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August 23, 2007

Mr. Jim Baskin, AICP, Coastal Planner
California Coastal Commission
North Coast District Office
710 E Street, Suite 200
Eureka, CA 95501

Re: City of Eureka and Humboldt Bay Harbor, Recreation & Conservation District - Eureka Waterfront and Woodley Island Marina Cooperative Maintenance Dredging Project. CDP Nos. 1-05-039 and 1-05-040.

Subject: Submittal of Post Project Monitoring Report of the Samoa Beach Dredge Spoils Disposal Site.

Dear Mr. Baskin:

On behalf of the City of Eureka and the Humboldt Bay Harbor, Recreation and Conservation District please find enclosed for the review by the California Coastal Commission the document prepared by Pacific Associates entitled: Samoa Beach Surf Zone Disposal Post Project Monitoring Report dated August 23rd, 2007. Infauna Community Survey Reports were prepared by Tetra Tech and are included in this report.

The California Coastal Commission (CCC) issued Coastal Development Permits 1-05-039 and 1-05-040 for the project on August 22nd, 2006. The CCC approved the Samoa Beach Monitoring Plan on August 26th, 2006 as a Special Condition attached to the Coastal Development Permits. Maintenance dredging commenced on November 10th, 2006 and terminated on March 31st, 2007. Approximately 230,065 cubic yards of dredged material were disposed at the Samoa beach disposal site over the duration of the project.

This report provides data following termination of the project from May, 2007 to July, 2007. The pre and 'during' project monitoring reports were submitted to the CCC on November 2nd, 2006 and June 7th, 2007 respectively. The 'during' project monitoring report included data from November, 2006 until April, 2007. The purpose of this report is to provide the data collected from the beach disposal site following dredging operations, which in conjunction with the pre and 'during' project monitoring data, will allow the CCC to evaluate the implementation of near shore ocean disposal for future maintenance dredging episodes.

Near shore beach disposal proved to be a successful dredging disposal methodology in this dredging episode and in the past three dredging episodes. Pacific Associates will continue to monitor the Samoa beach annually in July until 2011 as required by the California Coastal Commission.

Should you have any questions or require any additional information please contact me at (707) 445-3001 or via email to ytilles@pa-schneiderdock.com.

Sincerely,

Yoash Tilles
Project Manager
E.I.T. 117566

Enclosures: Samoa Beach Surf Zone Disposal Post Project Monitoring Report. Prepared by P.A and Tetra Tech.
August 23, 2007

cc: File 04-930/940 David Hall, CEO - HBHRCD
Mike Knight, Assistant City Manager - Operations - City of Eureka Debra A. O'Leary – DDMO, USACOE

CITY OF EUREKA

and

**HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION
DISTRICT**

**COOPERATIVE EUREKA WATERFRONT FACILITIES
MAINTENANCE DREDGING PROJECT**

EUREKA CHANNEL, HUMBOLDT BAY, CALIFORNIA



**SAMOA BEACH SURF ZONE DISPOSAL
POST PROJECT MONITORING REPORT**

PREPARED BY:



**PACIFIC AFFILIATES, INC.
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SUBMITTED AUGUST 23, 2007

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Tetra Tech. *Samoa Beach Dredge Disposal Infaunal Community Survey Report*. Dredge Disposal Sampling May 2007. Submitted to Pacific Affiliates, June 10, 2007.

Tetra Tech. *Samoa Beach Dredge Disposal Infaunal Community Survey Report*. Dredge Disposal Sampling June 2007. Submitted to Pacific Affiliates, July 10, 2007.

Tetra Tech. *Samoa Beach Dredge Disposal Infaunal Community Survey Report*. Dredge Disposal Sampling July 2007. Submitted to Pacific Affiliates, August 1, 2007.

CITY OF EUREKA AND HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT

COOPERATIVE EUREKA WATERFRONT FACILITIES MAINTENANCE DREDGING PROJECT

EUREKA CHANNEL, HUMBOLDT BAY, CALIFORNIA

SAMOA BEACH DISPOSAL SITE - POST PROJECT MONITORING

1.0 INTRODUCTION

The City of Eureka and the Humboldt Bay Harbor, Recreation and Conservation District contracted Nehalem River Dredging to conduct the maintenance dredging along the Eureka Waterfront and Woodley Island Marina located in the Inner and Outer reach of the Eureka Channel in Humboldt Bay. Dredging commenced November 10th, 2006 and terminated on March 31st, 2007. Approximately 230,065 cubic yards of dredged material were disposed at the Samoa beach disposal site over the duration of the project.

The California Coastal Commission (CCC) issued Coastal Development Permits (CDP) 1-05-039 and 1-05-040 for the project on August 22nd, 2006. The CCC approved the Samoa Beach Monitoring Plan on August 26th, 2006 as a Special Condition attached to the CDPs. The pre project monitoring report was submitted to the CCC and the U.S. Army Corps of Engineers (USACOE) on November 2nd, 2006. The 'during' and first-month post monitoring data from November, 2006 to April, 2007 was submitted to the CCC and the USACOE on June 7th, 2007. This report includes the data following termination of the project from May, 2007 to July, 2007. The purpose of this report is to provide the data collected from the beach disposal site following dredging operations, which in conjunction with the pre and 'during' project monitoring data, will allow the CCC and the USACOE staff to evaluate for future maintenance dredging the near shore dredge spoils disposal alternative that was employed for the duration of this dredging episode.

The post project surf zone disposal monitoring report provides information on the following natural ocean conditions: (1) the pattern of dispersal of material deposited at the site; (2) sediment characteristics at the disposal site and at the control site; (3) the species composition and abundance of intertidal invertebrates in areas that were directly affected by the disposal of dredge spoils and at a control site near the disposal area.

This document provides post project data on: (a) grain size distribution in the immediate area of the disposal site and a control site extending from the high tide strand to the swash zone to adequately monitor changes in the composition of the sediment and to monitor the movement and dispersal of discharged materials. Sediment samples were collected on May 17th-18th, June 14th and July 12th -13th, 2007, (b) hydrographic surveys and turbidity measurements of the beach disposal and control sites conducted on May 1st, 2007 (provided in the 'during' project monitoring report), June 21st, 2007, and July 19th, 2007; land surveys of the beach transects were conducted on June 19th, 2007 and July 13th, 2007, and (c) aerial photographs of shoreline from the Mad to the Eel Rivers taken on April 13th, 2007 which were presented in the preceding report.

Sediment composition is addressed in Section 2 of this document. Patterns and rates of dispersal are discussed in Section 3.0 of this document. Hydrographic surveys at the disposal site and the control site are presented in Section 3.1 and aerial photographs in Section 3.2. Turbidity is measured in terms

of Total Suspended Solids (TSS) in milligrams per liter (mg/l) and is addressed in Section 4.0. Infaunal community reports are addressed in Section 5.0.

Monitoring data from the Samoa Beach disposal site and the control site over the last 11 months (September 2006 – July, 2007) indicate that disposal at the beach has no long term impacts on the beach. Sediment composition, invertebrate abundance and water quality data are used to demonstrate this conclusion in this document.

2.0 SEDIMENT COMPOSITION

Sediment composition at the beach disposal site and the control site was monitored by collecting sediment core samples for grain size analysis.

2.1 Sediment Sampling Locations

The same four transects sampled prior to commencement, and during dredging operations were sampled again following disposal operation for four consecutive months (April – July, 2007). These four transects were established perpendicular to the beach slope in the following locations:

- Transect A: Dredge disposal site, where the pipeline empties into the surf zone,
- Transect B: Control site, on the beach 1,000 meters (~3,280 feet) south of the pipeline terminus.
- Transect C: 100 meters (~328 feet) north of the pipeline terminus (Transect A)
- Transect D: 100 meters (~328 feet) south of the pipeline terminus (Transect A)

Sediment samples were collected at the high tide line, at the swash zone at low tide, and at a station along the middle of each transect as listed in Table 1 and shown in Figure 8. Each sampling location was recorded using a GPS device. The GPS horizontal and vertical accuracy for the Eureka area is within 0.3 feet.

Table 1: Locations of sediment samples collected at the beach disposal site and the control site.

Sample I.D.	Transect	Latitude	Longitude
A1-1-GSA	Pipeline - Bottom	40° 49' 37.26" N	124° 11' 18.23" W
A2-1-GSA	Pipeline - Middle	40° 49' 40.01" N	124° 11' 16.75" W
A3-1-GSA	Pipeline - Top	40° 49' 35.79" N	124° 11' 14.76" W
B1-1-GSA	100m North -Bottom	40° 49' 11.02" N	124° 11' 36.53" W
B2-1-GSA	100m North -Middle	40° 49' 10.26" N	124° 11' 34.74" W
B3-1-GSA	100m North -Top	40° 49' 09.36" N	124° 11' 32.31" W
C1-1-GSA	100m South - Bottom	40° 49' 40.01" N	124° 11' 16.75" W
C2-1-GSA	100m South - Middle	40° 49' 39.10" N	124° 11' 14.67" W
C3-1-GSA	100m South - Top	40° 49' 38.70" N	124° 11' 13.57" W
D1-1-GSA	Control - Bottom	40° 49' 34.63" N	124° 11' 20.27" W
D2-1-GSA	Control - Middle	40° 49' 33.88" N	124° 11' 18.41" W
D3-1-GSA	Control - Top	40° 49' 09.28" N	124° 11' 32.25" W

The sampling team made an effort to collect the sediment samples from the furthest oceanward locations along each transect that could be reached without putting staff at risk and to collect the samples from the same location throughout the monitoring period.

2.2 Sediment Sampling Methodology

Samples were collected by drive-tube methodology. A sediment sampler was designed and manufactured by AMS, Inc. for this project. The sampler consistently collected undisturbed samples to the required depth below the sediment surface without contaminating the samples. The upper two centimeters of the sediment column were evaluated. When the upper two centimeters of sediment were collected, a minimum penetration depth of four-five centimeters was achieved for each acceptable sample. A minimum of 100-150 grams of sediment was collected. The material was then transferred to the appropriately labeled lab supplied wide-mouth 4-Oz glass jars. A more detailed discussion of the sediment sampling methodology is described in Samoa Beach Monitoring Plan (Pacific Affiliates, 2006).

2.3 Description of Sediment Sampling Events

A total of 12 grab samples were collected during each sampling event by Yoash Tilles, EIT and Jeremy Webb. A duplicate of each sample was also collected and is stored at Soils Control Lab. Chain-of-Custody forms and original lab results can be found in Appendix I. Samples were collected on April 25th, 2007, May 17th-18th, 2007 June 14th – 16th, 2007, and July 12th -13th, 2007.

2.4 Laboratory Procedures

Grain size distribution was determined by sieve analysis for particles greater than 63 micrometers and less than 32 millimeters (Plumb, 1981). Below 63 micrometers fraction size was determined by settling rates. The pipette method was used to determine the settling rates of the particles. A more detailed discussion of the laboratory procedures is described in Samoa Beach Monitoring Plan (Pacific Affiliates, 2006).

2.5 Sediment Sampling Results

The fraction of sand in each sediment samples from the monitoring locations (Transect A, B, C, and D) was inspected to determine temporal changes in sediment composition over time at the beach. Grain size composition (sand, silt, and clay) was also compared between the project monitoring sites (Transects A, C, and D) and the control site (Transect B) to determine whether the disposal operations contributed to changes in the grain size distribution at the disposal site.

At the Pipeline Transect the least percent sand, 95.79 was found in April at the bottom of the transect in the swash zone (Figure 4). Prior to disposal operations this location had 99.93 percent sand. However, by July, 2007, 99.81 percent sand was present at this location, indicating a decrease of 0.02 percent sand. At the Control Transect, the least percent sand, 95.17, was found in January at the bottom of the transect (Figure 1). Prior to disposal operations this location had 99.86 percent sand. By July, 2007, 99.77 percent sand was present at the bottom of the control site. The sediment composition in the sample collected from the bottom of the pipeline transect was approximately the same prior to and three month following termination of the project. The sample collected at the control transect in July, 2007 had a higher fraction of sand in the sample collected prior to disposal operations. The location most impacted during disposal operations was the bottom of the Pipeline Transect. Nevertheless, the temporal changes in sediment composition indicate that the sediment distribution at the bottom of Samoa Beach disposal site was predominantly governed by natural weather and ocean conditions (tides, swell, currents, and winds). Three months following termination of the project the sediment composition at the Pipeline Transect returned to pre project conditions.

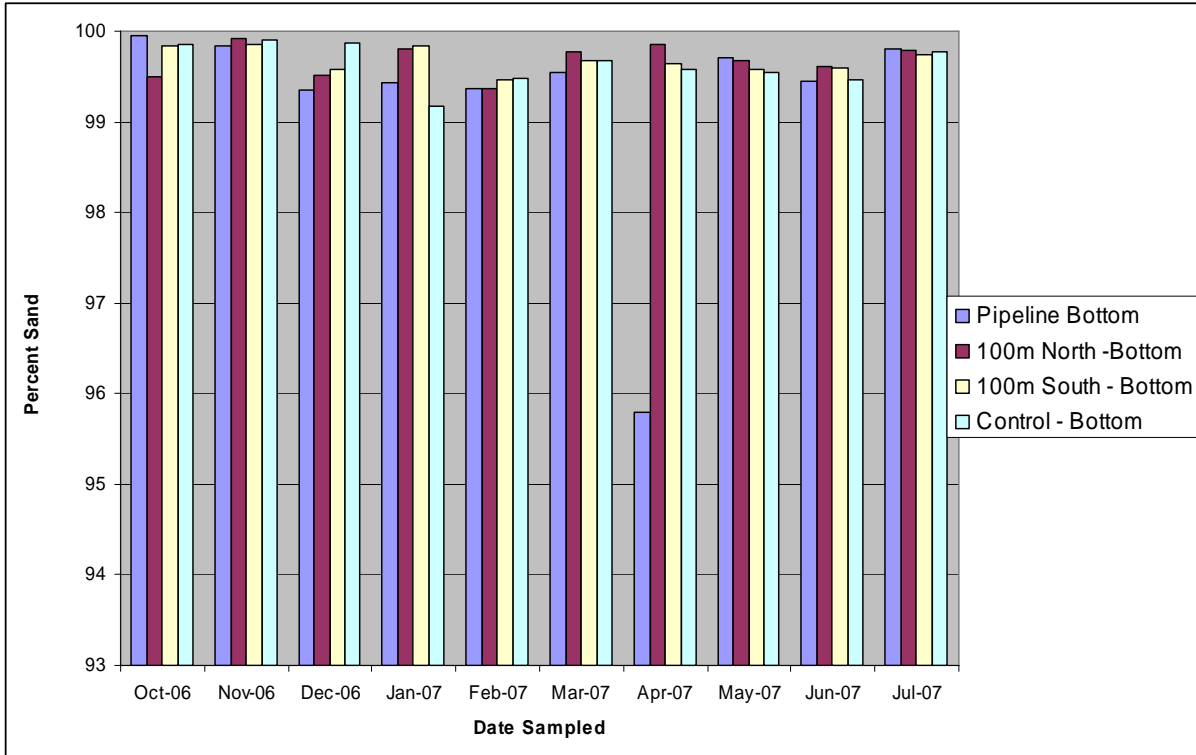


Figure 1: Comparison of sand fraction in sediment samples from the bottom of each transect indicated that no significant difference has occurred in the sediment composition as a result of dredge spoils disposal operations.

