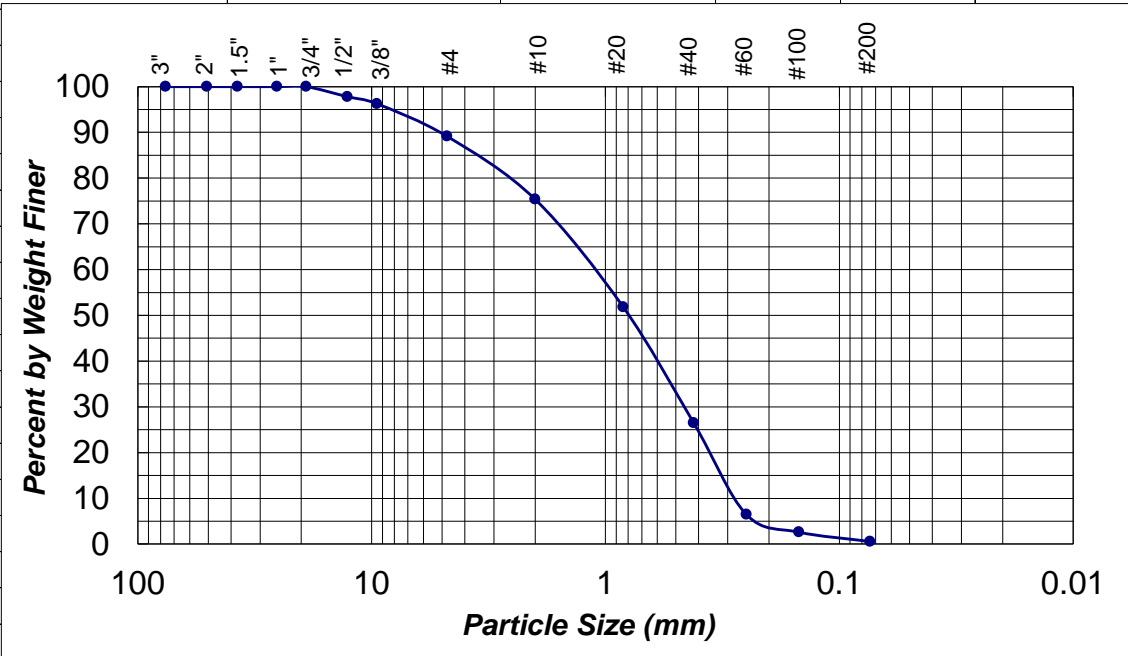
PROJECT NAME: EcoAnalysts		PROJECT No: 97008			
Rockland Fish Pier		DATE: 25-Jul-16			
SAMPLE SOURCE: Sediments		SAMPLE No: 1			
SAMPLE DESCRIP: Brown medium to fine SAND					
with shells					
DATA					
			SPECIFICATION		
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u>	<u>Max</u>	<u>P/F</u>
3	76.2	100.0			
2	50.8	100.0			
1.5	37.5	100.0			
1	25.4	100.0			
3/4	19.1	100.0			
1/2	12.7	99.0			
3/8	9.5	98.5			
#4	4.76	97.8			
#10	2.0	96.8			
#20	0.84	94.5			
#40	0.42	70.1			
#60	0.25	19.2			
#100	0.149	4.8			
#200	0.074	0.5			



Water Content (%) =	13.3
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Grain Size Analysis - ASTM D421

