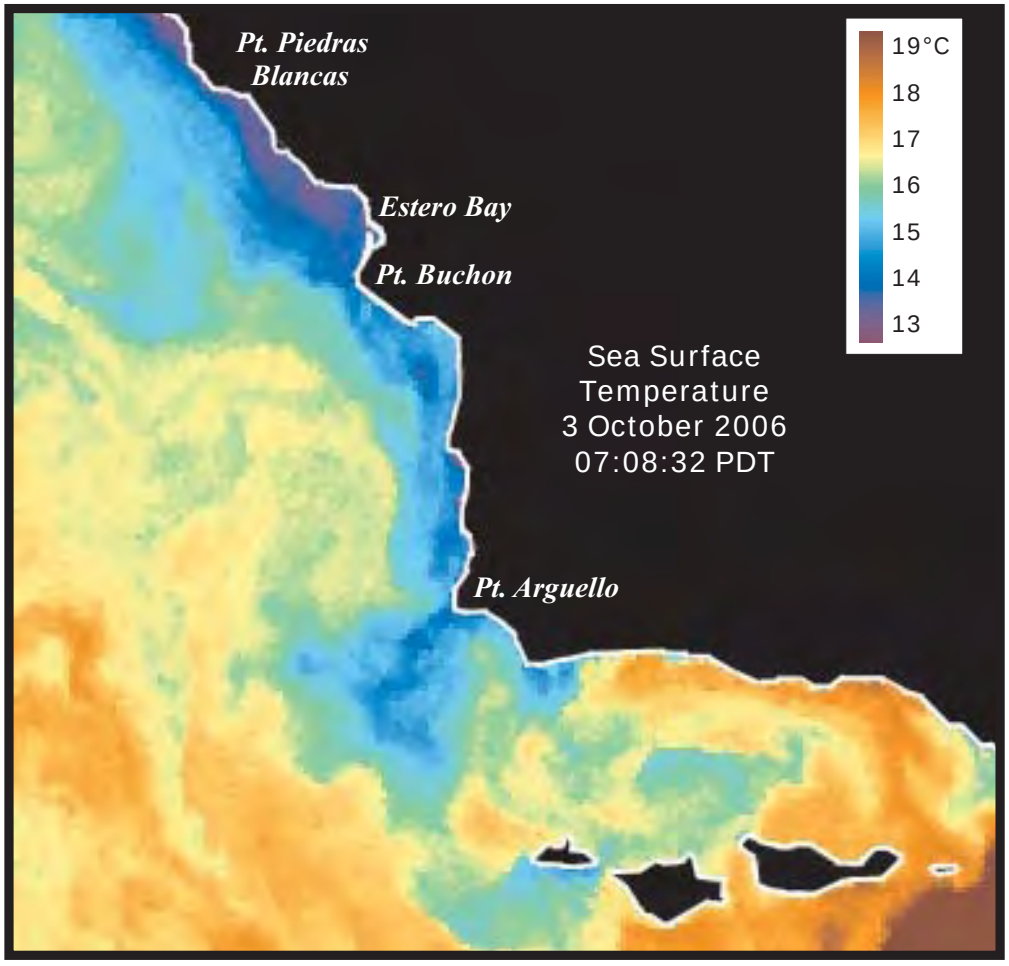
City of Morro Bay and
Cayucos Sanitary District

OFFSHORE MONITORING AND REPORTING PROGRAM

2006 ANNUAL REPORT



Marine Research Specialists

3140 Telegraph Rd., Suite A
Ventura, California 93003

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Report to

City of Morro Bay and
Cayucos Sanitary District

955 Shasta Avenue
Morro Bay, California 93442
(805) 772-6272

OFFSHORE MONITORING AND REPORTING PROGRAM

2006 ANNUAL REPORT

Prepared by

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and

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February 2007

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marine research specialists
3140 Telegraph Rd., Suite A · Ventura, CA 93003 · (805) 644-1180

Mr. Bruce Keogh
Wastewater Division Manager
City of Morro Bay
955 Shasta Avenue
Morro Bay, CA 93442

27 February 2006

Reference: 2006 Annual Monitoring Report

Dear Mr. Keogh:

Enclosed is the referenced report. It documents the continued effectiveness of the treatment process, the absence of marine impacts, and compliance with the discharge limitations and reporting requirements specified in the NPDES discharge permit.

Please contact the undersigned if you have any questions regarding this report.

Sincerely,

Douglas A. Coats, Ph.D.
Project Manager

Enclosure (Five Copies)

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I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Mr. Bruce Ambo
City of Morro Bay

Date

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LIST OF ACRONYMS AND DEFINITIONS

ACOE	**U.S. Army Corps of Engineers**
Anomaly	**A deviation or departure from ambient (mean) conditions in one of the six measured seawater properties: salinity, temperature, density, dissolved oxygen, alkalinity, or transmissivity. The amplitude of the anomaly is quantified as the difference between the measured seawater property at given station and the mean of that property measured at all other stations at the same depth level or distance above the bottom.**
Anthro-pogenic	**Changes to the environment induced by human activities**
BCCE	**Brown and Caldwell Consulting Engineers**
BEHP	**Bis 2-Ethyl Hexyl Phthalate is a ubiquitous compound in the environment that leaches out of plastics.**
BIP	**A Balanced Indigenous Population is as an ecological community which exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted environmental conditions**
BNL	**Bottom nepheloid layer is a common phenomenon on continental shelves where increased turbidity near the seafloor is caused by the presence of naturally occurring particulates formed from light-weight flocs of detritus. These flocs are easily suspended by oscillatory bottom currents generated by passing surface gravity waves.**
BOD_5	**Five-day biochemical oxygen demand**
BTEX	**Benzene, toluene, ethyl benzene, and xylene**
Cal/OSHA	**California Department of Industrial Relations, Division of Occupational Safety and Health**
CAM-17	**CAM is an acronym for California Administrative Manual and CAM-17 refers to the list of heavy metals identified in the California Code of Regulations (CCR 2003), Title 22, Chapter 11: Identification and Listing of Hazardous Waste.**
CEQA	**California Environmental Quality Act**
CCR	**California Code of Regulations (CCR 2003)**
CDFG	**California Department of Fish and Game**
Coordinate Datum	**All coordinates cited in this report are referenced to the WGS84 datum**
COP	**The California Ocean Plan (SWRCB 1997) has been revised but the 1997 edition was in force when the current NPDES discharge permit was issued to MBCSD.**
CTD	**An instrument package that continuously records Conductivity, Temperature, and Depth, in addition to a number of other physical oceanographic parameters in the water column.**

LIST OF ACRONYMS AND DEFINITIONS
(Continued)

CV	**A coefficient of variation is used to compare the relative amounts of variation in populations having different means. It is defined as the standard deviation expressed as a percentage of the mean.**
DDT	**Dichloro Diphenyl Trichloroethane, a chlorinated pesticide.**
DHS	**California Department of Health Services**
DMR-QA	**Discharge Monitoring Report Quality Assurance (DMR-QA) Study administered by the United States Environmental Protection Agency (USEPA)**
DO	**Dissolved Oxygen**
ELAP	**California Department of Health Services, Environmental Laboratory Accreditation Program**
EQ	**Exceptional Quality (EQ) compost that meets the Federal and State requirements for beneficial reuse in the local community.**
ERL	**Effects Range Low: a sediment toxicity concentration below which adverse biological effects are not expected to occur**
ERM	**Effects Range Median: a sediment toxicity concentration above which adverse biological effects are expected to occur**
GPM	**Gallons per Minute**
Hazwopper	**Hazardous Waste Operations and Emergency Response**
HCl	**Hydrochloric Acid**
HCH	**Isomers of hexachlorocyclohexane including alpha, beta, gamma (lindane), and delta**
I&I	**Inflow and Infiltration**
Isopycnal	**A surface of constant seawater density**
Leachate	**A solution formed by leaching, especially a solution containing contaminants picked up through the leaching of soil.**
LC_{50}	**Lethal 50% Concentration: A toxicity endpoint where 50% of the specimens will die after a 96-hr exposure period**
MBCSD	**The City of Morro Bay-Cayucos Sanitary District**
MTBE	**Methyl Tertiary Butyl Ether, an additive to gasoline that boosts octane to reduce air emissions but has contaminated groundwater in many regions after accidentally leaking from underground storage tanks.**
MDL	**Method Detection Limit, which is the lowest concentration that can be reported under ideal conditions where the sample contains only the compound of interest with a concentration in an optimal calibration range and in a medium that does not interfere with the performance of the analytical instrument.**
MGD	**Million Gallons per Day**

LIST OF ACRONYMS AND DEFINITIONS
(Continued)

mg/Kg	**Milligrams per Kilogram = μg/g dry weight = parts per million (ppm)**
mg/L	**Milligrams per Liter = aqueous parts per million (ppm)**
Mixed liquor	**A mixture of activated sludge, wastewater, and oxygen where organic sewage constituents are biologically assimilated**
MLLW	**Mean Lower Low Water**
MMS	**Minerals Management Service**
MPN	**Most Probable Number**
MRS	**Marine Research Specialists**
MT	**Metric Ton = 1,000 kg**
NEP	**National Estuary Program**
NOAA	**National Oceanic and Atmospheric Administration**
NOEC	**No Observable Effect Concentration**
NPDES	**National Pollutant Discharge Elimination System**
NTU	**Nephelometric Turbidity Units**
O&G	**Oil and Grease**
OIT	**Operator-in-Training**
P1 – P12	**Individual identifiers for discharge-related perturbations in seawater properties**
PAH	**Polynuclear Aromatic Hydrocarbons**
PCA	**Principal Component Analysis is a multivariate technique that arranges samples along an axis based on species composition. This arrangement is conducted independently along a number of dimensions (usually 2 or 3) that approximate some pattern of response of the intertidal community to underlying environmental gradients. PCA condenses the complex species-abundance database to a few factors responsible for observed variability within the intertidal community structure, while retaining ecologically meaningful biological information.**
PCB	**Polychlorinated Biphenyl**
PCi/L	**Pico-Curies per liter, a measure of aqueous radioactivity**
Perturbation	**A small but detectable variation (anomaly) in one or more seawater properties caused by the presence of dilute effluent within the receiving waters. Individual Perturbations identified in this report are designated P1 through P12.**
PG&E	**Pacific Gas and Electric**
POTW	**Publicly-Owned Treatment Works**
Power (1-β)	**The probability correctly rejecting the null hypothesis depending on the significance criterion, the variability of the sample results, and the size of the impact.**
ppm	**Parts per million = mg/L in solution , or mg/Kg = μg/g dry weight**

LIST OF ACRONYMS AND DEFINITIONS
(Continued)

PQL	**Practical Quantification Limit, which is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.**
PSDWF	**Peak seasonal dry-weather flow**
***p*-value**	**Low *p*-values (<0.05) indicate a high degree of confidence that the computed quantity is statistically significant.**
PWWF	**Peak wet-weather flow**
Pycnocline	**A region of rapid vertical change in the density field of the seawater column**
QA/QC	**Quality Assurance and Quality Control**
RAS	**Return Activated Sludge is returned continuously to the aeration tank to provide a seed of developed bacteria for rapid digestion of incoming wastewater. Some sludge is wasted (WAS) to prevent excessive solids buildup.**
RWQCB	**State of California Regional Water Quality Control Board - Central Coast Region**
SAIC	**Science Applications International Corporation**
SBE	**Sea-Bird Electronics, Inc.**
SCBPPFCT	**Southern California Bight Pilot Project Field Coordination Team**
SCCWRP	**Southern California Coastal Water Research Project**
SEP	**Supplemental Environmental Project**
Sigma-T	**σ_t units are a measure of the density of water equal to the 1000 times the specific gravity minus one**
SJCF	**San Joaquin Composting Facility located in Kern County California and owned by McCarthy Family Farms, Inc.**
STLC	**Soluble Threshold Limit Concentration applies to the measured concentration in the liquid extract from a biosolid sample, as determined by a Waste Extraction Test or WET. Biosolids with leachate concentrations exceeding the STLC are classified as hazardous in the State of California.**
SWRCB	**State Water Resources Control Board**
Thermocline	**A region of rapid vertical change in the temperature field of the seawater column**
TIC	**Tentatively Identified Compound TIC is a compound that can be seen by the analytical testing method, but its identity and concentration cannot be confirmed without further analytical investigation. Many analytical methods can report TICs but the analysis is not targeted specifically for their detection.**
TKN	**Total Kjeldahl Nitrogen**
TRC	**Total Residual Chlorine in effluent determined from grab samples collected beyond the chlorine contact chamber**
TSS	**Total Suspended Solids**

LIST OF ACRONYMS AND DEFINITIONS
(Continued)

TTLC	**Total Threshold Limit Concentration that applies to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTLC.**
TUa	**Acute Toxicity Units**
TUc	**Chronic Toxicity Units**
TVS	**Total Volatile Solids**
USEPA	**U.S. Environmental Protection Agency**
USGPO	**U.S. Government Printing Office**
USMMS	**U.S. Minerals Management Service**
VFD	**Variable-Frequency Drives are electronic motor-speed controllers used at the MBCSD WWTP to precisely control the influent pumping rate at the plant headworks by adjusting the frequency of electrical power sent to the pump motors.**
WAS	**Waste Activated Sludge is removed from the treatment process to prevent excessive solids buildup.**
WERF	**The Water Environment Research Foundation is a nonprofit organization that helps utilities and corporations manage water resources.**
WET	**Waste Extraction Tests measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant in a biosolids sample exceeds ten times the STLC.**
WWTP	**City of Morro Bay-Cayucos Sanitary District Waste Water Treatment Plant**
Zeolite	**An inorganic porous material having a highly regular structure of pores and chambers that allows some molecules to pass through, and causes others to be either excluded, or broken down**
ZID	**Zone of Initial Dilution is a limited volume of water surrounding the outfall where wastewater rapidly mixes with receiving waters. Most receiving-water objectives of the Ocean Plan do not apply within the ZID.**

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EXECUTIVE SUMMARY

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) jointly own the wastewater treatment plant operated by the City of Morro Bay. The treatment plant discharges effluent to the open ocean environment of northern Estero Bay under the authority of National Pollutant Discharge Elimination System (NPDES) permit No. CA0047881. The current permit was issued in December 1998. The permit allows discharge of blended primary and secondary-treated wastewater, although the vast majority of the wastewater receives secondary treatment. The discharge permit requires a monitoring and reporting program to evaluate short- and long-term effects of the effluent discharge on receiving waters, benthic sediments, and infaunal communities. This 2006 Annual Report is submitted in partial satisfaction of those reporting requirements.

This document presents a comprehensive analysis of the extensive monitoring data collected over the last two decades. Virtually every aspect of the treatment process, receiving waters, and seafloor sediments was monitored. An exhaustive quantitative analysis of all measured parameters demonstrates that the effluent discharge consistently meets the discharge requirements, and has no discernible effect on the ocean environment. A comparison of the properties of the influent and effluent affirms the treatment plant's proficiency at removing contaminants and reducing organic loads within the wastewater stream. All offshore receiving-water measurements showed that the effluent plume was primarily restricted to a narrow 15-m zone-of-initial-dilution around the outfall. Measurements within the effluent plume within a few feet of a diffuser port quantified the plume's rapid dispersion, and demonstrated that the structure was operating better than predicted by modeling. Finally, the absence of adverse discharge-related impacts to the physics, chemistry, and biology of benthic sediments verified the effectiveness of the treatment process, the high dilution of effluent within receiving waters, and the low toxicity of the discharged effluent. These conclusions were supported by two independent reviews conducted by the United States Environmental Protection Agency (USEPA 1998, 2005). The additional data presented in this report are consistent with conclusions based on historical data insofar as the treatment plant's continued low mass-emission of contaminants, low toxicity of the effluent stream, and absence of impacts to the marine environment.

The plant operates under a 301(h)-permit that modifies the general NPDES requirements on suspended-solid and biochemical oxygen demand (BOD) emissions. All other NPDES limits, including restrictions on the discharge of toxic substances, apply to the MBCSD discharge without exception. Regardless, the partial-secondary treatment currently performed by the plant routinely achieves reductions in suspended solids and BOD that are close to, and often exceed, full secondary requirements. In fact, the effluent usually consists entirely of wastewater that has received full secondary treatment. Blending of primary- and secondary-treated wastewater is usually only required during brief periods of exceptionally high flow, such as during rainstorms. During 2006, the blending was only required 4.9% of the time.

Effluent monitoring during 2006 documented a year of exceptionally high operational performance by the treatment plant. Major effluent constituents, including suspended solids, BOD, and oil and grease (O&G) all had much lower concentrations and mass emissions than the permitted maximums, as has been the case in prior years. In fact, in 2006, key measures of treatment performance were among the best reported in the over two decades of monitoring. The average suspended solids concentration within effluent was the lowest on record, while the solids removal rate was the second highest on record. Combined with the plant's low total flow, the plant's solids-removal process resulted in the lowest annual mass emission of suspended solids recorded since monitoring began in 1986. Similarly, the average effluent O&G and BOD concentrations in 2006 were substantially lower than average, despite high influent concentrations.

Some of the reduction in mass emissions was attributable to the lower overall flow in 2006 compared to prior years. In the past few years, marked reductions in flow have been achieved through the successful elimination of some of the major sources of rainwater inflow and groundwater infiltration into the collection system. In addition, a more accurate flow meter was commissioned in 2002. As a result of these efforts, the annual average flow reported in 2006 was one of the lowest on record. However, even with the low flow in 2006, the plant continued to remove major wastewater constituents from the influent at consistently high rates.

Although the treatment process efficiently removed major organic wastewater constituents such as suspended solids, BOD, O&G, and coliform bacteria, the general lack of other chemical contaminates within effluent was largely due to their absence within the influent stream. Like most publicly owned treatment works, the MBCSD plant is not designed to extract heavy metals and synthetic organic compounds, such as pesticides and PCBs, from wastewater. Instead, the MBCSD effluent's low toxicity is primarily due to the lack of heavy industry within its service area. The few businesses that discharge to the sewer system produce wastewater that is similar to that of domestic sources, only on a larger scale. These sources are documented in a comprehensive industrial waste survey that is maintained and periodically updated by plant personnel. In addition, an ongoing public-outreach program and the convenience of an onsite household hazardous waste recycling facility have further reduced the introduction of pollutants into the waste stream. Since its opening in August 2000, the permanent household hazardous waste disposal site at the treatment plant has become one of the most heavily used hazardous-waste receiving facilities in San Luis Obispo County. During 2006, the facility collected over 153 tons of paint, flammable liquids, antifreeze, car batteries, motor oil, electronic waste, and hazardous materials that otherwise may have been discharged to the ocean or placed in a landfill.

Over more than two decades of operation, the treatment plant has consistently outperformed expectations for wastewater treatment based on regulatory standards. During this time, there has been no indication of deterioration in plant performance, and effluent quality has consistently exceeded the performance criteria anticipated in the original design. On rare occasions where exceptions to standards or criteria have occurred, they have been the direct result of unforeseen external events, or brief, unavoidable mechanical failure of a treatment-system component. In spite of a diligent program of preventative maintenance, the challenge for plant personnel has been to quickly respond to unanticipated failures in system components.

Among the thousands of samples and measurements collected as part of the monitoring program during 2006, there were no exceptions to the waste-discharge requirements specified in the NPDES permit. This perfect level of compliance is laudable, and represents the culmination of many years of hard work by dedicated and experienced MBCSD personnel. As a result of their knowledge and experience they regularly enact appropriate proactive measures that ensure the smooth operation of this facility despite occasional mechanical upsets and unforeseen events.

A new more-rigorous offshore-monitoring program was instituted when the current NPDES permit was issued in 1998. It effectively doubled the number of water-quality samples collected close to the outfall, and significantly improved the ability to detect potential discharge-related impacts in the marine environment. All of the receiving-water stations were relocated to within 100 m of the diffuser structure. Additionally, four new benthic sediment stations were positioned 60 m from the diffuser, providing a six-fold increase in the ability to detect contaminant accumulations. As in prior years, and despite the increased spatial resolution, no evidence of adverse discharge-related marine impacts was found during 2006. As has been the case throughout more than two decades of monitoring, all measurements fully complied with requirements of the discharge permit and the objectives of the California Ocean Plan (COP).

Receiving-water quality was evaluated with quarterly offshore water-column surveys. The high-precision measurements collected during the surveys were capable of resolving minute changes in ambient water properties. . These measurements were used to detect and delineate effluent as it mixed with receiving waters upon discharge from the diffuser. Slight anomalies in water properties associated with the presence of dilute effluent were observed near and within the zone of initial dilution (ZID). These highly localized anomalies were within the limits specified in the NPDES permit, even those taken in close proximity to the discharge and well within the ZID, where such limits do not apply. The high degree of effluent dilution observed close to a diffuser port attested to the continued effectiveness of the diffuser structure in rapidly mixing the wastewater within receiving waters. The limited spatial extent of perceptible effluent properties should also allay concerns that the discharge may potentially affect the waters of nearby Morro Bay, which is a national marine estuary. Even with the use of highly sensitive instrumentation, the presence of wastewater constituents could not be detected more than 86 m from the diffuser structure. Consequently, the discharge could not have materially affected the adjacent shoreline, 830 m to the east, much less the sheltered Bay waters lying 2.8 km to the south.

Sampling of the surfzone for coliform bacteria was another component of receiving-water monitoring during 2006. Surfzone samples were collected at seven locations along Atascadero State Beach. The few 2006 samples that contained detectable quantities of coliform bacteria were associated with non-point source contamination rather than the discharge of effluent. Historically, elevated surfzone coliform measurements have been occasionally observed over the twenty years since in monitoring began. These isolated measurements have generally fallen into one of four categories: 1) they were measured at distant reference stations, 2) they coincided with rainfall events, 3) they were proximal to a shoreline source of organic debris, or 4) they consisted mostly of non-fecal coliform. For example, one instance of elevated surfzone coliform that occurred during 2006 consisted of predominately non-fecal bacteria, which would be contrary to the result expected if the discharge were involved. In addition, the surfzone sample was collected at a reference station that was located far outside the discharge's sphere of influence. The general absence of detectable coliform levels within discharged effluent during 2006 confirmed the effectiveness of the treatment plant's disinfection process at eliminating viable microbial contaminants from the waste stream. During 2006, surfzone measurements along Atascadero State Beach met the stringent limitations governing shellfish harvesting.

The physics, chemistry, and biology of benthic sediments around the outfall have also been monitored for more than two decades. Benthic environments are important indicators of the presence of marine pollution because they act as a major reservoir for most contaminants that enter the ocean. The lack of perceptible impacts to the benthic environment around the diffuser structure during 2006 confirmed that the treatment process effectively removed contaminants from the influent stream, and that the diffuser structure efficiently diluted wastewater upon its discharge into receiving waters.

Three sediment-chemistry analyses document the absence of discharge-related benthic impacts. First, chemical concentrations measured within Estero Bay sediments during 2006, and in prior years of monitoring, were below thresholds that have been identified as toxic to marine organisms. This includes samples collected close to the diffuser structure, as well as those found more than 1 km away. In fact, measured concentrations were comparable to those found in benthic sediments collected throughout the region, but were generally much less than those found within the Southern California Bight. Second, benthic samples collected during 2006 did not exhibit a gradient of consistently increasing contaminant concentration with increasing proximity to the outfall. Finally, although the concentrations of several metals have exhibited a slight but steady increase over time, these increases appear to be regional in nature, and are unrelated to effluent discharge. Specifically, the volumes of metals discharged within effluent were

too small to account for the slight increases in sediment concentrations that have been observed throughout Estero Bay. Additionally, the trace-metal concentrations measured in the bulk sediment samples arise from metal that is bound into the mineral matrix of sand grains, where it has little affect on marine organisms. This is apparent from the comparatively low dissolved-metal concentrations found in the pore water surrounding the seafloor sediments.

Infauna residing within seafloor sediments also serve as indicators of marine contamination because of their limited mobility and well-defined responses to pollution. Numbers of species, abundance, biomass and other parameters describing infaunal community structure can indicate the presence of contaminant-induced stresses if, for example, gradients extending from a pollutant source to distant, unaffected areas are observed. More than 145,000 infaunal organisms have been collected and examined since the beginning of the benthic monitoring program over two decades ago. Throughout the monitoring program, there has never been any indication of outfall-related impacts to benthic biota. Instead, the data have revealed a consistently healthy indigenous infaunal community, with uniformly high diversity that does not decline with proximity to the diffuser. These observations hold true despite widespread and significant temporal variation in the abundance of individual organisms. Over the years, different taxa have dominated the infaunal community and then declined in response to natural changes in the environment. For instance, changes brought about by the strong El Niño in late 1997 and early 1998 resulted in one of the most diverse infaunal communities observed in more than a decade. El Niño was also responsible for a huge influx of juvenile sand dollars in 1999, mirroring a similar population increase in 1988 following the 1987 El Niño event. The infaunal trophic index provides an independent measure of the overall health of the benthic community. It remained uniformly high during 2006, as it has over the prior twenty years, reflecting a marine community dominated by suspension-feeding organisms living in clean sediments.

1.0 INTRODUCTION

The City of Morro Bay and the Cayucos Sanitary District jointly own the wastewater treatment plant operated by the City of Morro Bay. A 301(h)-modified National Pollutant Discharge Elimination System (NPDES) permit was originally issued to the City of Morro Bay and the Cayucos Sanitary District (MBCSD) in March 1985 (Permit Number CA0047881). The permit was issued by Region IX of the U.S. Environmental Protection Agency (USEPA) and the Central Coast California Regional Water Quality Control Board (RWQCB). Following extensive evaluation processes, the permit has been re-issued twice, once in March of 1993 (RWQCB-USEPA 1993ab) and again in December 1998 (RWQCB-USEPA 1998ab). This report addresses compliance with the provisions of the latest permit.

Marine Research Specialists began conducting the Offshore Monitoring and Reporting Program for the City of Morro Bay/Cayucos Sanitary District in July 1993. Since that time, samples have been collected and analyzed by the Treatment Plant staff, Marine Research Specialists, and subcontracted laboratories that included BC Laboratories and Aquatic Testing Laboratories in 2006.

1.1 REPORT ORGANIZATION

This year-2006 annual report summarizes results from the four major monitoring components that analyze the treatment plant, receiving waters, marine sediments, and benthic biota. The document is organized in a manner similar to that of previous annual reports to provide continuity with the reporting aspects of the monitoring program. Other than this brief introductory chapter, the major sections include the following:

Chapter 2	Treatment Plant Performance
Chapter 3	Receiving Water Quality
Chapter 4	Bottom Sediments and Biota
Chapter 5	Conclusions and Recommendations
Chapter 6	Literature Cited

Chapter 2 details all aspects of the onshore portion of the monitoring program, including the operation and performance of the treatment plant, as well as a discussion of the collection and conveyance system as it pertains to the treatment process. It also describes sludge quality, and the disposition of biosolids during 2006. Chapter 3 documents the four offshore surveys that were conducted during 2006 to assess the quality of ocean waters where the effluent is discharged. Chapter 4 documents the analysis of sediment samples collected during an offshore survey conducted in October 2006. It places the chemical and biological measurements in historical context by incorporating time-series analyses of the entire 21-year database. Finally, Chapter 5 briefly reiterates the major conclusions of this report, and presents some recommendations for future actions concerning the operation of the treatment plant and the monitoring program.

In addition to these chapters, a large set of appendices provides detailed supporting documentation for the analyses contained in the body of this report. Appendix A lists the design specifications of the wastewater treatment plant. Quality control and quality assurance procedures for the analytical laboratories are provided in Appendix B. The results of all major chemical analysis performed on effluent and biosolid sam-

ples collected during 2006 are tabulated in Appendix C. Appendices D and E contain summaries of all data collected during the October benthic survey. Appendix D documents physicochemical analyses performed on offshore benthic samples, while Appendix E details the biological analysis of offshore sediment samples.

CHAPTER 2

Treatment Plant Performance

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2.0 TREATMENT PLANT PERFORMANCE

During 2006, as in prior years, the treatment plant efficiently removed virtually all organics and other solids from the wastewater stream. The dramatic difference between influent and effluent loading of organic constituents attested to the plant's high operational performance throughout the year. Because of a proactive operations and maintenance program, there were no exceptions to the limits specified in the NPDES discharge permit during 2006. The high operational performance of the plant is demonstrated by analyses of key diagnostic constituents, including suspended solids, biochemical oxygen demand (BOD), and oil and grease (O&G). The benign environmental character of the effluent is demonstrated through periodic analyses of effluent for trace metals, pesticides, priority pollutants, and toxicity. The sections below use these analyses to evaluate regulatory compliance through a comparison of measured wastewater characteristics and the limits cited in the NPDES discharge permit issued to the City of Morro Bay and Cayucos Sanitary District in December 1998 (RWQCB-USEPA 1998a).

Data collected during 2006 augment 20 years of prior monitoring information. This extensive database documents a treatment process that has consistently performed at a high level for more than two decades. As in prior years, removal of suspended solids and oxygen-demanding materials during 2006 was consistently and substantially above permit-required minimum limits. The treatment plant's performance routinely approached and exceeded the requirements for full secondary treatment even though those requirements do not apply to this partial-secondary facility. In fact, the effluent usually consists entirely of wastewater that has received secondary treatment. Blending of primary- and secondary-treated wastewater is only required during infrequent periods of particularly high flow, such as during rainstorms. During 2006, the blending valve was open only 4.9% of the time.

Despite processing a high proportion of sewage during 2006, the plant discharged only 17% of the allowed solids, while still attaining removal rates that were 18% higher than the permitted minimum. Throughout the entire year, the treatment plant removed solids at a rate (93%) significantly exceeding the 85% requirement for full secondary treatment. Average effluent suspended solids concentrations in eleven months were at or below the 30-mg/L criteria for full secondary treatment. During the other month (July), average concentration (33 mg/L) was close to the standard. Settleable solids were imperceptible within the effluent samples collected throughout the year.

During 2006, the treatment plant also achieved a high removal rate for BOD (84%). The lowest monthly removal rate of 79.8% was more than double the minimum required rate of 30%. Average BOD removal rates for the remaining eleven months met or exceeded 80% and, during four months, exceeded the 85% monthly removal standard for full secondary treatment. The average effluent BOD concentration (45 mg/L) was only about a third of the permitted maximum (120 mg/L), and the mass emission (75 MT) was only about a fifth the allowed BOD discharge (342 MT).

The general absence of industrial contaminants in the wastestream bears testimony to the benign nature of the influent, which is almost entirely generated by non-industrial residential sources. Chemical analyses for 13 trace metals and over 150 synthetic organic compounds detected only a few low-level concentrations of common wastewater constituents, and three naturally occurring trace metals. All measured concentrations were well below permit limitations. Chronic bioassays of composite samples demonstrated that the effluent discharged during 2006 had low toxicity to marine organisms, as has been the case for the last 13 years of regular testing. In contrast to the chronic bioassays, the acute toxicity bioassays conducted in 2006 were confounded by ammonia interference, which is an artifact of the new bioassay proto-

cols that were instituted in April 2003. Despite this artificial increase in reported acute toxicity, all toxicity endpoints were below permitted limits.

Finally, the effectiveness of the treatment plant was demonstrated by its ability to accommodate unusual flow events and unforeseen mechanical upsets. Six anomalous plant conditions were identified in the monitoring data during 2006. None of these events were related to random perturbations in the efficiency of wastewater treatment. On the contrary, all were directly attributable to external events such as flow increases due to storms and tourism. Four events were perceptible increases in plant inflow during rainstorms. One of these rainfall events coincided with slight but perceptible increases in plant throughput due to population increases during the New-Year Holiday. The two remaining flow-related events were directly associated with increased tourist populations during the holidays. None of the events during 2006 caused an exceedance of the NPDES permit limits.

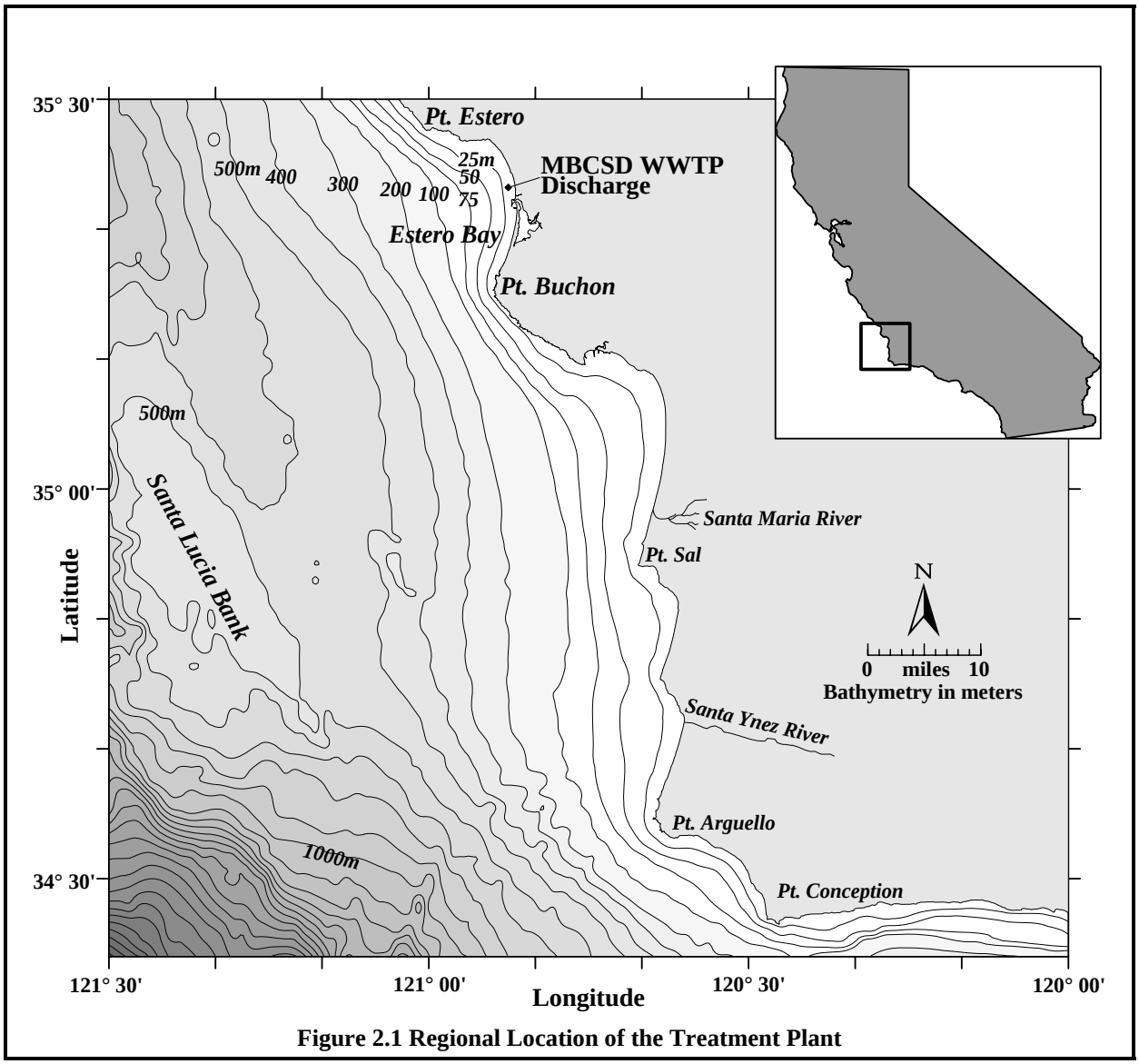


Figure 2.1 Regional Location of the Treatment Plant

2.1 WASTEWATER TREATMENT PLANT

The Morro Bay/Cayucos Wastewater Treatment Plant (hereinafter WWTP) is publicly owned and operated under the auspices of the City of Morro Bay and the Cayucos Sanitary District (hereinafter MBCSD). The WWTP is located in the City of Morro Bay along the central coast of California within San Luis Obispo County (Figure 2.1). Based on the year-2000 census, the plant serves the communities of Morro Bay and Cayucos, which have a combined population of approximately 13,293, 10,350 for Morro Bay and 2,943 for Cayucos. The treatment plant discharged an average of 1.19 million gallons per day (MGD) during 2006. The plant was designed to accommodate an average dry-weather flow of 2.06 MGD, a peak seasonal dry-weather flow (PSDWF) of 2.36 MGD, and a maximum wet-weather flow (PWWF) of 6.64 MGD. None of these design flow limits were approached during 2006.

2.1.1 Operations

During 2006, nine trained personnel operated the Wastewater Treatment Plant (Table 2.1). Mr. Bruce Keogh was both the Wastewater Division Manager and Laboratory Director. Mr. Les Girvin continued as Wastewater Treatment Plant Supervisor. On 25 September, Mr. Jim Hayes resigned to become the Collection System Supervisor for the City of Morro Bay. On 4 November, Mr. George Helms was hired. He subsequently obtained his OIT certification on 1 December 2006.

Table 2.1 Morro Bay/Cayucos WWTP Personnel During 2006

Name	Grade and Certification No.
Bruce Keogh	IV – 8978
Les Girvin	III – 8499
Steven Aschenbrenner	II – 7548
Jim Hayes	II – 9221
David Williams	II – 9601
John Gunderlock	II – 10500
Eric Zatt	II – 10621
Steve Sibley	I – 8005
George Helms	OIT

The WWTP personnel provided laboratory workspace to the National Estuary Program (NEP), which is dedicated to protecting and restoring the natural resources of Morro Bay and its watershed. NEP volunteers used the WWTP laboratory to analyze bacterial samples that were collected throughout the Morro Bay watershed.

WWTP personnel maintained their expertise by attending a number of workshops, seminars, and continuing-education classes throughout 2006. Training-course topics included media relations, CPR and first aid, OSHA compliance and workplace safety, CWEA workshops, and the California Integrated Water Quality System (CIWQS). WWTP personnel also conducted a number of plant tours for the public, students from local schools and colleges, equipment suppliers, and RWQCB staff.

In addition to performing the periodic effluent analyses required by the NPDES Permit, laboratories involved in the analyses of the MBCSD WWTP samples participated in laboratory performance evaluations. During 2006, the WWTP laboratory, and the laboratories subcontracted to the WWTP, conducted mandatory tests that are intended to evaluate the accuracy of effluent measurements and assure the overall quality of the monitoring reports. The WWTP laboratory analyzes effluent parameters that are reported on a daily and weekly basis, including residual chlorine, suspended solids, turbidity, coliform, pH, biochemical oxygen demand, and oil and grease. Aquatic Testing Laboratories conducts bioassay tests to evaluate the toxicity of effluent to marine organisms. BC Laboratories conducts semiannual chemical analyses to determine the concentration of a wide range of constituents in effluent. BC Laboratories also performed the analysis of biosolid samples collected in 2006. Finally, BC Laboratories performed the chemical analyses of benthic sediments that are described in Chapter 4 of this report. Each laboratory's quality assurance and control plan is included in Appendix B of this report.

Several State and Federally sponsored laboratory performance evaluations were successfully completed during 2006. The results from all of these studies were deemed acceptable by the regulatory agencies. They included:

- The California Department of Health Services Water Pollution Study 134 (WP-134) evaluation of microbial analysis capabilities,
- The United States Environmental Protection Agency's (USEPA) Discharge Monitoring Report-Quality Assurance Study (DMR-QA-26), which assessed analytical chemistry capabilities, and
- The USEPA DMR-QA Whole Effluent Toxicity Test (WETT) determination of the accuracy of bioassay capabilities.

In recent years, both the City of Morro Bay and the Cayucos Sanitary District have more actively sought to identify and eliminate sources of inflow (rainwater runoff) and infiltration (of groundwater) within their respective collection systems. In late 2000, a major source of groundwater infiltration was eliminated after the 18-inch sewer line along Atascadero Road was repaired using cured-in-place pipe-lining technology. These and other repair projects have eliminated a substantial volume of groundwater infiltration into the collection system. These reductions in inflow and infiltration (I&I) have measurably decreased the amount of non-wastewater throughput that was unnecessarily processed by the treatment plant.

As part of the Atascadero Road project, the City of Morro Bay identified considerable damage in a major sewer lateral serving Morro Bay High School. This leaking lateral was replaced in 2001. Additional laterals that flow into the Atascadero Road sewer line were sealed and grouted to reduce leakage at the point where they connect to the new lining. At that time, pipe conditions in other areas were evaluated and prioritized for future repair. This process was continued in subsequent years with the inspection, pressure washing, and repair, as needed, of all manholes encountered during the regular course of line cleaning, and the replacement of manholes and manhole collars due to deterioration from hydrogen sulfide exposure.

During 2006, the City's Public Works Department also continued to perform routine cleaning and grit-removal within the City's collection system. Over the course of the year, a total of 296,921 feet of sewer line were cleaned. The program centers on a state-of-the-art hydrovac sewer cleaner purchased in 2001. This powerful hydrovac truck is capable of removing a large volume of grit from sewer lines that would normally be washed down the line during standard cleaning operations. Grit removal reduces the potential for line blockage and spills, and decreases the volume of solids that eventually enter the treatment plant and needlessly abrade the plant's equipment.

In 2003, the City approved the commissioning of a Sewer Master Plan update, and after an extended period of analysis, the Sewer Master Plan was adopted by the City Council in May 2006. The updated plan included the installation and monitoring of wastewater flow at eleven drainage basins within the City, which was used to quantify flow during significant rainfall events. Localized metering stations served to address site-specific I&I contributions, and evaluated the performance of individual lift stations. The plan also includes collection-system hydraulic modeling. Finally, it provides recommendations for a capital improvements program, including staffing and O&M budget analysis.

During 2006, the Cayucos Sanitary District (CSD) also continued to upgrade their collection system and proactively address potential areas of concern. Funding for major upgrades to the collection system originates in the District's five-year capital improvements program. This program is re-budgeted on an annual basis. During 2006, there were several significant improvements to the system beyond the more routine efforts to further reduce storm-drain cross-connections, seal visible leaks in manholes and chimneys, and install plastic inserts in manholes subject to surface water immersion.

For example, the District replaced approximately 1,340 linear feet of damaged sewer lines, and performed video and cleaning of approximately half the sewer lines in the District. Staff combined this video information with recordings from previous years to earmark the future replacement of sewer lines and defective lateral connections. District staff also performed video inspections on sewer laterals as a condition of the District's will-serve process. Defective laterals are to be replaced by the property owner to prevent sewer spills and reduce infiltration to the collection system.

During 2006, the District also performed a system wide flow study to identify inflow and infiltration, and contracted for flow simulations to be performed on the Main Street line to help assess future capacity needs and identify deficiencies. Furthermore, the District installed two "sealing" manholes along Main Street at locations that have historically been prone to sewer spills near storm drain inlets. The District is also currently developing Requests for Proposals on two Generator Sets that serve as emergency power for Lift Stations # 2 and 5. These should be installed in the 2006-2007 fiscal year. Finally, the District purchased a new Automatic Transfer Switch for the Lift Station #5 Emergency Generator Set. It also contracted aerial and sewer line topographic surveys to precisely map the District's collection system.

At the WWTP, plant personnel maintained a diligent, proactive preventative maintenance program that included major preemptive repairs of various components of the treatment process. These activities were documented in the monthly operations summaries submitted to the RWQCB (MBCSD 2006a-l). As part of the routine maintenance procedures, the exterior of the ocean outfall and the diffuser structure were inspected for signs of damage. The visual inspection was conducted by SCUBA on 11 August 2006. The outfall was found to be in good condition, with no broken or plugged diffuser ports. A video recording of the diffuser structure documented the continued presence of sensitive filter-feeding anemones and other high-relief hard-substrate organisms residing on and near the diffuser ports.

Figure 2.2 is a photograph of a diffuser port taken during a prior outfall inspection. It depicts a dense cover of marine epifaunal organisms thriving on the outer surface of the diffuser port. A large colony of club-tipped anemones (*Corynactis californica*), which are bright pinkish-red in color, covers the top surface of the port. Their presence attests to the benign nature of the effluent discharge, as well as to the value of the outfall as an artificial reef. Based on quantitative biological surveys conducted within the region, these anemones are more typical of high-relief rock surfaces that are only occasionally found within Estero Bay, and then only in deeper water (>85 m) (Morro Group, Inc. 1999). Ostensibly, their rarity on lower-relief rocks found nearshore results from their susceptibility to elevated suspended sediment loads. Their preponderance on the diffuser confirms that the outfall's particulate discharge has little negative impact on marine organisms. In fact, the effluent's organic content probably provides a beneficial food source for these filter-feeding organisms.



Figure 2.2 Photograph of a Diffuser Port Discharging Effluent

The two spar buoys marking the offshore location of the diffuser structure were also found to be in good condition during the diver inspection conducted on 11 August 2006. In September the spar buoys were brought to the plant for repair and maintenance, where MBSCD staff removed marine growth, replaced the Coast Guard specified markings, and provided new ground tackle before reinstalling the buoys. However, on 4 December, damage to one of the spar buoys was noted while the ground tackle on the other spar buoy was being adjusted. The cracked spar buoy was immediately retrieved, and a temporary buoy installed until such time as a new buoy could be built to replace it. The new spar buoy was installed on 2 January 2007.

Other routine maintenance and minor repairs were regularly conducted on various treatment-plant components. For example, the emergency standby generator was tested on a regular basis under full load. Every quarter, the standby generator was inspected, and a certified contractor performed scheduled maintenance. During several power outages experienced during 2006, it was found to be operating properly. Annual inspections were also performed on the Plant's cathodic protection system and back-flow prevention devices.

In addition, a number of major repairs and preventative-maintenance measures were instituted during 2006. The largest maintenance effort to occur in 2006 involved taking (primary) Digester #3 off-line for cleaning, inspection, and maintenance, and then reinstating it as a primary digester. Although preparations for this effort began in early 2005, the actual cleaning of the digester did not take place until January 2006. Inspection and maintenance of key components of the digester continued through March 2006. In April 2006, the digester was placed back on-line as a secondary digester. In May, the digester was converted from a secondary digester to a primary digester. This process included slowly increasing the oper-

ating temperature of the digester, and mixing the digester using both the sludge recirculation system as well as the digester gas recirculation system.

The second major maintenance effort during 2006 involved the draining and inspection of both primary clarifiers during the months of October and December. On separate days, the clarifiers were taken off-line and drained. While off-line, the tanks and other essential components were inspected. Although no major problems were noted, a small quantity of debris and rags was removed from primary clarifier #1. The clarifiers were off-line for approximately 24 hours each.

In conjunction with these major maintenance efforts in 2006, WWTP staff performed the following noteworthy activities:

- Replaced the sodium bisulfite-dosing pump with a new pump (January);
- Installed a new sample supply pump and a new sample cell assembly on the total chlorine residual analyzer (January);
- Replaced a faulty motor on the grit dewatering screw (January);
- Modified and augmented the supply sample piping for the total chlorine residual analyzers to increase throughput and operational flexibility (February);
- Replaced gas piping on Digester #3 with new stainless steel piping (March);
- Dislodged rocks and debris from two of the pressure relief valves located on the floor of Digester #3 (March);
- Removed a large piece of wire bundle lodged in the cutter cartridge of the muffin monster (March);
- Replaced the air regulator, air-water separator, and oil reservoir assembly on the main influent sluice gate air feed line (March);
- Replaced the coupler on the hot water circulation pump on the boiler and replaced the packing on the Sludge Recirculation Pump #2 (March);
- Installed an ADA compliant wheelchair access ramp on the south entrance to the administration building (March);
- Placed Digester #3 back on-line as a secondary digester following completion of cleaning, inspection, and maintenance procedures (April);
- Installed new pressure relief and vacuum valves on all three digesters (April);
- Replaced a faulty pump head on the influent composite sampler (April);
- Performed standard maintenance on the high-low chlorine residual alarm following an alarm sounding, (May);
- Completed repairs on the 4” and 6” grit piping in the grit disposal area of the headworks (May);
- Replaced: a faulty motor on the Digester Gas Recirculation Blower #2, the seal on Influent Pump #3, the monitor on the emergency auxiliary generator switchgear, and the 10” butterfly valve on the discharge pumping line for the biofilter circulation pump (May);
- Installed new motors on the digester gas recirculation blowers on Digesters #2 and #3, and replaced piping on the digester gas recirculation system (June);
- Cleaned, inspected, and performed routine maintenance on Scum Pump #2 (June);
- Relocated the muffin monster control panel from the lower headworks screening area to the motor control center in the upper headworks (July);
- Performed preventative maintenance on both sludge pumps; replaced the check balls and removed debris from the check valves downstream of the pumps (July);

- Replaced the drive belts on Grit Pump #1, and cleaned out and replaced the sand in the center column in Sludge Drying Bed #2 (July);
- Calibrated the influent flow meter and verified calibration of the electromagnetic flow meters for the primary sludge pumping line to the digesters and the sludge pumping line to the solids contact channel (August);
- Replaced the gaskets, check valves, and supply and discharge hoses on the sodium bisulfite dosing pumps (August);
- Replaced the lower bearings in the motor used to power the laboratory fume hood and replaced the couplers on the hot water recirculation pumps for the boilers and digester heat exchanger system (August);
- Inspected the plant cathodic protection system, and replaced the rectifier used to power the system (September);
- Repaired a small hole in the lining of the cyclone grit separator that resulted in a leak of sand and grit (September);
- Replaced a faulty time clock on the controls for one of the sludge pumps, and replaced the level-sensing device on the above ground diesel storage tank for the emergency auxiliary generator (September);
- Installed a new drive unit for the flights in the chlorine contact chamber (October);
- Calibrated and replaced a faulty ground wire in the electromagnetic flow meter that is used to measure primary sludge flow to the digesters (October);
- Replaced the diaphragm and supply hosed on the residual-paced sodium bisulfite-dosing pump (October);
- Drained and inspected Primary Clarifier #2. Once the clarifier was offline, staff inspected the tank and associated mechanical components (October);
- Installed a new oxygen sensor and performed calibration procedures on the hand-held atmospheric monitor used during confined-space entries (November);
- Repaired a small sodium hypochlorite leak on the supply piping to the residual paced sodium hypochlorite dosing pump and installed new O-rings and gaskets on the 4" backflow device (December);
- Drained Primary Clarifier #1 for inspection and once offline, staff inspected the tank and components, and removed debris (December); and
- Installed new breakers for the two headworks motor control centers, which also involved installing, testing, and operating a bypass pumping system that was designed to function while the main influent pumps were offline during installation of the new breakers (December).

During 2006, the MBCSD also continued their biosolids recycling program involving windrow composting to improve the quality of biosolids produced by the WWTP. Changing the current Class-B biosolids designation to Class-A (exceptional quality, composted) biosolids allows the final product to be made available to the public for beneficial reuse as a high-quality soil amendment.

2.1.2 Plant History

The original WWTP was built in 1954 and was enlarged 10 years later to meet the demands of a growing coastal community. Its initial capacity was 0.7 MGD with a 1-MGD maximum. The original plant included a headworks structure, primary and secondary clarifiers, a biofilter, a single-stage digester, chlorination facilities, biosolids drying beds, and a short ocean outfall.

The plant was upgraded in 1964 to a nominal capacity of 1 MGD and a 1.3-MGD maximum. This upgrade added a pump station, a splitter box, a primary clarifier, a secondary clarifier, a biofilter, chlorination facilities, biosolids beds, and another primary digester, which allowed the existing digester to be converted to a secondary capacity. A new office and laboratory were also constructed during this upgrade.

During the 1970s, the City of Morro Bay developed a plan for additional upgrades to the existing facilities to further augment the plant's capacity. It included the construction of a new outfall to better protect the marine environment. The new outfall was designed following a yearlong study of oceanographic conditions within Estero Bay. The new outfall and diffuser system extended the discharge from the surfzone to a point well offshore, in deeper water. Deeper discharge provides increased dilution of wastewater within the open-ocean environment.

Design of the planned facility improvements commenced in 1980. The design of the new outfall was completed in April 1981. In June 1982, immediately after construction was completed, the new outfall was placed into service. The design of the treatment-plant improvements was completed in September 1981. The design called for a final effluent suspended-solids concentration of 30 mg/L and an equivalent limit on BOD. However, financial aid from state or federal agencies to finance the construction of a treatment plant that could meet these full secondary-treatment levels was not available at that time. Because discharge through the new outfall from the old plant was not causing any apparent adverse environmental impact, and because the projected flow rates were low, the state could not justify providing financial aid for this Plant's upgrade. At that time, other higher-priority projects were seeking similar financial assistance. As a compromise, the treatment plant's design was modified to provide secondary treatment to a majority (1 MGD), but not all, of the projected flow. In this way, the state water-quality standards, as set forth in the California Ocean Plan or the COP (SWRCB 1990), could still be met. State officials concurred with this level of treatment, provided that the USEPA approved a 301(h)-modified NPDES discharge permit that adjusted full secondary-treatment requirements on suspended-solid and BOD emissions.

In a letter dated 16 March 1983, the staff of the California Regional Water Quality Control Board (RWQCB) indicated their tentative determination that the proposed altered discharge would comply with applicable state laws, including water-quality standards, and would not result in requirements for additional treatment, pollution control, or other requirements on any other point or non-point source. This tentative determination was made pursuant to Title 40 of the Code of Federal Regulations, Section 125.60(b)(2) [40 CFR 125.60(b)(2)] (USGPO 1982a) and 40 CFR 125.63(b) of the 301(h) regulations dated November 1982 (USGPO 1982b).

Treatment-plant upgrades performed between 1983 and 1985 increased plant capacity to 2.06-MGD average dry-weather flow and a peak wet-weather flow of 6.6 MGD. The plant now includes primary treatment of all influent by screening, grit removal, and primary sedimentation. Depending on the hydraulic conditions within the plant, the majority of the flow (up to 1 MGD) can be diverted through a secondary treatment process consisting of trickling filters, clarifiers, and a solids contact chamber. This achieves at least a 75% solids removal in the subsequent blend of primary and secondary effluent. The new secondary-treatment process utilized the two existing trickling filters, a new aerated solids contact channel, and a new secondary sedimentation tank. The original 1954 sedimentation tank was converted into a chlorination system in which the primary and secondary effluents are mixed and disinfected prior to dechlorination and discharge through the ocean outfall.

On 29 March 1985, water-quality standards for the MBCSD treatment plant were established in an NPDES permit based on a Section 301(h) modification. The permit mandated that the treatment plant achieve a suspended solids content of no more than 70 mg/L (75% removal) and a maximum BOD of 120 mg/L. An extensive monitoring program was also required to assure the maintenance of environmental quality. The permit was valid for five years and expired on 8 March 1990. Following an evaluation process, the permit was reissued in December 1992. Improvements to the treatment facilities during this period included the installation of a sludge removal system in the mixing chamber of the chlorine contact tank. Sludge buildup in the mixing chamber had been increasing the effluent BOD, so a system of high-pressure nozzles and scraper flights was installed to alleviate this problem. Effluent BOD declined after this installation.

During the permit renewal process in 1992, concerns were expressed that the discharge could affect the waters within Morro Bay, to the south of the discharge. Consequently, a shellfish-monitoring program was instituted. Subsequent analysis demonstrated that the discharge was too far from this newly designated national marine estuary to materially affect its waters. At a typical 1-cm/sec flow speed, effluent would take more than three days to reach the entrance to the Bay located 2.8 km (1¾) miles to the south. Over a much shorter distance and time, intense open-ocean turbulence rapidly mixes and disperses the effluent beyond recognition. This is evident from the inability of extremely sensitive instruments to detect the presence of the effluent plume even short distances beyond the zone-of-initial dilution, which extends only 15 m from the diffuser structure (see Chapter 3). Similarly, effluent discharge does not affect the Monterey Bay National Marine Sanctuary, whose southern boundary is near Cambria Rock, 20 miles to the north.

In anticipation of permit expiration in early 1998, the MBCSD applied for renewal of their 301(h)-modified NPDES permit in May 1997. The application was supported by an extensive technical review of more than a decade of monitoring data (MRS 1997a). An administrative extension was granted through 11 December 1998 to allow time for review and issuance of a new discharge permit (RWQCB 1998). A series of discussions with RWQCB and USEPA staff concerning new permit revisions were held throughout 1998. Changes implemented in the new permit included:

- a 12.7% reduction in the allowed mass-emission of suspended solids, BOD, and O&G,
- more extensive reporting requirements for biosolids,
- elimination of shellfish monitoring,
- a revised benthic sampling pattern eliminating seasonal sampling and increasing the number of stations close to the diffuser structure,
- a revised receiving-water sampling program eliminating bottle casts and doubling the number of CTD casts close to the diffuser structure, and
- specification of mass emission goals for toxic chemicals.

In July 1998, RWQCB staff determined that the discharge described in the MBCSD application '*…would comply with applicable state laws, including water quality standards, and would not result in additional treatment, pollution control, or other requirements on any other point or nonpoint source.*' In September 1998, Region IX of the USEPA issued a tentative decision that MBCSD be granted a permit that modifies secondary treatment requirements under Section 301(h) of the Clean Water Act. In December 1998, the RWQCB approved a modified NPDES permit that moderated some of the full secondary treatment requirements (Permit No. CA0047881). On 13 January 1999, the California Coastal Commission ruled that the Waste Discharge Requirements incorporated in the current NPDES permit were consistent with the

California Coastal Zone Management Act. On 26 January 1999, the USEPA issued the latest NPDES permit, effective 1 March 1999.

The current NPDES permit was approved by the RWQCB with the proviso that a comprehensive water-reclamation feasibility study be conducted within the following year (that is, in 1999). A draft report was submitted to the RWQCB on 7 October 1999 that included a detailed evaluation of reclamation options and feasibility, and a review of water supply and demand for the region around Morro Bay and Cayucos (Carollo Engineers 1999). Staff of the RWQCB provided comments on the feasibility study on 16 February 2000, and the report was finalized after these comments were included by reference.

The report considered water reuse for irrigation of agricultural crops, irrigation of landscapes, parks and public facilities, industrial reuse, stream-flow augmentation, estuary/wetlands enhancement, groundwater recharge, and seawater intrusion barriers. The study found that implementation of a reuse project would require upgrading the entire wastewater flow to full secondary treatment, and that the portion of wastewater going to reuse would need to be upgraded to tertiary treatment. The study also determined that the existing water supply adequately meets demand, and there would be little utilization of recycled water.

The current NPDES permit was due to expire on 1 March 2004. In anticipation of its expiration, an application for a new discharge permit was submitted on 3 July 2003 (MBCSD 2003). The application included a supplemental report (MRS 2003a) that provided an extensive technical review of monitoring data collected over the previous decade and a half. Based on the general absence of perceptible impacts from the historical discharge, and high effluent quality projected for the upcoming five-year permit term, an application was submitted based on a continuation of discharge under a 301(h) modification of secondary treatment requirements. On 4 February 2004, the RWQCB (2004) administratively extended the current permit to allow time for review. On 10 September 2005, the USEPA Region 9 (2005) issued a tentative decision concurring with the issuance of a permit to the MBCSD in accordance with Section 301(h) of the Clean Water Act. On 6 April 2006, the USEPA and RWQCB staff issued a joint notice for a proposed action to reissue the 301(h) modified NPDES discharge permit to the MBCSD. On 11 May 2006, the RWQCB and the USEPA conducted a joint public hearing on the reissuance of the MBCSD permit, and the RWQCB voted for a continuance of the hearing.

2.1.3 Regulatory Setting

The 1972 Federal Clean Water Act and its amendments in 1977 established national water-quality goals and created a national permit system (NPDES) with minimum standards for the quality of discharged waters (USGPO 1997a). It required states to establish standards specific to water bodies and designated the types of pollutants to be regulated. Since 1973, the California State Water Resources Control Board and its nine Regional Water Quality Control Boards have been delegated the responsibility for administering permitted discharges into the coastal marine waters of California. The State Board prepares and adopts the COP, which incorporates the state water-quality standards that apply to all NPDES permits. The Central Coast Region of the California Water Quality Board (RWQCB) established a Water Quality Control Plan for the basin containing San Luis Obispo County waters (RWQCB 1994). The basin standards incorporate the applicable portions of the COP, and are more specific to the beneficial uses of marine waters adjacent to the outfall site. Water-quality objectives and toxic material limitations in the basin plan are designed to protect the beneficial uses of ocean waters within specific coastal areas. The basin plan identifies the following existing beneficial uses for the waters of Estero Bay.

- ***Water Contact Recreation (REC-1).*** *Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing and fishing.*

- ***Non-Contact Water Recreation (REC-2).*** *Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.*

- ***Industrial Service Supply (IND).*** *Uses of water for industrial activities that do not depend primarily on water quality, including, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.*

- ***Navigation (NAV).*** *Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels. The regional water quality control board interprets NAV as any natural body of water that that has sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, and pleasure.*

- ***Marine Habitat (MAR).*** *Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife, such as marine mammals and shorebirds.*

- ***Shellfish Harvesting (SHELL).*** *Uses of water that support habitats suitable for the collection of filter-feeding shellfish such as clams, oysters, and mussels, for human consumption, commercial, or sport purposes. This includes waters that have in the past, or may in the future, contain significant shellfisheries.*

- ***Ocean Commercial and Sport Fishing (COMM).*** *Uses of water for commercial or recreational collection of fish, shellfish, or other organisms, including uses involving organisms intended for human consumption or bait purposes.*

- ***Preservation of Rare, Threatened, or Endangered Species (RARE).*** *Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.*

- ***Wildlife Habitat (WILD).*** *Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.*

Section 301(b) of the Clean Water Act requires publicly owned treatment works (POTW) to meet effluent limitations based on secondary treatment, which is defined in terms of limits on three technology-based effluent parameters (40 CFR 133; USGPO 1997a). These limitations are:

- Total suspended solids (TSS) concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%;
- Biochemical oxygen demand (BOD) concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%; and
- Hydrogen-ion concentration (pH) between 6.0 and 9.0.

Section 301(h) of the Act allows an NPDES permit to be issued that modifies some or all of these full secondary treatment requirements, if certain conditions are met. The MBCSD WWTP is a combined primary and secondary treatment facility that has operated under a Section 301(h)-modified NPDES permit (number CA0047881) since March 1985. The modification in this NPDES permit applies only to the TSS and BOD requirements, so all other NPDES limitations apply without exception, including those for wastewater pH and toxic compounds. The modification was issued only after additional conditions were satisfied by the MBCSD. These included the following:

- The existence of a water-quality standard specific to the pollutant for which the modification is requested (40 CFR 125.61; USGPO 1997a). The COP specifies limits on TSS and dissolved oxygen depression (SWRCB 1997). In January 1999, the California Coastal Commission determined that the discharge is consistent with the State Coastal Zone Program that incorporates standards specified in the Ocean Plan.

- The discharge does not adversely impact public water supplies or interfere with the protection and propagation of balanced, indigenous biological populations (40 CFR 125.62). The U.S. Fish and Wildlife Service (USDOI 1998) and the National Marine Fisheries Service (NOAA 1998 2004) have determined that the discharge will not adversely impact threatened or endangered species, or critical habitats, pursuant to the Endangered Species Act.

- A monitoring and reporting program is in place that is capable of evaluating the effects of the discharge (40 CFR 125.63).

- The discharge will not result in any additional treatment requirements on any other point or non-point source (40 CFR 125.64).

- Because there are no known sources of toxic pollutants or pesticides in the influent, the WWTP is exempt from general pretreatment requirements in lieu of a pollution prevention program. Because the discharge is considered small, it is exempt from the urban pretreatment requirement (40 CFR 125.65).

- The MBCSD pollution-prevention program implements public-education and source-reduction programs to limit the entrance of toxic pollutants or pesticides into the treatment plant. Therefore, it meets the requirement for a non-industrial source control program (40 CFR 125.66).

- There will be no new substantially increased discharge of BOD and TSS beyond those specified in the permit (40 CFR 125.67). This conclusion is based on the historically high performance of the plant process, and the limited projected growth in population and industry within the service area. The analyses in this report demonstrate the continued veracity of this conclusion during 2006.

- The WWTP exceeds the minimum requirements for primary treatment (40 CFR 125.60) because it performed: '*…treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate'* (40 CFR 125.58(r); USGPO 1997a).

The MBCSD WWTP is categorized as a Class III wastewater treatment facility by the California State Water Resources Control Board, Office of Operator Certification. It was reclassified in 2001 from a Class-IV facility. The plant classification was changed based on the treatment process and volume of flow through the plant. A typical Class-IV facility treats in excess of 20 MGD in the primary process, while the MBCSD plant processes a total flow of approximately 1.2 MGD. The change in classification acknowledges the exceptionally small volume of flow handled by the plant, and reduces the operator grades required by personnel running the plant.

