

---

## **H. Jet Probe Survey**

---

)

)

)

**CAMBRIA COMMUNITY SERVICES DISTRICT  
PROPOSED DESALINATION FACILITY**

**MARINE GEOLOGICAL INVESTIGATION:  
Jet-Probe Survey Offshore of San Simeon Creek  
San Luis Obispo County, California**

**Prepared for:**

**Cambria Community Services District  
P.O. BOX 65  
2284 Center Street  
Cambria, California 93428**

**Contact: David J. Andres, General Manager**

**Prepared by:**

**Rick Ware  
Coastal Resources Management  
3334 E. Coast Highway # 434  
Corona del Mar, California 92625  
(714) 673-3076**

**and**

**Leland E. Fausak  
Marine Resource Consultants, Inc.  
Post Office Box 2057  
Santa Barbara, California 93120  
(805) 898-0401**

**April 21, 1995**

**MARINE GEOLOGICAL INVESTIGATION  
JET-PROBE SURVEY OFFSHORE OF  
SAN SIMEON CREEK, SAN LUIS OBISPO COUNTY, CALIFORNIA**

**INTRODUCTION**

Coastal Resources Management (CRM) was retained by the Cambria Community Services District (CCSD) to conduct a marine geological survey of the sediments offshore of San Simeon Creek, San Luis Obispo County, California (Exhibit 1). The purpose of the survey was to define the thickness of unconsolidated sediments in the area where the CCSD desalination plant intake and discharge structures are proposed to be sited. In addition, CRM collected water and sediment samples for laboratory analysis and measured bottom water turbidity at the proposed junction of the intake and discharge structure.