At the South Transect, the maximum percent sand, 99.96, was found at the middle of this transect in November, 2006, following commencement of disposal operations. This location had 99.00 percent sand in May, 2007 and increased to 99.78 percent by July 2007 following disposal operation (Figure 2). At the Control Transect, the maximum percent sand, 99.86, was found at the middle of this transect in October, 2006, prior to commencement of disposal operations. The middle sampling site had the lowest fraction of sand when compared to the upper and lower sampling locations along this transect. This site had 99.43 percent sand in May, 2007 (as with the South Transect) and increased to 99.83 percent by July 2007 following disposal operation (Figure 2). This comparison shows that the sediment composition at the middle of the Control and South Transect exhibit similar temporal patterns in sediment distribution. The temporal pattern that emerges is that the fraction of sand decreases during the winter and increases back to pre-winter conditions in the spring and the summer.

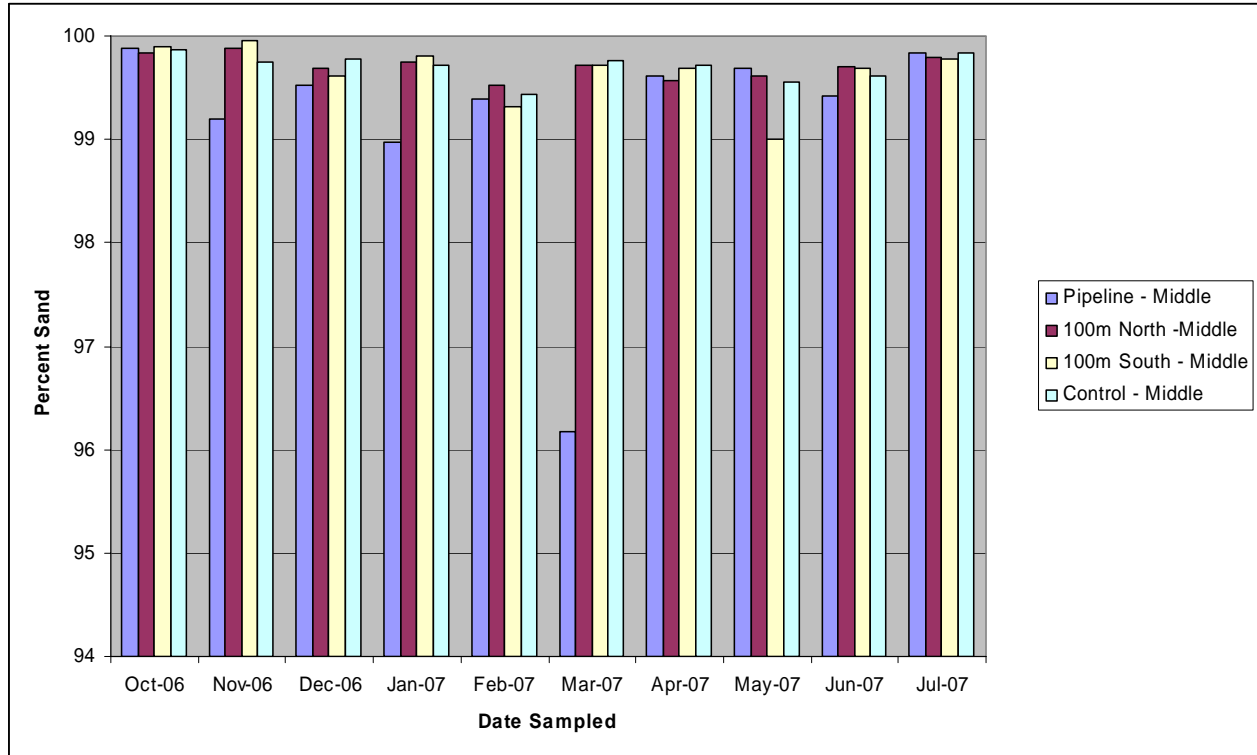


Figure 2: Percent sand at the middle of four monitoring transects.

The top of all monitoring transects including the Control Transect exhibit the least temporal variation in sediment composition when compared to the middle and bottom sampling locations (Figure 3). At the top of the Pipeline Transect the percent sand varied between a maximum of 99.94 percent in July, 2007 and a minimum of 98.35 percent in November, 2006 (1.59 percent difference). At the top of North Transect the maximum percent sand, 99.92, was found in October, 2006, prior to commencement of disposal operations. This location had 99.89 percent sand in May, 2007 and decreased to 99.73 percent by July 2007, three month following disposal operation (0.19 percent difference). The sediment composition at the top of the South Transect varied between a maximum of 99.93 percent in January and a minimum of 98.97 percent in March, 2007 (0.96 percent difference). The sediment composition at the top of the Control Transect varied from a minimum of 99.39 percent in November, 2006 and a maximum of 99.92 in July, 2007 (0.53 percent difference). The data indicates that a change in sediment composition at the Samoa beach is a function of both time of the year and location. The exact direction in which each section of the Samoa beach faces determines the effects of weather and ocean conditions on the sediment composition and transport at a specific monitoring location. The data suggests that weather and ocean conditions dominate any effects dredge disposal operations may have on sediment composition, if any, at the top of the north, south, and control transects.

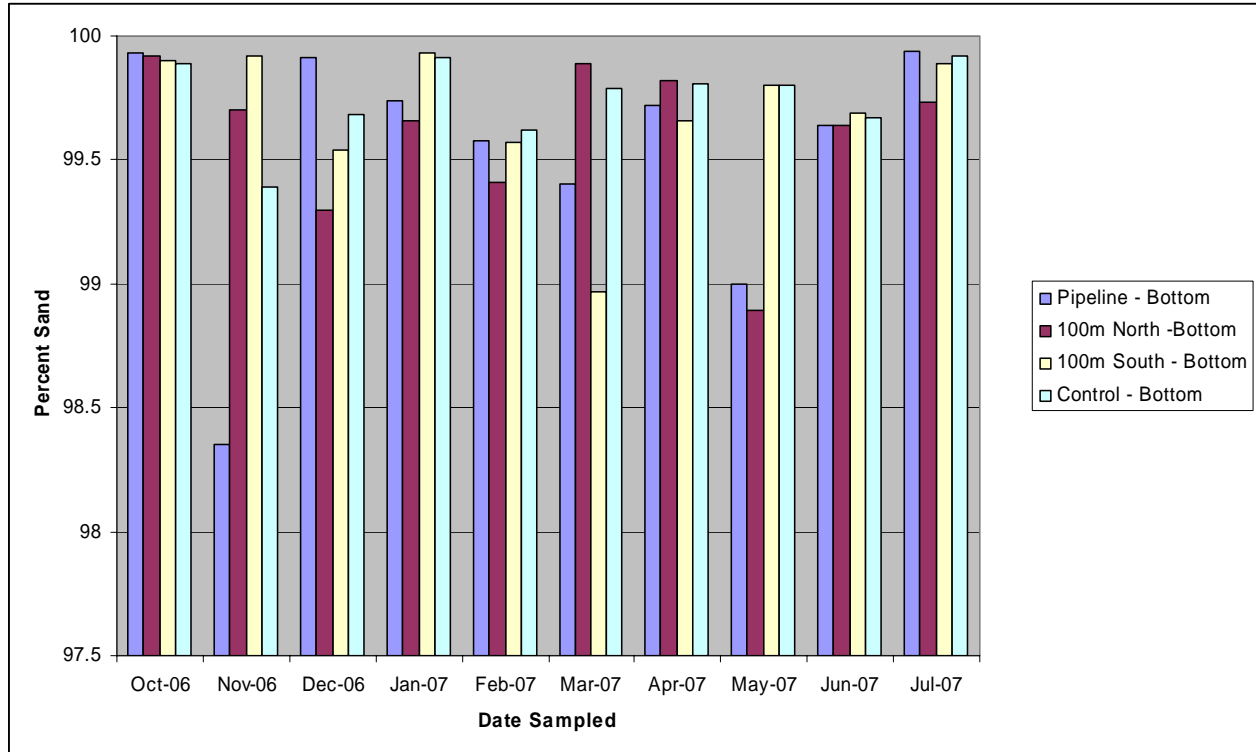


Figure 3: Percent Sand at the top of the monitoring transects.

The analysis presented above indicates that the sediment composition along the North and South Transects, located 100 meters from either side of the pipeline transect, did not change significantly between October, 2006 and July 2007. The analysis suggests that the variation in sediment composition was not affected by dredge disposal operations. Changes in the percent sand in the sediment were less than one percent along the North, South and Control Transect.

The results indicate that the affects of the dredge spoils disposal operation are localized. The only location that a significant change in sediment composition occurred during disposal operations was along the Pipeline Transect (Tables 2-4). There was a difference of 1.59 percent in the fraction of sand between the sediment sample collected in November, 2006 and the sediment sample collected in July, 2007. The difference in percent sand, however, in the sample collected in July, 2007 and the samples collected prior to disposal operations in October, 2006 is 0.01 percent, indicating that the top of pipeline transect recovered from disposal operations. Percent sand in the sediment collected at the middle of the pipeline transect varied by 3.71 percent between October, 2006 and March, 2007. The difference in the percent of sand in the samples collected prior to the commencement of the project in October and in the sediment sample collected in June was 0.05 percent, indicating that the middle of the pipeline transect had also returned to pre project conditions. Finally, the fraction of sand in the sediment samples collected at the bottom of the beach varied by 4.16 percent between October, 2006 and April, 2007. The difference in the percent of sand in the samples collected prior to the commencement of the project in October and in the sediment sample collected in July, three months following termination of the project, was 0.14 percent. This analysis of the data demonstrates that the sediment composition at the Pipeline Transects returned to pre project conditions three months following termination of disposal operation. The sediment composition along the North and South Transects was not affected by disposal operations.

Table 2: Grain size distribution in sediment from the beach disposal and control sites.

Transect	Sample I.D.	Prior to Dredging October 5-6, 2006			During Dredging November 14, 2006			During Dredging December 18, 2006		
		% Sand	% Silt	% Clay	% Sand	% Silt	% Clay	% Sand	% Silt	% Clay
Pipeline - Bottom	A1-1-GSA	99.95	0.00	0.05	99.83	0.03	0.14	99.35	0.11	0.55
Pipeline - Middle	A2-1-GSA	99.88	0.06	0.06	99.19	0.41	0.40	99.52	0.14	0.33
Pipeline - Top	A3-1-GSA	99.93	0.03	0.04	98.35	1.42	0.23	99.91	0.08	0.01
100m North -Bottom	C1-1-GSA	99.50	0.36	0.14	99.92	0.05	0.03	99.52	0.17	0.31
100m North -Middle	C2-1-GSA	99.83	0.05	0.13	99.88	0.06	0.06	99.68	0.11	0.21
100m North -Top	C3-1-GSA	99.92	0.00	0.08	99.70	0.15	0.15	99.30	0.09	0.61
100m South - Bottom	D1-1-GSA	99.83	0.04	0.13	99.86	0.05	0.09	99.57	0.18	0.25
100m South - Middle	D2-1-GSA	99.90	0.03	0.07	99.96	0.03	0.01	99.62	0.13	0.25
100m South - Top	D3-1-GSA	99.90	0.08	0.02	99.92	0.08	0.01	99.54	0.16	0.30
Control - Bottom	B1-1-GSA	99.86	0.12	0.02	99.90	0.07	0.03	99.87	0.09	0.04
Control - Middle	B2-1-GSA	99.87	0.04	0.09	99.74	0.11	0.15	99.78	0.08	0.15
Control - Top	B3-1-GSA	99.89	0.02	0.09	99.39	0.20	0.41	99.68	0.09	0.23

Table 3: Grain size distribution in sediment from the beach disposal and control sites.

Sample I.D.	Transect	During Dredging January 17, 2007			During Dredging February 15, 2007			During Dredging March 20, 2007		
		% Sand	% Silt	% Silt	% Sand	% Silt	% Clay	% Sand	% Silt	% Clay
A1-1-GSA	Pipeline - Bottom	99.43	0.16	0.41	99.37	0.25	0.38	99.55	0.04	0.40
A2-1-GSA	Pipeline - Middle	98.98	0.64	0.38	99.39	0.12	0.49	96.17	2.42	1.41
A3-1-GSA	Pipeline - Top	99.74	0.14	0.12	99.58	0.10	0.33	99.40	0.44	0.16
C1-1-GSA	100m North - Bottom	99.81	0.13	0.06	99.36	0.31	0.33	99.78	0.19	0.04
C2-1-GSA	100m North - Middle	99.75	0.15	0.10	99.52	0.15	0.33	99.72	0.14	0.14
C3-1-GSA	100m North - Top	99.66	0.26	0.08	99.41	0.39	0.21	99.89	0.05	0.05
D1-1-GSA	100m South - Bottom	99.84	0.08	0.08	99.46	0.27	0.26	99.67	0.14	0.19
D2-1-GSA	100m South - Middle	99.80	0.12	0.08	99.31	0.38	0.31	99.72	0.21	0.07
D3-1-GSA	100m South - Top	99.93	0.07	0.00	99.57	0.28	0.16	98.97	0.99	0.04
B1-1-GSA	Control - Bottom	99.17	0.69	0.14	99.48	0.17	0.34	99.67	0.27	0.06
B2-1-GSA	Control - Middle	99.71	0.11	0.18	99.43	0.28	0.29	99.76	1.64	0.61
B3-1-GSA	Control - Top	99.91	0.04	0.05	99.62	0.15	0.23	99.79	0.19	0.02

Table 4: Grain size distribution in sediment from the beach disposal and control sites.

Sample I.D.	Transect	Following Dredging April 17, 2007			Following Dredging May 17, 2007			Following Dredging June 14-15, 2007			Following Dredging July 13, 2007		
		% Sand	% Silt	% Clay	% Clay	% Silt	% Clay	% Sand	% Silt	% Clay	% Sand	% Silt	% Clay
A1-1-GSA	Pipeline - Bottom	95.79	2.64	1.57	99.70	0.00	0.30	99.45	0.05	0.50	99.81	0.05	0.14
A2-1-GSA	Pipeline - Middle	99.61	0.14	0.25	99.68	0.04	0.28	99.42	0.45	0.14	99.83	0.08	0.09
A3-1-GSA	Pipeline - Top	99.72	0.11	0.17	99.00	0.05	0.96	99.64	0.20	0.16	99.94	0.06	0.01
C1-1-GSA	100m North - Bottom	99.86	0.05	0.09	99.67	0.08	0.25	99.61	0.07	0.32	99.79	0.09	0.12
C2-1-GSA	100m North - Middle	99.57	0.06	0.19	99.62	0.10	0.28	99.70	0.00	0.30	99.79	0.09	0.12
C3-1-GSA	100m North - Top	99.82	0.05	0.12	98.89	0.10	1.02	99.64	0.10	0.26	99.73	0.15	0.11
D1-1-GSA	100m South - Bottom	99.65	0.09	0.26	99.58	0.07	0.35	99.59	0.06	0.35	99.74	0.13	0.14
D2-1-GSA	100m South - Middle	99.68	0.08	0.23	99.00	0.67	0.33	99.68	0.07	0.25	99.78	0.11	0.11
D3-1-GSA	100m South - Top	99.66	0.13	0.21	99.80	0.01	0.19	99.69	0.09	0.22	99.89	0.05	0.06
B1-1-GSA	Control - Bottom	99.57	0.03	0.22	99.54	0.07	0.39	99.47	0.11	0.42	99.77	0.06	0.17
B2-1-GSA	Control - Middle	99.71	0.05	0.23	99.55	0.04	0.41	99.62	0.09	0.29	99.83	0.02	0.15
B3-1-GSA	Control - Top	99.81	0.07	0.12	99.80	0.06	0.14	99.67	0.05	0.28	99.92	0.02	0.06

Sediment samples from the Samoa beach disposal site and control site will be collected monthly until July, 2011.

3.0 PATTERNS AND RATES OF DISPERSAL

The pattern and rates of dispersal of deposited sediment at the beach disposal site was monitored by conducting hydrographic surveys and obtaining aerial and land photographs of the coast from the Mad to the Eel River mouths.