2.1.4 Description of the Treatment and Outfall System

The WWTP operating characteristics are listed in Appendix A. All wastewater is treated through a primary treatment process, which includes screening, grit removal, and primary sedimentation, as shown in Figure 2.3. Typically, the vast majority of the flow (often more than 1 MGD) is diverted for an additional secondary treatment process consisting of biofilters, a solids-contact chamber, and a secondary clarifier. The secondary process consists of parallel single-stage, high-rate, trickling filters whose combined outflow goes to a solids contact channel, and then to a secondary sedimentation tank. Secondary-treated effluent is subsequently blended with primary effluent. The entire blend is chlorinated for disinfection and then dechlorinated. The disinfected effluent is discharged into Estero Bay through a 4400-ft (1341-m) outfall terminating in a multi-port diffuser system. Waste biosolids are anaerobically digested, dried, composted and used as soil conditioner/fertilizer. A schematic of the biosolid process is shown in Figure 2.16 on Page 2-44.

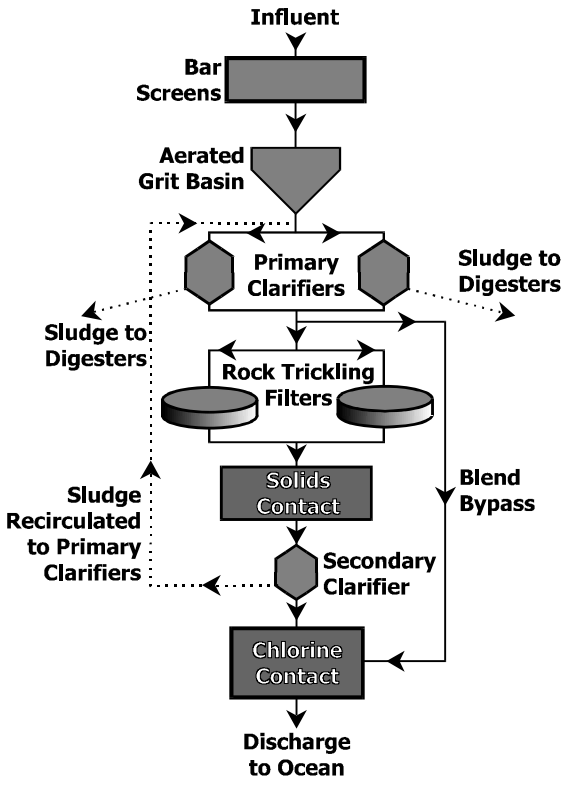


Figure 2.3 Schematic of the Wastewater Treatment Process

The location of the Morro Bay-Cayucos WWTP and outfall within Estero Bay is shown in Figure 2.4. The discharge is into unstressed, open-ocean waters at 35°23'11"N latitude and 120°52'29"W longitude. Treated effluent flows through a 27-in (0.69-m)-diameter outfall that extends a distance of approximately 4,400 ft (1,341 m) in a northwesterly direction. The outfall terminates in a multi-port diffuser situated approximately 2,700 ft (827 m) from shore. The diffuser lies in 50 ft (15.2 m) of water, referenced to Mean Lower Low Water (MLLW). Twenty-eight of the 34 available diffuser ports are currently open. The remaining six ports can be made operational if the sustained discharge exceeds 6.60 MGD. The diffuser is 170-ft (51.8 m) long.

Because of its location, the MBCSD discharge does not interfere with the maintenance of water quality and designated beneficial uses within Estero Bay (see Section 2.1.3 on Page 2-11). The discharge occurs in well-flushed, open coastal waters where re-entrainment or accumulation of effluent will not result in violations of applicable water-quality standards, even if combined with pollutants from other sources. Intakes and outfalls from other publicly owned treatment works (POTWs) are far removed from the MBCSD outfall. For example, water intake for the desalinization plant is from salt-water wells and not from the ocean environment where the MBCSD discharge occurs. Similarly, surface discharge of water from the LS Power Group plant (formerly Duke Energy and PG&E), when it does occur, is located well south of the MBCSD discharge point and does not add chemical loads to the ocean environment.

2.1.5 Pollution Prevention Program

The MBCSD continued to advance its Pollution Prevention Program along several fronts during 2006. The program's purpose is to minimize the introduction of pollutants and pesticides into the treatment process. The NPDES permit requires an annual status report detailing efforts to comply with the requirements for a Pollution Prevention Program. This section serves as that report. Three aspects of pollution prevention were emphasized during 2006. First, the comprehensive industrial waste survey that was completed in 1999 has been updated annually, including in 2006. Second, a public outreach program, initiated in 1999, was continued in 2006. As the result of a vigorous advertising campaign over the past several years, the household hazardous waste facility was heavily used during 2006, with between 20 and 50 participants utilizing the facility each weekend. Finally, influent and effluent were diligently monitored for industrial contaminants.

Industrial Waste Survey

The MBCSD economy is predominately based on commercial fishing and tourism, with no heavy industry or manufacturing of environmental significance. As testimony to its tourism base, an unusually large number of restaurants, approximately 50, are listed in the industrial database for this small community. Accordingly, comprehensive monitoring for more than a decade and a half has found that effluent discharged from the treatment plant consists largely of relatively benign constituents. The industrial waste surveys conducted during 2006 and in prior years support these findings because they quantified a comparatively low volume of influent from light industrial sources containing nontoxic constituents typical of wastewater from domestic sources. Over all the years of modern treatment-plant operation, there has been virtually no expansion of the industrial base in this largely residential community. There is no input from heavy industrial sources. During 2006, the absence of significantly elevated levels of industrial pollutants within wastewater was indicative of the continued lack of substantive industrial input.



Figure 2.4 Location of the MBCSD Outfall and Monitoring Stations within Estero Bay

During 2006, industrial-waste survey activities relied heavily on the results of a detailed survey originally conducted in 1999. An update of the survey was completed in 2005. The design and implementation of a digital database included an inventory of all potential industrial users located within the service area. The database lists business names, addresses, names of contacts, telephone numbers, inventories of chemicals, discharge volumes, and other pertinent information. The computer database expedites quantitative assessments of industrial usage, and facilitates annual updates of contact information.

The master list of businesses in the database was developed from business license applications on file with the City of Morro Bay and from input provided by the Cayucos Sanitary District. The master list is subdivided into businesses that have no potential for industrial discharges, such as offices and retail

stores, and those that have the potential for industrial waste discharge. All businesses with potential industrial discharge were either interviewed in person or provided with a Commercial User Questionnaire.

Based on the more-detailed information provided in the questionnaire, additional businesses were excluded from further consideration as industrial dischargers because they either did not generate wastewater at all, or discharged only domestic wastewater. These businesses included theaters, beauty shops, barbershops, and various retail firms. For the remaining industries, waste discharge volumes were estimated in proportion to water usage determined from billing records provided by the City Water Department. Follow-up activities for these businesses included scheduled return visits, surprise onsite inspections, and formal tours of the facilities. Based on this phase of the survey, certain industrial dischargers were identified for continued close monitoring by future site visits, scheduled annually. These include the commercial laundries, car washes, dry cleaners, print shops, and the oil-water separator maintained by the City of Morro Bay. Several businesses were targeted with unannounced inspections in 2006.

Overall water use within the communities has changed little between 1999 and 2006. Table 2.2 lists the ten largest water users in the service area during 2006. The constituents added to the wastestream by these large water users are not particularly toxic to humans or aquatic organisms, and are not thought to interfere with the operation of the treatment process. In addition, the volume of wastewater contributed by commercial businesses and government agencies constituted only approximately 0.172 MGD or 14.5% of the influent processed by the treatment plant during 2006. The vast majority of wastewater processed by the plant came from domestic sources.

Table 2.2 Entities with the Largest Estimated Water Use

Business	Water Use (gpd)[1]	Fraction[2] (%)
City of Morro Bay	36,972	3.10
Morro Bay High School	28,910	2.42
Pacific Care Center	20,661	1.73
Inn at Morro Bay	20,503	1.72
Mission Linen	19,405	1.63
Morro Elementary School	11,118	0.93
Morro Dunes RV Park	10,544	0.88
State Department of Parks	9,843	0.83
Silver City Mobile Home Park	7,576	0.64
Motel 6	6,798	0.57
Total Use	**172,330**	**14.45**

[1] Gallons per day [2] Fraction of average WWTP flow for 2006 (1.192 MGD)

The industrial-waste database subdivides these commercial and government entities into two groups depending on their type of discharge. The first group discharges wastewater that is similar to domestic waste from residential users. These dischargers include city offices, schools, hotels, mobile home parks, the Morro Bay State Park, and the Pacific Care Center. The Pacific Care Center is a senior care facility that has also been known as the Bayside Care Center, Casa de Flores, or Seashell's Communities. The Bayside Care Center houses approximately 220 residents and has dining and laundry facilities on site. The Bayside Care Center laundry facilities wash approximately 4,000 lbs of laundry in a 20-hour daily operating schedule. Their water use includes irrigation of the grounds, so not all of the 0.021 MGD ends up in the collection system.

Wastewater discharged by Morro Bay High School also consists mostly of effluent similar to residential users, albeit in higher volume. In addition, although the school is listed as the second largest water user in the service area, not all of that volume ends up in the collection system. Before June 2006, water consumption reported for the high school was much higher due to the agriculture program's use of city water. However, in June 2006, the agriculture program began using water from a dedicated well. In any regard, little of the water used by the agriculture program was discharged to the treatment plant. This is also true of the water used for grounds maintenance. Specifically, the school's water usage doubled after the installation of football and baseball fields at the school, but wastewater discharge remained relatively constant.

Because of these factors, the high school's estimated 2.42% contribution to plant influent, which is based on its 0.029 MGD of water usage, overestimates of its actual contribution to the collection system.

Other large commercial water users that discharge wastewater similar to residential users include the hotels with onsite laundry facilities, and the two large RV parks that lie within the collection area. Of these, the 98-room Inn at Morro Bay is by far the largest commercial user. All of these facilities, along with the public laundromats discharge wastewater that contains constituents similar to residential users, namely, detergents, but at volumes larger than their residential counterparts.

The only large discharger of a more industrial nature was Mission Linen. However, discharge from this light industrial source constitutes only 1.6% (0.019 MGD) of the wastewater processed by the treatment plant. Nevertheless, this commercial laundry uses several industrial-grade detergents, bleaches, surfactants, and brighteners. Some of these compounds can be harmful to bacteria within the secondary treatment system, and there is a potential for contaminants entering the wastestream from solvents, oils, and other substances that are washed from material that is laundered. Because of this potential, its discharge is pretreated prior to discharge into the collection system. The pretreatment system was installed in 2002 and includes pH buffering with phosphoric acid to neutralize excessive increases in wastewater alkalinity that could interfere with the operation of the treatment works at the plant.

Other light industrial users with much smaller discharges include the car washes within the collection area. Their discharge is considered to be of an industrial nature because of the volume of solids, oils, and greases that are washed from vehicles. Because of this, the car washes employ grease separators to pretreat their wastewater prior to discharge into the collection system. Smaller contributors, such as gas stations and repair garages, are restricted from disposal of known contaminants into the collection system by authority of the sewer-use ordinance within the City of Morro Bay municipal code. Similarly, under the municipal code, restaurants and self-service car washes are required to install and maintain grease traps within sewer line connections.

In addition to chemicals from the industrial sources that contribute to the influent, there are three chemicals purposefully introduced into the treatment process by the WWTP itself. Sodium hypochlorite is added to disinfect the wastewater prior to discharge through the ocean outfall. Currently, most wastewater facilities disinfect with some form of chlorine. A concern with chlorine disinfection is the possibility of a reaction between organic matter in the wastewater and residual chlorine. In addition, residual chlorine, even at low concentrations, can be hazardous to aquatic life. This means that treatment plants must dechlorinate to remove free and combined chlorine ions, thereby reducing effluent toxicity. Sodium bisulfite was used by the MBCSD as the dechlorinating agent during 2006. The amount of sodium hypochlorite used by the plant ranged from a minimum of 2,993 gallons in November to a maximum of 4,758 gallons in July (MBCSD 2006kg). Sodium bisulfite usage generally tracked chlorine usage, exhibiting a peak in usage of 2,676 gallons in July (MBCSD 2006g). The third chemical used at the treatment plant was ferrous chloride. It was primarily used for odor control in the collection system and to reduce hydrogen sulfide emissions during flaring of digester gas and heating of the digesters at the WWTP. The latter application was required by the Air Pollution Control Board.

Public Outreach

Public awareness literature pertaining to the proper disposal of hazardous household chemicals, is considered an integral part of the pollution prevention program. In 2006, additional literature was disseminated which discussed pending upgrades to the plant, addressed frequently asked questions about the plant and plant processes, and educated the public about the plant's operating history. The literature also supplied

vital information to ratepayers concerning issues such as the plant's permit renewal status, upcoming public hearing meetings, and topics of current biological interest, such as *Toxoplasma gondii*.

Disposal guidelines were also discussed with industrial users during the industrial-waste survey site visits. Industrial users are told how strict adherence to the disposal guidelines minimizes damage to the treatment plant and collection systems, and ensures effective treatment of wastewater. The sewer-use ordinance within the City of Morro Bay municipal code also provides the legal authority for protection of the WWTP and collection systems. It limits the introduction of pollutants that could: a) interfere with the operation of the treatment works, b) pass through the WWTP into the environment, c) reduce the ability to reuse wastewater and biosolids, or d) expose WWTP employees to hazardous chemicals.

A major milestone in public outreach was achieved during 2000 when a new household hazardous waste disposal site was established at the wastewater treatment plant. Prior to that time, household waste disposal was only available on limited days at the distant Chicago Grade and Cold Canyon landfills. Treatment-plant staff assisted the Integrated Waste Management Authority in establishing a permanent collection facility on the grounds of the treatment plant. The facility opened to the public in August 2000. Since then, it has been open every Saturday from 11:00 AM to 3:00 PM, except holiday weekends.

An on-going public-education campaign advertises the availability of the hazardous-waste disposal site, and has been instrumental in making it one of the top sites in the county in terms of the volume of material collected. The availability of hazardous waste disposal at the treatment plant, as well as general information about waste disposal, continued to be heavily advertised in the local media throughout 2006. Between 20 and 50 individuals used the household hazardous waste disposal facility each weekend, with more than 1,500 people disposing of waste at the facility during the course of the year. From July 2005 to June 2006, over 153 tons of household hazardous wastes were processed through the disposal site, and a large portion of the collected material was recycled. This amount is more than double the tonnage collected and processed at the facility during the previous year. Collected materials included over 69,260 pounds of oil-based paint, 29,585 pounds of latex paint, 12,754 pounds of flammable liquids, 12,355 pounds of aerosol containers, 5,245 pounds of anti-freeze, 42,900 pounds of car batteries, 23,366 pounds of motor oil/oil products, and 1016 pounds of household batteries. Without the permanent hazardous waste facility, much of this material would have ended up in a landfill or been discharged into the ocean.

Additionally, in 2006, the hazardous-waste disposal site collected 48,380 pounds of electronic waste (e-waste) including video display devices such as television and computer monitors, which the facility expanded to accept during 2004. The expansion helps to address a long-standing problem with the proper disposal of e-waste. Cathode Ray Tubes (CRTs), the picture tubes used in many of the older computer monitors and television screens, contain large quantities of five known toxic chemicals. Cadmium, mercury, chromium, lead, and phosphorous are all typically found in CRTs. In fact, the EPA estimates that discarded CRTs contribute at least 40% of the known lead in U.S. landfills. Flat panel monitors, cell phones, digital cameras, and other computer hardware also contain multiple hazardous waste elements. Although, normally, these contaminants are safely sealed within the finished product, the heavy equipment used to compact wastes at a landfill compromises the structural integrity of these products. Once the structural integrity of the housing is compromised, the hazardous materials are released into the surrounding area, where a leaching process occurs. Proper recycling of these products can prevent such contamination.

Source Identification

Although waste minimization measures have been implemented to reduce the introduction of incompatible contaminants into the wastestream, concentrations of interest are occasionally noted in the periodic chemical analysis of effluent. When this occurs, personnel from the City of Morro Bay and the Cayucos Sanitary District trace the contaminants to the source, and work with the source owner to eliminate the contamination. During 2006, however, the State Water Resources Control Board adopted new statewide waste discharge requirements for sanitary sewer systems. As a result, the responsibility for the introduction of Fats, Oils, and Grease, and other components of source control and identification programs has been transferred from the WWTP to the City's Collection Department. In any event, no unusual contaminants were detected within the wastestream during 2006.

Ongoing source identification and resolution efforts that extended into 2006 included a grease-trap inspection program that began in 2002. Originally, 68 businesses subject to grease-trap requirements were identified within the City of Morro Bay. However, in 2006, this figure dropped to only 54 businesses that were subject to the requirements. Spot checks were conducted at over twenty of these establishments throughout the year, including two markets, a senior center (with a restaurant, four grease traps, and an onsite laundry), and a hotel (with restaurant, interceptor, and laundry). Six source control inspections were also performed over the course of the year. No issues of concern were raised during any of these inspections.

2.2 WASTEWATER CHARACTERIZATION

Monthly wastewater characterizations documented a number of different aspects of the treatment plant's performance in 2006 (Table 2.3). Monthly wastewater characterizations documented a number of different aspects of the treatment plant's performance in 2006 (Removal rates quantified the plant's performance in terms of its ability to reduce major contaminants within the wastestream. Effluent concentrations characterized the overall quality of effluent discharged through the ocean outfall, while mass emissions quantified the cumulative load of wastewater constituents that were introduced into the marine environment.

The monthly averages of the principal influent and effluent characteristics listed in Table 2.3 were computed from numerous samples that were collected and analyzed by treatment-plant personnel throughout 2006. The WWTP personnel regularly determine the principal physicochemical properties of the effluent, including suspended solids, BOD, pH, O&G, total residual chlorine (TRC), turbidity, settleable solids, and total coliform bacteria. The frequencies at which individual samples were collected, and the duration over which the samples were collected, varied among the parameters. For example, average reductions in suspended solids and BOD were determined from 24-hr composite samples of influent and effluent that were collected and analyzed at least weekly. Analyses for the concentration of most of the remaining constituents were conducted only on effluent samples. Discrete effluent grab samples were analyzed for pH, TRC, temperature, turbidity, and settleable solids on a daily basis. Effluent grab samples were also analyzed for total coliform five times each week, whereas O&G concentrations were determined weekly. Effluent ammonia was determined from monthly grab samples.

Table 2.3 Monthly Averages of Influent and Effluent Parameters

		Suspended Solids				Biochemical Oxygen Demand			
Month	**Flow (MGD)**	**Influent (mg/L)**	**Effluent (mg/L)**	**Removal (percent)**	**Mass Emission (kg/day)**	**Influent (mg/L)**	**Effluent (mg/L)**	**Removal (percent)**	**Mass Emission (kg/day)**
January	1.244	308	20	93.7	99	260	40	83.9	178
February	1.091	348	20	94.1	83	256	43	83.3	182
March	1.319	297	23	93.4	117	234	39	82.8	209
April	1.391	259	18	91.2	98	291	35	87.6	192
May	1.260	265	17	91.5	78	284	55	80.7	277
June	1.206	342	21	93.6	93	295	42	85.5	184
July	1.326	337	33	88.8	165	316	63	80.2	315
August	1.209	366	21	92.5	97	278	52	81.1	237
September	1.096	339	18	95.1	71	269	43	84.0	181
October	1.043	432	18	96.1	69	376	40	88.9	147
November	1.048	396	17	95.3	68	396	45	88.2	184
December	1.064	335	21	93.3	82	239	46	79.8	192
Average	**1.192**	**335**	**21**	**93.2**	**93**	**291**	**45**	**83.8**	**206**
Monthly Limitation	**≤2.36[1]**		**≤70**	**≥75.0**	**≤546**		**≤120**	**≥30.0**	**≤936**
Annual Total (MT)					**34**				**75**
Nominal Annual (MT/year)					**≤199**				**≤342**

Table 2.3 (continued) Monthly Averages of Influent and Effluent Parameters

	pH					Oil and Grease		
Month	**Influent**	**Effluent**	**Turbidity (NTU)**	**Settleable Solids (ml/L)**	**30-Day Median[2] Total Coliform (MPN/100ml)**	**Influent (mg/L)**	**Effluent (mg/L)**	**Mass Emissions (kg/day)**
January	7.8	7.6	23	<0.1	2	44.1	5.8	25
February	7.7	7.6	26	<0.1	2	70.2	5.4	21
March	7.7	7.6	32	<0.1	2	29.6	5.9	42
April	7.8	7.6	22	<0.1	3	25.8	7.4	43
May	7.8	7.7	26	<0.1	2	106.0	3.9	17
June	7.7	7.6	28	<0.1	2	53.7	2.7	12
July	7.8	7.6	36	<0.1	4	41.2	4.2	22
August	7.7	7.7	27	<0.1	<2	28.9	3.0	13
September	7.8	7.7	23	<0.1	<2	28.6	3.6	14
October	7.7	7.6	22	<0.1	<2	33.6	2.7	10
November	7.8	7.7	22	<0.1	<2	56.7	1.9	7
December	7.7	7.6	22	<0.1	2	14.0	2.9	11
Monthly Average	**7.7**	**7.6**	**26**	**<0.1**		**43.5**	**4.1**	**20**
Monthly Limitation	**6-9**		**≤75**	**≤1.0**	**≤23**		**≤25.0**	**≤195**

[1] Peak Seasonal Dry-Weather Flow (PSDWF)
[2] Computed from samples collected in the 30 days prior to the last day of the month (MBCSD 1997a)

Detailed analysis of over two decades of these measurements documents has shown that the plant consistently outperformed expectations for wastewater treatment, based on regulatory standards. Over the long history, there has been no indication of deteriorating plant performance, and effluent quality has consistently exceeded expectations, based on the original design criteria. On rare occasions when exceptions to standards or criteria have occurred, they have been the direct result of a brief, unavoidable mechanical failure of a treatment-system component or the external introduction of a contaminant within the influent stream. In spite of a diligent program of preventative maintenance, the challenge for plant personnel has been to quickly respond to unanticipated failures in system components.

Because of their potential impact on effluent quality, rain events, population fluctuations, and equipment-related incidents that were experienced during 2006 are briefly described in Table 2.4. As in past years, unusual measurements in plant parameters were directly related to one or more identifiable incidents. The strong relationship between external events and effluent parameters demonstrates the overall effectiveness of the treatment process and the high degree of control that is exercised by the plant personnel under normal operating conditions. If this were not the case, excursions in effluent properties would be random and uncorrelated with external events. During 2006, none of these events resulted in an exceedance of the discharge limits specified in the NPDES permit. In the following discussions of the various wastewater characteristics, reference is made to the six events listed in the Table 2.4.

Table 2.4 Events that Affected the Treatment Process during 2006

#	Date(s)	Event Description	Effect on Treatment Process
E1	12/30/05-01/02/06	• Rainfall (4.6 inches) from a 4-day storm • Rainfall (3.65 inches) on 1/1/06 alone • Temporary increase in population during the New Year's holiday	a) 4.4 MG of I&I into the collection system b) 2nd & 3rd highest daily flows (2.8 MGD) c) 4th highest effluent TSS (57 mg/L) d) Highest TSS emission (563 kg/day) e) 4th highest effluent turbidity (68 NTU) f) Lowest effluent pH (7.4)
E2	3/26-4/1	• Rainfall (2.4 inches) from a 7-day storm • Spring break for various school systems	a) 2 MG of I&I into the collection system b) 4th & 5th highest daily flows (2.5 & 2.3 MGD) c) Highest effluent O&G (13.2 mg/L) d) Highest O&G emission (124 kg/day) e) Highest influent pH (8.2)
E3	4/3-4/11	• Rainfall (1.5 inches) from a 9-day storm • Spring break and Easter holiday	a) 4.2 MG of I&I into the collection system b) 6th highest daily flow (2 MGD) c) Lowest influent TSS (169 mg/L) d) 2nd Lowest TSS removal (83%) e) 2nd highest effluent O&G (10.6 mg/L) f) 2nd highest O&G emission (76 kg/day)
E4	5/21	• Rainfall (2.6 inch) from a 1-day storm • High water level in primary clarifiers prior to opening of the blending valve	a) 2.5 MG of rainwater inflow into the collection system b) Highest daily flow (3.4 MGD) c) 2nd highest effluent BOD (82 mg/L) d) Highest BOD emission (458 kg/day)
E5	7/1-7/6	• Large temporary increase in the tourist population during the week of the Independence Day holiday	a) 1.5 MG of additional wastewater throughput b) Three highest effluent TSS (81, 69, & 69 mg/L) c) 2nd, 3rd, & 4th highest TSS emission (438, 336, & 335 kg/day) d) Highest effluent BOD (92 mg/L) e) 2nd highest BOD emission (428 kg/day) f) 2nd lowest BOD removal rate (72%) g) 1st & 2nd highest effluent turbidity (75 & 70 NTU)

#	Date(s)	Event Description	Effect on Treatment Process
E6	9/2-9/4	• Temporary increase in the tourist population during Labor Day weekend	a) 0.6 MG of additional wastewater throughput

2.2.1 Flow Rate

Flow data collected in 2006 demonstrate that plant throughput was far below design capacity, which is reflected in the discharge limitations specified in the NPDES permit. The waste discharge requirements (RWQCB-USEPA 1998a) specify that '*…the peak seasonal dry weather flow* (PSDWF) *shall not exceed a monthly average of 2.36 MGD*….' This permit limitation was not exceeded during the 2006 dry season (April through September), or in any month during 2006 (Table 2.3). The highest monthly average flow of 1.391 MGD occurred in April as a result of two extended spring rainfall events that combined to contribute almost 4 inches of rain during that month (Events E2 and E3 in Table 2.4 and Figure 2.5). Normally, April is considered a "*dry weather*" month for permit-compliance purposes, but in 2006, it received nearly 13% of the annual rainfall. As a result, April also had the highest 30-day running average flow at 1.5 MGD as shown by solid thin line in Figure 2.5. Even so, both the April running average (1.5 MGD) and monthly total (1.4 MGD) represented less than 64% of the monthly permit limit for dry-season flow, which is shown by the thick shaded line that spans the '*dry*' season.

Identifiable contributions to the annual average flow rate of 1.192 MGD are listed in Table 2.5. These contributions are described in the subsections below. The largest single identifiable component of flow arose from the infiltration of groundwater into the collection system. It contributed at least 0.107 MGD to the average flow through the treatment plant, and probably much more. Combined population increases by residents on weekends, and tourists during the summer and various holidays, accounted for approximately 13.6% of the reported annual throughput. Inflow of rain into the collection system, although significant during rainstorms, increased the flow by only approximately 3.4% during 2006.

Table 2.5 Contributions to Annual Flow Rates (MGD)

Source	Rate	Fraction
Total [1]	1.192	100.0%
Base	0.883	74.1%
Infiltration	0.107	9.0%
Weekends [2]	0.081	6.8%
Seasonal Tourism [3]	0.061	5.2%
Inflow	0.041	3.4%
Holiday Tourism [4]	0.019	1.6%

[1] From Table 2.3
[2] Increased resident population on weekends and some local tourism
[3] Increased population during the summer and early fall
[4] Population increases during holidays

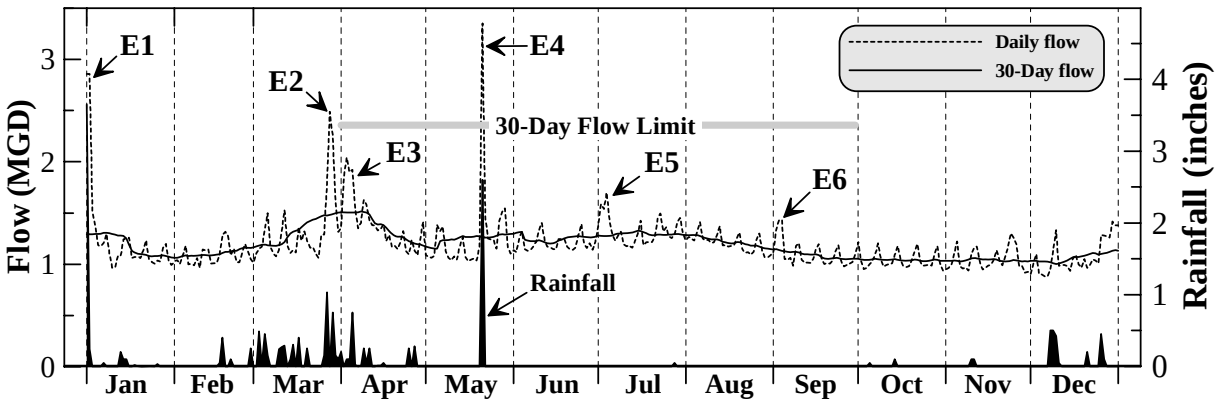


Figure 2.5 Daily Effluent Flux and Rainfall Accumulations

The remaining 0.883 MGD of base flow was equal to the lowest reported daily flow, which was recorded on consecutive days in early December, after the summer tourist season had ended, and before the major winter storms began. However, it is likely that this entire base flow does not represent wastewater purely of sewage origin that was generated by the full-time resident populations of Cayucos and Morro Bay. Instead, because it is based on the lowest reported flow, it undoubtedly includes contributions from ongoing infiltration that occurs throughout the year, including the day with the lowest flow of the year. In fact, a much lower flow of 0.741 MGD was recorded in 2002. It suggests that at least another 0.142 MGD of "*Base*" 2006 flow can be ascribed to infiltration, bringing the infiltration contribution closer to a level exceeding 20%. The actual amount of infiltration is probably even higher than that, but a precise estimate of infiltration cannot be determined from an analysis of the time series of daily flow rates alone. In any regard, the 2006 infiltration contribution listed in Table 2.5 probably significantly underestimates the true level of infiltration.

Overtotalized Flow

In 2006, overtotalization of daily flow volumes was negligible. The general absence of overtotalized flow contrasts markedly with the artificially elevated daily flow rates reported prior to 2002 (shaded portion of Figure 2.6). Before July 2001, flow rates were reported using the effluent meter. Because it routinely overestimated discharge rates by at least 25%, an influent flow meter was installed and tested in 2000. Although it was consistently more accurate than the effluent flow meter, it, too, would overtotalize the flow on rare occasions when hydraulics in the influent flume were compromised. Influent flow was measured using a prefabricated metering manhole and an ultrasonic transducer capable of highly accurate flow determinations based on precise water-level measurements. However, when the water level within the headworks wet well exceeded a certain point, influent would backup along the 350 ft of pipe between the treatment plant and the metering flume. The ultrasonic depth transducer would misinterpret the resulting increase in water level within the flume as increased flow.

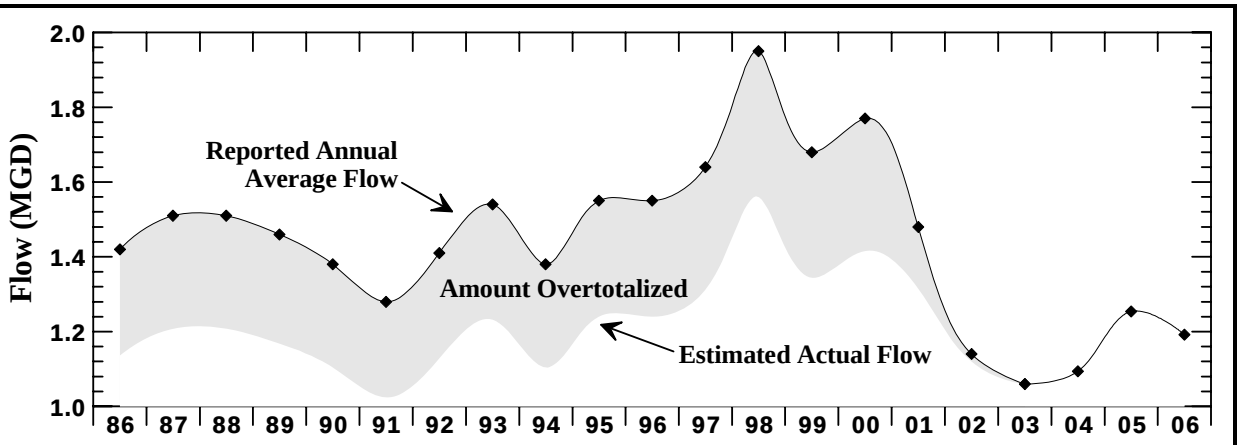


Figure 2.6 Annual Average Flow Rate

Based on recommendations resulting from analyses performed on 2002 flow data (MRS 2003b), and beginning in 2003, an adjusted effluent flow measurement was reported instead of the flow measured by the influent meter on rare occasions when the metering flume was surcharged. Since that time, there have been only a few occasions when adjusted effluent measurements were reported in place of erroneous influent measurements. In 2006, reported flows were based on adjusted measurements on five occasions,

including two consecutive days during heavy rainfall in early January, on May 6th when valves inadvertently left open in the chlorine contact chamber caused significant recirculation within the plant, and on two days in December when bypass pumping was required during maintenance activities.

Inflow and Infiltration

Throughout 2006, a measurable portion of influent came from inflow (direct runoff of rainwater into the collection system) and infiltration (seepage of groundwater into the collection system). Processing this relatively clean inflow and infiltration (I&I) does not tax the treatment capabilities of the plant to the same extent as does processing equivalent volumes of pure sewage. Municipal sewage is higher in total suspended solids (TSS), biochemical oxygen demand (BOD), and other organic contaminants customarily associated with wastewater. This is why NPDES maximum flow limits are typically applied to measurements collected during the '*dry season*,' when contributions from I&I are expected to be negligible. It is thought that this is when the treatment process is subjected to the greatest concentrations of organic particulates.

However, the flow recorded at the MBCSD WWTP throughout 2006 included measurable I&I and was not representative of a wastestream (that is, pure sewage) that challenges the treatment process. By ignoring the I&I component, one would incorrectly conclude that the plant had reached approximately 61% of its design capacity, namely, the measured flow averaged over the '*dry*' season (1.25 MGD) relative to the design capacity (2.06 MGD). However, at least 0.11 MGD, and probably much more of the measured average dry-weather flow arose from inflow and infiltration, so the plant was probably well below 55% of its capacity to process wastewater entirely of sewage origin.

Rainfall-induced increases in daily plant flow appear as a series of isolated spikes in the dashed line of Figure 2.5 on Page 2-23, particularly during the first five months of 2006. Their timing relative to major rainfall events (shown in solid black at the bottom of the Figure) demonstrates that they were caused by surface runoff flowing into the collection system. The 17.9 inches of rain that fell during 2006 generated an additional 14.8 million gallons of flow through the collection system. This indicates that approximately 830,000 gallons of additional flow through the treatment plant were generated by each inch of rain that fell. This rate of inflow would be produced by runoff entering the collection system from a 30-acre drainage area. This is a small fraction of the area covered by the collection system and indicates how difficult it will be to locate and repair the existing sources of inflow.

It is also noteworthy that a number of inflow events were associated with rainstorms that occurred during the '*dry season*.' This is evident from the rainfall and associated elevated flow measurements that occurred throughout April, and on a single day in May. Rainfall events during the dry season alone added more than 4.5 MG in plant flow. Rainfall event (E4) was particularly unusual because of its intensity and because it occurred well into the dry season. Because of its unexpected nature, hydraulics within the plant were not initially prepared for the highest flow of the year (Table 2.4). The blending valve was opened in response to a high-level alarm in the primary clarifiers. It is unclear whether the slightly elevated BOD concentration measured on the following day was related to the event, but in combination with the increased flow at the time, it resulted in the highest BOD emission reported in 2006.

In addition to episodic inflow of rainwater into the collection system, rains also increase infiltration of groundwater into the system. In contrast to inflow events, infiltration extends beyond the duration of the rainfall event. Winter rainfall recharges the aquifers and raises the water table above the shallower sections of the collection system. As a result, groundwater infiltration increases. As the rains dissipate

through the dry season, the contribution of groundwater infiltration declines as the water table drops. At the same time, the contribution of sewage-derived wastewater increases due to seasonal increases in tourist populations. As shown by the solid black line in Figure 2.5, these offsetting contributions to plant flow maintained a relatively constant 30-day running-mean flow from May through July. In August and September, declining contributions from both the tourist population and infiltration resulted in a steady decline in average flow. These declines ultimately led to a minimum in 2006 flow rate measured at the beginning of December. The long-term decrease in flow averages during 2006 indicates that groundwater infiltration contributed at least 0.107 MGD (9.0%) to the plant throughput.

Population-Related Flow Events

The economy of MBCSD is heavily influenced by tourism, as is the flow of sewage-derived wastewater through the treatment plant. The presence of over 50 restaurants in the small community of Morro Bay bears testimony to the importance of tourism. Its influence is apparent in the population fluctuations of Morro Bay and Cayucos, where population increases coincide with both holidays and weekends. These population fluctuations are reflected in the wastewater output from the treatment plant. The increases in flow resulting from weekend visitors and permanent residents that remain home on the weekends are evident in the daily flow measurements shown by the dashed line of Figure 2.5. They appear as regular weekly oscillations with amplitudes of approximately 0.083 MGD that occur throughout the flow record. Averaged over the year, these population increases on weekends added approximately 0.081 MGD (6.8%) to the annual average flow rate.

Superimposed on these weekly oscillations are larger, episodic population increases that coincide with major holidays. Of particular note were the population-related Events E1 (New Year's), E5 (Independence Day), and E6 (Labor Day) (Table 2.4 and Figure 2.5). In 2006, the population increase during the New-Year Holiday (Event E1) coincided with a major rainfall event. As a result, the precise proportion of the short-term flow increase that was solely due to the population fluctuation was difficult to determine in the combined event. Nevertheless, historical rates of population-related flow increases during that same holiday provided a sound basis for apportioning plant flow in that event. On most major holidays, population increases added approximately 0.2 MGD to the flow rate over the span of the holiday. However, when averaged over the entire year, holiday tourism added only approximately 0.019 MGD, or 1.6%, to the annual average flow.

Nevertheless, some of these short-duration population increases stand out as brief increases in the daily flow totals shown in Figure 2.5. For example, increased tourist populations over the Fourth-of-July holiday (Event E5) added approximately 1.5 MG of sewage to the collection system. In Cayucos, where a parade, barbecue, and fireworks display draw large crowds during the Independence-Day holiday, the population increased by approximately 10,000 people. This is more than three times the estimated population of permanent residents. A somewhat smaller volume of wastewater (0.6 MG) was generated by the population increase that coincided with Labor Day weekend (Event E6).

Over longer periods, the influence of increased tourist and resident populations in the summer is reflected by the consistent level of 30-day average flow rates in June and July (solid line in Figure 2.5). Beginning in August, long-term flow averages began to steadily decline through the end of September. Integrated over this time frame, the total contribution of this seasonal tourist population to the annual average flow was approximately 0.061 MGD (Table 2.4). Seasonal tourism generated approximately 5.2% of the influent processed by the treatment plant in 2006.

2.2.2 Suspended Solids, Turbidity, and Settleable Solids

Suspended solids, turbidity, and settleable solids are measures of the particulate load within the wastewater stream. One of the primary functions of the treatment process is to remove organic particulates from the wastestream. The treatment plant's high overall performance during 2006 is reflected by its removal of over 93% of the total suspended solids (TSS) (Table 2.3 on Page 2-21). This is far better than is required by the NPDES permit, which necessitates removal of only 75% of the suspended solids on a monthly basis.

Accordingly, the average annual TSS concentration of only 21 mg/L was well below the monthly permit limit of 70 mg/L. Benchmark monthly removal rates in all months exceeded 85%, which is the limit established for full secondary treatment. Figure 2.7d shows that the running 30-day average TSS concentra-

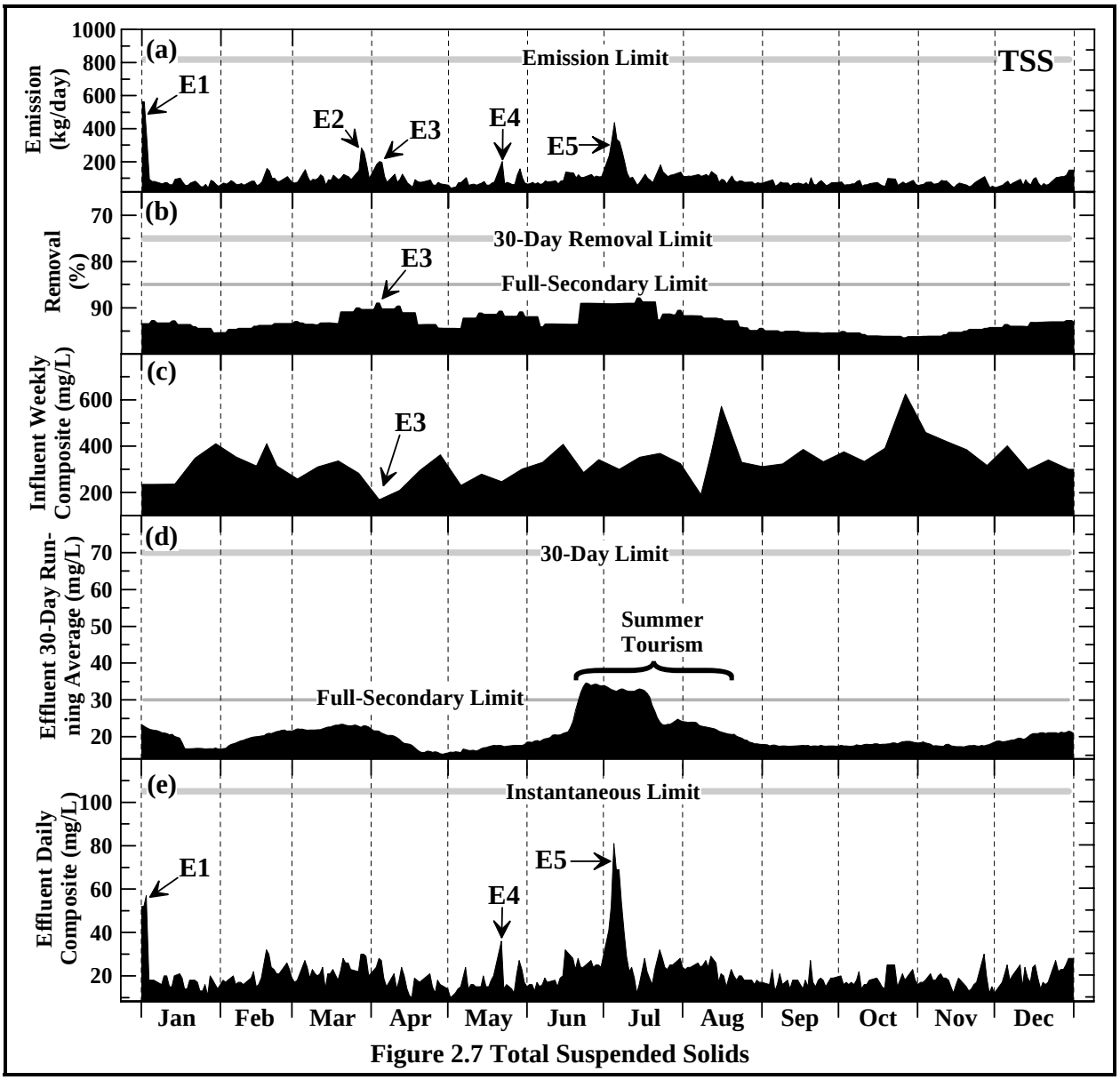


Figure 2.7 Total Suspended Solids

tion was also at or below the full-secondary standard during a great majority of the year. Although slight, the only time the monthly running mean extended above 30 mg/L was during the summer tourist season. Overall, the monthly TSS data demonstrate that the treatment plant routinely performs at levels that exceed secondary treatment requirements for both TSS removal rates, and TSS effluent concentrations.

The light sediment loads in discharged wastewater are reflected in the diffuse particulate cloud that is apparent in photograph of the diffuser shown in Figure 2.2 on Page 2-6. Over the entire year, approximately 34 metric tons of suspended solids were discharged to the ocean. This mass emission represented only 17% of the 199 metric tons that would be discharged with a permit-specified TSS concentration of 70 mg/L and the allowed average dry-weather flow rate of 2.06 MGD.

High removal rates are often difficult to achieve when TSS loads within influent are already low. Regulators recognize that high removal rates are unnecessary when effluent has already achieved low TSS concentrations. Consequently, the NPDES discharge permit imposes the 75% monthly removal rate only when effluent TSS concentrations exceed 60 mg/L (RWQCB-USEPA 1998a, SWRCB 1997). However, monthly effluent TSS levels for the MBCSD WWTP were well below 60 mg/L throughout 2006 (Table 2.3, Figure 2.7d). Thus, although the plant was not subject to the 75% monthly removal rate during any month of 2006, it consistently met this removal criterion.

At least in part, lower influent TSS results from rainwater inflow and groundwater infiltration. Rainwater is relatively devoid of organic particulates, yet the plant still achieved high TSS removal rates even during major rainstorms. For example, the TSS removal rate (83%) measured on April 4th far exceeded both the 75% minimum removal benchmark, and the 30% minimum required for primary treatment (USGPO 1997a). This particular removal-rate measurement was accomplished despite the comparatively low influent TSS concentration (169 mg/L in Figure 2.7c) associated with flow Events E2 and E3, which combined to deposit almost 4 inches of rain over the region.

Over shorter periods, the influence of rainwater inflow events are readily apparent in the record of daily TSS emissions (Figure 2.7a). Events E1 through E4 all coincided with major rainfall events, which resulted in marked temporary increases in plant flow (Figure 2.5, Table 2.4). Because emissions are a function of flow rate, elevated TSS emissions are associated with Events E2 and E3 (Figure 2.7a) even though effluent TSS concentrations were not particularly noteworthy during those events (Figure 2.7e). This is largely true of the brief, but major rainstorm in May, when effluent TSS concentrations were only marginally elevated despite the highest flow of the year (Event E4 in Figure 2.7a and e).

In contrast to rainwater inflow events, increased TSS emissions associated with population increases in Events E1 and E5 (Figure 2.7a) arose because of comparatively high effluent TSS concentrations (Figure 2.7e) in addition to high flow rates. For example, the population increase during the Independence Day holiday (Event E5) coincided with the three highest recorded TSS concentrations within effluent (Figure 2.7e, Table 2.4), which resulted in the markedly increased emissions (Figure 2.7a). Furthermore, the tourist-derived increase in flow associated with Event E5 was modest compared to flow increases during the rainfall events (Figure 2.5). Increased population during holidays generates a higher volume of organic particulates that tax the treatment process more than inert natural sediments suspended within rainwater runoff. However, the record of influent TSS concentrations (Figure 2.7d) during the two major population events does not reflect the increased particulate loading because collection of the weekly influent samples did not happen to coincide with the holiday. Over long periods, the influence of increased organic loading from the summer tourist populations is particularly apparent in the 30-day running mean concentration

(Figure 2.7d) during the months of June through August. Again, however, this increase in long-term loading had little effect on the plant's ability to remove solids from the process stream (Figure 2.7b)

The effectiveness of the treatment plant's screening, grit removal, sedimentation, filtration, and clarifying processes was also reflected by the record of consistently low effluent turbidity shown in Figure 2.8, and in the absence of detectable settleable solids within the effluent (Table 2.3). None of the 365 effluent samples contained a detectable amount of settleable solids despite the low detection limit of 0.1 mg/L. Figure 2.8 shows that the individual turbidity measurements, as well as their averages, were all well below their respective permit limits. There were only two isolated instances when turbidity measurements were above the norm (Figure 2.8c). One event (E1), in addition to coinciding with a population increase over the New Year holiday, was directly associated with a substantial rainwater inflow event. The remaining anomalous turbidity measurement (E5) was related to the population increase on Independence Day.

The two highest recorded turbidity measurements (75 NTU on 7 July and 70 NTU on 4 July) occurred in conjunction with the population increase over Independence Day holiday (Event E5), while the fourth highest measurement (68 NTU on 2 January) occurred over the New Year holiday (Event E1), and coincided with a heavy rainfall event. Nevertheless, these turbidity measurements were still only one third of

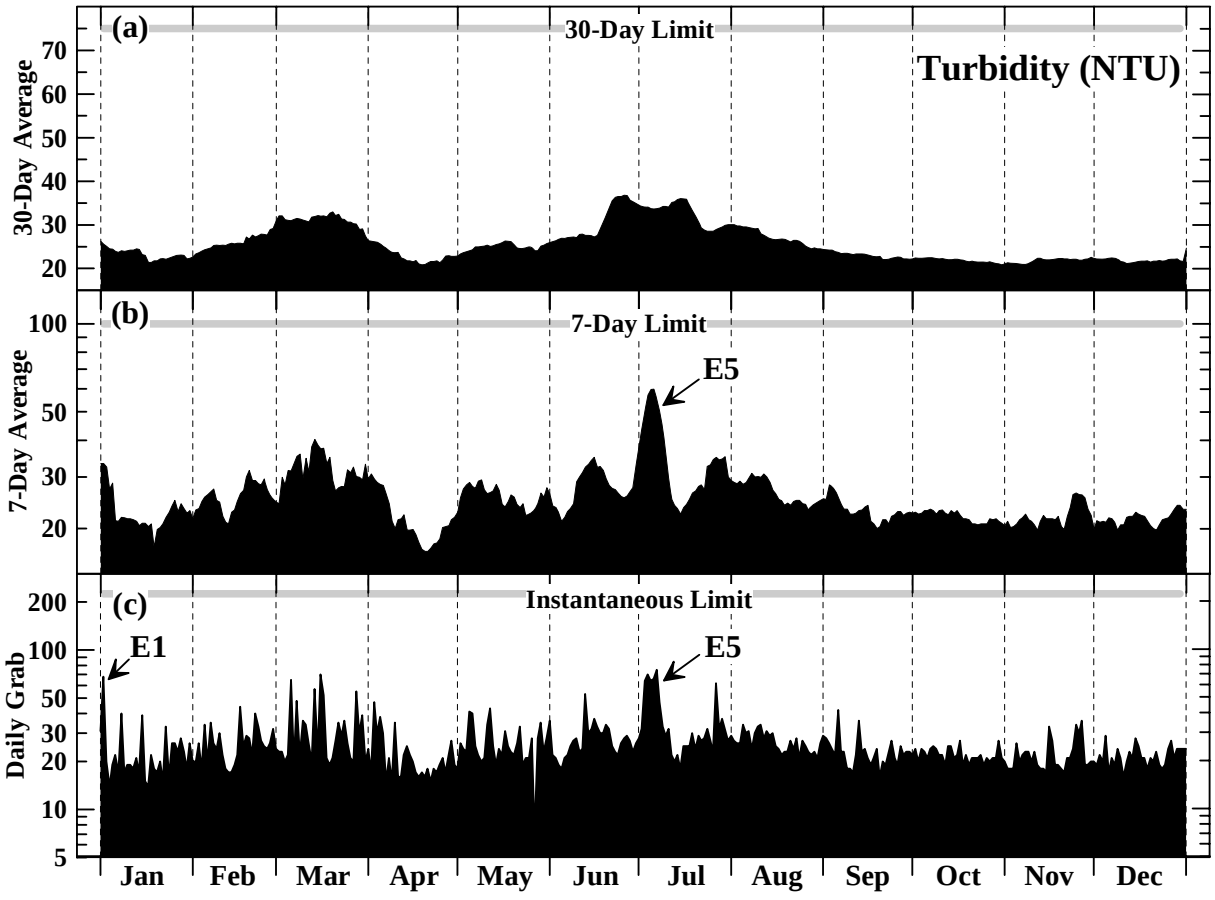


Figure 2.8 Effluent Turbidity

the instantaneous permitted limit of 225 NTU. Additionally, because these events were of comparatively short duration, both the seven-day and 30-day average concentrations remained well below their respective permit limits.

2.2.3 Biochemical Oxygen Demand

Biochemical oxygen demand (BOD) measures the level of organic loading within the wastewater stream. Organic loading is indirectly determined from the amount of oxygen required for aerobic bacteria to decompose organic matter in a sample of wastewater. Organic material, which supports bacterial degradation and demands oxygen, can lead to harmful environmental effects if the process of organic decomposition severly depleats the dissolved oxygen within receiving waters.

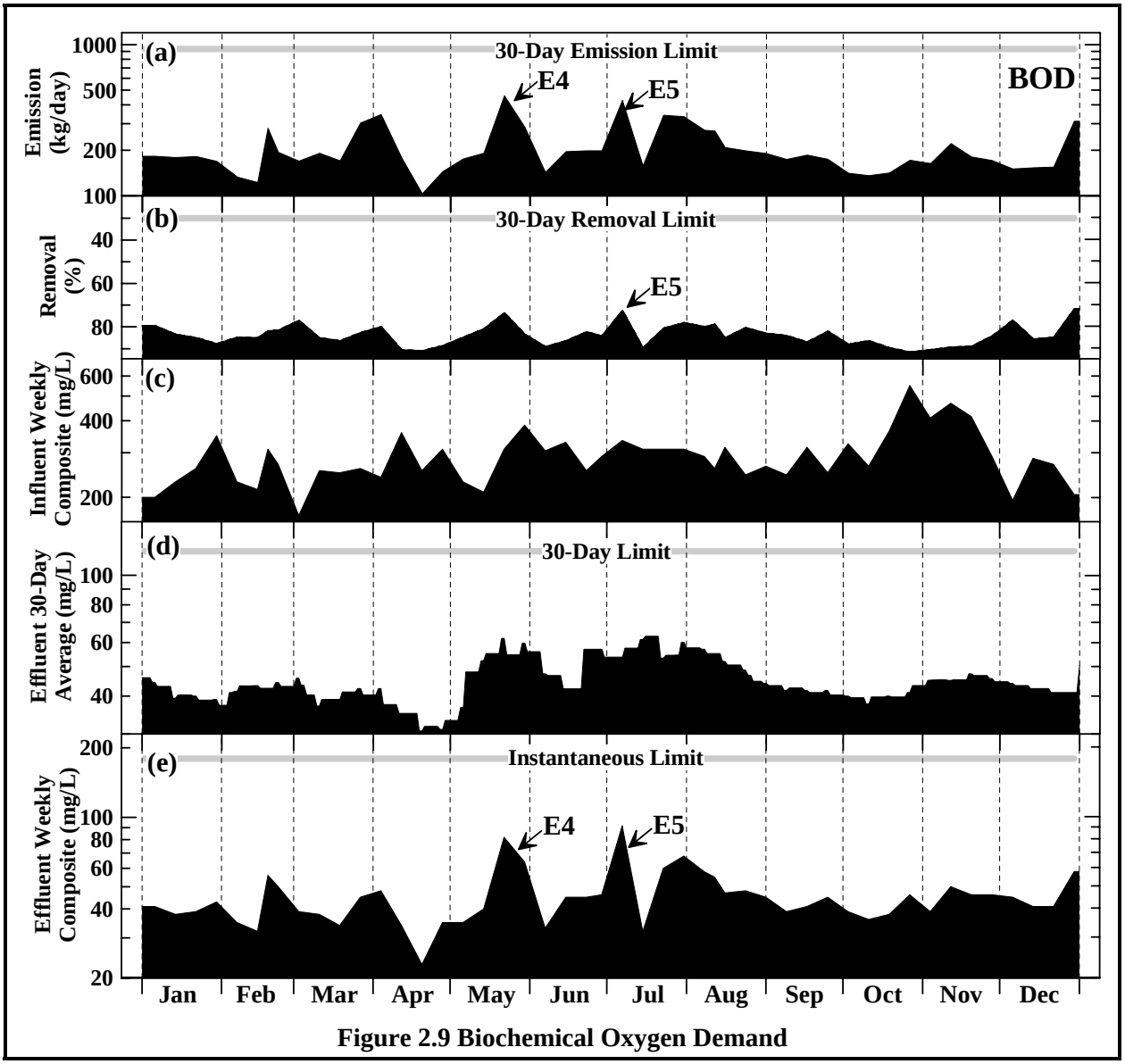


Figure 2.9 Biochemical Oxygen Demand

During 2006, the treatment process reduced influent organics by an average of almost 84%, as determined from the weekly composite samples analyzed for BOD (Table 2.3 on Page 2-21). This was more than twice the minimum monthly limit in the NPDES discharge permit, which requires removal of at least 30% of the BOD material. Even the lowest instantaneous removal rates of 72% (Event E5 in Table 2.4 on Page 2-22) was more than double the 30% minimum required for primary treatment (USGPO 1997a). Because of the high removal rates, total mass emission of oxygen-demanding organic matter during 2006 (75 MT) was less than a fourth of the annual discharge limit of 342 MT.

At no time during 2006 did measured BOD concentrations in the effluent exceed the 30-day limit of 120 mg/L (Figure 2.9d), much less the permitted instantaneous maximum of 180 mg/L (Figure 2.9e). Although fluctuations in effluent BOD concentration occurred throughout the year, only two of the excursions were noteworthy. As shown in Figure 2.9e, they coincided with Events E4 and E5. Increased organic loading from the tourist population over the Independence Day holiday (Event E5) resulted in the highest effluent BOD (92 mg/L), 2nd lowest BOD removal rate (Figure 2.9b) and the second highest BOD emission of 2006 (Figure 2.9a). Similarly, the heavy rainfall event in May (Event E4) which deposited 2.6 inches in 24 hours, resulted in the second highest measured effluent BOD (82 mg/L in Figure 2.9e) and highest recorded mass emission of BOD (Figure 2.9a). It is unclear exactly why an elevated BOD concentration coincided with this particular high flow event. However, it may have had something to do with plant hydraulics and the opening of the blending valve to accommodate the high plant flow.

2.2.4 pH

The permit requires that the hydrogen-ion concentration (pH) of the effluent remain within a range of 6 to 9 pH units at all times. Section 301(h) of the Clean Water Act allows an NPDES discharge permit to be issued that exceeds these pH limitations. However, the discharge permit issued to the MBCSD does not allow such an exception because the plant's partial secondary treatment can routinely treat wastewater to the pH standards that apply to full secondary treatment. Moreover, the general absence of heavy industrial input into the collection system results in an influent stream with nominal pH that already meets the discharge requirements without treatment.

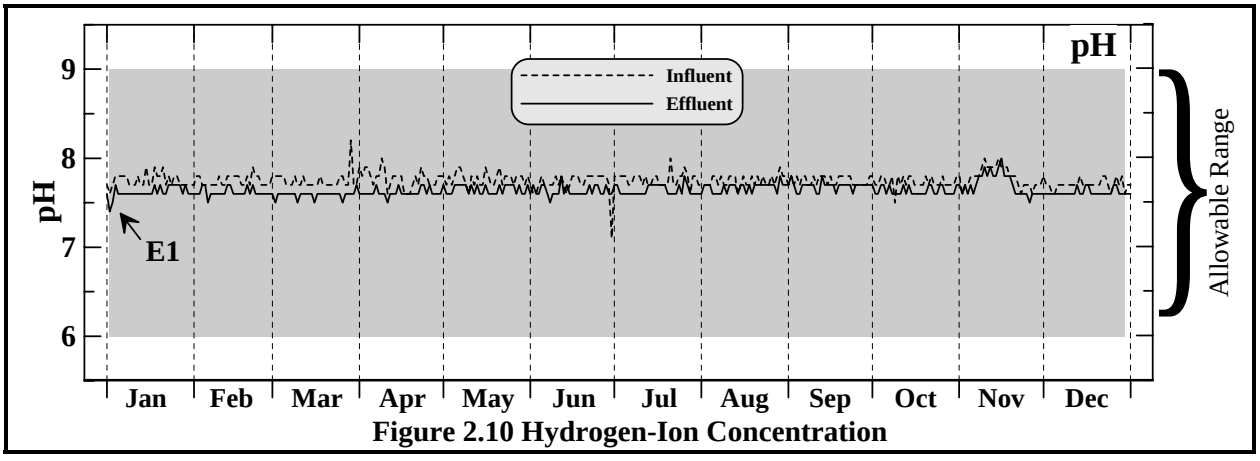


Figure 2.10 Hydrogen-Ion Concentration

Because influent pH already met the discharge criteria (dashed line in Figure 2.10), effluent pH measurements also remained within the allowable range throughout 2006 (solid line in Figure 2.10). The treatment process moderated the amplitude of some of the short-term fluctuations that occurred in the influent

pH, such as the slightly elevated influent pH (8.2 during Event E2) and the low influent pH (7.1) that was recorded on 30 June, immediately prior to Event E5. While the cause of these isolated influent pH excursions is unknown, they were successfully buffered by the treatment process. On average, the treatment process reduced influent pH by 0.1 pH units, in addition the influent coefficient of variation (CV) of 1.1% was reduced to 0.9% by the treatment process. Thus, the effluent was slightly less alkaline and more stable than the influent. It was closer to the neutral hydrogen-ion concentration of pure water.

The only noteworthy effluent pH measurements are the slightly reduced effluent pH (7.4) recorded on January 2nd in conjunction with Event E1, and the slight month-long increase in influent and effluent pH seen in November. As with the other unusual readings associated with Event E1, the slightly more acidic conditions within the process stream at that time were probably related to the extended period of rainfall, and the associated increased plant throughput. Also, although small in amplitude (an average increase of 0.07 pH units), the cause of the increase noted in November remains a mystery. It has only recently been noticed as a consistent feature in most of the pH records since 2002, when a corresponding improvement in pH recording accuracy also took place.

2.2.5 Oil and Grease

During 2006, the treatment process reduced average O&G concentrations within the influent stream by a factor of 10 (Table 2.3). The resulting effluent concentrations remained low, only exceeding 10 mg/L on two occasions over the course of the 52 weekly measurements (Figure 2.11c). The samples collected on March 28th (Event E2) and April 4th (Event E3) had respective O&G concentrations of 13.2 mg/L and 10.6 mg/L. While these three measurements were perceptibly higher than other measurements (<8.2),

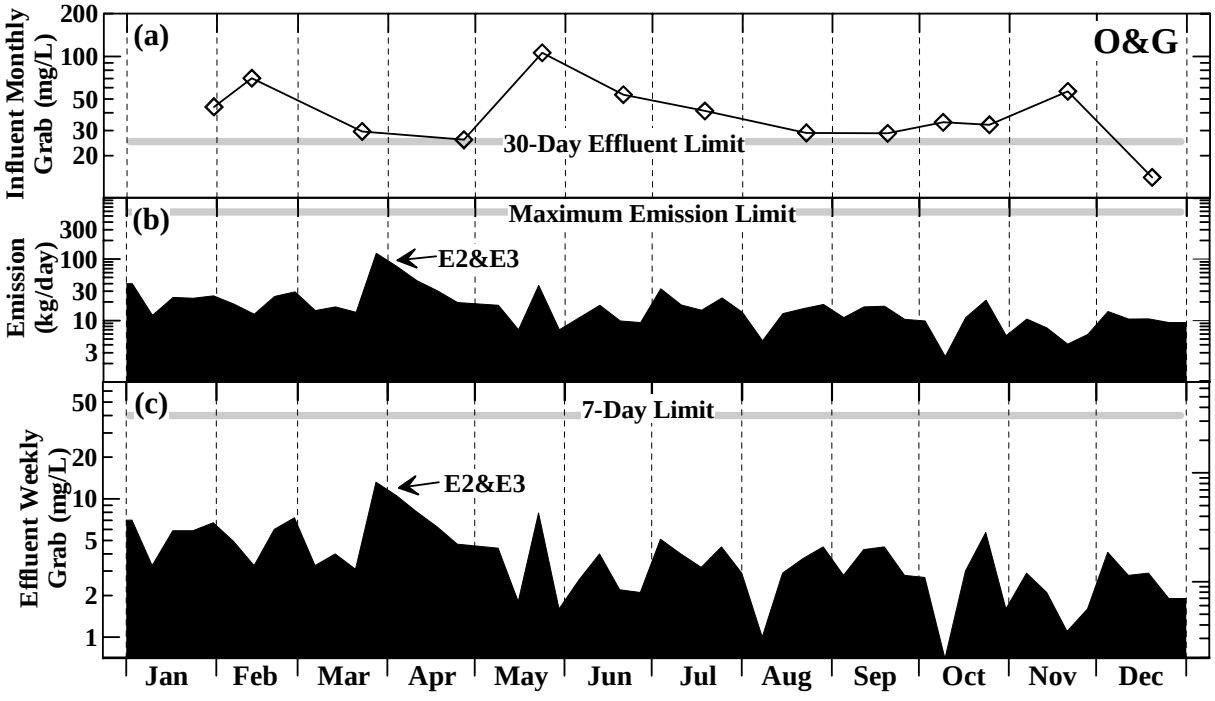


Figure 2.11 Oil and Grease

both concentrations were still more than five times lower than the instantaneous permit limit of 75 mg/L. It is not immediately evident why the effluent O&G was abnormally high in the these rainfall events, but they coincided with holiday periods that included an extended spring-break period when various school systems were in recess in the weeks leading up to a relatively late Easter Sunday on the 14th of April.