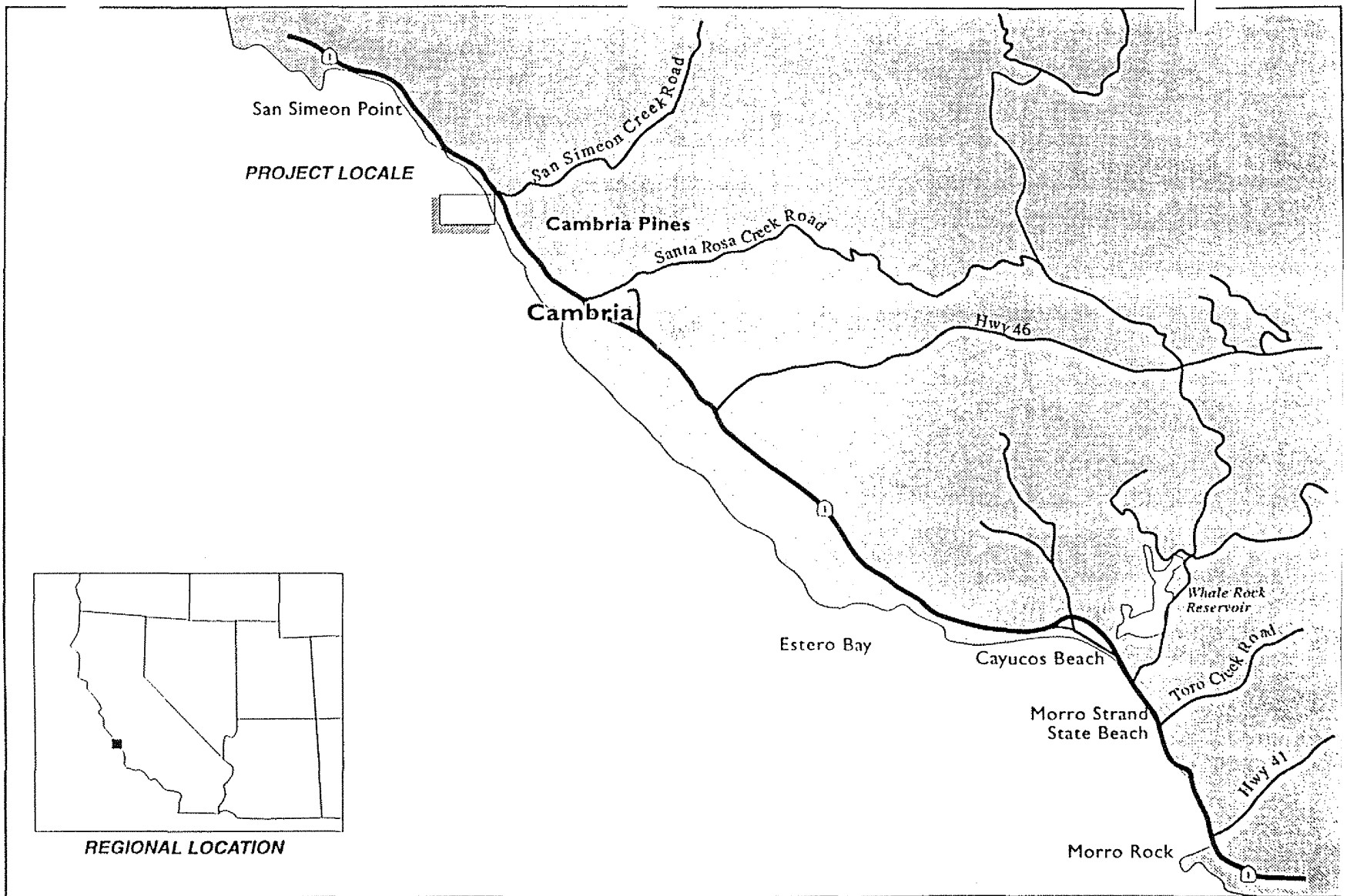
**PHYSICAL SETTING**

The study area is located approximately 1,500 feet offshore of San Simeon Creek at water depths between 28 and 32 feet below Mean Lower Low Water (MLLW) in a sand channel bracketed on the north and south by kelp beds and rock outcrops. The width of the sand channel is approximately 1,000 feet.

**PREVIOUS GEOLOGICAL INVESTIGATIONS**

Jones & Stokes (1994) conducted a vibrocore survey of the sediments at eight sites in the sand channel in June 1994 using a Rossfelder Model P-5 vibrocorer and a 10-foot long sample tube. They were able to document as much as six feet of sediment in one corer, and 3-4 feet of sediment in six additional cores. No sediment was collected in the remaining core which was sampled within a kelp bed habitat.

Two other efforts were conducted to determine identify substrate types and sediment thickness in the sand channel using remote sensing subbottom profiler methods. Coastal Frontiers Corporation (1994) conducted a subbottom profiling survey for Coastal Resources Management offshore of San Simeon Creek in October 1994. They interpreted the upper layer of subbottom strata (to a depth between 2 and 4.5 feet) to be sand, and underlain by a deeper reflective horizon that was probably composed of more densely compacted material. Fugro West, Inc. resurveyed the sand channel in January 1995 (Fugro West, Inc., 1995) and suggested that the intake and effluent outfall alignments are likely to be underlain by only a minimal thickness of sediment, and that the thickness of the sediment may fluctuate seasonally and in response to storm events. The actual thickness of the sediment layer could not be determined in either survey, but both suggested that bedrock lay at shallow subbottom depths of 2-5 feet.



1 mile 0 1 mile 3 miles



October/November, 1994

**EXHIBIT ONE**  
**REGIONAL AND PROJECT LOCALE**  
 Cambria Community Services District Proposed Desalination Facility

Source: Coastal Resources Management

The present field effort was conducted to confirm the interpretations of the two previous subbottom profiling surveys and the results of the sediment vibracoring study through direct field measurements of sediment thickness.