3.1 Hydrographic Surveys

3.1.1 Surveying Methodology

Sounding were recorded using Pacific Affiliates' survey vessel *Hydro I*, a class I survey vessel in accordance with the specifications of the "Manual of Hydrographic Surveying". Bathymetric measurements were taken using a sonar scanning device five times each second while conducting the hydrographic survey. *Hydro I* is also equipped with a Global Positioning System (GPS). Beach transects were recorded using the vertical datum NAVD 88 and were converted to Mean Lower Low Water (MLLW) and referenced horizontally to NAD 27, California Coordinate System, Zone 1, Lambert Conformal Project.

3.1.2 Description of Hydrographic Survey Events

Hydrographic surveys were conducted along the same transects established for sediment sampling and were extended approximately 3,000 feet (900 meters) from the point of discharge to the closure depth of approximately -36.1 feet MLLW (-40 feet mean sea level). Beach soundings were recorded on May 1st, 2007 between 12:50 pm and 2:30 pm, June 21st, 2007 between 1:00 pm and 2:00 pm, and on July 19th, 2007 between 3:00 pm and 4:30 pm.

Land surveys were conducted at low tide on May 1st, 2007, June 21st, 2007, and July 13th, 2007 along the lengths of the transects that were not accessible with *Hydro I* due to the shallow bottom elevations along the intertidal zone. The lengths of the land surveys varied with the time and location (See Figures 7-10).

Land surveys and hydrographic surveys were combined to form almost continuous transects. The interpolated distances between land and hydrographic surveys along the Pipeline, Control, North and South Transects varied between the transects and ranged from no interpolation needed (i.e. complete transect surveyed) to approximately 350 ft. (Figures 4-7).

3.1.3 Hydrographic Surveys Data

Soundings at a couple locations in the intertidal and subtidal zones along Transects A, B, C, and D are described below for the purpose of comparison between the transects. This summary should be accompanied by Figures 4-7. A description of the entire transect survey is also provided.

Transect A was inspected at a point located 1,500 feet (457.2 meters) west of the top of the berm, located at the top of the beach along Transect A. The elevation of the top of the berm did not change between September and July, 2007 and is 28.78 feet (8.77 meters) above MLLW. Prior to disposal operations in September 2007 the depth, 1,500 feet west, of the top of the berm was 21.28 feet (6.49 meters) below MLLW. During disposal operations in December, January, and March, the depth recorded at the same location was 13.11 feet (4.0 meters), 22.94 feet (6.99 meters), and 26.23 feet (7.99 meters) below MLLW respectively. Following termination of the project in May, June, and July the depth recorded at the same location was 19.94 feet (6.08 meters), 9.90 feet (3.04 m), and 9.03 feet (2.75 m) below MLLW respectively (see Figure 4). The data shows that sediment accumulated at this location between November and December (during disposal operations), transported away from this location between December and March (following disposal operations) and then accumulated during the spring and summer months (May – July). Inspection of this transects shown in Figure 4 shows that the shape of the north transect was predominantly the same over the last 9 months. In general the

beach slopes westward until approximately 1,250 feet from the top of the beach. Most variations in accumulated and transported sediment occurred at approximately 1,250 - 2,000 feet from the top of the beach. From 2,000 - 3,000 feet the beach continues to slope westward.

Along Transect D at approximately 1,500 feet west of the top of the berm, located at the top of the beach, the elevation is 21.70 feet (6.61 meters) below MLLW. During disposal operations in December, January, and March, the depth recorded at the same location was 13.50 feet (4.11 meters), 24.00 feet (7.31 meters), and 27.17 feet (6.45 meters) below MLLW respectively. Following termination of the project in May, June and July the depth recorded at the same location was 25.45 feet (7.76 meters), 12.91 feet (3.94 meters), and 14.63 feet (4.46 meters) below MLLW respectively (see Figure 5). Sediment accumulated at this location between September and December and was transported away from this location between December and January. Between January and May sediment was transported away from this location, but accumulated significantly at this site between May and July ((10.8 feet, (3.29 meters) increase). These data sets indicate that south site exhibits the least variation in quantities of sediment at this location over time.

Along Transect C at a point approximately 1,500 feet west of the top of the berm, located at the top of the beach, the elevations is 27.9 feet (8.05 meters) above MLLW. During disposal operations in December, January, and March, the depth recorded at the same location was 21.45 feet (6.54 meters), 21.44 feet (6.53 meters), and 23.33 feet (7.11 meters) below MLLW respectively. Following termination of the project in May, June and July the depths recorded at the same location were 24.90 feet (7.59 meters), 15.29 feet (4.66 meters), and 14.00 feet (4.27 meters) below MLLW (see Figure 6). Sediment accumulated at this location between September (pre project survey) and December, and transported from this location between December and May, and accumulated significantly again between May and July ((10.9 feet, (3.32 meters) increase).

Along Transect B at a point 1,500 feet west of the top of the berm, located at the top of the beach, the depth was 15.60 feet (4.75 meters) below MLLW. During disposal operations in December, January, and March, the depth recorded at the same location was 14.20 feet (4.33 meters), 23.26 feet (7.09 meters), and 20.47 feet (6.24 meters) below MLLW respectively. Following termination of the project in May, June, and July the depth recorded at the same location was 16.79 feet (5.12 meters), 7.70 feet (2.35 meters), and 8.22 feet (2.51 meters) below MLLW (see Figure 7). Sediment was transported away from this location between December and January and transported to this location between January and March. Sediment accumulated at this location between March and July (12.8 feet (3.90 meters) increase).

As of July 2007, the elevations have increased (sediment accumulated) by 12.3 feet (3.74 meters), 7.9 feet (2.42 meters), 13.9 feet (4.24 meters), and 7.08 feet (2.16 meters) respectively at a point 1,500 feet along Transects A, B, C, D, from the elevations measured in September 2006, prior to commencement of the project. All transect, including the control transect, exhibit seasonal variations in the amount of sediment transported and deposited at the site.

In the intertidal zone, locations that were to the east of interpolated range were compared. The interpolated range varied with time and location (see Figures 4-7). The comparison between the bottom elevation of four points along Transect A, B, C, and D in the intertidal zone is provided below. These points are located 300 feet (81.44 meters), 340 feet (103.63 meters), 520 feet (158.5 meters), and 487 feet (148.44 meters) along Transects A (pipeline), D (south), C (north), and B (control) respectively.

In the intertidal zone, the elevations at a point located 300 feet (91.44 meters) west of the top of the berm along Transects A was inspected for comparison (Figure 4). Prior to disposal operations in September the depth at this location was 5.00 feet (1.69 meters) below MLLW. During disposal operations in December, January, and March, the depth recorded at the same location was 2.00 feet (0.61 meters) below MLLW, 0.64 feet (0.20 meters) and 3.54 feet (1.08 meters) above MLLW respectively. Following termination of the project in May, June, and July the depth recorded at the same location was 2.88 ft (0.88 meters), 6.99 feet (2.13 meters), and 7.99 (2.55 meters) feet above MLLW. Thus, sediment accumulated at this location in the intertidal zone between September, 2006 and July, 2007.

Prior to the project implementation Transect D was land surveyed to approximately 340 feet (103.63 meters) west of the top of the berm, located at the top of the beach (Figure 5). Prior to disposal operation in September, 2006 the recorded depth, 340 feet west of the top of the berm was of 5.6 feet (1.71 meters) above MLLW. During disposal operations in December the depth recorded at the same location was 0.02 feet (0.01 meters) below MLLW, and in January and March, 0.01 feet (0.00 meters) and 1.71 feet (0.52 meters) below MLLW respectively. Following termination of the project in May, June, and July, the depths recorded at the same location was 1.63 feet (0.50 meters), below MLLW, 1.52 feet (0.46 meters), and 1.27 feet (0.39 meters) above MLLW. Thus, sediment was transported away from this section of the beach between September, 2006 and March, 2007 and accumulated at the site between May and June. No significant changes in depth were observed at this location between June and July.

Prior to the project implementation Transect C was land surveyed to approximately 520 feet (158.5 meters) west of the top of the berm located at the top of the beach. In September, 2006, prior to commencement of disposal operation, the depth recoded 520 feet west of the top of the berm was 4.43 feet (1.35 meters) below MLLW. During disposal operations in December and January the depth recorded at the same location were 6.95 feet (2.12 meters) and 0.68 feet (0.21 meters) below MLLW respectively, and 1.95 feet (0.95 meters) above MLLW in March. Following termination of the project in May, June, and July, the depths recorded at the same location was 0.01 feet (0.00 meters) below MLLW, 0.99 feet (0.30 meters) and 1.95 feet (0.60 meters), (Figure 6). Sediment was transported away from this location between September and December, 2006, and accumulated between December, 2006 and March, 2007. Sediment was transported away from this location between March and May, 2007 and accumulated at this site between May and July, following cessation of disposal operations and the winter months. The soundings from the North Transect exhibit most variation over time in comparison to the data sets from Pipeline, South and Control Transects.

Prior to the project implementation Transect B was land surveyed to approximately 487 feet (148.44 meters) west of the top of the berm, located at the top of the beach (Figure 7). Prior to disposal operations, the depth 487 feet west of the top of the berm was 5.0 feet (1.524 meters) above MLLW. The depth recorded during disposal operations In December, January, and March, at the same location was 4.39 feet (1.34 meters), 2.65 feet (0.81 meters), and 0.28 feet (0.09 meters) above MLLW respectively. Following termination of the project in May, June and July, the depths recorded at the same location was 1.08 feet (0.33 meters), 8.66 feet (2.6 meters), and 10.4 feet (3.18 m) above MLLW respectively. Thus, sediment was transported away from this portion of the beach during the winter months (November, 2006 - March, 2007) and transported to this location between May and July.

The data provided above indicates that the variation in quantities of sediment in the intertidal and subtidal zones along the monitored transects are predominantly affected by the winter conditions including large swells, high tides, and fast moving currents. Disposal operation could have only contributed a minor fraction to the amount of sediment that accumulated along Transects B, C, and D. The trend that is observed at the monitoring sites including the control site is that during the winter (December, 2006 – March, 2007) sediment is predominantly transported away from these locations and during the spring (March – May), sediment is transported to these locations. In the summer (June-July) sediment is either transported at lower rates than in the winter to the site or no change occurs. This pattern was also observed in past dredging episodes. The winter Davidson Current may be responsible for the sediment transport offshore during the winter. In the spring and the summer the current along the Pacific Coast changes and is predominantly in the southerly direction, when sediment is transported to the site.

As observed by the Project Manager the Samoa Beach went through major weather changes between September 2006 and July, 2007. The large swells, fast moving currents, and gale winds recorded and reported in the 'During'; Project Monitoring Report were no longer present between April and July. The dredging window "November - March" selected and approved for this project is the only time during the year that nearshore ocean disposal can be implemented in a manner that will cause the least disturbance to the Samoa Beach. Observations by the Project Manager indicate that the north and south transects located only 100 meters (328 feet) north and south of the outfall location were not affected by disposal operations.

3.2 Aerial Photographs

3.2.1 Surveying Methodology

Aerial photographs were taken by Cartwright Aerial Surveys, Inc. to provide a view of the ocean conditions along the shoreline prior to, during, and following cessation of disposal operations. Aerial photographs of the surf zone at the disposal area and the shoreline from the mouth of the Eel River to the mouth of the Mad River cover an area of approximately 46.5 square miles, extending approximately 27.25 miles from the Mad to the Eel River mouths and 0.75 miles perpendicular to the shoreline (see SAP for Vicinity Map).

All images were captured with a high-resolution Zeiss RMK TOP 15 mapping camera for photo acquisition. The camera is equipped with FMC (Forward Motion Compensation). The cameras' platform was a 2000 Cesna T06H Statioair.

3.2.2 Description of Flights

Three flights were conducted: the first prior to commencement of the project on October 9th, 2006, the second approximately one week following commencement of disposal operations on November 14th, 2006, and the third flight 14 days following the cessation of beach disposal operations on April 13th, 2007 (submitted with the 'During' project Monitoring Report). Each flight is described below:

'During' Project Aerial Photo Event

Tom Hutcheon, the pilot, and Bill Calmes reported that they encountered scattered clouds at 1,500 feet during the November 14th flight. Black and white photography was obtained in two flight lines with 25 exposures on the first and 10 on the second. Photography was initiated at 1:41 pm and concluded at 1:59 pm. The direction of travel was northerly. The photo scale is 1" = ±1,000'.

The beach disposal area is shown on the November 14th series in Exposure 1-21 and 1-22. The Eel River mouth is shown on Exposures 1-1, 1-2, and 1-3. The Mad River mouth is shown on Exposures 2-8, 2-9, and 2-10.

The swell was 15.6 feet at 12:00 am on the day of the flight and dropped to 11.7 feet by 6:00 pm. High tides of 6.3 feet and 5.4 feet MLLW occurred at 8:10 am and 7:41 pm respectively. Strong northerly winds in the morning with 16.9 knots peak gusts decreased in the afternoon to 8.0 knots.

Post project Aerial Photo Event

Tom Hutcheon, the pilot and Bill Calmes reported that during the April 13th flight the skies were clear with visibility of 40 miles, and no turbulence was encountered. Black and white photography was obtained in two flight lines with 25 exposures on the first and 15 on the second. The direction of travel was northerly. The photo scale is 1" = ±1,000'.

The beach disposal area is shown on the April 13th series on Exposures 1-21 and 1-22. The Eel River mouth is shown on Exposures 1-1, 1-2, and 1-3. The Mad River mouth is shown on Exposures 2-11, 2-12, and 2-13.

3.2.3 Description of Aerial Photographs

Disposal operations at the Samoa beach were not evident on the aerial photographs. Exposures 1-21 and 1-22 taken during project implantation show the discharge channel created by dredge spoils disposal operations. However, the sediment deposited cannot be distinguished from the sediment present in the water and no sediment plumes were evident. During and post project aerials from the

Mad and the Eel Rivers exposures show the plume of sediment (in lighter color) that is deposited from these rivers and is still evident following the winter months. The outfall area on the beach can be seen in the aerial due to the change in the topography of the berm located at the top of the beach.

4.0 WATER QUALITY DATA

Suspended Solids Concentrations (SSC) in water samples collected prior, during, and following disposal operations from along the Pipeline, North, and Control Transects are used to evaluate changes in the water quality as a result of disposal operations. Water samples were collected by Pacific Affiliates and analyzed by North Coast Laboratories located in Arcata, CA.

4.1 Total Suspended Solids Sampling Methodology

Samples were collected by Travis Schneider, RCE from on board *Hydro I*, Pacific Affiliates' hydrographic survey vessel. Samples were collected using a discrete water sampler, manufactured by AMS, Inc. for this project, and transferred to 500 ml plastic bottles. A more detailed discussion of the sampling methodology is described in Samoa Beach Monitoring Plan (Pacific Affiliates, 2006).

Samples were collected while the following conditions being present onsite: (1) on a high tide to allow the hydrographic survey vessel to reach as close to the beach as safely as possible; (2) with predicted favorable weather conditions and the marine forecast indicating a sea state of four feet or less swell/waves; and (3) during daylight hours.

4.2 Description of Ocean Water Sampling Locations and Events

A total of three water samples were collected during each sampling event. Water samples were collected from the top of the water column along Transects A, B, and C at a depth of approximately 40 feet below MLLW. Duplicates of all samples, collected from the same locations, were stored at North Coast Labs for a maximum eight days. Chain-of-Custody forms and original lab results can be found in Appendix II. Samples were collected following disposal operations, on and May 1st, 2007 between 3:00 pm and 4:00 pm, and on July 19th, 2007 between 12:30 pm and 1:30 pm. Each sampling event is described below:

On May 1st, 2007, the crew reported no observable difference in the water color between the monitoring transects and along the Samoa Peninsula coast. They did observe surfers at the Control Site. On July 19th, 2007, Pacific Affiliates crew reported that waves were breaking closer to the shore at the disposal site than at the control site. They could not observe any direction of sediment transport and did not observe any swimmers or surfers at the disposal site or control site, but did observe surfers at the North Jetty.