In any regard, all of the measurements were well below the instantaneous limit of 75 mg/L, and despite the high flow rates caused by rainwater inflow during these events, the associated emissions of 124 kg/day (E2) and 76 kg/day (E3) were only a fraction of the permitted maximum emission of 585 kg/day (Figure 2.11b). The influent O&G concentrations are even more diagnostic of O&G compliance. Figure 2.11a shows that the monthly measurement of influent O&G concentration was close to the 30-day effluent limiting concentration of 25 mg/L in nearly half of the samples. Thus, the influent often contained low O&G concentrations that were already close to the permitted O&G discharge concentrations without any treatment whatsoever. This was certainly the case for the sample collected in December, which contained an O&G concentration of only 14 mg/L, far below any of the limits promulgated in the permit.

2.2.6 Temperature

Although there are no limits imposed on effluent temperature, it is an important physical property to document (Figure 2.12). The greater the difference between effluent (top line) and ocean temperature (lower line), the greater the initial dilution of the wastewater plume upon discharge. Effluent temperature exhibits a distinct semi-annual cycle with increasing temperatures beginning in April, peaking in July, and declining in November and December. Because of the influence of upwelling, the increase in receiving seawater temperature lagged behind effluent temperature and only began increasing in June. This resulted in maximum thermal differences in May and June, which enhanced the buoyancy induced dispersion of the plume.

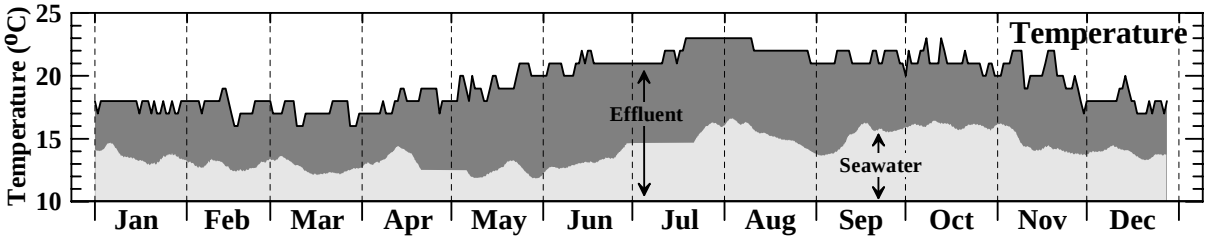


Figure 2.12 Effluent and Receiving-Water Temperature

2.2.7 Ammonia

The concentration of ammonia as nitrogen (NH_3-N) was uniformly low throughout 2006. Grab samples that were analyzed for ammonia on a monthly basis had concentrations that were at or below 35 mg/L (Figure 2.13). Peak concentrations were 23 times lower than the permitted instantaneous limit of 804 mg/L imposed for the protection of marine aquatic life, and less than half of the 6-month median limit of 80.4 mg/L. No noteworthy ammonia measurements were recorded in 2006.

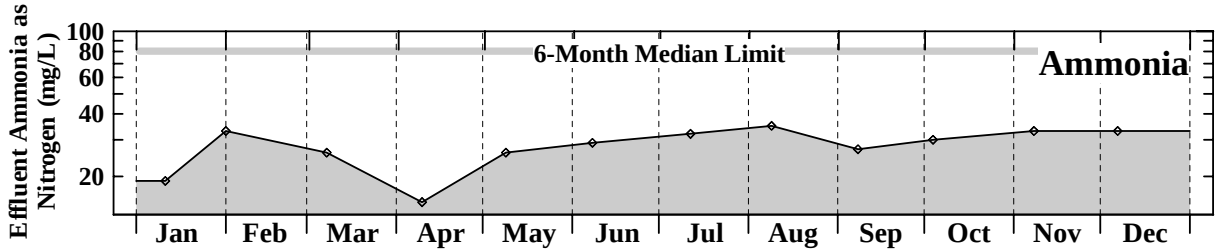


Figure 2.13 Effluent Ammonia

2.2.8 Residual Chlorine

Total residual chlorine (TRC) is a measure of the chlorine remaining in the effluent following disinfection with sodium hypochlorite and subsequent dechlorination or buffering with sodium bisulfite. Daily grab samples for chlorine residual were collected at times when concentrations of effluent constituents are expected to be at their highest levels, namely, during peak flow. Balancing chlorination and dechlorination to obtain adequate disinfection (coliform reduction) without dosing the marine environment with high levels of chlorine can be challenging. The chlorine demand is constantly changing due to continuous variations in flow rates and organic loading within the wastestream. Consequently, the disinfection process occasionally requires direct operator intervention. If too much sodium hypochlorite is added, beyond what is needed to meet the coliform demand, then dechlorination may be made difficult and TRC levels in the effluent may increase.

Throughout 2006, treatment plant personnel maintained careful control over the disinfection and dechlorination processes. Only 5%, or 17, of the 365 grab samples had detectable concentrations of effluent TRC. Consequently, the running 6-month median TRC never exceeded the 0.05-mg/L detection limit. This detection limit is five-times lower than the 6-month median limit of 0.27 mg/L specified in the discharge permit. Additionally, on no occasion during 2006 did measured TRC concentrations exceed the permitted maximum daily limit of 1.07 mg/L, which was established to protect marine aquatic life (Figure 2.14). No noteworthy TRC measurements were recorded in 2006, which differs from prior years. The disinfection process relies on complex interactions between automated measuring devices and dosing apparatuses. In the past, both often required adjustment, repair, and maintenance. Over the years, plant personnel have redesigned and improved the dosing systems, installed alarms, and instituted a regular maintenance schedule. It was only through these efforts that the disinfection process was flawless in 2006.

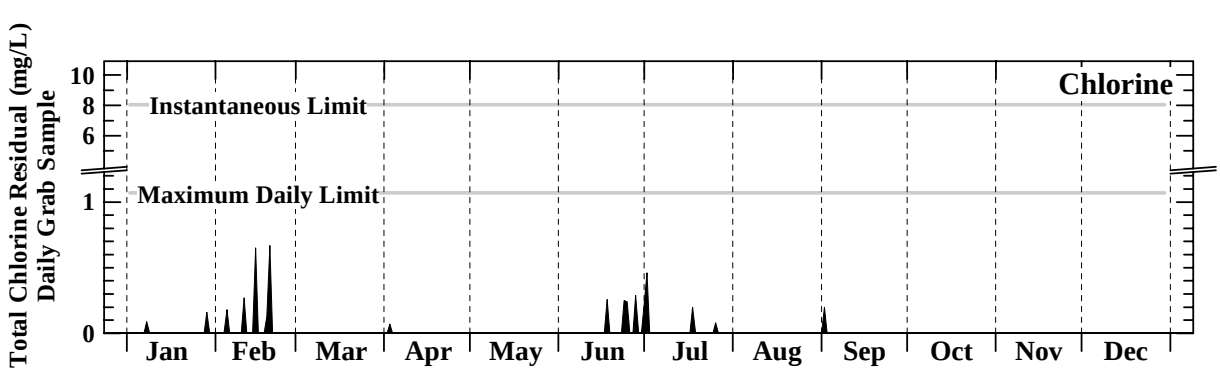


Figure 2.14 Effluent Total Residual Chlorine

2.2.9 Coliform Bacteria

Effluent samples were collected on five consecutive days each week and analyzed for the most probable number of total coliform organisms per 100 ml (MPN/100ml). The monthly median coliform densities computed at the end of each month (Table 2.3) were all less than one fifth of the 30-day median limit of 23 MPN/100ml specified in the NPDES permit. Figure 2.15 shows that measured daily coliform densities were also well below the permitted instantaneous maximum of 2400 MPN/100ml. In fact, more than half of the 282 effluent samples analyzed in 2006 had no measurable coliform. The highest coliform density of 1600 MPN/100ml was measured on July 10th. The second highest coliform was also recorded in July, on the 24th. These and the handful of other samples with detectable coliform densities did not bear any clear relationship to events that affected the treatment process.

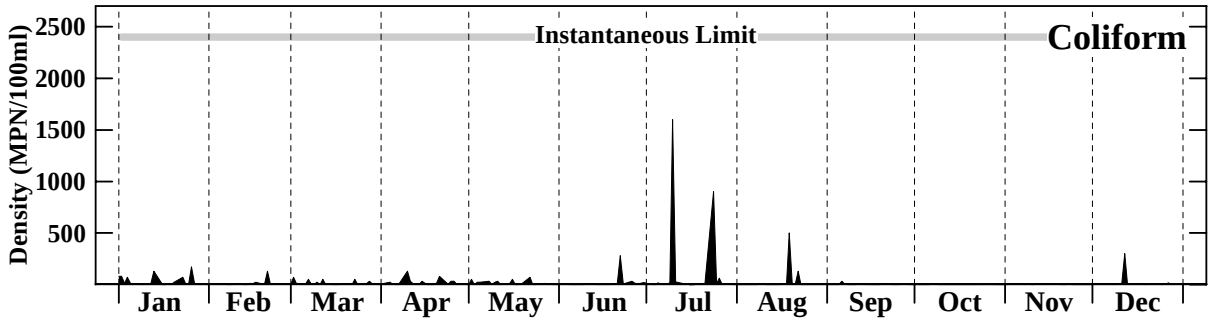


Figure 2.15. Effluent Total Coliform

2.2.10 Effluent Toxicity

Effluent samples were tested quarterly and semi-annually for toxicity using two types of bioassays. Chronic bioassays were conducted on composite effluent samples collected in January and July (Table 2.6), while acute toxicity tests were conducted on effluent grab samples collected in January, April, July, and October (Table 2.7). The chronic bioassay tests found consistently low effluent toxicity, with levels far below limits specified in the discharge permit. Although the acute bioassays also measured toxicity levels that were consistently below permit limits, the tests were confounded by ammonia interference, which artificially elevated the reported results compared to earlier tests that eliminated interference.

Table 2.6 Giant Kelp (*Macrocystis pyrifera*) Chronic Bioassay Analyses

Criteria	Duration	NOEC (%)	TUc	Permit Limit TUc
16 January 2006				
Germination	48 hour	18	5.6	134
Growth	48 hour	18	5.6	134
17 July 2006				
Germination	48 hour	32	3.12	134
Growth	48 hour	32	3.12	134

The chronic toxicity tests conducted in January and July measured spore germination and growth response in giant kelp (*Macrocystis pyrifera*) after exposure to a range of effluent dilutions. The results of bioassays conducted in 2006 are summarized in Table 2.6. They demonstrate the effluent's low chronic toxicity during 2006. Both chronic-toxicity endpoints were more than an order of magnitude lower than the applicable permit limitation of 134 TUc for the daily maximum toxicity. The reported chronic toxic units (TUc) were based on a '*No Observable Effects Concentration*' (NOEC), which is the highest efflu-

Table 2.7 Fathead Minnow (*Pimephales promelas*) Acute Bioassay

Date 2006	LC_{50} (%)	Toxicity Concentration (TUa)[2]	Permit Limitations (TUa)[1] 30-day Average	7-day Average	Instantaneous Maximum
16-19 January	70.7	1.41	1.5	2.0	2.5
10-13 April	70.7	1.41			
17-20 July	70.7	1.41			
2-5 October	70.7	1.41			

[1] Permit limitations for acute toxicity were based on an outdated version of the COP (SWRCB 1997). The current COP (SWRCB 2001) sets the daily TUa limit at 4.29.

[2] Acute toxicity levels were artificially elevated due to unavoidable ammonia interference introduced by a change in bioassay protocol that was required by the RWQCB (2003b)

ent concentration that does not cause an adverse effect statistically different from a control sample. They indicate that the chronic bioassays did not detect adverse effects in marine organisms exposed to effluent concentrations at or below 18%. The permit allows adverse effects in concentrations as low as 0.75%.

The raw test data, pertinent QA/QC data, and chains of custody for the chronic bioassays were provided in the semiannual effluent reports (MRS 2006gh). As part of quality control, chronic bioassays were also conducted using a reference toxic chemical (copper chloride) to determine the sensitivity of these particular sets of giant kelp sporophyll (*M. pyrifera*) to toxins. QC results demonstrated that the kelp specimens were highly susceptible to toxic exposure because they experienced a significant reduction in both germination and growth in concentrations as low as 32 µg/L of the reference toxicant. The concomitant germination and growth NOEC's for the reference toxicant were 18 µg/L, which was comparable to toxic concentrations found in tests from prior years. This suggests that these particular batches of kelp spores were sensitive to toxic materials. Toxic screening studies conducted in 1993 established that giant kelp (*M. pyrifera*) is substantially more sensitive to MBCSD effluent than other species, such as the larvae of the inland silverside (*Menidia beryllina*) and bay mussel (*Mytilus edulis*) (MRS 1994). Nevertheless, chronic bioassays conducted during 2006 demonstrated that giant kelp was only minimally affected by exposure to treatment plant effluent.

Although chronic bioassays are far more sensitive and accurate than acute tests, the current NPDES discharge permit requires acute bioassays in addition to the chronic tests described above. However, in lieu of chronic bioassays, the COP (SWRCB 2001) no longer requires that acute tests be conducted on effluent with a dilution ratio comparable to that of the MBCSD discharge. Moreover, when acute bioassays are conducted, the latest COP promulgates limitations that are much higher than those specified in the current NPDES issued to the MBCSD. For the MBCSD discharge, the new daily TUa limit of 4.29 is almost three times higher than the 30-day average limitation (TUa=1.5) specified in the current NPDES discharge permit.

More importantly, one of the major drawbacks to acute bioassays conducted on wastewater samples is that they are easily confounded by presence of ammonia. Ammonia interference strongly skewed the results of the acute bioassays conducted in 2006 (Table 2.7). The acute bioassays examine the mortality of the Fathead Minnow (*Pimephales promelas*) exposed to various concentrations of effluent. However, it is well known that Fathead Minnows are particularly sensitive to presence of moderate levels of ammonia. Ammonia interference caused the artificially high acute toxicities (TUa>1) that were measured prior to 1995, and in assays conducted since 2003, as discussed in Chapter 5. From 1995 through 2002, reliable

measurements of acute toxicity were achieved by reducing ammonia levels in effluent samples prior to testing through treatment of effluent samples with zeolite ion-exchange resin prior to bioassay testing. However, this practice was discontinued in April 2003 at the request of the RWQCB staff in their comments on the 2002 Annual Monitoring Report for the MBSCD Wastewater Discharge (RWQCB 2003ab).

Because of ammonia interference, the acute bioassays conducted on the January, April, July, and October effluent grab samples in 2006 erroneously indicated that the projected lethal concentration (LC_{50}), at which 50% of the specimens die after a 96-hour exposure period, exceeded 70.7% (Table 2.7). In terms of toxicity units, this yields a TUa of 1.41, which is only slightly below the permit-specified toxicity limit of TUa =1.5. However, as described above, the measured acute toxicity in recent prior years was artificially inflated compared to the more accurate assays conducted from 1995 through 2002. This apparent increase in toxicity is not due to any change in the characteristic toxicity of the effluent itself, but is instead an artifact of changes in the protocols used to assess acute toxicity. The protocols introduced an artificial increase in measured acute toxic concentrations. In contrast, the protocols for chronic bioassays remained the same throughout the monitoring program, as did the measured chronic toxicity.

The mechanism for the recent artificial increase in measured acute toxicity is related to ammonia chemistry in the bioassay test chambers. During the tests, complex chemical changes within the test solutions caused the effluent ammonia to become highly toxic to the test organisms. Similar chemical changes do not occur in effluent upon discharge, so marine organisms are not exposed to the same levels of toxicity that were measured in the 2006 effluent samples.

At the pH of seawater and wastewater, most ammonia is in the relatively benign, ionic ammonium form. As a result, the peak ammonia concentration (35 mg/L) measured in the MBCSD effluent was 20-times lower than the instantaneous limit (804 mg/L) imposed for the protection of marine life (see Section 0 on Page 2-33). However, because the effluent remains static in test chambers during an acute bioassay, complex interactions with the organic constituents in the effluent cause pH to increase. As pH increases, ammonium is converted into a deionized form of ammonia that is highly toxic to the test organisms. In contrast, the pH of marine receiving waters is stabilized by the highly buffered oceanic carbonate system, so discharged effluent never experiences tangible changes in pH. Thus, the ammonia toxicity that is present in acute bioassays is not representative of conditions in marine receiving waters.

Various methods have been developed over the years to reduce the well-recognized artifactual toxicity that results from ammonia deionization in wastewater during bioassay tests. Aeration, addition of acid, and pretreatment of the effluent with zeolite are common practices that have been effective at reducing ammonia interference in tests for decades. In the recent past, ammonia interference in the acute bioassays conducted on MBCSD effluent has been successfully eliminated through the use of zeolite pretreatment. Prior to that, when the Kopperdahl (1976) bioassay protocol was required in the previous NPDES discharge permit, CO_2 and O_2 enrichment were found to mitigate the pH drift.

However, after January 2003, the RWQCB (2003ab) specified the use of a new USEPA test protocol (USEPA 2002) that recommends reduction of artifactual ammonia toxicity solely through the use of renewal methods in which the test chambers are periodically refreshed with new test solutions. The RWQCB staff further directed that there should be no other manipulation of the effluent sample prior to testing. However, implementation of daily static renewal of test solutions is significantly more complex and costly than previous bioassay procedures. More importantly, as is clear from the 2006 bioassay results, daily static renewal falls far short of reducing the significant artifactual toxicity that arises from ammonia deionization.

Because static renewal procedures are only marginally effective in accommodating artifactual toxicity resulting from pH-induced ammonia interference, significant effort was expended attempting to reduce impacts from ammonia during the tests. The new bioassay protocols were implemented using daily deliveries of fresh effluent samples from the MBCSD WWTP. Extra care was taken to remove all headspace in sample containers and to maintain low sample temperature during transit to the bioassay laboratory. As recommended in the protocols, sodium thiosulfate was added to some of the effluent samples to neutralize residual chlorine. Although this reduces chlorine toxicity, sodium thiosulfate itself can introduce an artificial increase in measured toxicity. Finally, care was also taken during renewal to avoid physical impacts to the larval fish specimens. Renewal of the test waters can introduce artifactual toxicity from the thermal and physical stress experienced by test organisms during the exchange process.

Despite these efforts, ammonia interference continued to be significant during the acute bioassays conducted in 2006. Its undue influence was evident from the pH and dissolved-oxygen concentrations measured in the test chambers throughout the assays. Ammonia toxicity that was an artifact of the test procedure resulted in the artificially high acute toxicities reported in Table 2.7. The reported results imply that the effluent acute toxicity during the all four of the 2006 effluent tests was only 0.09 TUa below the permitted limit, or 94% of the permitted toxicity. In reality, the effluent discharge does not result in pH-induced ammonia toxicity, DO depletion, elevated residual chlorine, sodium thiosulfate, or repeated physical stress on marine organisms upon discharge into receiving waters. Consequently, the reported results are not representative of the toxicity that is experienced by marine organisms exposed to MBCSD effluent.

Moreover, the acute toxicity limitation specified in the current NPDES permit is outdated and unreasonably stringent. The measured acute toxicity concentrations, even when elevated by toxic ammonia interference, would easily meet the limits imposed by the current COP. The most recent version of the COP implicitly acknowledges problems associated with ammonia interference, and the inconsistency in acute toxicity limits that are imposed at the point of discharge rather than at the margin of the initial dilution zone.

In lieu of the much more sensitive chronic bioassay, the COP no longer requires acute bioassays of discharges with dilution ratios less than 1000:1. Because the critical initial dilution of the MBCSD discharge is 133:1, MBCSD would not be required to conduct acute bioassays under the new COP. Even if it were, the revised acute toxicity limits in the current COP would establish a daily maximum acute toxicity concentration of 4.3 TUa for the MBCSD discharge. This is nearly three-times higher than the current limit of 1.5 TUa listed in Table 2.7. Under this revised limit, the acute toxicities reported in 2006 (1.41 TUa), despite being artificially inflated due to ammonia interference, would still be well below the new limit. It is incongruous to require the use of new bioassay protocols that were not in place when the NPDES discharge permit was issued to MBCSD without applying improved toxicity limits that are specified in the current COP. In either regard, the actual toxicity of the MBCSD discharge to marine organisms is far lower than is indicated by a comparison of reported and permitted toxicity concentrations in Table 2.7.

2.2.11 Chemical Contaminants

Effluent composite samples were analyzed semiannually in January and July for the presence of 145 chemical contaminants, including trace metals, chlorinated and non-chlorinated phenolic compounds, volatile organic compounds, organochlorine pesticides, PCBs, cyanide, and base-neutral compounds. Chemical analysis of the July sample encompassed an additional 20 compounds, including radionuclides, organophosphorus pesticides, asbestos, and dioxins. Only nine of the total 165 compounds were present

in quantifiable amounts within the effluent samples collected during 2006. The measured concentrations for all nine compounds were well below the permitted limits. Annual mass emissions of these compounds were also within the goals set forth in the reporting provisions of the discharge permit.

Twelve additional compounds were detected in the semiannual effluent samples, but in concentrations that were too low to be reliably quantified. Specifically, the measured concentrations of these compounds were above the Method Detection Limit (MDL) but below the Practical Quantification Limit (PQL). These detected but not quantified concentrations were first reported during analysis of the July 2005 sample; analysis of prior samples only reported quantifiable concentrations above the PQL. Reporting of detected but not quantified concentrations is not required in the current NPDES discharge permit issued to the MBCSD. However, the latest version of the COP (SWRCB 2001) expands the chemistry reporting requirements, and it is likely that subsequent discharge permits issued to the MBCSD will require reporting of detectable concentrations even though they cannot be reliably quantified. In 2006, these detected but non-quantifiable compound included five trace metals, two BTEX compounds, two phthalates, and three halomethanes.

Table C.1 in Appendix C provides a summary of the chemical analyses conducted on effluent samples, along with the corresponding concentration limits specified in the NPDES discharge permit. The laboratory data sheets, pertinent QA/QC data, and chains of custody for the chemical analyses were provided in the semiannual effluent reports (MRS 2006gh). Concentrations for detected compounds are highlighted in bold in the Table. The Table also reports quarterly flow totals, bioassay results, radioactivity measurements, phenolic-compound concentrations determined from grab samples, and ammonia concentrations that were measured on a monthly basis. The compounds with quantifiable concentrations included three trace metals (copper, lead, and zinc), cyanide, radionuclides, benzyl alcohol, two chlorination by-products, and a common phthalate compound (bis 2-ethylhexyl phthalate). Two other common chemical constituents, ammonia and chlorine, were also present in effluent samples, as discussed in Sections 0 and 2.2.8.

Trace Metals

Five of the thirteen metals were not found in effluent samples despite low quantification levels. In Table 2.8, compounds with concentrations too low to be detected are indicated by the 'less-than' (<) symbol preceding the reported PQL. An additional five metals were detected in the samples, but there concentrations were too low to be reliably quantified. These concentrations are indicated by a 'approximation' (≅) symbol preceding the reported concentration. The three metals whose concentrations were quantified in the 2006 effluent samples have been found in at least a third of the effluent samples collected over the last decade. In all cases, the concentrations measured in

Table 2.8 Effluent Trace-Metal Concentrations

	Concentration (µg/L)			Mass Emission (kg/yr)	
Metal	**Limit[a]**	**January**	**July**	**Goal**	**Measured**
Antimony	160800[b]	≅21[c]	≅11	285	≅26.7
Arsenic	670	≅1.8	≅1.9	17	≅3.0
Beryllium	4.42[b]	<10[d]	<10	28	<16.5
Cadmium	130	<10	<10	88	<16.5
Chromium	270	<10	<10	93	<16.5
Copper	140	**14**	**20**	690	27.8
Lead	270	**2.2**	**2.1**	465	3.6
Mercury	5	≅0.03	<0.2	1.4	<0.18
Nickel	670	<10	≅4.4	142	<12.1
Selenium	2010	≅1.0	≅1.9	65	≅2.4
Silver	70	<10	<10	28	<16.5
Thallium	1880[b]	<1	<1	285	<1.7
Zinc	1620	**61**	**60**	244	99.7

[a] 6-month median unless otherwise indicated [b] 30-Day Average

[c] "≅" indicates the substance was detected above the method detection limit but could not be accurately quantified because it was below the PQL

[d] "<" indicates the substance was not detected. The Practical Quantification Limit (PQL) is listed after the "<" symbol.

2006 were comparable to the average of concentrations measured in the past. Thus, their presence in the 2006 samples is not indicative of a new contaminant source within the collection system.

Unlike synthetic organic compounds, trace metals occur naturally within the mineralogy of sediments along the central California coast. Six of the metals listed in Table 2.8 are present in measurable concentrations in seafloor sediments, as described in the benthic chemistry section of this report (see Table 4.6 in Section 4.2.1). These include the three metals quantified in effluent samples. Thus, the presence of detectable concentrations of these metals within effluent samples is not unexpected based on inflow of naturally occurring sediments into the collection system from runoff. However, copper, lead, and zinc can also enter the collection system through internal corrosion of household plumbing systems.

Regardless of their source, the quantifiable concentrations of the three metals were well below the limitations specified in the NPDES discharge permit. Estimated mass emissions for these trace metals were also well below their respective emission goals. Detectable concentrations of copper have been found in over 80% of the effluent samples collected over the last decade. The presence of detectable concentrations of lead and zinc in the 2006 samples is only somewhat more unusual, with historical occurrence frequencies of 45% and 35%, respectively. However, recent alterations in the analytical methods for metals have resulted in a lower PQL for lead (1 mg/L) compared to that of historical analyses (50 mg/L). Therefore, the detection of lead in both effluent samples in 2006 may be an artifact of this reduction in the detection limit, rather than any increase in concentration or frequency of occurrence. Lead may have always been present in effluent samples at concentrations comparable to the 2 mg/L reported in 2006, but the analytical method was unable to reliably quantify them until now.

Synthetic Contaminants

Table 2.9 summarizes the remaining pertinent analytical results for tests performed on the two effluent samples collected in 2006. As with the trace metals, the measured concentrations for these constituents were below applicable NPDES discharge limits; in most cases, they were several orders of magnitude lower. Nevertheless, all of these compounds have been occasionally detected in effluent and biosolids samples collected in prior years, and some discussion of potential sources is warranted. Each detected chemical is discussed below.

Bis 2-Ethylhexyl Phthalate (BEHP)

This common phthalate compound has been detected in more than 80% of the effluent samples collected over the last decade, and was present in both the January and July effluent samples collected during 2006. Phthalate esters, such as BEHP, are components of synthetic dyes, resins, plasticizers, insecticides, and, pharmaceuticals. Nearly 2.7 million metric tons (6 billion pounds) of phthalate esters are produced each year, of which more than half is BEHP. BEHP is a physical plasticizer that is added to plastic resins to soften them, providing increased flexibility. It is not, however, covalently bound to the resin, which allows it to slowly leach out of the plastic and into the environment over time through evaporation or dissolution. Because of their mobility, high vapor pressure, and the massive scale at which they are produced, phthalate esters in general and BEHP in particular, have become pervasive in the environment. However, although this phthalate compound can negatively affect human health, concentrations would have to be 20-times higher than those measured in July 2006 to be of a human-health concern.

Table 2.9 Quantifiable Concentrations of Other Constituents within Effluent Samples

	Concentration[a] (µg/L)			Mass Emission (kg/yr)	
Constituent	**Limit[b]**	**January**	**July**	**Goal**	**Measured**
Benzyl alcohol	—[c]	**2.3**	<20[d]	—[e]	<17.7
Bis 2-ethylhexyl phthalate	470	**16**	≅22[f]	320	≅31.1
Chloroform	17400[g]	**1.2**	**0.83**	5	1.7
Chloromethane	17400	**≅0.26**	**0.85**	25	≅0.89
Cyanide	130	<20	**30**	57	<40.8
Radioactivity - α (pCi/L)	15.0[h]	—[i]	**0.26±0.55**	—	—
Radioactivity - β (pCi/L)	50.0[h]	—[i]	**17.4±4.01**	—	—

[a] 24-Hour Composite Sample [b] 30-Day Average [c] No limit specified
[d] "<" indicates the substance was not detected. The Practical Quantification Limit (PQL) is listed after the "<" symbol.
[e] Goal not specified
[f] "≅" indicates the substance was detected above the method detection limit but could not be accurately quantified because it was below the PQL
[g] Limit on halomethanes [h] Drinking water limit [i] Testing not required

Halomethanes (Chloroform and Chloromethane)

Chloroform and chloromethane are part of a group of compounds known as halomethanes. These compounds are common by-products of wastewater and drinking water chlorination, and form during the disinfection process when organic substances are present. Chloroform has been occasionally detected in quantifiable concentrations in effluent samples collected in prior years. However, at the low reported concentrations, it is not clear whether their presence is the result of wastewater disinfection within the treatment plant, or is the result of drinking-water chlorination. Although these compounds can negatively affect human health, the concentrations detected in July 2006 were several orders of magnitude below the permitted limit.

Cyanide

Cyanide was detected in the July effluent sample at concentrations only marginally exceeding its PQL of 20 µg/L. The measured concentration was almost 4-times lower than the permit limitation and therefore, not of ecological concern. Although cyanide is detected in less than half of the effluent samples, it is commonly found in low concentrations in biosolids. Although there are many natural sources of cyanide, it is frequently used in pigments and can be introduced into the collection system during photo processing and newspaper printing. Cyanide is also a component in many insecticides.

Additionally, however, cyanide derivatives may form in effluent as byproducts of the chlorination process used for disinfection of the effluent. Until recently, much of the chemistry surrounding the formation and degradation of cyanide in treatment plant processes was largely unknown. However, recently the Water Environment Research Foundation (WERF 2003) confirmed that most (if not all) treatment plants produce cyanide in their treatment process. Although cyanide formation patterns varied significantly among treatment plants, the chlorination of naturally occurring thiocyanate seemed to be the most important mechanism for the formation of free cyanide in wastewater treatment processes. Regardless, at the 2006 flow rate, the mass emission of cyanide remained well below the stringent mass-loading goal of 57 kg/yr identified in the NPDES permit.

Benzyl Alcohol

The presence of measurable concentrations of benzyl alcohol in the effluent sample is somewhat unusual in that it has been detected in effluent samples on only one other occasion. In 1997, it was measured in an effluent sample at a comparable concentration of 2.2 µg/L. Both detections were only slightly above the PQL of 2.0 µg/L. Alcohols are widely used as solvents, fuels and chemical raw materials. Benzyl alcohol is also used in making soap, perfume, and flavors, and as an antipruritic to relieve itching. Most commonly, however, this compound is used as a dyeing assistant for filament nylons, such as nylon carpeting. Benzyl alcohol enters the environment through fugitive emissions during its production, and during its formulation and use in commercial products, and from the exhaust of motor vehicles. When released to water, this compound is undergoes rapid microbial degradation, and is not expected to bioaccumulate in fish and aquatic organisms. Consequently, it does not have a limiting concentration in the discharge permit.

Radioactivity

A small amount of radionuclides have always been present in effluent samples. Their presence in the 2006 effluent samples is reflected in the alpha (α) and beta (β) radioactivity levels reported in most samples of sediments in Table 2.9. The presence of radionuclides within effluent samples is not unusual given that they occur naturally in the mineralogy of the region. Nevertheless, the levels of gross alpha (α) and beta (β) radioactivity in the July effluent sample were well below drinking water standards. The maximum contaminant levels, pursuant to the California Code of Regulations, Title 22, §64441 and §64443 (Barclay 1997), are 15 pico-Curies per liter (pCi/L) for gross alpha particle activity, including radium-226 but excluding radon and uranium, and 50 pCi/L for gross beta particle activity. Alpha particle activity arises from natural mineral deposits that enter the collection system through erosion. Beta particle activity arises from radioactive decay in both natural and synthetic materials.

2.2.12 Mass Loading

The NPDES Monitoring and Reporting Program identifies goals for limiting the mass emission of contaminants from the MBCSD treatment plant (RWQCB-USEPA 1998b). In contrast to the concentration limits specified in the NPDES permit, the mass-emission goals are not part of the waste discharge requirements. Nevertheless, the MBCSD is required to report mass-emission rates for all effluent constituents that have goals listed in the permit. As required, emission rates for 2006, along with the flow rates used in the computations, are provided in Table C.1 of Appendix C.

However, direct comparisons between the goals and reported emissions can be misleading because of how the emission goals were established. As is apparent from the discussion in the previous section, very few chemical compounds have concentrations high enough to be detected in MBCSD effluent. Consequently, most of the mass-emission goals were established using historical PQLs, or, for those chemicals whose PQLs exceeded the permitted limit, the goal was computed using the permit limit. Consequently, most emission goals are reflective of the capabilities of historical chemical analyses, rather than their potential for environmental impact. For most compounds, almost any measurement of a quantifiable concentration would automatically exceed the emission goal, even if the measured concentration remained well below the maximum allowed concentration listed in the Discharge Requirements. Although this has been the case in prior years, no such instance occurred during 2006.

Different computational methods were used to establish the emission goals, depending on whether the constituent had a quantifiable concentration in samples collected between 1994 and 1998. Only six of the 78 compounds listed in the Waste Discharge Requirements had detectable concentrations in effluent samples collected during that period. Their computed mass emissions have the greatest credibility because they were computed from actual measurements, namely, the 99th percentile of their historical concentrations, and a design flow of 2.06 MGD. These compounds are denoted by footnote '13' in the emission-goals listed in the Monitoring and Reporting Program (RWQCB-USEPA 1998b). However, these emission goals are based on past effluent concentrations, rather than on potential impacts to the environment. Such impacts are more-accurately reflected by the much-higher concentrations listed in the NPDES discharge permit. Nevertheless, for these six compounds, a mass loading that exceeds its goal has been deemed '*indicative of statistically significant increases in loading and will trigger the need for antidegradation analysis in the following permit cycle*' (RWQCB-USEPA 1998b). The six compounds are arsenic, copper, zinc, chloroform, halomethanes, and tetrachloroethene. During 2006, none of these compounds exceeded its emission goal (see Table C.1 in Appendix C of this report)

The mass-emission goals for the remaining compounds with historical concentrations that were unquantifiable were established using either the maximum allowed concentration listed in the Waste Discharge Requirements (RWQCB-USEPA 1998a) or the historical PQL, whichever was smaller. Because no actual measured concentrations were used to establish the emission goals for these compounds, comparison with actual mass loading in any given year lends no insight into the statistical significance of deviations from the goals, or into the potential for ecological impacts.

Between 1994 and 1998, 15 of these compounds had PQLs that were greater than the maximum allowed concentration listed in the Discharge Requirements. They are denoted with a footnote '*m*' in Table C.1. For these compounds, the effluent discharge limitation was too low to be measured by standard analytical techniques available at the time the goals were established. As a result, almost any detectable concentration will violate the concentration limits established in the NPDES discharge permit. However, for these compounds, it is inappropriate to compare a mass emission computed from the PQL with a goal computed from the permit limit. Specifically, seven of the 15 compounds had maximum estimated emissions, computed from the PQL, that appear to exceed their goals. They are denoted with footnote '*n*' in Table C.1. However, comparing the projected maximum emission with the goal is misleading because the goals were established using unattainable detection limits. For these seven substances, exceedance of emission goals is indeterminate and their reported maximum emission does not lend insight into treatment-plant performance or the potential for marine impacts. Therefore, as described in the Monitoring and Reporting Program requirements, these seven instances are not subject to the antidegradation analyses described above.

2.3 BIOSOLIDS

The monitoring and reporting requirements of the NPDES permit (RWQCB-USEPA 1998b) stipulate that the biosolids be characterized in accordance with 40 CFR 503 (USGPO 1997b). To that end, this section describes the disposition of biosolids generated by the WWTP during 2006. Part of this discussion also addresses the major constituents within the sludge produced by the plant, because they determine the suitability of biosolids for composting and land application.

Annual biosolids production for 2006 was approximately 210.5 dry metric tons. This annual production was slightly higher than in most previous years because of the preparations for the cleaning and inspection of Digester #3. Approximately half of the 2006 production, 113.2 dry metric tons, was transported to

McCarthy Family Farm's San Joaquin Composting facility on November 22nd and 27th, while an additional 61.3 dry metric tons were composted at the treatment plant. The remaining 35.9 metric tons of biosolids were in storage at the WWTP at the time of this report.

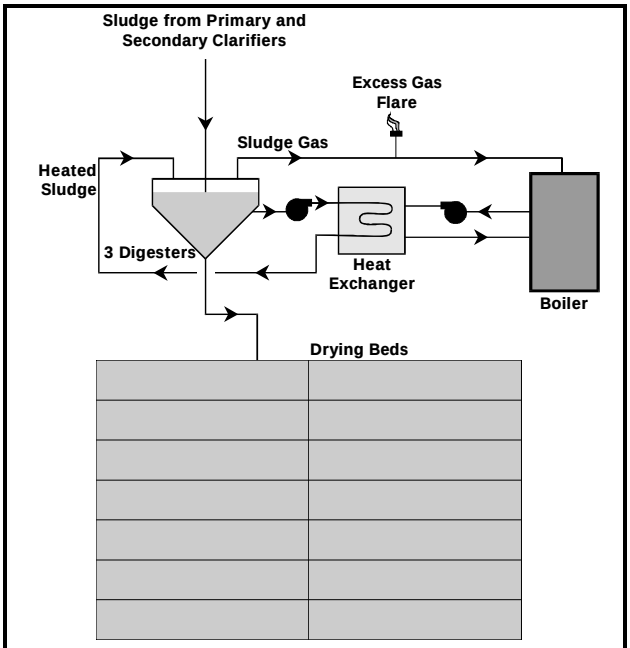


Figure 2.16 Biosolid Process Schematic

Solids removed by the primary clarifiers (Figure 2.3 on Page 2-14) are processed as shown in the schematic of Figure 2.16. Sludge is stabilized using two of the three available digesters. It is heated to 36°C and mixed in a primary digester that is coupled in series with a secondary digester. Solids settle in the secondary digester and the supernate is cycled back through the treatment process. The primary digester's capacity is 192,000 gallons, and the secondary digester's capacity is 166,000 gallons, giving a total capacity of 358,000 gallons (1.36 megaL). The volume of sludge pumped to the primary digester from the clarifiers averages 8,000 gallons per day. Average detention times are 44 days. Digester temperature and flow are recorded daily.

Stabilized sludge is drawn from the secondary digester to one of 12 sludge-drying beds, each with a capacity of 5200 ft^2 (483 m^2). Each of these beds has an under-drain and decanting system that re-circulates runoff through the treatment process. Sludge is applied to the beds up to a depth of 12 to 14 inches (33 cm). Drying times typically range from two to four months depending on the weather conditions. Once dried, the biosolids are removed from the beds and stored in a concrete containment area that also drains rainfall runoff through the treatment system. Biosolids are stored in this area until they are removed from the WWTP for composting and eventual use as a soil amendment. Biosolid storage times are generally less than six months.

The biosolids process is highly effective in removing pathogens. This is reflected in the series of pathogen assays conducted on sludge samples that were collected from three different stages of the process in 2002 (Table 2.10). Concentrations of coliform and salmonella were reduced by orders of magnitude in each step of the process, and eventually reached undetectable levels in the composite biosolids sample collected from the drying beds. It had no detectable densities of coliform, salmonella, enteric viruses, or viable helminth (parasitic-worm) ova. Thus, the biosolids conformed to the microbial standards necessary to achieve a Class-A status. Class-A biosolids are considered safe for direct contact and unrestricted land application.

Table 2.10 Pathogen Levels in Different Stages of the Biosolids Process

Stage	Fecal Coliform (MPN/ml)	Salmonella (MPN/4g)
Primary Sludge	160,000	80
Digested Sludge	400	8
Dried Biosolids	<2	<2.2

Over the past four years, treatment-plant personnel have been developing a beneficial reuse program for biosolids. The program's goal has been to develop and implement a cost effective technique for producing compost that meets the Class-A standards for metals, pathogen reduction, and vector-attraction reduction that are contained in Federal and State regulations. The resulting product meets all the requirements for Exceptional-Quality (EQ) compost and is beneficially reused in the local community. In 2006, 29% of the plant's biosolids were composted and made available to the public for use as a high-quality soil amendment. The composting program utilizes windrow composting similar to that of McCarthy Family Farms, which is described below.

Biosolids removed from the WWTP in December 2006 were composted at the 162-acre San Joaquin Composting Facility (SJCF) owned by McCarthy Family Farms, Inc. The SJCF is located in Kern County California and operates under Solid Waste Facility Permit No. 15-AA-0287 (Permit Resolution No. 1999-96 adopted by the California Integrated Waste Management Board). The SJCF uses windrow and aerated static pile composting for further reduction of pathogens and limit vector attraction. Windrows are divided into three temperature-recording stations. A windrow passes the high-temperature phase after all three stations maintain a temperature of 55°C for 15 days, and the windrow has been turned at least five times. Six temperature stations are monitored for aerated static pile composting. All six stations must maintain a temperature of 55°C for 3 days before pathogen reduction is considered complete. After maintaining 40°C for 14 days, reduction of vector attraction is also considered complete.

The dried biosolids were sent to the composting facility from the MBCSD treatment plant on November 22nd and 27th. Prior to shipping, the MBCSD provided a Class-B-biosolid certification statement based on chemical analyses performed on biosolid samples collected at the treatment plant. Chemical analyses were conducted on a composite sample collected on September 20th from the 210 dry tons of biosolids that were ready for shipment from the treatment plant at the time. Following the requirements of the Monitoring and Reporting Program, the analyses were conducted on a composite of biosolid samples collected from the drying beds. The full laboratory results including chains of custody, instrument calibration reports, and analyses of method blanks and spikes, were reported by MRS (2006b). The results of those chemical analyses are detailed in Table C.2 of Appendix C. They are compared with regulatory limits in Table 2.11.

The tables show that biosolid contaminant concentrations were well below regulatory criteria that would designate them as hazardous, or limit their use for land application or composting. The analyses tested for the presence of 167 potential contaminants, and measured seven other properties and nutrients within the biosolid sample. Three metals (barium, cobalt, and vanadium) that had not been analyzed prior to 2003 were included in the analyte list to provide a complete suite of CAM-17 analytes, even though their analysis is not required under the current NPDES discharge permit. Of the 167 potential contaminants, only 19 chemicals were detected, and 17 of these were naturally occurring trace metals.

All trace-metal concentrations were below Total Threshold Limit Concentrations (TTLC) that would designate the biosolids as hazardous (Table 2.11). Two metals, copper and lead, had bulk wet-weight concentrations that exceeded ten-times the Soluble Threshold Limit Concentration (STLC). Accordingly, waste extraction tests (WET) were conducted to assess their water solubility. These elutriate tests demonstrated that the metals had low solubility, with dissolved concentrations that were well below STLC levels at which the potential for leaching into groundwater would be of concern. Instead, their low solubility shows that the metals were tightly bound into a mineral matrix, with little bioavailability. The insolubility of trace metals was further confirmed by the low concentrations found in effluent samples (Table 2.8 on Page 2-39). Both of these metals occur naturally in the mineralogy of ambient sediments in the coast re-

gion and, as a result, their presence in biosolids is not unexpected. In any regard, the dry-weight concentrations for all detected metals in the biosolid sample were well less than half of the federally mandated limits, including the monthly limit for materials suitable for agricultural land application (Table 2.11).

Only two synthetic organic contaminants, bis(2-ethylhexyl)phthalate (BEHP) and xylene, were detected in the biosolids sample. As discussed in Section 2.2.11, BEHP has been consistently detected at low levels in effluent and biosolids samples collected over the past decade. There is no limit on this compound specified in State and Federal regulations governing biosolids. Because of its mobility, high vapor pressure, and the massive scale of production, BEHP has become pervasive in the environment. The second, gasoline-related compound, xylene, was detected at a very low concentration (0.012 ppm). Xylene comprises one of the four aromatic hydrocarbon compounds collectively known as BTEX (benzene, toluene, ethyl benzene, and xylene) that are primarily associated with gasoline contamination. These compounds are occasionally detected within effluent samples; however, xylene has a low potential for accumulation in aquatic environments and groundwater.

The other compounds listed in Table 2.11 further characterize the biosolids, as required in the waste discharge requirements. Although testing for asbestos is no longer required as part of the NPDES permit, it was included for completeness. Additionally, Table 2.11 also contains the results of a modified WET test (STLC) for total dissolved solids (TDS) that was conducted in response to a request from the composter.

Table 2.11. Comparison between Measured Biosolid Concentrations and State and Federally Mandated Limits for Hazardous-Waste Designation

		Wet Weight				Dry Weight		
		Measured		Limit		Measured	Limit	
Constituent	Units	Bulk	WET[a]	STLC[b]	TTLC[c]	Bulk	Monthly[d]	Ceiling[e]
Solids	%	79.9.	—[f]	—	—	—	—	—
Cyanide	ppm	1.5	—	—	—	1.9	—	—
Antimony	ppm	≅4.8[g]	—	15.	500.	6.0	—	—
Arsenic	ppm	≅2.2	—	5.	500.	2.7	41.	75.
Barium	ppm	450.	—	100.	10,000.	560.	—	—
Beryllium	ppm	<0.2	—	0.75	75.	<0.25	—	—
Boron	ppm	≅15.	—	—	—	19.	—	—
Cadmium	ppm	4.2	—	1.	100.	5.2	39.	85.
Chromium (Total)	ppm	57.	—	560.	2,500.	71.	—	—
Chromium (Hexavalent)	ppm	—	<0.13	5.	500.	—	—	—
Cobalt	ppm	≅5.3	—	80.	8,000.	6.7	1,500.	4,300.
Copper	ppm	**560.**[h]	6.1	25.	2,500.	700.	1,500.	4,300.
Lead	ppm	**68.**	0.74	5.	1,000.	85.	300.	840.
Mercury	ppm	0.77	—	0.2	20.	0.96	17.	57.
Molybdenum	ppm	37.	—	350.	3,500.	46.	—	—
Nickel	ppm	47.	—	20.	2,000.	59.	420.	420.
Selenium	ppm	6.1	—	1.	100.	7.7	100.	100.
Silver	ppm	4.9	—	5.	500.	6.1	—	—
Thallium	ppm	<4.2	—	7.	700.	<3.8.	—	—
Vanadium	ppm	26.	—	24.	2,400.	33.	—	—
Zinc	ppm	1,100.	—	250.	5,000.	1,400.	2,800.	7,500.
Asbestos	%	ND	—	—	1.	ND	—	—
Bis(2-ethylhexyl) phthalate	ppm	150.	—	—	—	188.	—	—

Constituent	Units	Wet Weight				Dry Weight		
		Measured		Limit		Measured	Limit	
		Bulk	WET[a]	STLC[b]	TTLC[c]	Bulk	Monthly[d]	Ceiling[e]
Xylenes (Total)	ppm	0.012	—	—	—	0.015	—	—
Hydrogen-Ion	pH	7.64	—	—	—	—	—	—
Phosphate	ppm	57,000.	—	—	—	71,300.	—	—
Ammonia	ppm	4,400.	—	—	—	5,500.	—	—
Nitrate (NO_3)	ppm	140.	—	—	—	175.	—	—
TDS[i]	ppm	—	4,400.	—	—	—	—	—
TKN	ppm	20,000.	—	—	—	25,000.	—	—
Organic Nitrogen	ppm	15,600.	—	—	—	29,500.	—	—
Oil & Grease	ppm	64,000.	—	—	—	80,000.	—	—

[a] Waste Extraction Tests (WET) measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant exceeds ten times the STLC.

[b] Soluble Threshold Limit Concentrations (STLC) apply to the measured concentration in the liquid extract from a biosolid sample, as determined by a WET. Biosolids with leachate concentrations exceeding the STLC are classified as hazardous in the State of California, as described in the California Code of Regulations (CCR 2003).

[c] Total Threshold Limit Concentrations (TTLC) apply to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix, rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTLC, as described in the CCR (2003).

[d] Federally mandated dry-weight limits imposed on biosolids suitable for application on agricultural land apply to monthly average concentrations as defined in Table 3 of the Code of Federal Regulations (USGPO 1997b). [40 CFR §503.13(b)(1)].

[e] Federally mandated dry-weight ceiling concentrations above which biosolids are considered hazardous waste as defined in Table 1 USGPO (1997b).

[f] Measurement not required or limit not specified.

[g] Concentrations preceded by a "≅" symbol were too low to be reliably quantified.

[h] Bulk concentrations shown in bold were greater than ten times the STLC and a WET was conducted.

[i] Total dissolved solids determined in a modified STLC extraction

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CHAPTER 3

Receiving Water Quality

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3.0 RECEIVING WATER QUALITY

This chapter describes environmental conditions within the ocean waters immediately adjacent to the MBCSD wastewater discharge during 2006. The first section presents the details of the monitoring program used to assess compliance with the water-quality objectives of the California Ocean Plan (COP; SWRCB 1997) as embodied in the NPDES permit covering the MBCSD discharge (hereinafter referred to as "*the NPDES permit*," RWQCB–USEPA 1998ab). The second section discusses the disposition of the effluent plume within the receiving waters and how it is influenced by the hydraulic design of the outfall and stratification of the receiving waters.

The final section describes the measurements collected during the four 2006 surveys, and compares them with the waste discharge requirements specified in the NPDES permit. The offshore measurements were previously described in quarterly reports (MRS 2006cdef). Quantitative analyses of continuous instrumental measurements and the qualitative visual observations are also described in the last section. All of these observations demonstrate that the diffuser structure was operating as designed, efficiently diluting treated wastewater within the zone of initial dilution (ZID) that surrounds the outfall. During all four of the 2006 surveys, dilute wastewater was detected within the receiving waters. The slight discharge-related perturbations in the water-property fields indicated that the treated wastewater was being rapidly mixed upon discharge. Projected contaminant concentrations were far below receiving-water limitations specified in the NPDES permit and the discharge fully complied with the objectives of the COP. The observed perturbations were also small compared to the natural variability in seawater properties that is observed along this portion of the central California Coast. In summary, the highly localized, transient seawater perturbations associated with the effluent discharge were too small in amplitude to be of environmental significance.

3.1 MONITORING PROGRAM

Monitoring of wastewater chemistry (Chapter 2), receiving waters (this chapter), and the biology and physicochemistry of seafloor sediments (Chapter 4) constitute the major components of the MBCSD monitoring program. During 2006, as in the prior 20 years, monitoring of receiving water quality included quarterly offshore surveys conducted near the wastewater discharge within northern Estero Bay, and periodic surfzone coliform sampling along the adjacent shoreline. Measurements collected during the offshore surveys included instrumentally recorded water-property fields, flow velocity determined from drifter trajectories, qualitative observations of general oceanographic and meteorological conditions, and ancillary visual observations of beneficial uses.

3.1.1 Objectives of Sampling

Monitoring of receiving water quality is required under provisions of a 301(h)-modified NPDES permit to determine compliance with the water-quality objectives of the COP (SWRCB 1997) and the Central Coast's Basin Plan (RWQCB 1994). The monitoring program also satisfies the provisions of the Clean Water Act (40 CFR 125.63c) which require a water-quality monitoring program that '… *Provide*[s] *adequate data for evaluating compliance with water quality standards or water quality criteria*….' In addition, water column measurements provide background information on the vertical structure of ambient marine waters near the discharge location. This information aids in estimating minimum initial dilution rates, which are partially determined by the maximum stratification of receiving waters as described in Section 3.2.2 below.

3.1.2 Scope of Monitoring

Many measurements are required to assess whether the water-quality objectives of the COP are being met. These objectives are summarized in Table 3.1. They apply to samples collected in an area where initial dilution of the wastewater has been completed.

Initial dilution is the rapid turbulent mixing of wastewater and seawater surrounding the point of discharge. Ambient seawater is forcibly entrained into the discharge plume by two physical processes. Close to the diffuser ports, the momentum of the wastewater jet induces turbulent shear that rapidly entrains near-bottom seawater, thereby diluting the discharge. Additional turbulent mixing occurs as the warm, buoyant effluent-seawater mixture rises through the water column. This buoyancy-induced entrainment can cause the density of the effluent plume to approach ambient density (neutral buoyancy) at some point in the water column. Depending on ambient stratification at the time of the discharge, the plume can either reach the surface or become trapped at some intermediate depth level. Thus, initial dilution, where a majority of effluent dilution is achieved, is complete when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

To better assess compliance with the COP standards, the receiving-water monitoring program was extensively modified when the current NPDES permit was issued in 1999 (RWQCB–USEPA 1998b). Prior to 1999, the effluent plume was rarely observed in the instrumental measurements and when it was, its lateral extent was largely indeterminate. This was partially due to the pattern of widely spaced water-sampling stations that coincided with the benthic sampling pattern. Additionally, collection of discrete water samples for suspended solids, coliform, and oil and grease concentrations was required. This water-bottle sampling was time-consuming and compromised the synoptic nature of the instrumental measurements. Beginning with the 1999 surveys, bottle casts were eliminated, the number of stations was doubled, and the lateral extent of the survey was reduced from 1000 m to 100 m. Since that time, rapid instrumental sampling within the tighter sampling pattern has consistently provided high-resolution synoptic snapshots of the ocean waters immediately surrounding the outfall. As a result, the disposition of the effluent plume has been accurately delineated in all 32 surveys conducted since the beginning of 1999.

Sampling at the closely spaced stations only became feasible with the increased navigational accuracy of the differential global positioning satellite (DGPS) system. A DGPS system was installed on the survey vessel in 1998, and was used to precisely determine the location of the open section of the diffuser structure during a diver survey (MRS 1998abc). These data allowed accurate determination of the location of measurements relative to the discharge point. During the four quarterly surveys of 2006, an automated probe system collected precise *in situ* measurements continuously throughout the water column at each offshore station. Measured seawater parameters consisted of temperature, salinity, dissolved oxygen (DO), acidity/alkalinity (pH), and light transmittance (water clarity). Qualitative visual observations made during the offshore surveys provided information on any potential wastewater contributions to levels of floating particulates, seawater discoloration, odors, algal blooms, and surface water clarity. Wildlife and recreational use, as well as general weather and sea conditions, were also noted.

Table 3.1 California Ocean Plan Water-Quality Standards

A. Bacterial Characteristics

1. Water-Contact Standards

Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline and in areas outside this zone used for water contact sports, as determined by the Regional Board, but including all kelp beds, the following bacterial objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a density of total coliform organisms less than 1,000 per 100 ml (10 per ml); provided that not more than 20 percent of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 ml) and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml (100 ml).

b. The fecal coliform density based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per ml.

The "Initial Dilution Zone" of wastewater outfalls shall be excluded from designation as "kelp beds" for purposes of bacterial standards and Regional Boards should recommend extension of such exclusion zone where warranted to the State Board (for consideration under Chapter VI.F.) Adventitious assemblages of kelp plants on waste discharge structures (e.g., outfall pipes and diffusers) do not constitute kelp beds for purposes of bacterial standards.

2. Shellfish Harvesting Standards

At all areas where shellfish may be harvested for human consumption, as determined by the Regional Board, the following bacterial objectives shall be maintained throughout the water column:

The median total coliform density shall not exceed 70 per 100 ml and not more than 10 percent of the samples shall exceed 230 per 100 ml.

B. Bacterial Assessment and Remedial Action Requirements

Describes guidelines for monitoring enterococcus bacteria. (See Plan for full description).

C. Physical Characteristics

1. Floating particulates and grease and oil shall not be visible.
2. The discharge of the waste shall not cause aesthetically undesirable discoloration of the ocean surface.
3. Natural light shall not be significantly reduced at any point outside the initial dilution zone as a result of the discharge of waste.
4. The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.

D. Chemical Characteristics

1. The dissolved oxygen concentration shall not at any time be depressed more than 10 percent from which occurs naturally, as a result of the discharge of oxygen demanding waste materials.
2. The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.
3. The dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions.
4. The concentration of substances set forth in Chapter IV, Table B in marine sediments shall not be increased to levels which would degrade indigenous biota.
5. The concentration of organic materials in marine sediments shall not be increased to levels which would degrade marine life.
6. Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota.

E. Biological Characteristics

1. Marine communities, including vertebrate, invertebrate and plant species, shall not be degraded.
2. The natural taste, odor and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.
3. The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not be bioaccumulated to levels that are harmful to human health.

F. Radioactivity

1. Discharge of radioactive waste shall not degrade marine life.

As in prior years, surfzone monitoring was conducted along Atascadero State Beach to assess aesthetic conditions for the beneficial uses described in Section 2.1.2. Bacteriological conditions along the shoreline are of particular interest for shellfish harvesting and for water-contact recreation, namely swimming and surfing. To assess these conditions, nearshore water samples were collected and analyzed for total and fecal coliform densities. The other beneficial uses, such as fishing and non-contact recreation, including beachcombing, boating, and picnicking, were addressed by observations of other aesthetic conditions noted during the surfzone surveys. These ancillary observations included weather conditions, ocean currents, tides, and any evidence of water discoloration, floating oil and grease, turbidity, odor, or materials of sewage origin on the beach or in the water. WWTP personnel conducted these surfzone surveys on a weekly basis during the summer and on a monthly basis during the winter.

3.1.3 Sampling Station Design

Water sampling was conducted at 16 offshore stations and eight surfzone stations (Figure 3.1). The surfzone stations were located at gradient distances upcoast and downcoast relative to Station C, which was positioned at the onshore site closest to the offshore discharge location. The location of historical surfzone measurements was reevaluated during a high-resolution navigational survey conducted on 6 July 2005. A handheld GPS device was used to benchmark the actual locations of the surfzone sites that have been sampled for the past two decades. Historically, the locations of the sampling sites were determined from visual landmarks along the shoreline. Although the locations of the sampling sites have been consistent throughout the monitoring program, their coordinates had never been precisely compared with the target distances specified in the NPDES discharge permit.

A comparison of the target and actual along-shore distances is shown in Table 3.2. The detailed shoreline survey, in conjunction with the aforementioned diver survey of the diffuser structure, provided a more precise determination of the distance of the discharge from the shoreline. The closest portion of the diffuser structure lies 827 m from the shoreline while the diffuser structure itself extends an additional 52 m toward the northwest along the seafloor. This closest-approach shoreline position was determined at the water's edge when the tidal level was +2.7 ft, referenced to mean lower low water (MLLW). The beginning of the section of the diffuser structure containing open diffuser ports lies directly offshore surfzone Station C (Figure 3.1).

Table 3.2 Target and Actual Locations of Surfzone Sampling Stations

Station	Description	Target Along-Shore Distance[1] (m)	Latitude[2]	Longitude	Actual Along-Shore Distance (m)
A1	Upcoast Reference	1700 N	35° 23.966' N	120° 52.113' W	1334 N
A	Upcoast Midfield	610 N	35° 23.744' N	120° 52.060' W	916 N
B	Upcoast Nearfield	305 N	35° 23.520' N	120° 52.002' W	492 N
C	Onshore of Diffuser	0	35° 23.256' N	120° 51.952' W	4 N
D	Downcoast Nearfield	305 S	35° 23.032' N	120° 51.915' W	422 S
E	Downcoast Midfield	610 S	35° 22.762' N	120° 51.895' W	918 S
F	Downcoast Reference	1520 S	35° 22.395' N	120° 51.883' W	1596 S
G	Morro Creek[3]	—[4]	—	—	—

[1] Along-shore distance and direction from Station C as specified in the NPDES permit.
[2] As described in the glossary, all coordinates cited in this report are referenced to the WGS84 datum.
[3] Immediately before flowing to the ocean.



Figure 3.1 Locations of Receiving-Water and Surfzone Sampling Stations

Seven of the eight surfzone stations were regularly sampled at fixed locations. The location of the Morro Creek Station (G) varied depending on the along-shore position of the creek outflow. In addition, Station G was only sampled when the creek was flowing to the ocean. Consequently, during 2006, samples were not collected at Station G between mid-August and December, when surface outflow from the creek was not observed. Bacterial levels within the creek outflow are monitored because it is a known source of elevated coliform densities that are unrelated to the discharge of treated wastewater offshore.

Offshore water-quality sampling focused on the water column close to the discharge location (Figure 3.1). Twenty-eight of the 34 available ports discharge effluent along a 42-m section of the diffuser structure. The diffuser ports were hydraulically designed to rapidly dilute effluent within the receiving seawater immediately upon discharge. Most of this turbulent mixing occurs within a zone of initial dilution (ZID), which extends laterally to a distance of approximately 15 m from the center of the diffuser structure.

Beyond the ZID, energetic waves, tides, and coastal currents within Estero Bay further disperse the effluent plume within open-ocean receiving waters. Areas of special concern, such as sanctuaries and estuaries

are too distant to be materially affected by the treated wastewater discharge. The southern boundary of the Monterey Bay National Marine Sanctuary is located 38 km to the north, near Cambria Rock. The entrance to Morro Bay lies 2,800 m to the south of the discharge. In 1995, Morro Bay was included in the National Estuary Program. Because of its distance from the discharge, incursion of unmixed wastewater into the Bay is implausible. Direct seawater exchange between the discharge point and the Bay is restricted by Morro Rock, which lies between the outfall and the south-facing entrance to the Bay. Morro Rock is the largest physiographic feature along the adjacent coastline and extends into Estero Bay approximately 2,000-m south of the point of discharge (Figure 3.1).

During 2006, the discharge's region of influence was evaluated quarterly using water-quality data collected at 16 offshore stations (Table 3.3, and Figure 3.2 on Page 3-7) The stations were situated at three gradient distances from the ZID in order to detect potential discharge-related trends in water properties. The four closest stations, which are on the margin of the ZID, were located 15-m from the closest approach of the diffuser, rather than from the center point of the diffuser structure. The remaining, more-distant stations were located relative to the center point of the diffuser structure.