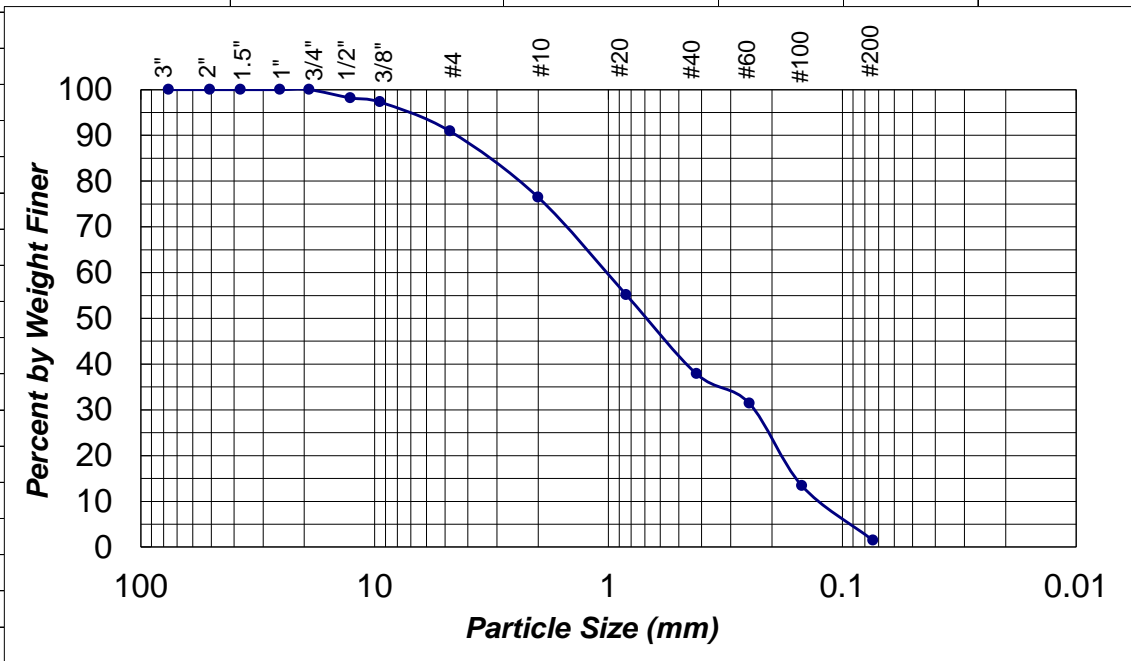
PROJECT NAME: EcoAnalysts		PROJECT No: 97008	
Rockland Fish Pier		DATE: 25-Jul-16	
SAMPLE SOURCE: Sediments		SAMPLE No: 2	
SAMPLE DESCRIP: Brown coarse to fine SAND, little gravel with shells			
<u>DATA</u>			
		SPECIFICATION	
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u> <u>Max</u> <u>P/F</u>
3	76.2	100.0	
2	50.8	100.0	
1.5	37.5	100.0	
1	25.4	100.0	
3/4	19.1	100.0	
1/2	12.7	97.8	
3/8	9.5	96.3	
#4	4.76	89.1	
#10	2.0	75.4	
#20	0.84	51.8	
#40	0.42	26.5	
#60	0.25	6.5	
#100	0.149	2.6	
#200	0.074	0.6	



Water Content (%) = 19.1

Grain Size Analysis - ASTM D421

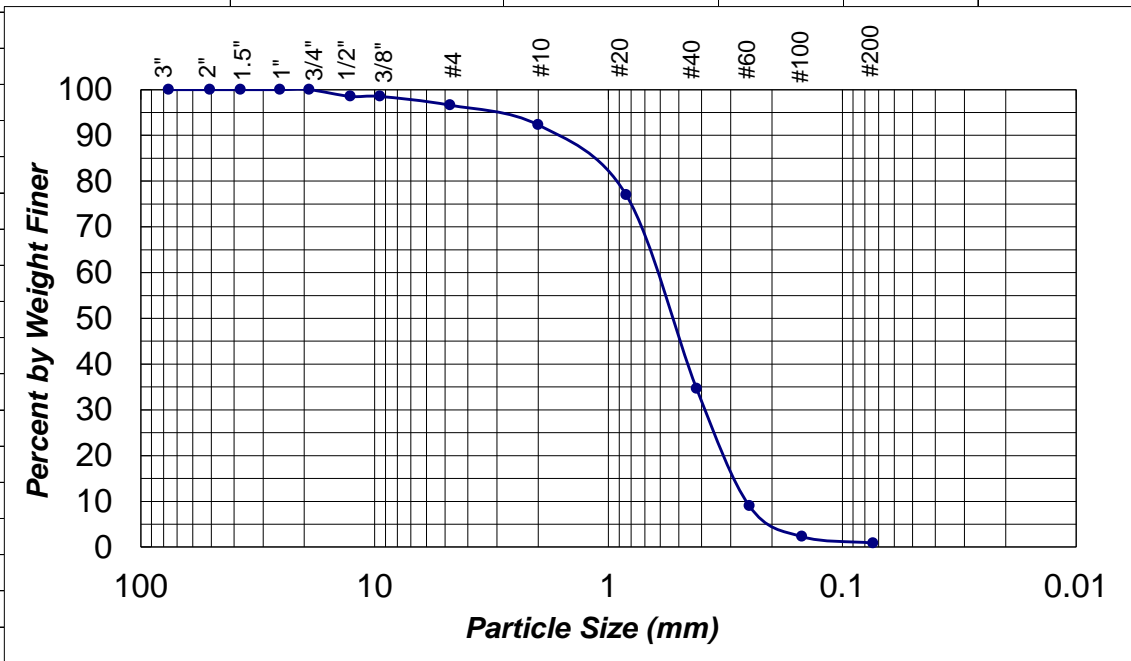
PROJECT NAME: EcoAnalysts		PROJECT No: 97008	
Rockland Fish Pier		DATE: 25-Jul-16	
SAMPLE SOURCE: Sediments		SAMPLE No: 3	
SAMPLE DESCRIP: Dk Brown coarse to fine SAND, trace gravel with shells and organics			
<u>DATA</u>			
		SPECIFICATION	
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u> <u>Max</u> <u>P/F</u>
3	76.2	100.0	
2	50.8	100.0	
1.5	37.5	100.0	
1	25.4	100.0	
3/4	19.1	100.0	
1/2	12.7	98.2	
3/8	9.5	97.3	
#4	4.76	90.9	
#10	2.0	76.5	
#20	0.84	55.1	
#40	0.42	37.8	
#60	0.25	31.4	
#100	0.149	13.4	
#200	0.074	1.5	