Tables 4, 5, and 6 below show the water sampling locations by the month surveyed. Figures 8 shows a plan view of the monitoring area with the water sampling location marked.

Table 5: Water sampling locations at the beach disposal and control sites (Dec., 2006 – Jan., 2006).

Sample I.D.	Transect	December, 2006		January, 2007	
		Latitude	Longitude	Latitude	Longitude
A1-1-TSS	Pipeline	40° 49' 45.82" N	124° 11' 47.34" W	40° 49' 45.82" N	124° 11' 47.34" W
B1-1-TSS	Control	40° 49' 20.38" N	124° 12' 05.12" W	40° 49' 20.38" N	124° 12' 05.12" W
C1-1-TSS	100m North	40° 49' 50.89" N	124° 11' 45.39" W	40° 49' 50.89" N	124° 11' 45.39" W

Table 6: Water sampling locations at the beach disposal and control sites dated (Mar., – May, 2007).

Sample I.D.	Transect	March		May	
		Latitude	Latitude	Latitude	Longitude
A1-1-TSS	Pipeline	40° 49' 19.90" N	40° 49' 19.90" N	40° 49' 50.00" N	124° 11' 52.06" W
B1-1-TSS	Control	40° 49' 45.50" N	40° 49' 45.50" N	40° 49' 18.44" N	124° 12' 09.09" W
C1-1-TSS	100m North	40° 49' 50.66" N	40° 49' 50.66" N	40° 49' 53.22" N	124° 11' 51.66" W

Table 7: Water sampling locations at the beach disposal and control sites dated July 2007.

Sample I.D.	Transect	July	
		Latitude	Longitude
A1-1-TSS	Pipeline	40° 49' 49.41" N	124° 11' 49.99" W
B1-1-TSS	Control	40° 49' 49.32" N	124° 11' 49.15" W
C1-1-TSS	100m North	40° 49' 53.22" N	124° 11' 49.40" W

Water samples that were supposed to be collected from the Pipeline, Control, and South Transects were collected in July 2007 from one location along the Pipeline Transect (Figure1).

4.3 Laboratory Procedures

Provided below is a brief summary of the laboratory procedures, a more detailed discussion of the laboratory methods are described in Samoa Beach Monitoring Plan (Pacific Affiliates, 2006). TSS determination was made according to procedure described in US EPA Method 160.2 and APHA Method 2540 D. The procedures entail the measurements of material retained on filters. However, a 0.40 - or 0.45 µm membrane filter was used to remove suspended solids instead of the glass fiber filter specified in US EPA and APHA methods, because the pores of the membrane filters are more uniform in size than those of the glass fiber filters.

4.4 Total Suspended Solids Results

Analytic work was performed by North Coast Laboratories. Table 8 below shows the TSS analysis results (see Appendix II for laboratory report and COC forms):

Table 8: TSS results (mg/l) from water samples collected at the beach disposal and control sites.

Sample I.D.	A1-1-TSS	B1-1-TSS	C1-1-TSS
Location	Pipeline Transect	North Transect	Control Transect
September 27, 2006	5.7	4.2	6.4
December 3, 2006	7.0	7.0	7.0
January 16, 2007	8.0	7.4	12
March 18, 2007	11	8.0	6.8
May 1, 2007	3.2	3.0	2.6
June – No Data	N.A.	N.A.	N.A.
July 19, 2007	4.0	4.0	4.0

Water sampling events were conducted from Pacific Affiliates hydrographic surveys vessel *Hydro I*. Completion of the water sampling events was dependent upon weather conditions.

TSS concentrations most likely increased due to the storm events that occurred during the winter months (November – March). Water samples from the Control, Pipeline and North Transects all indicated an increase in SSC during the winter months (November to March). The most significant difference in turbidity was observed at water samples collected from the Control Transect. There was a 46.7 percent difference at the Control Transect between September (pre project) and December (during project) samples. The SSC in samples collected at the Pipeline and North Transects increased by 28.75 and 43.24 percent respectively between September and December.

Note that the water samples from the December, 2006 and July, 2007 sampling events had SSC of seven and four mg/L respectively. The samples collected in December were from the required locations along Transects A, B, and C, indicating that SSC was the same at Transects A, B, C, and D. The samples collected in July, however, were collected approximately 50 ft. (15.2 meters) one from the other (Figure 8). The crew could not collect the samples from the exact required locations due to ocean conditions including swell, currents, and wind.

Water samples collected from along all transects including the Control Transect showed higher SSC in January, 2007 than in September and December, 2006. All transects showed a significant decrease in SSC concentrations following termination of the project and the end of the winter season in May, 2007 and remained predominantly the same until the end of the post project monitoring period in July, 2007.

The data indicates that SSC at the Samoa Beach change throughout the year. In the winter, turbidity increases due to storm events that accelerate the rate at which sediment is transported from the rivers into the ocean which results in the suspension of particles in the water column along the Samoa Peninsula. This is evident in the increase in SSC at the Control Transect and from the pre and during project aerial photographs that show the plume of suspended sediment at the mouth of the Mad and the Eel Rivers. In the spring and summer (April – July), the weather changes and the rate of sediment transport is decreased significantly as evident in the lower SSC measured at the pipeline transect in May and July, 2007.

5.0 COMPOSITION AND ABUNDANCE OF INTERTIDAL INVERTEBRATES

Representative sediment grab samples from the disposal site and the control site are used to monitor changes (if any) in species composition and abundance at the disposal site due to dredge disposal operations.

This Section of the Report was prepared for Pacific Affiliates by Tetra Tech which analyzed the samples and provided the data. Appendix B provides the monthly biological monitoring reports prepared by Tetra Tech. The reports provide the monthly data collected and an analysis of the data including a monthly comparison between the transects based on the Jaccard's Coefficient of Similarity statistical method.

5.1 Benthic Sampling Locations

Prior to commencement of disposal operations, four (4) transects were established perpendicular to the beach slope for the purpose of sediment sampling for monitoring the benthic community (Figure 1):

- Transect A: Dredge disposal site, where the pipeline empties into the surf zone,
- Transect B: Control site, on the beach 1,000 meters (~3,280 feet) south of the pipeline terminus.
- Transect C: 100 meters (~328 feet) north of the pipeline terminus
- Transect D: 100 meters (~328 feet) south of the pipeline terminus

When establishing transects and sampling locations:

- a. Each transect was established by inspection of the beach at or near low tide. Each transect begins at the top of the beach and extends to the swash zone.
- b. Samples were taken at two (2) meter intervals along each transect and composited. As different organisms occupy different elevation zones in the intertidal and move with the tides, compositing the whole transect into a single sample ensured that all organisms were sampled.
- c. Three randomly placed transects were established at each sampling site. Replicate transects were separated by at least 5 meters. Transects were located and marked on Figure 1 using a Global Positioning System, (GPS) device.

Sediment core samples were collected once monthly by Yoash Tilles, EIT and Jeremy Webb for three consecutive months following termination of the project. Samples were collected on May 16th - 18th, 2007, June 14th - 16th, 2007, and July 12th - 14th, 2007. Samples were composited and prepared for analysis in the field to yield a total of 12 composite samples. Samples were analyzed by Mr. Nick Wiersemma of Tetra Tech.

5.2 Benthic Sampling Methodology

Provided below is a brief summary of the sampling methodology, a more detailed discussion of the sampling methods is described in Samoa Beach Monitoring Plan (Pacific Affiliates, 2006). At each of the four (4) transect locations, three (3) replicates sampling transects were established. Along each of the four (4) transect locations, individual samples were collected a two (2) meter intervals and composited. Each sample was collected using a 10 centimeter diameter coring device. The coring device was pushed to a depth of 20 centimeters. The cored material was then washed, sieved through a 1000 micron sack, eliminating the finer silts, and sands. The remaining coarse mineral and vegetative debris and organisms were the placed within 16 Oz sampling jars, and preserved as described in the Samoa Beach Monitoring Plan.

Transects were sampled while the following condition being present onsite: (1) on a tide below two feet MLLW (swash zone section of the transects were sampled during low tide), (2) with predicted favorable weather conditions and the marine forecast indicating a sea state of four feet or less swell/waves, and (3) during daylight hours.

During all there sampling events, which occurred monthly (May –July) over a two to three day period, weather conditions were calm. On July 12th, 2007, the wind was from the southeast at 5 to 15 knots. There were wind-waves of one to three feet with a west swell of three feet. On June 14th, 2007, the swell was 7.2 feet. (2.2 meters) at 9:00 am and the wind was from the north at 17 knots. On May 16th, 2007 the swell 3.6 feet (1.11 meters) and the wind was from the north at 11.7 knots. These conditions are representative of spring and summer condition variation along the north coast. Winter conditions vary significantly and were described in the ‘during’ project report.

Samples in the lower portion of each transect were collected during the lowest tides available. On May 16th, 2007 the tide was -2.0 feet (-0.61 meters) MLLW, -1.97 feet (0.60 meters) MLLW at 6:00 am on June 14th, 2007, -1.55 feet (0.47 meters) MLLW on July 13th, 2007 at 5:55 am.

5.3 Processing of Biological Samples

At the Laboratory, each sample was transferred to a 500 micron sieve for washing, to eliminate fine sediments and preservatives. The samples were then transferred to a sorting tray. The infaunal invertebrates were then sorted from the coarse material and vegetative debris. After, the large and obvious invertebrates were sorted out and the remaining material was sieved under a stereo

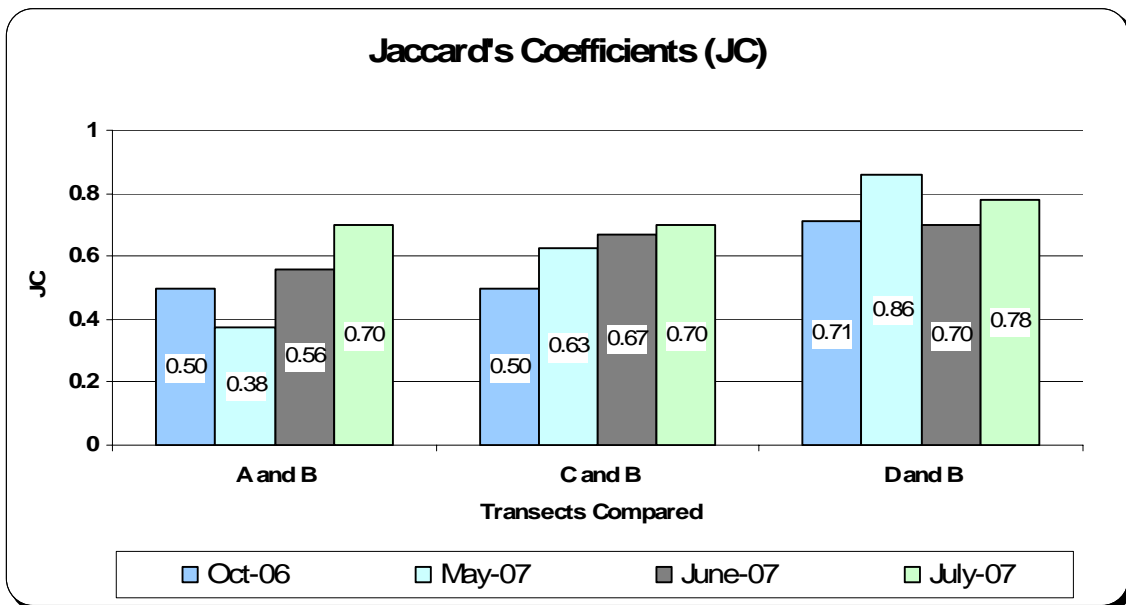
microscope for completeness. All organisms were placed into glass vials with 70% ethanol for preservation. After, 12 samples were sorted the infaunal invertebrates were identified and enumerated. Each species type was additionally weighted. All samples are stored at MFG, Inc. in Austin, Texas. Samples were transferred 24 hours following collection to 70% ethyl alcohol and can therefore be held indefinitely.

Below is a summary of the project results and analysis prepare by Tetra Tech. Please refer to Tetra Tech’s individual monthly monitoring reports provided in Appendix B.

5.4 Results and Discussion

From the Figure 8 below it can be seen that across all monitoring events benthic infauna taxa at Transect D shared the most in common with Transect B. It is additionally evident that the Dredge Disposal site (Transect A) showed an increasing trend towards greater similarity with the Control Transect (Transect B) in the months following the dredge disposal. Transects A and B were considered more similar to each other in June and July 2007, than prior to the dredge disposal action (Wiersema, 2007).

Figure 8: Jaccard’s Coefficients Comparing Investigational Transects (A,C, and D) to the Control Transect (B) by Monitoring Event.



With Jaccard’s Coefficients ranging from 0.6 to 0.86 for Transects C and D, it could be interpreted that the dredge disposal action at Transect A, had little if any measurable effect on the benthic infauna to the north and south (Figure 9). Additionally of interest is the very low Jaccard’s Coefficients observed for the Control Transect (B).

Figure 9: Jaccard's Coefficients Comparing Pre-dredge Disposal Conditions at the Investigational Transects (A,C, and D) and Control Transect (B) to Post-dredge Disposal Conditions

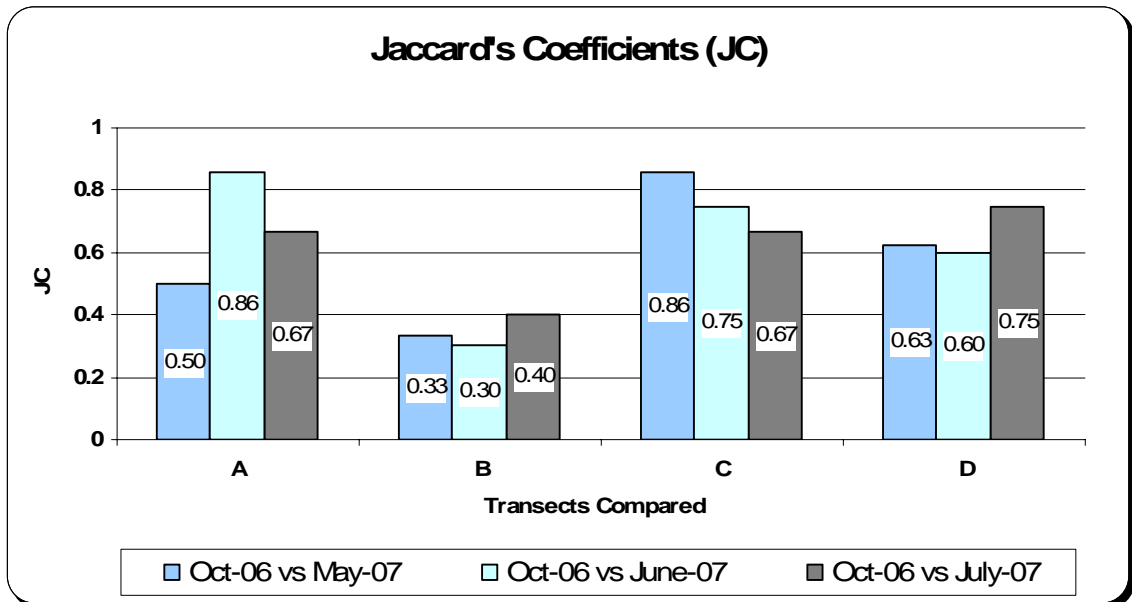
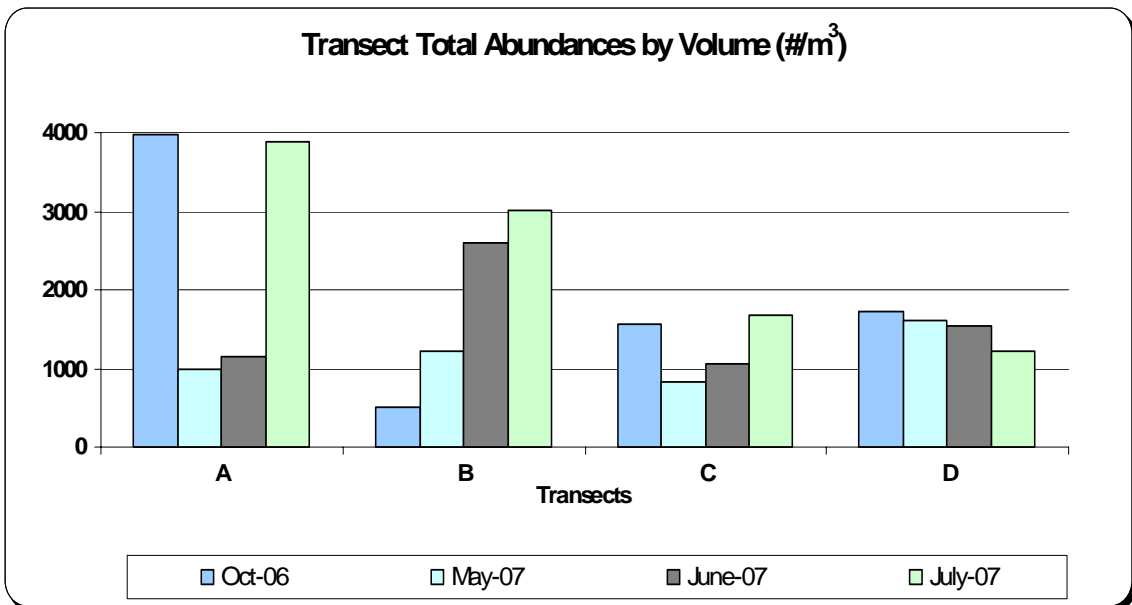


Figure 10 shows that the dredge disposal site (Transect A) generally had greater total abundances than all the other monitoring transects. Of specific interest is the fact that the total abundances at Transect A were approximately the same in October 2006 and July 2007, further indicating that the dredge disposal site has recovered from any measurable effect of the disposal action.