## METHODS AND MATERIALS

### **SURVEY LOGISTICS AND PERSONNEL**

This investigation was conducted by Mr. Rick Ware and Mr. Lee Fausak. Mr. Ware is a marine biologist with 19 years of experience conducting both benthic marine biological studies and sedimentological investigations. Mr. Fausak is a geological oceanographer with over 25 years of experience in nearshore marine geological and physical oceanographic investigations, including several prior studies of bottom and subbottom geology in areas of known or supposed buried stream channels. Mr. Ware and Mr. Fausak were assisted by Mr. Mark Wilson and Mr. Michael Harris.

The field survey was conducted on April 15, 1995 between 0815 and 1300 hours aboard the Research Vessel *Bonnie Marietta*, owned and operated by Mr. Mark Tognazzini of Morro Bay, California. Sea and weather conditions remained favorable through the survey. The swell was approximately 4-6 feet and the winds were less than 10 knots out of the northwest. Bottom water temperature was 52 degrees Fahrenheit and the surface water temperature was 53.5 degrees F. The surface water current was running towards the beach throughout the survey.

### **JET PROBE METHODOLOGY**

The diver-operated jet probe comprised a water pump and a steel probe, connected by a length of flexible hose. The pump was a gasoline-driven, 3-inch centrifugal pump; it had a filtered sea water intake which was placed overboard. The pump was connected by a length of collapsible fire hose to the probe, which comprised four 3-foot lengths of 1½-inch galvanized pipe; the sections were connected by pipe collars and the probe tip was a reducer fitting in which several holes had been drilled. The probe was marked at 1-foot intervals so the divers were able to measure the penetration.

The probe was used on the sea floor by a pair of divers, who held the probe erect and allowed it to penetrate into the sea floor. In unconsolidated granular sediments, the probe usually would jet itself into the bottom under its own weight; in coarse or stiffer materials, the divers worked the probe until penetration continued or refusal was met. Tactile and audio signals allowed the experienced divers to discern the kind of material the tip of the probe had encountered; loose sands were easily distinguished from gravels, cobbles, or finer materials. Under good visibility conditions, the material washing up out of the probe hole (typically 12-14 inches in diameter) could be seen and noted. Hard substrate, such as boulders, was recognized by a distinctive ringing of the probe, as if the pipe were impacting a concrete slab.

At each probe station, replicate probes were made (typically 3-4) in order to ascertain the local variability in sub-seafloor conditions. The replicate probes were all taken within a 2-3 foot radius. Notes were not recorded underwater during the probe operation; the divers recollected their observations, which were recorded on deck by a dive tender, as soon as they were back on deck after each set of probes was taken. A set of 3-4 probes at a station typically took 8-10 minutes, after which the vessel was moved to the next station.

#### **LOCATION OF JET-PROBES**

Sub-seafloor sediments were probed at five locations arrayed in a cross pattern, with one station in the center and 4 others arranged 200 feet each from the central station (Exhibit 2). The center station (station 1) was located at the designated location of the round filtration structure in the sand channel approximately 250-300 feet south of hard bottom reef habitat in a water depth of -30 feet (MLLW); two stations were in the same water depth 200 feet to the northwest and southeast (stations 2 and 3 respectively); one station was situated 200 feet offshore at a water depth of -32 feet (MLLW); and the remaining station was situated 200 feet inshore at a depth of -28 feet (MLLW) (stations 4 and 5 respectively).