Water Content (%) = 19.1

Grain Size Analysis - ASTM D421

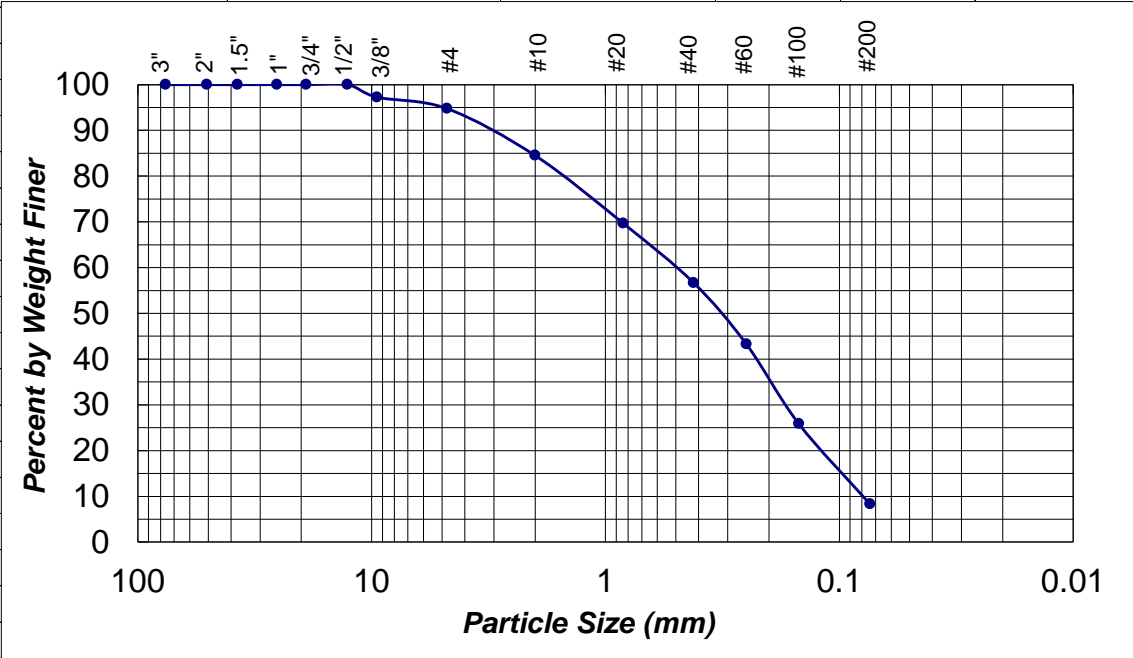
PROJECT NAME: EcoAnalysts		PROJECT No: 97008			
Rockland Fish Pier		DATE: 25-Jul-16			
SAMPLE SOURCE: Sediments		SAMPLE No: 4			
SAMPLE DESCRIP: Dk Brown medium to fine SAND with shells and organics					
<u>DATA</u>					
			SPECIFICATION		
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u>	<u>Max</u>	<u>P / F</u>
3	76.2	100.0			
2	50.8	100.0			
1.5	37.5	100.0			
1	25.4	100.0			
3/4	19.1	100.0			
1/2	12.7	98.5			
3/8	9.5	98.5			
#4	4.76	96.6			
#10	2.0	92.3			
#20	0.84	77.0			
#40	0.42	34.6			
#60	0.25	9.0			
#100	0.149	2.3			
#200	0.074	0.9			