Table 3.3 Target Locations of Offshore Receiving-Water Sampling Stations

Station	Description	Latitude	Longitude	Closest Approach Distance[1] (m)	Center Distance[2] (m)
1	Upcoast Midfield	35° 23.253' N	120° 52.504' W	88.4	100
2	Upcoast Nearfield	35° 23.231' N	120° 52.504' W	49.4	60
3	Upcoast ZID	35° 23.210' N	120° 52.504' W	15.0	20
4	Downcoast ZID	35° 23.188' N	120° 52.504' W	15.0	20
5	Downcoast Nearfield	35° 23.167' N	120° 52.504' W	49.4	60
6	Downcoast Midfield	35° 23.145' N	120° 52.504' W	88.4	100
7	Offshore Midfield	35° 23.199' N	120° 52.570' W	85.8	100
8	Offshore Nearfield	35° 23.199' N	120° 52.544' W	46.7	60
9	Offshore ZID	35° 23.199' N	120° 52.519' W	15.0	23
10	Shoreward ZID	35° 23.199' N	120° 52.489' W	15.0	23
11	Shoreward Nearfield	35° 23.199' N	120° 52.464' W	46.7	60
12	Shoreward Midfield	35° 23.199' N	120° 52.438' W	85.8	100
13	Southwest Nearfield	35° 23.176' N	120° 52.532' W	59.8	60
14	Northwest Nearfield	35° 23.222' N	120° 52.532' W	40.2	60
15	Northeast Nearfield	35° 23.222' N	120° 52.476' W	59.8	60
16	Southeast Nearfield	35° 23.176' N	120° 52.476' W	40.2	60

[1] Distance from the closest open diffuser port
[2] Distance to the center of the open diffuser section

It is important to consider the '*closest-approach*' distance when evaluating impacts at stations near the wastewater discharge. Although the discharge has historically been considered a '*point source*' for most large-scale modeling purposes, it does not occur at a single location of infinitesimal size. Instead, the discharge is distributed along a 42-m section of the seafloor. The diffuser's finite size affects assessments of wastewater dispersion at sites close to the discharge. Specifically, the amount of wastewater dispersion at a given point in the water column is largely determined by its distance to the closest diffuser port rather than its distance to the center point of the diffuser structure. Near the source, this '*closest-approach*' distance can be much less than the distance to the center of the diffuser structure (Table 3.3 and Figure 3.2). It would be misleading to design a nearfield sampling pattern based on center-point distances rather than closest-approach distances. For example, Station 3 lies on the margin of the ZID, and is potentially influ-

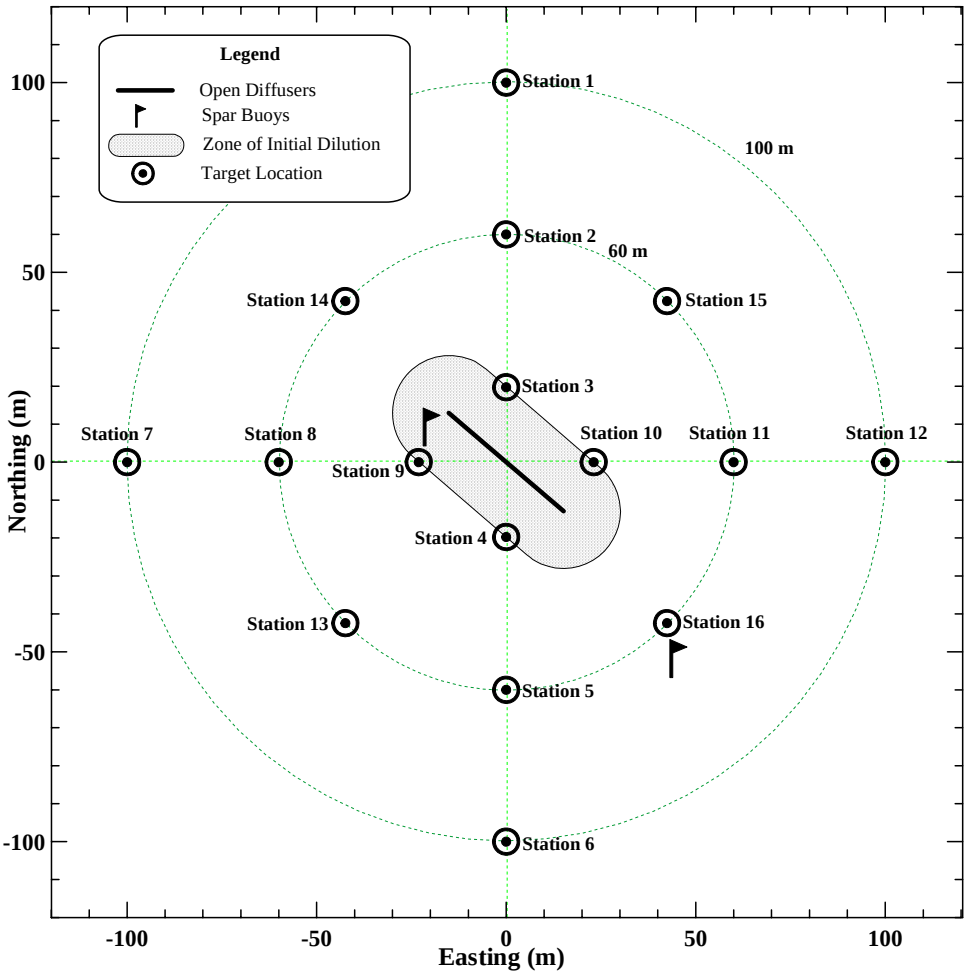


Figure 3.2 Location of Offshore Receiving-Water Stations

enced by wastewater that is discharged from a diffuser port that lies only 15 m to the southwest. Incorrectly assuming that the level of mixing at Station 3 resulted from a 20-m transit from the center point of the diffuser would overestimate the anticipated amount of wastewater dilution at that station.

With the closest-approach distances in mind, six of the monitoring stations were aligned along a north-south axis at the same isobath (15.2 m) as the diffuser center point. Stations 3 and 4 were positioned at the boundary of the ZID at a distance of 15-m upcoast and downcoast of the closest diffuser ports (Table 3.3). Stations 2 and 5 were located at nearfield distances (60 m) from the diffuser center point. Midfield Stations 1 and 6 represent reference stations situated 100 meters upcoast and downcoast of the center point. Depending on the direction of the local oceanic currents at the time of sampling, one or more of these near and midfield stations could conceivably be influenced by wastewater discharge. Under those circumstances, the midfield station on the opposite side of the diffuser acts as a reference station. Comparisons of water properties at these antipodal stations quantify departures from ambient seawater properties so that compliance with the NPDES discharge permit can be evaluated. Six other stations (7 through 12) were aligned along a cross-shore transect in a pattern matching that of the along-shore transect. The four

additional nearfield stations (13 through 16) measure the influence of effluent transported by ocean currents flowing at oblique angles to the bathymetry.

3.1.4 Navigation

Vessel positioning within the compact offshore sampling pattern only became feasible after the advent of DGPS. The accuracy of traditional navigation systems such as LORAN or standard GPS, is typically ±15 m, a span half of the width of the ZID itself. LORAN beacons are no longer maintained in lieu of the more widely available GPS navigation. Also, prior to 2 May 2000, standard commercial GPS receivers were not allowed to be perfectly accurate by law and a built-in-error system called Selective Availability (SA) was encoded into GPS transmissions. SA could introduce a misreading of up to 100 meters, although it altered most measurements by less than 30 meters. After May 2000, SA was turned off and the accuracy of standard GPS receivers improved substantially, with horizontal position errors that are typically less than 10 m. Nevertheless, extreme atmospheric conditions and physiographic obstructions can also cause signals to bounce around, leading to additional errors in position, beyond those that were introduced by SA. These other errors are greatly reduced with the Differential GPS (DGPS) system that was first implemented by the U.S. Coast Guard. DGPS incorporates a second signal from a nearby land-based beacon. Because the beacon is fixed at a known location, the position error in the reading from the GPS satellites can be precisely calculated. This correction is continuously transmitted to the DGPS receiver and results in extremely accurate offshore navigation, typically with position errors of less than 4 m.

At the beginning of 1998, the survey vessel F/V *Bonnie Marietta* was fitted with a Furuno™ GPS 30 and FBX2 differential beacon receiver. This navigational system was used on 29 July 1998 to precisely locate the position of the open section of the diffuser structure (MRS 1998b). Mr. Carson Porter, a diver performing the annual outfall inspection, deployed temporary buoys marking the first and last open diffuser ports. The DGPS locations of these buoys were used to establish the new target locations for the offshore monitoring stations listed in Table 3.3.

Knowledge of the precise location of the actual sampling sites relative to the diffuser is crucial for accurate interpretation of the water property fields. During any given survey, the actual sampling locations do not coincide with the exact target coordinates listed in Table 3.3. Winds, waves, and currents induce offsets of several meters during sampling. Even during quiescent periods, drift is induced by residual vessel momentum remaining after station approach. Prior to the use of DGPS, these offsets could not be resolved by the available navigation. In contrast, during the 2006 surveys, the actual sampling locations were precisely determined throughout the vertical profiling that was conducted at each station. This is an important consideration because, during every survey in 2006, station offsets caused some measurements to be collected within the ZID (shaded entries in Table 3.4).

Table 3.4 Closest Approach Distance between the Diffuser Structure and Actual Sampling Locations during the 2006 Water-Quality Surveys

		Closest-Approach Distance[1] (m)				
Station	**Description**	**Target**	**January**	**April**	**July**	**October**
3	Upcoast ZID	15.0	**16.0**[2]	**5.9**	**9.2**	**16.6**
4	Downcoast ZID	15.0	**8.0**	**23.8**	**17.0**	**18.6**
9	Offshore ZID	15.0	**15.3**	27.6	**19.4**	23.1
10	Shoreward ZID	15.0	19.5	**2.2**	26.7	**12.8**
14	Northwest Nearfield	40.2	35.7	33.4	50.1	30.8
16	Southeast Nearfield	40.2	49.2	50.9	37.6	36.7
8	Offshore Nearfield	46.7	56.7	42.4	50.1	47.1
11	Shoreward Nearfield	46.7	51.9	60.3	42.7	36.8
2	Upcoast Nearfield	49.4	55.0	32.5	60.1	46.6
5	Downcoast Nearfield	49.4	52.7	75.1	47.8	57.8
13	Southwest Nearfield	59.8	62.2	60.0	63.8	51.1
15	Northeast Nearfield	59.8	54.1	50.0	69.2	59.2
7	Offshore Midfield	85.8	86.4	87.1	96.0	84.1
12	Shoreward Midfield	85.8	86.2	88.3	84.8	82.2
1	Upcoast Midfield	88.4	94.4	116.4	82.7	87.4
6	Downcoast Midfield	88.4	92.6	109.0	86.8	85.2

[1] Average Distance to the closest open diffuser port.
[2] Portions of the profiles listed in bold typeface with shading were sampled within the ZID.

Table 3.4 also compares the target closest-approach distances from Table 3.3 with the distance to the diffuser from the average station location where measurements were actually collected during each quarterly survey. Ideally, measurements would be made at or beyond the ZID boundary, namely, at distances of more than 15 m from the diffuser structure. However, because of vessel drift, some samples were unavoidably collected well within the ZID, close to the diffuser structure. In every survey, portions of at least one vertical profile were sampled close (<15 m) to a diffuser port. Because of this, some measurements captured the signature of wastewater while it was continuing to undergo rapid initial mixing. Dilution rates determined from these close-in measurements were compared with critical initial dilution ratios that are expected based on modeling conducted during the design of the outfall. Because tests for compliance with the receiving-water limitations in the NPDES permit apply beyond this dilution zone, the measurements collected within the ZID were not subject to many of the COP standards outlined in Table 3.1. Regardless, most of the plume observations collected within the ZID were too small to be considered statistically significant, and were below the permit limits applicable to observations collected outside the ZID.

Vessel drift can be significant even within the minute or so it takes to complete the water-property profile at each station. For example, during the April survey, when winds and currents were particularly strong, the instrument package moved an average of 18 m laterally during its descent through the water column. This magnitude of lateral drift exceeds the dimensions of the 15-m ZID surrounding the diffuser structure and confounds the precise interpretation of compliance at the margin of the ZID. In fact, portions of the vertical profiles collected at Stations 3, 4, 9, and 10 often cross the ZID boundary. Vertical profiles which contain measurements collected within the ZID are indicated by bold typeface in Table 3.4. In some cases, the average positions reported in Table 3.4 are located beyond the ZID even though much of the data was collected within the ZID. To be consistent with historical data where a single location was reported at each station, average positions are based on the surface and bottom position fixes measured at

the beginning and end of the vertical profile. However, these average positions can be misleading. Specifically, the average positions reported for Station 3 during the January survey, Station 4 during the April survey, Stations 4 and 9 during the July survey, and Stations 3 and 4 during the October survey, would suggest that all of the associated water-quality data was collected well outside the 15-m ZID. In reality, large portions of the vertical profiles collected at each of these stations were measured within the ZID, where most of the water-quality limitations do not apply.

3.1.5 Sampling Equipment and Methodology

During 2006, the 38-ft F/V *Bonnie Marietta*, owned and operated by Captain Mark Tognazzini of Morro Bay, provided vessel support for all the offshore surveys. Dr. Douglas Coats and Ms. Bonnie Luke of Marine Research Specialists (MRS) provided scientific support. Captain Tognazzini supervised all vessel and deck-equipment operations during the water-quality surveys. Standard observations for weather, seas, water clarity/coloration, Secchi depth, and the presence of any odors and floating debris were recorded during the surveys. Wind speeds and air temperatures were measured with a Kestrel® 2000 Thermo-Anemometer. These observations were collected during the rapid water-column profiling that was conducted at each station using a CTD instrument package.

Ancillary Measurements

As vertical CTD profiles were being collected at each station, a Secchi disk was lowered through the water column to determine its depth of disappearance. This provided a visual measure of the water clarity within the upper water column. The depth of disappearance is inversely proportional to the average amount of organic and inorganic suspended material along a line of sight immediately below the sea surface. As such, the Secchi depth measures ambient light penetration, which can be limited by increased suspended particulate loads from onshore runoff and wastewater discharge. During most surveys, however, reduced light penetration resulted from natural increases in turbidity within the surface mixed layer that was caused by upwelling-induced primary productivity within the euphotic zone. The depth of the euphotic zone, where most oceanic photosynthesis occurs, extends to approximately twice the Secchi depth. Because Secchi depths are less precise than measurements collected with electronic sensors, these and the other qualitative observations described above, were ancillary to the rapid water column profiling conducted with an automated instrument package that was configured with extremely sensitive electronic sensors and probes.

At the beginning of each survey, a drifter was deployed at the center of the open section of the diffuser structure. The drifter was drogued at mid-depth (7 m) using the curtain shade design of Davis et al (1982). In this configuration, the drifter trajectory was largely determined by the oceanic flow field rather than surface winds. Beginning with the October 2004 water-quality survey, satellite navigation was added to the drifter, which allowed continuous recording of the precise time and position of the drifter trajectory rather than just the DGPS location at the points of location and recovery. From these trajectory measurements, the ambient flow velocity throughout each survey was determined.

Instrumental Measurements

Vertical water-column profiling was conducted using an electronic instrument package equipped with a number of probes and sensors. A Sea Bird Electronic SBE-19 Seacat CTD[1] instrument package was used to collect profiles of conductivity, salinity, temperature, light transmittance, DO, pH, density, and pressure at each station. A submersible pump on the CTD flushed water through the conductivity cell and oxygen sensor at a constant rate, independent of the CTD's motion through the water column. Prior to the surveys, the transmissivity, DO, and pH sensors were calibrated. The pre-cruise calibration for DO was accomplished by immersing the CTD in an aerated temperature-controlled calibration tank. In addition to this oxygen reading at full saturation, a zero-oxygen calibration point was determined by filling the oxygen-sensor plenum with an 8% solution of sodium sulfite (Na_2SO_3). Oxygen calibration coefficients were determined by regression analysis of sensor membrane current and temperature as recommended by the manufacturer (SBE 1993).

Calibration coefficients for the pH (alkalinity) sensor were determined from a linear regression of output voltage after immersion in three separate buffered solutions of known pH. Buffering solutions with a pH of 4±0.01, 7±0.01, and 10±0.02 were used to bracket the range of *in situ* measurements. The Sea-tech transmissometer was air calibrated by fitting the voltages recorded with and without blocking the light transmission path in air, as recommended by the manufacturer (SBE 1989). The revised calibration coefficients determined prior to each survey were used in the algorithms that convert sensor voltage to engineering units when processing the field data from each individual survey.

The last factory calibration of the entire CTD package was conducted in October 2001. This and all previous factory calibrations confirmed the continued accuracy of the temperature, pressure, and conductivity sensors as well as the operational integrity of the transmissometer, oxygen, and pH probes. The DO and pH sensors were returned to the factory in May 2003 and in June 2006 for testing and recalibration. Because of increasing temporal drift associated with the aging DO probe, it was replaced on both occasions with a new DO probe.

Six seawater properties were used to assess water quality during 2006. They were derived from the continuously recorded output from the electronic probes and sensors on the CTD. Pressure limitations on the combination oxygen/pH sensor confined the CTD to depths less than 200 m (Table 3.5), which is well beyond the maximum depth of the deepest station. The precision and accuracy of the various probes, as reported in manufacturer's specifications, are also listed in Table 3.5. Salinity (‰) was calculated from conductivity (Siemens/m) measurements. Density was derived from contemporaneous temperature (°C) and salinity data. It was expressed as 1000 times the specific gravity minus one, which is a unit of sigma-T (σ_t). All three of these physical parameters (salinity, temperature, and density) were used to determine the lateral extent of any discharge-related seawater perturbations. Additionally, they defined the layering (vertical stratification) of the receiving waters, which determines the character and dynamics of wastewater as it mixes with ambient seawater within the ZID.

[1] CTD stands for Conductivity-Temperature-Depth

Table 3.5 Instrumental Specifications for CTD Profiler

Component	Depth[1]	Units	Range	Accuracy	Resolution
Housing	600	—	—	—	—
Pump	3400	—	—	—	—
Pressure	680	psia	0 to 1000	± 5.0	± 0.5
Depth	—	meters	0 to 690	± 3.0	± 0.3
Conductivity	600	Siemens/m	0 to 6.5	± 0.001	± 0.0001
Salinity	600	‰	0 to 38	± 0.006	± 0.0006
Temperature	600	° C	–5 to 35	± 0.01	± 0.001
Transmissivity	2000	%	0 to 100	± 0.1	± 0.025
Dissolved Oxygen	200	mg/L	0 to 21.5	± 0.14	± 0.014
Acidity/Alkalinity	200	pH	0 to 14	± 0.1	± 0.006

[1] Maximum depth limit in meters

Data on the three remaining seawater properties were used to further characterize receiving waters and assess compliance with water-quality criteria. These properties include light transmittance (water clarity), hydrogen ion concentration (acidity/alkalinity – pH), and dissolved oxygen (DO). Light transmittance was measured as a percentage of the transmitted beam of light detected at the opposite end of a 0.25-m path. Increased transmittance indicates increased water clarity and decreased turbidity.

Before deployment at the initial station, the CTD package was held below the sea surface for a six- to ten-minute equilibration period. Subsequently, the CTD was raised to within 0.3 m of the sea surface and the profiling commenced. The CTD was lowered at a continuous rate to the seafloor. Multiple stations were collected during each deployment by towing the CTD package below the water surface while transiting between adjacent stations. Upon retrieval of the CTD, the profile data were downloaded to a portable computer.

Profile plots and data for each parameter were checked for accuracy and completeness in the field. During the surveys, no obvious irregularities were found that would suggest a malfunctioning sensor. CTD data were deemed satisfactory based on the range-acceptability criteria prescribed for waters of the mainland shelf of Southern California (Table 2 in SCBPPFCT 1995). As described in the next section on data analysis, slow temporal drift in the pH probe was removed prior to processing of data. The locations of the seawater measurements were determined by aligning the time stamps on the internally recording CTD data with the digital navigation log.

3.1.6 Data Analysis

In Section 3.3, the distribution of seawater properties measured during each survey is delineated using vertical sections of the water column. Each cross-shore and along-shore vertical section was derived from a transect of six collinear stations (Figure 3.2). The along-shore section was determined from measurements collected at Stations 1 through 6, which lie along a line paralleling the shoreline. The cross-shore vertical section is perpendicular to the shoreline and is determined from measurements collected at Stations 7 through 12. These vertical sections help identify the presence of water-property anomalies potentially related to wastewater discharge. They also reveal the inherent spatial variability that results from natural oceanographic processes, which helps to place the relative magnitude of discharge-related anomalies in context.

Although the sections are useful for identifying the presence of discharge-related anomalies, they do not accurately reflect the lateral extent of those anomalies. Consequently, the interpolated values shown in the vertical sections cannot be used to directly determine compliance because they overestimate the true lateral extent of the effluent plume in their depiction of the discharge-related anomalies. Because station spacing is comparable to the width of the ZID itself (Figure 3.2), contours in the vertical sections cannot delineate the sharp lateral discontinuities that define the limits of discharge-related perturbations in seawater properties. High-resolution measurements collected with a horizontally towed CTD have demonstrated that discharge-related anomalies are highly localized around the discharge point within the ZID (MRS 2003a). In contrast, the contouring algorithm used to produce the vertical sections from widely separated stations, applies a uniform gradient between the localized anomaly and surrounding stations, which often lie well beyond the ZID. In the absence of intervening observations, the artificially expanded horizontal dimension of the contours surrounding the anomaly may appear to extend beyond the ZID. In reality, this is purely an artifact of the contouring algorithm. Because of this, the sections should be used only to determine whether discharge-related anomalies were present at an individual station, and not to assess compliance based on interpolated values. Accordingly, each actual measurement was quantitatively assessed for compliance with the applicable receiving-water limitations using statistical hypothesis tests. The tests evaluated the significance of discharge-related anomalies, which were computed as the difference between each individual measurement and the mean computed from measurements at the same depth stratum at other stations.

Although all the measured parameters met the field acceptability criteria, the pH sensor exhibited temporal drift during the surveys. This easily identifiable drift has been present in measurements collected in prior years, and is due to ongoing sensor-equilibration (MRS 2001, 2002, 2003b, 2004a, 2005, 2006a). Fortunately, the drift can be accurately removed using regression analysis during post-processing of the data. The pH adjustments that were applied to individual vertical profiles measured during the first three surveys were less than 0.08 standard units, although most of the vertical profiles did not require a pH adjustment at all. Nevertheless, without slight temporal detrending at some stations, minute discharge-related pH anomalies, which are described in Section 3.3.2, would not have been evident. In contrast to the maximum pH adjustment applied in the first three surveys, data collected at the first three stations during the October survey required a larger pH adjustment (<0.225) due to a foreshortened equilibration period.

3.2 DISPERSION OF EFFLUENT WITHIN RECEIVING WATERS

Offshore monitoring is conducted to determine whether the wastewater discharge is causing significant impacts on the receiving waters of Estero Bay beyond the ZID. Section 3.3 makes this determination by comparing the water quality at the boundary of the ZID, and gradient areas beyond the ZID, with background water quality. However, the complex interaction between physical oceanographic processes and ambient seawater properties near the outfall makes detection of the relatively minor discharge-related changes challenging. The significance of potential water-quality impacts is best assessed through a comparison between the amplitude of discharge-related anomalies and the inherent variability in ambient seawater properties. Statistically speaking, if the amplitude of the effluent anomaly is small compared to the inherent variability in ambient seawater properties, then the impact is not deemed significant.

The first two subsections of this section describe the character of wastewater dispersion. The first subsection discusses the configuration of the diffuser structure and describes how it determines the dimensions

of the zone of initial dilution (ZID). The second subsection presents the dynamics of the rapid mixing that occurs immediately after discharge within the ZID.

The last two subsections document oceanographic processes that affect ambient seawater properties within northern Estero Bay. Regional processes cause major fluctuations in the character of the receiving waters near the diffuser. Seasonal changes in the vertical structure of seawater properties directly affect the magnitude of initial dilution, and the ability to detect the presence of dilute effluent.

3.2.1 Zone of Initial Dilution

Treated wastewater from the MBCSD WWTP is discharged into northern Estero Bay through a 1450-m outfall-diffuser system (Table 3.6). The existing outfall was constructed in 1982 with an upgraded 0.686-m diameter steel pipe lined and coated with cement mortar. The outfall extends to a water depth of about 15.2 m (50 ft), approximately 0.5 nautical miles offshore of Atascadero State Beach. At its terminus is a multiport linear diffuser consisting of 34 ports, each 5.08 cm in diameter. The ports are spaced 1.52 m apart on alternating sides of the pipe. The current level of discharge from the WWTP only requires the use of 28 of the 34 available ports.

Table 3.6 Hydraulic Characteristics of the Outfall

Parameter	Measurement
Outfall diameter (m)	0.686
Outfall length (m)	
Land	207
Ocean	1,449
Diffuser diameter (m)	0.686
Diffuser length (m)	51.8
Port orientation (° from horizontal)	0
Port diameter (m)	0.0508
Orifice contraction coefficient	0.89
Center point depth of outfall ports (m MLLW)	15.2
Number of ports open	28[1]
Port spacing[2] (m)	1.52
Design flow rate for each port (m^3/s)	0.01

[1] 28 of 34 ports available.
[2] Ports are located on alternating sides of the diffuser. Distance between ports on the same side of the diffuser is 3.04 m.
[3] Flow rate assuming 34 ports open in a total flow of 0.340 m^3/s (7.76 MGD). The outfall design capacity is 0.358 m^3/s (8.17 MGD).

A Zone of Initial Dilution (ZID) surrounds the diffuser structure and spans the region where the most intense turbulent mixing of effluent is thought to take place shortly after discharge. It is assumed to extend beyond the dimensions of the diffuser structure to a horizontal distance equal to the water depth (USEPA 1994). The water depth at the center point of the diffuser structure is 15.24 m (50 ft) measured relative to the mean lower low water (MLLW) tidal datum. Consequently, the ZID forms a vertical cylinder whose horizontal cross-section is an elongated ellipse as shown in Figure 3.2 on Page 3-7. Based on the diffuser specifications, the dimensions of the ZID are 73.15-m (240-ft) in length, 31.2-m (102.4-ft) in width, and 15.24-m (50-ft) in height. The length is twice the water depth (15.24 m) added to the 42.67-m (140-ft) long diffuser section where ports are open. The width of ZID is twice the water depth added to the inside diameter (0.68 m) of the diffuser pipe. Coatings, which add 0.2 m to the outside diameter of the pipe, and the angled diffuser ports, which extend beyond the edge of the pipe, were neglected for the purposes of determining ZID dimensions. The ZID covers an ocean surface area of approximately 3000 m^2.

In reality, the actual initial dilution zone at any given time departs markedly from the idealized vertical cylinder described above. In many surveys, the prevailing current flow carries the effluent plume beyond the boundaries of the idealized ZID long before it achieves buoyant equilibrium, and before initial mixing is complete. Nevertheless, because wastewater is highly diluted well before initial mixing is fully realized, the water-quality objectives of the COP are consistently met, even within the boundary of the idealized ZID.

3.2.2 Critical Initial Dilution Ratio

Immediately after discharge, wastewater dilution is determined by the physical characteristics of the diffuser system and stratification within the receiving waters. This rapid mixing occurs close to the diffuser structure within the ZID. There, the turbulent processes associated with the high-velocity discharge jet emanating from the diffuser ports, and the buoyant rise of the effluent plume through the water column, result in the rapid dilution of discharged wastewater. Subsequent transport and dispersion by regional oceanographic processes further dissipate the effluent, albeit at a slower rate. The dispersion associated with these oceanographic processes is not considered part of initial dilution.

The limiting concentrations for wastewater constituents specified in the NPDES permit (see Chapter 2) were determined by applying the critical initial dilution ratio for the MBCSD outfall to the open-ocean water-quality objectives specified in the COP for individual contaminants (Table B of SWRCB 1997). The critical initial dilution applicable to the MBCSD outfall was conservatively estimated to be 133:1 (Tetra Tech 1992). The following example shows how this dilution factor was applied to determine the wastewater limits that were established for cadmium in the NPDES permit. The COP's water-quality objective for cadmium in receiving waters has an instantaneous maximum concentration of 0.01 mg/L or less (SWRCB 1997). Based on modeling under highly stratified conditions, there will be at least 133 parts of ambient water mixed with each part of wastewater after completion of initial mixing. From the definition of dilution (Fischer et al. 1979), the concentration of a particular contaminant in wastewater is given by:

$$C_e \equiv C_o + D\left(C_o - C_s\right) \qquad \textbf{Equation 3.1}$$

where: C_e = the concentration of a constituent in the wastewater effluent,
C_o = the concentration of the constituent in the ocean after dilution by D,
D = the dilution ratio of the volume of seawater mixed with wastewater, and
C_s = the background concentration of the constituent in ambient seawater.

The background concentration (C_s) for cadmium in seawater is negligible so the wastewater limit is ($D+1$) times the COP objective (C_o). Thus for cadmium, the instantaneous maximum concentration in wastewater should be no more than 1.34 mg/L, or 134 times the seawater objective of 0.01 mg/L. Thus, under the worst-case scenario, wastewater containing 1.34 mg/L of cadmium will dilute to a cadmium concentration of 0.01 mg/L upon reaching the boundary of the ZID, and the receiving water objective will be met. This is how the maximum wastewater limit on cadmium concentration (1.34 mg/L) was established in the NPDES discharge permit granted to the MBCSD.

The foregoing calculation demonstrates how strongly the assumed initial dilution influences wastewater limitations that are specified in the discharge permit. Because a low value (133:1) was imposed for critical initial dilution, conservative wastewater limitations have been established for the MBCSD discharge. As discussed in Section 3.3, direct observations collected close to the diffuser during the year-2006 surveys indicate that dilutions much higher than 133:1 were achieved well within the ZID and below the assumed plume trapping depth of 6.4 m. The original plume modeling that established the 133:1 critical dilution (Tetra Tech 1992) applied an especially stringent vertical stratification that is not representative of the receiving waters close to the outfall. In addition, the model included 34 open diffuser ports when only 28 ports have been open since the outfall began operations more than two decades ago. Table 3.6 on Page 3-14 lists the other hydraulic properties of the outfall that were used in the initial dilution model.

The density profile used to establish the prescribed MBCSD critical initial dilution was collected at a now-abandoned monitoring station that was located 1 km south of the diffuser structure. At the time that particular density profile was measured, the water column at this location was consistently more stratified than the receiving waters close to the diffuser due to the influence of thermal discharge from the LS Power Group (formerly Duke Energy and before that, Pacific Gas and Electric PG&E) power. The energy plant was discharging heated water to the ocean surface near Station F next to Morro Rock (Figure 3.1 on Page 3-5). A decade of monitoring prior to 1999 demonstrated that the thermal outflow from the power plant measurably increased sea-surface temperature at the old monitoring station relative to ambient conditions near the MBCSD outfall. Because this monitoring station consistently exhibited anomalous water properties, it was discarded when the revised receiving-water monitoring program was promulgated in the new permit. Nevertheless, the original plume modeling that established the critical initial dilution ratio used a heavily stratified profile from this station. The model predicted that the receiving waters would trap the effluent plume 6.4 m below the sea surface. More recent dilution modeling demonstrated that with the weaker vertical stratification typical of the water column near the diffuser, a critical initial dilution of approximately 200:1 with a plume trapping depth of 1.4 m is more representative of the outfall performance (Lindstrom 1998).

Even with dilutions as low as 133:1 and highly sensitive instrumentation, the signature of the wastewater discharge would be difficult to detect within receiving waters, except very close to the diffuser ports. Accordingly, most wastewater-induced perturbations in water quality are imperceptible beyond the ZID, particularly in the presence of the large, natural oceanic variability that exists within northern Estero Bay. Some of the oceanographic processes that transport contaminants and introduce variability in ambient seawater properties are described in the following subsections.

3.2.3 Regional Oceanographic Processes

Although astronomical tides could occasionally influence the flow near the diffuser structure, a much broader suite of complex oceanographic processes determines the disposition of coastal marine waters within northern Estero Bay. Close to shore, a highly energetic wave field occasionally dominates the oceanographic conditions along this section of the central California coast. This wave energy increases the turbulence within nearshore waters and causes significant sediment re-suspension and sand transport along the outfall corridor. Farther offshore, bands of counter currents move ocean waters in alternating directions along the continental shelf. This large-scale along-shore current flow is interrupted by cross-shore tidal currents and by turbulent jets that occasionally form at major promontories such as Point Piedras Blancas, Point Buchon, and Point Arguello. These narrow energetic

jets transport materials far from the coast, and are repeatedly observed extending from upwelling centers located south of major coastal headlands in satellite imagery, such as is shown on the cover of this report. In addition to these processes, wind-driven upwelling alters the vertical distribution of water properties within Estero Bay, and contributes to the remarkably high productivity of the marine waters there.

The open ocean flow field largely controls ambient seawater properties within Estero Bay. Beyond the continental slope (>50 miles), the diffuse southward-flowing California Current represents the eastern limb of the clockwise-flowing gyre that covers much of the North Pacific Ocean. Before turning south to form the California Current, subarctic water is carried along at high latitudes where it is exposed to atmospheric cooling, nutrient regeneration, and precipitation. As a result, the waters of the California Current are characterized by a seasonably stable low salinity (32 to 34‰), low temperature (13°C to 20°C),

and high nutrient concentration. Because of the stabilizing effect of the California Current, central-coast seawater undergoes less seasonal variation than surface waters at similar latitudes along the eastern seaboard.

Immediately shoreward of the California Current, along the continental slope and shelf, is a northward flowing countercurrent that carries water from the Southern California Bight. These southern waters are warmer, more saline and less oxygenated than waters farther offshore. This northward-flowing Davidson countercurrent exhibits strong seasonal variability in intensity. Nevertheless, it maintains a sustained northward flow near Estero Bay, despite reversals observed elsewhere along the California Coast (Coats et al. 1991). The seasonal variability in the Davidson Current coincides with large-scale changes in coastal winds. On average, winds blow from the northwest, parallel to the coast. The Davidson Current is strongest when these northwesterly winds relax between December and February. A rapid spring transition to strong northwesterly winds occurs between March and June when the Davidson Current weakens. These strong northwesterly winds also induce upwelling near Points Estero, Buchon, and Sal (see Figure 2.1 for the location of these promontories). During the upwelling season, surface water near the coast is transported offshore and is replaced by deep cool, nutrient-rich seawater.

Significant inter-annual (year-to-year) variations in oceanographic and marine biological properties also occur along the central California coast. They also strongly influence the waters of Estero Bay. These large amplitude variations are associated with the El Niño – Southern Oscillation, which cycles at a period of 3 to 5 years (Graham and White 1988). During El Niño periods, such as in 1982/1983 and in 1997/1998, basin-wide changes in the dynamic balance of wind-driven currents result in modified flow patterns along the coastline of western North and South America (Chelton et al. 1982). Changes in the study region include an anomalous strengthening of Davidson-Current outflow from the Southern California Bight. This increased outflow carries warm, saline sub-tropical waters northward into Estero Bay. It also coincides with increased winter storm activity, reductions in zooplankton biomass, and the introduction of marine organisms typically found far to the south. A relatively strong El Niño condition was present during the latter half of 1997 and the beginning of 1998. It was the cause of the substantial increase in rainfall during the early part of 1998 and heavily impacted central-coast ocean waters.

Superimposed on these large-scale oceanic flows are a variety of transient phenomena including intense eddies, swirls, filaments, meanders, and narrow jets of flow. Some of these cross-shore turbulent features are evident in the satellite image on the cover of this report. They are capable of transporting significant quantities of heat, nutrients, and pollutants to offshore waters (Savoie et al. 1991). Tidal currents provide another mixing mechanism for ocean waters in the study region, although they are not responsible for significant net transport. Estero Bay experiences astronomical tides of diurnal inequality, which means that the two daily sets of tidal extrema are of unequal amplitude. Tidal fluctuations of as much as 2.1 m can combine with storm surges of up to 0.3 m. Typically, however, the range is approximately 1 m between mean high and low water at the outfall site.

At shorter periods, shoaling internal waves and surface gravity waves also mix coastal water properties in both the horizontal and vertical directions. This region of the central coast is relatively unprotected and experiences a comparatively high flux of wave energy, especially in winter when intense storm events are prevalent. Under certain conditions, this wave energy impinges on Atascadero State Beach at oblique angles. This generates substantial alongshore transport within the coastal littoral cell between Point Estero and Morro Rock. The wave-generated littoral cell can extend well offshore into Estero Bay and can encompass the MBCSD discharge location. Four primary meteorological sources generate waves in this region: 1) extratropical winter cyclones in the northern hemisphere, 2) northwesterly winds after the spring

transition, 3) tropical disturbances offshore Mexico, and 4) extratropical storm swells generated in the southern hemisphere during summer. The first two are the dominant influences on the wave climate along this section of the central California coast. The last two generate swell from the south, which is diminished near the outfall site by the sheltering effects of Point Buchon (Figure 2.1).

Winter storm waves generated by extratropical winter cyclones are often accompanied by locally severe weather along the south-central coast. These extratropical storms are associated with low-pressure systems that develop along the polar front in the North Pacific Ocean, and propagate westward toward the central coast. Thus, major wave events often coincide with an increased discharge from the outfall due to heavy rainfall and increased I&I. These storms occur predominantly in winter (December through March). Less than 5% of all major deepwater wave events (Hs>4 m) occur between the months of May and October (Everts Coastal 1996).

With the exception of major storm events, prevailing northwesterly winds are the predominant mechanism for generating waves in the outfall region. These winds dominate during the spring and summer when a high-pressure system is established over the eastern North Pacific Ocean. The winds are highly coherent over this section of the central coast and, consequently, can generate wind waves over a large fetch (Chelton et al. 1987). These locally generated waves tend to be of shorter period and smaller significant wave height than those generated by major winter storms.

3.2.4 Ambient Water Properties

Water properties within Estero Bay are governed by wind stress, wave climatology, runoff from land, and large-scale circulation patterns. The twenty-year record of quarterly water column surveys conducted as part of the MBCSD monitoring program provides the best insight into temporal variation close to the outfall. However, insight into the mechanisms that drive this variability can only be gleaned from a larger-scale study, such as the water-quality survey that was conducted in conjunction with an environmental impact report that examined processes throughout Estero Bay (Morro Group 1999). The vertical sections shown in Figure 3.5 (Page 3-20) and Figure 3.6 (Page 3-22) were collected approximately 7 km south of the MBCSD outfall in April 1999. The figures reveal the large-scale features associated with upwelling processes that are prevalent during the spring, summer, and early fall along the central coast. The upwelling event captured in the satellite image shown on the cover of this report demonstrates that these processes were also present during the October-2006 MBCSD survey.

Upwelling is an important feature of this coastal region and is largely responsible for its productive fishery. Upwelling moves nutrient-rich water to the sea surface, which significantly enhances primary productivity (phytoplanktonic blooms) that is otherwise limited by the lack of nutrients within the euphotic zone. Phytoplankton are the foundation of the marine food web and their increased abundance results in the greater diversity and increased biomass of marine organisms found along this section of the central coast.

Density, Temperature, and Salinity

The density stratification of coastal waters determines the amount of vertical mixing experienced by discharged wastewater as it rises through the water column (Fischer et al. 1979). Highly stratified waters inhibit vertical exchange of nutrients and other water properties, and can reduce dilution of contaminants introduced by seafloor point sources (e.g., ocean outfalls). Vertical stratification varies seasonally as shown in Figure 3.3. During periods when the upper water column is well mixed (weakly stratified), enhanced vertical mixing and increased initial dilution are expected. This normally occurs during the late fall and winter when convective cooling and mechanical wind stirring drive the main thermocline to great depth (50 m), leaving the nearshore water column with little vertical stratification. However, as shown by the blue line in Figure 3.3, the survey conducted in April 2006 exhibited the lowest stratification. The nearly uniform density profile was generated by downwelling that drove the main thermocline downward beyond the maximum water depth in the survey area. In contrast, mild upwelling conditions during January (black line) and October (green line) produced a weakly stratified water column. The strongest upwelling occurred during the July survey (red line). It produced a dense watermass below 14 m that contrasted with the lower density seawater in the upper water column.

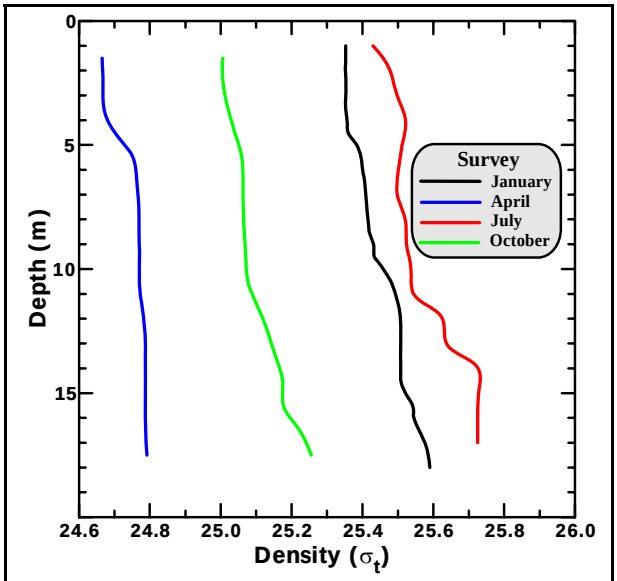


Figure 3.3 Vertical Profiles of Density (σ_t) at Station 7 during the Four Surveys of 2006

Because salinity exerts little influence on density, stratification in marine waters along the central coast is largely determined by temperature structure. Accordingly, Figure 3.4 shows that the vertical temperature structure closely mirrors the density structure shown in Figure 3.3. This was particularly evident during the summer (July) survey (red line), when the vertical range in seawater temperatures was largest. Overall, the water column temperatures were lower in the middle of summer (red line) than in April (blue) and October (green). Although this is contrary to seasonal variation in air temperature, it is diagnostic of strong upwelling conditions when shoreward transport of deep cool seawater results in the lower seawater temperatures near the outfall. Upwelling-induced shoreward movement of cold, dense seawater is delineated in Figure 3.5a by the dark blue shading that extends upslope near the seafloor.

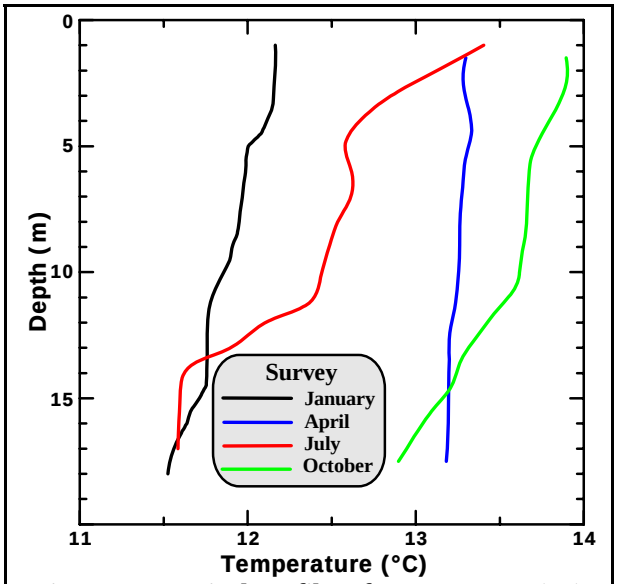


Figure 3.4 Vertical Profiles of Temperature (°C) at Station 7 during the Four Surveys of 2006

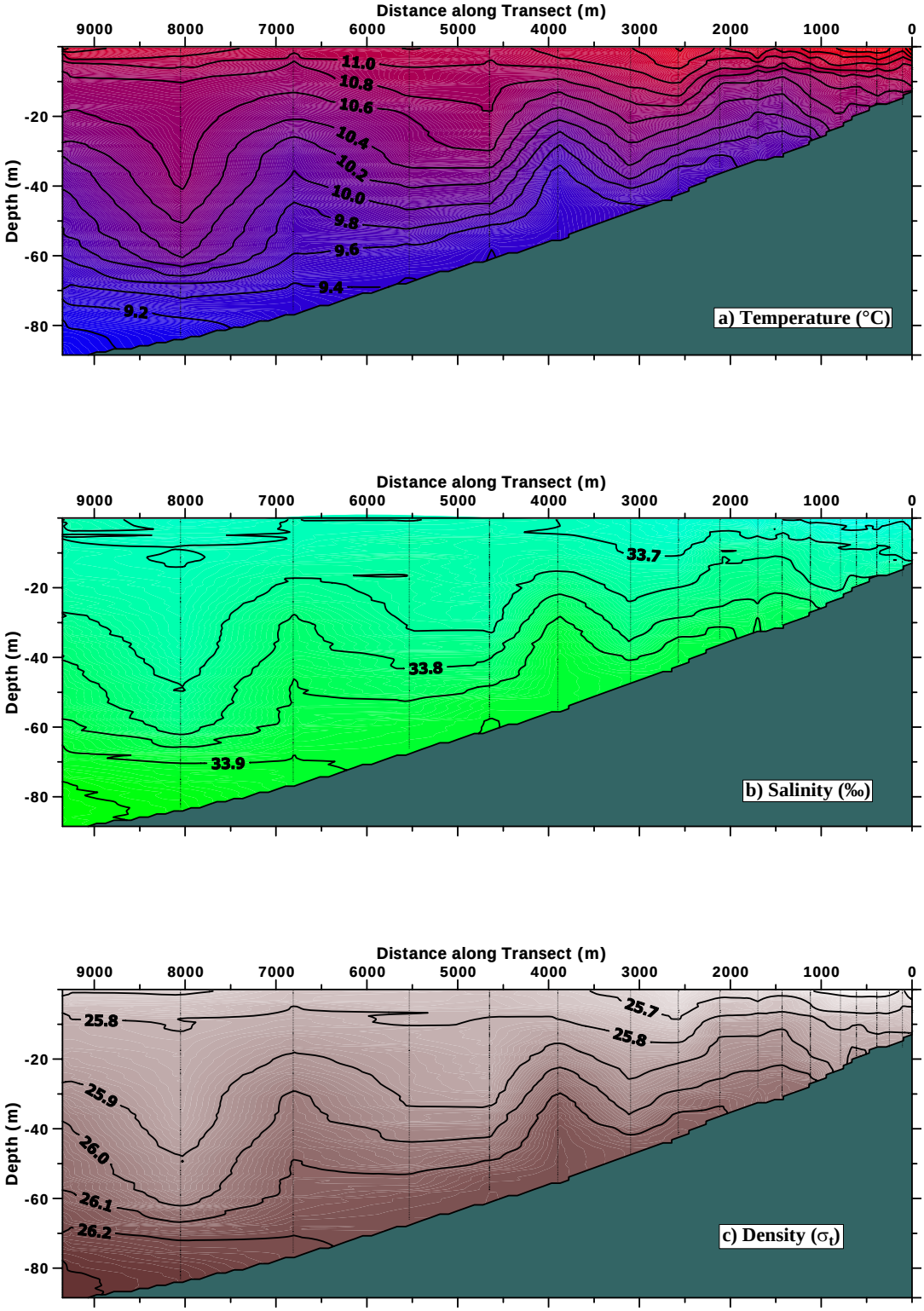


Figure 3.5 Cross-Shore Vertical Sections of a) Temperature, b) Salinity, and c) Density Collected across Estero Bay on 15 April 1999

Thermal stratification induced by upwelling is also evident in the temperature section of Figure 3.5a. The crowding of isotherms, which is evident between 20 and 60 m, resulted from the shoreward transport of cool water near the seafloor. This cool deep water (delineated in blue) moved shoreward, up the sloping bottom to water depths of about 20 m, approximately 1000 m from shore. Wave-like oscillations evident in the thermocline arose from internal waves and tides propagating along the interface. These short-period oscillations were captured by the rapid survey, which was completed in approximately 4 hours. Along the transect, the upwelling-induced thermocline also sloped upward toward shoreline, tracking the movement of the deep water.

The shoreward movement of deep, cool water during upwelling is also reflected in the salinity and density sections shown in Figure 3.5bc (middle and bottom frames on Page 3-20). The dense near-bottom water mass is more saline, which attests to its origins in the Southern California Bight. The northward flowing Davidson Current brings this saline water into the study region at depth. During upwelling, coastal salinity exhibits a seasonal maximum as a result of shoreward flow at depth. However, the vertical contrast in salinity is not as significant as the thermal contrast.

Dissolved Oxygen

In addition to nutrients, dissolved oxygen (DO) is necessary for a healthy marine ecosystem. Pollutants that are high in organic compounds can locally deplete oxygen levels and can have a deleterious affect on marine organisms. DO depletion arises from the bacterial degradation of oxidizable components in organic wastes. In extreme cases, this additional oxygen demand can reduce DO levels to below those necessary to support biological processes. These anoxic conditions can occur in the water column as well as in seafloor sediments, although their occurrence in the well-flushed open ocean is rare.

In general, surface waters are near saturation due to rapid gaseous exchange with the overlying atmosphere. These saturation concentrations are largely determined by sea surface temperature because it is the primary determining factor in gaseous solubility at the air-sea interface. Below this surface maximum, DO levels steadily decrease with depth due to natural losses from biotic respiration and decomposition, and from the lack of atmospheric exchange except when the water column is well mixed. Ambient DO concentrations within Estero Bay vary seasonally and range from 7.5 to 10.7 mg/L near the sea surface. Surface DO levels are typically lowest in the late summer and early fall when sea surface temperatures are highest. This reflects the inverse relationship between oxygen solubility and temperature. Under the stratified conditions during upwelling, DO levels decrease rapidly with depth and decline to 5 mg/L in as little as 50 m (Figure 3.6a, top frame on Page 3-22). These low oxygen concentrations are a consequence of the shoreward movement of deep, oxygen-poor water. These deep waters have not been in recent contact with the atmosphere, and ongoing respiration and decomposition have resulted in under-saturated oxygen levels along with enhanced nutrient levels.

pH

The hydrogen ion content (pH) of marine waters in the study region is similar to seawater in other oceans of the world. It is slightly alkaline, with a pH ranging between 7 and 8. The lack of strong geographic variation in pH is a consequence of the well-buffered nature of the carbonate system in seawater. The highest pH levels occur in the study region during spring upwelling when increased photosynthesis consumes carbon dioxide (CO_2) and produces oxygen near the sea surface. As the ratio of respiration to photosynthesis increases with depth, there is an increase in CO_2 and a decline in pH (more acidic).

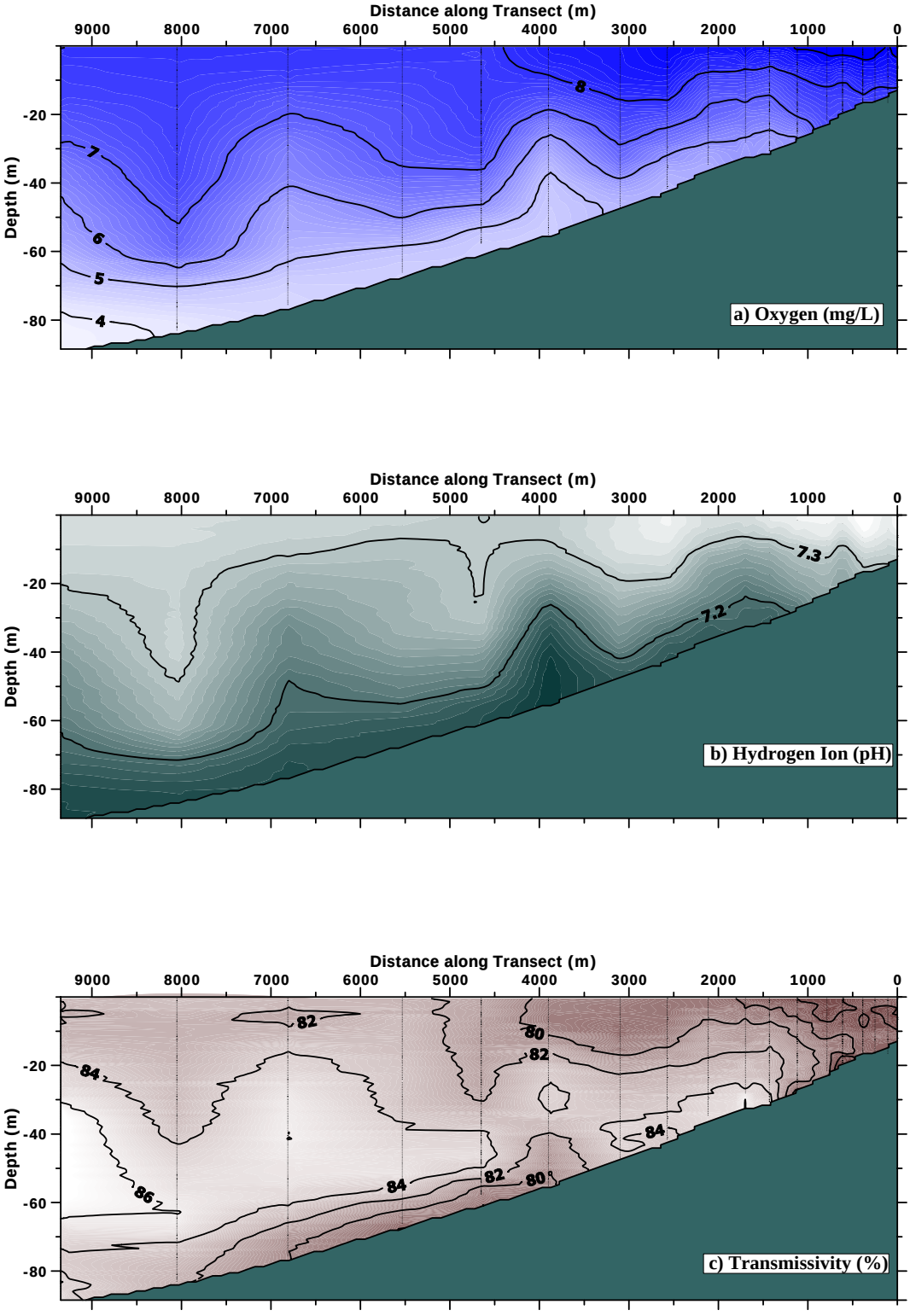


Figure 3.6 Cross-Shore Vertical Sections of: a) Oxygen, b) pH, and c) Transmissivity Collected across Estero Bay on 15 April 1999

Although the range is small, this vertical decrease in pH is evident in Figure 3.6b (middle frame on Page 3-22). Seawater alkalinity can also be temporarily affected by discharge of waste into the ocean if the pH of the wastewater is substantially different from that of the receiving waters. However, because of the well-buffered carbonate system, it tends to have only a localized effect in open-ocean waters.

Turbidity

Turbidity decreases the clarity of seawater and can limit the penetration of ambient light in the upper reaches of the water column. Turbidity is largely determined by the concentration of suspended particulate matter. Turbidity dictates the depth of the euphotic zone. The base of the euphotic zone is located where ambient light intensity is reduced to roughly 1% of surface illumination, which is the minimum necessary for phytoplankton growth. Turbidity is increased in coastal waters by phytoplankton blooms, storm runoff, sediment resuspension, and discharge of wastewater from municipal outfalls. Along the central California coast, substantial sediment input from rivers and runoff occurs in the form of large isolated pulses rather than a steady discharge of terrigenous material. Rare, intense storm events occasionally punctuate the prevailing semi-arid climate. Such storms generate large amounts of runoff which can result in profound but transient increases in coastal turbidity.

The MBCSD monitoring program measures turbidity around the outfall in two ways:

- *In situ* measurements of transmissivity, which is the relative amount of light transmitted along the fixed path of a transmissometer; and
- Secchi-disk depth, which measures ambient light penetration near the sea surface.

Secchi depths range between 1 m and 10 m within a few miles of the coast but extend to 30 m (100 ft) within the California Current farther offshore. In the survey area during 2006, most measured Secchi depths ranged between 3.5 and 7.5 m. The euphotic zone extends to approximately twice the Secchi depth. The greatest coastal water clarity in the upper water column and the deepest Secchi depths often occur during the late summer and fall when runoff and upwelling are normally minimal. During this time, the euphotic zone can extend throughout the entire water column near the coast. However, the increased planktonic biomass within the upper water column during the strong upwelling conditions around the time of the July survey, limited light penetration to approximately 7 m of the sea surface. Similarly, Secchi depths up to 9.5 m were recorded within the discharge plume during the October 2006 survey when it displaced deep low-turbidity seawater upward in the water column.

Coastal turbidity is also heavily influenced by wave-induced sediment re-suspension near the seafloor. Immediately outside the surfzone, transmissivity decreases near the seafloor during periods of high wave activity. This phenomenon is often observed at the outfall during the winter. When it coincides with upwelling, turbidity is also high at the surface from the presence of biogenic particulates. As a result, a mid-depth maximum in transmissivity (water clarity) is occasionally evident in vertical sections (Figure 3.6c, bottom frame on Page 3-22).

3.3 EFFECTS OF DISCHARGE

This section describes discharge-related trends in seawater properties observed during the four quarterly surveys of 2006. In particular, it evaluates compliance of the year-2006 wastewater discharge with the NPDES permit limitations on water quality. For the most part, the water-quality limitations were based on criteria in the COP (Table 3.1), the Central-Coast Basin Plan, and other state and federal policies that

were designed to protect marine life and beneficial uses of ocean waters. These receiving water standards are intended to evaluate whether discharges could cause significant impacts on water quality beyond the zone of initial dilution (ZID). Consequently, a part of this evaluation examines spatial trends that are related to outfall proximity, and whose amplitude significantly exceeds the inherent background variability arising from ambient oceanographic processes.

Spatial variability in offshore water quality is determined from the three-dimensional distribution of instrumental measurements of seawater temperature, salinity, density, transmissivity, DO, and pH that were collected on a quarterly basis. For timely reporting of water-quality status, a receiving-water report was prepared after each quarterly survey (MRS 2006cdef). Those reports included comprehensive listings of raw data that are not provided in this annual report. They also included more detailed discussions of vessel offset and perturbations observed in the instrumental measurements.

In contrast, the summary presented in this report consolidates the detailed results from each individual survey in an annual review where the influence of large seasonal variability in receiving-water properties becomes apparent. Table 3.7 provides a synopsis of conditions observed during the four offshore surveys. It guides the discussion of the seawater parameters presented in the subsections below. As described above, the ambient receiving-water conditions are largely dictated by the strength of upwelling processes that prevail at the time of the survey. The relative strength of upwelling can be gauged from indices determined from wind measurements collected along the central coast (Figure 3.7 on Page 3-25).

Table 3.7 Oceanographic Conditions during the Four Quarterly Receiving-Water Surveys

Conditions	January (winter)	April (spring)	July (summer)	October (fall)
Tide	Flood	Flood	Slack	Flood
Wave Height	1-2 /W	3-4 /SW	1-2 /W	1-2 /W
Flow Direction	SSW	North	West	NE then SE
Stratification	Low	Unstratified	Strong	Moderate
Water Clarity	Low	Moderate	Low	High
Upwelling	Weak	Downwelling	Strong	Moderate
Plume Visible	No	No	No	No
Plume Signature	Yes	Yes	Yes	Yes

As shown in the Figure, three of the four water-quality surveys were conducted on days when there was some degree of upwelling. The solid line shows the daily upwelling index where positive values reflect the strength of southeastward-directed winds near Estero Bay. These winds drive offshore surface flow, thereby inducing upwelling near the coast. A comparison of the daily index (solid line) and 30-day running average (dashed blue line) reveals substantial daily variation in the strength of the along-shore winds. The indices show that a consistent period of upwelling (delineated by the green shading in Figure 3.7) began shortly after the April survey and lasted through the end of the year, as delineated by green shading in the figure).

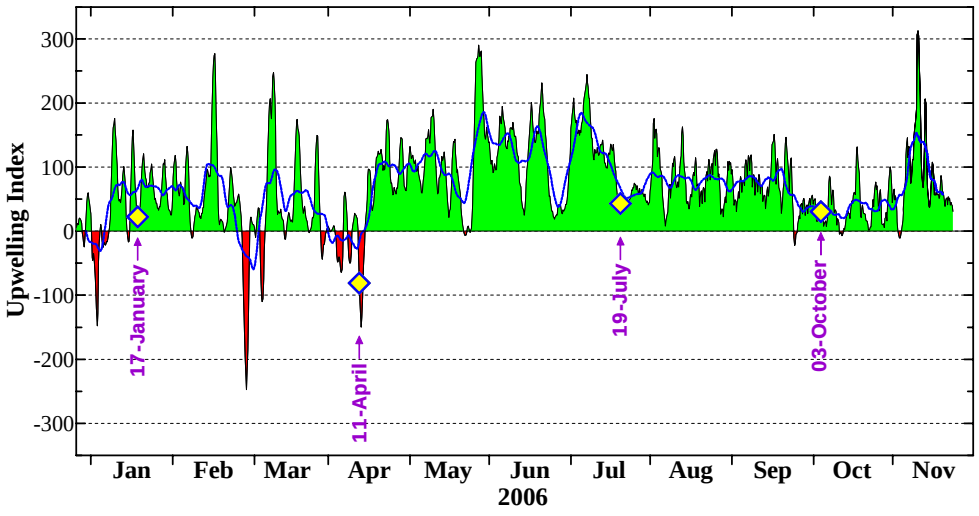


Figure 3.7 Daily and Monthly Average Upwelling Index ($m^3/s/100m$ of coastline)

Prior to that time, winds directed toward the northwest were associated with the passage of winter storms and caused brief periods of substantial downwelling (delineated by red shading in the figure). The April survey was conducted during one such storm event. Periods of rain were documented during the survey and wave heights were elevated compared to other surveys (Table 3.7).

As the antithesis of upwelling, downwelling associated with northward-directed storm-winds forces surface waters to move toward the shoreline. This displaces deeper water offshore, and results in a more uniform water column. The absence of stratification during the April survey is reflected by the nearly constant temperature that was measured throughout the water column. Compare, for example, the nearly straight blue line in Figure 3.4 on Page 3-19 with the stratified temperature profiles that were measured during the other surveys.

Upwelling was present, although its strength varied, during each of the other three surveys. The strongest northwesterly winds[2] and most intense upwelling prevailed during the July survey. Upwelling during the October survey was moderate, but was present all along the central coast. Its signature is apparent in the satellite image shown on the cover of this report. The cover image was recorded during the survey when clear skies permitted infrared sensors on one of NOAA's polar orbiting satellites to measure sea-surface temperatures throughout the region. The presence of much cooler seawater (<15°C) near the coast is delineated in the image by blue and purple shading. At Point Arguello, this upwelled water extends well offshore, as is typical during upwelling conditions. Within Estero Bay, somewhat colder sea-surface temperatures (near or below 14°C) were consistent with the near-surface temperatures measured by the CTD during the survey, as shown by the green line in Figure 3.4 on Page 3-19. The satellite image shows that because of coastal upwelling, seawater temperatures near the outfall were more than 4°C cooler than ambient temperatures farther offshore.

[2] "Northwesterly" winds refer to winds blow from the northwest toward the southeast.

Although the plume signature was detected by instrumental observations in all four surveys, it was not observed visually during any of the surveys. Accordingly, neither odors nor debris of sewage origin were observed at the sea surface. In fact, the instrumental data indicated that water properties beyond the ZID were typical of the range in natural background conditions within coastal seawater. Qualitative observations of aesthetic characteristics and beneficial uses also documented the lack of impacts from wastewater discharge. These aesthetic observations demonstrate compliance with Section C (Physical Characteristics) of the COP (Table 3.1). The two incidents of elevated coliform densities in the surfzone were associated with non-point onshore sources and not with the discharge of treated wastewater. All other receiving water parameters were also in compliance with permit criteria.

Compliance with discharge requirements notwithstanding, slight salinity anomalies indicated the localized presence of exceedingly dilute wastewater near and within the ZID during all the surveys. In one case, measurements close to a diffuser port captured the signature of wastewater shortly after discharge. It was characterized by small, highly-localized anomalies in all six seawater properties that reflected wastewater that was undergoing intense mixing and rapid dilution. These and the other discharge-related anomalies confirmed the continued effectiveness of the outfall and diffuser in rapidly dispersing treated wastewater shortly after discharge.

3.3.1 Observations of Beneficial Use

Observations of beneficial use demonstrated that the coastal waters in the outfall vicinity and along adjacent shoreline continued to be utilized by humans and wildlife during the 2006 water-quality surveys. There was no evidence indicating that the presence of the discharge enhanced or detracted from the beneficial uses that were identified for northern Estero Bay in the Basin Plan (see Section 2.1.2). Specifically, fish, marine mammals, and seabirds were observed utilizing the area within and around the ZID area as marine habitat (*viz.*, the *MAR* beneficial use identified for the waters of Estero Bay in the Central-Coast Basin Plan outlined in Section 2.1.2). The presence of surfers, beachcombers, and commercial and recreational fishing boats attested to the use of the waters for water recreation (*REC-1* and *REC-2*), transportation (*NAV*), and fishing (*COMM*).

A variety of marine organisms were observed during the 2006 water-quality surveys, including seabirds. Large numbers of California brown pelicans (*Pelecanus occidentalis californicus),* western gulls (*Larus occidentalis*), Heermann's gulls (*Larus heermanni*), pelagic cormorants (*Phalacrocorax pelagicus*), and Brandt's cormorants (*Phalacrocorax penicillatus*) were observed transiting through the survey area. Additionally, California least terns (*Sterna Antillarum Browni*) were observed foraging near the ZID, while several sooty shearwater (*Puffinus griseus*) and a lone common murre (*Uria aalge*) were observed in transit near the survey area.

In addition to seabirds, juvenile sea lions (*Zalophus californianus*) and southern sea otters (*Enhydra lutris nereis*) made their presence known during the surveys. Typically, higher numbers of sea lions and otters were observed near the Morro Bay harbor entrance during transit to the survey site, than at the survey site itself. Southern sea otters are a federally and state-protected species that feed almost entirely on macroinvertebrates (Ebert 1968, Estes et al. 1981, Riedman and Estes 1990). Since the arrival of a raft of 30 to 40 sea otters just north of Port San Luis was observed in 1974 (Gotshall et al. 1984), they have become increasingly prevalent in the vicinity of Estero Bay (Gotshall et al. 1986). Over the past several years, a semiannual census has regularly counted more than 100 otters in the region (CDFG 2005). Although the census data confirms that Estero Bay is not a major pupping or nursery area, recent telemetry studies have highlighted Estero Bay as a "male aggregate area" where adult and subadult male

otters are known to congregate (MMS 2006). Based on the spring 2006 census, there are currently about 2,735 southern sea otters in the waters off California extending from Half Moon Bay south to Santa Barbara. The majority of male otters make regular long-distance movements throughout this range

Recreational (*REC*) beneficial uses were also in evidence during the 2006 surveys. For example, non-contact water recreational activities, designated as *REC-2* in the Basin Plan, were consistently observed along Atascadero Beach during the regularly conducted surfzone surveys. Individuals were documented sunbathing, hiking, jogging, surf fishing, beachcombing, and walking their dogs on the beach. Beach camping is permitted at the Atascadero State Beach RV Park located near surfzone Station A shown in Figure 3.1. Water-contact recreation, designated *REC-1* in the Basin Plan, also occurs frequently along the beach adjacent to the outfall. This includes activities such as surfing, swimming, body surfing, kayaking, and kite and wind surfing.