#### **WATER AND SEDIMENT SAMPLING PROCEDURES**

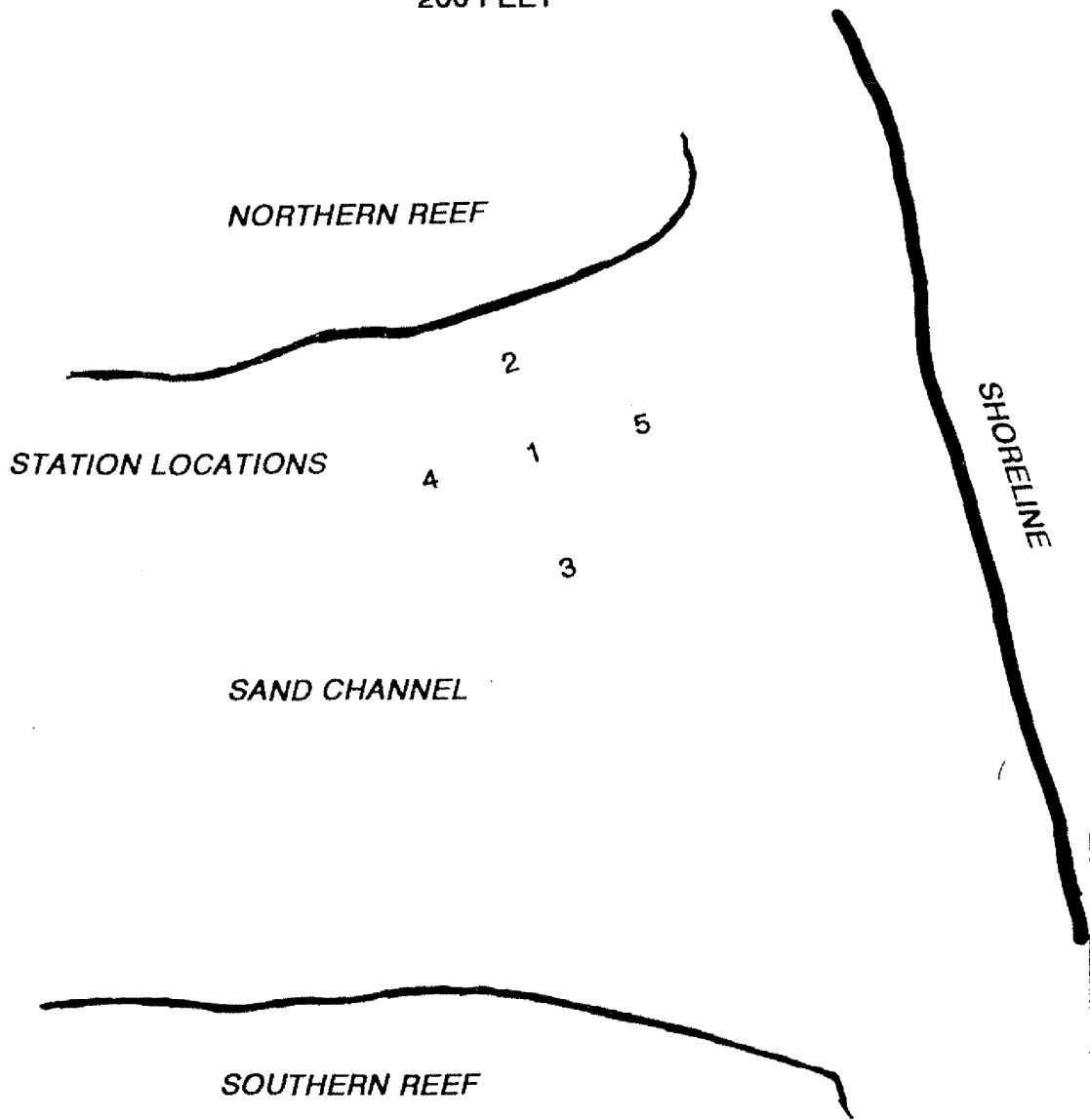
Bottom water samples were collected by CRM for later laboratory analysis by Oceaneering Technologies Inc. and Fugro West. A total of 25 gallons of water was collected from a depth of 1-2 feet above the bottom by divers using clean 5-gallon plastic buckets. Each 5-gallon container was lowered to the bottom and filled with ambient bottom water. The diver then capped each container, and ascended to the surface with the sample. The samples were stored at ambient temperature on the deck of the vessel.