Water Content (%) = 21.6

Grain Size Analysis - ASTM D421

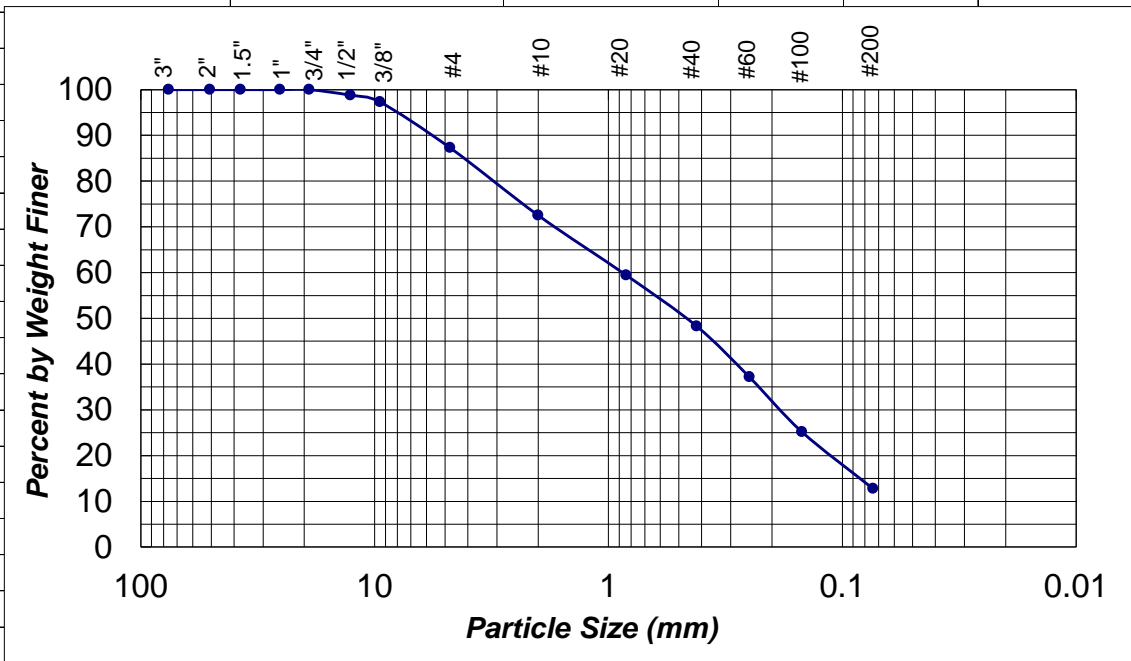
PROJECT NAME: <i>EcoAnalysts</i>		PROJECT No: 97008	
Rockland Fish Pier		DATE: 25-Jul-16	
SAMPLE SOURCE: <i>Sediments</i>		SAMPLE No: 5	
SAMPLE DESCRIP: <i>Dk Brown medium to fine SAND, li c-sa, tr gravel and silt with shells and glass</i>			
<u>DATA</u>			
		SPECIFICATION	
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u> <u>Max</u> <u>P/F</u>
3	76.2	100.0	
2	50.8	100.0	
1.5	37.5	100.0	
1	25.4	100.0	
3/4	19.1	100.0	
1/2	12.7	100.0	
3/8	9.5	97.3	
#4	4.76	94.8	
#10	2.0	84.5	
#20	0.84	69.7	
#40	0.42	56.7	
#60	0.25	43.3	
#100	0.149	25.8	
#200	0.074	8.3	



Water Content (%) =	24.8
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Grain Size Analysis - ASTM D421