Commercial and sport-fishing vessels were regularly observed during the course of the quarterly surveys, demonstrating the area's ocean-fishing (*COMM*) usage. For example, the party fishing vessel F/V *Patriot*, out of Avila Beach, was observed offshore of the survey area, while the bait vessel F/V Billy Boy, which is based in Morro Bay, was observed operating approximately 100 m inshore of the survey area during the October survey. The kelp cutter, M/V *Ocean Rose*, also based in Morro Bay, followed the survey vessel out of the bay before the July survey. It transited the survey area on its way to the kelp beds north of Estero Point. Other vessels, such as sailboats, also commonly travel through the survey area, demonstrating its use for navigational use (*NAV*). Dredging was occurring in the mouth of Morro Bay during the July 2006 survey. The dredge spoils were deposited south of the bay entrance, and the associated turbidity plume did not affect the survey area.

3.3.2 Instrumental Observations

The signature of the effluent plume was detected in all four surveys conducted during 2006. Table 3.8 and Table 3.9 on Page 3-28 summarize the seven identifiable perturbations in seawater properties that were associated with wastewater discharge. Portions of Perturbations P1 through P6 were located within the ZID boundary, where most receiving-water limitations do not apply. All of the perturbations were associated with anomalies in the salinity field (Figure 3.8 on Page 3-29). Additionally, all of the perturbations were also associated with anomalies in at least one of the other two seawater properties that determine the dynamics of the flow field, namely temperature and density (Table 3.8), as well as one or more of the three properties related to water quality, namely, transmissivity, DO, and pH (Table 3.9).

Two distinct discharge-related processes create anomalies in seawater properties. Both of these physical processes arise from the seafloor discharge of buoyant effluent.

- Effluent-induced anomalies are caused by the presence of trace amounts of wastewater constituents that have yet to completely mix with receiving waters.
- Entrainment-generated anomalies are caused by the upward displacement of deep ambient seawater that has been entrained by the rising effluent plume.

Table 3.8 Perturbations in Dynamical Seawater Properties Associated with Effluent Discharge

Perturbation	Survey	Station	Dilution	Anomaly[1] Salinity (‰)	Anomaly[1] Temperature (°C)	Anomaly[1] Density (σ_t)	Depth (m)	Height of Rise (mab)[2]	Diffuser Distance[3] (m)	Figure
P1	January	4	>126[4]	**–0.276**[5]	—[6]	**–0.188**	11.0	6.5	8.7	3.8a, 3.9a
P2	January	4	795	–0.042	–0.27	+0.045	3.5	14.0	5.8	3.8a
		5	669	–0.050	–0.27	+0.044	8.0	9.0	53.1	3.8a
P3	April	10	>>56	**–0.581**	**+0.13**	**–0.476**	15.5	0.5	1.1	3.8b, 3.10ab
P4	April	2	>427	–0.077	—	–0.051	8.5	8.0	27.0	3.8c
		3	>245	**–0.134**	—	**–0.106**	12.0	4.0	9.6	3.8c
P5	July	3	>734	–0.046	—	–0.069	2.5	14.5	7.8	3.8d
			>603	–0.056	+0.50	–0.096	10.0	7.0	9.2	3.8d, 3.11ab
P6	July	9	355	**–0.095**	–0.50	+0.068	3.5	13.5	23.2	3.8e
P7	October	4	375	**–0.089**	**–0.55**	+0.059	8.0	9.0	18.8	3.8f, 3.12ab
		5	412	**–0.081**	—	—	5.0	12.0	57.5	3.8f
		5	668	**–0.050**	—	—	11.0	6.0	58.4	3.8f
		6	498	**–0.067**	—	—	9.0	8.0	85.8	3.8f
		16	668	**–0.050**	—	—	3.0	14.0	37.8	—

[1] Amplitude of a water-property measurement above the average value computed from measurements at the same depth level at all other stations. For a given perturbation, the largest anomaly is listed.
[2] Height-of-rise in mab (meters above the bottom) to the largest anomaly within the water column, *i.e.* vertical distance measured from the seafloor rather than the sea surface.
[3] Horizontal distance from the largest salinity anomaly to the closest portion of the diffuser structure. Compare this distance with the 15.2-m wide ZID for assessing compliance.
[4] Based on the observed salinity anomaly and Equation 3.2.
[5] Anomalies highlighted with bold typeface and shading were found to be statistically significant at the 95% confidence level.
[6] No discharge-related anomaly was evident in this water property.

Table 3.9 Perturbations in Water-Quality Parameters Associated with Effluent Discharge

Perturbation	Survey	Station	Dilution	Anomaly Transmissivity (%)	Anomaly DO (mg/L)	Anomaly pH	Depth (m)	Diffuser Distance (m)	Figure
P1	January	4	>126	–11.8	—	—	12.0–15.0	8.9	3.9b
P2	January	4	795	+11.6	–1.3	–0.04	3.5–10.5	7.2	3.9b
		5	669	+16.0	–1.3	–0.05	4.5–11.5	53.2	
P3	April	10	>>56	**–5.9**	+0.06	–0.006	13.0–15.5	0.6	3.10cde
P4	April	2	>427	–3.9	—	—	7.0–9.0	27.9	—
		3	>245	–2.0	—	—	9.5–12.5	10.5	—
P5	July	3	>603	**–8.0**	+1.7	–0.021	11.0–16.5	10.2	3.11cde
P6	July	9	355	+4.6	–1.0	–0.08	0.0–6.5	22.6	—
P7	October	4	375	+5.4	–0.7	–0.04	1.0–12.5	15.6	3.12cde

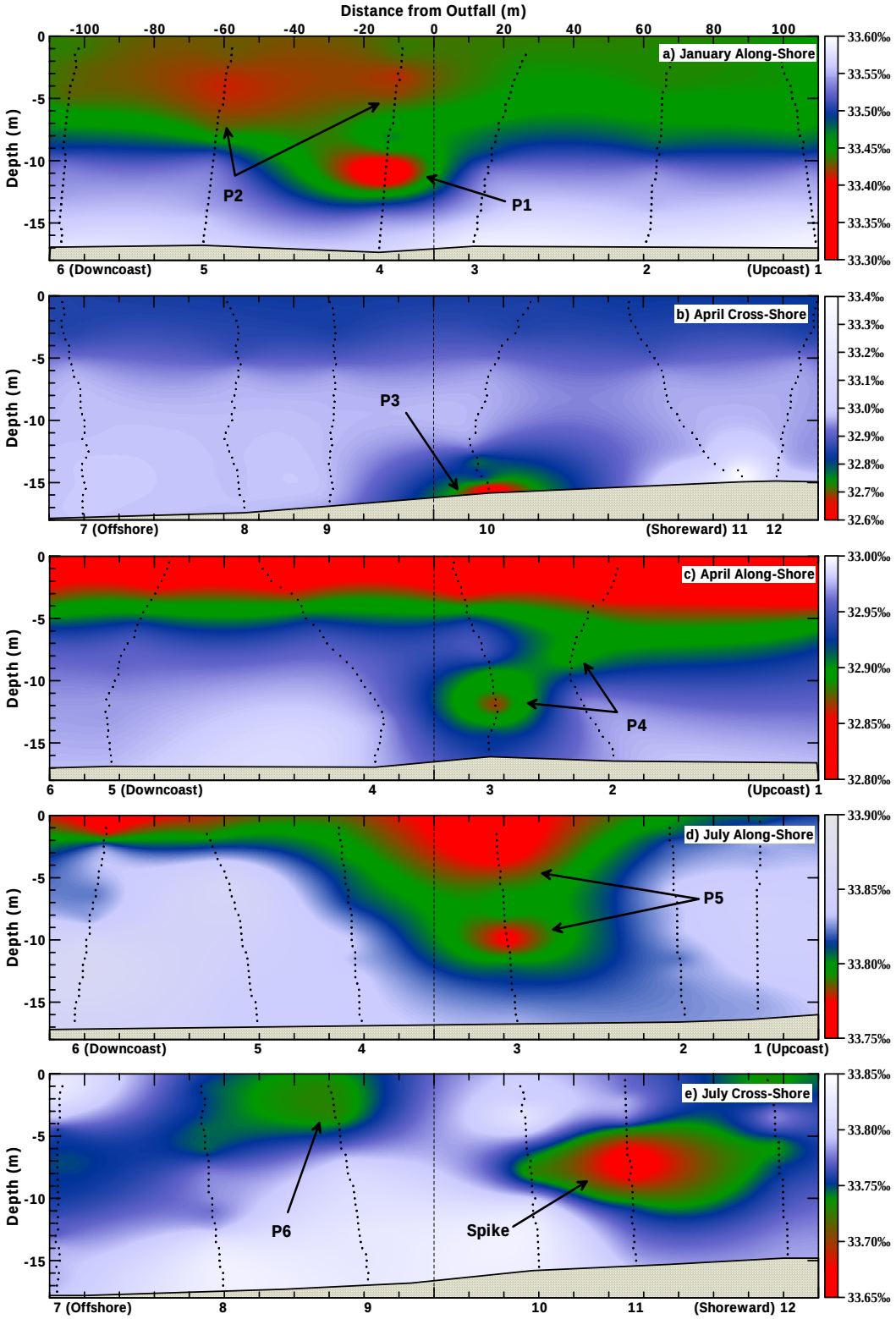


Figure 3.8 Discharge-Related Salinity Perturbations

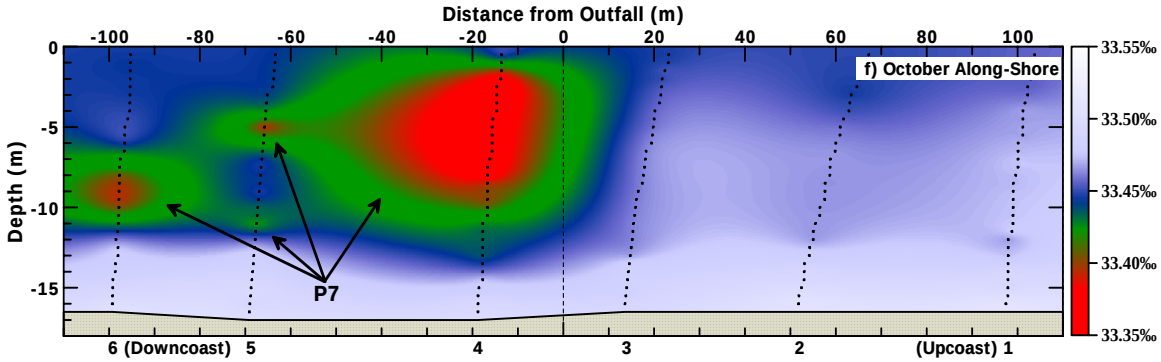


Figure 3.8 Discharge-Related Salinity Perturbations (continued)

Water-quality anomalies associated with four of the seven perturbations were generated by the upward displacement of deep ambient seawater that had been entrained by the rising effluent plume rather than by the presence of wastewater constituents. The only exceptions were the anomalies associated with Perturbations P1, P3, and P5, which were all measured close to the discharge point. These perturbations discerned slight increases in turbidity caused by the presence of trace amounts of wastewater particulates that were in the process of dispersing within the ZID shortly after discharge.

As is discussed below, the character of the seawater anomalies differentiates the two types of discharge-related processes. Often, both processes act together to form a series of vertical anomalies wherein slugs of partially mixed ambient bottom water are carried upward by the buoyant effluent plume. This creates tightly packed vertical gradients in seawater properties and inversions that are indicative of ongoing turbulent mixing (See for example, the distinctive character of Perturbation P3 in Figure 3.10 on Page 3-37).

Most of the time, anomalies in seawater properties other than salinity, are generated by the entrainment of ambient bottom water. This is evident from the similarity in the properties within the anomalies, and the properties within ambient seawater at depth. The vertical connection between entrainment-generated anomalies and deep ambient seawater is particularly apparent in Perturbation P7, which is shown in the vertical section of Figure 3.12 on Page 3-42. In contrast, wastewater-induced anomalies tend to be spatially isolated from the properties of ambient seawater near the seafloor. This isolation is apparent in several of the salinity anomalies shown in Figure 3.8. Similarly, the highly localized anomalies associated with Perturbations P1 (Figure 3.9 on Page 3-36), P3 (Figure 3.10 on Page 3-37) and P5 (Figure 3.11 on Page 3-39) were disconnected from ambient properties measured in the upper water column. They indicate areas where the wastewater particulates had yet to dissipate to levels below the detection limits of the highly sensitive CTD instrumentation.

Anomalies Unrelated to Discharge

A number of statistically significant anomalies identified in the 2006 water-quality database were clearly unrelated to the discharge. There were 12,234 water-quality observations reported at standard 0.5-m intervals in 2006. Each observation was evaluated for its departure from mean conditions. For each observation within a given survey, its departure or anomaly was computed by subtracting the observed value from the average of the 15 other measurements collected at the same depth level at other stations. Measurements collected within 10 m of the sea surface were compared with the mean of the measurements collected at the same distance below the ocean surface at the 15 other stations. Deeper measurements were

compared with the mean of measurements collected at the same height above the sloping seafloor. This is because deeper water properties tend to parallel the sloping seafloor rather than the horizontal sea surface.

The statistical significance of these departures from ambient conditions was evaluated using an analysis of variance that compared the amplitude of a single anomaly with the inherent natural variability in observations (see Page 228 in Sokal and Rohlf 1997). Natural variability was estimated from the standard deviation of all measurements for a given seawater parameter (e.g., salinity). The COP (SWRCB 1997) defines a '*significant*' difference '*as a statistically significant difference in the means of two distributions of sampling results at the 95 percent confidence level*.' Consequently, statistically significant anomalies were identified as those that departed from mean conditions by more than the 95-percent confidence interval determined from the standard deviation and number of observations used to compute the average.

Although 15 independent hypothesis tests were performed at each depth level, no Bonferroni adjustment to the error rate was applied; so the tests are conservative. As a result, the actual confidence level for the overall null hypothesis test for differences was higher, at approximately 99.7%, rather than the 95% level that applies to a single test. Also, the standard deviation that was applied in the tests was determined from the entire data set collected during a given survey. Thus, it reflects the full range in the variability in ambient properties, including vertical variations. As a result, an anomaly of given amplitude is less likely to be found statistically significant if it was measured at a time when the water column was highly stratified (July), than when the water column was relatively unstratified (April). That is why the thermal anomaly of +0.13°C associated with Perturbation P3 was determined to be a statistically significant departure from the uniform conditions during the April survey (listed with bold typeface and shading in Table 3.8), yet the much larger thermal anomaly (+0.5°C) found in the July survey (Perturbation P5) was not determined to be materially different given the highly stratified conditions that prevailed at that time.

About one-third of the discharge-related anomalies listed Table 3.8 and Table 3.9 were statistically significant. The other anomalies listed in the tables did not represent statistically significant departures from the mean conditions. Nevertheless, they were deemed to be related to the discharge because of their proximity to the diffuser structure and their spatial coincidence with anomalies in other seawater properties. Just as some discharge-related anomalies are not statistically significant, not all statistically significant anomalies are necessarily related to the discharge. Table 3.10 lists the eighteen statistically significant anomalies that were not included in Table 3.8 and Table 3.9 because they could not be ascribed to the discharge of wastewater.

Some of these significant non-discharge anomalies were associated with particular oceanographic processes that locally alter seawater characteristics, while others occurred by chance alone. Even in the absence of effluent discharge, one would expect to find a number of statistically significant anomalies in ambient seawater properties. By the very definition of a 95% confidence level, one '*significant*' departure out of every 20 measurements is expected to occur by chance alone. With 1,962 measurements examined for each parameter, it is not surprising that some depart from the mean by slightly more than the 95% confidence interval. With that many measurements, nearly 100 significant departures could be expected to occur by chance alone. The eighteen anomalies listed in Table 3.10 represent statistically significant departures in the individual half-meter measurements that were unrelated to the discharge. All have one or more specific characteristics that distinguish them from the discharge-related anomalies identified in Table 3.8 and Table 3.9. These characteristics are listed in the second column of Table 3.10, and are described in more detail below.

Table 3.10 Inventory of Statistically Significant Anomalies that were Unrelated to Effluent Discharge

Survey	Cause	Station	Depth (m)	Property	Magnitude
January	BL	1	16.0	Transmissivity	–23.8 %
	BL Sign	5	16.5	Transmissivity	+18.9 %
	BL	11	15.5	Transmissivity	–26.1 %
	BL	13	17.0	Transmissivity	–22.8 %
April	Unstratified Equilibration	1	13.5-15.0	pH	–0.008 pH
	Unstratified Equilibration	2	14.5-16.0	pH	–0.008 pH
	Unstratified	5	3.0	Dissolved Oxygen	–0.18 mg/L
	Unstratified	7	5.5	Dissolved Oxygen	–0.13 mg/L
	Unstratified	13	6.5	Dissolved Oxygen	–0.13 mg/L
	Unstratified	15	8.0	Dissolved Oxygen	–0.13 mg/L
July	Spike	10	8.0	Salinity	–0.094 ‰
	Spike	11	4.5-9.0	Salinity	–0.169 ‰
	Spike	12	2.0	Salinity	–0.124 ‰
	Spike	13	4.5	Salinity	–0.089 ‰
	Spike	16	5.5-6.0	Salinity	–0.119 ‰
	Spike	16	9.5-10.0	Salinity	–0.092 ‰
	BL Sign	13	17.0	Transmissivity	+8.4 %
October	Equilibration	2	13.0-16.0	pH	–0.067 pH

In addition to the individual features of these anomalies that distinguish them from the discharge-related anomalies in Table 3.8, the non-discharge anomalies listed in Table 3.10 were not spatially coincident with other seawater anomalies. In particular, most were not spatially coincident with perceptible salinity anomalies, which often provide the best indicator of the presence of wastewater constituents. Thus, discharge-related anomalies tend to be spatially coincident with anomalies in other water properties, especially salinity variations. In particular, when there is a perceptible increase in turbidity due to the presence of wastewater particulates (negative transmissivity), it always coincides with a strong negative salinity anomaly. For example, the 5.9% reduction in water clarity measured near the seafloor at Station 10 (Perturbation P3 in Table 3.9), coincided spatially with a marked reduction in salinity (Table 3.8). Reduced salinity is the clearest signature of the presence of dilute wastewater constituents. It is the largest, and often the only signature of wastewater constituents within the receiving waters.

Thus, the discharge-related anomalies listed in Table 3.8 and Table 3.9, and shown in the vertical sections, demonstrate that discharge-related perturbations tend to be distinguished by coincident anomalies in a number of independent seawater properties. In contrast, the isolated occurrences of a significant anomaly in only one seawater property, such as those listed in Table 3.10, result largely from inherent variability in ambient seawater properties that is unrelated to the discharge. The origins of these significant, non-discharge related anomalies are related to one or more of the specific causes that are discussed below.

BL (Boundary Layer): A sharply defined, turbid layer of seawater often resides immediately above the seafloor. Oscillations in the thickness of this benthic boundary layer (BL), or differences in the height of the CTD measurement within this layer, can result in lateral anomalies in water properties that are per-

ceived to be statistically significant. Transmissivity measurements are particularly susceptible to these errors because even a slight upward displacement of the boundary associated with this turbid seafloor layer generates statistically significant differences with the markedly less-turbid measurements collected at the same depth level at other stations. A particularly distinct benthic boundary layer was present during the January and July surveys. During these surveys, the boundary layer was only about 0.5-m thick. Thus, the nominal CTD sampling interval of 0.5 m spanned a significant portion of this thin layer. The BL interface was also particularly sharp, so the slight variations in the location of the near-bottom CTD measurements relative to the BL interface resulted in lateral variations in transmissivity that appear as statistically "*significant*" lateral differences (Table 3.10).

Sign: Often, the sign or direction of an anomaly determines its origin. Effluent is generally more turbid, less dense, warmer, and much less saline than receiving ocean waters. Consequently, negative density and salinity anomalies, combined with positive thermal anomalies, are clear indicators of effluent that is continuing to undergo intense mixing within receiving waters. Conversely, positive transmissivity anomalies reflect less-turbid water, which is not indicative of the presence of wastewater particulates. In this regard, two of the BL anomalies in Table 3.10 were particularly diagnostic of the effects of random variation in the thickness of the BL. The transmissivity anomaly near the seafloor at Station 5 during the January survey was a positive anomaly where water clarity was higher than at surrounding stations. Thus, it could not have been caused by the presence of turbid wastewater. Instead, it was generated because the BL at that station was thinner than at the surrounding stations (Figure 3.9b). The statistically significant transmissivity anomaly observed near the seafloor at Station 13 during the July survey reflected a similar situation. Because both of these transmissivity anomalies represented increases in water clarity, they could not have been generated "*…as the result of the discharge of waste*" (SWRCB 1997).

Unstratified Receiving Water: In the April 2006 dataset, six DO and pH observations were found to be statistically significant but unrelated to the discharge (Table 3.10). Even though they represented significant departures from the mean condition during that survey, the magnitudes of these anomalies were extraordinarily small. In fact, they were deemed significant only because overall variability within that particular dataset was limited by the lack of vertical stratification at the time of the survey. During other surveys, discharge-related DO and pH anomalies, which were an order of magnitude larger (Table 3.9), were not found to be statistically significant relative to the stronger vertical variation in ambient seawater properties. The four isolated DO anomalies observed in the upper water column at Stations 5, 7, 13, and 15 during the April survey were artifacts of slight instabilities in the oxygen sensor that became apparent only because of the relatively uniform field of ambient DO measurements. Their amplitudes (≤0.18 mg/L) were close to the stated accuracy of the sensor (refer to Table 3.5 on Page 3-12). Similarly, as discussed below, the statistical significance of the two pH anomalies in April resulted from the incomplete equilibration of the pH sensor at the beginning of the survey. As with the DO anomalies, the amplitudes of the pH anomalies (0.008 pH) were also very close to the instrument resolution (± 0.006 pH) stated by the manufacturer. None of the DO or pH anomalies were spatially coincident with the discharge-related perturbations in other seawater properties. These anomalies would not have been significant had they been measured when the water column was more stratified.

Equilibration: Incomplete equilibration of the pH sensor was apparent in the data collected at the beginning of the April and October surveys. The pH sensor requires an extended period of time to fully equilibrate to seawater after exposure to the atmosphere between deployments. While the resulting temporal trend can be reliably removed from the pH measurements, prolonged exposure to the atmosphere between surveys can also affect the initial dynamic range of the pH measurements. During the initial deployment at Stations 1 and 2 during the April survey, the reduced dynamic range in the pH sensor resulted in meas-

urements that were slightly lower than the pH measurements taken near the seafloor at surrounding stations. Although small in amplitude, this pH difference was large enough to be statistically significant when compared to the negligible variation among other pH measurements collected during the survey. In both those cases, and at Station 2 during the October survey, the temporal correction did not fully accommodate the initially reduced dynamic range of the pH probe. As a result, slight, but statistically significant departures from mean conditions were artificially generated near the seafloor. As discussed above, the significance of these departures was compounded by the low overall range in pH during the April 2006 survey, causing even slight differences in the pH measurements to appear relatively important.

Salinity Spiking: Although negative salinity anomalies are often indicative of the presence of wastewater constituents, salinity anomalies can also be artificially introduced when the CTD instrument package crosses a sharp thermocline. Salinity is computed from conductivity and temperature readings from probes that do not measure the same water parcel because the sensors are physically separated within the CTD instrument package. In addition, the sensors do not have the same response times. Consequently, when passing though regions of sharp temperature gradients, the mismatch between the conductivity and temperature measurements causes erroneous spikes in salinity. Salinity spiking is a common occurrence when the water column is well stratified. This was the case during the July 2006 survey (red line in Figure 3.4 on Page 3-19), when salinity spiking caused excursions that were large enough to be statistically (Table 3.10). The erroneous salinity spikes were identified from visual inspection of high-resolution vertical profiles of temperature and salinity. The localized influence of salinity spiking in the dataset is also visually apparent at Stations 10, 11, and 12 in Figure 3.8e.

Wastewater-Induced Anomalies

Negative salinity anomalies are the only consistent indicator of the presence of wastewater constituents within receiving water (Table 3.8). Salinity in wastewater is negligible compared to that of the receiving seawater, and a distinct salinity minimum provides *de facto* evidence of the presence of wastewater constituents. All seven of the discharge-related perturbations were associated with salinity anomalies. Five of the seven perturbations exhibited statistically significant reductions in salinity. The remaining two Perturbations (P2 and P5) had salinity anomalies that were visually apparent in the vertical sections (Figure 3.8ad), but were too small to be of significance relative to the ambient variability in salinity at the time of the surveys.

Salinity is particularly useful as a tracer of wastewater constituents because it directly quantifies the amount of dilution that has been achieved by initial mixing. Specifically, wastewater has essentially no salinity, so C_e can be neglected in Equation 3.1, and dilution (D) can be computed from the salinity anomaly ($A = C_o - C_s$) as:

$$D = \frac{-C_o}{(C_o - C_s)} \equiv \frac{-C_o}{A} \qquad \textbf{Equation 3.2}$$

where:

D = the dilution ratio of the volume of seawater mixed with wastewater,
C_o = the salinity of the wastewater-seawater mixture after dilution by D,
C_s = the background seawater salinity, and
$A = C_o - C_s$ = the salinity anomaly.

The instantaneous dilution factors (D) shown in Table 3.8 and Table 3.9 on Page 3-28 were computed using each respective salinity anomaly in Equation 3.2. The computed dilution factors range from 56:1 for the strong salinity anomaly (Perturbation P3) measured within a discharge jet during the April survey, to 795:1 for the weak anomaly (Perturbation P2) measured far (53 m) from the diffuser during the prior survey. Based on the smallest statistically significant salinity anomaly (Perturbation P7), wastewater-induced salinity anomalies with amplitudes less than approximately |-0.05‰| cannot be reliably discerned against the backdrop of ambient salinity variability. Accordingly, wastewater diluted more than approximately 700 times becomes imperceptible within the variable ocean environment, even for highly sensitive instrumentation capable of resolving extremely small salinity variations (0.0006‰ from Table 3.5 on Page 3-12).

Except for the discharge-related salinity anomalies, only a few small, highly localized anomalies in other seawater properties were induced by the presence of wastewater constituents. Instead, as discussed in the next section, most of the discharge-related anomalies were produced by the entrainment of ambient bottom water. Anomalies induced by the presence of dilute wastewater constituents were apparent as:

- Reduced density and transmissivity within Perturbations P1, P3, and P5;
- Increased temperature and DO within Perturbations P3 and P5; and
- Reduced pH within Perturbation P3 and P5.

The offset direction in each property was consistent among the wastewater-induced perturbations. This was because wastewater is generally warmer, more turbid, more oxygenated, more acidic, and less dense than the receiving waters at depth. In contrast, offsets generated by the upward displacement of ambient seawater were not always consistent among perturbations because they were dictated by natural vertical differences present at the time of the surveys.

The density and transmissivity anomalies associated with Perturbations P1 and P2 (Figure 3.9) highlight the differences between wastewater-induced anomalies, and anomalies generated by the upward displacement of ambient seawater. The vertical sections shown in Figure 3.9 captured a transient dynamic condition where effluent was undergoing rapid turbulent mixing during the plume's buoyant ascent. Perturbation P1, which is located at depth at Station 3, is diagnostic of the presence of wastewater constituents, while Perturbation P2 reflects the upward movement of ambient seawater. Figure 3.9a shows the buoyant Perturbation P1 pushing a slug of higher density seawater above it (Perturbation P2). Such an inversion is not normally observed under natural conditions because overturn occurs rapidly under ambient open-ocean conditions. Turbulent vertical overturn induces rapid mixing.

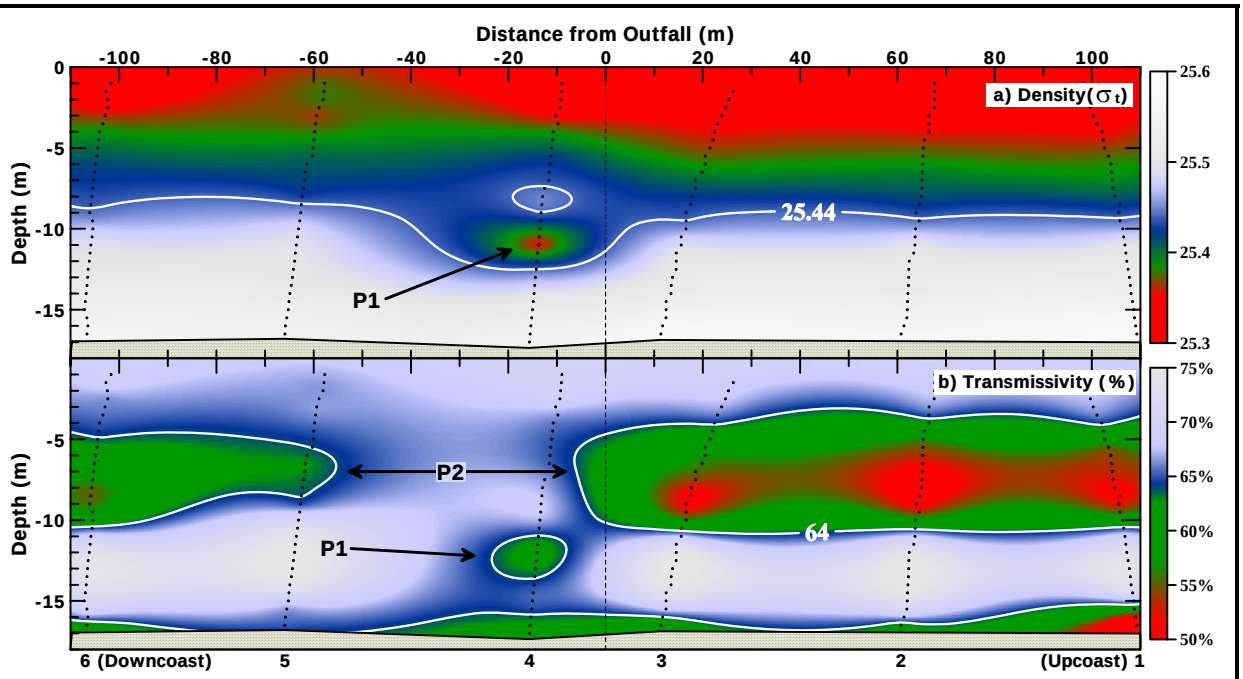


Figure 3.9 January Along-Shore Distribution of Seawater Properties Characterizing Perturbation P1

Figure 3.9b shows that Perturbation P1 had higher turbidity at Station 4 than ambient seawater at adjacent stations at the same depth. Increased turbidity would be expected from the presence of wastewater particulates. In addition, a naturally occurring layer of significantly increased turbidity was present between 5 m and 10 m throughout the area during the January survey. However, at Station 4, seawater that was naturally low in turbidity was displaced upward by the discharge. It penetrated the high-turbidity layer and resulted in the anomalous increase in water clarity that was associated with Perturbation P2 (Transmissivity in Table 3.9). An anomalous increase in water clarity is not expected from the presence of wastewater particulates, so this anomaly was undoubtedly produced by a physical process (upward displacement) rather than the presence of wastewater constituents.

High-resolution measurements within Perturbation P3 provided new empirical insight into the rapid dispersion of wastewater shortly after discharge, and into the influence of various wastewater constituents on seawater properties. The CTD instrument package passed particularly close (<1 m) to the diffuser structure in the vertical profile at Station 10 during the April survey. As a result, it recorded dilution values within the turbulent discharge jet shortly after ejection from a diffuser port. The resulting negative salinity and density anomalies had the largest amplitudes ever recorded in two decades of monitoring (Perturbation P3 in Table 3.8). This unusual encounter also documented the presence of wastewater particulates as reflected by the highly localized reductions in density, transmissivity, and pH (Figure 3.10ace on Page 3-37), and the increased temperature and DO near the seafloor at Station 10 (Figure 3.10bd).

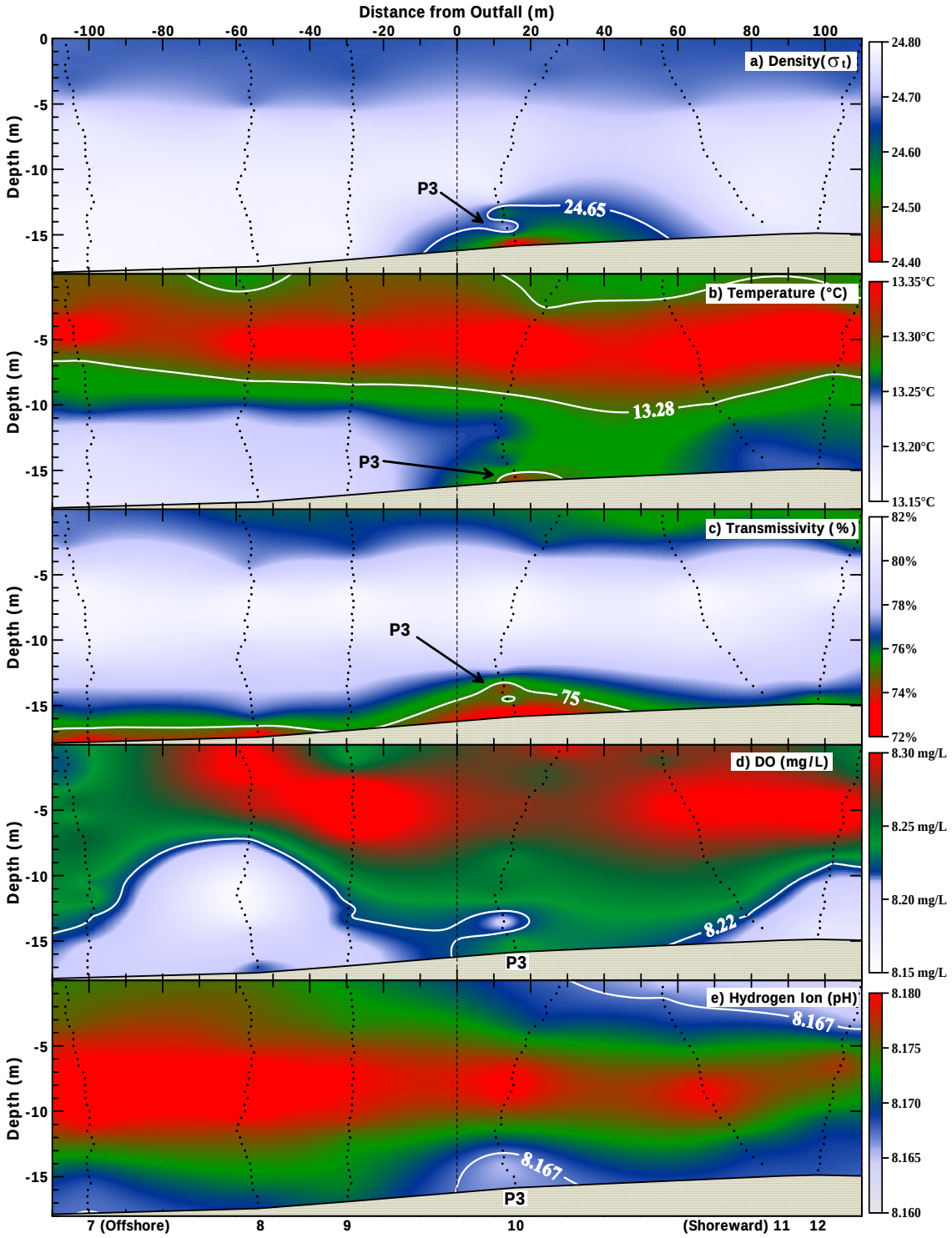


Figure 3.10 April Cross-Shore Distribution of Seawater Properties

It is noteworthy that the anomalies in DO and pH associated with this perturbation were not statistically significant, despite the perturbation's proximity to the discharge (Table 3.9 on Page 3-28). Instead, as discussed in the following section, significant anomalies in these properties are usually generated by the upward displacement of ambient seawater entrained in the effluent plume. The increase in DO concentration associated with Perturbation P3 reflects the high dissolved oxygen content of the effluent that results from its recent contact with the atmosphere. Normally, reductions in DO due to the discharge of oxygen-demanding materials within wastewater are of greatest concern. However, the MBCSD treatment efficiently removes nearly all of this organic material, and, as a result, dissolved oxygen levels within the effluent are actually higher than those of the ambient seawater at depth.

The thermal anomaly associated with Perturbation P3 is also indicative of the presence of dilute wastewater (Figure 3.10b). The positive thermal anomaly was observed less than 1 m from a discharge port and reflects a 0.13ºC temperature increase over the surrounding seawater near the seafloor.

In contrast to the wastewater-induced thermal anomaly within Perturbation P3, it is not clear that the associated turbidity anomaly was entirely due to the presence of wastewater particulates. It is likely that the transmissivity anomaly was amplified by entrainment of turbid seawater within the benthic boundary layer that was present at most other stations during April survey (delineated by red and green shading in Figure 3.10c). In this case, some of the increased turbidity may have been generated by the entrainment of naturally turbid water near the seafloor. In any regard, this transmissivity anomaly was relatively small in amplitude, particularly considering its close proximity to the point of discharge. Even though it was statistically significant, it is apparent from the transmissivity cross-section that the measured transmissivity was comparable to ambient seawater near the seafloor at Stations 7 and 8.

During the July survey, the presence of wastewater constituents was also evident as anomalies in all six water properties (Perturbation P5 in Table 3.8, Table 3.9, Figure 3.8c and Figure 3.11). A comparison of Figure 3.10 and Figure 3.11 shows that the appearance of the wastewater-induced anomalies differed between the two surveys. Although this was partially due to the close proximity of the April measurements to a functioning diffuser port, differences in anomalies also arose because of distinct differences in water-column stratification during the two surveys. The water column during the April survey (Figure 3.10) was vertically uniform whereas the July survey (Figure 3.11) was conducted during strongly stratified conditions. As a result, the anomalies associated with Perturbation P5 in Figure 3.11 are apparent as a downward bowing of mid-depth isopleths at Station 3. The amplitudes of the thermal, transmissivity, DO, and pH anomalies were also much larger during the July survey (Table 3.8 and Table 3.9) because the deep portions of the stratified water column provided a much greater contrast for the wastewater characteristics.

The anomalies associated with Perturbation P5 could not have been generated by the upward movement of ambient seawater alone, not only because their properties differed from those of ambient seawater at depth, but in many cases, anomalies were also vertically isolated from seawater properties in the upper water column. This vertical isolation is apparent in the vertical bifurcation of salinity anomalies at Station 3 in Figure 3.8d. The vertical isolation of the deeper portion of this perturbation is closely mirrored in the cross-sections of temperature, transmissivity, DO, and pH in Figure 3.11.

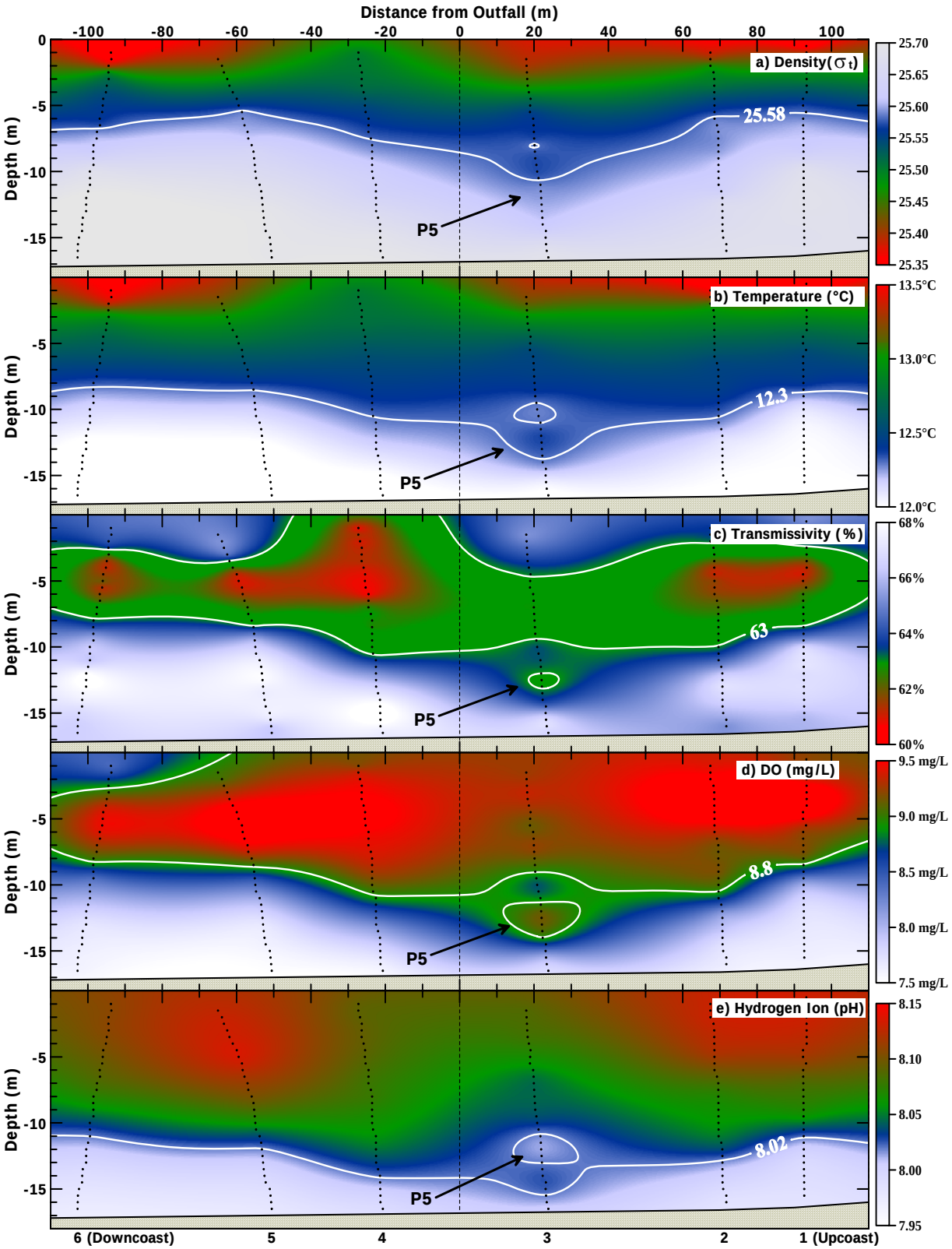


Figure 3.11 July Along-Shore Distribution of Seawater Properties

The wastewater-induced anomalies, which are apparent in these cross-sections, lie immediately below a pocket of seawater having characteristics consistent with ambient bottom water. This is a situation similar to the relationship between Perturbations P1 and P2, where a parcel of low-density wastewater-induced was pushing a slug of higher-density ambient seawater above it. The resulting density inversion is apparent in Figure 3.11a. This is an unnatural occurrence because overturn occurs rapidly under normal open-ocean conditions.

Four of the seven discharge-related perturbations were associated with negative density anomalies (Perturbations P1, P3, P4, and P5 in Table 3.8). As discussed previously, negative density anomalies and inversions are indicative of localized instabilities within the water column. These instabilities rapidly resolve themselves through turbulent overturn. This buoyancy-induced mixing is part of the initial dilution process. Accordingly, all four of the negative density perturbations were measured well within the 15-m ZID. This is apparent from an inspection of the diffuser distances for Perturbations P1 (8.7 m), P3 (1.1 m), P4 (9.6 m), and P5 (7.8 m) that are listed in the last column in Table 3.8.

Because these perturbations captured the signature of the effluent plume while it was still undergoing rapid turbulent dispersion, the dilution levels determined from the salinity anomalies underestimate the actual dilution that would be eventually achieved once the plume reaches buoyant equilibrium. Consequently, the estimated dilution levels listed in Table 3.8 and Table 3.9 for these Perturbations are qualified with a "greater-than" symbol (>). This indicates that the actual dilution ultimately achieved when the plume extends beyond the ZID will be substantially higher than the dilution estimate where the salinity anomaly was observed.

Entrainment-Generated Anomalies

In contrast to the wastewater-induced anomalies described above, the other water-quality anomalies were generated by the upward displacement of ambient seawater that was entrained in the buoyant effluent plume. In particular, the anomalies listed in Table 3.9 within Perturbations P2, P4, P6, and P7 were caused by the movement of ambient seawater, rather than the presence of wastewater constituents. This was also the case for all of the negative thermal anomalies listed in Table 3.8. This type of discharge-related anomaly is generated when ambient bottom water is entrained in the rising effluent plume. After being displaced upward, bottom-water properties are juxtaposed with shallow-water properties, and the contrast becomes apparent as an anomaly. The anomalies arise because of a difference in the properties of the ambient water near the seafloor, and the seawater properties in the upper water column.

For example, seawater immediately above the seafloor tends to be naturally low in DO and pH. Consequently, upward movement results in the negative DO and pH anomalies that are found within Perturbations P2, P6, and P7 (Table 3.9). Similarly, seawater at depth is cooler, and its upward displacement produced the negative thermal anomalies that are apparent within the same three perturbations (Table 3.8).
There are no DO, pH, and thermal anomalies associated Perturbation P4 because entrainment-generated anomalies are only produced when there are naturally occurring vertical differences in seawater properties. In contrast to the stratified conditions present during the other surveys, the water column was well-mixed and exhibited little vertical stratification in these seawater properties during the April survey. With little tangible vertical variation in DO, pH, and temperature, these properties were not effective tracers of the upward movement of ambient seawater entrained within the discharge plume.

However, in contrast to the otherwise uniform conditions during the April survey, turbidity exhibited strong natural vertical variation because a turbid boundary layer was present just above the seafloor. Naturally turbid seawater entrained in the rising effluent plume produced the slight decreases in transmissivity at Stations 2 and 3 (anomalies of -3.9% and -2% within Perturbation P4 in Table 3.9).

Of all the entrainment-generated perturbations, Perturbation P7 in Figure 3.12 provides the clearest visualization of deep ambient seawater that has been pushed upward by the rising effluent plume. The five vertical sections trace the upward extension of seafloor properties within a localized region around Station 4. Not only is the connection between the shallow anomalies and the ambient seafloor properties clear from the Figure, but the direction of the offsets in some of the anomalies demonstrates why they could not have been induced by the presence of wastewater constituents.

Wastewater is less dense, warmer, and carries higher suspended particulate loads than receiving ocean waters. If wastewater properties were materially contributing to the perturbation, then positive thermal anomalies, and negative density and transmissivity anomalies would result. Instead, the opposite was the case within Perturbation P7. By the time the plume had risen to a depth of 5 m, it had largely achieved buoyant equilibrium due to turbulent mixing. Nevertheless, the momentum of the rising plume caused the plume to overshoot the equilibrium level. This resulted in the slight upward bowing of the $25.07\sigma_t$ isopycnal (constant density surface) that is apparent in Figure 3.12a at Station 4. Accordingly, it resulted in the slight positive density anomaly ($+0.059\sigma_t$ within Perturbation P7 in Table 3.8). This positive offset is the opposite of an anomaly that would be produced by the presence of dilute wastewater. Similarly, the statistically significant reduction in temperature within the shallow Perturbation P7 (at Station 4 in Table 3.8) would not be expected from the presence of warmer wastewater. Instead, Figure 3.12b shows its connection to seawater at a depth near 15 m.

The associated transmissivity is more diagnostic of the origin of Perturbation P7. Figure 3.12c shows that the plume moved low-turbidity seawater, with 80% transmissivity, upward into a slightly more turbid surface layer, containing seawater with only 75% transmissivity. The associated anomaly of +5.4% (Table 3.9) reflects increased seawater clarity that could only have been generated by the upward displacement of deep, ambient seawater that was naturally low in turbidity.

Movement of low turbidity water into the upper water column at Station 4 was independently corroborated by a 2 m increase in Secchi depth that was observed at that location. Although water clarity was unusually high during the October survey, it was the only survey with a substantial (+0.7 m) difference between light penetration at nearfield and reference stations Table 3.11). This difference was due to the much higher Secchi depth of 9.5-m measured at Station 4. When this unusual Secchi depth was first recorded at Station 4, a second confirmatory Secchi cast was performed because the initial measurement was so different compared to that of other stations. It was only after the transmissivity data from the CTD was analyzed, that the reason for the increase in light penetration at Station 4 became apparent. Namely, naturally low turbidity seawater at depth had been entrained in the rising effluent plume and was brought close to the sea surface.

Table 3.11 Average Secchi Depths (m) measured near the Diffuser and at Distant Locations

Survey	Nearfield[1]	Reference
January	3.8	4.0
April	6.5	6.2
July	3.8	3.6
October	8.1	7.4

[1] Within 30 m of the diffuser structure

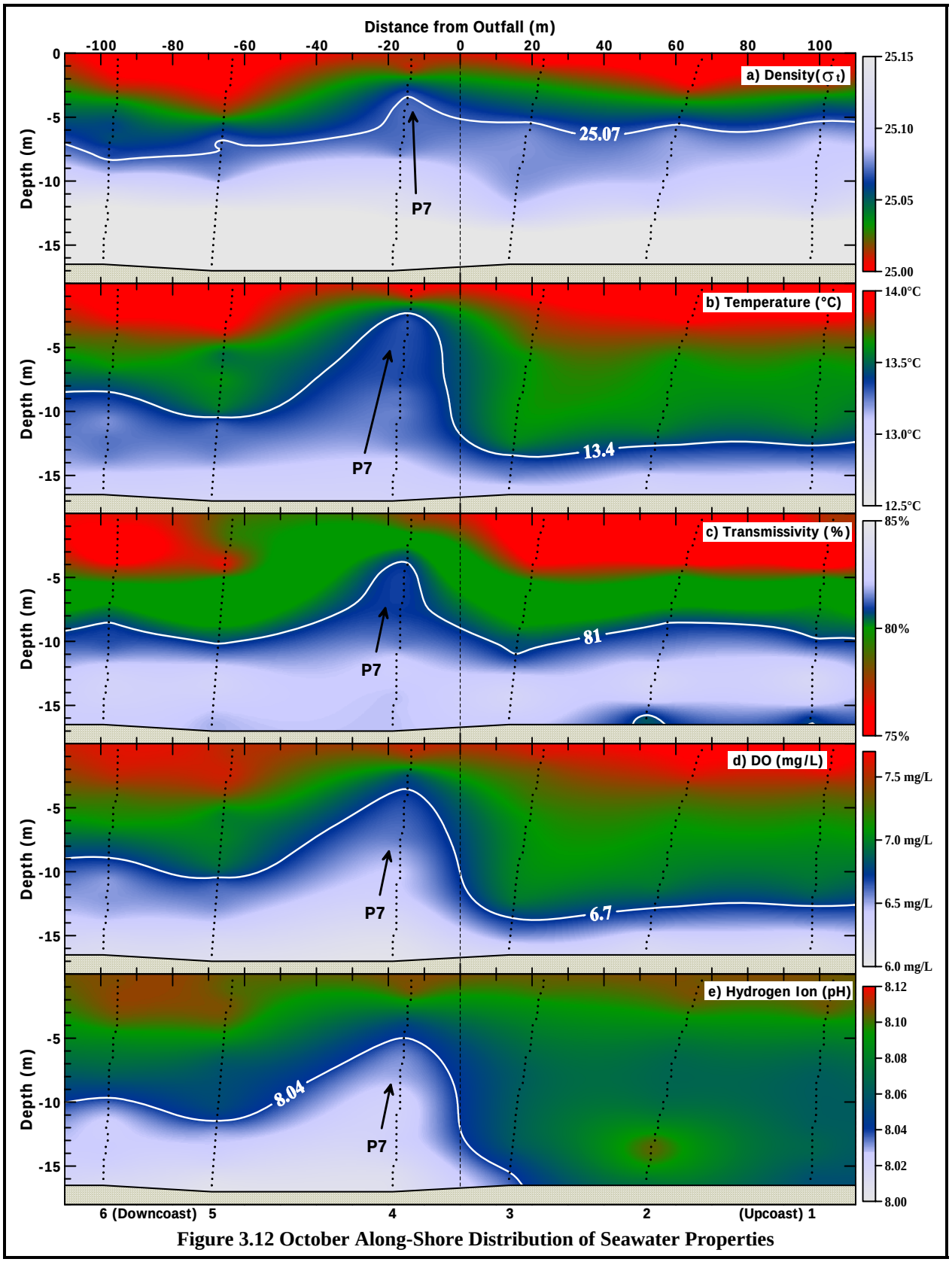


Figure 3.12 October Along-Shore Distribution of Seawater Properties

3.3.3 Compliance with Receiving-Water Limitations

As in prior years, measurements collected during the 2006 surveys demonstrated that the discharge fully complied with receiving water limitations. Irrespective of the cause of the discharge-related perturbations in seawater properties, or their location, none of the perturbations constituted an exception to the limitations promulgated by the NPDES discharge permit, the COP, or the central-coast Basin Plan. Even within the ZID, where exceptions to numeric limitations in the COP are allowed, most of the observed discharge-related anomalies were too small to be reliably detected even at the 95% confidence level. In general, only slight salinity anomalies and a couple of transmissivity observations revealed the presence of very well mixed effluent close to the diffuser structure. Those observations demonstrated that discharged wastewater was undergoing rapid dilution immediately after discharge. Overall, water-quality measurements were indicative of a diffuser structure that was operating at a level better than originally designed.

Each of the discharge-related anomalies listed in Table 3.8 and Table 3.9 was evaluated for compliance with the receiving-water limitations. Specifically, the limits stated in the NPDES discharge permit were not exceeded because the discharge did not cause:

1. *the temperature of the receiving water to adversely affect beneficial uses;*
2. *a significant reduction in the transmittance of natural light at any point outside the initial dilution zone;*
3. *the pH outside the zone of initial dilution to be depressed below 7.0, raised above 8.3, or changed more than 0.2 units from that which occurs naturally; or*
4. *the dissolved oxygen concentration outside the zone of initial dilution to fall below 5.0 mg/L or to be depressed more than 10 percent from that which occurs naturally.*

Discharge limitations are not imposed on the salinity and density fields. Other than density and salinity anomalies, the only statistically significant discharge-related anomaly found beyond the ZID during the 2006 surveys was the negative thermal anomaly (–0.55°C) associated with Perturbation P7. Given the small amplitude of this anomaly, its highly limited lateral extent, its transient nature, and its origin in ambient seawater at depth, this discharge-related alteration of receiving waters would not have affected any of the designated beneficial uses. The two statistically significant transmissivity anomalies associated with Perturbations P3 and P5 were located within the ZID, where permit limitations do not apply. Compliance with each of the four receiving-water limitations listed above is addressed in more detail below.

Temperature

The NPDES discharge permit states that wastewater-induced temperature changes should not adversely affect beneficial uses. This requirement was based on the policies promulgated by the California Thermal Plan (SWRCB 1972). Beneficial uses designated for the waters within northern Estero Bay were discussed previously in Section 2.1.2. Beneficial uses that could conceivably be affected by large fluctuations in seawater temperature include recreation, marine habitat, shellfish harvesting, and fishing. However, the amplitudes of all six discharge-related thermal anomalies identified in Table 3.8 were less than 0.6°C. These thermal anomalies would not tangibly affect beneficial uses such as water-contact sports or marine habitat because they are small in amplitude, highly localized within a restricted depth range, and occur in an area well offshore where few water-contact activities take place. The discharge-related reductions in near-surface temperature are particularly negligible when compared to the 6°C range in ambient

sea surface temperatures that typically prevail along the central coast of California at any given time. Such a range in sea-surface temperatures is evident in the satellite image on the cover of this report.

Furthermore, only two of the thermal anomalies, those within Perturbations P3 and P7, were found to be statistically significant compared to natural fluctuations in the ambient ocean environment that prevailed during each respective survey. The positive thermal anomaly of +0.13°C was observed very close to a diffuser port, shortly after wastewater discharge. Because the effluent was still undergoing intense mixing at that location, the receiving-water limitations do not apply.

The other statistically significant thermal anomaly, of –0.55°C, was observed just beyond the boundary of the ZID. However, as discussed previously, this slight reduction in temperature was due to the upward displacement of ambient bottom water, and not the presence of effluent itself. The presence of warm effluent would cause a positive thermal anomaly, the exact opposite of the observed anomaly. Because it was generated by the upward displacement of cool bottom seawater, and not by the presence of warm wastewater constituents, it represents a temperature variation that was naturally present in the marine environment at the time of the discharge.

Water Clarity

The NPDES waste discharge requirements place restrictions on impacts to water clarity resulting from the discharge. Specifically, they dictate that the discharge shall not cause a '*…Significant reduction in the transmittance of natural light at any point outside the initial dilution zone*.' This requirement derives from COP Objective C.3 in Table 3.1. There were no exceptions to this requirement in the water-quality data collected during 2006, even though significant discharge-related decreases in transmissivity (water clarity) were detected in Perturbations P3 and P5 (Table 3.9).

The discharge-related decrease in transmissivity associated with Perturbation P3 during the April survey constituted a relatively rare measurement of effluent particulates as they were being dispersed within the ZID (Figure 3.10c). Because the significant decrease in transmissivity occurred within the ZID, the limitation that pertains to the penetration of natural light does not apply. In addition, the vertical section shows that the discharge-induced reduction in water clarity was restricted to the seafloor, where it did not constitute an exception to the COP objectives. Because it was located just above the seafloor, it could not have caused the penetration of "*Natural light to be significantly reduced.…*" Based on the deepest average Secchi depth of 6.5 m (Table 3.11), the maximum depth limit of the euphotic zone was approximately 13.0 m, indicating that very little natural light was reaching the seafloor where the statistically significant anomalies in transmissivity were observed.

Although the other statistically significant turbidity anomaly extended to a shallower depth (12 m in Figure 3.11c), it was also located within the ZID and was below the 7.2 m euphotic zone that was present at the time of the July survey. A third discharge-related decrease in transmissivity (–11.8% within Perturbation P1 in Table 3.9 and Figure 3.9b), although larger in amplitude than the two transmissivity anomalies described above, was not found to be statistically significant due to the greater ambient variability in transmissivity that was present at the time of the January survey. In any regard, this anomaly was also located well within the ZID at a depth (<12 m) that was below the 8 m reach of the euphotic zone that was present at the time of the January survey.

Table 3.11 shows that there were no significant reductions in the penetration of ambient light near the diffuser during the 2006 surveys. In fact, during most surveys, nearfield Secchi depths extended to a

slightly greater depth than those at distant stations. This was particularly true of the October survey, where the penetration of ambient light near the diffuser was enhanced through entrainment by the discharge. As described previously, the upward displacement of low-turbidity bottom water increased near-surface water clarity at Stations 4 and 5.

Alkalinity (pH)

The NPDES permit places the following restriction on discharge-related changes to the pH of receiving waters: '*The discharge shall not cause:…pH outside the zone of initial dilution to be depressed below 7.0, raised above 8.3, or changed more than 0.2 units from that which occurs naturally*.' Compliance with these receiving water limitations is easily demonstrated because the wastewater itself had a pH that remained between 7.4 and 7.8 throughout 2006 (see Chapter 2). Consequently, the presence of wastewater constituents could not have induced an excursion below 7.0 or above 8.3 within the receiving waters. Accordingly, none of the more than 2000 pH measurements recorded during the offshore surveys dropped below 7.8, or exceeded 8.2 during 2006.

The difference between the average pH of discharged wastewater (7.64) and receiving waters (8.04) was negligible after dilution. Because of the well-buffered nature of the carbonate system in seawater, the slightly increased acidity of the wastewater, which averages only 0.40 pH units lower than that of receiving waters, was quickly assimilated shortly after discharge. This was particularly evident from an analysis of Perturbation P3, which was measured immediately after discharge at a point where effluent only been diluted 56-fold. The small amplitude of the associated pH anomaly (–0.006) attests to the rapid assimilation of slight pH differences between wastewater and seawater. This rapid assimilation is also apparent in the relatively small amplitude of the wastewater-induced pH anomaly (–0.021) within Perturbation P5.

In contrast, entrainment-generated pH anomalies were larger because they were generated by a process unrelated to the character of wastewater constituents. Table 3.9 shows that entrainment-generated Perturbations (P2, P6, and P7) were characterized by larger-amplitude pH anomalies (>0.04 units). These anomalies were produced when ambient seawater near the seafloor, which is naturally low in pH, was displaced upward in the water column. Seawater near the seafloor is slightly more acidic due to the production of carbonic acid (dissolved carbon dioxide CO_2) by biotic respiration and decomposition. The naturally occurring vertical difference in pH between seafloor and surface waters was particularly evident during the October survey. The entrainment-generated pH anomaly at Station 4, and its connection to the seafloor pH, is visually apparent in the vertical section shown in Figure 3.12e on Page 3-42. Because this and other entrainment-generated pH anomalies originated from ambient seawater that was naturally low in pH, they cannot be considered to have changed the receiving waters by '*…more than 0.2 pH units from that which occurs naturally*.'

Dissolved Oxygen

As with the other water-quality parameters, all receiving-water measurements of dissolved oxygen (DO) that were collected during 2006 complied with the requirements of the NPDES discharge permit. The receiving water limitations in the NPDES permit state that the '*…discharge shall not cause…dissolved oxygen concentration outside the zone of initial dilution to fall below 5.0 mg/l or to be depressed more than 10 percent from that which occurs naturally*.' The first requirement derives from the Central Coast's Basin Plan (RWQCB 1994) which states that, in addition to the provisions of the COP, '*The mean annual dissolved oxygen concentration shall not be less than 7.0 mg/l, nor shall the minimum dissolved oxygen concentration be reduced below 5.0 mg/l at any time*.'

The second limitation derives from COP Objective D-1 in Table 3.1. It qualifies the cause of the oxygen depression to be the '*…result of the discharge of oxygen demanding waste materials*.' As described in Section 3.2.4 on Page 3-19, a reduction in DO within receiving waters can be a concern with wastewater discharge into semi-enclosed water bodies. In some cases, the seafloor accumulation of oxygen-demanding materials derived from wastewater particulates can deplete the receiving water of its oxygen content and impact marine and estuarine organisms. Oxygen depletion, however, is rarely a problem with open-ocean discharges such as those into Estero Bay. Also, as described in Section 2.2.3, the MBCSD treatment process consistently removes most of the oxygen-demanding materials from the influent stream. As a result, the plant wastewater's biochemical oxygen demand (BOD_5) has been far below the permit maximum, not only in 2006, but throughout the past two decades of operation (See Section 5.1). In addition to its low BOD_5, the MBCSD discharge occurs in a particularly well-flushed, open-ocean environment where wastewater particulates are rapidly dispersed shortly after discharge.

The general lack of oxygen-demanding materials in the treated effluent is apparent from the amplitude and positive offset of the wastewater-induced DO anomalies that were observed in conjunction with Perturbations P3 and P5 (Table 3.9, Figure 3.10d, and Figure 3.11d). In both cases, the dissolved-oxygen concentration of the dilute wastewater was higher than that of the ambient seawater. As discussed previously, this positive DO anomaly could only have been generated by the discharge of water that was recently in contact with the atmosphere and that was also low in oxygen-demanding materials.

None of the DO anomalies were subject to permit limitations because they were not statistically significant, were recorded well within the ZID, or were not produced "*…as a result of the discharge of oxygen demanding waste materials*." Nevertheless, all of the DO anomalies complied with the numerical limits specified in the permit. Specifically, none of the anomalous DO concentrations fell below 5.39 mg/L, which is above the minimum specified in the Basin Plan and the NPDES discharge permit. Similarly, the average DO concentration within the 2,039 seawater measurements collected in 2006 was 7.54, which is above the basin-plan limit that states an *annual dissolved oxygen concentration shall not be less than 7.0 mg/L*. Given that all of the negative DO anomalies were generated by the upward displacement of ambient seawater that was naturally depleted in oxygen at depth, none of the discharge-related anomalies can be considered "*…to be depressed more than 10 percent from that which occurs naturally*."

