UPPER NEWPORT BAY
ECOSYSTEM RESTORATION PROJECT
ORANGE COUNTY, CALIFORNIA

GEOTECHNICAL APPENDIX

U.S. ARMY ENGINEER DISTRICT, LOS ANGELES
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1. INTRODUCTION.

1.1 Authorization.

This geotechnical report was prepared in support of the engineering design tasks for Upper Newport Bay Ecosystem Restoration Project located in Newport Beach, California. It is meant to be an integral part of the ongoing Design Document Report (DDR) during the preparation of the Plans and Specifications.

1.2 Scope.

This report incorporates and organizes previous and current geotechnical explorations, investigation and laboratory testing results, and engineering analyses. This information will be used to create cost estimates, identify potential disposal sites, identify beach re-nourishment compatibility for dredged sediments, evaluate disposal options to include compatibility with offshore disposal site LA-3, determine side slopes of dredge areas within the project area, and design an island creating new least tern habitat.

1.3 Purpose.

The purpose of this project is to dredge large portions of Upper Newport Bay reducing the dredge frequency to twenty-one (21) years. In addition, the project will be creating and/or maintaining wildlife habitat with the objective of maintaining a balance of open water, mud flats, and marsh areas. Other benefits will include features that control the deposition of sediments in the ecological reserve and the potential beneficial use of dredged and excavated sediments.

2. TOPOGRAPHY

Newport Bay is located in Orange County on the Southern California coast, approximately 65 km south of Los Angeles and 120 km north of San Diego. The bay is located at the southeastern terminus of the Los Angeles coastal plain and adjacent to the southern edge of the Inglewood-Newport Uplift.

From the harbor entrance at the rocky headland at Corona del Mar, Newport Bay extends in a north-northeast direction about 8 km inland. The bay is a coastal estuary rimmed by steep bluffs up to 30 meters high and is divided into two portions. The Lower Bay parallels the coastline and is separated from the ocean by a sand spit called Balboa Peninsula. The Upper Bay lies north of the Highway 1 (Pacific Coast Highway) Bridge and extends 5.5 km inland. The Upper Bay is bordered to the west by Costa Mesa, a flat topped, uplifted landform underlain by bedrock. To the north lies the Tustin Plain, an alluvial floodplain composed of sediments derived from the surrounding San Joaquin and Santiago Hills, and to the east lie the San Joaquin Hills.

The perceptible bulge in the lower bay's sand spit named Balboa Beach is a natural irregularity due to the presence of a submarine canyon, which is the offshore extension of the ancestral Santa Ana River. The submarine canyon present offshore, called Newport Submarine Canyon, reduces the wave heights over the canyon and adjacent surf. This favors sand deposition being transported along the beach by southerly longshore currents.

Newport Bay receives terrigenous sediment primarily from two tributaries, San Diego Creek and the Santa Ana-Delhi Flood Control Channel. The Newport Bay watershed encompasses approximately 300 square km of land with uses including agricultural, residential, urban, and open space. San Diego Creek is by far the largest contributor, draining 270 square km of the surrounding foothills and much of the Tustin Plain, and delivering 94% of the sediment carried annually to the Upper Bay. The Santa Ana-Delhi Channel subwatershed drains approximately 30 square km. The total average annual volume of sediment being carried into the bay is estimated to be 125,000 m^3/year, based on the record spanning the 1972-1996 period.

3. GEOLOGY

3.1 Regional Geology

The project is located between the San Joaquin Hills and Newport Mesa within the southern central portion of the Los Angeles Basin. The region is tectonically active and complex. This part of the Los Angeles Basin is in the Peninsular Range Province near where it transitions into the Transverse Ranges to the north. The Tansverse Ranges consist of a series of east-west trending ridges and valleys that truncate the prevailing north-northwest trending Coastal and Peninsular Ranges. The Los Angeles Basin is underlain by Cretaceous to Quaternary sedimentary marine and alluvial sediments up to 15,000 feet thick. Below the thick accumulation of sediments is the Mesozoic Eastern (metamorphic) Los Angeles Basement Complex.

3.2 Site Geology

Newport Bay is located at the southeastern end of the Los Angeles coastal plain, and crosses the southeastern edge of the Inglewood-Newport Uplift. The cliffs surrounding Upper Newport Bay are composed of Pliocene and Miocene sedimentary rocks. The southern part of the bay has outcrops of diatomaceous Miocene Monterey shale in the adjacent bluffs. The north, the bluff sediments transition in to the silty to sandy Capistrano Formation rocks and Unnamed Sandstone Unit. The Upper portion of the Newport Mesa and the San Joaquin Hills adjacent to the bay has various thicknesses of older alluvial deposits. The sediments in the Newport Back Bay consist generally of silts and clays with some sands.

3.3 Seismic Setting

The site is located within the seismically active area of southern California. The Intersection of the northwest trending San Andreas Fault System and east-west trending Transverse Ranges Fault system dominate the seismicity of southern California. The project site has the potential to experience strong ground shaking from local and regional faults. Active faults near Upper Newport Bay include Newport-Inglewood, San

Andreas, San Jacinto, and Whittier-Elsinore (Blake 2000). The closest active fault to the site is the Newport-Inglewood Fault (main branch) located about 4 km or greater offshore from the site. The epicenter of the Magnitude 6.3, 1933 Long Beach earthquake was centered on the offshore section of the Newport-Inglewood Fault near the City of Newport Beach. The maximum credible earthquake using deterministic calculations for the Newport-Inglewood Fault has a magnitude of 6.9.

Utilizing data from the U.S. Geological Survey at the National Seismic Hazard web site (http://eqint.cr.usgs.gov/eq/html/zipcode.html), the site probabilistic data is presented in a Table below.

Ground motion hazard values, expressed as a percent of the acceleration of gravity, (%g), are presented in the table. Peak Ground Acceleration, (PGA) is shown as 0.2 second period spectral acceleration, (SA), 0.3 second period (SA), and 1.0 second period (SA) for 10%, 5%, and 2% probability of exceedance, (PE), in 50 years. These ground motion values are calculated for 'firm rock' sites, which correspond to a shear-wave velocity of 760 m/sec. in the top 30m. Different soil sites may amplify or de-amplify these values

Ground Motion Hazard Values

	10%PE in 50 yr	**5%PE in 50 yr**	**2%PE in 50 yr**
PGA	39.16	57.63	84.75
0.2 sec SA	101.11	127.43	185.64
0.3 sec SA	93.75	123.80	178.74
1.0 sec SA	32.70	47.84	71.95

The San Andreas Fault is located about 80 km northeast at its nearest point to Upper Newport Bay. The maximum credible earthquake for the San Andreas Fault (Southern) is 7.4. The closest portion of the San Jacinto Fault is located about 70 km northeast of Upper Newport Bay. The maximum credible earthquake for the San Jacinto Fault is 6.7. The closest portion of Whittier-Elsinore Fault is located about 29 km north of

Upper Newport Bay. The maximum credible earthquake for the Whittier-Elsinore Fault is 6.8.

Other faults not considered active include the Pelican Hill Fault, which crosses the northern portion of the back bay of Newport Bay. The Shady Canyon Fault, which is also not considered active, is about a kilometer to the north of the Pelican Hill Fault.

3.4 Geologic Hazards

3.4.1 Ground Surface Rupture

The Newport-Inglewood Fault is interpreted as having the potential for generating the highest onsite ground accelerations at the project location. A portion of the Newport-Inglewood fault zone crosses the site or projects into Upper Newport Bay in the geologic literature reviewed. The Newport-Inglewood Fault Zone is primarily a strike strip fault and displacement has been mapped to the north, near the surface in the Newport Mesa area. In Upper Newport Bay, the potential of ground surface fault rupture is possible but unlikely at the site.

3.4.2 Secondary Seismic Effects

Secondary seismic effects for any site include liquefaction and associated ground settlement, slope instability, tsunami and seiches, and ground lurching.

Liquefaction involves a sudden loss in strength of a saturated, cohesionless soil (predominantly sand) caused by cyclic loading such as an earthquake. This phenomenon results in elevated pore-water pressures that temporarily transform the soil into a fluid mass resulting in vertical settlement and could include lateral spreading. Typically, liquefaction occurs in areas where groundwater is less than 50 feet from the surface and where the soils are comprised of predominantly poorly-consolidated sands. Since material within the areas to be dredged consists of saturated, unconsolidated silts, sands, and silty sands, there is a potential for liquefaction of this material within Upper Newport Bay.

The topography within the project site is essentially flat. The surrounding bluffs may have some slope failures during a large earthquake in the area of the Newport Bay. Lurching may also develop along the edges of bluffs due to focusing of seismic energy at the bluff edge.

All low-lying areas along California's coast are subject to potentially dangerous tsunamis. Tsunamis are long-period waves generated primarily from distant and local submarine earthquakes, landslides, or volcanic eruptions. Heights of the 100- and 500-yr tsunami have been predicted at Newport Harbor entrance to be on the order of 1.2 meters and 1.8 meters, respectively (Ziony, 1985). Despite being at sea level and connected to the open sea, the tsunami hazard for Upper Newport Bay is relatively low due to the distance from the open sea through Newport Harbor Channel and Lower Newport Bay.

Due to the relatively small surface area of Upper Newport Bay, the potential hazard from seiches is not considered likely (City of Newport Beach, 1975).

Ground lurching usually forms during seismic events along cliffs, ridges, stream banks and/or along the ridge of artificial embankments. The general topography and soil conditions in the area indicate a low risk from ground lurching.

4. SAMPLING METHODS

All sediment collection, handling, and preservation techniques with the exception of the 1995 sampling event followed the procedures outlined in the Ocean Testing Manual (USEP/USACE 1991). The sediments were logged according to the Unified Soil Classification System (USCS) and in adherence with ASTM D-2487, Unified Soil Classification System (USCS) and in adherence to ASTM D-2487, "Standard Practice for Description and Identification of Soils (Visual Manual Procedure)".

4.1.1 Vibratory Core Collection Procedures.

A vibratory corer sampler consists of a core barrel and a vibratory driving mechanism mounted on a four-legged tour guide and platform. The vibratory core assembly is lowered to the mud line below the water by a small deck-mounted crane system. After being positioned on the bottom, flexible hoses supply compressed air from the barge to the vibratory unit. An oscillating hammer (vibrator) drives the core barrel into the materials below the mud line. After the core barrel has been driven to the required penetration depth, the sample is retracted from the bottom and returned to the deck of the barge. The core barrel has a catcher at the bottom to prevent sediment loss during removal. A removable plastic corebarrel containing the sediment is removed from the sampling device after extracting from the water. The vibratory core tube is laid on the barge deck for observation and the ends are capped for sample preservation until the sample is extruded.

4.1.2 Vibratory Core Logging Procedures.

Once collected, all sediment samples were brought aboard the barge and logged as time permitted. The vibratory cores were measured, photographed, and logged before being packaged for shipment to a laboratory for physical analysis. Once logged, the sediment was placed into plastic bags and sent to the Los Angeles District soils lab in El Monte for physical testing.

4.1.3 Diver Core Collection Procedures.

The diver core exploration was conducted utilizing Navy (SCUBA) contract divers. Sediment samples were collected using a 10-foot (3 meter) long, 1-1/4 inch (3.2 cm) diameter, and clear lexan sampling tube. The tubes were driven by hand or with the aid of a 10-pound slide hammer attached to the top of the tube. The divers also twisted and turned the tube in conjunction with hammering. In addition to the tube sampling, the divers made visual observation of the seafloor in the vicinity of the sampling location.

The standard operating procedure for diver core collection is as follows: Divers were transported by boat (a 25 foot/7.6 m Boston Whaler) to the pre-mapped sediment sampling locations within the proposed project area. The locations were located with an onboard DGPS (differential global positioning system) and a buoy was dropped to mark the final borehole location. The DGPS aboard the boat was calibrated twice each day to the vessel tie-up locations. The vessel tie-up location was a slip at the Newport Dunes Marina.

The dive sampling was initiated once the dive boat moved to a buoy location. Upon arriving at the buoy location, divers would submerge into the water and follow the buoy line down to the sampling point at the bottom of the bay floor (the mud line).

Once the divers reached the mud line, they would immediately begin to drive and/or twist a lexan sampling tube into the bottom while the sediment sample was simultaneously suctioned up into the tube via a piston and valve rod attached inside the tube. Once the required depth or refusal was reached, the tube was then pulled from the hole and immediately capped and brought to the surface. After reaching the surface, the tube was placed in the vessel, where it was stored in a vertical position throughout transport.

Refusal occurred when the tube could no longer be advanced to its fill length of 3 meters. Refusal most often is due to a dense sediment interval such as stiff clay, compacted sand, or gravel layer.

4.1.4 Diver Core Logging Procedures.

Once collected, all sediment samples are taken back to the dock for logging. The diver cores are then measured, photographed, and logged. Once logged, the sediment is placed into plastic bags to be sent to the Los Angeles District soils lab for physical testing.

4.1.5 Beach Profile Collection Procedures.

Beach profile collection procedures are involve the collection of sediment by grab samples. The samples are then placed in a plastic bag for storage, and if sampling occurred under water, the samples are then brought to the surface. The beach profile samples are collected along transects perpendicular to the beach. Samples are collected at depths of +4, +2, 0, -2, -4, -6, -8, and –10 m MLLW.

4.1.6 Hollow Stem Auger

Hollow stem augers are used by a power drill rig to advance a borehole and take undisturbed samples through the center of the auger column, which acts as casing during drilling. A center plug used during the drilling process is removed and conventional drill samplers are run to the bottom of the hole when a sample is desired. Hollow stem sampling was utilized at only the 23rd Street location.

4.1.7 Hand Auger Procedures

A hand held auger consists of an auger blade that is threaded to a pipe with a cross-arm attached to the other end. The diameter of the hand auger blade used on this project was 102 mm. The hand auger method was generally used in land areas inaccessible to a truck or track mounted drill rig. Hand auger samples were obtained at 23rd Street, Bullnose West, Shellmaker Island, Main Dike, and Least Tern Island.