Figure 10: Comparison of Volume Normalized Total Abundances Across Monitoring Sites and Events.



6.0 DISCUSSION AND CONCLUSION

On behalf of the City of Eureka and the Humboldt Bay Harbor, Recreation and Conservation District, Pacific Associates monitored the Samoa beach disposal site prior, during, and after the cooperative maintenance dredging in the Eureka Channel of Humboldt Bay (September 2006 – March 2007). The purpose of the Samoa Beach Monitoring Report is to provide data to the regulatory and resource agencies that will allow them to re-evaluate the near shore ocean disposal methodology.

The data in this report indicates that the percent of sediment composition at the Samoa Beach Disposal Site returned to pre project conditions three months following termination of disposal operations. Sediment composition along the North and South Transects, located 100 meters from either side of the pipeline transect, did not change significantly between October, 2006 and July 2007 (less than one percent). Sediment along the Control Transect exhibited similar variation in sand composition to the Pipeline, North, and Control Transects prior, during, and, following dredging operations. The affects of the dredge spoils disposal operation on sediment composition are temporary and localized (limited to the pipeline transect during disposal operations).

The hydrographic data of the Samoa beach provided in this report indicate that the variation in quantities of sediment in the intertidal and subtidal zones along the monitored transects are predominantly affected by the winter conditions including large swells, high tides, and fast moving currents. The trend that is observed at the monitoring sites including the control site show that during the winter (December - March) sediment was predominantly transported away from the locations, during the spring (March - May) sediment is transported to these locations and during the summer (June - July) sediment is either transported to the site or no change occurs. This pattern was also observed in past dredging episodes.

The aerial photographs show that no plume was developed from the sediment deposited at the Samoa beach, but plumes were observed at the Eel and Mad River mouths.

Suspended Sediment Concentrations most likely also increased due to the storm events that occurred during the winter months (November – March). Water samples from the Control, Pipeline and North Transects all indicated an increase in SSC. All transects showed a significant decrease in SSC following termination of the project and the end of the winter season in May, 2007. Turbidity did not change significantly between May and July.

Infaunal community survey reports indicate that the biological communities along the monitoring transect returned to pre project conditions. High Jaccard coefficients between pre and post monitoring events at the pipeline transect indicate that the abundance and richness of macroinvertebrates returned to pre-project conditions three months following termination of the project. The biological communities along pipeline transect were only affected during disposal operations. Similarities were also observed between the Control and the Project Transects. The data suggests that the biological communities at the North and South Transects were not affected by the dredge disposal operations.

Pacific Associates will continue to monitor the Samoa beach annually in July until 2011. Near shore beach disposal proved to be a successful dredging disposal methodology in this dredging episode. This disposal methodology was also used in three past dredging episodes. The pre, during, and post monitoring report and past dredging episode monitoring reports demonstrate that the pre-project conditions are present at the disposal site within three months following termination of disposal operations.

7.0 REFERENCES

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Tetra Tech. *Samoa Beach Dredge Disposal Infaunal Community Survey Report.* Dredge Disposal Sampling June 2007. Submitted to Pacific Affiliates, July 10, 2007.

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National Oceanic and Atmospheric Administration. National Data Buoy Center.

APPENDIX I

**SEDIMENT AND WATER SAMPLING RESULTS AND COC FORMS
NORTH COAST LABORATORIES
SOILS CONTROL LAB**

APPENDIX II

**Tetra Tech. Samoa Beach Dredge Disposal Infaunal Community Survey Reports.
Dredge Disposal Sampling October 2006. Submitted to Pacific Affiliates,**

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: A1-1-GSA, collected 04/25/07 12:53
 Our Laboratory #: 7041018-1

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	1.75	1.75
-1 4- 2	2.33	4.08

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	5.47	5.47
1 1-0.5	4.47	9.94
2 0.5-0.25	64.90	74.84
3 0.25-0.125	19.50	94.34
4 0.125-0.062	1.45	95.79
5 0.062-0.031	0.95	96.74
6 0.031-0.016	0.74	97.48
7 0.016-0.008	0.52	98.00
8 0.008-0.004	0.43	98.43
9 0.004-0.002	0.28	98.71
>9 < 0.002	1.29	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
95.79	2.64	1.57

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: A2-1-GSA, collected 04/25/07 11:35
 Our Laboratory #: 7041018-2

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.06	0.06
2 0.5-0.25	61.29	61.35
3 0.25-0.125	37.11	98.47
4 0.125-0.062	1.14	99.61
5 0.062-0.031	0.05	99.66
6 0.031-0.016	0.06	99.72
7 0.016-0.008	0.03	99.75
8 0.008-0.004	0.00	99.75
9 0.004-0.002	0.00	99.75
>9 < 0.002	0.25	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.61	0.14	0.25

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: A3-1-GSA, collected 04/25/07 11:24
 Our Laboratory #: 7041018-3

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.00	0.00
2 0.5-0.25	59.35	59.35
3 0.25-0.125	39.70	99.05
4 0.125-0.062	0.68	99.72
5 0.062-0.031	0.05	99.77
6 0.031-0.016	0.02	99.78
7 0.016-0.008	0.05	99.83
8 0.008-0.004	0.00	99.83
9 0.004-0.002	0.00	99.83
>9 < 0.002	0.17	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.72	0.11	0.17

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: B1-1-GSA, collected 04/25/07 13:52
 Our Laboratory #: 7041018-4

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	1.18	1.18

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	2.76	2.76
1 1-0.5	9.36	12.13
2 0.5-0.25	76.38	88.50
3 0.25-0.125	11.19	99.70
4 0.125-0.062	0.05	99.75
5 0.062-0.031	0.00	99.75
6 0.031-0.016	0.03	99.78
7 0.016-0.008	0.00	99.78
8 0.008-0.004	0.00	99.78
9 0.004-0.002	0.00	99.78
>9 < 0.002	0.22	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.75	0.03	0.22

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: B2-1-GSA, collected 04/25/07 13:43
 Our Laboratory #: 7041018-5

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.03	0.03
1 1-0.5	2.95	2.98
2 0.5-0.25	84.06	87.04
3 0.25-0.125	12.52	99.56
4 0.125-0.062	0.15	99.71
5 0.062-0.031	0.05	99.76
6 0.031-0.016	0.00	99.76
7 0.016-0.008	0.00	99.76
8 0.008-0.004	0.01	99.77
9 0.004-0.002	0.01	99.78
>9 < 0.002	0.22	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.71	0.05	0.23

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: B3-1-GSA, collected 04/25/07 13:37
 Our Laboratory #: 7041018-6

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	3.57	3.57
2 0.5-0.25	86.33	89.90
3 0.25-0.125	9.65	99.55
4 0.125-0.062	0.27	99.81
5 0.062-0.031	0.02	99.84
6 0.031-0.016	0.02	99.86
7 0.016-0.008	0.00	99.86
8 0.008-0.004	0.02	99.88
9 0.004-0.002	0.00	99.88
>9 < 0.002	0.12	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.81	0.07	0.12

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: C1-1-GSA, collected 04/25/07 12:48
 Our Laboratory #: 7041018-7

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.39	0.39
-1 4- 2	0.23	0.61

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	1.30	1.30
1 1-0.5	9.69	10.99
2 0.5-0.25	76.05	87.05
3 0.25-0.125	12.75	99.80
4 0.125-0.062	0.07	99.86
5 0.062-0.031	0.02	99.88
6 0.031-0.016	0.01	99.90
7 0.016-0.008	0.01	99.91
8 0.008-0.004	0.00	99.91
9 0.004-0.002	0.01	99.92
>9 < 0.002	0.08	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.86	0.05	0.09

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: C2-1-GSA, collected 04/25/07 12:08
 Our Laboratory #: 7041018-8

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.03	0.03
2 0.5-0.25	68.44	68.47
3 0.25-0.125	31.19	99.65
4 0.125-0.062	0.10	99.75
5 0.062-0.031	0.03	99.78
6 0.031-0.016	0.01	99.79
7 0.016-0.008	0.01	99.80
8 0.008-0.004	0.01	99.81
9 0.004-0.002	0.01	99.82
>9 < 0.002	0.18	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.75	0.06	0.19

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: C3-1-GSA, collected 04/25/07 11:57
 Our Laboratory #: 7041018-9

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.03	0.03
2 0.5-0.25	71.56	71.59
3 0.25-0.125	27.68	99.26
4 0.125-0.062	0.56	99.82
5 0.062-0.031	0.00	99.82
6 0.031-0.016	0.05	99.88
7 0.016-0.008	0.00	99.88
8 0.008-0.004	0.00	99.88
9 0.004-0.002	0.00	99.88
>9 < 0.002	0.12	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.82	0.05	0.12

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: D3-1-GSA, collected 04/25/07 12:21
 Our Laboratory #: 7041018-10

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.25	0.25
1 1-0.5	3.58	3.82
2 0.5-0.25	84.34	88.16
3 0.25-0.125	11.38	99.54
4 0.125-0.062	0.12	99.66
5 0.062-0.031	0.06	99.71
6 0.031-0.016	0.05	99.76
7 0.016-0.008	0.00	99.76
8 0.008-0.004	0.03	99.79
9 0.004-0.002	0.00	99.79
>9 < 0.002	0.21	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.66	0.13	0.21

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: D1-1-GSA, collected 04/25/07 13:03
 Our Laboratory #: 7041018-11

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.07	0.07
2 0.5-0.25	61.00	61.07
3 0.25-0.125	38.11	99.18
4 0.125-0.062	0.47	99.65
5 0.062-0.031	0.03	99.68
6 0.031-0.016	0.01	99.70
7 0.016-0.008	0.04	99.74
8 0.008-0.004	0.00	99.74
9 0.004-0.002	0.01	99.75
>9 < 0.002	0.25	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.65	0.09	0.26

Pacific Affiliates
 990 W. Waterfront Drive
 Eureka, CA 95501
 Attn: Yoash Tilles

Project #/Name: 930/940 / Samoa Beach Monitoring
 Method: Plumb 1981
 Date Analyzed: May 2, 2007
 Matrix: Sediment
 Client Site ID: None
 Client Sample ID: D2-1-GSA, collected 04/25/07 12:28
 Our Laboratory #: 7041018-12

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.00	0.00
2 0.5-0.25	64.05	64.05
3 0.25-0.125	35.08	99.13
4 0.125-0.062	0.56	99.68
5 0.062-0.031	0.03	99.72
6 0.031-0.016	0.03	99.74
7 0.016-0.008	0.03	99.77
8 0.008-0.004	0.00	99.77
9 0.004-0.002	0.03	99.79
>9 < 0.002	0.21	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.68	0.08	0.23

**SAMOA BEACH DREDGE DISPOSAL
INFAUNAL COMMUNITY SURVEY REPORT**

DREDGE DISPOSAL SAMPLING MAY 2007

PREPARED FOR:

PACIFIC AFFILIATES, INC.

A CONSULTING AND ENGINEERING GROUP

990 W. WATERFRONT DRIVE

EUREKA, CA 95501

PREPARED BY:

TETRA TECH, INC.

7800 SHOAL CREEK BLVD., SUITE 253E.

AUSTIN, TX 78757

CONTACT:

N.A. WIERSEMA

Ph: 512-338-1667

JUNE 4, 2007

INTRODUCTION

In May of 2007 four transect locations were sampled on May 16th through the 18th. Three of these locations correspond approximately to those transect locations sampled as part of previous dredge disposal events. In October 2006 a sampling event was performed to characterize pre-dredge disposal conditions. This sampling event was performed as the first of three sampling events to characterize the post-dredge disposal conditions. The four sampling transect locations are as follows:

- Transect A: Dredge disposal site. Location where dredge pipeline empties into the surf zone.
- Transect B: Control site. Located on the beach approximately 1,000 meters south of the pipeline terminus.
- Transect C: 100 meters north of the pipeline terminus (Transect A).
- Transect D: 100 meters south of the pipeline terminus (Transect A).

SAMPLING METHODOLOGY

Provided below is a brief summary of the sampling methodology, a more detailed discussion of the sampling methods can be found within the dredge disposal monitoring plan (Pacific Affiliates, 2006). At each of the four transect locations, three replicate sampling transects were established. Along each of these replicate transects, individual samples were collected at 2-meter intervals and composited. Each sample was collected using a 10 centimeter diameter coring device. The coring device was pushed to a depth of 20 centimeters. The cored material was then washed, sieving the material through a 1000 micron sack, eliminating the finer silts, and sands. The remaining coarse mineral and vegetative debris and organisms were then placed within sample jars, and preserved as described within the dredge disposal monitoring plan (Pacific Affiliates, 2006).

SAMPLE PROCESSING

Each sample was transferred to a 500 micron sieve for washing, to eliminate fine sediments, and preservatives. The samples were then transferred to a sorting tray. The infaunal invertebrates were then sorted from the coarse material and vegetative debris. After, the large and obvious invertebrates were sorted out the remaining material was viewed under a stereo microscope for completeness. All organisms were placed into glass vials with 70% ethanol for preservation. The infaunal invertebrates were then identified and enumerated. Each species type was additionally weighed. Table 1, presents these data.

STATISTICAL ANALYSIS AND SAMPLE SITE COMPARABILITY

Past disposal of dredge spoil material and subsequent biological community monitoring have not indicated any longer term changes in species composition, when compared to pre dredge conditions, the control location and areas receiving dredge spoil (Pacific Affiliates, 2006). This

conclusion was drawn using similarity analysis, Jaccard's Coefficient of Similarity. This analysis was based on the presence/absence of individual crustacean and polychaete species between years. Routine differences in species abundances have been documented and are expected to occur as a result of dredge spoil discharge. Seasonal variations in abundances are also expected to occur.