3.3.4 Coliform Bacteria

The surfzone along Atascadero State Beach was monitored to assess bacteriological levels, aesthetic conditions, and compliance with the NPDES permit and the COP. MBCSD WWTP personnel monitored the surfzone stations on a weekly basis during the summer months (May through October) and at least monthly during the winter months (November through April). Samples were analyzed for total and fecal coliform densities. A regional map depicting the eight surf-zone stations is presented in Figure 3.1 on Page 3-5 and the coordinates of the stations are listed in Table 3.2 on Page 3-4. During 2006, as in prior years, the MBCSD discharge was in compliance with the surfzone bacterial objectives specified in the NPDES permit. Although there were isolated, localized instances of elevated beach coliform, none were related to the discharge of wastewater which is disinfected at the treatment plant prior to discharge.

The small creeks feeding into northern Estero Bay have long been identified as a major source of coliform contamination within the surfzone along Atascadero State Beach. This non-point source contamination is unrelated to treated wastewater discharge through the offshore outfall. The mouth of Morro Creek lies close to the treatment plant, and, in 1993, Station G in the creek's outflow was added to the surfzone monitoring program to document the time-varying influence of non-point-source coliform input from

nearby creeks. Station G is sampled only when Morro Creek is flowing into the ocean, and its coliform densities are not used to assess numerical compliance with the bacteriological objectives in the NPDES permit. Instead, coliform densities in the creek's outflow aid in the interpretation of surfzone bacteriological measurements by providing an index of non-point source contamination in samples collected at the regularly sampled surfzone stations (Stations A1 through F).

During 2006, Morro Creek was lagooned for about half of the year, beginning in about mid August (Table 3.12 on Page 3-49). As a result, samples were collected at Station G on 19 of the 33 surfzone sampling occasions during 2006. All but two of the 19 Morro Creek samples were contaminated with total coliform densities at or above 130 MPN/100 ml. Eleven of these samples were heavily contaminated with total coliform densities at or above 1600 MPN/100 ml. Fecal coliform densities within these samples were correspondingly high, suggesting that most of the bacterial contamination in the creek was of fecal rather than vegetative origin. Large herds of grazing cattle within the watershed are probably primarily responsible for the creek contamination.

Despite significant bacterial input from creek outflow and other non-point sources in the region, fecal coliform organisms were not detected in nearly half (49%) of the 231 surfzone samples. When coliform organisms were detected, they were usually found at densities near the detection limit of 2 MPN/100 ml. Nearly three-quarters (72%) of the samples had fecal coliform densities at or below the detection limit.

Most of the shoreline samples collected at the regular surfzone monitoring stations during 2006 contained coliform densities that were below the most stringent bacteriological standard specified in the NPDES discharge permit. Only two samples had total coliform densities exceeding 70 MPN/100 ml. These elevated measurements are highlighted in bold typeface in Table 3.12. For the reasons described below, both were demonstrably unrelated to effluent discharge.

The first elevated coliform density (80 MPN/100 ml) was measured in the surfzone sample collected at Station F on July 10th. This elevated surfzone measurement was unrelated to the discharge of effluent even though an unusually high total-coliform density (1600 MPN/100 ml) was measured in effluent samples on that same day. However, the discharge was not the cause of the increased total coliform density in this surfzone sample for two reasons.

First, the elevated coliform density measured in the July 10th surfzone sample was collected from a reference station (Station F in Table 3.2 on Page 3-4). That station was selected as a control because it was considered too distant from the offshore discharge site to be influenced by it. Station F is located 1.8 km southeast of the outfall, where it is well outside the discharge's 15 m sphere-of-influence (Figure 3.1 on Page 3-5). Accordingly, intervening surfzone stations (C, D, and E) did not exhibit similarly elevated coliform densities, much less a gradient of increased density related to outfall proximity.

Second, wastewater bacteria are almost entirely of fecal origin, whereas the coliform bacteria measured in the surfzone sample consisted largely of non-fecal forms. This is apparent from a comparison between the total coliform density (80 MPN/100 ml) and the much lower density of fecal bacteria (27 MPN/100 ml) measured in the same surfzone sample. Untreated wastewater, by its very nature, contains almost exclusively fecal coliform. In contrast, the elevated total coliform densities measured in the July 10th surfzone sample arose largely from vegetative rather than animal sources. The decay of kelp and other plant mate-

rial along the beach was probably largely responsible for the elevated non-fecal coliform densities observed in that localized area of the surfzone. Alternatively, it is possible that non-point source runoff from onshore contributed significantly to the observed increase in surfzone coliform. Water samples collected from the Morro Creek Station G were significantly elevated throughout the first half of the year, including the day the surfzone samples were collected.

The only other surfzone sample with a comparatively elevated coliform density (110 MPN/100 ml) was collected at Station C on November 6th. In contrast to the July 10th surfzone sample, the coliform in the November 6th sample consisted almost entirely of fecal coliform. However, on that particular day, the disinfection process within the treatment plant was highly effective, eliminating nearly all of the coliform within the effluent, and reducing coliform densities to 4 MPN/100 ml prior to discharge. Thus, wastewater densities were 27-times lower than those measured in the surfzone sample. Considering that treated wastewater is diluted by at least two orders of magnitude immediately after discharge, it is inconceivable that coliform densities measured in the effluent could have materially contributed to the elevated surfzone density measured at Station C on November 6th.

Regardless of their origin, the two isolated surfzone samples containing coliform densities exceeding 70 MPN/100 ml still meet the stringent requirement for areas where shellfish is harvested for human consumption (see Standard A.2 in Table 3.1 on Page 3-3) because the limit applies to a thirty-day median rather than to isolated measurements. Both of the coliform measurements were the only elevated measurements recorded at a given station within any individual month and neither measurement was recorded at the same station repeatedly. Combining these measurements with the other, much lower measurements taken within a thirty-day period, brought the medians to well below the standard considered safe for shellfish harvesting. As such, the less-stringent standards for water-contact beneficial uses were also easily met. The most stringent water-contact standard is based on a fecal coliform density of 200 MPN/100 ml. None of the 231 individual surfzone measurements approached that standard, much less their averages over time.

In 2006, as in prior years, none of the elevated coliform densities measured in the surfzone samples could be ascribed to the MBCSD wastewater discharge. The wastewater is disinfected prior to discharge and consequently, has a consistently low coliform density. With the 100-fold dilution achieved within a few meters of the discharge, discharge-related coliform densities in the receiving water beyond the ZID are imperceptible. Furthermore, the discharge occurs well offshore and prevailing currents are rarely directed toward the shoreline. In contrast, onshore non-point sources are demonstrably responsible for contamination events that are occasionally observed in the surfzone.

Table 3.12 Effluent and Surfzone Coliform Bacteria (MPN/100 ml), and Rainfall (inches) during 2006

	Total Coliform Bacteria									Fecal Coliform Bacteria								
Date	**Effluent**	**A1**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**A1**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**Rainfall [1]**
09-Jan	<2	21	14	4	8	4	7	4	**>1600**	14	4	2	2	2	4	<2	50	0.1
06-Feb	8	2	<2	<2	<2	2	4	4	30	<2	<2	<2	<2	<2	4	4	30	0.0
09-Mar	<2	2	8	2	4	<2	2	2	30	2	4	2	2	<2	2	<2	30	0.6
14-Apr	<2	22	2	<2	8	23	14	7	**500**	4	2	<2	4	23	2	4	**240**	0.3
01-May	<2	<2	<2	<2	<2	<2	<2	13	**900**	<2	<2	<2	<2	<2	<2	13	**900**	0.3
10-May	22	7	2	2	2	4	2	9	**900**	7	2	<2	2	2	2	9	**500**	0.0
15-May	4	2	2	2	<2	2	<2	2	**900**	2	2	2	<2	2	<2	2	**900**	0.0
23-May	<2	30	2	4	2	8	8	50	**1600**	8	<2	<2	2	8	8	50	**900**	2.6
30-May	<2	<2	<2	<2	<2	<2	<2	2	**>1600**	<2	<2	<2	<2	<2	<2	2	**>1600**	0.0
05-Jun	<2	<2	<2	<2	<2	<2	<2	<2	**>1600**	<2	<2	<2	<2	<2	<2	<2	**>1600**	0.0
12-Jun	2	<2	4	<2	<2	<2	<2	2	**300**	<2	4	<2	<2	<2	<2	<2	**300**	0.0
20-Jun	<2	2	2	2	<2	<2	2	2	**300**	2	2	2	<2	<2	2	2	**300**	0.0
26-Jun	30	<2	<2	<2	2	2	8	4	**>1600**	<2	<2	<2	2	2	8	2	**>1600**	0.0
03-Jul	<2	2	4	8	11	<2	<2	4	**>1600**	<2	4	8	11	<2	<2	<2	**900**	0.0
10-Jul	**1600**	33	30	23	34	30	50	**80**	**>1600**	26	30	23	34	30	50	27	**1600**	0.0
17-Jul	<2	<2	8	<2	<2	4	8	4	**1600**	<2	8	<2	<2	4	8	2	**900**	0.0
24-Jul	**900**	8	2	<2	2	<2	8	14	**>1600**	8	2	<2	2	<2	8	14	**>1600**	0.0
31-Jul	<2	<2	2	23	4	17	11	4	**>1600**	<2	2	23	4	17	11	4	**>1600**	0.1
07-Aug	<2	<2	2	2	<2	<2	<2	<2	**>1600**	<2	2	2	<2	<2	<2	<2	**>1600**	0.0
14-Aug	<2	13	50	11	2	<2	<2	<2	—	13	22	11	2	<2	<2	<2	—	0.0
21-Aug	<2	<2	4	<2	<2	<2	<2	13	—	<2	4	<2	<2	<2	<2	13	—	0.0
28-Aug	<2	17	2	8	<2	2	<2	2	—	17	2	8	<2	2	<2	2	—	0.0
05-Sep	<2	2	<2	<2	2	2	2	11	—	2	<2	<2	<2	2	2	11	—	0.0
11-Sep	<2	2	<2	<2	2	4	2	50	—	2	<2	<2	2	4	2	50	—	0.0
18-Sep	<2	<2	<2	<2	<2	<2	<2	<2	—	<2	<2	<2	<2	<2	<2	<2	—	0.0
25-Sep	<2	2	<2	<2	4	2	2	<2	—	<2	<2	<2	4	2	2	<2	—	0.0
02-Oct	<2	70	4	<2	<2	<2	<2	4	—	70	4	<2	<2	<2	<2	4	—	0.0
09-Oct	<2	4	<2	34	2	2	7	14	—	4	<2	34	2	<2	2	9	—	0.0
16-Oct	<2	<2	<2	<2	<2	<2	2	<2	—	<2	<2	<2	<2	<2	2	<2	—	0.4
23-Oct	<2	<2	<2	2	<2	<2	2	2	—	<2	<2	2	<2	<2	2	2	—	0.0
30-Oct	<2	<2	<2	<2	13	<2	7	2	—	<2	<2	<2	8	<2	7	<2	—	0.0
06-Nov	4	8	22	<2	**110**	2	<2	<2	—	8	22	<2	**110**	2	<2	<2	—	0.0
04-Dec	2	8	<2	70	<2	<2	2	<2	—	4	<2	70	<2	<2	2	<2	—	0.0

[1] Cumulative rainfall in inches on the day of surfzone sampling and over the four days prior to sampling.

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CHAPTER 4

Marine Sediments and Benthic Biota

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4.0 MARINE SEDIMENTS AND BENTHIC BIOTA

This chapter describes the coastal benthos within Estero Bay where the MBCSD effluent is discharged. The MBCSD Offshore Monitoring Program includes benthic observations to assess potential impacts of wastewater discharge on marine sediments near the outfall, and on infaunal communities that live within them. Benthic environments are important indicators of the presence of marine pollution. They are the major reservoir for most contaminants that enter the ocean. Deleterious changes in the benthic environment, resulting from the deposition of effluent particulates, have been observed around other coastal outfalls (e.g., Stull et al. 1986a). However, no such impacts have been found after more than two decades of benthic monitoring around the MBCSD outfall. This includes the October 2006 survey described in this chapter.

Both the physicochemical and biological properties of the benthos are described in this chapter. Dissolved, suspended, and sinking types of organic and inorganic matter are dynamically interrelated in the marine ecosystem. The quality of this material directly affects the health of infaunal communities. Infauna residing within sedimentary environments serve as indicators of contaminated sediments because of their limited mobility and well-defined responses to pollution. Numbers of species, abundance, biomass, and other parameters of community composition can indicate contaminant-caused stresses if, for example, gradients extending from a pollutant source to distant, unaffected areas are observed.

This chapter presents results from a benthic survey conducted in October 2006. After 1998, semiannual surveys were eliminated because seasonal variability had been well determined by winter and summer surveys conducted over the previous 13 years. In lieu of two surveys each year, the single October survey increased spatial resolution around the outfall by adding four stations at nearfield distances from the diffuser structure. The decrease in sampling frequency and increase in spatial resolution was incorporated in the revised Benthic Monitoring Program (RWQCB-USEPA 1998b) after a collaborative review of historical data by MBCSD consultants and the staff of the MBCSD, RWQCB, and USEPA (USEPA 1998; RWQCB-USEPA 1998c; MBCSD 1997b, 1998; MRS 1997ab, 1998efgh).

The reporting schedule was also changed so that separate benthic monitoring reports were no longer generated. Instead, the full results of the October 2006 benthic survey are presented in this annual report. Physicochemical data from the survey are tabulated in Appendix D of this report, while benthic biological data are provided in Appendix E. BC Laboratories conducted the relevant chemical analyses following methods described by Tetra Tech (1986ab). Marine Research Specialists performed the infaunal community analyses and data synthesis.

The following section describes the benthic-monitoring program, including collection methods and station design. The second section of this chapter presents the findings related to the physicochemical analysis of the sediments. The last section describes the health of the benthic infaunal community residing within Estero Bay during 2006.

4.1 MONITORING PROGRAM

As with water-quality monitoring described in Chapter 3, sediment samples were collected at reference and outfall stations to investigate any potential discharge-related impacts to the benthos. The samples were analyzed for physicochemical properties and infaunal community composition in order to compare the benthic environment at these two sets of stations, and at gradient stations in between.



Figure 4.1 Benthic Sampling Stations

4.1.1 Scope of Monitoring

On the 3rd, 4th, and 16th of October 2006, offshore sediment samples were collected at nine stations within Estero Bay (Figure 4.1). The field sampling and laboratory procedures adhered to the requirements of the current Monitoring and Reporting Program (Number 98-15; RWQCB-USEPA 1998ab). This was the eighth benthic survey to implement the changes to the benthic-monitoring program specified in the NPDES discharge permit. During the more than two decades of offshore monitoring, the benthic-monitoring program has undergone a number of major modifications. The original permit, issued in 1985, required semiannual sediment collection at six stations with physicochemical analysis of a composite of three replicate grab samples collected at each station. The stations were distributed around the outfall along a north-south isobath. Five of these original stations have continued to be sampled throughout the monitoring program. The sixth station, a '*reference*' station located 1 km to the south, was dropped when the permit was reissued in 1993 because it was unrepresentative of the benthic environment near the outfall.

The discharge permit issued in 1993 (RWQCB-USEPA 1993ab) also changed laboratory protocols. It initially required separate chemical analysis of each replicate sample collected at the original five stations. Separate analyses of replicate samples quantified the within-station variability and lent insight into the statistical significance of spatial differences among stations. In particular, this report uses the replicate chemical analyses conducted in 1993 and 1994 to establish confidence intervals around concentrations measured at each station. In 1995, chemical analysis reverted to a composite protocol where aliquots from each of the three replicates collected from a station were homogenized into a single composite sample in the laboratory before extraction. Other modifications included changing the frequency of analysis for '*remaining priority pollutants*' and '*other pesticides*' from a semiannual basis to an analysis of only the samples collected during the October survey.

Based on an analysis of 13 years of benthic data collected as part of the MBCSD monitoring program, further modifications were implemented when the current NPDES permit was issued in 1998 (RWQCB-EPA 1998ab). These changes included the elimination of the post-winter survey, and the addition of four benthic sampling stations close to the outfall. After 13 years, the amplitude of seasonal fluctuations had been adequately determined. As a result, the focus of monitoring shifted to the determination of interannual changes in spatial patterns. To that end, four additional stations, located 60 m from the outfall, were added to the five historical stations. The cross-shore configuration of two of these new stations provides a more spatially balanced sampling pattern capable of detecting potential impacts that may not be restricted to along-shore directions. Finally, replicate chemistry samples were no longer required in the current permit. Instead, chemical analyses were performed on a single grab sample collected at each of the nine stations.

4.1.2 Sampling Station Design

Regular benthic sampling was conducted at the nine stations shown in Figure 4.1 on Page 4-2 and in Figure 4.2 on Page 4-7. The target positions for sample collection were specified in the current NPDES permit and are summarized in Table 4.1 below. Eight of the nine stations were located within 150 m of the diffuser structure. The remaining station (1) was located 1,000 m north of the outfall, well beyond the discharge's sphere of influence. The reference station (1), midfield stations (2 and 7), and ZID[3] stations

Table 4.1 Target Locations of Benthic-Sediment Sampling Stations

				Distance (m)	
Station	**Description**	**Latitude**	**Longitude**	**Closest[a]**	**Center[b]**
1	Upcoast Reference	35° 23.730' N	120° 52.677' W	1,000	1,016
2	Upcoast Midfield	35° 23.280' N	120° 52.504' W	138	150
3	Upcoast Nearfield	35° 23.231' N	120° 52.504' W	49	60
4	Upcoast ZID	35° 23.210' N	120° 52.504' W	15	20
5	Downcoast ZID	35° 23.188' N	120° 52.504' W	15	20
6	Downcoast Nearfield	35° 23.167' N	120° 52.504' W	49	60
7	Downcoast Midfield	35° 23.118' N	120° 52.504' W	138	150
8	Offshore Nearfield	35° 23.199' N	120° 52.544' W	47	60
9	Onshore Nearfield	35° 23.199' N	120° 52.464' W	47	60

[a] Distance from the closest open diffuser port
[b] Distance to the center of the open diffuser section

(4 and 5) have all been regularly sampled throughout the more than two decades of benthic monitoring. All lie along a north-south isobath (15.2 m) that intersects the center of the diffuser structure. In 1999, four new stations (3, 6, 8, and 9) were added at nearfield distances (60 m) from the center of the diffuser structure. Two of the new stations (3 and 6) were located along the 15-m isobath, whereas the other two (8 and 9) were equidistant from the center of the diffuser structure in a cross-shore direction.

As described in Section 3.1.3 on Page 3-6, the finite length of the diffuser structure creates ambiguity in the distance measured to the outfall. For discussion purposes, station separations are usually referenced to the center of the diffuser. However, in terms of contaminant dispersion, the closest-approach distance is the controlling parameter.

Sampling at four new stations located close to the diffuser structure was intended to improve impact assessment. Assessments that rely solely on a comparison of sediment properties in a sample collected from the northernmost reference station (1) and properties averaged over stations close to the outfall can be misleading. Because of its 1-km separation from the outfall, the reference station has a measurably different infaunal community composition (MRS 1998bi), and as described below, an inherently different sediment physicochemistry. These differences are a consequence of its spatial separation alone. To ameliorate these zoogeographic differences, the current impact assessment incorporates an evaluation of gradients close to the outfall, where any impairment would be expected to increase with proximity to the source.

Because the four new nearfield stations are configured in a symmetrical pattern around the outfall, they stand a better chance of detecting impacts early, especially if preferential contaminant transport were to occur in a cross-shore direction. Also, by locating these new stations only 60 m from the outfall, they provide an early warning of any potential expansion of the discharge footprint. The existing '*gradient*' stations (2 and 7) were separated by three diffuser lengths from the discharge (150 m), and consequently, were much less likely to resolve benthic impacts related to effluent discharge. Assuming a uniform dispersion, a six-fold increase in contaminant discharge would have to occur before impacts would be detected at these two distant stations, as compared to the four new, nearfield stations.

4.1.3 Benthic Sample Collection and Processing

Field sampling and laboratory procedures adhered to the requirements of MBCSD Monitoring and Reporting Program Number 98-15 (RWQCB-USEPA 1998ab). The 38-ft F/V *Bonnie Marietta*, owned and operated by Mr. Mark M. Tognazzini of Morro Bay, provided vessel support during the offshore survey. Dr. Douglas Coats of Marine Research Specialists (MRS) logged navigation fixes and assisted in benthic grab operations. Ms. Bonnie Luke, also of MRS, sieved the infaunal samples. Mr. Jerry Mason of BC Laboratories collected the sediment subsamples for chemical assay.

Equipment

Sediment chemistry and benthic infaunal samples were collected using a chain-rigged Young grab whose design was modified from that of a Van Veen sediment sampler. The Young grab was also equipped with

[3] The ZID is the "zone of initial dilution" as defined in the list of acronyms at the beginning of this report.

a frame that enhanced the penetration, stability, and the proficiency of the grab in collecting a level, undisturbed sample. Also, the stainless-steel grab was coated with Dykor®. Dykor® has properties similar to Teflon® and improves the chemical inertness of the grab sampler. This limited contamination of the sediment chemistry samples by the grab itself, particularly from trace metals. The pair of jaws on the grab acquired sediments from a 0.1-m^2 area of the seafloor. At each of the nine monitoring stations during the October 2006 survey, a single grab sample was collected for sediment chemistry and bulk properties, and five replicate grab samples were collected for benthic infaunal analyses (Table D.1). Pore water was extracted from the chemistry grab sample collected at each of the stations.

Prior to the field survey in 1999, the grab was completely refurbished. Rocks had damaged the jaws during an unrelated survey in early 1999 (Morro Group 1999). A stainless steel lip was also welded to the mouth of the jaw to improve the seal, which aids in sample retention during ascent. Finally, the entire grab was sandblasted and recoated with Dykor® in September 1999.

Offshore navigation aboard the survey vessel was supplied by a Furuno™ GPS 30 coupled to an FBX2 differential beacon receiver. Global positioning satellite (GPS) navigational fixes were recorded digitally at 1-second intervals. Electronic recordings of waypoints were used to mark the trip-time of the grab sampler and other pertinent information. Navigational errors inherent in standard GPS readings were greatly reduced with the use of a Differential GPS (DGPS) system that was first implemented by the U.S. Coast Guard. DGPS incorporates a second signal from a nearby land-based beacon. Because the beacon is fixed at a known location, the position error in the reading from the GPS satellites can be precisely calculated. This correction is continuously transmitted to the DGPS receiver and results in extremely accurate offshore navigation, typically with position errors of less than 2 m.

Physicochemical Samples

Prior to and during the survey, the sampling equipment was thoroughly cleaned to eliminate the introduction of contaminants into the samples and to prevent cross-contamination between stations. Before the survey, the grab sampler and sediment scoops were washed with Alconox®, deionized water, and 10% Hydrochloric Acid (HCl). During the survey, the grab and sampling utensils were washed with Alconox®, rinsed with seawater, and subsequently decontaminated with deionized water, methanol, and 1% HCl prior to sampling at each station.

Surficial sediments were collected from the upper 2 cm of the single grab sample recovered from each of nine benthic stations. Sufficient sample volumes were collected to provide material for QA/QC analyses. Samples were stored in the appropriate glass or plastic containers and refrigerated at approximately 4ºC prior to analysis. Chain of custody forms accompanied all sample shipments from the field and between laboratories. Appendix D.2 of this report contains the chains of custody and laboratory QA/QC analysis, while the other portions of Appendix D include a description of the samples and the chemical results as reported by the laboratory.

The sediments from each of the nine benthic-monitoring stations were separately analyzed for the analytes listed in Table 4.2. A summary of the analytical methods used and their authority is provided in Table D.2 of Appendix D. Analyses for other pesticides, hexachlorocyclohexane (HCH) isomers, cyanide, methylene chloride, and other volatile organics, are no longer performed because they have not been found in past sediment samples, are not elevated in effluent, and are not likely to accumulate within seafloor sediments.

Table 4.2. List of Analytes in Sediment Samples

• Sediment particle size	• Biochemical oxygen demand	• Total Kjeldahl nitrogen (TKN)
• Pore water dissolved sulfide	• Oil and grease	• Total volatile solids (TVS)
• Moisture content	• 11 trace metals	• Non-chlorinated phenolic compounds
• Chlorinated phenolic compounds	• Aldrin	• Dieldrin
• Chlordane	• DDT, DDE, DDD	• Endrin
• PAHs[4]	• PCBs[5]	• Toxaphene

Infaunal Samples

In addition to samples collected for sediment chemistry, five replicate grab samples were collected at each of nine benthic-monitoring stations for infaunal analyses. Upon retrieval of the grab, the sample was inspected for acceptability. Acceptance criteria were based on penetration depth, surface condition, and overall sample integrity. These observations are reported in Table D.1 in Appendix D of this report. Sediment samples that met the acceptability criteria were lightly washed, and elutriated onto a 1.0-mm mesh sieve. The extracted material was then washed into a labeled 16-oz. jar and preserved with 10% buffered formalin. After 48 hours, the formalin was rinsed from the samples on a 0.5-mm mesh sieve and the samples were transferred to 70% alcohol for processing, preservation, and storage.

Upon transfer, five replicate samples (Replicate 4 at Station 4, Replicates 3 and 5 at Station 6, and Replicates 2 and 4 at Station 7) were found to be improperly preserved due to an inadequate dose of formalin in the field. As a result, these replicates were subsequently resampled on 16 October 2006 as documented in Table D.1. After transfer to alcohol, all infaunal samples were stained with a Rose Bengal solution to aid in sorting of the organisms into the following major taxonomic groups: annelida and nemertea, mollusca, crustacean, echinodermata, and miscellaneous phyla.

All individual organisms were enumerated and identified to species level where possible. Voucher collections have aided in the consistent identification of organisms collected throughout the 21-year benthic-monitoring program. The voucher collections contain specimens representative of each species identified, and are augmented as new taxa are collected. The qualifications and experience of the taxonomic specialists responsible for species identification are presented in Appendix E.1.

[4] Polynuclear Aromatic Hydrocarbons

[5] Polychlorinated Biphenyl

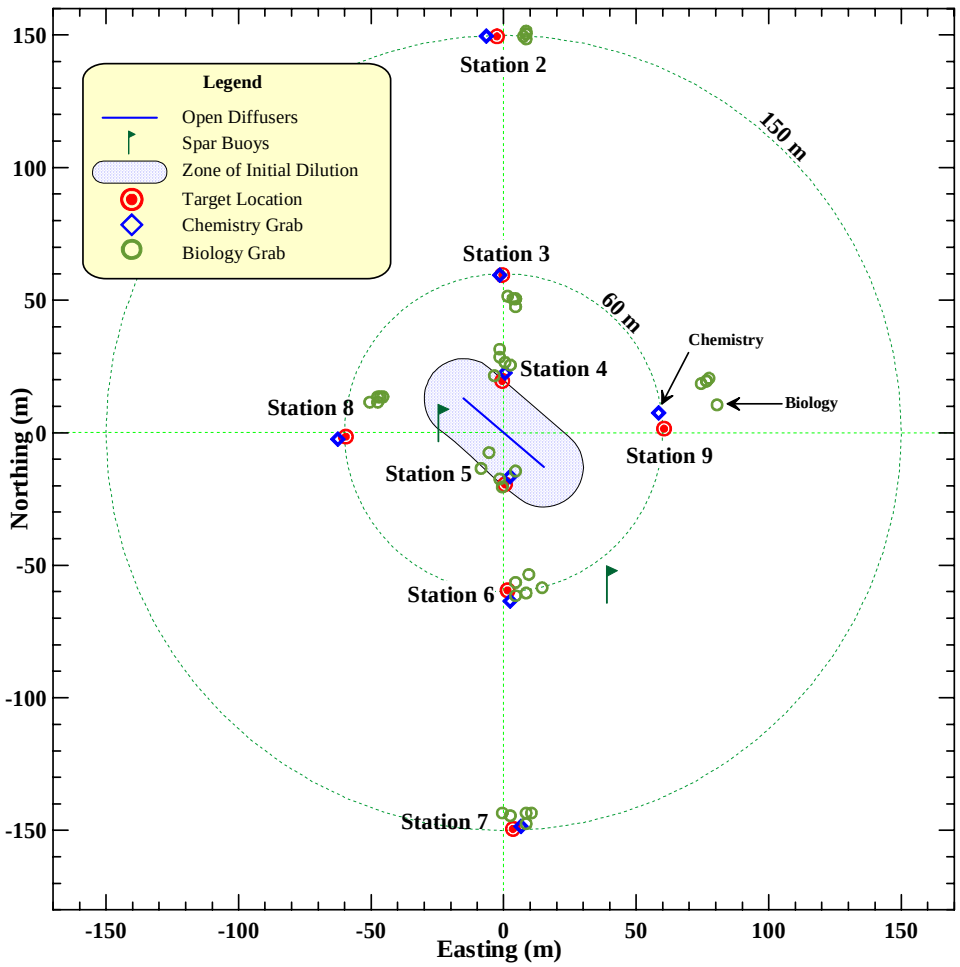


Figure 4.2 Actual and Target Locations of Benthic Monitoring Stations

Sampling Location Offsets

As described in Chapter 3, there are a number of unavoidable factors that prevent collection of offshore samples at the exact target locations listed in Table 4.1 on Page 4-3. Figure 4.2 shows the actual position of the five infaunal (green) and additional chemistry (blue) grabs, relative to each target location (red) that was specified for Stations 2 through 9.

Differences between the sampling and target positions arise because the vessel swings about the anchor location along a scope of approximately 20 m. The vessel set relative to anchor position is difficult to predict based on the constantly changing wind, wave, and current conditions. Changes in position during sampling at an individual station also arise because of these changing conditions, and because of anchor drag. These within-station position changes are evident in Figure 4.2 as dispersion among the infaunal grabs shown in green. However, for a given station, position differences between the group of infaunal (green) grabs and the chemistry (blue) grabs also arise because they were collected on three separate days.

Consequently, some of the offsets shown in the Figure are due to differences in the anchoring locations on each day.

Despite the many unavoidable factors affecting vessel offset, differences between the target position and average grab location were less than the 30-m width of the ZID. Although it was not possible to collect samples at the precise target locations, knowledge of the actual location where samples were collected allowed the spatial offsets to be factored into the gradient analysis. Table 4.3 lists the average position of the six grabs collected at each station. The largest offset from the target coordinates was 20 m at Station 9, and offsets of a similar magnitude occurred at Stations 1 and 7. For most of the stations however, the average offset was less than 10 m. Without the benefit of differential GPS navigation, most of these offsets would never have been resolved.

Table 4.3 Average Location of Benthic-Sediment Grab Samples at each Station

				Distance (m)		
Station	**Description**	**Latitude**	**Longitude**	**Closest[a]**	**Center[b]**	**Offset[c]**
1	Upcoast Reference	35° 23.737' N	120° 52.673' W	1010	1027	13
2	Upcoast Midfield	35° 23.280' N	120° 52.499' W	139	150	8
3	Upcoast Nearfield	35° 23.227' N	120° 52.502' W	43	52	9
4	Upcoast ZID	35° 23.213' N	120° 52.504' W	19	26	7
5	Downcoast ZID	35° 23.191' N	120° 52.505' W	12	15	5
6	Downcoast Nearfield	35° 23.167' N	120° 52.500' W	47	59	6
7	Downcoast Midfield	35° 23.120' N	120° 52.502' W	133	145	5
8	Offshore Nearfield	35° 23.205' N	120° 52.537' W	35	51	15
9	Onshore Nearfield	35° 23.207' N	120° 52.455' W	66	76	20

[a] Distance from the closest open diffuser port [b] Distance to the center of the open diffuser section
[c] Average offset from Target Locations listed in Table 4.1

4.1.4 Benthic Analysis

A wide variety of physical, chemical, and biological parameters were determined from the 54 sediment samples collected during the October 2006 survey. This report examines these parameters for any potential discharge-related spatial patterns. They are also compared to historical measurements to reveal any potential temporal trends that could be associated with a buildup of contaminants. Finally, the interrelation between biological and physicochemical parameters is evaluated for possible toxicological effects.

Organic-Loading Properties

Sediment samples collected at the nine benthic-monitoring stations during the October survey were analyzed for moisture content, oil and grease, eleven trace metals, and 100 synthetic organic contaminants. The organic-loading parameters, total volatile solids (TVS), total Kjeldahl nitrogen (TKN), and biochemical oxygen demand (BOD), are particularly relevant to sewage-outfall monitoring. If the volume of organic solids discharged by the outfall is not adequately dispersed, then a buildup of TVS, TKN, and BOD can occur beyond the ZID.

The total volatile solids (TVS) concentration quantifies the amount of organic matter in the solid fraction of bottom sediments. It is reported as percentage of dry-sample weight. Total Kjeldahl nitrogen (TKN) measures the amount of organic nitrogen present as ammonia, as well as that bound into organic com-

pounds in the aqueous phase of the benthic samples. However, natural TKN levels vary widely among seafloor sediment samples, so anthropogenic (human-induced) impacts are difficult to discern from TKN measurements alone. Other properties related to organic loading from effluent discharge include sulfides, and oil and grease (O&G).

Biochemical oxygen demand (BOD) measures the depletion of dissolved oxygen caused by aerobic microorganisms during decomposition of organic material. Excessive BOD can be deleterious to marine organisms if decomposition significantly depletes dissolved oxygen levels. This can occur when aerobes metabolize excess organic matter deposited by effluent discharge. However, BOD is difficult to accurately measure in sediment samples, and interference from errant pieces of organic material has resulted in erroneously high levels in previous surveys, particularly prior to 1992 (Figure 4.9b on Page 4-29). Occasionally, though, interference still occurs. For example, BOD analysis of the sediment sample collected at Station 9 during the October 2000 survey exhibited marked interference, and it resulted in an erroneously high BOD (MRS 2001). Because of persistent interference in BOD determinations, overall confidence in BOD results for benthic sediment samples remains low.

Sulfide

Sulfide dissolved within pore water can be indicative of anoxic conditions and, in the form of hydrogen sulfide (H_2S), can be harmful to marine organisms. Sulfides are ionic compounds containing one or more sulfur ions bonded to carbon, metal, or other non-oxygen atoms. In marine sediments, sulfides exist both as insoluble precipitates and as dissolved sulfide compounds. In the presence of oxygen, sulfide rapidly oxidizes to sulfate, or in some instances, to elemental sulfur. Sulfides, therefore, are usually associated with hypoxic or anoxic conditions such as may occur in highly organic and undisturbed fine-grained sediments. Hydrogen sulfide (H_2S), the toxicologically important form of sulfide, is produced when bacteria reduce sulfates and putrefy proteins.

The analytical approaches used to measure sulfide levels within benthic sediments have evolved over the years of offshore monitoring. Consequently, long-term trends in sulfide concentration cannot be reliably determined from the dataset. Moreover, because of limitations in analytical approaches used prior to 2003, compliance with the sulfide standards specified in the COP[6] could not be unequivocally evaluated. Beginning with the 2003 survey, an involved technique was implemented to extract pore water in the field. This technique produced aqueous samples that could be accurately analyzed for dissolved sulfide using EPA method 376.2. This resulted in high-resolution dissolved sulfide measurements that allowed direct evaluation of the COP limitation on "*…dissolved sulfide concentration of waters in and near sediments.*…" Unfortunately, the flocculation and settling component of the technique requires comparatively calm offshore conditions, which may not always be available during future benthic surveys.

There were a variety of limitations associated with the analytical approaches used to measure sulfide in samples collected prior to 2003. The Green and Schnitker (1974) method was used to determine sulfide concentrations in sediment samples collected prior to 2001. Not only was it difficult to properly implement in the field, but it led to large random variations in the measured sulfide levels. In addition to the complex sample-preparation in the field, the laboratory analysis required the use of specialized ion-specific electrodes. The practical quantification limit (PQL) was relatively high (2 mg/Kg), so sulfide was

[6] The COP is the 1997 edition of the California Ocean Plan that applies to the current discharge permit for the MBCSD.

not detected in most samples. Occasionally, a comparatively high sulfide concentration would be reported in an isolated random sample, probably as a result of the presence of errant organic matter, such as a piece of detached kelp or sea grass, that happened to be included in the sediment sample.

In an attempt to stabilize the sulfide measurements, sediment samples collected in the 2001 and 2002 surveys were analyzed for sulfide concentrations using EPA Method 9030. Although the results were more reliable, they reported total sulfide concentrations, which markedly differed from the purely dissolved fraction addressed by the COP. Because a large portion of the total sulfide concentration arose from acid-soluble metallic sulfides associated with particulate matter, reported concentrations were much higher than those of dissolved sulfides. More importantly, they failed to track trends in dissolved sulfide concentrations, making evaluation of the dissolved-sulfide standard in the COP impossible. Moreover, a slight difference in the implementation of EPA Method 9030 caused a marked increase in 2002 sulfide concentrations compared to those of 2001. The increase was purely an artifact of the difference in laboratory digestion techniques, even though both analyses conformed to the method protocols.

In part, accurate measurement of dissolved sulfide in previous benthic surveys was hampered because sediment samples, rather than water samples, were being collected. Sediment samples do not lend themselves to chemical analysis methods designed for purely aqueous samples. The inappropriateness of the prior sulfide measurements was demonstrated by the analysis of the pore water samples collected during the 2003 and subsequent surveys. Dissolved sulfide concentrations were determined using EPA method 376.2, which has very low MDL of 0.05 mg/L. Dissolved sulfide was not detected in any of the 36 samples collected using the improved sampling technique.

The improved sampling technique was originally developed and applied for high-resolution trace-metal analyses that were conducted in an assessment of the marine bioavailability of chromite-mine contamination within Estero Bay. In preparation for the dissolved-metal investigation, interstitial pore-water samples were collected by hand vacuuming using an aquarium air stone. This method has been found to be effective for the *in situ* collection of pore-water samples that were subsequently used to accurately define small gradients in dissolved constituents associated with shallow-water sediments (Sarda and Burton 1995). The technique was adapted for offshore sampling by working the air stone into a sediment sample while it was still contained within the grab sampler onboard the survey vessel. The pore water was then extracted using a 60-mL syringe that was attached to the air stone with plastic tubing.

To avoid post-sampling increases in dissolved sulfide levels due to oxidation, the samples required preservation shortly after collection. However, suspended particulates in the sediment samples also had to be removed as part of EPA Method 376.2. Consequently, the pore-water samples were first treated with sodium hydroxide (HNaO) immediately after collection onboard the vessel. They were left to stand for approximately ten minutes with zero headspace in 250-mL containers while the suspended flocculates settled out. The supernate was then transferred to another container that held zinc acetate [$Zn(C_2H_3O_2)_2$] as a preservative. In rough seas, this sampling procedure would not be possible because vessel motion induced by large waves would unduly agitate the pore-water samples, thereby hampering the timely settling of suspended particulates.

Synthetic Organic Compounds

The presence of synthetic organic compounds within sediment samples is often indicative of anthropogenic input and, in high enough concentrations, these compounds can be deleterious to the marine ecosystem. Phenolic compounds, which are used in plastics, adhesives, and coatings, are among the most com-

mon synthetic organic compounds measured in effluent. Benthic sediment samples were analyzed for phenolic compounds as well as for the pesticides aldrin, dieldrin, chlordane, DDT, endrin, and toxaphene. During the October 2006 survey, sediments were also analyzed for the toxic compounds PCB and PAH. As described in Chapter 2, few of these synthetic organic compounds have ever been detected in MBCSD effluent and, when they are, their concentrations are extremely low. Nevertheless, benthic sediments continue to be monitored for organic contaminants because a long-term discharge could conceivably result in a slow buildup over time, whereby sediment concentrations could eventually reach detectable levels. None of these synthetic organic compounds were detected in sediment samples collected at any of the stations during 2006, nor have any been detected in the sediment samples collected over the previous 20 years.

Trace Metals

In contrast to synthetic compounds, the presence of trace metals within seafloor sediments is not necessarily indicative of anthropogenic input. Most trace metals are found in detectable concentrations within naturally occurring mineral deposits, and some are even needed by marine organisms to survive. However, elevated levels of certain trace metals can be indicative of anthropogenic input, and excessive levels can cause deleterious effects in marine organisms.

Nine trace metals have been measured in seafloor sediments since the inception of the monitoring program. They are arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. The toxicity of these metals to marine organisms has been examined in numerous laboratory bioassays and field experiments (Long and Morgan 1991, Long et al. 1995). These studies have been summarized in the form of biological effects levels, most notably an effects-range low (ERL), below which toxic effects are not expected, and an effects-range median (ERM), where adverse biological effects can be expected.

The benthic monitoring program described in the current NPDES discharge permit added aluminum and iron to the metals to be measured within sediments. Unlike the other nine metals, aluminum and iron are not particularly toxic to marine organisms, and their naturally occurring concentrations are relatively insensitive to anthropogenic input. The latter attribute makes them ideal tracers of natural variations in all the trace metals. Consequently, they have been used to normalize observed concentrations in the other nine metals so that background variation is reduced and anthropogenic trends can be revealed. In particular, iron has been used as a reference element for determining anthropogenic enrichment of trace metals within the Southern California Bight (Schiff and Weisberg 1997) and in many other offshore regions (Daskalakis and O'Conner 1995).

Physical Properties

Moisture content and grain-size distribution are two important physical properties of marine sediments. Moisture content is a measure of the volume of pore water present in the sediment samples. While not an indicator of discharge effects, it is an important parameter that is used to convert chemical concentrations measured in a wet sediment sample to a dry-weight basis. Dry-weight concentrations allow a more direct comparison of contaminant levels associated with bulk sediments by eliminating variations in sample mass that arise because of arbitrary differences in water content. Moisture content is also used, along with salinity measurements, to eliminate the bias introduced by salt content in grain-size determinations.

An increase in fine particulates near a municipal ocean outfall can be indicative of excessive deposition of particulates discharged by a treatment plant. In addition, the amount of fine sediment directly affects the composition of the infaunal community that resides within those sediments, although the precise mecha-

nism for the relationship is rarely clear (Snelgrove and Butman 1994). Finally, natural variation in trace-metal concentrations has been correlated with the fine-sediment (mud) fraction and, like aluminum and iron, has been used to normalize metal concentrations (Dossis and Warren 1980, Ackerman et al. 1983, Horowitz and Elrick 1987).

In recognition of the potential influence of fine particulates, the previous NPDES discharge permit issued to MBCSD (RWQCB-USEPA 1993b) required that trace metal concentrations be normalized by the fine particulate fraction. However, this normalization was problematic because, in the case of the Estero Bay sediments, the fraction of fine particles was very small. Normalization (division) by the small fine fraction was found to unduly amplify tiny, random fluctuations in grain size, which produced erroneous contamination patterns. The current NPDES permit no longer requires normalization by the fine sediment fraction.

Accurate measurement of the fine sediment fraction is also important for the interpretation of the marine biological data. Otherwise, variability in benthic community's composition could be erroneously ascribed to effluent discharge, when instead it may be the result of natural variation in the distribution of fine particulates. One of the major difficulties in the accurate measurement of the fine fraction in marine sediments is that the standard pipette method described by Plumb (1981) and Folk (1980) overestimates the finest (clay) fraction. This occurs because the procedure incorrectly includes the weight of the dissolved solids (salt) when weighing the dried pipette extraction. This often generates an artificial bimodal grain-size distribution, where the smallest clay fractions exceeded silt fractions.

In 1994, the anomalous character of the bimodal size distribution in the MBCSD database led to a number of internal investigations and confirmatory grain-size analyses by outside laboratories (MRS 1995). These investigations led to the development of the refined analysis method that is currently in use, which accounts for the presence of dissolved solids by correcting for the measured salinity in the pipette fractions (MRS 1998i and Coats et al. 1999). The refined particle-size analysis method was instituted in the MBCSD monitoring program in 1998. As a result, the finest size fractions determined in sediment samples collected after October 1997 are far more accurate than those determined in prior surveys. Thus, some, if not all, of the long-term trends in the MBCSD grain-size database can be ascribed to improvements in methodology rather than actual changes in the benthic environment.

Biological Parameters

Determination whether the discharge is causing adverse biological effects involves assessing whether a balanced indigenous population (BIP) of shellfish, fish, and wildlife exists in areas potentially affected by the discharge. A BIP is an ecological community which exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted environmental conditions. Certain biological characteristics of the community examined in an evaluation of a BIP including species composition, abundance, biomass, dominance, and diversity; spatial and temporal distributions; trophic structure; and the presence or absence of indicator species. Most marine monitoring programs determine the presence of a BIP using data on the infaunal organisms that live with sediments surrounding a potential pollutant source. In evaluating a BIP, infauna have many advantages over other marine organisms, such as marine mammals or finfish. Infauna are relatively easy to collect in numbers large enough for reliable statistical testing. Also, they have limited mobility and cannot easily escape exposure to pollutants. Finally, decades of benthic monitoring studies have established well-defined responses of infaunal taxa to pollutant stress.

In the earliest MBCSD monitoring surveys, analysis of biological samples produced two types of data on infaunal organisms: the number of organisms for each taxon, and the biomass of major taxonomic groups within each sample. However, the current NPDES permit no longer requires the determination of biomass because it is of little interpretive value, and its measurement is fraught with difficulty (MRS 1999b). Biomass is difficult to interpret because the erratic presence of large, undersampled organisms tends to severely skew results. Also, in practice, the heavy calcareous shells and exoskeletons of mollusks and crustaceans are troublesome to remove, and alcohol evaporation during weighing affects the determination of wet-weight biomass. Because of these problems, the USEPA does not recommend biomass for inclusion in 301(h) monitoring programs (USEPA 1987).

Pollution affects marine ecosystems by changing the number and type of benthic organisms found in the sediments. However, subtle changes in community composition are not always readily apparent in the large volume of raw data generated by a long-term monitoring program. Over the more than two decades of MBCSD monitoring, more than 145,300 individual organisms representing 345 individual taxa have been collected. To assess whether the infaunal community has been impacted, these data must be summarized into concise parameters that are indicative of pollutant stresses. Biodiversity is a common indicator of the well-being of ecological systems, and forms the cornerstone of most impact assessment studies. Unfortunately, biodiversity is difficult to define quantitatively.

Diversity has two major components: species richness and evenness. Species richness measures the variety (number) of species, while evenness measures the distribution (abundance) of individuals among the species (Magurran 1988). Healthy ecosystems are thought to be both rich in species and have an even distribution of individuals among those species. Although no single measure can accurately represent changes in both evenness and richness along a pollution gradient, many indices attempt to do so. The Shannon Diversity Index (H') is the most widely used diversity index because it exhibits some degree of sensitivity to both evenness and richness. In addition, most diversity indices only measure the diversity within a local area at a particular time, *viz*., among replicate samples from a single station (α-diversity). In contrast, pollutant stresses tend to induce marked changes in community composition between samples separated spatially and temporally (β-diversity; Smith et al. 1979). Multivariate analysis techniques are better suited to the evaluation of β-diversity.

Most diversity indices are also poorly suited for describing potential impacts to infaunal communities because they lack biological meaning, show little correlation with environmental quality, are difficult to interpret ecologically, and often result in ambiguous or biased estimates of diversity (Goodman 1975, Washington 1984, Green 1979). As a result, many indices are not recommended for routine inclusion in 301(h) monitoring programs (USEPA 1987). Nevertheless, the current NPDES permit requires that a number of infaunal community indices be reported and examined for temporal trends (RWQCB-USEPA 1998b). However, because of limitations associated with the indices, spatial differences with respect to outfall proximity, which are evaluated using standard statistical hypothesis tests, must be interpreted carefully. Table 4.4 lists the infaunal indices computed in this report. The associated algorithms and guidance on how to interpret them are presented in Appendix E.2.

Table 4.4. List of Infaunal Parameters

• Number of individuals	• Number of species
• Number of individuals per species	• Species richness (*S*) (Magurran 1988)
• Margalef species richness (d) (Margalef 1951)	• Shannon-Wiener index (*H'*)
• Simpson dominance (*C*') (Simpson 1949, Wittaker 1965)	• Brillouin index (*h*)
• Pielou evenness index (*J*') (Pielou 1977)	• Swartz dominance (S_w)
• Infaunal Trophic Index (*ITI*)	

4.2 MARINE SEDIMENT QUALITY

The quality of marine sediments surrounding the MBCSD outfall provides a definitive measure of potential marine impacts caused by the discharge of effluent. Specifically, discharge-related impacts have been demonstrated in other outfall monitoring programs, where marked changes in the benthic environment have been observed surrounding oceanic discharges located offshore of both central and southern California. For example, prior to improvements in effluent quality, contaminant buildup was observed in sediments surrounding large outfalls offshore southern California (Phillips and Hershelman 1996, Stull et al. 1986b). Another example comes from the continental shelf south of Estero Bay, where sediments exhibited small but statistically significant chemical signatures that were indicative of drilling mud discharges distributed over wide regions (Hyland et al. 1994, Coats et al. 1991, Coats 1994). If the MBCSD effluent discharge were causing significant impacts to the marine environment, similar changes in sediment properties would be evident near the diffuser structure. The challenge is in distinguishing changes that are caused by naturally occurring processes from changes that result from human activities.

Physicochemical changes in sediments provide a good indication of marine impacts for four main reasons. First, because outfalls are located on the seafloor, sediments are proximal to the source of potential contamination. Second, many contaminants are hydrophobic and tend to preferentially adhere to the fine particulates as they settle out of the effluent plume. Third, contaminants incorporated into seafloor sediments tend to have a long residence time because of the slow dispersive processes that prevail within pore waters. Finally, infaunal organisms that live within seafloor sediments are continuously exposed to any benthic contaminants because they cannot easily escape the source of pollution. If seafloor sediments or pore waters become polluted, then infaunal organisms can be impacted. Sedentary infaunal organisms provide a food source for other, more mobile organisms, such as finfish and shellfish. These trophic relationships can lead to bioaccumulation of contaminants within the marine food chain.

Despite the sensitivity of the benthos to effluent discharge, there has never been any indication of deleterious impacts to seafloor sediments as a result of the MBCSD discharge. This remained true during 2006, as it has in the previous two decades of monitoring. This lack of negative benthic impacts is largely due to the comparatively low mass-emission of contaminants from the outfall. There has never been a large industrial contributor to the MBSCD influent stream, and the total discharge volume is small compared to ocean dischargers to the south, where discharge volumes can be over 100-times greater (e.g., SCCWRP 1995).

The lack of benthic impacts is evident from three sets of analyses performed on the chemical properties of sediment samples collected around the MBCSD outfall. Each of these three sets of analyses is discussed in the following subsections. First, concentrations of potential contaminants measured in sediment samples were below levels that have been identified as toxic to marine organisms. Second, there was no long-term trend in sediment concentrations that would suggest a buildup of contaminants close to the outfall.

Finally, the spatial pattern of sediment concentrations near the outfall during 2006 bore no consistent relation to outfall proximity.

4.2.1 Sediment Contaminant Concentrations below Toxic Levels

In keeping with the California Ocean Plan (SWRCB 1997), the narrative receiving-water limitations in the Waste Discharge Requirements (RWQCB-USEPA 1998a) issued to the MBCSD state that the discharge should not cause chemical substances in marine sediments '… *to be increased above levels which would degrade indigenous biota*….' This requirement was established because contaminants that reside in sediments for long periods have the potential to exert acute and chronic effects on resident marine organisms (NOAA 1991ab, Finney and Huh 1989, Bertine and Goldberg 1977).

Over the 21 years of continuous benthic monitoring, there has never been any indication of an effluent-related degradation of marine organisms within Estero Bay. In large part, this is due to the consistently low contaminant concentrations within the discharged effluent (see Chapter 2). As a result, contaminant concentrations measured within Estero Bay sediments, both near and distant to the outfall, have been below thresholds considered harmful to marine biota. In fact, the comparatively pristine marine environment of Estero Bay is reflected in benthic contaminant levels that are well below concentrations measured in sediments offshore southern California.

Thresholds of Biological Effect

Over the years, marine monitoring programs have placed considerable emphasis on benthic contamination. This experience has resulted in a set of thresholds of biological concern that can be used to screen measured contaminant concentrations at individual sites. Specifically, these biological benchmarks can be used to assess whether the contaminant concentrations measured in sediments have the potential for adverse biological effects. Although the thresholds are not regulatory criteria, they provide toxicological guidelines that help assess the potential environmental significance of specific contaminant concentrations measured in the field.

The toxicological benchmarks advanced by NOAA (Long and Morgan 1991) are used in this report to evaluate contaminant levels measured during 2006. These guidelines were based on a correlation between chemical concentrations and observed biological effects in numerous modeling, laboratory, and field studies (Long et al. 1995). The studies identified two toxicological endpoints, an Effects-Range Low (ERL) and an Effects-Range Median (ERM) concentration. The lower toxicological endpoint (ERL) is associated with the concentration of a particular compound that produced an adverse biological effect in only 10% of the data. Below the ERL, adverse biological effects are unlikely. Above the ERM, which is based on the median of the toxicological data, adverse effects are considered likely to occur. The most conservative benchmark (ERL) was used in this report to determine the potential for marine biological impacts from most of the contaminant concentrations that were measured within Estero Bay during 2006. However, the accuracy of these benchmarks varies considerably among the sediment contaminants. For example, the relationship between nickel concentrations and the incidence of effects in the toxicological database very weak. Consequently, even the upper (ERM) benchmark for nickel is poor predictor of levels where biological effects might be expected.

Both trace-metal and organic contaminants are of concern in the benthic environment. However, their natural occurrence differs markedly. Synthetic compounds, such as PAHs, PCBs, and pesticides, are the organic constituents that can have the most significant anthropogenic impact if found in sufficient con-

centration. However, in this and many other marine sediment studies, their concentrations are below detection limits. In contrast, trace metals occur naturally in the marine environment and are commonly detected in sediment samples. Because of this, trace metals can serve as a powerful surrogate for evaluating the regional transport and fate of a host of other particulate contaminants.

Grain-Size Distribution

Within deep offshore basins, sediment trace metals accurately record the history of contaminant accumulation because they are ubiquitous and long-lived. However, these deep benthic sediments often contain significant fractions of fine-grained sediments, which support an increased number of trace-metal bonding sites per unit of volume. Thus, large differences in trace metal concentrations among sediment samples can be caused by natural differences in mud fractions that are unrelated to human activities. Because of this, many marine benthic studies normalize trace metal concentrations by the mud, iron, or aluminum fraction. This reduces much of the inherent natural variability and, as a result, can reveal anthropogenic contaminant patterns normally masked by the natural association between metals and fine particulates (Dossis and Warren 1980).

In contrast, nearshore environments are subject to energetic oceanographic processes that erode fine particles, leaving behind coarser, more transport-resistant sandy sediments. These sandy sediments usually have comparatively low metal concentrations. Also, metals tend to be incorporated into the mineralogy of the sand grains rather than adsorbed onto particulate surfaces, as is the case with silts and clays. Because of this, metals are less likely to dissolve and become assimilated by marine organisms in sandy sediments. Because of the lower bioavailability of metals in sands, NOAA does not recommend normalization of trace-metals for samples with less than 20% fine-grained material (Long and Morgan 1991). Estero Bay sediments consist almost entirely of sand (>99%, Table 4.5), and normalization grossly overemphasizes small inherent differences in the fine-particulate distribution (MRS 1998bh). Consequently, the monitoring requirements specified in the current NPDES permit no longer specify normalization of contaminant concentrations by fine sediment fractions (RWQCB-USEPA 1998b). In keeping with this, mud-normalized concentrations are not reported here.

Table 4.5 Grain-Size Distribution (%) in Seafloor Sediment Samples Collected on 4 October 2006

	Clay (9 to 12ϕ)	Silt (5 to 8ϕ)	Fine to Medium Sand (1 to 4ϕ)	Coarse Sand (1ϕ)	Very Coarse Sand (0ϕ)	Gravel (-1ϕ to –3ϕ)
Station 1	0.01	0.42	99.12	0.39	0.04	0.01
Station 2	0.22	0.33	99.09	0.30	0.07	0.00
Station 3	0.29	0.28	98.53	0.78	0.11	0.02
Station 4	0.09	0.35	99.21	0.31	0.04	0.01
Station 5	0.12	0.30	99.34	0.16	0.07	0.00
Station 5[a]	0.19	0.23	99.16	0.33	0.07	0.02
Station 6	0.17	0.39	99.33	0.08	0.02	0.00
Station 7	0.19	0.22	99.17	0.27	0.11	0.04
Station 8	0.36	0.41	98.06	0.91	0.25	0.00
Station 9	0.18	0.23	99.45	0.11	0.02	0.01
Mean[b]	**0.16**	**0.31**	**99.08**	**0.32**	**0.07**	**0.01**

[a] Duplicate analysis of Station-5 sediment sample
[b] Mean computed after arc-sine transformation

Nevertheless, it is useful to examine the grain-size distributions independent of the trace-metal investigation. For example, an increase in fine fractions close to the discharge point can be indicative of a buildup in effluent particulates within the surficial sediments. Also, the overall character of the grain-size distribution is indicative of the dynamics within a particular benthic environment. Increased mud fractions are indicative of quiescent depositional environments, while well-sorted sands result from energetic wave environments that winnow fine particulates as they constantly rework the surficial sediments.

The statistical analyses of grain-size distributions are summarized in Appendix Table D.4. The Table shows that Estero Bay sediments consist of well-sorted fine sands with a distribution skewed slightly toward the finer fractions. Mean particle diameters range from 143 μm to 162 μm and lie in the middle of the fine-sand portion of the grain-size distribution. The high degree of sorting is reflected by low standard deviations (σ<0.41). The small, but consistently positive skew to the distribution reflects a slight excess in the finer fractions relative to larger fractions. Together, these properties point to a highly energetic flow regime that tends to winnow fines from the surficial sediments. The contribution of larger-diameter fractions was negligible in that the combined coarse sand and gravel fractions (1 to -3ϕ) represented less than 0.05% of the total sample weight (Table 4.5). These largest fractions consisted mainly of fragments of shell hash that are randomly distributed on the surface of sediments in many shallow subtidal coastal areas.

Undetected and Nontoxic Metals

In 2006, trace-metal concentrations within sediment samples were either not detected or were below levels that are potentially toxic to marine organisms (Table 4.6). Cadmium and silver were not detected within the 2006 sediment samples, as has been the case in most prior monitoring surveys. The detection level for cadmium (MDL=0.1 mg/Kg-dry) was much smaller than the lowest toxic-effects level (ERL=1.2 mg/Kg). Similarly, silver's MDL (0.07 mg/Kg-dry) was 14-times lower than its lowest threshold of biological effects. Thus, even if these two metallic elements were present in Estero Bay sediments at concentrations below their respective detection limits, they would not be likely to affect marine organisms.

Table 4.6 Metal Concentrations (mg/Kg-dry) in Seafloor Sediment Samples Collected on 4 October 2006

Station	Aluminum	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Silver	Zinc
1	7300	3.5	<0.09[a]	69	3.4	11,700	2.5	<0.05	50	<0.07	21
2	6200	4.0	<0.09	53	3.2	10,200	2.2	≅0.15[b]	48	<0.06	18
3	6000	4.0	<0.09	51	3.2	10,100	2.0	≅0.06	51	<0.07	18
4	6000	4.1	<0.10	51	2.9	10,000	2.1	<0.06	47	<0.07	17
5	5700	3.8	<0.09	48	3.0	9,700	2.0	<0.05	48	<0.07	17
6	6400	3.7	<0.09	57	3.3	10,800	2.2	<0.05	51	<0.07	20
7	6300	3.8	<0.09	52	3.1	10,500	2.2	<0.05	47	<0.07	18
8	7000	4.2	<0.10	61	4.0	11,800	2.6	<0.06	59	<0.07	20
9	5400	4.1	<0.10	44	2.9	9,100	2.0	<0.05	42	<0.07	16
Mean[c]	**6200**	**3.9**	**<0.10**	**54**	**3.2**	**10,400**	**2.2**	**<0.15**	**49**	**<0.07**	**18**
ERL	**—[d]**	**8.2**	**1.2**	**81**	**34.0**	**—**	**46.7**	**0.15**	**20.9**	**1.0**	**150**
ERM	**—**	**70.0**	**9.6**	**370**	**270.0**	**—**	**218.0**	**0.71**	**51.6**	**3.7**	**410**
SCB[e]	**—**	**6.3**	**0.2**	**29**	**12.2**	**—**	**10.6**	**—**	**29**	**0.2**	**46**

[a] "<" indicates that the metal was not detected above the MDL, which is reported after the "<" symbol.

[b] "≅" indicates that the metal was detected but the reported concentration was not quantified. Namely, the reported concentration exceeded the method detection limit (MDL) but was below the PQL.

[c] After logarithmic transformation [d] Guideline not specified

[e] Concentration that would be considered enriched relative to background concentrations in the Southern California Bight based on normalization by iron (Schiff and Weisberg 1997).

Similarly, mercury was not detected at seven of the nine stations. Again, the detection limit (0.06 mg/Kg-dry) was well below the concentration where biological effects can first become noticeable (ERL=0.15 mg/Kg). Mercury was detected in concentrations too low to be quantified at Stations 2 and 3. Although the reported mercury concentration at Station 2 was comparable to its ERL, the actual concentration was indeterminate within a concentration range between the MDL (0.05 mg/Kg-dry) and the PQL (0.21 mg/Kg-dry). Even if actual concentration was equal to the PQL, it would still be three-times lower than the ERM (0.71 mg/Kg) where biological impacts are expected.

Two of the remaining eight metals, namely aluminum and iron, are not toxic to marine organisms. The concentrations of these two metals quantify changes in the concentrations of the other trace metals that occur naturally within the sediment samples because of inherent differences in mineralogy. The other six metals have been consistently detected in Estero Bay sediments throughout the history of the benthic-monitoring program. Although they have the potential for anthropogenic enrichment, their mean concentrations have remained comparable to ambient levels for the region, and below (ERM) levels likely to be toxic to marine organisms. In 2006, as in previous years, five of these six metals had concentrations well below the ERL where biological effects can begin to become apparent. Only the mean nickel concentration was above the ERL. Each of these six detected metals is described below.

Chromium

Historically, most of the chromium detected in the Estero Bay sediments was in a trivalent form that occurs naturally as chromite ore. This is evident from the lack of measurable hexavalent chromium levels in samples collected prior to 1999 (MRS 1996, 1997c, 1998bi, and 1999b). Industrial processes generally produce the hexavalent and metallic oxidation states of chromium. Although chromite ore is a widely distributed mineral deposit, it is more prevalent along the south-central coast of California (SAIC 1986).

Naturally occurring chromite is introduced to the Central Coast's waters by fluvial transport of eroded ultrabasic minerals found in the Franciscan formation. The Franciscan formation outcrops along the headlands north of Point Estero and in the Santa Ynez Mountains. The influence of these local sources of chromite ore is evident in the high total chromium concentrations measured in Estero Bay relative to background concentrations observed offshore southern California (Schiff and Weisberg 1997). An average ambient chromium concentration near 17 mg/Kg was found in sediment samples collected within the Southern California Bight (SCB). At 54 mg/Kg, average chromium concentrations within Estero Bay were much higher than the SCB average, and were nearly double the concentration (29 mg/Kg) considered to be enriched in the Bight (Table 4.6). Only approximately 25% of the Bight had sediments with chromium concentrations higher than those measured in Estero Bay. Most of this area was within Santa Monica Bay, where a high mass-emission of contaminants from POTWs[7] occurred before 1988. In addition, slightly elevated chromium concentrations were found in the Santa Barbara Basin in the northern reaches of the Bight. As with the Central California Coast region, they can be ascribed to the presence of naturally occurring chromite ore in the region (Chow and Earl 1978).

The fact that chromium also occurs naturally in the mineralogy of the Central Coast explains its overall enrichment within the marine sediments of northern Estero Bay. However, ordinary erosional processes may not be able to fully account for the observed increase in chromium concentrations that has occurred for at least the last two decades. Long-term increases in chromium, arsenic, copper and nickel are docu-

[7] Publicly-Owned Treatment Works

mented in Section 4.2.3. Although these metals are naturally enriched in onshore mineral deposits, nearshore depositional sediments should have reached equilibrium with onshore sediments that have been eroded within the adjacent watershed throughout geologic time. Instead, the increases in marine sediment concentrations that have been observed throughout the monitoring program suggest that the erosion of these mineral deposits has been accelerated by human activities, such as mining. As described by MRS (2000b, 2001), sediment samples collected in conjunction with a supplementary environmental project indicate that erosion around abandoned chromite mines is the likely cause for the increases observed in the marine sediments of Estero Bay.