5. GEOTECHNICAL EXPLORATIONS.

Geotechnical explorations in support of dredging and habitat enhancement/restoration were conducted in the Upper Bay during 1995 (TOXSCAN, 1995), November 2000 and March 2001, February and March 2002, and October and November 2003. These investigations compared existing sediments within Upper Newport Bay to sediments located at the LA-3 offshore disposal area as well as the proposed nearshore/beach disposal location at Newport Beach.

5.1 1995 Upper Newport Bay Investigations.

In 1995 UNB was sampled utilizing a vibratory corer and grab sampling. Twelve separate locations were sampled. Six samples from six locations representing the access channel were taken from the Pacific Coast Highway Bridge to the Unit II Basin. These six samples were composited into one sample and sent to a lab for physical, chemical, and bioassay analysis.

The remaining 12 samples were collected from 6 different locations (2 from each location) within the Unit I/III Basin and the channel between Unit I/III and Unit II Basins. Vibratory corer obtained samples were divided into a top portion and a bottom portion for testing and analysis.

The top portion is from –0.8m MLLW to –3.0 meter MLLW and the bottom portion from –3.0 m MLLW to –5.1 m MLLW. All samples from the top portion were composited together and all samples from the bottom portion were composited together for a separate sample. Once collected, the samples were sent to a lab for physical, chemical, and bioassay analysis. Grain size analysis results are shown in Table 1.

5.2 1995 LA-3 Disposal Site Sampling.

Representative samples were taken from the LA-3 Disposal site as reported in TOXSCAN 1995. Table 2 shows the physical analysis results for LA-3 sediments taken in May 1995. Bioassay tests were also performed on samples taken from LA-3.

5.3 February 2002 Investigations

The February explorations consisted of 49 diver cores taken at 48 separate locations. The diver core-sampling objective was to obtain continuous samples throughout the bay. Diver core depth recoveries ranged from 0.4 to 2.6 meters. The purpose of this investigation was to study geologic conditions, obtain subsurface information, and determine the physical characteristics of the sediments. Physical results can be seen in table 3.

Physical analysis was performed on all samples to gather grain size distribution, density information, and other physical characteristics. For more information see "Geotechnical Site Characterization Study Upper Newport Bay, Newport Beach, California," prepared by Group Delta Consultants, Inc.

5.4 March 2002 Investigations

A total of 27 locations were sampled. The 27 locations were then separated into areas. The areas and hole locations in each area are designated Unit II Basin (A-1, A-2, A-3, A-5, and A-6) Unit I/III Basin (B-1, B-3, B-5, B-7, and B-8), channel between Unit I/III and Unit II Basins (D-48, D-52, and D-56), channel between Unit II Basin and Lower Bay (PCH Bridge) (D-6, D-16, D-24, D-32, and D-38), Tern Island channel (HD-2 and HD-3), New Island east channel (N-1and N-3), Middle Island West channel (M-1 and M-3), Shellmaker Island east channel (S-2 and S-4), Shellmaker Island “dendritic” channel (S-6 and S-7), Santa Ana-Delhi channel (SA-1 and SA-3), and LA-3 Reference site. Samples from each boring location were composited into one sample for testing. Two areas were split into an upper and lower set of samples and each set of samples were analyzed. Vibratory cores were collected utilizing a 102 mm outside diameter core barrel at depths ranging from 1.5 to 7.8 m. Vibratory core analysis consisted of physical, chemical, and bioassay analysis. Physical analysis results can be seen in Table 4.

Physical analysis was performed on all samples to gather grain size distribution, density information, and other physical characteristics. Density analyses included pocket penetrometer readings performed in the field and penetration rates using the vibratory corer system. Results can be seen in Table 5.

5.5 Postulated Salt Layer Exploration

On 21 November exploration was undertaken on Skimmer Island for any evidence of a possible salt layer as postulated by the USF&W at a TRC meeting (March 2002) at the Visitors Center. Exploration participants were R. Walker, A. Shak, S. Murphy, and J. Jackson representing USACE and T. Rossmiller representing county of Orange. Sampling took place between 0900 and 1130 hours during a tidal phase of +5.8 to +4.0 feet (+1.77 to+1.22 m) MSL.

Two hand auger holes (H-1 and H-2) at estimated elevation +/- 6.0 ft (1.83 m) MSL were bored to a depth of 7.0 feet (2.13 m) below the dry surface of the island. Hole H-1 was at the extreme east end of the island and H-2 was 180 meters to the west. Both holes encountered fine sand and silt with clay to 3.0 feet (0.91m). Below 3.0 feet, plastic clay with silt (with organics and shells) was encountered; water level in each hole was 5.5 feet (+0.5 ft. MSL). Based on the 1961 RBF engineering study map of the salt works obtained by T. Rosmiller, a salt layer, if one were present, should occur at elevation +5.0 (+1.52 m) MSL (Personal communication, 9/24/02).

No evidence of a concentrated salt layer was encountered in either hole. No visible evidence of salt crystals was seen in any sample. Based on the results of the two test holes, it is the conclusion of the team members that any in-place salt layer at the old mining operations was likely washed away by the floods of December 1969, when the main dike was breached and the evaporative basins flooded. Additionally, any residual salt has been subject to dissolution over the past thirty years by the daily tides rising and falling between the mean range of 3.7 feet (1.13 m).

Organic plastic clays encountered in both auger holes below three feet suggest that materials to be excavated from Skimmer Island might not be suitable for use in the top several feet of the new tern island.

5.6 October and November 2003 Investigations

The October and November 2003 sampling event consisted of 13 samples taken in 4 different areas using hand augers and vehicle mounted hollow stem augers. The samples were taken at Northstar Beach, Bullnose West, Shellmaker Island, Main Dike, and 23rd Street. The samples were collected and analyzed to obtain additional subsurface information, determine physical characteristics, and to run chemical analysis on 23rd Street, Northstar Beach, and Shellmaker Island.

6. LABORATORY TESTING

6.1 Chemical Testing

Bulk sediment chemistry analyses performed in 1995 (TOXSCAN 1995) on 4 composite samples (Unit I/III Basin bottom sediments, Unit I/III Basin top sediments, Access Channel, and LA-3 reference site sediments). Chemical contaminant levels have been determined to be within acceptable levels as determined by the Environmental Branch, SPL, and USEPA. For additional information see ‘Chemical and Toxicity Evaluation of Sediments Proposed for Dredging and Ocean Disposal'. Prepared by TOXSCAN, INC.’

The Navy Regional Environmental Laboratory (NREL), San Diego, California, coordinated chemical testing for the March 2002 sampling event. For more information see ‘Sampling and Tier III Analysis of Sediments Proposed for Dredging as Part of the Upper Newport Bay Ecosystem Restoration Project’ prepared by MEC for the U.S. Army Corps of Engineers.

Chemical testing for the November and December 2003 sampling event was coordinated by the NREL. The samples were collected in the 23rd Street, Shellmaker Island, and Northstar Beach locations. Results of the chemical analysis for these areas indicate the materials are compatible with Newport Beach.

6.2 Bioassay Testing

Bioassay tests were performed in 1995 (TOXSCAN 1995) on three composite samples from UNB and one reference sample from LA-3. Results of the bioassay tests indicate disposal of the sediments from Upper Newport Bay in LA-3 disposal site is allowable. This is reflected in the Record Of Decision, Upper Newport Bay Ecosystem Restoration Project, California signed 24 September 2001.

Bioassay tests were also performed on sediment samples from the February and March 2002 sampling event. Tests were performed on sediment from 11 separate areas including a representative sample from LA-3. Based on results of the testing and analysis, all materials evaluated are suitable for disposal at LA-3.

6.3 Physical Testing

The tests run on the sediment samples typically consisted of sieve analysis (in accordance with ASTM D-422) and Atterberg Limits determination (liquid limit and plastic limit, in accordance with ASTM D-4318). All sediments were classified according to ASTM D-2487, except for density samples with greater than five-percent fines, which were classified according to field logs and ASTM D-2488.

6.3.1 1995 Testing

Results of the 1995 TOXSCAN testing for samples taken within UNB are summarized in Table 1. These results indicate sediments in Unit I/III and II Basins as well as the Access Channel have a large range of sand-silt-clay mix. The sediment samples range from 16% to 60% by weight sand, 18% to 26% by weight silt, and from 21% to 57% by weight clay. These samples were not tested in accordance with ASTM requirements.

Samples were also obtained from the representative sediments from LA-3. Grain size analyses performed. The sediments are predominantly silt with some clay, and a small percentage of sand. Table 2 presents the results from this analysis. These samples were not tested in accordance with ASTM requirements.

6.3.2 February and March 2002 Testing.

Sampling in February and March 2002 included testing for grain size analyses, Atterberg Limits Tests, and in-situ density. Sampling undertaken throughout Upper Newport Bay showed the sediments are predominantly poorly graded sand, silt, and clay with minor gravel in some areas. Results indicate a high variability of fines (from 1% to 98%) and sandy material throughout the bay. The results also indicate the fine sediment percentages are randomly spread throughout the bay. Laboratory testing of the Navy Dive Core samples taken in February 2002 are presented in Table 3 and the vibratory corer samples taken in March 2002 are presented in Table 4. Also included is the average grain size distribution of all samples providing a good indication of the overall sediment size distribution.

For additional information see Appendices B and C of "Geotechnical Site Characterization Study Upper Newport Bay, Newport Beach, California," dated October 2002 prepared for the Los Angeles District by Group Delta Consultants, Inc.

6.3.3 October 2002 Beach Profile Testing.

In October 2002, Navy Divers obtained 24 grab samples. Eight sampling were collected along 3 separate transects (STA 668+53, STA 689+00, and STA 713+28). Transects locations coincide with 29th Street, 50th Street, and 60th Street on Newport Beach Peninsula. Samples were collected at approximate elevations +4, +2, 0, -2, -4, -6, -8, and –10 m, MLLW. The results are presented in Table 6.

6.3.4 November and December 2003 Testing.

Samples were collected using hand held and track mounted augers at Northstar Beach, Bullnose west, Shellmaker Island, Main Salt Dike, and 23rd Street. Testing of these sediments included grain size analyses for each location. The laboratory test results are presented in Table 7 along with the fine limit, coarse limit, and average grain sizes for each location.

Chemical and bioassay analysis was performed on selected vibracore samples throughout the bay. The samples were selected from eleven representative areas. Samples from each area were then composited and analysis performed on each of the 11 composite samples. One reference sample was obtained from LA-3 and analyzed.

For more information see "Geotechnical Site Characterization Study Upper Newport Bay, Newport Beach, California," prepared by Group Delta Consultants, Inc.

7. ANALYSES AND RESULTS.

7.1 Slope Stability Analysis.

Stability analysis was performed on side slopes throughout Upper Newport Bay. Analyses were performed for varying conditions and various locations. Slope stability analyses for slopes located along the edges of the main channels, basins, Least Tern Island, and small channels were performed using Utexas4 computer program. In addition to the Utexas4 program, the "Geotechnical Engineering in the Coastal Zone" (USACE), the “Engineering and Design-Slope Stability EM 110-2-1902” manual, and observations of existing conditions were utilized in the decision making process. Pressure exerted by water due to depth and soil type mainly determines slope stability within Upper Newport Bay. Since the soil type throughout Upper Newport is similar, the analyses are centered mainly on tidal effects. Slope stability analyses using Utexas4 program was performed using the most conservative scenario, rapid drawdown. A factor of safety of 1.3 was used.

Side slopes that are continually inundated having a stable or semi stable external water pressure applied to the side slopes are much more stable at steeper gradients than slopes experiencing a larger change in external water pressure in relation to slope height. Tidal influences range from 0 m MLLW to 1.65 m MLLW in the vicinity of Upper Newport Bay. The side channels are 1.5 m deep and tidal effects will nearly drain the channels daily. During high tide, the side slopes will experience an increase in external water pressure being exerted as well as an increase in pore pressures when the channel is full. At low tide, the side slopes will experience an elimination of water pressure being exerted on all or a portion of the side slope depending upon the magnitude of the tide as well as a reduction in pore pressure and a draining of water from the side slopes. All of these factors contribute to reducing the stability of the side slopes. Side slopes in the side channels having 1.5 m depths are not able to maintain 1V:3H slopes.

The following are the results of the analysis: side slopes of 1V:5H or flatter are stable in all areas; slopes of 1V:3H are stable in the deeper channels (e.g., 4.3 m deep and 30 m wide channels); slopes of 1V:3H are not stable in some areas in the more shallow channels (e.g., 2 m deep, 15 m wide channels) due to tidal effects. It should be noted that it is not possible to determine which areas will remain stable and those that will not remain stable without extensive investigative data. Therefore, due to the non-critical nature of these side slopes, it is recommended that these channels be dredged at a 1V:3H side slope and allowed to adjust naturally where necessary in an effort to preserve as much mud flat habitat as possible. However, slopes around islands should be 1V:5H in order to maintain stability of the islands and slopes of 1V:8H are necessary near structures, roadways, and other areas requiring structural stability.

Experience indicates that not all of the steeper side slopes of 1V:3H will be stable in areas that experience wave, propeller wash, and currents. These areas are expected to experience localized adjusting in some areas to a more stable slope of approximately 1V:5H.

7.2 Riprap Protection.

The riprap shall be quarried, angular stone, and reasonably well distributed.

7.2.1 San Diego Creek Scour Protection.

Riprap shall be placed and grouted at the confluence of San Diego Creek and Unit I/III Basin. The grouted riprap, designated A-1000 stone will serve as scour protection.. Ninety-five to one hundred percent (95-100%) of the stone shall be greater than 1000kg. Fifty to 100 percent shall be greater than 400 kg. Fifteen to forty nine percent (15-49%) shall be greater than 100kg. Not more than zero to three percent (0-3%) shall be smaller than 30kg.

The total volume grouted riprap is approximately 1,745 cubic meters. With a void ratio of 0.35, the mass of riprap is approximately 4,000 metric tons and the volume of grout is approximately 500 cubic meters. These estimates are based on a specific gravity of 2.65.

7.2.2 Northstar Beach Erosion Protection.

Riprap shall be placed at Northstar Beach to protect the beach from erosion due to tidal currents. The riprap gradation shall be as follows: The maximum diameter shall be not more than twenty three centimeters (23cm); ninety to one hundred percent (95% to 100%) shall be 23cm; Fifty to one hundred percent (50% to 100%) shall be larger than 15cm ; not less than fifteen percent (15%) and not more than 49 percent (49%) shall be 12cm; zero to three percent (0-3%) may be less than 7cm.