In addition, to standard composition and structure measures (total abundance and total taxa), biomass, diversity measures and community similarity analyses were performed and presented in Tables 1 and 2. A simplified Jaccard's Coefficient was used to compare community similarities between pre and post dredge samples for each transect and between the primary sample transects (A, C and D) and the control transect (B) using the following formula:

$$JC = \frac{c}{s1 + s2 - c}$$

where:

c = number of species found in common between two different transect (eg. Transect A and B, or Transect A and C) samples, and

s1 = total number of species (total taxa) found in community 1, and

s2 = total number of species (total taxa) found in community 2, and

JC = Jaccard's coefficient.

Jaccard's coefficient ranges in value from 0 to 1, and the closer it is to 1 the more similar the communities are.

Numbers and biomass of each species was determined and presented as raw number per transects, transect total, averages, and normalized by volume (i.e. cubic meters of sands, gravels, silts, fines, vegetative debris, etc., sieved). Biomass measures include total biomass (wet weight in grams) and the contribution of crustacean and polychaete to the total biomass was also be evaluated between transect samples. Richness and evenness was evaluated using the Shannon-Weaver Diversity Index (H').

Following sample volume normalization, it can be seen that Transect D had the greatest abundance and biomass per cubic meter. The pipe-end dredge disposal Transect (A) and the Control Transect (B) were comparatively similar in both abundances and biomass, however, Transect C had the second highest biomass per cubic meter, but the least abundance per cubic meter. This was largely due to the presence of mature sand crabs with in the sample.

Table 1. Species Abundance, Biomass and Composition Measures

Species	Transect A			Transect B			Transect C			Transect D										
	A-1-INV	A-2-INV	A-3-INV	B-1-INV	B-2-INV	B-3-INV	C-1-INV	C-2-INV	C-3-INV	D-1-INV	D-2-INV	D-3-INV								
	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)								
Crustacea																				
<i>Eremita analoga</i>					2	<1	1	3	8	1	9	4								
<i>Archaeomysis grebnitzkii</i>		4	<1	5	<1	4			1	<1	2	7								
<i>Megalorchestia californiana</i>	3	<1	5	2	<1		3	<1	3	<1	5	12								
<i>Dogielonotus loquax</i>				5	<1		8	<1	2	<1	4	<1								
<i>Excirrana linquifrons</i>	22	<1	16	58	<1	31	28	<1	9	<1	22	<1								
<i>Crangon stylirostris</i>			1	2																
Polychaetes																				
<i>Nephtys californiensis</i>				4	<1	1	2	<1				7								
<i>Euzoron williamsi</i>						3	<1	1												
<i>Pygospio californica</i>									1	<1	6	<1								
Insecta																				
<i>Emphegylus? (larvae)</i>				1																
Total Abundance and Biomass	25	1	41	1.5	24	3.5	74	2.5	47	3	40	2.5	40	11.5	50	6.5	32	8.5	43	6
Total Richness (Taxa)	2	3	4	5	6	5	6	4	6	6	6	5	6	6	6	6	5	5	5	5
Crustacean Biomass	1	1.5	3.5	2	2	1.5	2	4.5	10	4.5	11	6	10	11	6	8.5	6	8.5	6	6
Polychaete Biomass	0	0	0	0.5	1	1	0.5	0	1	0	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0
Transect Total Abundance			90		161				99							125				
Transect Total Taxa			4		7				6							6				
Transect Total Biomass (g)			6		8				26.5							21				
Transect Total Biomass (g/m³)			66.7		60.2				219.0							269.2				
Transect Total Abundance (#/m³)			1000		1210				818							1602				
Transect Average Abundance			30.0		53.7				33.0							41.7				
Transect Average Richness			3.0		5.3				5.3							5.3				
Transect Average Biomass (g)			2.0		2.7				8.8							7.0				
Shannon-Weaver Diversity (H')			0.741		1.083				1.274							1.314				

For total biomass, organisms weighing less than 1 gram were treated as 0.5 gram. g = grams

Table 2. Jaccard's Coefficient of Similarity

Transects	c	s1	s2	JC
May 2007				
A and B	3	4	7	0.375
C and B	5	6	7	0.625
D and B	6	6	7	0.857
October 2006 (Pre-dredge)				
A and B	4	7	5	0.5
C and B	4	7	5	0.5
D and B	5	7	5	0.714
May 2007 and October 2006				
A and A	4	7	5	0.5
B and B	3	5	7	0.333
C and C	6	7	6	0.857
D and D	5	7	6	0.625

From the analysis of the May 2007 samples (Table 2) it can be seen that the dredge disposal pipe-end Transect (A) could be considered the least similar to the Control Transect (B), i.e. the lowest Jaccard's Coefficient (0.375). This is largely due to a lack of polychaetes and sand crabs (*Emerita analoga*) at Transect A. Additionally, Transect A had one species only observed there. Since polychaetes and sand crabs were observed at Transect A during the Pre-dredge disposal sampling the absence of sand crabs and polychaetes from the Transect A, in May 2007, could be interpreted as a result of the dredge disposal. Differences in grain size and other factors are likely contributing to the results observed in May 2007 at Transect A. However, as observed in past dredge disposal projects in the area, it is expected that sand crabs and polychaetes will repopulate those areas affected by the dredge disposal activities. This will be investigated as part of the up coming sampling events in June and July of 2007.

Transect A and Transect B shared little in common during the Pre-dredge sampling event in October 2006, as well. However, these differences were due to a greater number of species found at Transect A, compared to the Control Transect (B). This could indicate that there is a significant difference in habitat at these transects. However, since the Pre-dredge samples at Transect B in October 2006 and the post-dredge disposal samples of May 2007, showed very little in common, it seems to indicate a less stable community at the Control Transect (B).

Overall, the north and south transects (Transects C and D), were comparatively similar to the Control Transect (B) following the dredge disposal activities, and showed intra-transect similarity when comparing pre and post dredge samples. This is an indication that the dredge disposal activities are not having and affect on the north and south transect areas.

REFERENCES

Pacific Affiliates, 2006. Samoa Beach Surf Zone Disposal Monitoring Plan. Cooperative Eureka Waterfront Facilities Maintenance Dredging Project. Prepared for the City of Eureka and Humboldt Bay Harbor, Recreation and Conservation District. Revision IV, August 2006.

SOIL CONTROL LAB

42 HANGAR WAY
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7060555-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A1-1-GSA, collected 06/15/07 05:57
Our Laboratory #: 7060555-1

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.58	0.58

Analysis of fraction that is less than 2mm

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	2.43	2.43
1 1-0.5	28.26	30.69
2 0.5-0.25	61.44	92.14
3 0.25-0.125	7.26	99.40
4 0.125-0.062	0.05	99.45
5 0.062-0.031	0.04	99.49
6 0.031-0.016	0.01	99.50
7 0.016-0.008	0.00	99.50
8 0.008-0.004	0.00	99.50
9 0.004-0.002	0.01	99.51
>9 < 0.002	0.49	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.45	0.05	0.50

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A2-1-GSA, collected 06/14/07 11:23
Our Laboratory #: 7060555-2

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.32	0.32
2 0.5-0.25	76.86	77.17
3 0.25-0.125	22.17	99.34
4 0.125-0.062	0.07	99.42
5 0.062-0.031	0.01	99.42
6 0.031-0.016	0.41	99.83
7 0.016-0.008	0.00	99.83
8 0.008-0.004	0.03	99.86
9 0.004-0.002	0.00	99.86
>9 < 0.002	0.14	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.42	0.45	0.14

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A3-1-GSA, collected 06/14/07 11:17
Our Laboratory #: 7060555-3

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	0.05	0.05
2 0.5-0.25	45.54	45.60
3 0.25-0.125	52.73	98.33
4 0.125-0.062	1.31	99.64
5 0.062-0.031	0.13	99.77
6 0.031-0.016	0.02	99.79
7 0.016-0.008	0.00	99.79
8 0.008-0.004	0.05	99.84
9 0.004-0.002	0.02	99.86
>9 < 0.002	0.14	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.64	0.20	0.16

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B1-1-GSA, collected 06/16/07 07:35
Our Laboratory #: 7060555-4

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	2.25	2.25
-1 4- 2	0.00	2.25

Analysis of fraction that is less than 2mm

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.04	0.04
1 1-0.5	2.34	2.38
2 0.5-0.25	76.14	78.52
3 0.25-0.125	20.80	99.33
4 0.125-0.062	0.14	99.47
5 0.062-0.031	0.02	99.49
6 0.031-0.016	0.04	99.53
7 0.016-0.008	0.00	99.53
8 0.008-0.004	0.05	99.58
9 0.004-0.002	0.00	99.58
>9 < 0.002	0.42	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.47	0.11	0.42

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B2-1-GSA, collected 06/16/07 07:45
Our Laboratory #: 7060555-5

Pebbles as percent of whole sample

SIZE INTERVAL

Phi	mm	INTERVAL (%)	CUMULATIVE (%)
<-5	>32	0.00	0.00
-4	32-16	0.00	0.00
-3	16- 8	0.00	0.00
-2	8- 4	0.00	0.00
-1	4- 2	0.06	0.06

Analysis of fraction that is less than 2mm

Phi	mm	INTERVAL (%)	CUMULATIVE (%)
0	2- 1	1.29	1.29
1	1-0.5	38.95	40.24
2	0.5-0.25	53.96	94.20
3	0.25-0.125	5.39	99.59
4	0.125-0.062	0.03	99.62
5	0.062-0.031	0.04	99.67
6	0.031-0.016	0.03	99.70
7	0.016-0.008	0.00	99.70
8	0.008-0.004	0.01	99.71
9	0.004-0.002	0.00	99.71
>9	< 0.002	0.29	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.62	0.09	0.29

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B3-1-GSA, collected 06/16/07 07:55
Our Laboratory #: 7060555-6

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.94	0.94
2 0.5-0.25	81.55	82.49
3 0.25-0.125	17.12	99.61
4 0.125-0.062	0.06	99.67
5 0.062-0.031	0.01	99.68
6 0.031-0.016	0.04	99.72
7 0.016-0.008	0.00	99.72
8 0.008-0.004	0.00	99.72
9 0.004-0.002	0.00	99.72
>9 < 0.002	0.28	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.67	0.05	0.28

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C1-1-GSA, collected 06/14/07 10:59
Our Laboratory #: 7060555-7

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.14	0.14

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	1.56	1.56
1 1-0.5	22.19	23.75
2 0.5-0.25	68.61	92.36
3 0.25-0.125	7.23	99.59
4 0.125-0.062	0.02	99.61
5 0.062-0.031	0.02	99.63
6 0.031-0.016	0.05	99.68
7 0.016-0.008	0.00	99.68
8 0.008-0.004	0.00	99.68
9 0.004-0.002	0.01	99.69
>9 < 0.002	0.31	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.61	0.07	0.32

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C2-1-GSA, collected 06/14/07 11:06
Our Laboratory #: 7060555-8

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.50	0.50
2 0.5-0.25	77.78	78.28
3 0.25-0.125	21.30	99.58
4 0.125-0.062	0.12	99.70
5 0.062-0.031	0.00	99.70
6 0.031-0.016	0.00	99.70
7 0.016-0.008	0.00	99.70
8 0.008-0.004	0.00	99.70
9 0.004-0.002	0.00	99.70
>9 < 0.002	0.30	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.70	0.00	0.30

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Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C3-1-GSA, collected 06/14/07 10:59
Our Laboratory #: 7060555-9

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	0.40	0.40
2 0.5-0.25	61.78	62.18
3 0.25-0.125	36.75	98.93
4 0.125-0.062	0.71	99.64
5 0.062-0.031	0.08	99.72
6 0.031-0.016	0.01	99.73
7 0.016-0.008	0.00	99.73
8 0.008-0.004	0.01	99.74
9 0.004-0.002	0.00	99.74
>9 < 0.002	0.26	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.64	0.10	0.26

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Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D1-1-GSA, collected 06/15/07 07:23
Our Laboratory #: 7060555-10

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	1.94	1.94
2 0.5-0.25	82.60	84.53
3 0.25-0.125	14.99	99.52
4 0.125-0.062	0.07	99.59
5 0.062-0.031	0.04	99.63
6 0.031-0.016	0.00	99.63
7 0.016-0.008	0.00	99.63
8 0.008-0.004	0.02	99.65
9 0.004-0.002	0.00	99.65
>9 < 0.002	0.35	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.59	0.06	0.35

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7060555-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D2-1-GSA, collected 06/14/07 11:35
Our Laboratory #: 7060555-11

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.73	0.73
2 0.5-0.25	83.99	84.72
3 0.25-0.125	14.86	99.58
4 0.125-0.062	0.10	99.68
5 0.062-0.031	0.06	99.74
6 0.031-0.016	0.01	99.75
7 0.016-0.008	0.00	99.75
8 0.008-0.004	0.00	99.75
9 0.004-0.002	0.02	99.77
>9 < 0.002	0.23	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.68	0.07	0.25

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7060555-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: June 21, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D3-1-GSA, collected 06/14/07 11:28
Our Laboratory #: 7060555-12

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.33	0.33
2 0.5-0.25	59.05	59.39
3 0.25-0.125	39.54	98.93
4 0.125-0.062	0.76	99.69
5 0.062-0.031	0.04	99.72
6 0.031-0.016	0.00	99.72
7 0.016-0.008	0.04	99.76
8 0.008-0.004	0.02	99.78
9 0.004-0.002	0.00	99.78
>9 < 0.002	0.22	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.69	0.09	0.22

Mike Galloway

**SAMOA BEACH DREDGE DISPOSAL
INFAUNAL COMMUNITY SURVEY REPORT**

DREDGE DISPOSAL SAMPLING JUNE 2007

PREPARED FOR:

PACIFIC AFFILIATES, INC.

A CONSULTING AND ENGINEERING GROUP

990 W. WATERFRONT DRIVE

EUREKA, CA 95501

PREPARED BY:

TETRA TECH, INC.

7800 SHOAL CREEK BLVD., SUITE 253E.

AUSTIN, TX 78757

CONTACT:

N.A. WIERSEMA

Ph: 512-338-1667

JULY 10, 2007

**SAMOA BEACH DREDGE DISPOSAL
INFAUNAL COMMUNITY SURVEY REPORT**

DREDGE DISPOSAL SAMPLING JUNE 2007

PREPARED FOR:

PACIFIC AFFILIATES, INC.

A CONSULTING AND ENGINEERING GROUP

990 W. WATERFRONT DRIVE

EUREKA, CA 95501

PREPARED BY:

TETRA TECH

7800 SHOAL CREEK BLVD., SUITE 253E.

AUSTIN, TX 78757

CONTACT:

N.A. WIERSEMA

Ph: 512-338-1667

JULY 10, 2007

INTRODUCTION

In June of 2007 four transect locations (A through D, see below) were sampled on June 14th through the 16th. Three of these locations (A, B, and C) correspond approximately to those transect locations sampled as part of previous dredge disposal events, prior to 2006. In October 2006 a sampling event was performed to characterize pre-dredge disposal conditions. In May 2007 the first of three proposed sampling events to characterize the post-dredge disposal conditions was performed. The June 2007 monitoring event is the second of three planned post-dredge disposal monitoring events. The four sampling transect locations are as follows:

- Transect A: Dredge disposal site. Location where dredge pipeline empties into the surf zone.
- Transect B: Control site. Located on the beach approximately 1,000 meters south of the pipeline terminus.
- Transect C: 100 meters north of the pipeline terminus (Transect A).
- Transect D: 100 meters south of the pipeline terminus (Transect A).