Three 3-inch diameter by 10-inch long sediment core samples were also collected by a diver at the proposed offshore site of the seawater intake structure. For each sample, the diver carefully worked the core tube into the sediment until the top of the core was flush with the sediment surface, capped the top of the core tube with a plastic cap, carefully excavated down around bottom of the core tube, and then capped the bottom of the core tube. Extreme care was taken to keep the samples in an undisturbed state. Samples were packed in a 5-gallon container, and stored at ambient temperature.

Water turbidity was measured by collecting a 2.2 liter water sample at a depth of one foot above the bottom with a Van Dorn-style water sampler. The sample was then analyzed aboard the *Bonnie Marietta* using two methods. Turbidity was measured in Nephelometric Turbidity Units (NTU) with a LaMotte Model 2008 portable turbidimeter, and as a function of total dissolved solids (TDS) using a Hanna Instruments DiST WP 2 Portable and Total Dissolved Solids Pocket Tester. The DiST WP 2 measures in concentrations of parts per million (ppm).

EXHIBIT 2  
COASTAL RESOURCES MANAGEMENT  
JET-PROBE SURVEY  
APRIL 15, 1995

SCALE:  
  
200 FEET



Latitude and Longitude for Station 1 (Center Station)  
Source: Oceaneering Technologies, Inc

N 35° 35' 37.3"

S 121° 07' 54.4"

## RESULTS

### **DESCRIPTION OF PROBES**

#### **Station 1 (Center Station)**

Three jet-probes were made within a radius of approximately 3 feet. The first probe penetrated through 5 feet of coarse sand and shell hash and met refusal on hard rock (the probe casing resounded as if it had met hard concrete). The second probe penetrated through mixed layers of sand, gravel, and shell material down to the maximum length of the probe (12 feet). The third probe penetrated through unconsolidated sands to approximately 7 feet, then encountered a thin layer (less than 1 foot) of silt and clay, and then continued to penetrate to the full probe length of 12 feet.

#### **Station 2 (Northern Station)**

Four replicate probes were made within a radius of approximately 3 feet; all exhibited similar stratigraphy. In all probes, penetration was easy down to a depth of 9-10 feet, where a thin layer of pea gravel overlaid stiff silty clay. Refusal was met in all probes on a firm substratum at depths of 9 to 12 feet; small bits of clayey material were recovered from the nozzle of the jet-probe after retrieval. The materials down to the depth of refusal were primarily fine sands, with thin layers of shell material, coarse sands, and gravel.

#### **Station 3 (Southern Station)**

Four replicate probes were made within a radius of approximately 3 feet. The first probe penetrated easily through unconsolidated sands to a depth of 6 feet, where it encountered coarse gravels and cobbles; refusal was ultimately met at 9 feet in gravel. The second probe encountered sandy material to 5-6 feet, then a cobble layer approximately 2 feet thick, and then sandy material again down to a penetration depth of 14 feet (the length of the probe plus the length of diver's arm). Shell fragments were observed washing out of the hole in the lower sandy layer. The third and fourth probes were essentially similar to first two, with a gravel/cobble layer at 5-6 feet, and full penetration to 14 feet.

#### **Station 4 (Offshore Station)**

Three probes were taken within a 3-foot radius; all exhibited similar characteristics. Each of the three penetrated easily through clean medium sands to a depth of approximately 5 feet where a layer of coarse sand, gravel, cobbles, and shell hash was encountered. That layer of coarse material was approximately 2-3 feet thick, below which the probe penetrated easily until it encountered a silty clay layer at a depth of 11 feet. Refusal in all probes was on the clayey layer at 11 feet depth.

### **Station 5 (Inshore Station)**

Three replicate probes were made within an approximate 3 foot radius; all encountered similar materials below the seafloor and all three penetrated to a depth of 14 feet (the full probe length plus the extent of the diver's reach). In each case, the upper 3-4 feet comprised silty sands, below which was a layer approximately 5 feet thick of coarse sands, gravel, and cobbles; underlying the coarse layer were finer material through which the probe penetrated easily under its own weight. Some thin layers of shell material were encountered at all depths.