7.3 Grout.

Grout shall be used for the grouted riprap. The grout shall be composed of cement, sand, gravel, and water and meet specifications of ASTM C 33, C150, and C309.

7.4 Beach Compatibility Analysis and Results.

7.4.1 Physical Analysis and Results

Los Angeles District Corps of Engineers Beach Compatibility guidelines states that proposed dredge material grain size shall be similar to the receiving beach. The proposed material may be coarser than the receiving beach unless esthetic or other conditions restrict beach disposal. The proposed dredge material may be finer, but shall not exceed the percent fines in the finest beach sample by more than 10 percent.

The grain size analysis of the 3 transects taken at Newport Beach in October 2002 are shown in Table 6 and in graph form in Figure 1. The results of the Beach samples show 2 samples with high percentages of fines material (39 and 27%). The test results for these 2 samples were not considered representative since they are significantly higher than the remaining samples. Using the 39 and 27 percent fines would result in placing sediments in the near shore having a much higher fines content. Therefore 21 percent was used to determine near shore placement of sediments. Samples taken from Newport Beach with the smallest percent of fine sand (0.075 mm) is 1 percent. Criteria allow proposed sediments to be finer, but shall not exceed the percent fines in the finest beach sample by more than 10 percent. Therefore 11 percent maximum fines are allowable for placement onto the beach. Compatibility requirements for sediments proposed for near shore placement shall not exceed the beach sample with the greatest percentage of fines by more than 10 percent. Beach samples containing the largest percent fines are 21 percent. Therefore 31 percent fines are allowable for near-shore placement.

The grain size analyses for samples obtained in November and December 2003 (Northstar Beach, Bullnose West, Shellmaker Island, Main Salt Dike, and 23rd Street) are shown in Table 7. The data from these samples are compared to the results of the Newport Beach sample gradations. Table 8 shows a comparison of Newport Beach results (fine limit, coarse limit, and composite) vs. composite samples from each of the 5 sites sampled in November and December 2003. According to Los Angeles District Corps of Engineers Beach Compatibility guidelines, sediments from 23rd Street, Shellmaker Island, and Northstar Beach meet the requirements for near shore placement at Newport Beach. Figure 2, 3 and 4 presents the information in graph form as a comparison of each area (23rd Street, Bullnose, Shellmaker Island, and Northstar Beach) to that of Newport Beach grain size.

The sediments currently located within the Upper Newport Bay proposed dredge area contain a relatively high concentration of fines (a composite average of 26% silt and 34% clay totaling 60% fine material less than 0.074 mm). Approximately 26 out of 98 samples contain less than 21% fines (e.g., 21% of the material is less than 0.074 mm). Although this appears to be a significant amount of samples with less than 20% fines, most of these sample locations are spread throughout Upper Newport Bay making separation and/or sorting too costly. Therefore beach nourishment or near shore disposal using this material is not an option.

Material to be used for the upper 0.61 m of the New Least Tern Island and Hot Dog Tern Island shall be sand with a small amount of shell fragments. The sand should come from Shellmaker Island and/or Northstar Beach. The site with the largest percentage of shell is recommended.

7.4.2 Chemical Compatibility.

Three onshore locations have been analyzed for chemical compatibility with Newport Beach and LA-3. The three sites are 23rd Street, Northstar Beach, and Shellmaker Island. All three areas have been determined to be compatible with Newport Beach and/or the offshore LA-3 site.

7.5 Pumpability Analysis.

The pumpability for Upper Newport Bay is based on the sediment gradation, median and maximum grain sizes, and grain shape. The maximum grain size indicates the maximum pump clearance needed to pump the sediment (i.e., large size coarse sediments, such as gravels, large cobbles, and boulders may not pass through dredge pumps and therefore reduce production rates of the hydraulic or pneumatic dredge methods). Smaller size coarse sediments, such as sands can pass through dredge pumps. The median grain size is an indicator of the energy required to pump the sediments as a slurry (i.e., a larger median grain size requires more pump energy).

The presence of seashells within the sediment should not cause excess pump wear since the shells are widely scattered throughout the borrow area sediments and uncemented.

The most recent exploration data indicates that sediment within Upper Newport Bay typically consists of sandy silt (MH) and silty sand (SM). According to logs and sieve analysis, sediments encountered range from fine silt and clay to coarse grained, subrounded to rounded gravel with a very minor amount of coarse gravel.

7.6 Dredgeability Analysis.

All project alternatives providing improvement in the Upper Newport Bay environment include the need for dredging to remove accumulated sediment. Although many parameters must be evaluated to consider the acceptability of dredging operations, the analysis presented here is limited to consideration on the physical dredgeability (ability to dredge the material with standard clamshell, backhoe, or hydraulic dredging equipment) and any limitations to dredging given current guidelines for sediment chemical contaminants.

7.6.1 Previous Experience.

Based on extensive previous experience within Upper Newport Bay during the past 20 years, it is clear that dredging is possible within Upper Newport Bay by standard regional dredging methods. Bedrock is located below any of the proposed dredge depths within the proposed project limits. Also, the dredge material is unconsolidated alluvium, ranging from clay to gravel. Both hydraulic and clamshell dredging have been utilized in the Upper Bay with success in the past. In 1987, a clamshell dredge and barges (3,000 cubic yard capacity) were used to remove over one million cubic yards of sediment from the Upper Bay, at a rate of approximately 5,000-10,000 cubic yards per day. During 1998-99, clamshell-dredging operations removed 784,000 cubic yards of sediment from the Unit I/III Basin and access channels. During this program, hydraulic dredging removed 75,000 cubic yards from the Dover Shores area. The rate of dredge production varied significantly but averaged about 3,000 cubic yards/day.

The second consideration in determining the acceptability of dredging sediment from the Upper Bay is the need to meet the criteria established by the EPA and USACE for the evaluation of dredge material. The recent 1998-1999-dredge program in the Upper Bay allowed offshore disposal of the material at the LA-3 disposal site. All Federal and State requirements for dredged sediment quality were achieved in order for this offshore dumping to occur.

Recent comprehensive testing for chemical contaminants of the sediments within Upper Newport Bay has been conducted. Results indicate that the sediments from Upper Newport Bay are suitable for disposal in LA-3.

7.6.2 In-Situ Density Analysis.

Insitu and relative density are indicators of how easily the materials can be dredged. Extremely soft or loose sediment can be suctioned, while dense to very dense sediment may have to be scoured by cutting or hydraulic disturbance in order to excavate and remove.

The depth of sample penetration achieved by a hand held penetrometer as well as the Navy diver core itself provides a qualitative in-situ density analysis for most areas. For example, loose to dense sands and very soft-to-soft silts and clays are fully penetrated by the vibratory corer (usually to 3 meters). Table 10 shows depths and times achieved using the vibratory corer equipment. Table 11 shows total penetration of the Navy Divers push cores at each location. Dense to very dense sands, medium stiff to very stiff clays and silts, and medium grained gravels are penetrated only a few inches (7 to 15 cm) by the diver core.

The qualitative in-situ density for Upper Newport Bay is a soft to increasingly dense sediment. Upper Newport Bay sediments mainly consist of Bay Deposits of very soft silts, clay, loose sand, silty sand, and clayey sand. Sediment density located in the vicinity from the Pacific Coast Highway Bridge up to Station 3+500 can be anticipated as loose sand. Sediments from Station 3+500 up to and including the Unit II Basin can be considered soft and classified as a mixture of silt, sandy silt, silty clay, and sandy clay. Sediments in the Middle Island Channel are considered loose with a mixture of sand and silt with a medium dense under layer of gravel and sand. Sediments in the Santa Ana-Delhi channel can be classified as soft clay. Sediments located in the channel connecting the Unit II and Unit I/III Basins and including the Unit I/III Basin have a mixture of soft sediments classified as sandy silt, elastic silt, sandy clay, clay, with an under layer of dense sand and gravel with sandy clay in some areas. Sediments located in the New Island Channel are considered soft and classified as sandy clay, silty clay, and clay.

7.7 Sediment Chemistry Analysis and Results.

7.7.1 1995 Analysis and Results

Three composite samples (Unit I/III Top, Unit I/III Bottom, and Access Channel) were tested in 1995. The sediment samples are uncontaminated with metals. All metal values were below their recent ERL values published by Long, et al (1995) and concentrations of most metals in the test sample (Unit I/III Top, Unit I/III Bottom and Access Composite) were lower than those in the LA-3 reference sediment.

The sediments were evaluated for ocean disposal in accordance with the draft Regional Implementation Agreement (RIA, 1992). With the presence of existing data, an established process for determining whether additional testing is necessary is explained in the following text. The Corps and Region IX EPA representative(s) reviewed existing data. Once the review was complete, the Corps provided EPA with a recommendation regarding the need for any further testing under the US Army Corps of Engineers/US Environmental Protection Agency's tiered approach for dredged sediments as shown in EPA-503/8-91/00 "Evaluation of Dredged Material Proposed for Ocean Disposal," also known as the "Green Book." Under the tiered approach, a recommendation can be no further environmental testing is required, or a higher tier level evaluation is necessary to make final determination on ocean disposal suitability. In the case of Upper Newport Bay, the Corps determined to go directly to Tier III testing based on past sampling chemistry results and potential sources of contamination from runoff into Upper Newport Bay. Tier III analyses includes toxicity and bioaccumulation testing. Based on these tests results, the Corps determined that the material to be dredged from Upper Newport Bay is suitable for ocean disposal at LA-3. EPA concurrence is required for all suitability determinations, including testing protocols. EPA has concurred with this determination.

7.7.2 2002 Analysis and Results

Chemical analysis was performed on 11 separate areas. Analyses results indicate sediments dredged from Upper Newport Bay are suitable for disposal at LA-3.

7.7.3 2003 Analysis and Results

Chemical analysis was performed on samples taken in 2003. Three sites were analyzed (23rd Street, Northstar Beach, and Shellmaker Island). Results indicate sediments from all three areas are suitable for nearshore placement along Newport Beach between 39th Street and 60th Street.

7.7.4 Chemical Acceptability.

Generally, all contaminants detected are within ER-L (effects range low as determined by NOAA's National Status and Trends (NS&T) Program). For the few contaminants exceeding the ER-L, none of the samples exceeded the ER-M (effects range medium).

7.8 SKIMMER ISLAND, HOT DOG TERN ISLAND, AND NEW LEAST TERN ISLAND.

7.8.1 Removal of Skimmer Island.

Removal of Skimmer Island may be performed using dredge equipment.

7.8.2 Hot Dog Tern Island.

Hot Dog Tern Island will remain in place. The top material will be removed and replaced with 0.61 m sand-shell mixture from Shellmaker Island. Minimum side slopes of 1V:5H are necessary to maintain the integrity of the sand-shell layer.

7.8.3 New Least Tern Island.

Creation of the New Least Tern Island may be constructed using excavated material from upland sources. Dredge material from within UNB may also be used if needed for the island foundation. A 0.61 m sand-shell mixture shall be placed on the top of the island to maintain a dry and stable surface. Side slopes of 1V:5H are necessary to maintain the integrity of the sand-shell layer.

8. CONCLUSIONS.

- Physical characteristics from prior sampling events are consistent with the most current sampling events.
- The proposed receiving beach (Newport Beach between the Santa Ana River and the Newport Pier) has fines contents ranging from 1 to 39% with an average 6%. For compatibility calculation, the maximum fines content for beach placement is limited to 11 percent. The maximum fines content for near shore placement is 31 percent.
- Twenty-third Street, Shellmaker Island, and Northstar Beach sediments are nearshore compatible with Newport Beach in respect to both grain size and chemistry.
- Sediment from Bullnose West in not onshore compatible but is nearshore compatible. The average fines content is 60%.
- The sediment in the lower portions of the Upper Newport Bay (from the Pacific Coast Highway Bridge to the confluence of Upper Middle Island Channel to the main channel) consists mainly of poorly-graded sand and silt. The sediment contained within the upper portions of Upper Newport Bay (from upper Middle Island Channel and the effluent of San Diego Creek) consists mainly of sandy silt and clay mixed throughout. The relative density of the sediment within Upper Newport Bay as observed by field personnel indicates the following: a high percentage (65 to 75%) of borings show a soft to very soft overlying material; less than 15% of the borings show a soft to very soft overlying material of medium dense underlying material and only two borings show a stiff underlying material; approximately 25% of the total borings indicate a medium to stiff material based on penetration rates of either the vibratory core or diver cores. All methods of dredging may be used for the entire area.
- Sediment samples were collected at Newport Beach and compared with samples collected from Upper Newport Bay to determine compatibility for near shore placement. The sediments from Upper Newport Bay contain a much higher percentage of fine material (material passing the #200 mesh) than the sediments from Newport Beach. Therefore, sediments from Upper Newport Bay are not compatible with Newport Beach profiles. Placing Upper Newport sediments on Newport Beach or near shore will create undesirable conditions and therefore is not an option.

- Tidal effects play an important role in slope stability throughout Upper Newport Bay. Side slopes are stable at 1V:3H in areas that do not experience significant tidal effects in relation to slope height. Areas with the larger tidal effects in relation to slope height, the slopes are not able to maintain as steep a gradient as other areas. Therefore -0.61 m (MLLW) deep restoration channels are not stable at 1V:3H.

9. RECOMMENDATIONS

- 1V:5H side slopes in all restoration channels (e.g., -0.61 m deep channels).
- 1V:3H side slopes throughout the access channel and basin areas except as stated below.
- 1V:5H side slopes around all islands.
- 1V:8H side slopes along sensitive areas (e.g. roadways and buildings) where the top of slope is within 1 meter of the sensitive area.
- All sediments dredged from below MHHW within the bay shall be disposed in LA-3 disposal site. These sediments may be used to construct the New Least Tern Island if the volume of upland materials is not adequate to complete construction of the island.
- Sediment from 23rd Street, Shellmaker Island, and Northstar Beach is suitable for near shore placement. This material shall be placed near shore at Newport Beach.
- Sediments from Bullnose West, Main Dike, the top portion of Skimmer Island, and Hotdog Tern Island should be used as the foundation for the New Tern Island.
- A sand-shell mixture of 0.61 m thick should be placed on top of the New Least Tern Island and Hotdog Tern Island. The sand-shell mixture will come from Shellmaker Island and/or the upper 0.61 meters of the existing Least Tern Island.