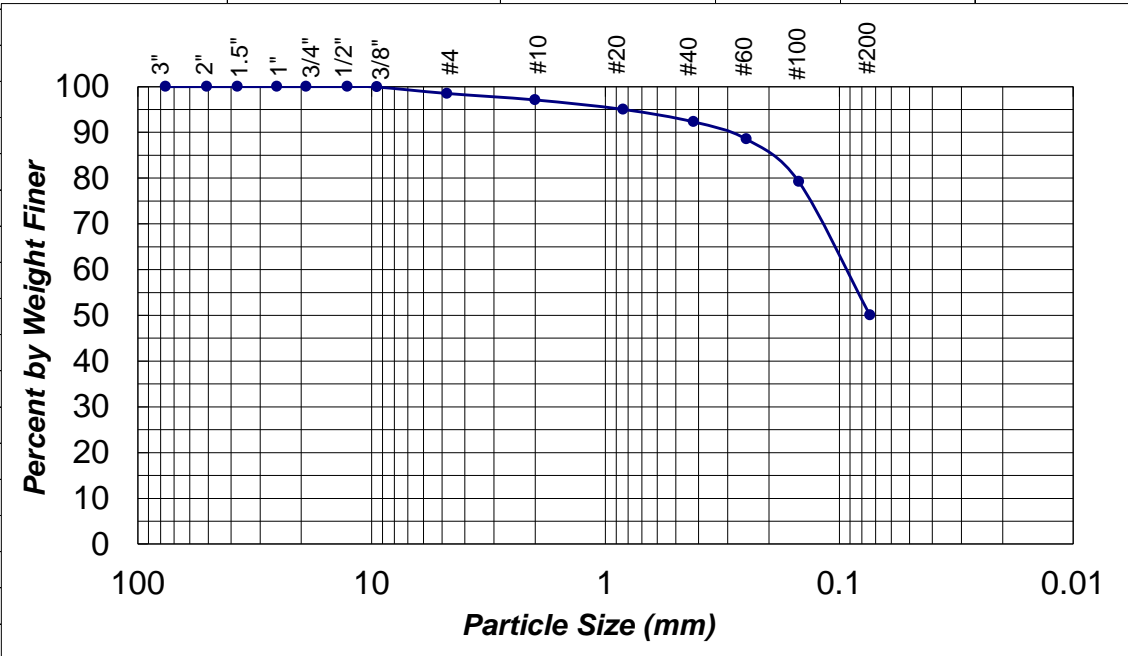
PROJECT NAME:	EcoAnalysts		PROJECT No:	97008	
	Rockland Fish Pier		DATE:	25-Jul-16	
SAMPLE SOURCE:	Sediments		SAMPLE No:	6	
SAMPLE DESCRIP:	Dk Brown coarse to fine SAND, li gravel and silt with shells and organics				
<u>DATA</u>					
			SPECIFICATION		
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u>	<u>Max</u>	<u>P/F</u>
3	76.2	100.0			
2	50.8	100.0			
1.5	37.5	100.0			
1	25.4	100.0			
3/4	19.1	100.0			
1/2	12.7	98.8			
3/8	9.5	97.3			
#4	4.76	87.3			
#10	2.0	72.5			
#20	0.84	59.4			
#40	0.42	48.3			
#60	0.25	37.2			
#100	0.149	25.2			
#200	0.074	12.8			



Water Content (%) = 29.0

Grain Size Analysis - ASTM D421

PROJECT NAME: EcoAnalysts		PROJECT No: 97008			
Rockland Fish Pier		DATE: 25-Jul-16			
SAMPLE SOURCE: Sediments		SAMPLE No: 7			
SAMPLE DESCRIP: Gray fine sandy SILT with shells and organics					
<u>DATA</u>					
			SPECIFICATION		
<u>U.S Std SIEVE (in.)</u>	<u>PARTICLE SIZE (mm)</u>	<u>% by WT. FINER</u>	<u>Min</u>	<u>Max</u>	<u>P/F</u>
3	76.2	100.0			
2	50.8	100.0			
1.5	37.5	100.0			
1	25.4	100.0			
3/4	19.1	100.0			
1/2	12.7	100.0			
3/8	9.5	99.9			
#4	4.76	98.5			
#10	2.0	97.1			
#20	0.84	95.0			
#40	0.42	92.3			
#60	0.25	88.5			
#100	0.149	79.2			
#200	0.074	50.0			



Water Content (%) = 47.4	
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