Regardless of their source, chromium concentrations in all sediment samples collected during 2006 remained below the lowest toxicity benchmark where biological effects might first be observed. The highest concentration (69 mg/Kg-dry) was measured at Station 1 and was still well below the ERL of 81 mg/Kg (Table 4.6). It was one-fifth of the concentration where biological effects become probable (ERM = 370 mg/Kg). Although the toxicity benchmarks were reliably determined, elevated chromium concentrations are not '*highly predictive of adverse biological effects,*' as stated by Schiff and Gossett (1998) in their review of contaminant concentrations within the SCB. On the contrary, Long et al. (1995) state that the incidence of effects in the toxicological studies used to establish the levels for chromium were '*greatly influenced and exaggerated by data from multiple tests conducted in only two field surveys*.' In any regard, because measured concentrations within Estero Bay sediments during 2006 were below the lowest effects level, it is unlikely that chromium is causing any adverse effects on marine organisms.

Arsenic

Arsenic is a highly poisonous metallic element used in insecticides, herbicides, solid-state doping agents, and various alloys. Arsenic is also present in naturally occurring substances and is widely distributed throughout nature. As a result, mine tailings may contain high residual arsenic levels due to the presence of arsenopyrites in the ore, overburden, and soil. Depending on the location and composition of the mine overburden, arsenic may be released into surface and ground waters through erosion.

Regardless, mean arsenic concentrations in Estero Bay sediments were less than half of the lowest toxicity level (ERL of 8.2 mg/Kg) where adverse biological impacts would first begin to appear and were an order of magnitude smaller than the ERM (70 mg/Kg) where biological impacts become probable. For comparison, approximately 75% of the area within the Southern California Bight has arsenic concentrations exceeding the mean levels measured in Estero Bay during 2006 (Schiff and Gossett 1998). After adjustment for the mean iron concentration, average arsenic levels would have to be 2.4 mg/Kg higher to be considered enriched relative to background concentrations in marine sediments to the south (SCB = 6.2 mg/Kg in Table 4.6).

Copper

As with arsenic and chromium, copper commonly occurs in Central-Coast minerals. However, the average copper concentration (3.2 mg/Kg) in marine sediments collected at the nine benthic-monitoring stations in 2006 was well below the level that would be considered enriched relative to background concentrations in sediments within the SCB (12.2 mg/Kg). Approximately 90% of the SCB contains sediments with higher copper concentrations than those measured in Estero Bay. All of the sediment samples had measured copper concentrations that were also far below levels that would begin to affect marine organisms (ERL=34 mg/Kg). In contrast to chromium effect levels, the biological effect levels of copper are well defined by toxicological studies. Regardless, the highest measured copper concentration was 50-times lower than the ERM level where adverse effects become probable.

Lead and Zinc

Lead and zinc concentrations in Estero Bay sediments are also low compared to ERL levels where adverse biological effects first become noticeable. They are also low compared to concentrations within the SCB, where approximately 95% of the area has higher concentrations. Most of the elevated lead and zinc concentrations to the south were measured within Santa Monica Bay and on the Palos Verdes Shelf, where large POTWs have discharged for many decades. However, most of the mass emissions of metals from these treatment plants occurred prior to the substantial improvements in effluent quality that were realized in 1988. Apparently, the historical discharges from these outfalls have accumulated within adjacent sediments and have persisted for decades (Stull et al. 1986b). In contrast, the historically low emission of contaminants from the MBCSD treatment plant has had no measurable effect on the high sediment quality within Estero Bay.

Nickel

Although unrelated to wastewater discharge, nickel was the only trace metal whose concentration in Estero Bay sediments consistently exceeded its ERL level (Table 4.6). In fact, in the more than two decades of benthic monitoring, only one sample has contained nickel in concentrations less than the ERL of 20.9 mg/Kg. In 2006, however, the nickel concentration at Station 8 even exceeded the ERM level (51.6 mg/Kg) where adverse effects are normally considered probable. Despite measured nickel concentrations that exceed marine-toxicological benchmarks, there were no apparent deleterious impacts to infaunal organisms living within northern Estero Bay sediments. There are two possible reasons for this.

First, nickel exhibits a very weak relationship between the incidence of effects and concentrations in the database used to establish the toxic-effect ranges (Long et al. 1995). Because of this weak toxicological relationship, specification of bulk nickel concentrations that induce adverse reactions in marine biota is highly uncertain. Much of this uncertainty arises from wide variability in nickel bioavailability. When nickel is in a dissolved form, or adheres to surfaces of fine-grained sediments, it is much more likely to impact organisms that ingest or come into contact with the sediments. Conversely, nickel that is bound into the mineralogy of larger sand grains has less influence on marine organisms. The sandy sediments within the MBCSD benthic monitoring area fall into the latter category.

The second reason for the lack of impacts from elevated nickel concentrations stems from the fact that nickel occurs naturally in the mineralogy of the southern Central California Coast (Steinhauer et al. 1994). Because nickel and chromium often co-occur in mineral deposits, it is likely that the increased nickel concentrations found offshore also derive from the Franciscan geologic formation that outcrops at Point Estero. Thus, much of the measured nickel is bound into the mineral matrix of the sand grains themselves, where marine fauna cannot readily metabolize it. Additionally, even if there is a slightly higher dissolved-phase nickel concentration within the pore waters of Estero Bay, benthic organisms may have adapted to the elevated nickel concentrations that have probably been present for epochs.

Nickel and chromium are the only metals whose measured bulk concentrations in Estero Bay sediments consistently exhibit '*anthropogenic enrichment*' relative to background concentrations in the SCB (Schiff and Weisberg 1997). However, this designation is not correct because much of the regional enrichment arises from natural erosional processes, rather than from accelerated erosion of contaminated mine tailings. In fact, the influence of regional mineralogy is plainly evident in the SCB database where '*background*' nickel concentrations steadily increase from south to north. Schiff and Gossett (1998) did not account for this natural variability in ore deposits and erroneously included nickel trends in their assessment of anthropogenic contamination within the Southern California Bight.

Organic Pollutants

Benthic sediments were also analyzed for synthetic organic compounds, including chlorinated phenolic compounds, non-chlorinated phenolic compounds, PCBs, PAHs, and pesticides. None of the 100 measured compounds were detected at any of the nine stations (See Appendix D.1). PQLs for all the organic compounds were well below ERL guidelines where marine biological impacts become likely for these compounds.

There are no well-established marine biological effects levels for organic-loading parameters such as TKN, BOD, TVS, and O&G (Table 4.7). Moisture content, mud fraction, TKN, BOD, and TVS measured in the sediment samples collected in 2006 were comparable to levels measured in the past five years. As described in Section 4.1.4 on Page 4-8, the dissolved-sulfide analyses conducted on pore-water samples in 2006 represent a significant improvement over previous sulfide analyses. As a result, the 2006 measurements provide the best evaluation of compliance with the sulfide limitation in the COP. No dissolved sulfides were detected in the survey, even though the detection limit was very low (MDL=0.05 mg/L).

Table 4.7 Non-metal Concentrations (mg/Kg-dry)[a] in Seafloor Sediment Samples Collected on 4 October 2006

Station	Moisture (%)	Dissolved Sulfides (mg/L)	BOD	Oil & Grease	TKN	Volatile Solids (%)
1	23.4	<0.05	43	<35	124	1.85
2	22.5	<0.05	44	<35	101	2.12
3	21.9	<0.05	44	<35	96	2.37
4	25.3	<0.05	50	<36	115	2.05
5	23.4	<0.05	57	<35	98	2.28
6	23.3	<0.05	57	<35	116	2.11
7	21.8	<0.05	49	<35	110	1.91
8	25.7	<0.05	52	<36	131	2.23
9	24.5	<0.05	49	<36	91	2.03
Mean[b]	**23.5**	**<0.05**	**49**	**<36**	**108**	**2.10**

[a] Unless otherwise indicated
[b] Arc-sine transformation for % and logarithmic transformation for mg/Kg

4.2.2 Contaminant Distribution Unrelated to Outfall Proximity

In 2006, as in previous years, contaminant distributions failed to exhibit a spatial pattern indicative of a benthic environment that was impaired by discharged effluent. Specifically, there was no consistent evidence that sediment contaminant concentrations near the diffuser structure were elevated relative to distant sites. A gradient of steadily decreasing contaminant concentrations with increasing distance from the outfall would be *prima faci*e evidence of discharge-related impacts in the marine environment. This pattern of impairment has been observed around larger outfalls servicing more industrialized locales (Phillips and Hershelman 1996, Stull et al. 1986b, Stull 1995, Diener et al. 1995). The lack of contaminant loading around the MBCSD outfall was confirmed through application of rigorous statistical hypothesis tests and by qualitative comparisons of concentration levels ranked by distance from the diffuser structure.

During any given year, a sediment constituent may exhibit an anomalous concentration at one or more stations that results in what appears to be a spatial trend related to outfall proximity. Occasionally, that trend is determined to be statistically "*significant*" at the 95% confidence level. However, by the very definition of the 95% confidence level, one in twenty tests would be expected to reveal a "*significant*" gradient when, in fact, none exists. Over the years, many constituents have been tested for spatial gradients, and occasionally the analysis identifies one that may be statistically significant at some particular time. Upon further analysis, however, the gradient has always been found to be unrelated to the discharge. Approximately half of the time, statistically "*significant*" gradients are associated with a pattern of increasing contamination with distance from the outfall, which is opposite of the spatial trend expected from impacts associated with effluent discharge.

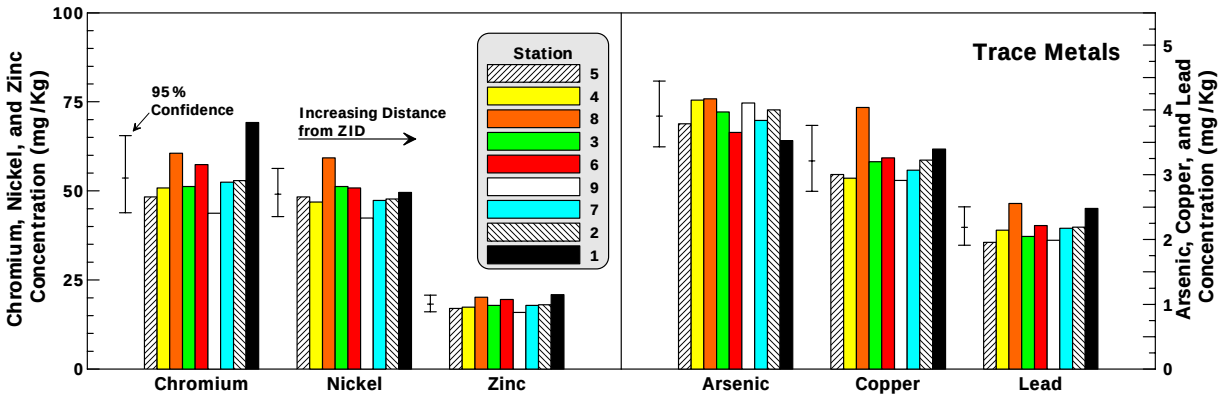


Figure 4.3 Trace-Metal Distribution in Sediment Samples Collected during 2006

The bar graphs in Figure 4.3 show trace-metal concentrations ranked by distance from the diffuser. Consistent spatial gradients are not visually apparent in the bar graphs. Instead, most concentrations vary randomly about the survey mean within the 95% confidence interval (shown to the left of each bar graph). This demonstrates that the differences in concentration measured in samples collected from individual stations are largely due to sampling variability rather than to actual differences in contaminant concentrations among the stations. The confidence limits reflect the typical variability in concentrations found among replicate samples collected at an individual station.[8] Hence, there is a low degree of confidence in perceived differences between stations that are smaller than the inherent sampling error reflected by the 95% confidence interval. Figure 4.3 shows that most of the concentration differences among the stations can be ascribed to measurement uncertainty rather than actual spatial trends.

Only the elevated chromium concentration at (reference) Station 1, and the elevated nickel, copper, and lead concentrations at Station 8, extend well beyond the 95% confidence limits. However, these locally anomalous trace-metal concentrations, as well as some of the smaller differences among other stations, can be attributed to natural processes. This is apparent because the variability in aluminum and iron concentrations, shown in Figure 4.4, tends to track the spatial distribution of many of the anthropogenic metals shown in Figure 4.3. In particular, the highest aluminum and iron concentrations were observed at Stations 1 and 8.

Both aluminum and iron are good indicators of natural trace-metal variability because anthropogenic activities

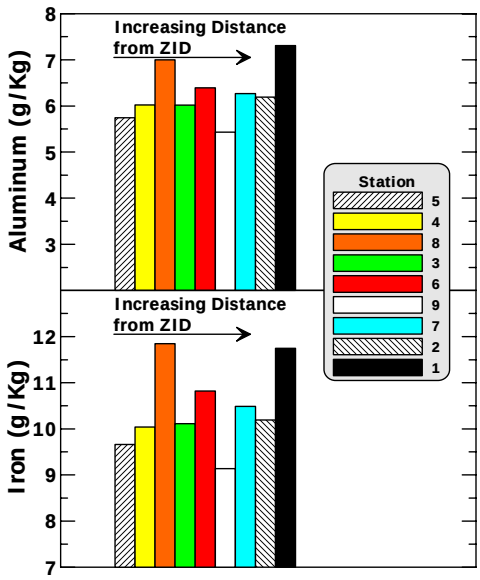


Figure 4.4 Aluminum and Iron Distributions in Sediment Samples Collected during 2006

[8] The confidence intervals were determined from three replicate chemistry samples that were collected and separately analyzed at each station in 1993 and 1994.

have little influence on them, and they are not enriched in the MBCSD discharge. Instead, increased concentrations in these two metals reflect the presence of a more quiescent depositional environment where fine sediments are preferentially deposited by natural processes. Normalization of raw trace-metal concentrations by aluminum, iron, or mud concentrations is common practice in impact-assessment studies because it can reveal anthropogenic patterns that are otherwise masked by variability in background concentrations. Alternatively, normalization can demonstrate when perceived spatial differences in raw concentrations are in fact related to natural processes, as is the case here.

Accordingly, normalizing, or dividing the raw trace-metal concentrations (Figure 4.3) by each respective station's aluminum or iron concentration (Figure 4.4) often reduced the spatial variability trace-metal concentrations among stations (Figure 4.5). In particular, the scatter in raw chromium, nickel, and zinc concentrations among stations (left frame of Figure 4.3) was significantly reduced after normalization by aluminum (upper left frame of Figure 4.5). The large chromium outlier at Station 1 (black bar), and the nickel outlier at Station 8 (orange bar), were especially tempered by the aluminum normalization. Normalization by iron (lower right frame of Figure 4.5) was effective at tempering the apparently elevated copper and lead concentrations at Station 8 (right frame of Figure 4.3).

Normalization by aluminum reduced the spatial coefficient of variation (CV) in chromium, nickel, and zinc concentrations by more than 6.8%. The copper and lead spatial variability were reduced by more than 5.2% by iron normalization. At the same time, normalization did not introduce any new trends indicative of an impact signature wherein contaminant concentrations consistently increase with proximity to the outfall.

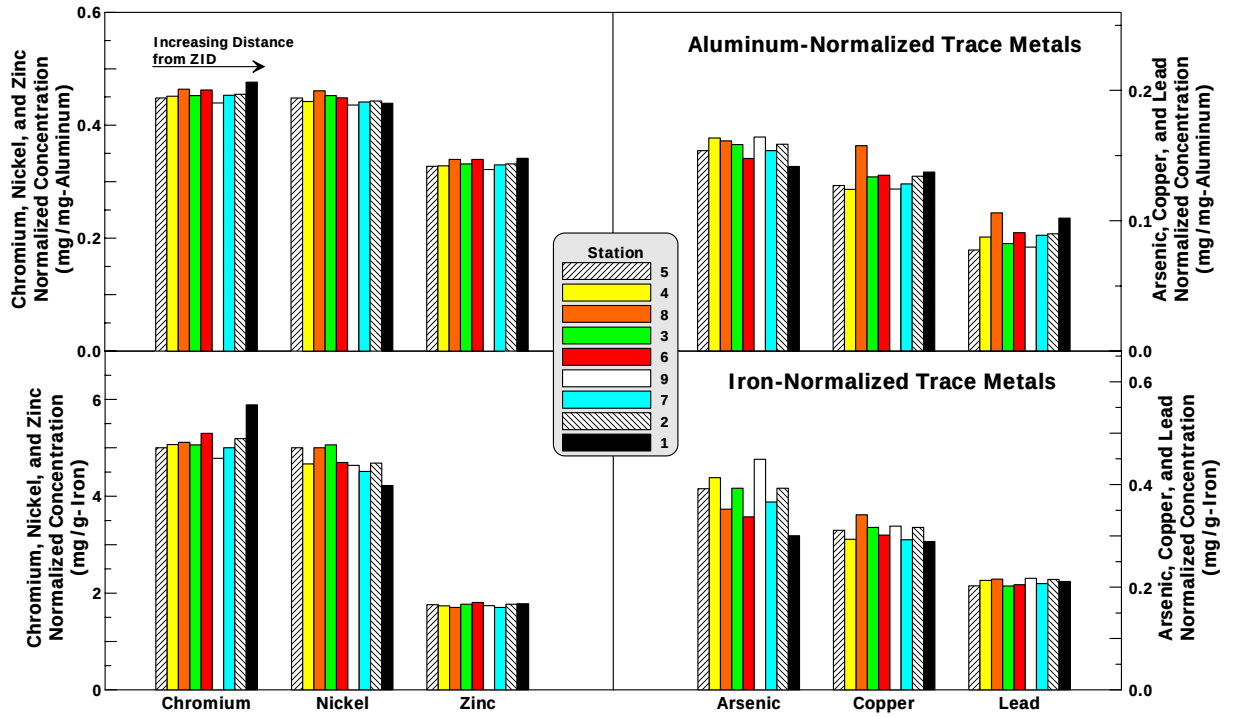


Figure 4.5 Aluminum-Normalized and Iron-Normalized Trace-Metal Distributions in Sediment Samples Collected during 2006

The significance of any perceived spatial differences in concentrations can be rigorously tested with statistical hypothesis tests. The results of these tests are shown in Table 4.8. The hypothesis tests evaluate whether differences in mean concentrations at near- and far-field stations can be considered statistically significant at the 95% confidence level. These tests compare the average concentration at stations within 70 m of the diffuser structure with the average concentration measured at the more distant stations. The tests evaluate whether this difference is large enough to be considered relevant given the inherent variability in the individual measurements. It is a form of an "Analysis of Variance" or ANOVA that is commonly applied in statistical hypothesis testing. The ratio of the difference in average concentrations to their variability is represented by the "*t*" statistic listed in the fourth column of the table. If "*t*" is large, then there is a higher probability that a perceptible difference in concentrations exists. The compliment of this probability is reflected by the "*p*" value listed in the fifth column of the table. Namely, a smaller the *p*-value indicates that the difference is more statistically significant. Thus, a *p*-value of 0.05 (5%) coincides with the 95% confidence level and reflects a 5% risk that the difference is not significant, but due to chance alone.

Note that for all but two trace metals, the average raw concentrations near the diffuser were lower than that of distant stations. The presence of a lower contaminant concentration near the diffuser is a pattern opposite of that expected in a benthic environment impaired by effluent discharge. The table reflects these

Table 4.8 Tests for Significant Increases in Contaminant Concentrations near the Diffuser

Parameter	Mean (mg/Kg) Distant[a]	Near[b]	*t*[c]	*p*[d]	Iron-normalized *p*[e]	Aluminum-normalized *p*
Aluminum (g/Kg)	6.57	6.08	-1.23	[0.13]	[0.01]	—
Arsenic	3.78	3.97	1.18	0.14	0.13	0.11
Chromium	57.7	51.7	-1.19	[0.14]	[0.09]	[0.14]
Copper	3.23	3.21	-0.09	[0.47]	0.12	0.48
Iron (g/Kg)	10.8	10.2	-0.86	[0.21]	—	**0.01**
Lead	2.28	2.14	-0.95	[0.19]	[0.35]	[0.19]
Nickel	48.2	49.5	0.41	0.35	**0.02**	0.11
Zinc	18.9	17.9	-0.84	[0.21]	[0.50]	[0.27]
BOD	45.1	51.3	1.90	**0.05**		
TKN	111	107	-0.42	[0.34]		
TVS (%)	1.91	1.98	2.29	**0.03**		
Mud (%)	1.50	1.45	-1.74	[0.06]		

[a] Mean concentration computed among Stations 1, 2, and 7, which lie at a distance of 133 m or more from a diffuser port (see Table 4.3 and Figure 4.2). An arc-sine or logarithmic transform was applied as appropriate.

[b] Mean concentration computed among Stations 3, 4, 5, 6, 8, and 9, which lie within 66 m of a diffuser port

[c] *t*-value computed from the difference in near and far mean concentrations relative to measurement variability. A negative *t*-value indicates that the computed mean concentration was lower at stations near the diffuser, opposite of that expected in an environment impacted by effluent discharge.

[d] *p*-value representing the probability that a higher nearfield mean concentration is not significant. In this study, *p*-values less than 0.05 (95% confidence) indicate that nearfield means are significantly higher, and the null hypothesis can be rejected. Note, however, that a '*one-sided*' *t*-test was performed, in which only higher, rather than lower, nearfield concentrations are meaningful. Consequently, *p*-values for negative *t*-values are not pertinent and are indicated with brackets.

[e] Hypothesis tests performed on trace-metal concentrations normalized by the iron and aluminum concentration to reduce the potential influence of inherent variability in background metal concentrations.

inapplicable cases with negative "*t*" statistics, and *p*-values enclosed in brackets. The table shows that the only trace metals that exhibit a spatial trend in average raw concentrations potentially consistent with effluent impacts were arsenic and nickel. However, the *p*-values associated with these differences (0.14 and 0.35) show that the perceived trends were not reliable given the high variability among the measurements. Normalization demonstrated that the relationship between the iron and aluminum trends were highly significant (p=0.01). It also introduced a potentially significant trend in the iron-normalized nickel distribution (p=0.02), although, as discussed above, aluminum provided a better normalization for chromium, nickel, and zinc. The aluminum-normalized nickel trend was not statistically significant (p=0.11).

Table 4.8 shows that slightly higher average concentrations in two organic loading parameters near the diffuser were potentially significant at the 95% confidence level. The tests showed that possibility of an increased BOD concentration at nearfield stations could not be rejected (p=0.05), nor could the increase in average TVS concentrations (p=0.03). However, Figure 4.6 shows that concentrations reported at individual stations were well within the measurement error of individual stations (the 95% confidence interval associated with the variability in measurements collected at an individual station). Moreover, the Figure does not exhibit a steady decrease in concentration with increasing distance from the outfall. Instead, as described above, the marginally significant results of the hypothesis tests in these two cases were artifacts of the probabilistic analysis, where one in twenty tests will find statistically significant departures when in fact none exists.

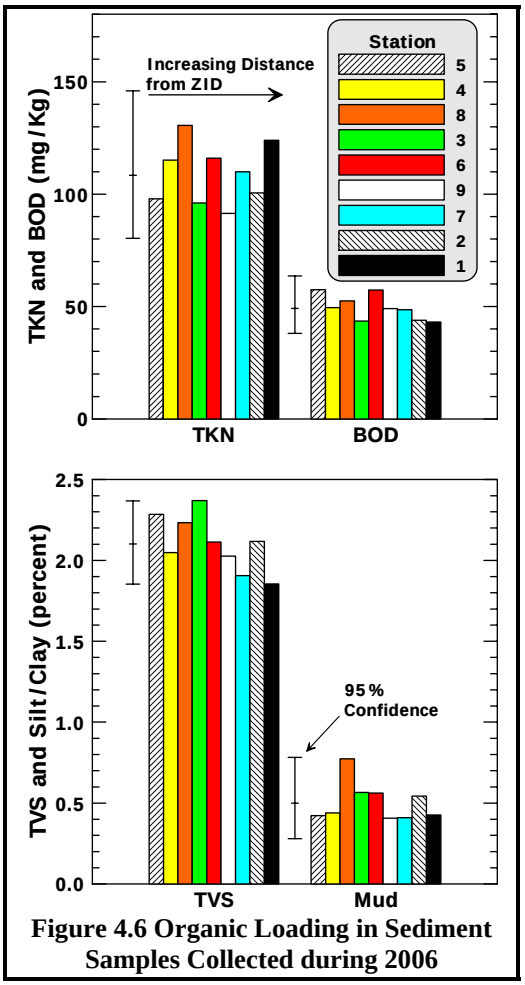


Figure 4.6 Organic Loading in Sediment Samples Collected during 2006

Figure 4.6 also shows a marginally significant increase in the mud fraction at Station 8 (orange bar in the lower right bar graph) relative to other stations. However, in this case, the increased fine fraction at Station 8 is expected because of its increased depth and distance from shore. Station 8 is located 60 m offshore of the diffuser structure in a water depth that is approximately a meter deeper than the isobath along which most of the other stations are located (Figure 4.2 on Page 4-7). Because wave-induced resuspension and scour decrease with increasing water depth, Station 8 retains a greater proportion of fine sediments in its more-quiescent benthic environment. The increased amount of fine sediments at Station 8 also accounts for its naturally increased concentration of trace metals. As discussed previously, fine sediments have a greater proclivity for trace metals due to their increased surface area per unit volume.

4.2.3 Long-Term Contaminant Buildup Unrelated to Effluent Discharge

The previous section examined the spatial distribution of constituents at a single point in time, namely, October 2006. However, as described above for Stations 1 and 8, the characteristics of ambient sediments at individual stations can be inherently different, which complicates the interpretation of any perceived

spatial gradients with respect to effluent discharge. Examining changes in spatial distributions over time, however, significantly improves the power to detect potential discharge-related impacts. Specifically, if there were any measurable marine impacts from wastewater discharge, they would be revealed by a long-term buildup of contaminants in sediments surrounding the outfall. Consequently, examining spatial differences in contaminant concentrations over time can reveal discharge-related trends that may masked in a spatial analysis of a single survey.

As revealed by the temporal analyses described in this section, there has been a long-term buildup in some sediment contaminants. However, these concentration increases have occurred consistently at all stations. Consequently, large-scale processes unrelated to effluent discharge are driving the ambient contaminant distributions within the sediments of Estero Bay.

Temporal Trends Independent of Outfall Proximity

As suggested above, time histories of contaminant concentrations within sediments are a powerful tool for discerning the fate of contaminants within the marine environment. A buildup over time indicates that contaminants are accumulating within benthic sediments. Differences in the rate of buildup at various locations can reveal the cause of the contamination, particularly if it is related to a localized point-source discharge, such as a wastewater outfall.

Detailed analyses of sediment time histories have never revealed a buildup of contaminants related to the discharge of wastewater from the MBCSD outfall. This is largely due to the very low emission of contaminants discharged by the outfall. As described in Chapter 2, low contaminant emissions arise both because of the comparatively small volume of wastewater discharged, and because contaminant concentrations within the effluent itself are low. Offshore sediment data collected during the October 2006 survey augment two decades of historical sediment chemistry data, and continue to demonstrate a lack of benthic impacts from MBCSD discharge.

Figure 4.7 and Figure 4.8 show time histories for the six trace metals that have consistently been detected in Estero Bay sediments. Time histories for measurable organic constituents within sediments are shown in Figure 4.9. Concentrations measured in sediment samples collected at the two stations closest to the diffuser, namely ZID Stations 4 and 5, are indicated in red. Concentrations at nearfield stations (3, 6, 8, and 9), which are located approximately 60 m from the center of the diffuser, are indicated by green symbols. These stations were added to the monitoring program in 1999, so they currently have a relatively shorter time line spanning eight years instead of 21 years. Finally, concentrations at midfield stations (2 and 7), which are 150 m from the diffuser, and the upcoast reference station (1) are indicated in black.

A discharge-related accumulation of contaminants would be evident in these figures as a gradual separation of the colors over time. The red stations would eventually be the highest, followed by green, with black the lowest. However, this temporal signature of contaminant accumulation is not evident in any of the records of trace-metal or organic parameters. On occasion, some metals have exhibited a comparatively consistent offset for several years in a row, particularly at Stations 1 and 8. For the most part, however, the relative ranking of station concentrations has fluctuated randomly from survey to survey.

In fact, within any given survey, the range in concentrations among stations has often been smaller than the sampling uncertainty associated each station's reported concentration. This within-station sampling variability is indicated by the 95% confidence intervals shown to the right of each constituent's time history. These confidence intervals were discussed in the previous section and are the same as those shown in Figure 4.3 and Figure 4.6. However, Figure 4.7 and Figure 4.8 allow a quick visual comparison

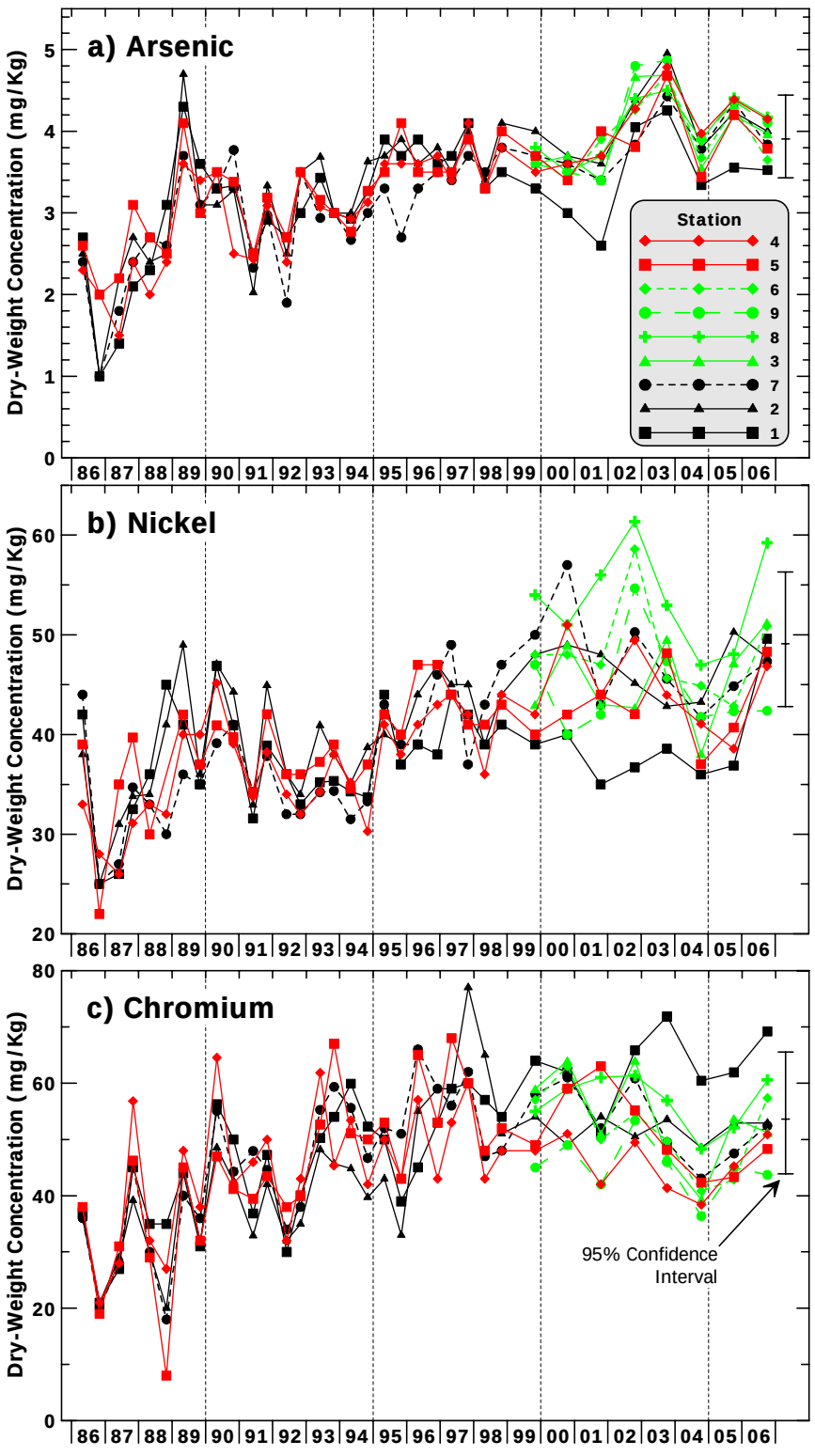


Figure 4.7 Records of Arsenic, Nickel, and Chromium Concentrations in Sediments

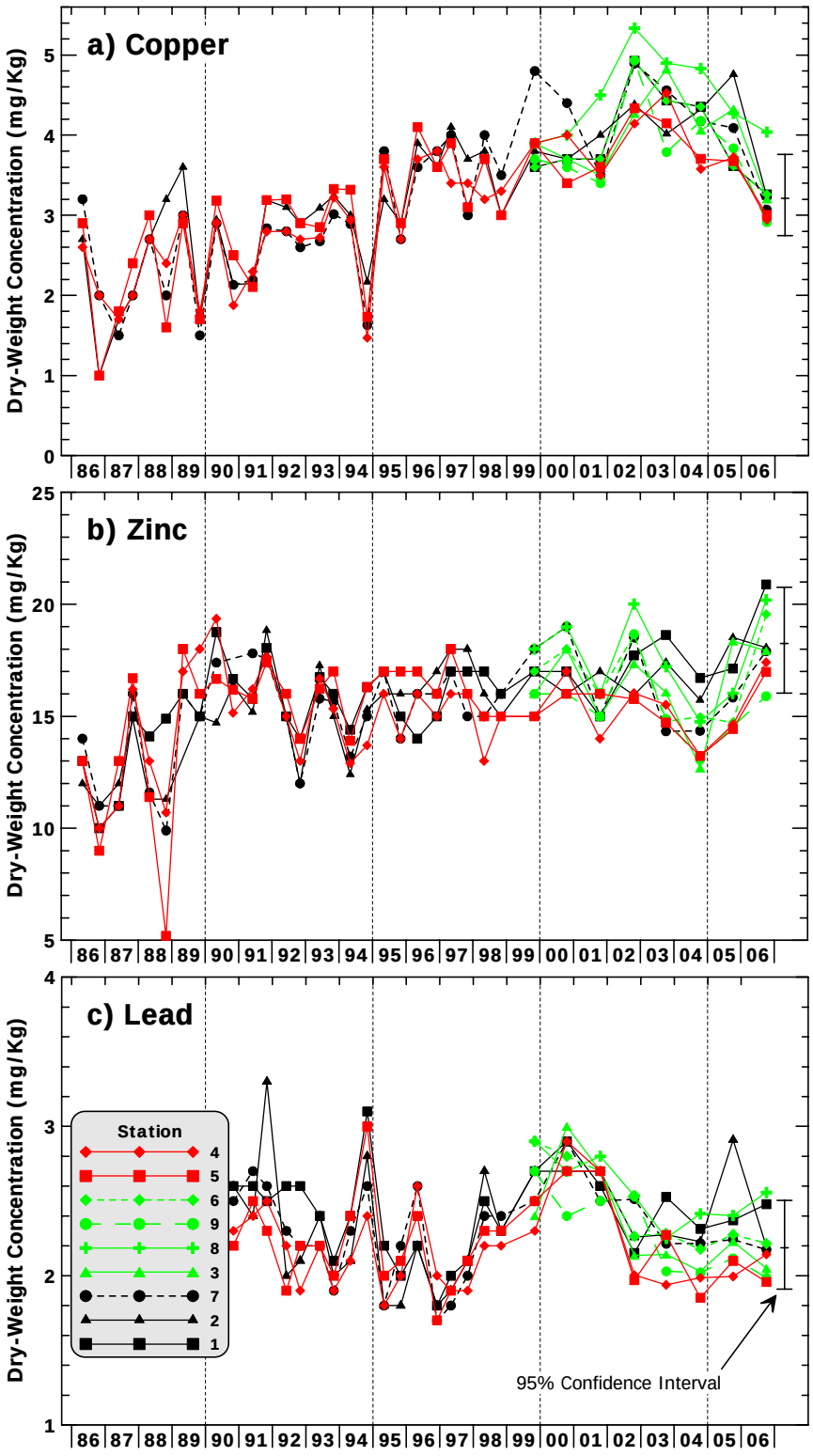


Figure 4.8 Records of Copper, Zinc, and Lead Concentrations in Sediments

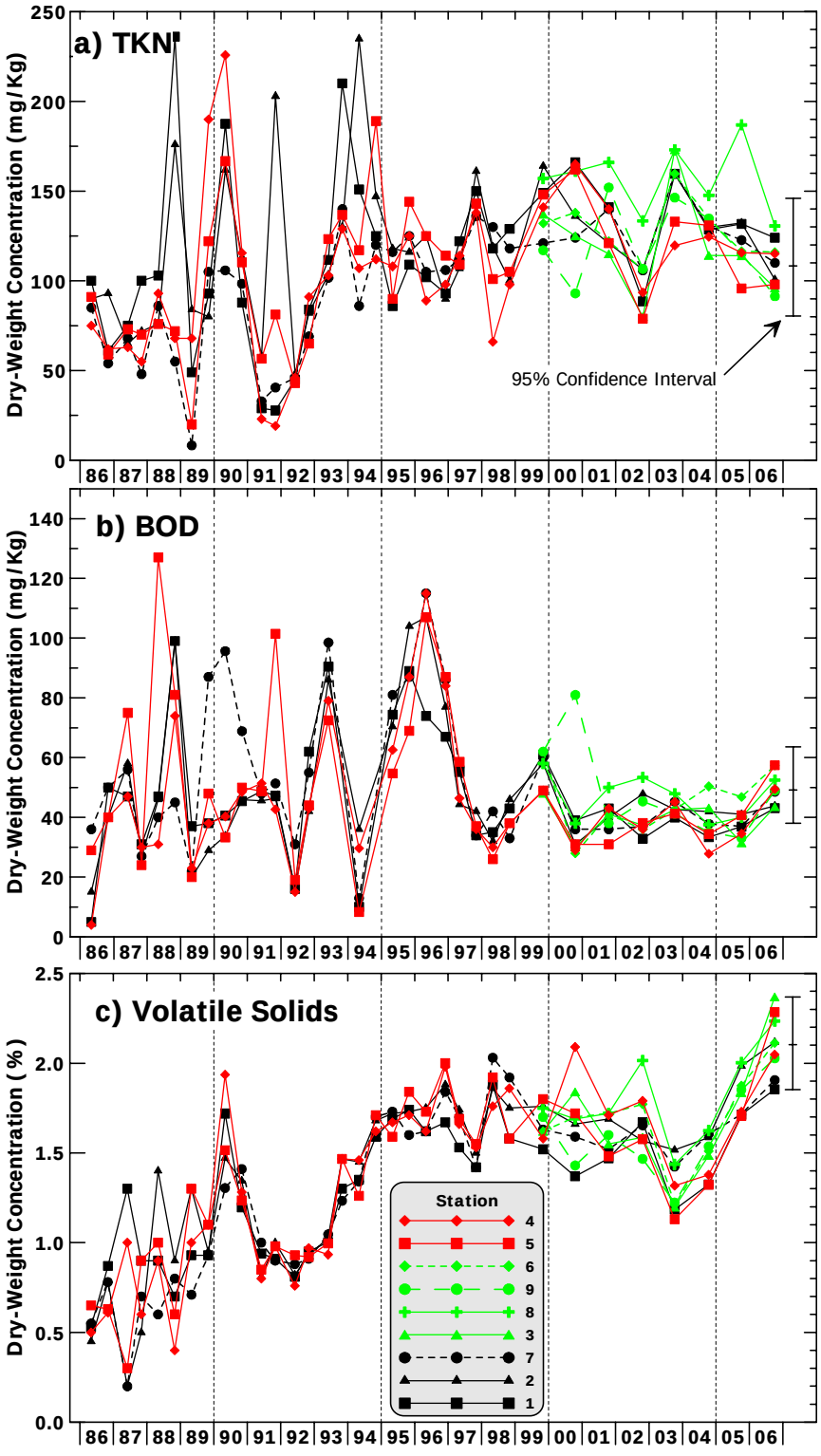


Figure 4.9 Records of TKN, BOD, and Volatile Solid Concentrations in Sediments

between the width of this sampling uncertainty and the scatter in reported concentrations within individual surveys throughout the historical record. The comparison shows that spatial differences at any given time were generally not statistically significant. In contrast, interannual and seasonal fluctuations tend to be much larger in amplitude than the spatial differences among stations that are observed at a particular time, and larger than the sampling uncertainty reflected in the confidence intervals. Thus, long-term temporal trends, and many shorter-term interannual fluctuations, tend to occur in unison at all stations. This indicates that temporal changes in large-scale processes, such as basin-wide onshore erosion and runoff, are influencing metal concentrations at the monitoring stations as a whole.

Despite the overwhelming influence of regional processes, subtle differences in sediment properties at Stations 1 and 8 are occasionally apparent in the records of chemical concentrations. As with regional processes, these slight differences are due to an inherent variation in depositional processes rather than the influence of the MBCSD discharge. Station 8 is located in a more quiescent depositional environment and consequently, it tends to have a slightly higher fraction of fine sediments. Station 1 is located more than 1 km from the other monitoring stations, and consequently is not always subject to exactly the same oceanographic processes. As a result, slight differences in un-normalized trace-metal concentrations can also occasionally be discerned at these stations.

For example, in the past five-to-nine years, offsets have occurred in arsenic, chromium, and nickel concentrations measured at (reference) Station 1 (Figure 4.7abc). Slightly lower arsenic and nickel concentrations are evident between 1998 and 2003 as a separation in the solid black line with black squares (■) in the Figure. The relatively increased chromium concentrations reported since 2002 appears to reflect a similar scenario, albeit with an opposite offset in the Station-1 concentrations (Figure 4.7c). In addition, while the Station-1 offsets in nickel and arsenic concentrations appear to have recently reconverged with mean conditions, chromium concentrations have yet to do likewise. Moreover, elevated chromium concentrations at Station 1 are incongruous with the comparatively depressed arsenic and nickel concentrations that occurred at Station 1 around the same time. This suggests that the trace-metal composition of the depositional material that has accumulated at Station 1 in recent years may have departed slightly from that of the other monitoring stations.

Similarly, the records of nickel, copper, and TKN exhibit slight but consistently higher concentrations at Station 8 compared to most other stations. The time history of chemical concentrations in sediments collected at Station 8 are delineated by the solid green line with plus-sign symbols (+) in the figures. In contrast to the anomalous behavior at Station 1, the offset in concentrations at Station 8 has been relatively consistent across the six-year duration of sample collection at that station. Specifically, chemical concentrations in Station 8 samples were consistently among the highest measured for all parameters, but particularly for nickel (Figure 4.7b), copper (Figure 4.8a), and TKN (Figure 4.9a).

The higher concentration in sediment properties measured at Station 8 is related to the higher fraction of naturally occurring fine particulates present there. Station 8 is the only station that lies offshore of the diffuser structure in deeper water. Based on drifter measurements and plume distributions determined in the water-quality component of the monitoring program, the effluent plume is preferentially transported along the 15.2-m isobath and rarely extends offshore toward benthic Station 8 (see the current rose in Figure 7 on Page II-22 of MRS 2003a). In contrast, a naturally occurring offshore increase in background metal concentrations is often observed in benthic monitoring programs (Schiff and Gossett 1998, Steinhauer et al. 1994, Coats 1995). This concentration increase has been ascribed to the increase in fine particulates that naturally occurs with increasing depth and distance from shore.

The comparatively elevated iron, aluminum, and mud concentrations at Stations 1 and 8 (Table 4.6, Figure 4.4, and Figure 4.6) confirm the roll of natural processes in establishing the anomalous concentrations for other constituents measured in sediment samples from these two stations. As discussed previously, iron, aluminum, and mud fractions are commonly used as conservative tracers to differentiate natural from anthropogenic components of variation in sediment properties (Dossis and Warren 1980, Horowitz and Elrick 1987). Offshore of southern California, Schiff and Weisberg (1997) found that iron was the optimal reference element for reducing natural variability in trace-metal distributions. At the MBCSD monitoring sites, normalization by both iron and aluminum removed much of the concentration differences observed at Stations 1 and 8.

Contaminant Accumulation Rates

This section quantifies long-term increases that are visually evident in some of the time histories shown above. Because the accumulation generally occurs at all stations, including stations distant from the outfall, the increase is unrelated to effluent discharge. Table 4.9 presents the results of a series of linear regressions applied to the time history of average contaminant concentrations.[9] The pair of columns labeled '*p*-Value' reflects the statistical confidence in the rates listed in the next pair of columns. *P*-values less than 0.05 are considered statistically significant, so their corresponding accumulation rates are highlighted in bold typeface.

Two separate straight-line regressions were performed on the data for each parameter. The one labeled '*All*' spanned the entire 21-year time series and included means from each of the 33 available surveys. A subset of only the recent, post-1990 data was analyzed separately. Visual inspection of the time series plots in Figure 4.7, Figure 4.8, and Figure 4.9 indicates that after 1990, the precision of chemical analyses has improved. This is particularly evident in the time series of TKN, BOD, and TVS (Figure 4.9) where

Table 4.9 Temporal Trends in Sediment Contaminant Concentration

	p-Value[a]		Rate[c] (mg/Kg/yr)		Effects[d] Level	Years to Effect[e]		Emission (Kg/yr)[f]		
Parameter	Post-1990[b]	All	Post-1990	All		Post-1990	All	Actual	Post-1990	All
Arsenic	<0.001	<0.001	**0.09**	**0.09**	8.2	44	42	≅3.04	8	8
Chromium	0.097	<0.001	0.53	**1.14**	81	—	19	<16.5	—	101
Copper	<0.001	<0.001	**0.10**	**0.11**	34	307	280	27.8	9	9
Nickel	<0.001	<0.001	**0.83**	**0.70**	51.6[g]	4	5	<12.1	74	62
Lead	0.991	—	0.00	**—**	46.7	—	—	—	—	—
Zinc	0.246	0.003	0.07	**0.17**	150	—	781	99.7	—	15
TKN	0.019	0.003	**3.12**	**2.74**	—	—	—	—	—	—
BOD	0.777	0.979	-0.34	-0.02	—	—	—	—	—	—
TVS	<0.001	<0.001	**0.05**	**0.06**	—	—	—	—	—	—

[a] Trend significant if *p*-value less than 0.05
[b] Regression performed on more-reliable data collected after 1990
[c] Rate of concentration increase per year
[d] Concentration where biological effects become evident (ERL)
[e] Predicted number of years before concentrations reach biological effects levels (from year 2006)
[f] Actual mass-emission in 2006 compared to that needed to account for annual concentration increase
[g] Effects-range median (ERM) for nickel because its concentration currently exceeds the ERL

[9] The average contaminant concentration at each point in time is computed as the average of the concentrations reported for all the stations within a given survey.

large outliers are less prevalent in recent years. In recognition of this temporal difference in data quality, trends were quantified using two data sets, one with all of the data, and another with only the data collected after 1990.

The regression results reported in Table 4.9 reveal that almost all detected contaminants exhibited a statistically significant ($p<0.05$) increase in concentration over time. The only exceptions were lead, zinc, and BOD. Lead has only been measured since October 1990 (Figure 4.8c). Although it does not exhibit a long-term trend over the entire record, its concentrations revealed a long-period fluctuation between October 1996 and October 2002. In contrast, zinc concentrations increased slightly between 1986 and 1991, but leveled off in recent years (Figure 4.8b). Consequently, although the zinc depositional rate determined from the entire 21-year time history was statistically significant ($p=0.003$), in recent years it was not ($p=0.246$). This was true even though the average zinc concentration in 2006 was the second highest on record. Long-term trends in BOD could not be reliably resolved in either time period because of wide interannual fluctuations that occasionally occur as a result of interferences that randomly appear in a few of the analyses (Figure 4.9b).

The environmental relevance of depositional rates for other sediment constituents is not obvious from a comparison of their magnitudes alone. For example, Table 4.9 indicates that chromium and TKN have the highest rates of concentration increase, with magnitudes exceeding 1 mg/Kg per annum. However, their overall concentrations in sediments are also proportionally higher, so their percentage increase over time is similar to that of arsenic, copper, and TVS. In actuality, arsenic, chromium, copper, and TVS exhibited the largest increases relative to concentrations measured at the start of monitoring in 1986. The average copper concentration within sediments doubled in the past two decades (Figure 4.8a). Similarly, volatile-solid concentrations have nearly tripled since 1986 (Figure 4.9c). However, the TVS record shows that the precision of TVS determinations significantly improved after 1990, then declined again after 1998. Before 1990, laboratory analysis techniques were not as well refined as those of the subsequent analyses. Likewise, the increased scatter apparent after 1998 resulted from a procedural modification where a single grab sample was analyzed rather than a composite of three replicate grab samples. The replicate sampling conducted prior to 1998 lent additional stability to the reported concentrations for all sediment constituents.

Biological Implications

The environmental relevance of contaminant accumulation rates can also be evaluated in terms of their future potential for marine impacts. Estero Bay is one of the more pristine offshore regions along the western coast of the contiguous United States. However, continued accumulation of sediment contaminants at the current rates could eventually degrade the marine environment to levels comparable to some of the more-industrialized regions within Monterey Bay and the Southern California Bight. As described in this section, if the increases continue, some trace-metal concentrations will eventually reach levels where adverse impacts to marine biota might be considered possible.

The biological implications of the observed contaminant accumulations are assessed in the '*Years to Effect*' columns of Table 4.9. They project the number of years that it will take for contaminant concentrations within Estero Bay sediments to reach toxicological benchmarks, assuming they continue to accumulate at historical rates. Four trace metals, arsenic, chromium, copper, and nickel, are of particular interest because they exhibit highly significant ($p\leq0.001$) long-term increases in sediment concentration. The trends are visually evident in Figure 4.7a through Figure 4.8a, and, except for perhaps chromium and copper, there is no evidence that concentrations have stabilized in recent years.

The '*Years to Effect*' characterizes accumulation rates for these four trace metals in terms of their potential relevance to the marine ecosystem. Copper accumulations are of least concern. Currently, sediment copper concentrations (near 4 mg/Kg) are far below the marine effects level (ERL=34 mg/Kg) and even if they continue to increase at a rate comparable to that of the last decade, they will remain benign for three centuries (307 years). Similarly, current arsenic concentrations (also near 4 mg/Kg) are only about half of the lowest marine toxicological benchmark (ERL=8.2 mg/Kg). With annual increases of only 0.09 mg/Kg, it will be four decades before sediment arsenic concentrations might be expected to begin to impact marine biota.

Potential marine impacts resulting from future increases in chromium and nickel are potentially of more immediate concern. Because their concentrations are already naturally high in the marine sediments of northern Estero Bay, small annual increases will cause contaminant levels to rapidly approach marine toxicological benchmarks. If chromium concentrations continue to increase at approximately 1.1 mg/Kg each year, contaminant levels could begin to affect marine organisms in as little as 19 years, or by the year 2025. Over the past two decades, nickel concentrations within the sediments of northern Estero Bay have consistently exceeded the ERL where marine impacts are normally thought to begin to be evident. However, as described in Section 4.2.1, confidence in the effects-levels for nickel is very low. Nevertheless, average nickel concentrations are rapidly approaching the ERM where marine biological impacts are considered probable. At current accumulation rates, average nickel concentrations are predicted to reach potentially toxic levels by 2010.

Concerns that regional increases in chromium and nickel concentrations could soon reach biological effects levels should be tempered with the knowledge that the predictions are based on bulk metal concentrations rather than on dissolved metal concentrations. Bulk metal concentrations are often not good indicators of biological impacts. This is particularly true when the source of the elevated metal concentrations within Estero Bay is the erosion of naturally occurring mineral deposits. Chromite deposits contain little of the more-toxic hexavalent form of chromium. In contrast, it is likely that the toxicological database that was used to establish the ERL and ERM benchmarks included studies of exposure to industrially derived chromium, which can contain much higher hexavalent fractions. In addition, because of their erosional origin, the elevated trace-metal concentrations within Estero Bay sediments arise from metal that is bound into the mineral matrix of sand grains, where it has little influence on marine organisms. The dissolved phases of these metals are far more bioavailable and indicative of potential biological impacts.

Low dissolved-phase metal concentrations within Estero Bay sediments was confirmed by analyses conducted on pore-water samples collected during the 2003 benthic survey. Pore-water samples were found to contain average concentrations of arsenic (2.3 µg/L), chromium (0.7 µg/L), copper (0.4 µg/L) and nickel (1.5 µg/L) that were all far below the most-stringent saltwater criteria promulgated by the USEPA, which are 36 µg/L, 50 µg/L, 3.1 µg/L, and 8.2 µg/L. Moreover, the arsenic, chromium, and copper concentrations measured in the pore-water samples were comparable to background concentrations in clean coastal seawater. In contrast, the nickel concentrations that were measured in the pore-water samples were about three times higher than those observed in clean coastal seawater samples. However, it was subsequently determined that the reported dissolved nickel concentrations were artificially elevated due to incomplete filtration of the pore-water samples. Because of the presence of bulk sediment particles, the reported pore-water concentrations overestimated the dissolved-phase concentration. The presence of naturally occurring sediment particulates in the pore-water samples was apparent from the elevated dissolved-aluminum concentrations that were also found in the samples. Even if the dissolved nickel concentrations were slightly elevated within pore water, it is likely that indigenous infaunal populations would have adapted to the higher ambient concentrations that have probably existed for millennia.

Low MBCSD Metal Emission

The foregoing discussion identifies three trace metals, arsenic, chromium, and nickel, whose projected concentration increases could cause them to approach effects thresholds within a few decades. However, the observed historical increases in these metal concentrations were unrelated to wastewater discharge from the MBCSD outfall. As described in previous sections, the observed concentration increases are widespread and there are no consistent spatial gradients related to outfall proximity. Moreover, no heavy industry discharges into the MBCSD collection system, and trace-metal concentrations within effluent are uniformly low; so low, in fact, that MBCSD metal emissions do not appreciably contribute to the accretion of these metals in marine sediments. This can be demonstrated with an elementary mass-balance computation.

The right-hand columns of Table 4.9 compare the actual year-2006 mass-emission of each trace metal (from Chapter 2) with the lowest conceivable emission that could cause the concentration increase observed within surficial sediments surrounding the outfall. For all three metals of concern, actual mass emissions from the MBCSD outfall during 2006 were well below the emission that would be required to achieve the observed annual increase in sediment concentrations. Specifically, the 3-Kg upper-bound arsenic emission was less than half of the 8-Kg annual emission that would be required to raise sediment arsenic concentrations by the observed 0.09 mg/Kg each year. Similarly, an upper bound mass emission of less than 16.5 Kg of chromium cannot account for the observed 1.14-mg/Kg/yr increase in sediment chromium concentrations. In fact, the emission would have to be at least six times higher. Finally, the annual increase observed in nickel concentrations could be explained only by a discharge of well more than 62 Kg, while the actual discharge in 2006 was probably far less than 12.1 Kg.

In reality, the differences are much larger given the conservative assumptions incorporated in the mass-balance computation. First, the '*actual*' mass emissions from the outfall represent upper bounds based on the effluent detection limits for the metals. Chromium was not detected in any of the effluent samples, and reported arsenic and nickel concentrations were so low that they could not be quantified (Table 2.8). Consequently, the actual year-2006 emissions were probably far less than the upper-bound estimates listed in Table 4.9 because they were largely based on the lowest achievable resolution of the chemical analyses, rather than actual concentrations which could be far lower. Second, the projected emission rates, namely those required to attain the observed increases in sediment concentrations, were grossly underestimated. Metal concentrations are probably increasing within a much larger volume of seafloor sediments than was assumed in the mass-balance computation. The calculation conservatively assumed that the metals were accumulating only within the upper 2 cm of seafloor sediments where subsamples were collected in the field for subsequent chemical analysis. Moreover, the impact footprint was assumed to cover a radius of approximately 1 km, which represents the distance between the diffuser and the outermost sampling station. In reality, the concentration increases are probably occurring over a much wider area, and over a greater depth than that defined by the sampling limits of the monitoring program.

In any regard, the analysis of temporal trends in sediment contaminants demonstrates that contaminants are not preferentially accumulating near the outfall. In addition, upper-bound estimates of emissions from the outfall are too small to have materially contributed to the observed accumulation of trace metals within the sediments of northern Estero Bay.

4.3 BENTHIC INFAUNAL COMMUNITY

The infauna living within the surficial sediments of northern Estero Bay act as sentinels for possible impacts caused by the discharge of MBCSD wastewater. They serve as the best indicators of marine pollution because they have limited mobility and cannot easily escape exposure to contaminants in their immediate environment. Because of this, they are far superior to marine mammals or finfish that range widely, making it impossible to determine where the organisms were exposed to contaminants. Also, some infaunal species are known to be more sensitive to pollutant stress than others, and changes in relative abundance can imply degraded environmental conditions. Because infauna reside within seafloor sediments, they are closer to the potential source of pollution. The diffuser structure lies on the seafloor, where particulate contaminants discharged into marine waters ultimately settle and accumulate. Infauna are also important organisms to monitor because of their low trophic level within the marine food web. They are a major food source for more-mobile epifaunal and pelagic marine organisms, such as crabs, finfish, and marine mammals. Finally, many infauna are filter feeders that may bioaccumulate contaminants even when standard chemical assays of water samples are unable to detect low-level contamination.

In recognition of infauna's role as an early detector of marine pollution, the MBCSD discharge permit requires regular monitoring of the overall health of the benthic community within Estero Bay. Infaunal monitoring also addresses the COP requirement that the discharge not degrade indigenous marine biota. Benthic monitoring has now accumulated more than two decades of infaunal data. During that time, 145,000 specimens representing more than 345 individual taxa have been examined. Throughout the monitoring program, there has never been any indication of deleterious outfall-related impacts to the benthic community. Instead, the data have revealed a consistently healthy indigenous infaunal community with a uniformly high diversity that does not decrease with proximity to the diffuser.

These observations hold true despite widespread variation in the abundance of individual organisms that have occurred throughout the monitoring program. Over the years, the dominance of individual taxa have waxed and waned in response to natural changes in the environment. For many taxa, distinct differences are evident between the winter and summer sampling seasons. Others come and go in response to powerful long-term variations in the oceanographic environment. One such interannual variation is the El Niño – Southern Oscillation, whose impact was evident in benthic sediment samples collected within Estero Bay on at least three occasions during past the two decades of MBCSD monitoring. The first event was in 1988, and the second began at the end of 1997 and extended into 1998. Its influence on benthic organisms was still evident during 1999. Another minor event may have occurred in 1991.

Nearly 3,500 individual organisms were enumerated in the 45 sediment samples that were collected at nine stations during the benthic survey conducted in October 2006. A compendium of the taxonomic identifications and enumerations conducted on year-2006 sediment samples is provided in Tables E.1 through E.10 at the back of this report. Table E.11 and Table E.12 of Appendix E list infaunal indices that were computed from infaunal data, as required by the NPDES monitoring and reporting program. This section of the annual report combines these data with biological data collected over the prior 20 years to determine whether there have been discharge-related impacts to the benthic biota.

Three analyses demonstrate that there have been no deleterious impacts to benthic organisms as a result of the discharge. First, the organisms that inhabit the sediments around the outfall are indicative of an indigenous community of filter feeders that thrive only in clean sediments. Second, infaunal data collected during 2006 show no evidence of spatial gradients indicative of biotic degradation attributable to effluent discharge. Third, despite wide fluctuations in community parameters over time, there were no long-term

trends indicative of an increasingly degraded benthic environment around the outfall. All the stations tended to respond in unison to large interannual and seasonal influences on the infaunal community. To date, the indigenous benthic community remains healthy, with no perceptible influence from ambient contaminant levels, including the previously discussed long-term increases in trace-metal concentrations that have occurred throughout Estero Bay.

4.3.1 A Healthy Indigenous Infaunal Community Surrounds the Outfall

The type and abundance of benthic organisms directly reflect the quality of the marine sediments where they live. Degraded sediments have quantifiable differences in the composition of the biological community that lives on and within them. They tend to have low richness and diversity because they are populated by a few opportunistic pollution-tolerant taxa that feed on detritus and thrive in sediments that are high in subsurface organics. In contrast, clean sediments are populated by a diverse assemblage of organisms that include filter feeders, which extract nutrients from suspended particulates. These suspension feeders are sensitive to excessive particulate loads such as those discharged from treatment works. The widespread presence of suspension feeders around the MBCSD outfall clearly indicates that the discharge is not adversely affecting them. One such suspension feeder is the club-tipped anemone (*C. californica*). It is found carpeting the diffuser ports, as depicted in the photograph on Page 2-5. Its presence is indicative of the benign nature of the suspended sediments discharged by the treatment plant.

Excluded Organisms

The populations of two organisms, *Diopatra ornata* and *Dendraster exentricus*, have a profound effect on the MBCSD infaunal database. However, these organisms and their attached taxa are not particularly sensitive to changes in sediment quality, and their presence frequently confounds impact assessments. Consequently, their populations were removed from the database prior to the impact assessments described in this section.



Figure 4.10 Photograph of a Tubeworm (*Diopatra*)

Since 2000, the parchment tubes of the Ornate Tubeworm (*Diopatra ornata*) have been separated in the field prior to identifying and enumerating the infauna. However, in contrast to surveys conducted since that time, there were no adult *D. ornata* tubes found during the October 2006 survey. Removal of the parchment tubes in the field, prior to sieving, avoids the inclusion of large populations of epiphytes that live among the pieces of shells, algae, sticks, and other debris that are attached to these large tubes (Figure 4.10). The inclusion of large numbers of nestling epifauna that reside on the tube casings, particularly small crabs and other crustaceans, skews the enumeration of marine organisms that are truly infaunal in nature. Because epifauna live on the surface of marine substrates, they tend to be more mobile and less susceptible to sediment pollutants than the infauna, which live in the interstices between sand grains. The tubeworms themselves,

however, were included in the enumerations because they tend to congregate in higher densities close to both natural reefs and man-made structures, such as outfalls (Davis et al. 1982).

Statistical analyses also excluded Pacific Sand Dollar (*Dendraster excentricus*) populations. Sand Dollars were removed from the database prior to statistical analysis because they exhibit extreme population fluctuations from year to year (Figure 4.11). Because their large numbers overwhelmingly dominate the population statistics during high-recruitment years, they have the potential to mask any influence of the discharge on less-dominant taxa whose populations are more consistent and sensitive to potential discharge impacts. For example, during the October 2002 survey, Sand Dollars were by far the most abundant organism collected. In contrast, the Sand Dollar population in the following year (2003) was exceptionally low, and the removal of the 87 specimens of *D. excentricus* from the database had little impact on the statistical analyses. However, in 2006, Sand Dollars were the second-most abundant taxon, and community indices computed both with (Table E.11) and without (Table E.12) these 297 specimens were materially different. For some indices, the difference in station mean indices computed with and without *D. exentricus* was comparable to the standard deviation among replicate samples. This suggests that inclusion of *D. exentricus* would unduly influence the 2006 community statistics thereby making interannual comparisons difficult.