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Table 1: 1995 Composite Physical Sample Results.

Location	% Silt	% Clay	% Sand
Access Channel	18.5	21	60.5
Unit II Basin	36.5	26.4	37.1
Unit I/III Basin Top Portion -1.64 to -3.84 m MLLW	26.5	34.1	39.4
Unit I/III Basin Bottom Portion -3.84 m to –5.94 m MSL)	26.9	57.3	15.8
Average of all Samples	26.4	34.2	39.4

Source: Orange County, 1997

Table 2: 1995 LA-3 Reference Site Composite Sample Results.

Location	% Silt	% Clay	% Sand
33°31.70’N, 117°51.30’W	70.9	22.6	6.5

Source: City of Newport Beach, California

Table 3

2002 Navy Diver Cores Physical Analysis

(ASTM - D 2487) Beach Classification

Seive size (mm)			19	9.5	4.75	2.8	2	1.4	1	0.710	0.500	0.355	0.250	0.180	0.125	0.090	0.075	0.063			
HOLE No.	DEPTH METERS		Standard Sieve Number Designation																Atterberg Limits		
	TOP	BOT	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI	CLASSIFICATION
B-1	0	0.6	100	100	100	100	99	99	99	99	98	98	98	97	97	96	96	95	71	38	MH; elastic silt, soft, occassional shells
B-3	0	0.5	100	100	100	100	100	98	95	88	77	66	57	52	48	45	44	42			SM; silty sand, grey-green, w/rare gravel
B-5	0	1.5	100	100	100	100	100	99	99	99	99	99	98	98	97	96	95	95	58	31	CH; soft grey-green with shells
B-8	0	1.4	100	100	100	100	100	99	99	99	98	98	98	98	97	97	97	96	60	35	MH; elastic silt, soft, occassional shells
B-9	0	0.9	100	100	100	99	99	98	97	97	97	96	96	95	95	95	94	94	67	34	MH; elastic silt, black mud
D4-A	0.8	1.2	100	100	100	100	99	99	98	97	96	92	86	40	13	9	9	9	NP	NP	SP-SM; sand w/silt, light grey w/shells
D4-A	1.2	2	100	100	84	81	78	75	72	64	53	41	27	11	4	3	2	2	NP	NP	SP; poorly graded sand w/shells
D4-B	0	1.2	100	100	93	91	90	89	87	82	69	51	26	11	7	5	5	4	NP	NP	SP-SM; gravel at surface, sand w/silt, shell
D-6	0	1.4	100	100	87	85	83	81	80	78	73	64	35	8	2	1	1	1	NP	NP	SP; medium to coarse grained sand, w/shell
D-8	0	1.5	100	100	100	98	97	95	93	90	85	74	60	51	44	38	34	32	NP	NP	SM; silty sand, dark grey, organic odor
D-10	0	0.9	100	100	100	100	100	99	99	98	97	94	85	73	64	56	54	53			Surface mud, ML; sandy silt, orgainic silty clay
D-12	0	1.1	100	100	100	100	100	100	100	100	99	99	98	97	96	95	94	93			ML;silt, but sandy at mudline, soft, tan
D-12	1.1	1.4	100	100	100	98	97	96	95	93	86	69	40	20	10	6	5	5	NP	NP	SP-SM; sand w/silt, grey, occassional shells
D-14	0	1.4	100	100	100	100	100	99	99	99	98	97	94	89	79	67	60	54			ML; sandy silt, dark, occassional shells
D-14	1.4	1.9	100	100	94	90	89	87	86	84	79	67	45	27	17	12	11	10	NP	NP	SP-SM; sand w/silt, shell hash at bottom
D-16	0	1.2	100	100	98	98	97	96	96	95	90	82	9	45	21	8	5	4	NP	NP	SP-SM, sand w/silt, occassional shells
D-16	1.2	1.5	100	100	100	100	100	99	99	99	98	95	92	90	73	52	46	43	NP	NP	SM; silty sand, tan
D-16	1.5	1.7	100	100	100	99	98	98	97	99	98	98	96	90	73	52	46	43			SM; Silty Sand
D-18	0	0.2	100	100	98	96	95	94	93	91	88	83	69	48	34	23	19	17	NP	NP	SM; silty sand, soft
D-18	0.2	1.1	100	100	86	85	84	82	82	79	71	56	27	9	4	2	2	2	NP	NP	SP; medium grained sand with shells
D-20	0	1.4	100	100	84	79	76	74	72	71	69	64	43	15	6	3	3	3	NP	NP	SP; shells w/med grained sand.
D-22	0	2.4	100	100	100	100	100	100	100	99	99	98	85	47	23	7	5	4	NP	NP	SP-SM; sand w/silt, dark, med. Grained
D- 24	0	1.1	100	100	100	100	100	100	100	100	100	100	100	99	99	98	98	97			ML; silt, dark grey, slightly silty
D-24	1.1	2.6	100	100	97	94	93	92	91	90	88	82	67	39	14	2	1	1	NP	NP	SP; sand, dark grey with shells
D-26	0	3.1	100	100	100	100	99	98	98	97	95	92	83	48	16	5	3	3	NP	NP	SP; sand, dark grey with shells
D-28	0	2.6	100	100	100	100	100	100	100	99	99	98	92	52	19	9	8	7			SP-SM; sand w/silt
D-30	0	2.4	100	100	97	94	92	90	88	87	84	82	76	60	33	11	7	5	NP	NP	SP-SM; sand w/silt, minor clay, w/shell hash
D-32	0	2.4	100	100	100	99	98	97	96	94	90	78	54	30	20	1	1	1	NP	NP	SP; sand, dark grey, medium SP; dark grey
D-34	0	1.3	100	100	100	100	99	99	99	99	99	99	99	98	98	98	98	98	76	43	MH; black organic to 1.5m, elastic silt

Table 3

2002 Navy Diver Cores Physical Analysis

(ASTM - D 2487) Beach Classification

Seive size (mm)			19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063			
	DEPTH METERS		Standard Sieve Number Designation																Atterberg Limits		
HOLE No.	TOP	BOT	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI	CLASSIFICATION
D-36	0	0.9	100	100	98	92	88	84	81	78	74	69	62	55	47	36	32	28	47	27	SC; mucky clay to .15m, shells
D-38	0	8.5	100	100	100	98	97	96	95	95	94	92	90	86	74	52	44	40			SM; silty sand, minor clay, occassional shells
D-40	0	0.8	100	100	100	100	100	100	99	99	99	98	97	93	57	19	13	10			SM; silty sand, rare shell, well sorted
D-48	0	1.7	100	100	100	99	97	97	96	95	95	94	92	84	68	56	52	49	40	23	CL; dark, no shells, occ. thin black layers
D-50	0	2	100	100	100	99	99	98	98	98	97	97	94	87	75	64	59	56	33	12	CL; sandy clay, black, soft, organic
D-52	0	1.3	100	100	100	99	98	98	97	97	96	96	95	93	92	90	89	87	110	80	MH; elastic silt, black, organic
D-54	0	1.3	100	100	100	100	99	99	99	99	99	99	98	98	97	97	96	96	77	42	MH; elastic silt, soft, rare shells, greenish tan
D-56	0	1.4	100	100	100	99	98	97	96	95	92	89	81	70	63	59	58	56	30	14	Sandy Lean Clay
D-58	0	1.7	100	100	100	100	100	100	99	99	99	98	98	98	97	96	96	95	61	30	MH; elastic silt, soft occassional shell
HD-1	0	1.1	100	100	100	100	100	100	100	100	99	99	99	99	97	95	95	93	53	24	CH; fat clay, orgainic, soft, some silt & shells
HD-2	0	1.1	100	100	93	93	92	92	92	91	91	90	89	87	86	83	80	76	51	27	CH; clay w/sand, orgainic, soft, rare shells
HD-3	0	1.4	100	100	100	100	99	98	97	96	95	93	92	89	85	82	79	76	46	19	CL; organic muck to .2m, clay w/sand & shells
M-1	0	0.6	100	100	97	92	90	87	86	84	83	81	77	72	62	48	43	39	27	7	SC-SM, sility clayey, soft, with silt and shells
M-2	0	0.7	100	100	100	99	99	98	98	96	94	92	90	88	84	79	77	75	47	21	CL; clay w/sand, occassional shells
M-3	0	0.7	100	100	100	96	94	92	90	87	83	76	63	55	47	40	38	36	26	8	SC; clayey sand, occasoinal shells
M-4	0	0.8	100	100	100	100	99	99	98	98	96	93	82	68	56	42	38	36	28	11	SC; clayey sand, occasoinal shells
N-1	0	1.6	100	100	100	100	100	99	99	98	98	97	97	96	94	89	82	76	42	16	CL; clay w/sand, organic w/plant material
N-2	1.7	100	100	100	100	100	100	100	100	100	100	100	99	99	99	98	95	93			CL; clay, organic w/plant material & shells
S-1	0	0.6	100	100	97	96	96	95	95	95	95	94	93	89	72	42	35	31	NP	NP	SM; silty sand, high percentage of shells
S-2	0	0.7	100	100	100	99	99	98	97	97	96	95	94	91	88	81	79	77	36	9	CL; clay w/sand, soft w/ shells toward base
S-3	0	0.4	100	100	100	98	96	94	93	92	91	90	89	87	84	79	77	75			ML; silt w/sand, w/shells toward base
S-4	0	0.8	100	100	100	100	100	100	99	99	98	97	96	95	90	78	71	67	26	6	CL; silty clay, w/sand
S-5	0	0.4	100	100	96	95	95	95	94	94	93	91	85	74	52	28	23	20	NP	NP	SM; silty sand, very fine to fine, 40% shells
SA-1	0	0.8	100	100	96	94	92	90	87	81	75	71	68	65	62	55	50	46	46	19	SL; sandy clay, 20% shells
SA-2	0.3	0.9	96	94	88	83	79	75	70	65	58	50	41	35	31	27	25	23			CL; clay,
SA-2	0.9	1.5	100	100	100	100	99	98	97	95	93	91	88	86	83	81	80	78	47	26	SM; sility sand, w/coarse gravel, 50% shells
SA-3	0	1.2	100	100	100	100	99	99	98	97	96	95	93	91	88	85	83	80	52	29	CH; fat clay w/sand
Average			98	98	94	92	92	91	90	89	87	83	74	65	56	50	48	47			

Table 4

2002 Vibracore Physical Analysis

(ASTM - D 2487) Beach Classification

Seive size (mm)			19	9.5	4.75	2.8	2	1.4	1	0.710	0.500	0.355	0.250	0.180	0.125	0.090	0.075	0.063			
	Depth m		Standard Sieve Number Designation																ATTERBERG LIMITS		
HOLE N0.	TOP	BOT	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI	CLASSIFICATION
A-1 RUN1	0	2.4	100	100	100	100	100	100	100	99	99	98	97	96	94	86	73	59	NP	NP	ML; very soft, dark olive w/ shells, PP <25 Kpa
A-1 RUN1	2.4	5.2	100	100	100	100	100	100	99	99	99	99	98	98	98	97	96	93	24	7	CL-ML; very soft, dark olive with shells
A-1 RUN1	5.2	7.6	84	84	83	81	79	77	74	70	65	60	52	41	32	25	22	20	NP	NP	SW; silty sand with gravel, dark olive with shells
A-2 RUN2	0	2.4	100	100	100	99	98	98	97	96	96	95	94	92	91	89	83	76	41	18	CL; very soft, dark olive, fine grain sand with shells
A-2 RUN2	2.4	4.6	100	100	100	100	99	99	99	99	98	98	98	98	97	97	97	96	61	27	CH; fat clay, very soft, dark olive, w/shells
A-2 RUN2	4.6	5.2	100	100	100	99	99	98	97	93	87	80	71	61	53	49	46	45	28	11	SC; clayey sand, very loose, olive, fine grained w/shells
A-2 RUN2	5.2	7.6	100	100	100	98	97	95	91	83	72	61	49	37	28	23	21	20	NP	NP	SM; silty sand, fine grained sand with shells,
A-3 RUN2	0	7.3	100	100	100	97	96	95	94	93	92	91	90	90	89	87	85	81	45	20	CL; very soft with shells and orgaincs. PP<25 Kpa
A-4	0	6.1	100	100	100	100	99	99	99	98	98	98	97	96	95	92	87	82	50	28	CH; fat clay, very soft, dark olive, w/shells
A-5	0	6.1	100	100	100	100	100	99	99	99	98	98	98	98	97	97	96	95	39	16	CL' veryh soft, dark olive, with organics. PP<25KPa
A-6 RUN1	0	6.1	100	100	100	100	100	100	99	99	99	99	98	96	91	77	62	52	NP	NP	ML; Sandy silt, very soft,dark olive. PP<25KPa
A-6 RUN3	0	2.4	100	100	100	100	100	100	99	99	99	98	92	67	38	22	14	11	NP	NP	SM-ML; dark olive fine grained sand, some organics
A-6 RUN3	2.4	6.1	100	100	100	99	98	98	97	97	96	96	95	94	94	93	92	90	27	9	CL; very soft, olive with occassional shells
B-2	0	1.1	100	100	100	100	100	100	99	99	96	89	72	53	34	19	14	11	NP	NP	SM; silty sand, dark grey
B-2	1.1	2.1	100	100	100	100	100	100	100	100	100	99	97	95	93	92	91	91			ML; silt, dark grey. PP< 25KPa
B-2	2.1	2.7	100	100	100	100	99	99	97	94	88	82	73	65	56	52	5	47	NP	NP	ML; sandy silt, very stiff brown and olive. PP=300KPa
B-2	2.7	3.5	100	100	100	100	99	98	95	90	83	74	62	50	40	33	30	27			SM; silty sand, light olive
B-4	0	1.1	100	100	100	100	100	100	100	100	100	99	99	98	97	95	93	91	79	44	CH; fat clay, very soft with organics. PP< 25KPa
B-4	1.1	2.1	100	100	100	100	99	97	95	89	80	69	58	50	45	42	39	37	22	8	SC; clayey sand, loose to medium dense. PP=100KPa
B-4	2.1	2.7	100	100	100	100	99	99	98	98	97	95	93	89	82	72	66	61	54	38	MH; elastic silt, very stiff, dark grey. PP=325KPa
B-4	2.7	2.8	100	100	100	100	99	98	96	91	81	70	59	52	46	43	41	38			SM; silty sand, medium dense, light olive
B-5 RUN1	0	0.9	100	100	100	100	99	99	98	97	95	92	87	80	72	67	62	59	56	33	MH, silt, very soft, dark. PP<25KPa
B-5 RUN1	0.9	2.6	100	98	96	94	92	89	85	80	72	65	56	48	44	40	36	34	26	13	SC; clayey sand, medium dense, dark olive with shells
B-6	0	7.6	100	100	100	99	99	97	96	93	91	88	84	80	75	67	62	58	25	10	CL; sandy clay, very soft, olive with occassional shells
B-7 RUN1	0	2.4	100	100	100	98	96	95	94	93	93	92	91	89	88	87	86	82	25	6	CL-ML; silty clay, very soft, olive. PP<25KPa
B-7 RUN1	2.4	7.6	100	100	100	100	99	99	99	99	98	98	98	97	96	95	94	91	28	13	CL; clay, very soft, olive, fine grained sand with organics
B-8	0	6.1	100	100	100	100	99	98	97	96	96	95	94	94	93	92	91	90	31	23	CL; very soft, olive with shells. PP<25KPa
B-8	6.1	7.8	100	100	100	100	100	100	99	99	99	99	98	94	82	65	54	48	23	10	CL; very soft, olive
B-10 Run1	0	4.9	100	100	100	100	100	100	100	99	99	98	94	92	90	90	89	88	24	12	CL; very soft , olive with occassional shells
B-10 Run1	4.9	5.2	100	100	100	100	99	98	96	92	87	81	73	64	54	45	41	37	NP	NP	SM; silty sand, olive.
B-10 Run1	5.2	6.1	100	97	95	92	90	88	87	85	83	79	73	65	55	48	42	38	NP	NP	SM; silty sand, olive.