SAMPLING METHODOLOGY

Provided below is a brief summary of the sampling methodology, a more detailed discussion of the sampling methods can be found within the dredge disposal monitoring plan (Pacific Affiliates, 2006). At each of the four transect locations, three replicate sampling transects were established. Along each of these replicate transects, individual samples were collected at 2-meter intervals and composited. Each sample was collected using a 10 centimeter diameter coring device. The coring device was pushed to a depth of 20 centimeters. The cored material was then washed, sieving the material through a 1000 micron sack, eliminating the finer silts, and sands. The remaining coarse mineral and vegetative debris and organisms were then placed within sample jars, and preserved as described within the dredge disposal monitoring plan (Pacific Affiliates, 2006).

SAMPLE PROCESSING

Each sample was transferred to a 500 micron sieve for washing, to eliminate fine sediments, and preservatives. The samples were then transferred to a sorting tray. The infaunal invertebrates were then sorted from the coarse material and vegetative debris. After, the large and obvious invertebrates were sorted out the remaining material was viewed under a stereo microscope for completeness. All organisms were placed into glass vials with 70% ethanol for preservation. The infaunal invertebrates were then identified and enumerated. Each species type was additionally weighed. Table 1, presents these data.

STATISTICAL ANALYSIS AND SAMPLE SITE COMPARABILITY

Past disposal of dredge spoil material and subsequent biological community monitoring have not indicated any longer term changes in species composition, when compared to pre dredge conditions, the control location and areas receiving dredge spoil (Pacific Affiliates, 2006). This conclusion was drawn using similarity analysis, Jaccard's Coefficient of Similarity. This analysis was based on the presence/absence of individual crustacean and polychaete species between years. Routine differences in species abundances have been documented and are expected to occur as a result of dredge spoil discharge. Seasonal variations in abundances are also expected to occur.

In addition, to standard composition and structure measures (total abundance and total taxa), biomass, diversity measures and community similarity analyses were performed and presented in Tables 1 and 2. A simplified Jaccard's Coefficient was used to compare community similarities between pre and post dredge samples for each transect and between the primary sample transects (A, C and D) and the control transect (B) using the following formula:

$$JC = \frac{c}{s1 + s2 - c}$$

where:

c = number of species found in common between two different transect (eg. Transect A and B, or Transect A and C) samples, and

s1 = total number of species (total taxa) found in community 1, and

s2 = total number of species (total taxa) found in community 2, and

JC = Jaccard's coefficient.

Jaccard's coefficient ranges in value from 0 to 1, and the closer it is to 1 the more similar the communities are.

Numbers and biomass of each species was determined and presented as raw number per transects, transect total, averages, and normalized by volume (i.e. cubic meters of sands, gravels, silts, fines, vegetative debris, etc., sieved). Biomass measures include total biomass (wet weight in grams) and the contribution of crustacean and polychaete to the total biomass was also be evaluated between transect samples. Richness and evenness was evaluated using the Shannon-Weaver Diversity Index (H').

Following sample volume normalization, it can be seen that Transect B had the greatest abundance and biomass per cubic meter (Table 1). This is in contrast to the May event when Transect D had the greatest abundance and biomass. The pipe-end dredge disposal Transect (A), and north and south transects (C and D) were comparatively similar in abundances, but not biomass.

Table 1. Species Abundance, Biomass and Composition Measures

Species	Transect A						Transect B						Transect C						Transect D						
	A-1-INV		A-2-INV		A-3-INV		B-1-INV		B-2-INV		B-3-INV		C-1-INV		C-2-INV		C-3-INV		D-1-INV		D-2-INV		D-3-INV		
	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	
Crustacea																									
<i>Emerita analoga</i>					2	5	2	3	1	4	4	8	1	7	2	1									
<i>Archaeomysis grebnitzkii</i>	7	<1			1	<1	22	<1	44	<1	40	<1	12	<1	19	<1	14	<1					1	1	
<i>Megalorchestia californiana</i>	2	<1	5	<1	2	<1	1	<1		<1	3	<1					1	<1	3	<1	1	<1	2	<1	
<i>Dogielonotus loquax</i>					1	<1			2	<1	1	<1							1	<1			2	<1	
<i>Excirolana iniquiffrons</i>	27	<1	32	<1	20	<1	27	<1	26	<1	30	<1	19	<1	11	<1	13	<1	16	<1	14	<1	21	<1	
<i>Armadillium vulgare</i>							2	<1															2	<1	
<i>Mandibulophoxus sp.</i>																							1	<1	
Polychaetes																									
<i>Nephtys californiensis</i>							3	4	1	<1	2	<1	2	<1	3	<1			2	1	2	<1			
<i>Euzonus williamsi</i>							26	<1	24	<1	17	<1	12	<1	16	<1	3	<1							
<i>Pygospio californica</i>			26	<1	6	<1							1	<1	4	<1	8	<1	8	<1			1	<1	
Insecta																									
Total Abundance and Biomass	36	1.5	63	1.5	32	3.5	83	9.5	97	2.5	94	7	50	10.5	54	9.5	41	3.5	30	3	18	2.5	34	3.5	
Total Richness (Taxa)	3	3	3	3	6	6	7	7	5	5	7	7	6	6	6	6	6	6	4	4	5	5	7	7	
Crustacean Biomass	1.5	1	1	3.5	5	5	1.5	1.5	1.5	1.5	6	6	9	9	8	8	2.5	2.5	1.5	1.5	8.5	8.5	3	3	
Polychaete Biomass	0	0	<1	<1	<1	<1	4.5	4.5	1	1	1	1	1.5	1.5	1.5	1.5	1	1	0.5	0.5	0	0	0.5	0.5	
Transect Total Abundance			131					274						145									82		
Transect Total Taxa			6					8						7									9		
Transect Total Biomass (g)			6.5				19							23.5									9		
Transect Total Biomass (g/m³)			57.5				180.9							170.3									169.8		
Transect Total Abundance (#/m³)			1159				2609							1050									1547		
Transect Average Abundance			43.7				91.3							48.3									27.3		
Transect Average Richness			4.0				6.3							6.0									5.3		
Transect Average Biomass (g)			2.2				6.3							7.8									3.0		
Shannon-Weaver Diversity (H')			1.004				1.354							1.566									1.313		

For total biomass, organisms weighing less than 1 gram were treated as 0.5 gram. g = grams

Table 2. Jaccard's Coefficient of Similarity

Transects	c	s1	s2	JC
October 2006 (Pre-dredge)				
A and B	4	7	5	0.5
C and B	4	7	5	0.5
D and B	5	7	5	0.714
May 2007				
A and B	3	4	7	0.375
C and B	5	6	7	0.625
D and B	6	6	7	0.857
June 2007				
A and B	5	6	8	0.556
C and B	6	7	8	0.667
D and B	7	9	8	0.7
May 2007 and October 2006 (Pre-dredge)				
A and A	4	7	5	0.5
B and B	3	5	7	0.333
C and C	6	7	6	0.857
D and D	5	7	6	0.625
June 2007 and October 2006 (Pre-dredge)				
A and A	6	7	6	0.857
B and B	3	5	8	0.3
C and C	6	7	7	0.75
D and D	6	7	9	0.6

From the analysis of the June 2007 samples (Table 2) it can be seen that the dredge disposal pipe-end Transect (A) could be considered the least similar to the Control Transect (B), i.e. the lowest Jaccard's Coefficient (0.556). However, these two sites were far more similar to each other in June than was observed in May. This was largely due to a lack of polychaetes and sand crabs (*Emerita analoga*) at Transect A in May. As predicted within the May dredge disposal report (Tetra Tech, 2007), the presence of polychaetes and sand crabs at Transect A is expected.

Transect A and Transect B shared little in common during the Pre-dredge sampling event in October 2006, as well. However, these differences were due to a greater number of species found at Transect A, compared to the Control Transect (B). This could indicate that there is a significant difference in habitat at these transects. However, since the Pre-dredge samples at Transect B in October 2006 and the post-dredge disposal samples of May 2007 and June 2007, showed very little in common, it seems to indicate a less stable community at the Control Transect (B).

Overall, the north and south transects (Transects C and D), were comparatively similar to the Control Transect (B) following the dredge disposal activities, and showed intra-transect similarity when comparing pre and post dredge samples. This is an indication that the dredge disposal activities are not having and affect on the north and south transect areas.

REFERENCES

Pacific Affiliates, 2006. Samoa Beach Surf Zone Disposal Monitoring Plan. Cooperative Eureka Waterfront Facilities Maintenance Dredging Project. Prepared for the City of Eureka and Humboldt Bay Harbor, Recreation and Conservation District. Revision IV, August 2006.

Tetra Tech, 2007. Samoa Beach Dredge Disposal Infaunal Community Survey Report. Dredge Disposal Sampling May 2007. June 4, 2007.

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A1-1-GSA, collected 07/13/07 06:55
Our Laboratory #: 7070501-1

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.22	0.22
1 1-0.5	12.56	12.77
2 0.5-0.25	83.91	96.68
3 0.25-0.125	3.07	99.75
4 0.125-0.062	0.06	99.81
5 0.062-0.031	0.00	99.81
6 0.031-0.016	0.00	99.81
7 0.016-0.008	0.05	99.86
8 0.008-0.004	0.00	99.86
9 0.004-0.002	0.00	99.86
>9 < 0.002	0.14	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.81	0.05	0.14

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A2-1-GSA, collected 07/12/07 10:25
Our Laboratory #: 7070501-2

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> mm	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.43	0.43
2 0.5-0.25	83.94	84.37
3 0.25-0.125	15.41	99.78
4 0.125-0.062	0.04	99.83
5 0.062-0.031	0.02	99.85
6 0.031-0.016	0.06	99.91
7 0.016-0.008	0.00	99.91
8 0.008-0.004	0.00	99.91
9 0.004-0.002	0.02	99.93
>9 < 0.002	0.07	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.83	0.08	0.09

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
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USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: A3-1-GSA, collected 07/12/07 10:59
Our Laboratory #: 7070501-3

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	0.11	0.11
2 0.5-0.25	53.74	53.85
3 0.25-0.125	44.55	98.40
4 0.125-0.062	1.53	99.94
5 0.062-0.031	0.01	99.95
6 0.031-0.016	0.04	99.99
7 0.016-0.008	0.00	99.99
8 0.008-0.004	0.00	99.99
9 0.004-0.002	0.00	99.99
>9 < 0.002	0.01	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.94	0.06	0.01

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
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95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B1-1-GSA, collected 07/13/07 08:25
Our Laboratory #: 7070501-4

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	2.19	2.19
-1 4- 2	0.24	2.44

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	1.17	1.17
1 1-0.5	17.14	18.31
2 0.5-0.25	77.08	95.39
3 0.25-0.125	4.34	99.73
4 0.125-0.062	0.04	99.77
5 0.062-0.031	0.01	99.78
6 0.031-0.016	0.02	99.80
7 0.016-0.008	0.00	99.80
8 0.008-0.004	0.03	99.83
9 0.004-0.002	0.00	99.83
>9 < 0.002	0.17	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.77	0.06	0.17

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
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7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
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Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B2-1-GSA, collected 07/12/07 11:35
Our Laboratory #: 7070501-5

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.03	0.03
1 1-0.5	0.62	0.65
2 0.5-0.25	81.90	82.55
3 0.25-0.125	17.28	99.83
4 0.125-0.062	0.00	99.83
5 0.062-0.031	0.01	99.85
6 0.031-0.016	0.00	99.85
7 0.016-0.008	0.00	99.85
8 0.008-0.004	0.01	99.85
9 0.004-0.002	0.00	99.85
>9 < 0.002	0.15	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.83	0.02	0.15

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
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Pacific Affiliates
990 W. Waterfront Drive
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Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: B3-1-GSA, collected 07/12/07 11:43
Our Laboratory #: 7070501-6

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.09	0.09
1 1-0.5	6.84	6.93
2 0.5-0.25	79.25	86.18
3 0.25-0.125	13.36	99.54
4 0.125-0.062	0.39	99.92
5 0.062-0.031	0.01	99.94
6 0.031-0.016	0.00	99.94
7 0.016-0.008	0.00	99.94
8 0.008-0.004	0.01	99.94
9 0.004-0.002	0.01	99.96
>9 < 0.002	0.04	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.92	0.02	0.06

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C1-1-GSA, collected 07/13/07 06:55
Our Laboratory #: 7070501-7

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	2.95	2.95
2 0.5-0.25	85.18	88.13
3 0.25-0.125	11.63	99.76
4 0.125-0.062	0.03	99.79
5 0.062-0.031	0.07	99.85
6 0.031-0.016	0.00	99.85
7 0.016-0.008	0.02	99.88
8 0.008-0.004	0.00	99.88
9 0.004-0.002	0.00	99.88
>9 < 0.002	0.12	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.79	0.09	0.12

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C2-1-GSA, collected 07/12/07 10:10
Our Laboratory #: 7070501-8

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	4.96	4.96
2 0.5-0.25	88.34	93.30
3 0.25-0.125	6.49	99.79
4 0.125-0.062	0.00	99.79
5 0.062-0.031	0.06	99.85
6 0.031-0.016	0.01	99.86
7 0.016-0.008	0.00	99.86
8 0.008-0.004	0.02	99.88
9 0.004-0.002	0.01	99.89
>9 < 0.002	0.11	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.79	0.09	0.12

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
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USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: C3-1-GSA, collected 07/12/07 11:09
Our Laboratory #: 7070501-9

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.72	0.72
2 0.5-0.25	77.05	77.77
3 0.25-0.125	21.51	99.29
4 0.125-0.062	0.45	99.73
5 0.062-0.031	0.10	99.83
6 0.031-0.016	0.02	99.85
7 0.016-0.008	0.04	99.89
8 0.008-0.004	0.00	99.89
9 0.004-0.002	0.00	99.89
>9 < 0.002	0.11	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.73	0.15	0.11

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
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7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D1-1-GSA, collected 07/13/07 07:55
Our Laboratory #: 7070501-10

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.42	0.42
-1 4- 2	1.24	1.66

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	1.63	1.63
1 1-0.5	19.99	21.62
2 0.5-0.25	73.23	94.85
3 0.25-0.125	4.88	99.72
4 0.125-0.062	0.01	99.74
5 0.062-0.031	0.13	99.86
6 0.031-0.016	0.00	99.86
7 0.016-0.008	0.00	99.86
8 0.008-0.004	0.00	99.86
9 0.004-0.002	0.00	99.86
>9 < 0.002	0.14	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.74	0.13	0.14

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
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7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D2-1-GSA, collected 07/12/07 10:40
Our Laboratory #: 7070501-11

Pebbles as percent of whole sample

SIZE INTERVAL

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

<u>Phi</u> <u>mm</u>	<u>INTERVAL (%)</u>	<u>CUMULATIVE (%)</u>
0 2- 1	0.00	0.00
1 1-0.5	0.84	0.84
2 0.5-0.25	88.20	89.04
3 0.25-0.125	10.70	99.75
4 0.125-0.062	0.03	99.78
5 0.062-0.031	0.05	99.83
6 0.031-0.016	0.00	99.83
7 0.016-0.008	0.00	99.83
8 0.008-0.004	0.06	99.89
9 0.004-0.002	0.00	99.89
>9 < 0.002	0.11	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.78	0.11	0.11

Mike Galloway

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

7070501-12-654

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501
Attn: Yoash Tilles

Project #/Name: 930/940 / City of Eureka & Harbor District Maintenance Dredging - Beach
Method: Plumb 1981
Date Analyzed: July 30, 2007
Matrix: Sediment
Client Site ID: None
Client Sample ID: D3-1-GSA, collected 07/12/07 10:50
Our Laboratory #: 7070501-12

Pebbles as percent of whole sample

SIZE INTERVAL

Phi mm	INTERVAL (%)	CUMULATIVE (%)
<-5 >32	0.00	0.00
-4 32-16	0.00	0.00
-3 16- 8	0.00	0.00
-2 8- 4	0.00	0.00
-1 4- 2	0.00	0.00

Analysis of fraction that is less than 2mm

Phi mm	INTERVAL (%)	CUMULATIVE (%)
0 2- 1	0.00	0.00
1 1-0.5	0.24	0.24
2 0.5-0.25	60.44	60.68
3 0.25-0.125	38.21	98.89
4 0.125-0.062	1.00	99.89
5 0.062-0.031	0.01	99.91
6 0.031-0.016	0.03	99.94
7 0.016-0.008	0.01	99.94
8 0.008-0.004	0.00	99.94
9 0.004-0.002	0.01	99.95
>9 < 0.002	0.05	100.00

These percentages are of the portion passing a 2mm sieve

% sand	% silt	% clay
99.89	0.05	0.06

Mike Galloway

**SAMOA BEACH DREDGE DISPOSAL
INFAUNAL COMMUNITY SURVEY REPORT**

DREDGE DISPOSAL SAMPLING JULY 2007

PREPARED FOR:

PACIFIC AFFILIATES, INC.