### **TURBIDITY MEASUREMENTS**

The mean bottom water turbidity was 3.5 NTU (n=3 replicates). Total dissolved solid concentration of the same water sample 18,400 ppm. Comparatively, the bottom water turbidity on March 16, 1995 was 16.0 NTU, the week following extremely heavy rains in the area and significant freshwater discharge from San Simeon Creek.

## **DISCUSSION**

### **SUMMARY OF JET-PROBE FINDINGS**

The general pattern that emerges from this series of jet probes is one consistent with buried stream channel deposits underlying the sea bed. The jet probe penetrated unconsolidated sedimentary substrata composed of widely varying particle sizes, from cobbles to clayey materials. Variability in sediment properties also varies laterally, again consistent with stream channel deposits which over geological time are laid down and then cut and re-cut as the stream meanders across its flood plain. The process of repeated cutting and filling with newly deposited sediments results in strata that have limited horizontal extent. Because of their limited extent and highly variable properties, these types of deposits are difficult to map using acoustic subbottom profiling methods.

The jet-probing investigation has demonstrated that there is a sedimentary section measuring at least 14 feet in thickness within the sandy area offshore of the mouth of San Simeon Creek. The lateral extent of these sedimentary layers are unknown.

### **COMPARISONS WITH PREVIOUSLY COLLECTED GEOLOGICAL DATA**

These findings are not inconsistent with the results of the two prior investigations at the site. The vibracoring study carried out in June of 1994 found a maximum of about 6 feet of unconsolidated sediments (the greatest penetration of the corer); the corer met refusal most often at depths of 3½ to 4 feet. The jet-probes in most attempts encountered a very coarse sediment layer with gravels and cobbles at about 5 feet below the seabed.

The marine geophysical studies conducted in January of 1995 were carried out during rough weather; that circumstance, combined with the inherent difficulties of shallow water geophysical surveying and of mapping variable subbottom reflectors, produced inconclusive results from that investigation. Based on the evidence available, the investigators in that study suggested that shallow rock was to be found from 2½ to 5 feet below the sea bed. The lower end of that range agrees with the gravel/cobble layer found during this jet-probing investigation.

#### **SUGGESTIONS FOR ADDITIONAL SURVEYS**

Additional jet-probing stations could be used to further delineate the extent and depth of the sedimentary substrata. If carried out, we recommend that a probe capable (under good geological and operational conditions) of penetrating 25 feet into the seafloor be used, and that the exact locations be determined using precision position-fixing systems (e.g., electronic distance meters used from shore, range-range microwave position systems, differential GPS).

Water turbidity and total dissolved solids measurements will continue to be taken at scheduled six-week intervals at the time of current meter servicing and CTD water profiling studies.

#### **LITERATURE CITED**

- Coastal Frontiers Corporation. 1994. *Bathymetric and geophysical survey. Proposed location, intake and outfall structures. Cambria Desalination Facility, Cambria, California.* Prepared for Coastal Resources Management, Corona del Mar, Ca. Appendix F-3: Marine Resources in: Robert Bein, William Frost & Associates. Final Environmental Impact Report. Cambria Desalination Facility. December 1994.
- Fugro West Inc. 1995. *Subbottom profile survey. Cambria Desalination Plant intake and outfall structures. Proposed installation site. (Draft).* Prepared for Oceaneering Technologies, Inc. Ventura, California. February 1995.
- Jones & Stokes Associates, Inc. 1994. *Sea floor sediment sampling near San Simeon Creek, San Luis Obispo County, California.* Appendix D: Results of Seafloor Sediment Sampling in: Robert Bein, William Frost & Associates. Final Environmental Impact Report. Cambria Desalination Facility. December 1994.