Table 4

2002 Vibracore Physical Analysis

(ASTM - D 2487) Beach Classification

Seive size (mm)			19	9.5	4.75	2.8	2	1.4	1	0.710	0.500	0.355	0.250	0.180	0.125	0.090	0.075	0.063			
	Depth m		Standard Sieve Number Designation																ATTERBERG LIMITS		
HOLE N0.	TOP	BOT	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI	CLASSIFICATION
D-6	0	2.1	100	100	100	100	99	98	97	93	86	72	39	9	2	1	1	1	NP	NP	SP; sand, light grey fine to meduim sand with shells
D-16	0	2.1	100	100	100	99	98	97	96	94	85	69	51	31	13	5	3	2	NP	NP	SP; sand, dark grey, fine grained, shells, high organics
D-24	0	1.5	100	100	100	100	99	98	97	96	91	79	46	18	7	5	4	4	NP	NP	SP; sand, olive, fine grained sand with shells
D-32	0	0.3	100	100	100	100	100	100	100	100	99	99	99	99	99	99	98	98	30	24	CL; very soft, olive with shells
D-32	1.5	2.1	100	100	100	96	94	91	91	90	89	89	88	88	87	86	85	83	25	17	CL; very soft, olive with shells
D-38	0	3.1	100	100	100	100	100	99	99	98	97	94	85	93	34	17	8	6	NP	NP	SP-SM; sand w/silt, light grey
D-48	0	3.1	100	100	100	99	98	97	97	96	96	95	94	93	93	92	92	92	61	49	CH; fat clay, very soft, olive, no odor
D-52	0	1.1	100	100	100	99	98	97	96	95	94	93	91	89	87	85	84	82	56	32	CH; fat clay w/sand, dark grey, fine grained sand w/shell
D-52	1.1	1.5	100	100	100	99	99	98	97	95	91	85	72	52	36	28	25	22	NP	NP	SM; sility sand, very loose, dark olive
D-56	0	1.7	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	79	37	MH, elastic silt, very soft, dark grey
HD-3	0	1.4	100	100	100	100	100	99	99	99	99	99	99	99	98	98	97	96	31		CL; clay, very soft, organics w/tree roots. PP<25KPa
M-1	0	0.6	100	100	100	100	99	99	97	96	94	92	89	87	84	80	70	66	32	6	ML; silit w/sand, olive, ocassional gravel w/lots of shells
M-1	0.6	3.1	100	100	100	100	99	99	97	96	94	92	89	87	84	80	70	66	NP	NP	GP; poorly graded gravel w/sand, medium dense, brown
M-3		NA	100	100	100	96	94	92	90	87	83	76	63	55	47	40	38	36	NP	NP	SP-SM; sand w/silt, olive with lots of shells
N-1	0	2.9	100	100	100	98	98	97	96	96	95	95	94	94	93	89	83	76	25	9	CL; clay w/sand, very soft, dark olive, shells, no odor.
N-3	0	2.9	100	100	100	100	100	99	99	99	99	99	99	98	98	96	95	93	23	15	CL; clay, very soft, occassional shells. PP<25KPa
S-2	0	0.3	100	100	100	99	99	99	98	98	97	96	95	92	84	75	67	64	49	29	CL; sandy clay, very soft, dark olive
S-2	0.3	2.9	100	100	100	99	97	96	95	94	93	92	87	77	50	21	13	10	NP	NP	SM; silty sand, loose olive, with shells
S-4	0	1.1	100	100	100	100	99	99	99	98	97	96	95	94	93	90	89	87	71	37	MH; very soft, dark olive, PP<25KPa
S-4	1.1	2.7	100	100	100	96	93	89	87	84	78	64	40	20	8	4	3	2	NP	NP	SP; sand, light olive, fine grained sand w/shells
SA-1 RUN1	0	0.3	82	68	63	57	50	43	33	20	10	65	4	4	4	4	3	3	NP	NP	SP; poorly graded sand/gravel, greyish brown.
SA-1 RUN1	0.3	4.3	100	100	100	97	95	92	91	88	84	81	79	77	76	75	72	69	19	3	ML; silt w/sand; very soft, shells, odor. PP<25KPa
SA-3 RUN3	0	0.6	93	82	71	61	55	45	36	25	16	11	6	2	1	1	1	1	NP	NP	SP; poorly graded sand w/gravel, brown and grey
SA-3 RUN3	0.6	2.3	100	100	100	100	99	99	99	99	98	98	98	97	96	96	96	95	NP	NP	ML; very soft, olive.

TABLE 5

2002 Vibracore Insitu Density Testing

Boring Number	Location	Type	Total Depth(m)	Time (seconds)
A-1 Run1	Unit II Basin	Vibracore	7.6m	90sec
A-2 Run1	Unit II Basin	Vibracore	6.1m	26sec
A-2 Run2	Unit II Basin	Vibracore	7.6m	81sec
A-3 Run1	Unit II Basin	Vibracore	6.1m	58sec
A-3 Run2	Unit II Basin	Vibracore	7.3m	60sec
A-4	Unit II Basin	Vibracore	6.1m	67sec
A-5	Unit II Basin	Vibracore	6.1m	88sec
A-6 Run1	Unit II Basin	Vibracore	6.1m	78sec
A-6 Run2	Unit II Basin	Vibracore	6.1m	60sec
A-6 Run3	Unit II Basin	Vibracore	6.1m	113sec
B-1	Unit I/III Basin	Vibracore	3.0m	606sec
B-1Run2	Unit I/III Basin	Vibracore	3.2m	960sec
B-2	Unit I/III Basin	Vibracore	3.5m	540sec
B-3 Run1	Unit I/III Basin	Vibracore	3.8m	979sec
B-3 Run2	Unit I/III Basin	Vibracore	3.3m	1200sec
B-4	Unit I/III Basin	Vibracore	2.8m	748sec
B-5 Run1	Unit I/III Basin	Vibracore	2.6m	801sec
B-5 Run2	Unit I/III Basin	Vibracore	2.6m	960sec
B-6	Unit I/III Basin	Vibracore	7.6m	120sec
B-7 Run1	Unit I/III Basin	Vibracore	7.6m	60sec
B-8	Unit I/III Basin	Vibracore	7.8m	100sec
B-10 Run1	Unit I/III Basin	Vibracore	6.1m	300sec
D-6	Main Channel	Vibracore	2.1m	150sec
D-16	Main Channel	Vibracore	2.1m	102sec
D-24	Main Channel	Vibracore	1.5m	60sec
D-32	Main Channel	Vibracore	2.1m	86sec
D-38	Main Channel	Vibracore	3.0m	330sec
D-48	Main Channel	Vibracore	2.4m	62sec
D-52 Run1	Main Channel	Vibracore	1.5m	31sec
D-56	Main Channel	Vibracore	1.7m	110sec
HD-3	Tern Island Channel	Vibracore	3.0m	480sec
M-1	Middle Island Channel	Vibracore	3.0m	131sec
M-3	Middle Island Channel	Vibracore	3.7m	39sec
N-1	New Island	Vibracore	2.9m	42sec
N-3	New Island	Vibracore	2.9m	34sec
S-2	Shellmaker Island	Vibracore	2.9m	28sec
S-4	Shellmaker Island	Vibracore	2.7m	28sec
SA-1 Run1	Shellmaker Island	Vibracore	4.3m	31sec
SA-3 Run3	Shellmaker Island	Vibracore	2.3m	24sec

Table 6

2002 Navy Diver Cores Beach Transects Physical Analysis

24 October 2002 Beach Transects (39th Street, 50th Street, and 60th Street) on Newport Beach Peninsula

BEACH GRADATIONS TRANSECT A, STA 668+53 (39th Street)

Data #	Sample Location No.	Standard Sieve Number Designation																	
		3	1.5	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230
1	Sta A+4	100	100	100	100	100	100	100	100	100	99	94	77	29	6	1	1	1	1
2	Sta A+2	100	100	100	100	100	100	100	100	100	100	94	66	13	2	1	1	1	1
3	Sta A+0	100	100	100	100	100	100	100	99	99	98	95	90	79	51	20	4	1	1
4	Sta A-2	100	100	100	99	99	98	97	94	89	82	74	68	59	44	24	11	2	1
5	Sta A-4	100	100	100	100	99	98	98	97	97	97	97	96	93	82	43	7	2	1
6	Sta A-6	100	100	98	94	91	89	88	88	88	87	87	86	83	72	44	14	4	1
7	Sta A-8	100	100	100	100	100	100	100	100	100	100	100	99	97	93	86	52	21	9
8	Sta A-10	100	100	100	100	100	100	100	100	100	100	99	95	86	71	57	57	39	24
Average		100	100	100	99	99	98	98	97	97	95	93	85	67	53	35	18	9	5

BEACH GRADATIONS TRANSECT B, STA 689+00 (50th Street)

Data #	Sample Location No.	Standard Sieve Number Designation																	
		3	1.5	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230
1	Sta B+4	100	100	100	100	100	100	100	100	100	98	90	65	24	5	1	1	1	1
2	Sta B+2	100	100	100	100	100	100	100	100	100	100	96	73	22	4	1	1	1	1
3	Sta B+0	100	100	100	100	100	100	100	99	99	99	96	85	55	25	9	3	1	1
4	Sta B-2	100	100	100	100	100	100	100	99	99	97	93	89	80	55	25	24	1	1
5	Sta B-4	100	100	100	100	100	100	100	99	99	99	98	95	82	47	16	2	1	1
6	Sta B-6	100	100	100	99	98	97	96	96	95	93	91	86	73	45	18	13	1	1
7	Sta B-8	100	100	100	100	100	100	99	99	99	98	97	96	92	82	57	20	7	2
8	Sta B-10	100	100	100	100	100	100	100	100	100	99	99	97	93	85	75	60	27	14
Average		100	100	100	100	100	100	99	99	99	98	95	86	65	44	25	16	5	3

BEACH GRADATIONS TRANSECT C, STA 713+28 (60th Street)

Data #	Sample Location No.	Standard Sieve Number Designation																	
		3	1.5	3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230
1	Sta C+4	100	100	100	100	100	100	100	100	99	98	94	79	39	10	2	1	1	1
2	Sta C+2	100	100	100	100	100	100	100	100	100	100	99	90	42	8	2	2	1	1
3	Sta C+0	100	100	100	100	100	100	100	100	100	100	100	97	86	34	8	2	1	1
4	Sta C-2	100	100	100	100	100	100	100	99	99	97	93	86	77	53	22	22	1	1
5	Sta C-4	100	100	100	100	100	99	97	94	87	74	53	36	22	12	4	1	1	1
6	Sta C-6	100	100	100	100	99	99	99	99	99	99	99	98	96	85	51	34	3	1
7	Sta C-8	100	100	100	100	100	100	100	100	100	100	99	97	93	78	44	22	5	2
8	Sta C-10	100	100	100	100	100	100	100	100	100	99	98	95	90	81	62	29	15	6
Average		100	100	100	100	100	100	100	99	98	96	92	85	68	45	24	14	4	2

NOTE: The fines limit of 39% and 27% were not considered representative

Table 7

Physical Analysis of 2003 Sampling

Shellmaker Island

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
SM-01-03	0.0	2.7	3.0	0.3	100	100	100	100	99	97	96	93	87	75	49	23	9	9	2	2
	2.7	3.5	0.3	0.2	100	100	99	99	98	98	97	96	93	85	57	24	9	3	2	2
SM-02-03	0.0	1.2	2.0	0.8	100	100	100	99	97	96	94	92	86	76	67	42	28	21	20	19
SM-03-03	0.0	1.2	1.5	0.3	100	100	100	100	100	100	100	100	100	99	97	94	86	86	77	77
	1.2	3.7	0.3	0.2	98	95	90	87	85	84	83	82	80	75	58	40	28	20	19	19
		Fine Limit			100	100	100	100	100	100	100	100	100	99	97	94	86	86	77	77
		Coarse Limit			98	95	90	87	85	84	83	82	80	75	49	23	9	3	2	2
		Average			100	100	100	100	99	97	96	94	90	81	64	44	31	30	24	23

NOTE: Bottom elevations for SM-01-03 and SM-03-03 were adjusted to stop at the project elevation of +0.23 m MLLW.