A CONSULTING AND ENGINEERING GROUP

990 W. WATERFRONT DRIVE

EUREKA, CA 95501

PREPARED BY:

TETRA TECH

7800 SHOAL CREEK BLVD., SUITE 253E.

AUSTIN, TX 78757

CONTACT:

N.A. WIERSEMA

Ph: 512-338-1667

AUGUST 1, 2007

INTRODUCTION

In July of 2007 four transect locations (A through D, see below) were sampled on July 12th through the 17th. Three of these locations (A, B, and C) correspond approximately to those transect locations sampled as part of previous dredge disposal events, prior to 2006. In October 2006 a sampling event was performed to characterize pre-dredge disposal conditions. In May and June 2007 the first and second of three proposed sampling events to characterize the post-dredge disposal conditions were performed. The July 2007 monitoring event is the third planned post-dredge disposal monitoring events. The four sampling transect locations are as follows:

- Transect A: Dredge disposal site. Location where dredge pipeline empties into the surf zone.
- Transect B: Control site. Located on the beach approximately 1,000 meters south of the pipeline terminus.
- Transect C: 100 meters north of the pipeline terminus (Transect A).
- Transect D: 100 meters south of the pipeline terminus (Transect A).

SAMPLING METHODOLOGY

Provided below is a brief summary of the sampling methodology, a more detailed discussion of the sampling methods can be found within the dredge disposal monitoring plan (Pacific Affiliates, 2006). At each of the four transect locations, three replicate sampling transects were established. Along each of these replicate transects, individual samples were collected at 2-meter intervals and composited. Each sample was collected using a 10 centimeter diameter coring device. The coring device was pushed to a depth of 20 centimeters. The cored material was then washed, sieving the material through a 1000 micron sack, eliminating the finer silts, and sands. The remaining coarse mineral and vegetative debris and organisms were then placed within sample jars, and preserved as described within the dredge disposal monitoring plan (Pacific Affiliates, 2006).

SAMPLE PROCESSING

Each sample was transferred to a 500 micron sieve for washing, to eliminate fine sediments, and preservatives. The samples were then transferred to a sorting tray. The infaunal invertebrates were then sorted from the coarse material and vegetative debris. After, the large and obvious invertebrates were sorted out the remaining material was viewed under a stereo microscope for completeness. All organisms were placed into glass vials with 70% ethanol for preservation. The infaunal invertebrates were then identified and enumerated. Each species type was additionally weighed. Table 1, presents these data.

STATISTICAL ANALYSIS AND SAMPLE SITE COMPARABILITY

Past disposal of dredge spoil material and subsequent biological community monitoring have not indicated any longer term changes in species composition, when compared to pre dredge conditions, the control location and areas receiving dredge spoil (Pacific Affiliates, 2006). This conclusion was drawn using similarity analysis, Jaccard's Coefficient of Similarity. This analysis was based on the presence/absence of individual crustacean and polychaete species between years. Routine differences in species abundances have been documented and are expected to occur as a result of dredge spoil discharge. Seasonal variations in abundances are also expected to occur.

In addition, to standard composition and structure measures (total abundance and total taxa), biomass, diversity measures and community similarity analyses were performed and presented in Tables 1 and 2. A simplified Jaccard's Coefficient was used to compare community similarities between pre and post dredge samples for each transect and between the primary sample transects (A, C and D) and the control transect (B) using the following formula:

$$JC = \frac{c}{s1 + s2 - c}$$

where:

c = number of species found in common between two different transect (eg. Transect A and B, or Transect A and C) samples, and

s1 = total number of species (total taxa) found in community 1, and

s2 = total number of species (total taxa) found in community 2, and

JC = Jaccard's coefficient.

Jaccard's coefficient ranges in value from 0 to 1, and the closer it is to 1 the more similar the communities are.

Numbers and biomass of each species was determined and presented as raw number per transects, transect total, averages, and normalized by volume (i.e. cubic meters of sands, gravels, silts, fines, vegetative debris, etc., sieved). Biomass measures include total biomass (wet weight in grams) and the contribution of crustacean and polychaete to the total biomass was also be evaluated between transect samples. Richness and evenness was evaluated using the Shannon-Weaver Diversity Index (H').

Following sample volume normalization, it can be seen that in July Transect A had the greatest abundance per cubic meter (Table 1). This is in contrast to the May and June events when Transect D and B, respectively, had the greatest abundances (Tetra Tech, 2007a and 2007b). In July, the north and south transects (C and D) were comparatively similar in abundances, but not biomass. Differences in biomass between the four transects are largely due to the presence or absence of sand crabs, and more recently the presence of large female sand crabs carrying significant egg masses.

Table 1. Species Abundance, Biomass and Composition Measures

Species	Transect A						Transect B						Transect C						Transect D							
	A-1-INV		A-2-INV		A-3-INV		B-1-INV		B-2-INV		B-3-INV		C-1-INV		C-2-INV		C-3-INV		D-1-INV		D-2-INV		D-3-INV			
	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)		
Crustacea																										
<i>Erimia analoga</i>					3	7					2	8					1	6	2	10	4	13	1	<1	2	11
<i>Archaeomysis grebnitzkii</i>	4	<1															2	<1	2	<1	13	<1	2	<1	5	<1
<i>Megalorchestia californiana</i>		<1	3	<1	1	<1	4	<1			5	<1	7	1	11	<1	7	<1					3	<1	5	<1
<i>Dogielonotus loquax</i>			1	<1	1	<1					1	<1														
<i>Excirolana iniquifrons</i>	21	<1	19	<1	10	<1	30	<1			18	<1	25	<1	22	<1	22	<1	31	<1	11	<1	21	<1	16	<1
<i>Armadillium vulgare</i>											3	<1	2	<1												
<i>Mandibulophoxus sp.</i>	4	<1	1	<1													7	<1	18	<1	2	<1				
Polychaetes																										
<i>Nephtys californiensis</i>							1	<1	3	5							7	<1	6	<1	11	<1	2	<1	2	<1
<i>Euzonus williamsi</i>	3	<1	12	<1	21	<1	11	<1	17	<1	3	<1	3	<1	2	<1	10	<1	23	<1	2	<1	6	<1	3	<1
<i>Pygospio californica</i>	31	<1	63	<1	162	1	31	<1	33	<1	26	<1	15	<1	5	<1	9	<1	8	<1	8	<1	8	<1	6	<1
Insecta																										
<i>Emphayles fucicola</i>											1	---														
Total Abundance and Biomass	63	3	99	3.5	198	10	77	2.5	77	15.5	63	3	60	3.5	83	9.5	87	13.5	38	15	43	3.5	39	14	7	
Total Richness (Taxa)	5	5	2	2	1	1.5	1	1.5	6	6	2	1	1.5	1.5	8	8	12	1.5	1	5	7	2	14	12.5	1.5	
Crustacean Biomass																										
Polychaete Biomass																										
Transect Total Abundance																										
Transect Total Taxa																										
Transect Total Biomass (g)																										
Transect Total Biomass (g/m³)																										
Transect Total Abundance (#/m³)																										
Transect Average Abundance																										
Transect Average Richness																										
Transect Average Biomass (g)																										
Shannon-Weaver Diversity (H')																										
For total biomass, organisms weighing less than 1 gram were treated as 0.5 gram. g = grams																										

Table 2. Jaccard's Coefficient of Similarity

Transects	c	s1	s2	JC
October 2006 (Pre-dredge)				
A and B	4	7	5	0.5
C and B	4	7	5	0.5
D and B	5	7	5	0.714
May 2007				
A and B	3	4	7	0.375
C and B	5	6	7	0.625
D and B	6	6	7	0.857
June 2007				
A and B	5	6	8	0.556
C and B	6	7	8	0.667
D and B	7	9	8	0.7
July 2007				
A and B	7	8	9	0.7
C and B	7	8	9	0.7
D and B	7	7	9	0.778
May 2007 and October 2006 (Pre-dredge)				
A and A	4	7	5	0.5
B and B	3	5	7	0.333
C and C	6	7	6	0.857
D and D	5	7	6	0.625
June 2007 and October 2006 (Pre-dredge)				
A and A	6	7	6	0.857
B and B	3	5	8	0.3
C and C	6	7	7	0.75
D and D	6	7	9	0.6
July 2007 and October 2006 (Pre-dredge)				
A and A	6	7	8	0.666
B and B	4	5	9	0.4
C and C	6	7	8	0.666
D and D	6	7	7	0.75

From the analysis of the July 2007 samples (Table 2) it can be seen that all sampling transects (A, C and D) and the Control Transect (B) are comparatively similar, with Jaccard's Coefficients of 0.7 or greater. As noted before, Transect A and Transect B shared little in common during the Pre-dredge sampling event in October 2006. Based on the three post-dredge disposal monitoring activities a trend towards greater similarity (i.e. higher Jaccard's Coefficients) has been observed since the ceasing from of the dredge disposal activities.

Overall, the north and south transects (Transects C and D), were comparatively similar to the Control Transect (B) following the dredge disposal activities, and showed intra-transect similarity when comparing pre and post dredge samples. This is an indication that the dredge disposal activities are not having and affect on the north and south transect areas.

REFERENCES

Pacific Affiliates, 2006. Samoa Beach Surf Zone Disposal Monitoring Plan. Cooperative Eureka Waterfront Facilities Maintenance Dredging Project. Prepared for the City of Eureka and Humboldt Bay Harbor, Recreation and Conservation District. Revision IV, August 2006.

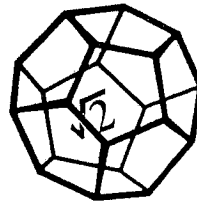
Tetra Tech, 2007a. Samoa Beach Dredge Disposal Infaunal Community Survey Report. Dredge Disposal Sampling May 2007. June 4, 2007.

Tetra Tech, 2007b. Samoa Beach Dredge Disposal Infaunal Community Survey Report. Dredge Disposal Sampling June 2007. July 10, 2007.

SAMPLE RECEIPT AND PROCESSING LOG

LAB_ID	CLIENT_ID	SAMPLING_DATE	CONDITION	PROCESSING_START_DATE
1	A-1-INV	7/16/2007	good	7/20/2007
2	A-2-INV	7/16/2007	good	7/23/2007
3	A-3-INV	7/16/2007	good	7/24/2007
4	B-1-INV	7/17/2007	good	7/24/2007
5	B-2-INV	7/17/2007	good	7/25/2007
6	B-3-INV	7/17/2007	good	7/25/2007
7	C-1-INV	7/12/2007	good	7/26/2007
8	C-2-INV	7/12/2007	good	7/26/2007
9	C-3-INV	7/12/2007	good	7/27/2007
10	D-1-INV	7/16/2007	good	7/27/2007
11	D-2-INV	7/17/2007	good	7/30/2007
12	D-3-INV	7/17/2007	good	7/30/2007

Received By:	Received Date:	Signature:
Nick Wiersema	7/19/2007	<i>Nick Wiersema</i>



**NORTH COAST
LABORATORIES LTD.**

July 30, 2007

Pacific Affiliates
990 W. Waterfront Drive
Eureka, CA 95501

Order No.: 0707476
Invoice No.: 68022
PO No.:
ELAP No. 1247-Expires July 2008

Attn: Yoash Tilles

RE: 930/940 CITY OF EUREKA & HARBOR DISTRICT DREDGING

SAMPLE IDENTIFICATION

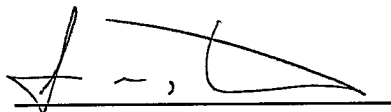
Fraction	Client Sample Description
01A	A-1-TSS
02A	B-1-TSS
03A	C-1-TSS

ND = Not Detected at the Reporting Limit

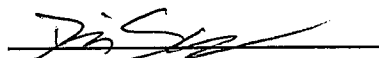
Limit = Reporting Limit

All solid results are expressed on a wet-weight basis unless otherwise noted.

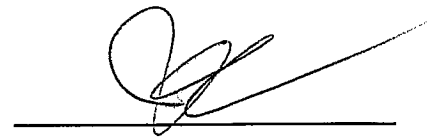
REPORT CERTIFIED BY



Laboratory Supervisor(s)



QA Unit



Jesse G. Chaney, Jr.
Laboratory Director

Date: 30-Jul-2007

WorkOrder: 0707476

ANALYTICAL REPORT

Client Sample ID: A-1-TSS

Received: 7/20/2007

Collected: 7/19/2007 3:45

Lab ID: 0707476-01A

Test Name: Non-Filterable Residue (TSS)

Reference: Std. Meth. 20th Ed. 2540 D

<u>Parameter</u>	<u>Result</u>	<u>Limit</u>	<u>Units</u>	<u>DF</u>	<u>Extracted</u>	<u>Analyzed</u>
Non-Filterable Residue(TSS)	4.0	1.0	mg/L	1.0		7/26/2007

Client Sample ID: B-1-TSS

Received: 7/20/2007

Collected: 7/19/2007 4:08

Lab ID: 0707476-02A

Test Name: Non-Filterable Residue (TSS)

Reference: Std. Meth. 20th Ed. 2540 D

<u>Parameter</u>	<u>Result</u>	<u>Limit</u>	<u>Units</u>	<u>DF</u>	<u>Extracted</u>	<u>Analyzed</u>
Non-Filterable Residue(TSS)	4.0	1.0	mg/L	1.0		7/26/2007

Client Sample ID: C-1-TSS

Received: 7/20/2007

Collected: 7/19/2007 3:53

Lab ID: 0707476-03A

Test Name: Non-Filterable Residue (TSS)

Reference: Std. Meth. 20th Ed. 2540 D

<u>Parameter</u>	<u>Result</u>	<u>Limit</u>	<u>Units</u>	<u>DF</u>	<u>Extracted</u>	<u>Analyzed</u>
Non-Filterable Residue(TSS)	4.0	1.0	mg/L	1.0		7/26/2007

North Coast Laboratories, Ltd.

Date: 30-Jul-2007

CLIENT: Pacific Affiliates

Work Order: 0707476

Project: 930/940 CITY OF EUREKA & HARBOR DIST

QC SUMMARY REPORT

Method Blank

Sample ID: MBLK	Batch ID: R48027	Test Code: NFRW	Units: mg/L	Analysis Date 7/26/2007	Prep Date:
Client ID:	Run ID: WC_070726G	SeqNo: 696601			
Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec
Non-Filterable Residue(TSS)	ND	1.0			

Sample ID: MBLK	Batch ID: R48027	Test Code: NFRW	Units: mg/L	Analysis Date 7/26/2007	Prep Date:
Client ID:	Run ID: WC_070726G	SeqNo: 696619			
Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec
Non-Filterable Residue(TSS)	ND	1.0			

Qualifiers: ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