Main Dike (Salt Dike)

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
SD-01-03	0.0	1.5	2.8	1.3	100	100	99	99	99	98	96	88	74	61	49	42	37	35	32	22
	1.5	3.7	1.3	-0.7	100	100	100	100	100	99	96	86	69	53	42	37	34	34	29	27
SD-02-03	0.0	1.8	3.0	1.2	100	100	100	100	100	99	96	86	70	56	44	37	32	30	28	25
		Fine Limit			100	100	100	100	100	99	96	88	74	61	49	42	37	35	32	27
		Coarse Limit			100	100	99	99	99	98	96	86	69	53	42	37	32	30	28	22
		Average			100	100	100	100	100	99	96	87	71	57	45	39	34	33	30	25

NOTE: Bottom elevations for SD-01-03 was adjusted to stop at the project elevation of -0.68 m MLLW.

Table 7

Physical Analysis of 2003 Sampling

Northstar Beach

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.08	0.063
			Elevation		Standard Sieve Number Designation															
	Depth		m MLLW		3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
NS-01-03	0.0	1.8	5.1	3.3	98	95	92	91	90	89	88	87	83	74	52	25	10	10	3	2
	1.8	3.1	3.3	2.1	98	97	94	93	92	91	90	88	84	76	51	26	12	5	4	3
	3.1	3.7	2.1	1.4	100	100	100	99	99	98	98	97	97	96	93	92	91	90	90	90
NS-02-03	0.0	2.1	3.0	0.9	97	95	91	89	88	87	85	82	74	57	31	14	6	6	2	2
	2.1	2.4	0.9	0.6	100	99	99	98	98	97	97	96	94	88	74	54	31	17	14	12
Fine Limit					100	100	100	99	99	98	98	97	97	96	93	92	91	90	90	90
Coarse Limit					97	95	91	89	88	87	85	82	74	57	31	14	6	5	2	2
Average					99	97	95	94	93	92	92	90	86	78	60	42	30	26	23	22

Bullnose West

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.08	0.063
			Elevation		Standard Sieve Number Designation															
	Depth		m MLLW		3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
BN-01-03	0.0	0.8	1.9	1.1	100	100	100	100	100	100	100	99	98	97	94	89	79	77	52	46
	0.8	1.8	1.1	0.2	100	100	100	100	100	100	100	99	99	97	93	86	81	81	75	74
BN-02-03	0.0	0.3	2.0	1.7	100	100	100	100	100	100	100	100	99	99	98	96	90	79	72	66
	0.3	0.9	1.7	1.1	100	100	100	99	99	96	91	80	60	40	27	22	20	20	18	17
	0.9	1.7	1.1	0.3	100	100	100	100	100	99	97	93	87	82	79	78	78	78	78	78
Fine Limit					100	100	100	100	100	100	100	100	99	99	98	96	90	81	78	78
Coarse Limit					100	100	100	99	99	96	91	80	60	40	27	22	20	20	18	17
Average					100	100	100	100	100	99	98	94	89	83	78	74	70	68	59	57

NOTE: Bottom elevations for BN-01-03 was adjusted to stop at the project elevation of +0.23 m MLLW.

Table 7

Physical Analysis of 2003 Sampling
23rd Street Sampling Areas

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
B-1	0.0	0.2	8.0	7.8	100	97	91												22	
	0.2	0.3	7.8	7.7	100	97	95												77	
	0.3	0.5	7.7	7.5	99	94	83												19	
	0.5	0.6	7.5	7.4	100	99	97												4	
	4.6	5.0	3.4	3.0	100	100	100	100	100	100	100	100	100	100	99	98	91	59	47	40
	6.1	6.6	1.9	1.5	100	100	100	94	90	86	82	77	71	64	56	48	38	29	25	23
	7.6	7.8	0.4	0.2	100	100	100	99	98	96	93	84	66	44	24	15	10	6	4	4
	9.1	9.4	-1.1	-1.4	100	100	100	100	99	99	97	92	82	70	54	46	40	34	31	29
	10.7	11.0	-2.7	-3.0	100	100	100	100	100	99	98	96	93	88	83	77	71	66	59	55
fine limit					100	100	100	100	100	100	100	100	100	100	99	98	91	66	77	55
coarse limit					99	94	83	94	90	86	82	77	66	44	24	15	10	6	4	4
average					100	99	96	99	97	96	94	90	82	73	63	57	50	39	32	30

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
B-2	0.0	0.3	7.2	6.9	100	100	100												25.1	
	0.3	0.6	6.9	6.6	100	99	99												8.5	
	0.6	0.9	6.6	6.3	100	100	100												21.6	
	0.9	1.2	6.3	6.0	100	99	96												62.1	
	1.2	1.5	6.0	5.7	100	99	98												62.4	
	1.5	1.8	5.7	5.4	100	99	99												78.3	
	1.8	4.0	5.4	3.2	100	100	99												21.1	
	4.0	4.6	3.2	2.6	100	100	100												5.9	
	4.6	4.7	2.6	2.5	100	100	100	100	100	100	100	100	99	99	98	96	65	28	19	15
	6.1	6.6	1.1	0.6	100	100	100	99	98	96	95	94	92	88	80	59	30	11	7	6
	7.6	8.1	0.2	0.2	100	100	100	100	100	100	100	99	99	99	98	94	80	61	54	50
	9.1	9.6	0.2	0.2	100	100	100	97	95	93	91	90	89	88	86	85	83	76	66	60
fine limit					100	100	100	100	100	100	100	100	99	99	98	96	83	76	78	60
coarse limit					100	99	96	97	95	93	91	90	89	88	80	59	30	11	6	6
average					100	100	99	99	98	97	97	96	95	94	91	84	65	44	26	33

NOTE: Bottom elevation for B-2 were adjusted to stop at the project elevation at this location which is +0.2 m MLLW.

Table 7

Physical Analysis of 2003 Sampling
23rd Street Sampling Areas

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
B-3	0.0	0.6	6.6	6.0	100	99	98												19.8	
	0.6	1.5	6.0	5.1	99	97	95												13.7	
	1.5	1.8	5.1	4.8	100	99	98												19.3	
	1.8	2.4	4.8	4.2	100	100	99												15.5	
	2.4	3.0	4.2	3.6	100	100	100												18.8	
	3.0	3.7	3.6	2.9	100	100	100												20.4	
	3.7	4.3	2.9	2.3	100	99	99												18.9	
	4.3	4.6	2.3	2.0	100	100	100												19	
	4.6	5.2	2.0	1.4	100	100	100	100	99	99	99	99	99	98	98	96	81	44	30	25
	6.1	6.4	0.5	0.2	100	100	100	98	97	96	96	95	93	91	86	75	47	22	15	12
	7.6	8.1	0.2	0.2	100	100	100	100	100	99	99	99	99	98	97	95	91	86	83	80
	9.1	9.4	0.2	0.2	100	100	100	97	94	92	90	88	84	82	79	77	75	74	71	70
fine limit					100	100	100	100	100	99	99	99	99	98	98	96	91	86	83	80
coarse limit					99	97	95	97	94	92	90	88	84	82	79	75	47	22	14	12
average					100	100	99	99	98	97	96	95	94	92	90	86	74	57	20	47

NOTE: Bottom elevation for B-3 were adjusted to stop at the project elevation at this location which is +0.2 m MLLW.

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
B-4	0.0	0.3	7.7	7.4	100	96	85												7.5	
	0.3	0.6	7.4	7.1	100	100	98												3.1	
	0.6	0.9	7.1	6.8	100	95	91												58.9	
	0.9	1.2	6.8	6.5	100	93	85												45	
	1.2	1.5	6.5	6.2	100	100	100												53.2	
	1.5	1.8	6.2	5.9	100	100	100												51.5	
	1.8	2.1	5.9	5.6	100	100	100												40.8	
	2.1	2.4	5.6	5.3	100	99	99												44.4	
fine limit					100	100	100	-	-	-	-	-	-	-	-	-	-	-	59	
coarse limit					100	93	85	-	-	-	-	-	-	-	-	-	-	-	3	
average					100	98	95	-	-	-	-	-	-	-	-	-	-	-	38	

Table 7

Physical Analysis of 2003 Sampling
23rd Street Sampling Areas

US Standard Sieve Sizes					19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Depth		Elevation m MLLW		Standard Sieve Number Designation															
					3/4"	3/8"	4	7	10	14	18	25	35	45	60	80	120	170	200	230
Location	Top	Bot	Top	Bot	fine gravel		coarse sand		medium sand					fine sand					fines	
B-5	0.0	0.3	7.0	6.7	100	100	100												26.7	
	0.3	1.2	6.7	5.8	100	100	100												12.1	
	1.2	1.4	5.8	5.6	100	100	100												47.3	
	1.4	1.8	5.6	5.2	100	100	100												81	
	1.8	2.3	5.2	4.7	100	100	100												85	
	2.3	2.7	4.7	4.3	100	100	100												42.6	
	2.7	3.4	4.3	3.6	100	100	100												12.3	
fine limit					100	100	100	-	-	-	-	-	-	-	-	-	-	-	85	-
coarse limit					100	100	100	-	-	-	-	-	-	-	-	-	-	-	12	-
average					100	100	100	-	-	-	-	-	-	-	-	-	-	-	39	-

TABLE 8

Grain Size Comparison (Bullnose, Main Dike, 23rd Street, Northstar Beach, Shellmaker Island, and Newport Beach)

Comparison of Newport Beach fines limit, coarse limit, and composite average to the composite averages of Bullnose, Main Salt Dike, Northstar Beach, Shelmaker Island, and 23rd Street sample composites (composite areas for 23rd Street, B-1, B-2, B-3, B-4, and B-5).

US Standard Sieve Sizes (mm)	19	9.5	4.75	2.8	2	1.4	1	0.71	0.5	0.355	0.25	0.18	0.125	0.09	0.075	0.063
	Standard Sieve Size Designation															
Location	3/4"	3/8"	No. 4	No. 7	No. 10	No. 14	No. 18	No. 25	No. 35	No. 45	No. 60	No. 80	No. 120	No. 170	No. 200	No. 230
Newport Beach fine limit	100	100	100	100	100	100	100	100	100	99	97	93	86	60	11	6
Newport Beach coarse limit	98	98	94	91	89	88	87	74	53	36	13	2	1	1	1	1
Newport Beach composite average	100	100	100	99	99	98	98	96	93	85	67	47	28	16	6	3
Bullnose composite average	100	100	100	100	100	99	98	94	89	84	79	75	70	69	59	58
Main Dike composite average	100	100	100	100	100	99	96	87	71	56	45	38	34	33	30	25
23rd Street B-1 composite average	100	100	99	12	12	11	11	11	11	11	10	8	5	2	34	1
23rd Street B-2 composite average	100	100	99	12	12	11	11	11	11	11	10	8	5	2	26	1
23rd Street B-3 composite average	100	99	99	17	17	17	17	17	17	17	17	16	12	7	20	4
23rd Street B-4 composite average	100	93	85	0	0	0	0	0	0	0	0	0	0	0	38	0
23rd Street B-5 composite average	100	100	100	0	0	0	0	0	0	0	0	0	0	0	39	0
Shellmaker Island composite average	99	99	97	96	95	94	93	91	87	80	62	41	28	25	24	20
Northstar Beach composite average	98	96	93	92	91	90	89	87	82	71	50	30	18	16	23	12

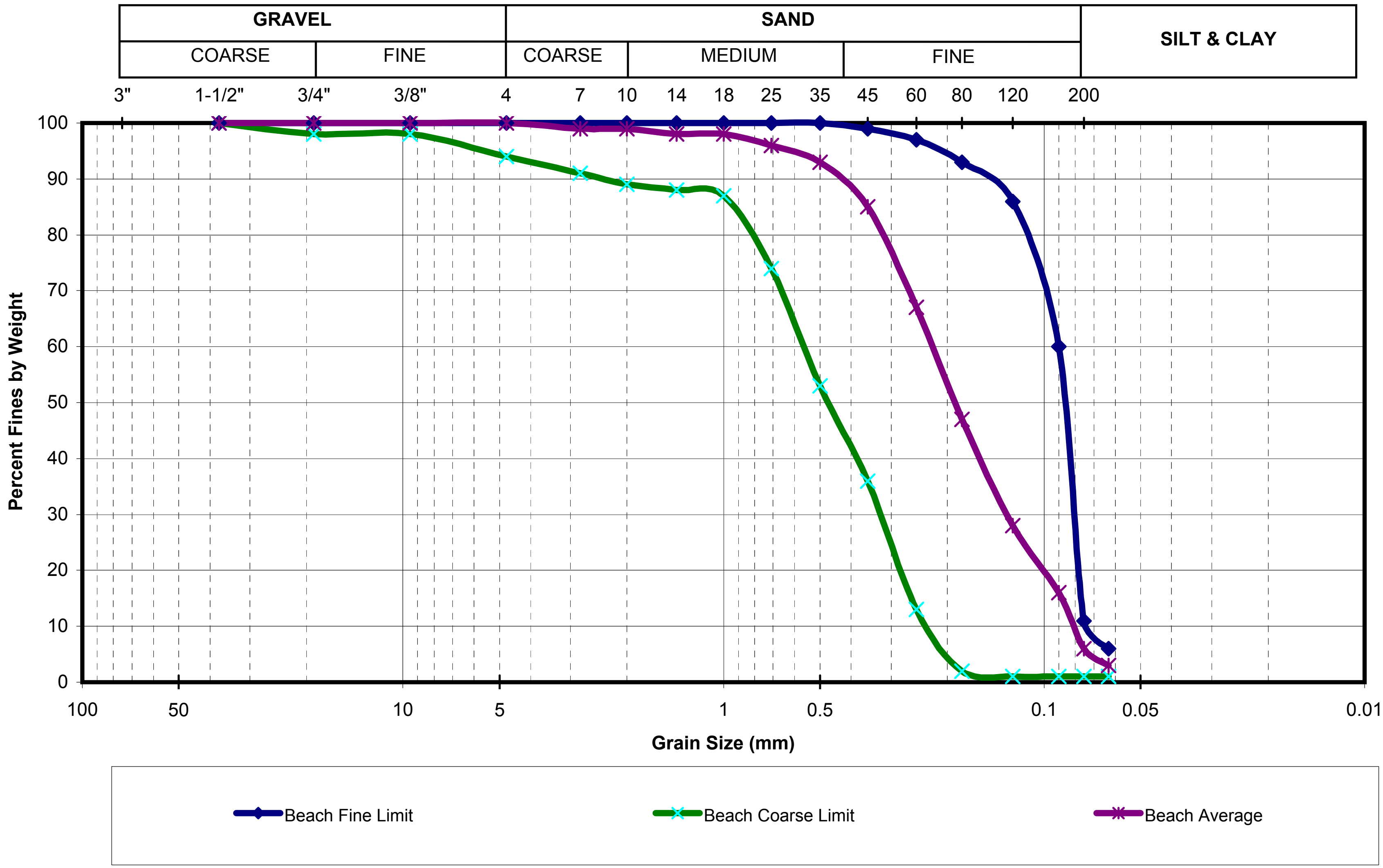

Figure 1

Beach Gradation Envelope (coarse limit, fine limit, and average)

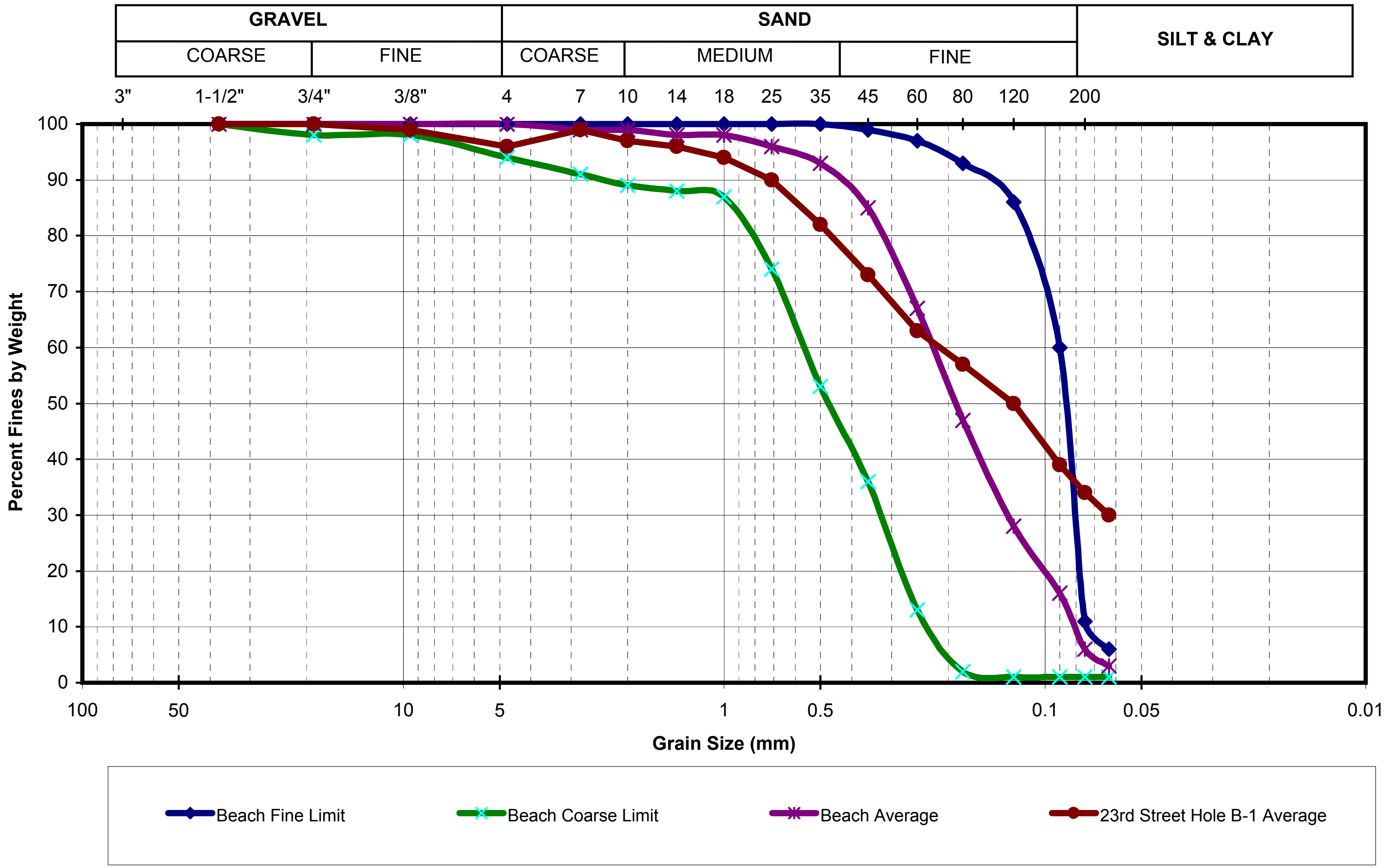

Figure 2

Beach Gradation Envelope vs. 23rd Street Average Grain Size Hole B-1

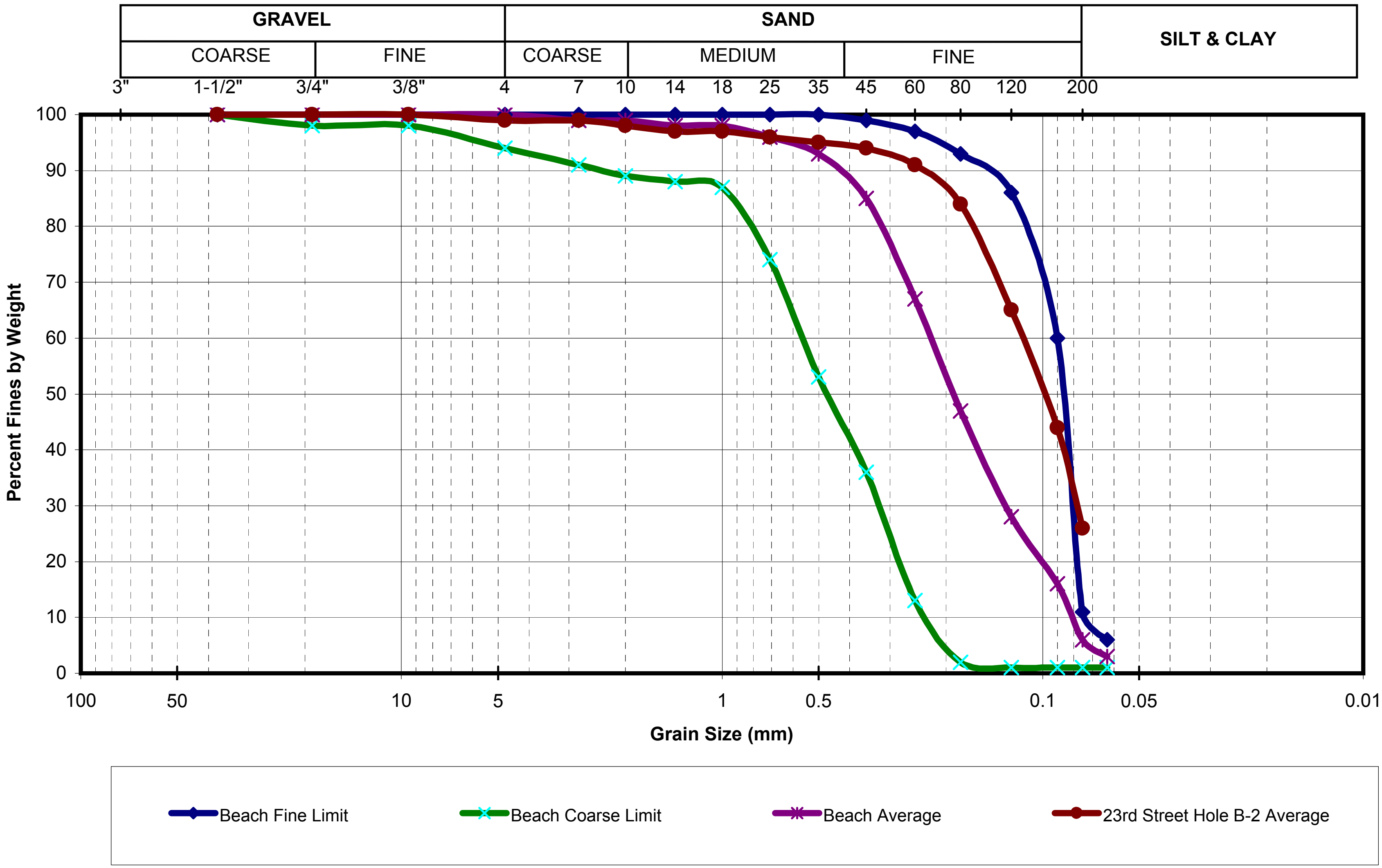

Figure 2
Beach Gradation Envelope vs. 23rd Street Average Grain Size Hole B-2

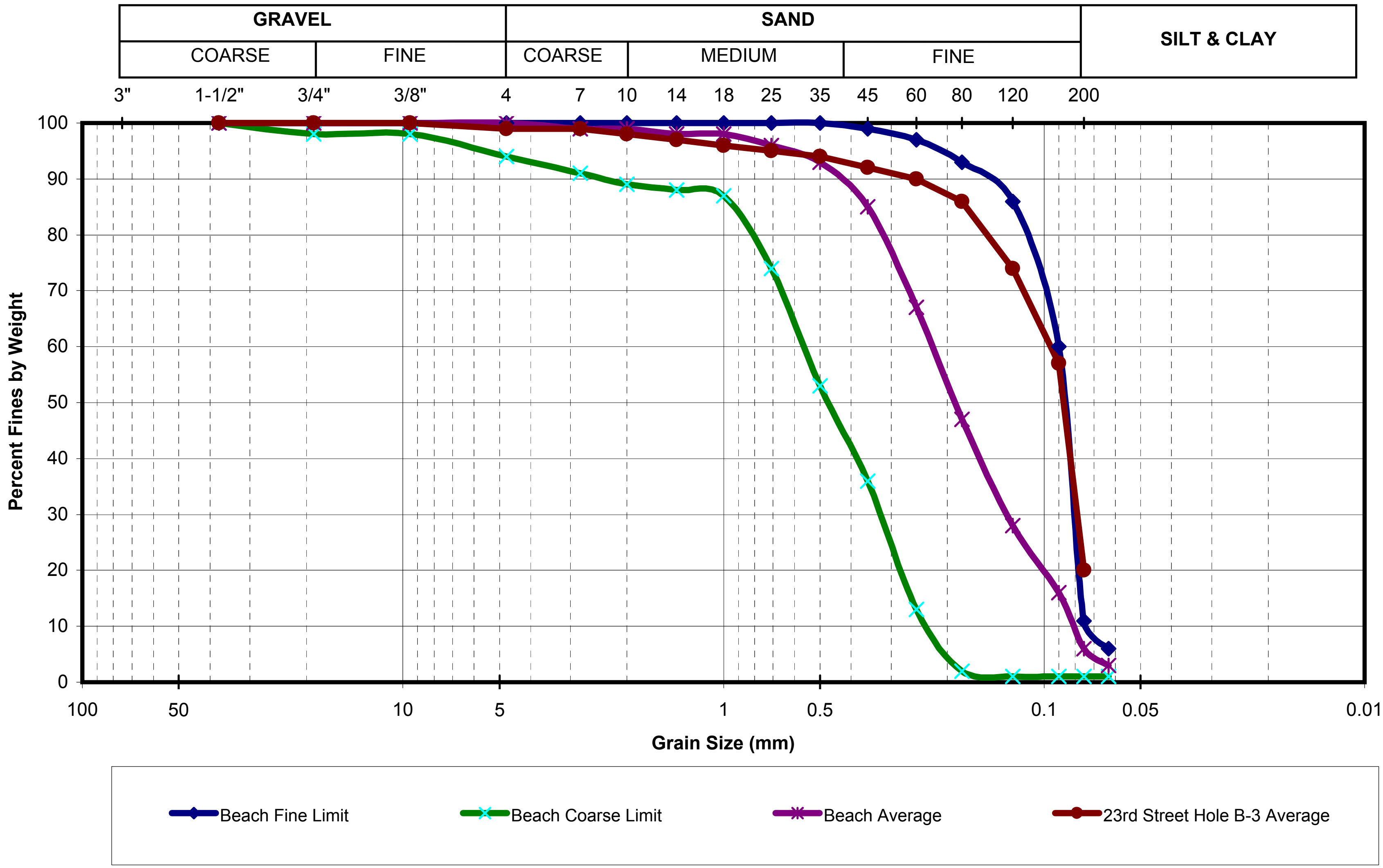

Figure 2
Beach Gradation Envelope vs. 23rd Street Average Grain Size Hole B-3

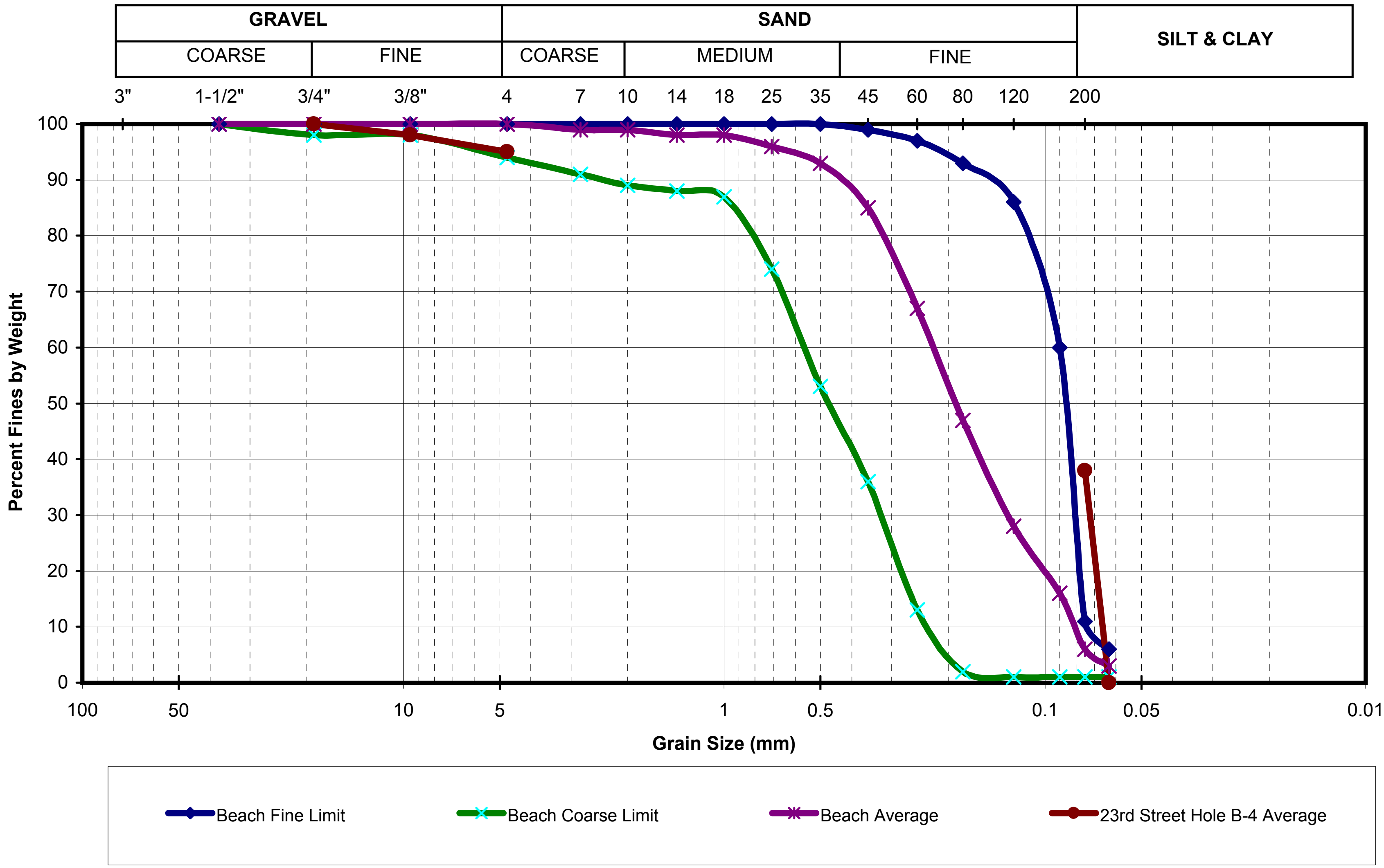

Figure 2
Beach Gradation Envelope vs. 23rd Street Average Grain Size Hole B-4

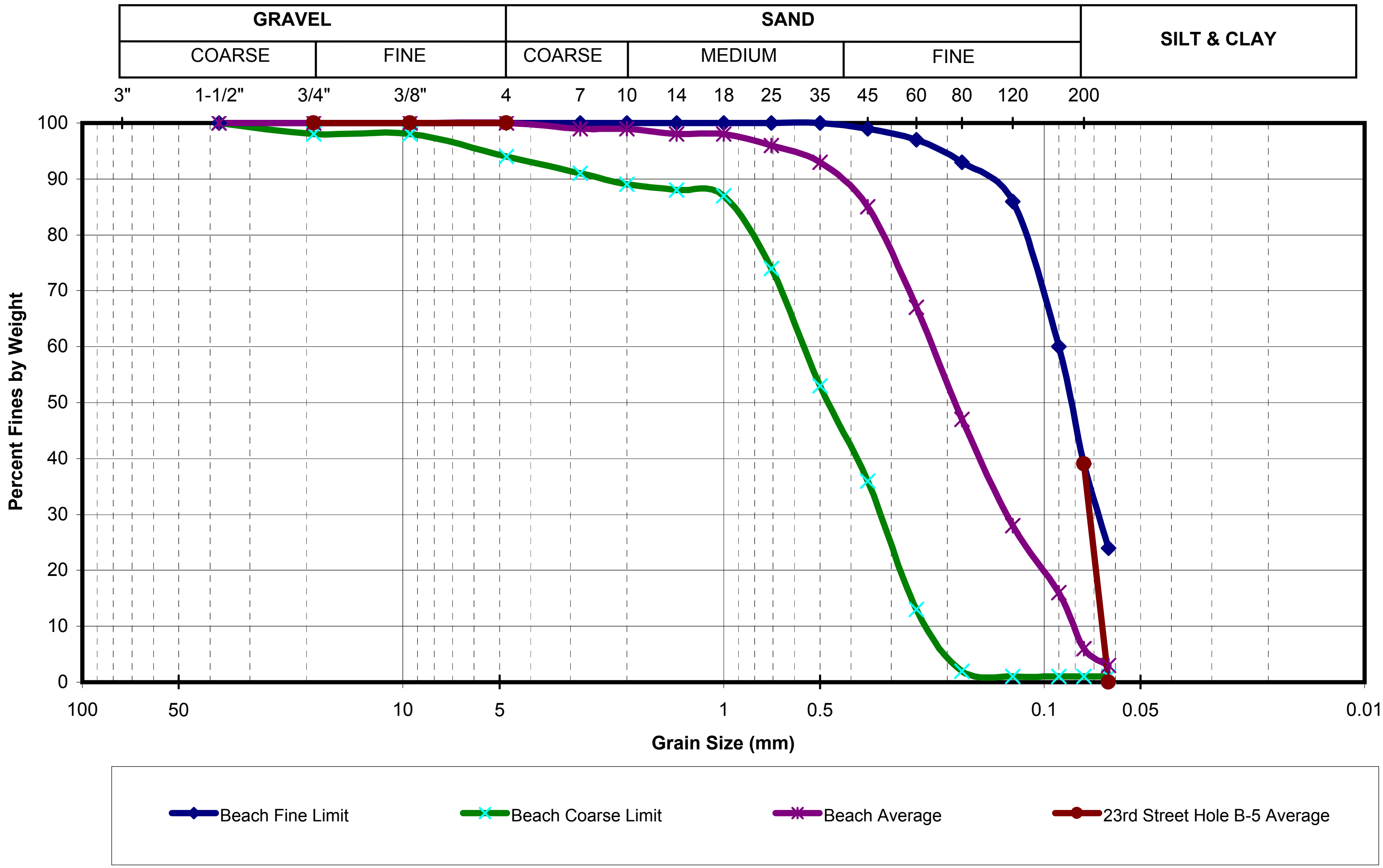

Figure 2
Beach Gradation Envelope vs. 23rd Street Average Grain Size Hole B-5

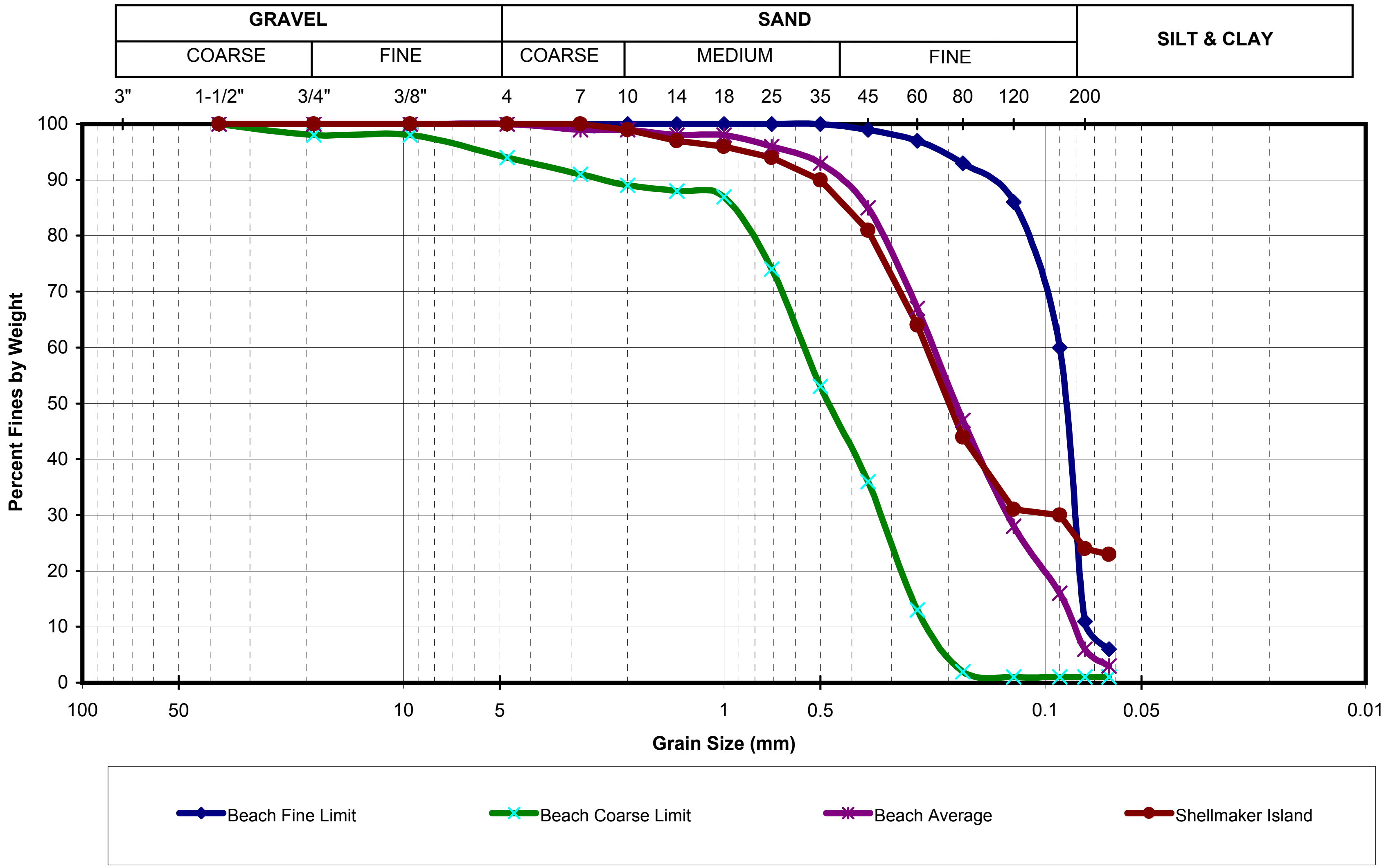

Figure 3
Beach Gradation Envelope vs. Shellmaker Island

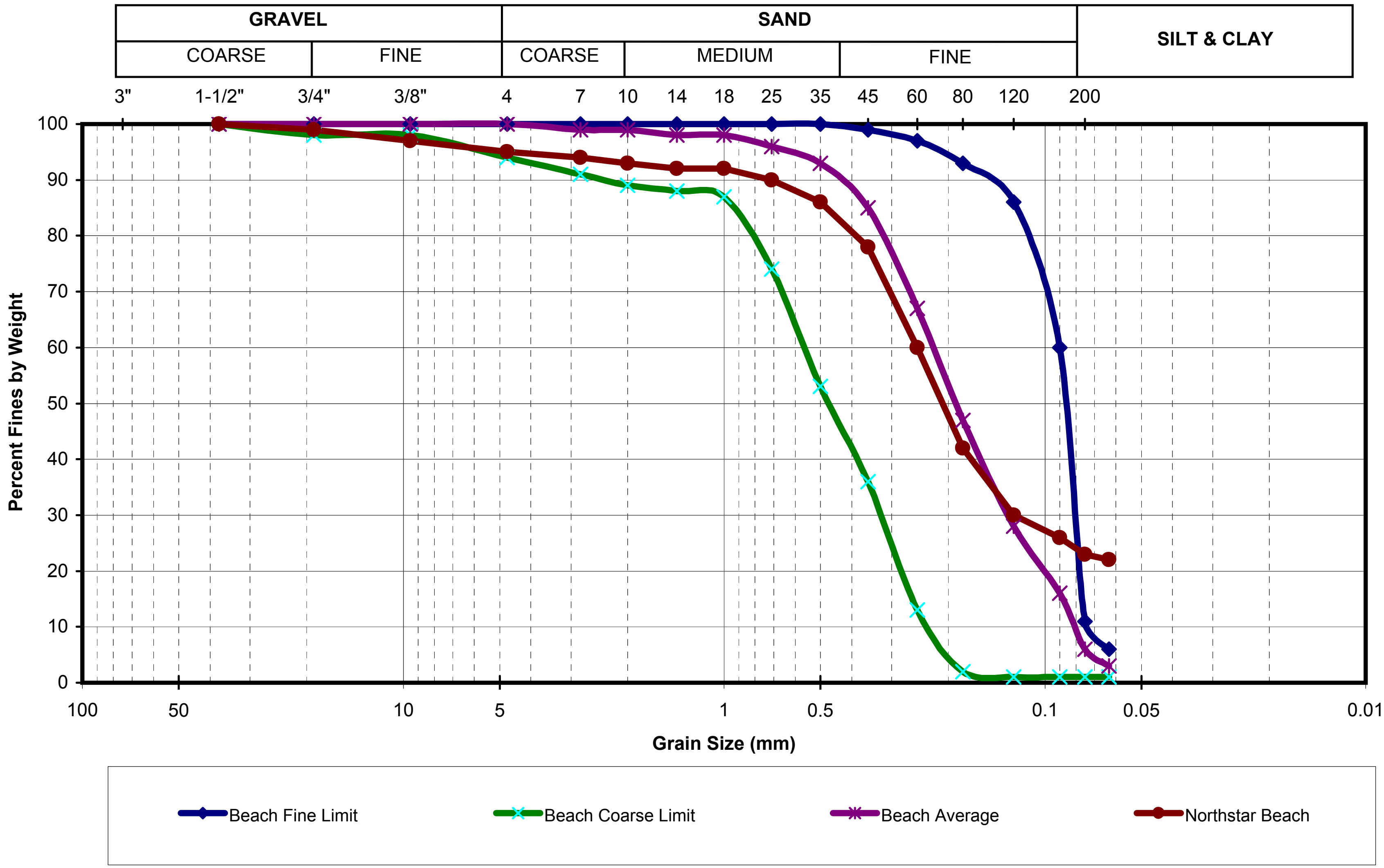

Figure 4
Beach Gradation Envelope vs. Northstar Beach