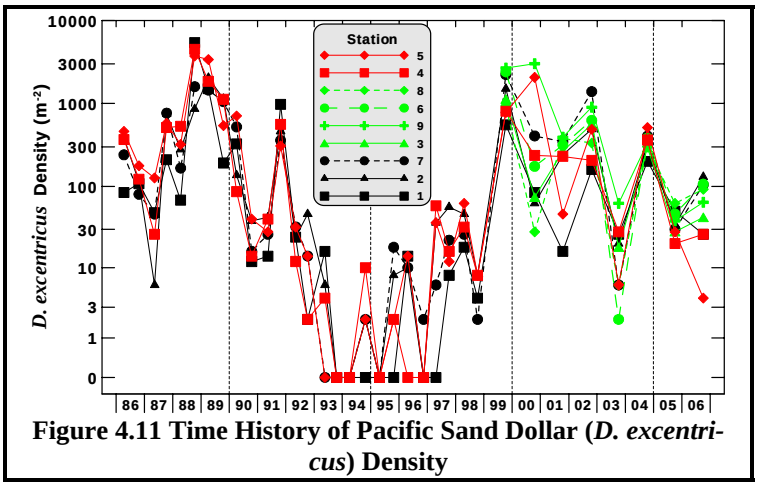


Figure 4.11 Time History of Pacific Sand Dollar (*D. excentricus*) Density

Exclusion of the highly transient Sand Dollar population does not detract from the impact evaluation because their distribution was clearly unrelated to effluent discharge. As with the chemical constituent time histories, spatial distributions of Sand Dollar populations related to outfall proximity would be evident in Figure 4.11 as a separation between the time histories for the ZID stations (red), for midfield stations (green), and stations well away from the diffuser structure (black). Instead, large fluctuations in Sand Dollar abundance tend to occur equally at all stations. The consistently low density of fully grown adult Sand Dollars, even during the high-population periods, demonstrates that their presence is transient and that there are no permanent Sand Dollar beds in the region (Brown and Caldwell 1989, 1993). It is well established that Sand Dollar beds are often dominated by a single age group (cohort) suggesting that recruitment is episodic and only occasionally successful (Cameron 1980, Oliver et al. 1980, Morin et al. 1985, Cameron and Rumrill 1982).

Although Sand Dollars are filter feeders and can be sensitive to pollution, external environmental effects cause their populations to fluctuate within northern Estero Bay. Specifically, the increased Sand Dollar recruitment that occurred in late 1988, 1991, and 1999 was probably associated with high-waves generated by El Niño events in 1988, 1998, and the weaker one in 1991. Sand Dollars form dense beds just seaward of the wave break, with disks on edge protruding at an angle from the sand and aboral sides facing into the current. The seaward border of the bed ends abruptly close to the wave break, which acts as a barrier for predacious sea stars. As a result, predation is limited because the sea stars can move over the

bed only at significant risk of tumbling into the surf zone with a passing wave (Morin et al. 1985). Consequently, Sand Dollar beds migrate shoreward in the summer and seaward in the winter in response to seasonal wave action (Oliver et al. 1980). A winter of strong wave action, usually associated with El Niño, reduces the numbers of predators, permitting recruitment of juvenile Sand Dollars. On numerous occasions during the 2002 survey, Short-Spined Sea Stars (*Pisaster brevispinus*) became jammed in the jaws of the grab sampler. This caused the loss of the sediment samples and resulted in an unusually high number of repeated grab sampling attempts at several stations. Interestingly, Sand Dollar populations in 2003 were markedly diminished from those found in the 2002 survey, suggesting that predation may have played a significant role in the reduction of Sand Dollar populations between 2002 and 2003. The resurgence of a juvenile Sand Dollar population in the October 2004 survey indicates that 2004 represented a new recruitment year for Sand Dollars within the monitoring area.

Abundance

In this report, the overall health of the benthic community within Estero Bay is reflected by the principal population parameters computed from samples collected at each station over the duration of the monitoring program. For the reasons described above, Sand Dollars (*D. excentricus*) were excluded from the population statistics to better evaluate the overall health of the benthic community. The community parameters provide a succinct description of the abundance, diversity, richness, and trophic (feeding) structure of benthic biota. Figure 4.12 shows the temporal variability in mean community parameters that were computed for each of the nine benthic monitoring stations. Each major category of community parameter is discussed in the sections that follow.

Organismal density, shown in Figure 4.12a, measures the total abundance, or number of organisms, within a 1-m^2 area of the seafloor. It is the most basic single measure of a community of organisms, but lacks valuable insight as to how the abundance is distributed among the differing taxa. Because of this deficiency, it is not a useful ecological measure by itself. Nonetheless, major declines in organism density can occur after a rapid increase in sediment contamination. This initial decline is often followed by a marked increase in total abundance when opportunistic species repopulate the degraded environment.

Throughout the monitoring program, the number of organisms collected at each station has fluctuated enormously (Figure 4.12a). Although the range in abundance covers almost an order of magnitude, differences in abundance among individual stations within any given survey tended to be much smaller. Namely, all the stations tend to track the temporal fluctuations as a group, and spatial differences among stations within a given survey were generally small compared to the wide temporal fluctuations between surveys.

The largest population changes occur on a seasonal basis. Post-summer populations are generally a factor of three higher than the post-winter populations. The reduced winter population, which was only measured prior to 1999, is a response to harsher oceanographic conditions. Winter storms generate intense wave-induced currents that scour the bottom near the 15-m water depth of the outfall. Summer populations reflect recruitment of the more delicate annelid worms that can only survive in more quiescent benthic-flow regimes.

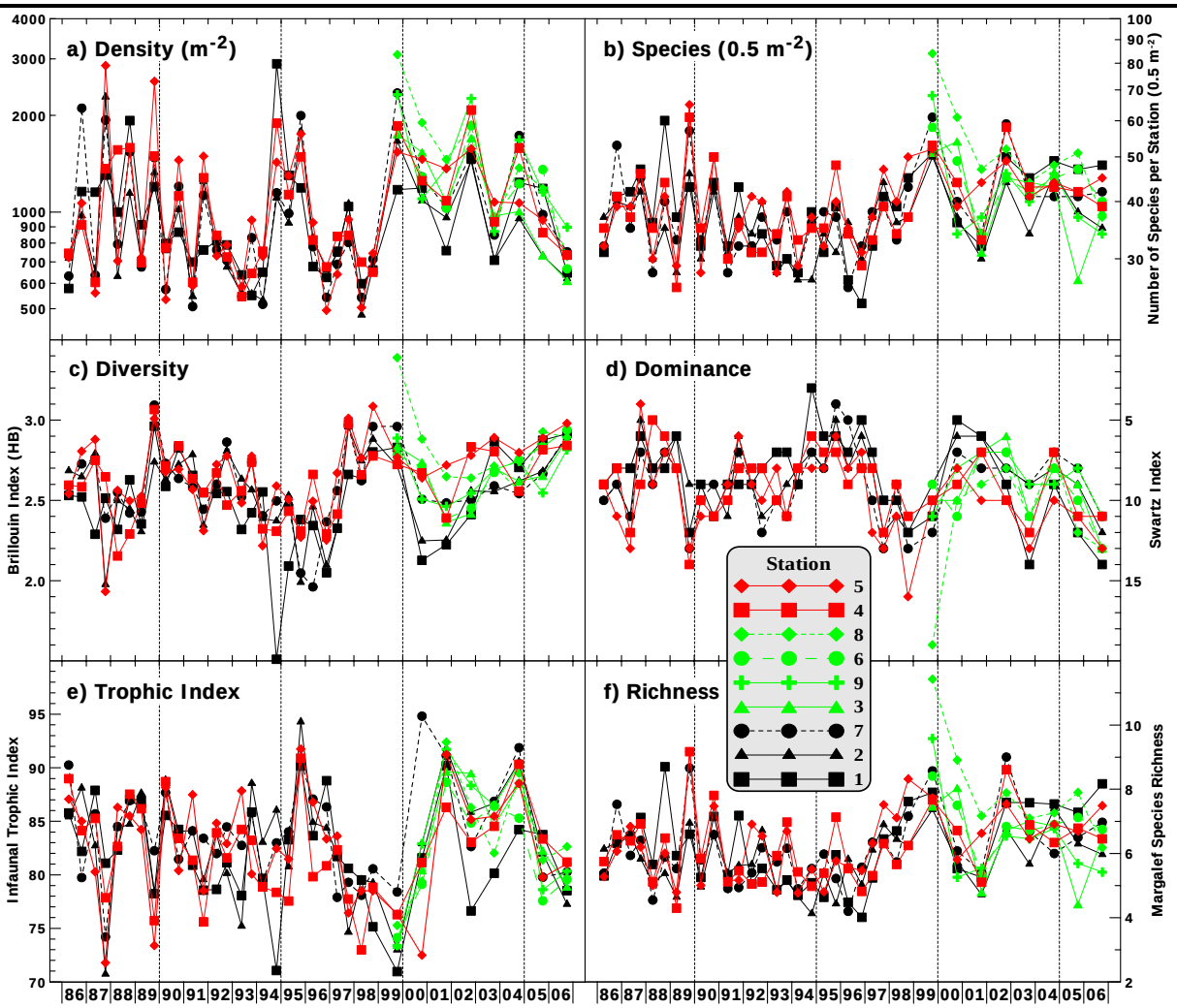


Figure 4.12 Time History of Infaunal Community Parameters

Any spatial gradients are completely masked by the large temporal fluctuations. In particular, the abundance at stations near the outfall (shown in red) was not consistently lower (or higher) than the density at distant stations (shown in black) throughout the monitoring program. This demonstrates that any accumulation of sediment contaminants from the effluent discharge over the past two decades has had no discernable impact on infaunal abundance, particularly when compared to large seasonal and interannual population fluctuations.

Number of Species

The total number of species is another measure of the overall health of benthic communities. Everything else being equal, infaunal communities can respond to environmental stresses by becoming less diverse, as reflected by a substantial reduction in the number of species. However, the number of species encountered in a sample is directly related to the number of organisms in the sample, i.e., it is inherently related to sample abundance. Because rare species are generally undersampled, the number of species automati-

cally decreases in samples with fewer organisms. Thus, it is difficult to tell if a decreased number of species is due to an actual decline in biodiversity, or simply due to decreased sample sizes (abundance). Irrespective of the influence of sample size, reductions in species counts would suggest a decline in diversity and degradation in the marine environment.

There was no obvious temporal trend in numbers of species that would suggest that sedimentary conditions near the outfall were being preferentially degraded (Figure 4.12b). Specifically, there was no divergence in the colors over time, where species counts at stations distant from the outfall, shown in black, would begin increasing relative to stations near the outfall. On the contrary, the largest numbers of species were often observed at the stations closest to the outfall diffuser (Stations 4 and 5, shown in red). However, as with abundance, these spatial differences were minor when compared to seasonal and interannual fluctuations. Beginning in 1996, there was a steady increase in the number of species encountered in samples. This trend culminated in 1999, when 84 species were collected at Station 8 alone. However, this increase was largely due to the increased prevalence of Ornate Tubeworms (*D. ornata*) within some of the samples. Before that time, between 1990 and 1996, only one, but usually no *D. ornata* specimens were collected during any given survey. In the post-winter surveys of both 1997 and 1998, two Ornate Tubeworms were encountered. By 1999, four of these tubeworms were found at Station 8 alone. These tubes were not removed prior to field sieving, and the elevated presence of epiphytic taxa resulted in the unusually large number of species recorded in 1999.

The other temporal fluctuations in species counts tended to track the fluctuations in abundance. Consequently, at least some of the variability in the numbers of species was an artifact of the larger sample size (abundance) rather than purely an increase in species richness or diversity.

Diversity

A large number of interrelated diversity indices have been developed in an attempt to account for the inherent relationship between the number of species and sample size or abundance. Two common indices are the Shannon Diversity (*H'*) and the Brillouin index (*HB*) (Appendix E.2). Both exhibit nearly identical time histories in the MBCSD database.

Ostensibly, diversity should decrease in a degraded benthos, although significant reductions can also occur in the absence of anthropogenic stresses. Nevertheless, temporal trends in diversity did not exhibit any evidence of a deteriorating benthic environment near the outfall. On the contrary, in recent years the highest diversity was typically observed at one of the two stations located closest to the outfall (shown in red). Higher diversity at the two ZID stations indicates a healthier infaunal community close to the outfall rather than a community impaired by the discharge of effluent. Although not immediately apparent in the time series shown in Figure 4.12, diversity was the only index that exhibited a statistically significant spatiotemporal trend. This trend is delineated with tests for parallelism that are presented in Section 4.2.3.

Two large historical outliers in diversity warrant some discussion. First, the markedly high diversity (3.39) that was measured at nearfield Station 8 in 1999 was largely an artifact of the enumeration of additional epiphytes residing on the casings of the Ornate Tubeworms. As discussed previously, the samples collected at this Station in 1999 were unusual because of the number of Tubeworms they contained. Diversity was high within the sample because there were a large number of epiphytic species (Figure 4.12b) containing a large number of individuals (Figure 4.12a).

The second unusual outlier was the very low diversity (1.51) that was found at Reference Station 1 during the October 1994 survey (black square ■ in Figure 4.12c). As with outlier described above, there were an unusually high number of organisms enumerated in samples collected at this station in 1994 (Figure 4.12a). However, in this case, the increased abundance was associated with a single species, the spioniform polychaete worm *Magelona sacculata*. Nearly 1,000 specimens were collected at that one station alone during the October 1994 survey. As a result of the numeric dominance of this one taxon, the computed diversity was low. In fact, what happened was that the grab encountered a highly localized pocket of densely populated *M. sacculata* in two of the five replicate samples. Although magelonids are common in sandy bottom sediments, their distribution is patchy, in northern Estero Bay, it is often one of the numerically dominant taxa, but only approximately 50 specimens are typically collected at each station. The presence of this surface detritus feeder can be considered marginally indicative of degraded sediment conditions. Regardless, its abnormally increased abundance in 1994 occurred at the reference station, and thus bore no relationship to effluent discharge.

Dominance

The Swartz species dominance differs from the other community indices because it does not make *a priori* assumptions concerning the distribution of individuals among species. Because it is non-parametric, it is less sensitive to the limitations that plague other community indices. It is defined as the total number of species accounting for 75% of the individual organisms collected. As such, it represents an inverted measure, in which increased dominance is associated with lower values of the Swartz index. Increased dominance is expected in degraded benthic communities where a few opportunistic, pollution-tolerant taxa abound in the absence of a wider array of pollution-sensitive organisms. As with the other community parameters, Figure 4.12d shows that differences in dominance among stations in a given survey were generally small compared to temporal fluctuations. Overall dominance was generally low, with five or more species typically sharing numerical superiority. In fact, in most surveys, organisms were more evenly distributed among taxa at the outfall stations (shown in red) than at more distant stations. This is opposite of the pattern expected if effluent discharge had degraded the benthic environment.

By far the lowest historical dominance occurred in samples collected at Station 8 during 1999. During that survey, nineteen species accounted for 75% of the specimens collected. Judging from a Swartz index that normally is near eight species, up to 10 of the 19 dominant species that were found at Station 8 during 1999 were epiphytic organisms associated with the presence of Ornate Tubeworms. The exclusion of these tubeworms from subsequent surveys has resulted in more representative Swartz indices.

On average, the benthic samples collected during the October-2006 survey had the second-lowest dominance recorded in the 21-year history of the monitoring program. During that survey, an average of 12.3 species accounted for 75% of the specimens collected. This indicated that infaunal abundance was evenly distributed among the species. Moreover, low dominance was the case at all the stations in the 2006 survey. This contrasts with the October 1998 survey, when a lower average dominance (12.8) was largely driven by a low dominance at Station 5.

Clean-Sediment Feeding Guilds

The Infaunal Trophic Index (*ITI*) (Word 1978 and 1980) compares the abundance of four soft-bottom assemblages that are distinguished by their feeding behavior. Because sensitivity or tolerance to organic enrichment differs among the four groups, shifts in the dominance of the individual feeding groups, as reflected in a changing Trophic Index, can be indicative of degraded environmental conditions. The *ITI* ranges between 0 and 100. When species in Group I (suspension feeders) and Group II (surface-detritus

feeders) dominate, index values are above 58 and sediments are considered relatively clean. Lower infaunal indices occur when populations of species in Group III (surface deposit feeders) and Group IV (subsurface detritus feeders) dominate in sediments that are high in organic contaminants.

The *ITI* has been consistently high throughout the monitoring program, and the 2006 survey was comparable to trophic indices recorded in past surveys (Figure 4.12e). The *ITI* has always been well above the critical *ITI* of 58 that normally indicates degraded conditions. In fact, trophic indices have always exceeded 70, which confirms the consistent dominance of suspension and surface-detritus feeders in the relatively clean sedimentary environment of northern Estero Bay. Moreover, there is no pattern of degradation close to the outfall evident in the *ITI* time series. Effluent-related degradation would appear as a reduced *ITI* at the ZID Stations (4 and 5). Effluent-related degradation would also emerge in Figure 4.12e as a gradual separation in colors over time, with stations closest to the diffuser structure (shown in red) eventually having the lowest *ITI*. This would be followed by a slightly higher *ITI* at nearfield stations, shown in green. Instead, as with the other community indices, and with the chemical concentrations, there is no consistent pattern of color separation from year to year.

The high *ITI*s measured in samples collected during 2006 reflect a healthy community where suspension feeders predominate. Specifically, the high trophic indices were a consequence of an infaunal population consisting largely of phoxocephalid amphipods, namely *Majoxiphalus major, Foxiphalus xiximeus*, *Rhepoxynius menziesi*, and *Rhepoxynius abronius* (see Table E.1). Together, these amphipods accounted for 19% of the non-*Dendraster* specimens collected during the survey. Phoxocephalids are active suspension feeders whose presence weighs heavily in the computation of the *ITI* as members of the Group-I feeding guild (See Page E-12 in the Appendix). The amphipod *R. abronius* was the third-most abundant taxon collected during the 2006 survey. It is also known to be particularly sensitive to pollution (Pearson and Rosenberg 1978) and, because of this, is often recommended for bioassay testing of marine sediments (ASTM 1992; USEPA-USACOE 1991, 1993). Its prevalence in samples collected at all stations in October 2006 lends confidence in the general lack of potential discharge-related impacts. This taxon is also particularly sensitive to increased amounts of fine sediments, and variations in grain-size distribution can often account for variations in its abundance (DeWitt et al. 1988). Not surprisingly, its greatest abundance was observed at Station 1 (42 specimens, Table E.1) and Station 8 (46 specimens) where mud fractions were elevated compared to the remaining stations (Figure 4.6 on Page 4-25).

In addition to substantial numbers of phoxocephalid amphipods, another pollution-sensitive taxon, the gammerid amphipod *Eohaustorius sincillus* was prevalent at all stations and accounted for nearly 7% of the non-*Dendraster* specimens collected overall (Table E.1). In contrast, opportunistic pollution-tolerant species, such as *Polydora ligni*, *Capitella capitata*, *Paraprionospio pinnata*, and oligocheate worms, were absent in samples collected during 2006, except for one *P. pinnata* specimen found at the reference Station 1. The prevalence of sensitive filter-feeding taxa and the general absence of pollution-tolerant opportunistic taxa led to the overall high levels of the infaunal trophic index in 2006. The uniformly healthy population found in benthic samples collected in 2006 was consistent with the infaunal population found in samples collected over the prior 20 years.

4.3.2 No Infaunal Spatial Trend Related to Outfall Proximity in 2006

The previous section documented the overall health of the infaunal community surrounding the outfall using a 21-year record of infaunal community indices. This section investigates whether spatial trends related to outfall proximity exist in the infaunal data collected in 2006. As described in Appendix E.2,

four of the biological indices are more informative than the other indices. They include the Brillouin Diversity Index, the Swartz Dominance Index, the Margalef Richness Index, and the Infaunal Trophic Index (*ITI*). The spatial distribution of average values for these four indices is shown in Figure 4.13.

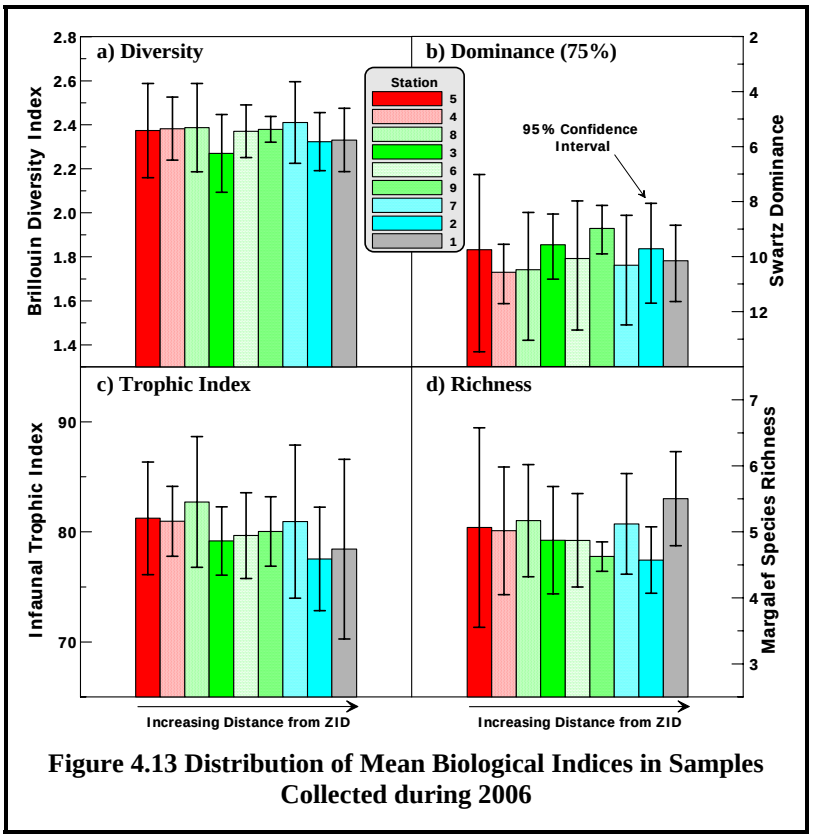


Figure 4.13 Distribution of Mean Biological Indices in Samples Collected during 2006

The bars shown in Figure 4.13 are arranged in order of increasing distance from the diffuser structure. The red-colored bars on the left are associated with the ZID stations located closest to the diffuser, while the four green bars in the middle represent the nearfield stations. Finally, the blue and gray bars that are farthest to the right represent the three distant stations, which lie 133 m or more from the outfall.

Impacts to infaunal communities from the discharge would be reflected in the bar chart as a spatial trend of steadily increasing diversity, ITI, or richness from left to right (Figure 4.13acd). In contrast, dominance would be expected to decrease with increasing distance from the outfall (Figure 4.13b). However, none of these spatial trends is visually apparent in the Figure. Additionally, none of the indices exhibited statistically significant gradients related to outfall proximity ($p \geq 0.38$). This was quantitatively confirmed with a log-linear regression analysis of all seven of the community indices listed in the discharge permit and collated in Table E.12.

Another way of evaluating whether significant spatial differences exist among the infaunal indices is to test whether any of the average values are significantly different from those of other stations, irrespective of their distance from the outfall. The height of the bars in Figure 4.13 reflects the average index computed from the five replicate samples collected at each station. The 95% confidence intervals represent the variability among replicate samples collected at each individual station. As such, the intervals reflect the inherent uncertainty in the determination of average station values. Thus, if the mean at one station is encompassed within the confidence interval at another station (or vice versa), then no statistical significance can be ascribed to any perceived difference between the averages at those two stations at the 95% confidence level ($\alpha \leq 0.05$).

Visual inspection of Figure 4.13 indicates that the average indices at almost all pairs of stations are encompassed by the associated confidence intervals. An analysis of variance (ANOVA) provides a rigorous statistical method for simultaneously testing for significant differences among all the station means. Its application to all seven of the community indices demonstrated that none of the differences in the average indices among the stations was statistically significant at the 95% confidence level ($p > 0.06$). This con-

firmed that any perceived difference in the indices among stations are not meaningful in light of the inherent scatter in the replicate measurements at individual stations.

4.3.3 Spatiotemporal Trends Unrelated to Infaunal Degradation from Effluent Discharge

As with the chemical constituents within northern Estero Bay sediments, subtle spatiotemporal trends in the infaunal community can be difficult to discern in the time series shown in Figure 4.12 on Page 4-39. The parameters exhibit wide fluctuations between seasons and years. Compared to these large temporal oscillations, the spatial differences among samples collected at a given time (i.e., within a given survey) were comparatively small. In other words, the stations generally tracked one another through time. This indicates that changes in infaunal communities that arise because of the influence of regional processes within Estero Bay are far larger than those induced by any localized effects from, for example, effluent discharge. By the same token, within a given survey, perceived spatial differences in infaunal parameters cannot be unequivocally ascribed to impacts from the discharge. Discharge-induced spatial differences in infaunal communities are confounded by larger natural differences in the sedimentary environment and other zoogeographic influences.

The limitations associated with these other approaches to impact evaluation are largely eliminated through the use of an analysis technique based on statistical tests for nonparallel trends at impact and reference sites (Coats et al. 1999, Skalski et al. 2001). In this application, statistical analyses based on parallelism are capable of discerning subtle temporal trends in the difference between average indices at stations located near the outfall, and those that are distant from the outfall, even though the indices as a whole widely fluctuate from survey to survey. As described previously, discharge-related spatiotemporal changes would appear in Figure 4.12 as a gradual separation of the colors as contaminants accumulate near the outfall and affect the resident organisms. However, because of the large coherent fluctuations that occur over time, subtle spatiotemporal changes may be present but not visually apparent in the time series. Taking the difference in average values at distant and near sites removes the temporal oscillations that occur on a seasonal and interannual basis. In effect, parallelism assumes that the large temporal excursions in indices that occur in unison at all stations represent a simultaneous response to regional influences, and removes them. The resulting time series of differences in parameters at ZID and distant stations are presented in Figure 4.14 at the top of Page 4-45.

If the discharge was impacting the benthic community over time, then the infaunal properties of populations at stations near the outfall (4 and 5) would slowly diverge from that of the distant stations (1, 2, and 7). This will appear as a trend or slope in the average difference shown in Figure 4.14. A regression test for a statistically significant trend (slope) in the difference is equivalent to a test of the null hypothesis that the population responses at impacted and non-impacted sites are parallel over time.

Parallelism tests applied to the entire 21-year MBCSD time series were unable to discern a statistically significant linear trend in any of the infaunal indices. Parallelism was strongly indicated (p>0.12) for all indices except diversity. The test for a trend in diversity was only marginally outside of the 95% confidence level (p=0.055). Figure 4.14 shows that the diversity time series is unusual because all but one of the 17 surveys conducted since 1993 exhibited a positive offset, namely, the average diversity at stations near the outfall was consistently higher than the diversity at the distant reference stations. However, the consistently positive offset was unrelated to a contaminant buildup from effluent discharge because it is the opposite of that expected from deleterious impacts arising from exposure to contaminant loads ema-

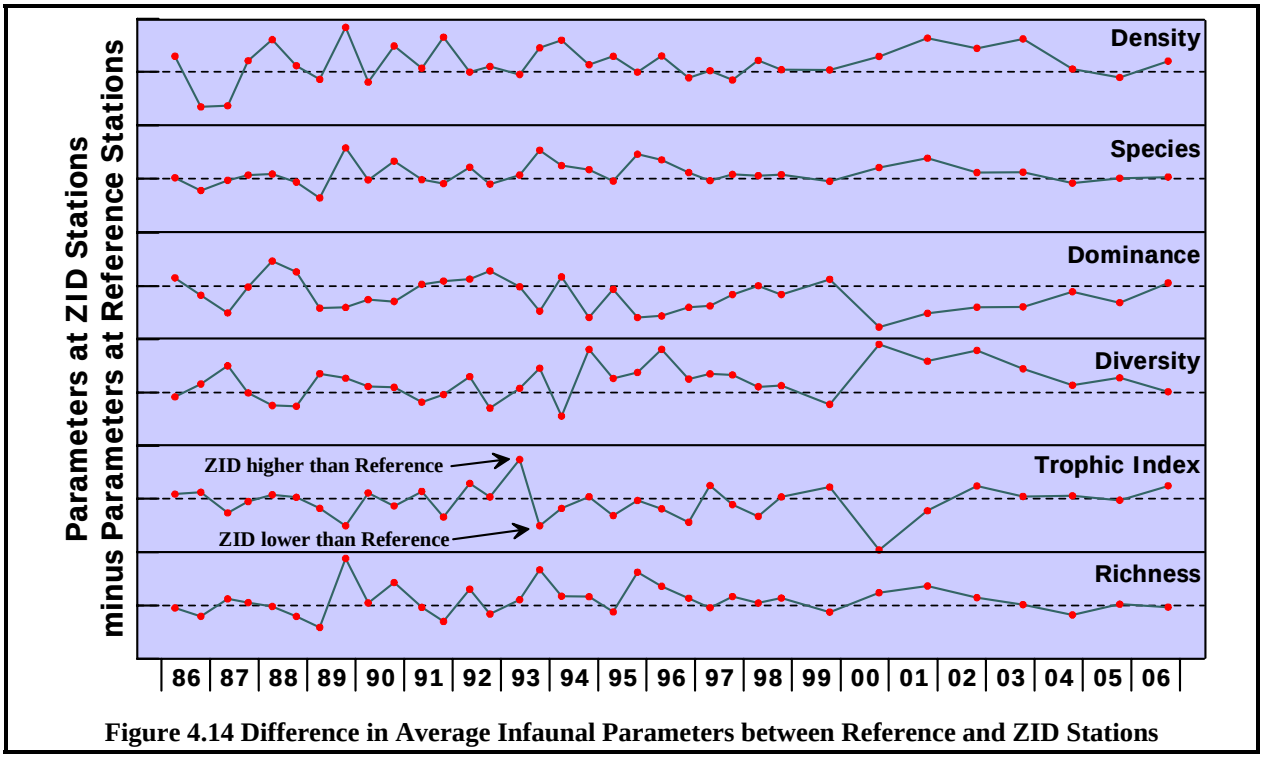


Figure 4.14 Difference in Average Infaunal Parameters between Reference and ZID Stations

nating from the outfall. Higher diversity at stations close to the outfall reflects a healthier infaunal community compared to distant reference stations.

It is also possible that the measured offset reflects a beneficial impact from the effluent discharge. The increased diversity of the benthic community near the outfall may result from an increased loading of suspended organic particulates that are relatively devoid of chemical contaminants. It could also arise from the physical presence of the diffuser structure itself. The structure not only influences flow within the benthic boundary layer, but its sheltering effects may provide a more hospitable environment for certain infaunal taxa (Davis et al. 1982). Finally, it is clear from Figure 2.2 that the structure acts as an artificial reef and supports a diverse community of epifaunal organisms. Localized dispersion of some of these epifaunal taxa may beneficially influence recruitment of infauna at the nearby ZID stations.

4.3.4 Factors Influencing Benthic Community Composition

The increased nearfield diversity that is described in the foregoing section is the opposite of that expected of a benthic habitat impaired by effluent discharge. Unfortunately, the univariate diversity indices described above provide only limited insight into the composition of infaunal communities and how they vary in space and time. Application of multivariate analysis, however, can provide the needed insight into the individual taxa that are responsible for the observed differences among the various monitoring stations. As such, multivariate analysis also lends insight into naturally occurring environmental factors that may be influencing site-specific infaunal communities.

Multivariate Analysis

Investigating changes in global community properties using total abundance or various diversity indices dilutes the value of information contained in the response of individual taxa. For example, a dominant pollution-tolerant taxon may show little change in response to contaminant exposure, while a less-abundant but more pollution-sensitive taxon may exhibit marked reductions or disappear altogether; allowing a more opportunistic taxon to takes its place. Under those circumstances, an infaunal index may only exhibit a weak response to the impact, even though the community composition was conspicuously changed. As a result of this dilemma, a variety of strategies have been developed to compare infaunal community composition by overcoming obstacles such as how to reduce the influence of rare species, and how to simultaneously analyze tens, and sometimes hundreds, of different individual taxa.

Multivariate analysis, which simultaneously examines changes in a large number of variables, provides a far superior measure of community composition. It distills pertinent information about the community into a limited number of parameters by reducing redundant information introduced by species whose responses are highly correlated. Although multivariate analysis encompasses a broad range of techniques, principal component analysis (PCA) is used here to identify those taxa that materially participate in the observed differences in community composition during 2006. PCA arranges samples along orthogonal axes (principal components) based on species composition. The distribution of samples along each principal axis often approximates some pattern of response of the infaunal community to underlying environmental gradients. Thus, PCA condenses the complex species-abundance database into a few factors responsible for the observed variability within the infaunal community. The PCA applied here is capable of balancing the influence of rare versus dominant taxa through selection of appropriate subsample sizes (Coats et al. 1999, Trueblood et al. 1994, Grassle and Smith 1976).

Differences in Community Composition

Figure 4.15 provides a visual interpretation of the PCA that was performed on the October 2006 infaunal data. It is called a biplot because it simultaneously displays differences among stations (by the location of discrete points) and the species that differentiate those samples (shown as arrows or vectors). Thus, the biplot arrows help identify the species most responsible for the differences in community composition among the nine stations.

The distribution of samples along the first principal component (x-axis) of the biplot unambiguously distinguishes the unique infaunal communities in samples collected at Station 1 from the infaunal community at each of the other Stations. This axis accounted for a large portion (37%) of the dissimilarity among the nine stations and clearly showed that the community composition at Station 1 was distinctly isolated from that of the remaining stations. Specifically, samples collected at Station 1 had a large positive offset with an Axis-1 sample scores of 0.45, as indicated by the location of the red diamond (♦).

The difference in the infaunal community at Station 1 was largely due to its physical separation from the majority of the other stations. It lies 1 km north of the diffuser structure and was separated from Station 2 by 889 m. The average separation of the other benthic monitoring stations was only 100 m. Therefore, biogeographic differences within Estero Bay probably account for most, if not all, of the obvious differences in the infaunal community at this distant reference station.

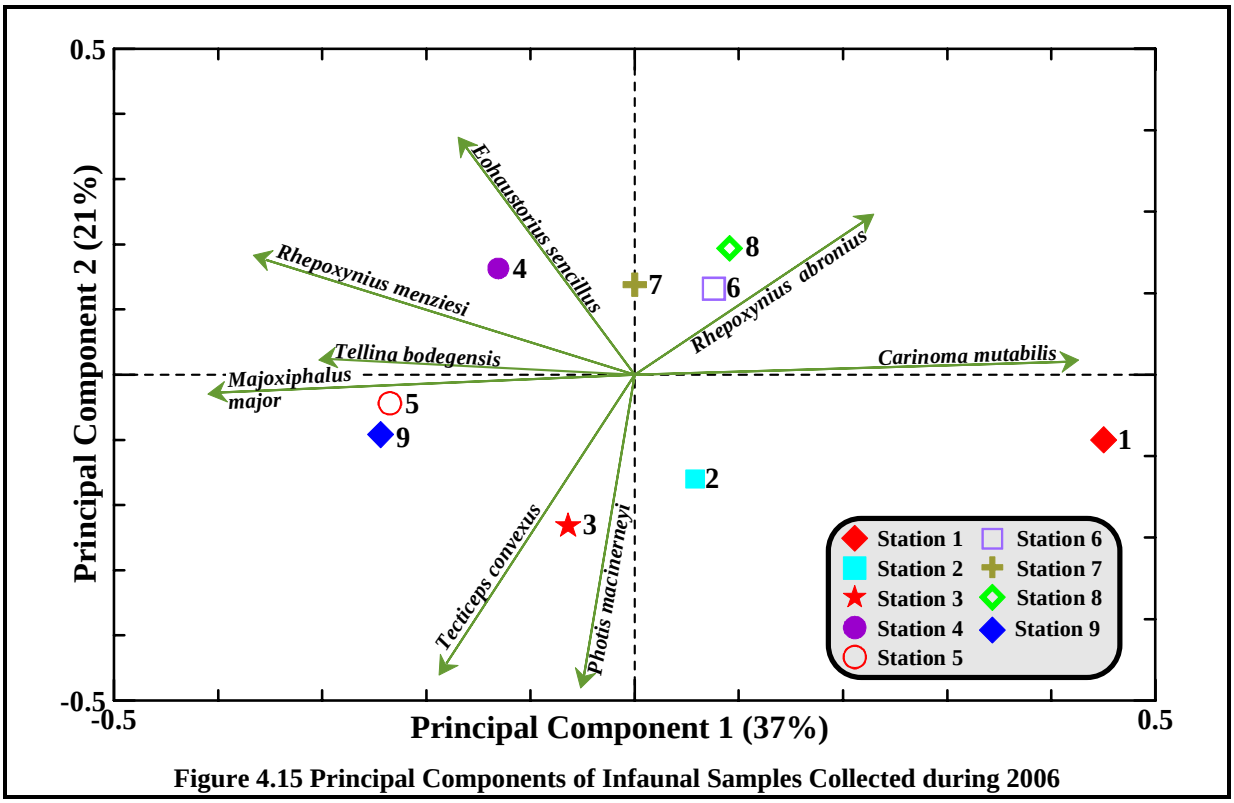


Figure 4.15 Principal Components of Infaunal Samples Collected during 2006

Influential Taxa

The taxa that account for the community difference at Station 1 are also evident in Figure 4.15. Biplots are designed so that the arrows point in the direction of samples with comparatively increased abundances of a given species. Thus, the arrows that point toward the right identify species that were conspicuously more abundant at Station 1. Conversely, the arrows that point toward the left identify taxa that were comparatively rare at Station 1, but were more prevalent in samples collected at Stations 5 and 9. Overall, the PCA identified eight taxa that were influential in distinguishing community composition among the samples collected in October 2006. Four of these taxa were largely responsible for the separation of samples along Principal Axis 1, namely, in distinguishing the infaunal communities in samples collected at Station 1 from the community in samples collected at the other stations, but particularly Stations 5 and 9. The remaining four taxa were largely responsible for the separation of samples along Principal Axis 2, namely, in distinguishing the infaunal communities at Nearfield Stations 4, 6, 7 and 8 from the communities in samples collected at ZID Stations 2 and 3.

Figure 4.15 shows that the infaunal community at Station 1 was distinguished by its comparatively higher abundance of the nermertean *Carinoma mutabilis*. Nemerteans are soft-bodied, unsegmented worms (Figure 4.16). They are carnivorous, eating other small infaunal invertebrates such as annelids and crustaceans. *C. mutabilis* is normally among the top five most populous organisms in the sediment samples collected as part of the MBCSD monitoring program. In 2006, 53 specimens where present in the samples collected at Station 1 whereas samples from other stations contained 35 or less (Table E.1). At Station 5, only eight specimens were present, which accounts for this station's PCA location along the negative portion of Axis 1in Figure 4.15.



Figure 4.16 Photograph of the nemertean worm *C. mutabilis*

The infaunal population at Station 1 was also distinguished by relatively low numbers of the Bodega tellin clam (*Tellina bodegensis*) Bodega tellin clams have narrow, thin shells and a wide blade-like foot (Figure 4.17). They remain buried a few centimeters beneath the sediment surface where they feed on organic detritus at the sand surface. At 349 individuals, more Bodega tellin clams were found in the 2006 benthic samples than any other organism (Table E.1). However, the samples collected at Station 1 only contributed nine specimens to that total. In contrast, Station-9 samples contained the most Bodega tellin clams (61), which, along with Station 9's low number of *C. mutabilis*, accounted for this station's PCA location along the negative portion of Axis 1, opposite of the Station-1 sample location (Figure 4.15). Station 9 is located closer to shore, in shallower water than the other monitoring stations (Figure 4.2). Comparatively higher abundances of Bodega tellins have been observed at Station 9 in past surveys, (MRS, 2003b). Their increased abundance at this station may be related to the increased wave action or to the reduced fine-sediment fraction found there.



Figure 4.17 Photograph of a Bodega Tellin Clam (*T. bodegensis*)

In the 2006 benthic samples, as well as those collected in past surveys, the phoxocephalid amphipod assemblage has been influential in distinguishing among the infaunal communities at the various stations (MRS, 2006a). The assemblage consists of the four amphipods: *Majoxiphalus major*, *Foxiphalus xiximeus*, *Rhepoxynius menziesi*, and the closely related *Rhepoxynius abronius*. Amphipods, such as the one pictured in Figure 4.18, are small shrimp-like scavengers that eat organic debris. These organisms



Figure 4.18 Photograph of an Amphipod

are laterally composed with small eyes, small heads, and strongly arched backs. They are benthic filter feeders that are generally found burrowing within the top few centimeters of sediment. As such, they are sensitive to contamination, high organic content, and the presence of fine grained sediments. Because of their narrow habitat specificities, phoxocephalid amphipods are found only at selected depth intervals and locations along the central and southern California coast.

Figure 4.15 shows that samples collected at Station 1 had relatively few specimens of *M. major* and *R. menziesi*, but supported relatively high abundances of *R. abronius*. Station 8, which is located at a greater water depth than the other monitoring stations, was especially differentiated by its elevated abundance of *R. abronius*. *R. abronius* is particularly sensitive to adverse environmental conditions, which has led to its use in bioassay testing (Ott 1986, ASTM 1992). The increased fine-sediment mud fractions found at Stations 1 and 8 reflects a more quiescent wave environment that is apparently better suited to *R. abronius*.

In contrast, Station 9 is located closer to shore where it is exposed to more energetic bottom disturbances from shoaling waves. Accordingly, relatively few *R. abronius* were found in samples collected at this station. In the absence of competition for the same ecological niche, two other closely related phoxocephalid amphipods, *R. menziesi* and *M. major*, were comparatively abundant at that station. These groupings are generally consistent with the results of the PCAs conducted in each of the past four years, further supporting the notion that physical characteristics, such as grain size distribution, are largely responsible for the differences in community structure among these stations.

As with benthic samples from previous surveys, multivariate analysis of the infaunal community surrounding the MBCSD outfall in 2006 effectively distilled the pertinent information concerning the differences in the infaunal communities at the various monitoring stations. Generally, the same limited number of species was found to be influential in differentiating the community structure at three specific stations (1, 8, and 9). The differences in the infauna at these stations can be ascribed to zoogeographic separation in the case of Station 1, and to differences in the water depth at cross-shore stations 8 and 9, along with the concomitant differences in orbital wave motion and fine sediment fractions at those stations. Compared to the differences in infaunal communities at these stations, there is little to distinguish the communities at Stations 4 and 5, which are located close to the outfall, and the more distant stations (2, 3, 6, and 7) that are located farther away along the same isobath. This, along with the analysis of physicochemical measurements described previously in this chapter, provides strong empirical evidence that the sediments surrounding the outfall, along with the organisms that reside within them, have not been perceptibly impacted by the discharge after more than two decades of monitoring.

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CHAPTER 5

Conclusions and Recommendations

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5.0 CONCLUSIONS AND RECOMMENDATIONS

The MBCSD Monitoring and Reporting Program was designed to evaluate the performance of the wastewater treatment plant and monitor the quality of the effluent discharged to the ocean. The offshore component of the monitoring program was intended to quantify any potential effects of the discharge on the local ecology and on the beneficial uses of the receiving waters. The reporting program, of which this report is a part, documents compliance with the discharge and receiving-water limitations specified in the NPDES discharge permit. This annual report evaluated permit compliance and documented potential discharge impacts through quantitative analyses of an extensive data set encompassing effluent constituents, receiving water quality, benthic sediment chemistry, and marine biota. Of the thousands of measurements collected as part of the monitoring program during 2006, none exceeded the discharge limitations.

5.1 TREATMENT PLANT

The Morro Bay/Cayucos Wastewater Treatment Plant has been operating under the provisions of a 301(h)-modified NPDES permit since 1986, with 2006 marking the twenty-first year of consistently high performance by this treatment facility. There is no evidence of a decline in treatment performance in the more than two-decades of annual averages shown in Table 5.1. In fact, many of the best measures of treatment performance were achieved during the past three years of operation. For example, the average effluent Total Suspended Solids (TSS) concentration in 2006 (20.5 mg/L) was the lowest on record, and was even lower than the 1987 average of 21.8-mg/L when El Niño related storms resulted in an unusually low influent TSS (274 mg/L). In contrast to 1987, the low effluent TSS concentration in 2006 was the direct result of the efficiency of the treatment process, which reduced high influent TSS concentrations (335 mg/L) by an average of 93.2%. This is the second highest average solids removal rate recorded in over two decades of operation and is only slightly lower than the all-time high average of 93.3% achieved in 2005. Combined with the low total flow in 2006, the plant's solids-removal process also resulted in the lowest annual mass emission of suspended solids (34 MT) recorded since monitoring began in 1986. This is only about one-sixth of the solids discharge permitted under the NPDES permit. Also, the 2006 solids emission was more than 8 MT lower than the next two lowest emissions recorded in 2004 and 2005. The record low emissions and high effluent quality measurements achieved over the past three years attest to the consistent, exemplary level of plant performance that has been achieved in recent years.

Oil and Grease (O&G) and Biochemical Oxygen Demand (BOD) effluent concentrations and emissions were also correspondingly low over the past three years. Again, this was a direct result of high plant performance as documented by removal rates that were high compared to the average rates achieved over the more than two decades of monitoring. Averages computed over the twenty-one years of monitoring are shown in bold near the bottom of Table 5.1. Across the board, effluent TSS, O&G and BOD concentrations and emissions were lower in the past three years than the overall monitoring-program averages despite having higher-than-average influent concentrations for these same constituents. Accordingly, removal rates for these three constituents were among the highest measured since monitoring began, far exceeding the average removal rate for the monitoring program overall. Mass emissions were particularly low in the three last years due to the lower-than-average flow rates that resulted from an aggressive source-identification program that substantially reduced inflow and infiltration (I&I) into the collection system.

5.1.1 Overall Performance

Irrespective of comparisons with historical performance, the average wastewater characteristics measured over the last three years demonstrate that the treatment process was routinely and substantially exceeding expectations based on the original plant design, the NPDES discharge permit, and established federal regulatory standards. For example, in 2006, the average suspended-solids removal rate was 18% above the permitted minimum, and the BOD removal rate was more than two and a half times the minimum permitted rate of 30%. The treatment process was so efficient that average effluent TSS and BOD concentrations during all but one month of 2006 remained well under the 60-mg/L threshold below which removal rate requirements are not imposed on the discharge. In July, the sole month to exceed the 60-mg/L threshold, the average effluent BOD concentration of 63 mg/L still remained far below all permit limits. Moreover, the plant routinely achieved treatment levels that exceeded the requirements for full secondary treatment. For example, monthly solids-removal rates surpassed the 85% full-secondary criterion throughout 2006, while BOD removal rates achieved full secondary levels during four months of the year. Other effluent constituents were also low during 2006. The discharge of settleable solids was imperceptible, and monthly averages of effluent turbidity, pH, ammonia, and coliform density remained far below the applicable permit limitations.

Table 5.1 Average Annual Wastewater Parameters

		Suspended Solids				Biochemical Oxygen Demand			
Year	Flow (MGD)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)
1986	1.42	332	32.8	89.8	64	235	77.0	67.2	151
1987	1.51	274	21.8	92.0	45	257	52.0	79.8	108
1988	1.51	397	29.8	90.0	62	242	43.9	81.9	92
1989	1.46	321	37.3	88.4	75	259	69.8	73.1	141
1990	1.38	345	36.0	89.6	69	261	75.7	71.0	144
1991	1.28	280	30.5	89.1	54	236	66.9	71.6	118
1992	1.41	310	43.0	86.3	84	224	59.3	73.5	116
1993	1.54	339	33.0	89.6	70	222	39.0	81.9	83
1994	1.38	310	32.0	89.4	61	249	33.0	86.4	63
1995	1.55	270	30.6	87.6	69	208	31.4	83.9	67
1996	1.55	344	33.1	89.9	70	241	35.7	85.0	73
1997	1.64	283	36.0	86.6	79	231	38.6	83.0	85
1998	1.95	236	38.8	83.9	101	216	39.1	81.5	99
1999	1.68	386	44.0	86.7	102	287	49.5	82.5	118
2000	1.77	337	37.4	87.5	91	271	50.3	81.1	125
2001	1.48	450	37.6	89.5	74	396	62.7	83.1	127
2002	1.14	374	49.2	86.0	77	386	67.5	82.4	101
2003	1.06	314	39.2	86.7	56	311	56.3	81.3	83
2004	1.09	354	28.9	91.3	44	336	53.3	83.8	81
2005	1.25	373	24.3	93.3	42	303	49.8	83.0	88
2006	1.19	335	20.5	93.2	34	291	45.3	83.8	75
Average	**1.44**	**332**	**34.1**	**88.9**	**68**	**270**	**52.2**	**80.1**	**102**
Limitation	**2.06**		**70.0**	**75.0**	**199**		**120.0**	**30.0**	**342**

Table 5.1 Average Annual Wastewater Parameters (continued)

Year	Oil and Grease				Turbidity (NTU)	pH	Acute Toxicity (TUa)	Chronic Toxicity (TUc)	Ammonia as NH_3-N (mg/L)
	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Mass Emission (MT)					
1986	64	13.8	78.4	27	26	7.7	1.3[1]		18
1987	44	6.2	85.9	13	23	7.5	1.9[1]		
1988	38	6.3	83.4	13	40	7.5	1.2[1]		
1989	28	6.1	78.2	12	49	7.4	1.1[1]		26
1990	34	8.5	75.0	16	55	7.4	1.4[1]		26
1991	73	6.9	90.5	12	50	7.3	1.4[1]		18
1992	33	5.3	83.9	10	56	7.3	1.2[1]		9
1993	26	6.0	76.9	13	43	7.4	1.7[1]	19.42[2]	20
1994	60	4.1	93.2	8	36	7.5	1.3[1]	4.37	27
1995	63	5.1	91.9	11	32	7.5	0.7	4.35	23
1996	52	7.9	84.8	17	34	7.7	0.5	4.83	23
1997	49	5.3	89.2	12	32	7.7	0.4	7.80	23
1998	51	5.4	89.4	15	34	7.6	0.1	7.80	19
1999	52	6.2	88.1	14	48	7.5	0.0	5.00	25
2000	74	5.5	92.6	13	39	7.5	0.0	5.60	24
2001	47	4.6	90.2	9	41	7.4	0.1	5.60	28
2002	39	4.4	88.7	7	41	7.5	0.0	4.98	31
2003	44	5.3	87.9	7	34	7.5	0.9[1]	7.80	27
2004	47	3.7	92.0	6	26	7.5	1.4[1]	5.60	29
2005	62	4.4	92.9	8	23	7.6	1.2[1]	5.60	27
2006	44	4.1	90.6	7	26	7.6	1.4[1]	4.36	28
Average	**49**	**6.0**	**86.8**	**12**	**38**	**7.5**	**0.9**	**6.65**	**24**
Limitation		**25.0**			**75**	**6-9**	**1.5[3]**	**134.00**	**322**

[1] Interference from ammonia artificially increased the reported acute toxicity.
[2] Screening bioassay of three marine species
[3] The acute-toxicity limitation that is consistent with the current California Ocean Plan is 4.3.

The benefits of past efforts to reduce rainwater inflow and groundwater infiltration (I&I), and to more accurately measure plant flow, are evident in the record of annual average flow rates listed in Table 5.1. Reported flow during 2006 was the third lowest on record, following the record low flows in 2003 and 2004. In 2006, 91 million fewer gallons flowed through the plant than the average annual throughput. However, some of this flow reduction is an artifact of improvements in the accuracy of flow measurements instituted in 2002.

Improved accuracy notwithstanding, a portion of the flow reduction was genuine, and was directly related to reductions in the fraction of flow arising from I&I. Increased efforts to reduce I&I in recent years have resulted in a decrease in the amount of relatively clean rain and groundwater that is unnecessarily treated at the WWTP. These I&I reductions have reduced the total volume of flow processed by the plant, thereby increasing the proportion of wastewater of sewage origin that is treated by the plant.

5.1.2 Influential Events

Along with the high overall performance of the treatment process during 2006, there were six isolated instances of noticeable short-term changes in wastewater parameters. As in past years, these anomalous measurements were all related to specific external events that occurred during the year. The fact that these abnormal wastewater measurements were few in number, and did not occur randomly, demonstrates the overall effectiveness of the treatment process, and the high degree of control exercised by plant personnel. All six of these events were related to short-term increases in flow resulting from rainwater inflow or population increases in the service area during holiday periods. The absence of equipment-related impacts to the treatment process in 2006 was the direct result of a vigilant and proactive program of preventative maintenance, wherein plant personnel acted diligently to seek out and correct potential mechanical impairment of treatment-plant components, and responded quickly to the inevitable, unforeseeable failures that occasionally occurred.

Since monitoring began in 1986, three major influences have identifiably increased measured plant flow in most years. These are overtotalization, I&I, and short-term population increases in the service area. Historically, the most influential factor has been the artificially increased flow that resulted from overtotalization. Overtotalization was particularly significant prior to 2002, when flow rates were reported using only the effluent flow meter. This resulted in flow rates that were consistently overestimated by as much as 25%. Without overtotalization, average flow over the two-decade record should be closer to 1.2 MGD rather than 1.44 MGD. Because the flow rates were overestimated prior to 2002, the annual mass emissions were also overestimated. Consequently, the average emissions, shown in bold at the bottom of Table 5.1, were slightly inflated. Specifically, the reported average annual TSS emission of 68 MT is actually closer to 57 MT. Similarly, the average annual BOD emission that is reported to be 104 MT is, in reality, closer to 86 MT, and the reported 12 MT of O&G discharged on average is closer to 10 MT.

In 2002, overtotalization was largely eliminated after flow measurements began to be based on the much more accurate influent flow meter. However, flow is still occasionally overtotalized due to aberrant influent flow readings that occur when the influent flume becomes temporarily surcharged after water backs up from the wetwell at the plant headworks. Judicious use of corrected effluent flow totals on these rare occasions effectively eliminates flow overtotalization. During 2006, for example, there were only five days when the corrected effluent flow totals were used in place of influent readings.

The second type of event that identifiably increases flow rates is rainwater inflow and groundwater infiltration. I&I was responsible for at least 14.8% of the flow measured during 2006. Brief but marked increases in the plant flow rate were directly correlated with rainstorms. Approximately 830,000 gallons of rainwater flowed into the collection system for every inch of rain that fell during 2006. This inflow rate was comparable to rates determined in prior years with comparable total rainfall amounts.

Over longer periods, infiltration of groundwater into the collection system observably increases plant throughput. Compared to the brief inflow events from rainstorms, groundwater infiltration contributes a much greater cumulative volume of water to the collection system. Moreover, at 0.11 MGD, the lower-bound estimate for the average infiltration reported for 2006 probably grossly under-represents the volume of infiltration that actually occurred in 2006. This is because the estimate neglects a potentially large unknown contribution that is lumped into the base flow estimate. In the absence of other information, this baseline flow level was simply selected as the lowest flow of the year. The reported minimum infiltration of 0.11 MGD was estimated from the relatively prolonged, storm-related increases in plant flow that ex-

tended above the baseline flow for periods of a week or longer. However, the baseline (lowest) flow varies significantly from year-to-year, so, clearly, it does not represent a good estimate of the pure sewage volume contributed by the permanent residents of the service area. Instead, it probably includes a substantial component of infiltration.

In any regard, the presence of significant I&I contributions during the dry season (April through September) gives the mistaken impression that the treatment plant was operating at approximately 61% of its dry-weather design capacity in 2006. Of particular interest was the 2.6 inches of rainfall that occurred on 21 May 2006. This unusual storm occurred well into the dry season and generated 2.5 MG of additional flow through the plant. However, I&I contributions are relatively devoid of organic solids, and consequently, do not tax the treatment process to the same extent that pure sewage does. In reality, after accounting for the minimum amount of I&I contributions, wastewater of purely sewage origin constituted much less than 54% of the plant's design capacity during the 2006 dry season.

The third type of identifiable event that noticeably affects plant flow arises from large population fluctuations within the service area. Short-term population increases on weekends and holidays accounted for approximately 8.4% of the total flow through the treatment plant during 2006. In comparison, longer-term population increases over the summer tourist season accounted for approximately 5.2% of the annual flow. Clearly, the predominantly tourist-based economies of Cayucos and the City of Morro Bay are responsible for a large portion of the population-related fluctuations in flow rates. Baseline flow through the treatment plant, without the additional flow contributed by tourisms and identifiable I&I fluctuations, represented about 74.1% of the total flow measured during 2006.

5.1.3 Effluent Contaminants

The treatment process is primarily designed to disinfect the effluent and to remove organic particulates from the wastewater stream. It is not designed to eliminate chemical contaminants that are dissolved in wastewater. Instead, the vigorous pollution prevention program of the MBCSD limits the introduction of chemical contaminants at the source, before they enter the collection system. The multifaceted pollution prevention program includes public education, an onsite hazardous waste collection facility, source identification, and inspections of industrial users. Over ninety percent of the sewage is generated by domestic users, and the remaining contribution from businesses comes from non-industrial users or light industry, which generate wastewater similar to that of domestic sources but on a larger scale. In the absence of heavy industry within the service area, there is a concomitant lack of industrial pollutants within the MBCSD wastewater.

As in prior years, a few common metals and ubiquitous chemical compounds were found in low concentrations within effluent and biosolid samples collected during 2006. Of the 167 chemical compounds tested in effluent, only eleven had quantifiable concentrations. The measured concentrations for each of these detected compounds were well below applicable NPDES discharge limits. In most cases, the concentrations were orders of magnitude lower. The associated mass emissions were also well below the goals identified in the NPDES Monitoring and Reporting Program for MBCSD.

Quantified compounds included three trace metals (copper, lead, and zinc), cyanide, a common phthalate compound (bis 2-ethylhexyl phthalate), two chlorination byproducts (chloroform and chloromethane), and benzyl alcohol. The ever-present ammonia, chlorine, and radionuclide constituents represented the three remaining compounds that were quantified in the 2006 effluent samples. Because of its sewage origin, ammonia is a regularly occurring constituent in wastewater. However, peak ammonia concentrations

in the MBCSD discharge were 23 times lower than the permitted instantaneous limit imposed for the protection of marine aquatic life. In contrast to ammonia, chlorine is a chemical that is introduced during the disinfection process at the treatment plant. If it is not fully buffered by the introduction of sodium bisulfite, then a residual amount of chlorine can occasionally appear in effluent samples. Careful control of the disinfection process throughout 2006 maintained residual chlorine at undetectable levels in 95% of the daily samples. None of the remaining 17 samples had chlorine concentrations that exceeded the permitted limits. Finally, as with the other common effluent constituents, some level of radioactivity in effluent samples is expected because of the presence of naturally occurring radionuclides. Measured radiation levels were well within limits established for drinking water standards and similar to historical levels.

Trace metals occur naturally within the mineralogy of sediments along the central California coast, although copper, lead, and zinc also enter the collection system through internal corrosion of household plumbing systems. Regardless of their source, the concentrations of these metals were all well below the limitations specified in the NPDES discharge permit. Similarly, bis2-ethylhexylphthalate (BEHP) was found at low concentrations in the 2006 effluent samples, as has been the case in most effluent and biosolid samples collected in the past. This chemical would have to be at least 20-times more concentrated in effluent before it would be a potential human-health concern.

Cyanide was also detected in the July effluent sample, but its concentrations were low, only slightly above its PQL. Cyanide was not detected in the January sample. Although cyanide is not regularly detected in effluent samples, it is commonly found in low concentrations in biosolids. Low concentrations of cyanide derivatives are known to form in effluent as a byproduct of disinfection processes that utilize chlorination or ultraviolet irradiation. Until recently, much of the chemistry surrounding their formation was largely unknown. However, in 2003, independent research confirmed that chlorination of naturally occurring thiocyanate is an important mechanism for its formation. Regardless, the July sample of MBCSD effluent contained cyanide concentrations that were four times lower than the concentration that would be considered of concern to the health of marine organisms, and then, only after continuous exposure those concentrations over a 6-month period. The maximum estimated mass emission of cyanide in 2006 remained well below stringent mass-loading goals identified in the NPDES permit.

Halomethanes can also form from organic substances during disinfection with chlorine. The concentrations of two halomethanes, chloroform and chloromethane, were quantified within the 2006 effluent samples. However, at the low reported concentrations, it is not clear whether these halomethanes resulted from wastewater disinfection within the treatment plant, or were introduced into the collection system with previously chlorinated drinking water. Although very high concentrations of these compounds can negatively affect human health, the concentrations measured in the 2006 effluent samples were more than four orders of magnitude below levels that would be deemed a potential health concern.

The presence of measurable concentrations of benzyl alcohol in the January 2006 effluent sample was somewhat unusual in that it has been detected in effluent samples on only one other occasion. In 1997, it was measured in an effluent sample at a comparable concentration of 2.2 µg/L. Both detections were only slightly above the PQL of 2.0 µg/L. Alcohols are widely used as solvents, fuels and chemical raw materials. However, given the lack of industrial input, benzyl alcohol probably entered the MBCSD effluent sample through fugitive emissions from its use in commercial products and from the exhaust of motor vehicles. When released into water, it undergoes rapid microbial degradation and does not bioaccumulate in fish and aquatic organisms. Consequently, it does not have a limiting concentration in the discharge permit.

As with effluent samples, chemical analyses of biosolid samples quantified only very low concentrations of some commonly occurring contaminants. In addition to the organic constituents, the only constituents with quantifiable concentrations included twelve ubiquitous trace metals, cyanide, xylene, and BEHP. All measured concentrations were low, and well below regulatory limits that would make the biosolids hazardous or unsuitable for composting and land application.

Largely because of low contaminant concentrations in effluent, bioassays conducted over the past decade consistently demonstrate that the MBCSD effluent has low toxicity to marine organisms. The chronic bioassays conducted in 2006 confirmed the benign nature of MBCSD effluent. Chronic bioassays are far more accurate and sensitive than the acute bioassays, which were also conducted on effluent samples in 2006. Although all toxicity measurements in 2006 were below permit limits, the acute bioassays were conducted using protocols that introduced significant interference from ammonia. This interference artificially elevated the acute toxicity levels reported in 2006, and in recent prior years.

5.2 RECEIVING WATERS

The receiving-water environment was monitored on a quarterly basis to evaluate the oceanographic conditions near the outfall, particularly with respect to any adverse impacts from wastewater discharge. Comparison of water quality at the boundary of the zone-of-initial dilution (ZID) with gradient areas beyond the dilution zone documented compliance with the receiving-water objectives of the California Ocean Plan as specified in the NPDES discharge permit. Extremely sensitive sensors provided a detailed picture of water quality during the four surveys conducted during 2006. Precise navigation and high-resolution data on light transmittance, density, temperature, salinity, pH, and dissolved oxygen were used to assess spatial variations within receiving waters.

During all four surveys, small anomalies in water properties associated with the submerged wastewater plume were detected. In all cases, the water-quality fluctuations were restricted to the ZID, were generated by the upward displacement of ambient seawater and not the presence of wastewater constituents, or were insignificant compared to the larger ambient variations that result from natural oceanographic processes. Several of these plume measurements captured the signature of wastewater while it was continuing to undergo rapid initial mixing within only 15 m of the outfall, namely, within the ZID. Dilution rates determined from these close-in measurements were compared with critical initial dilution ratios that are expected based on modeling conducted during the design of the outfall. They demonstrated that the diffuser structure had dispersed the wastewater to a much greater extent than predicted by modeling conducted during the outfall's design.

Because tests for compliance with the receiving-water limitations in the discharge permit only apply outside the ZID, the close-in measurements were not subject to the standards promulgated in the California Ocean Plan. Nevertheless, most of the plume observations collected within the ZID were too small to be considered statistically significant, and all were below the permit limits normally only applicable to observations collected outside this narrow 15-m mixing zone. None of the observed conditions suggested that unmixed wastewater was tangibly affecting receiving waters within and beyond the ZID. As with prior monitoring, water quality parameters measured in the year-2006 surveys confirmed that the diffuser was operating efficiently, and that wastewater was achieving more than a 100-fold dilution immediately following discharge from the diffuser ports.

5.3 BOTTOM SEDIMENTS

The monitoring program has evaluated physical, chemical, and biological conditions within the benthic sediments around the outfall for more than two decades. Temporal fluctuations in these factors have been directly related to natural influences, the largest of which occur on seasonal and interannual time scales. The more notable faunal variations have involved interannual population fluxes within individual taxa. For example, large increases in the abundance of the Pacific Sand Dollar (*Dendraster excentricus*) occurred in 1989, 1991, and 1999. During these recruitment years, Sand Dollar populations dominated the infaunal community. Their marked population increases coincided with the well-recognized global climate changes known as El Niño. These major changes affected all of the benthic monitoring stations, including reference sites, and thus could be clearly ascribed to inherent oceanographic variability rather than the discharge of effluent.

To test for outfall-related effects, a large number of biological indices and parameters were computed from an enumeration of the 145,000 specimens collected over more than two decades of benthic monitoring. None of these parameters exhibited statistically significant spatial distributions related to the effluent discharge, or long-term spatiotemporal trends that would be indicative of an increasingly degraded benthic habitat near the outfall. Not only were the measured spatial differences measured in 2006 small compared to inherent sampling variability, but they were also overwhelmed by seasonal and interannual changes in community structure resulting from natural environmental oscillations, such as El Niño. Despite large temporal fluctuations in the infaunal community, its health has remained uniformly high at all stations throughout the two decades of monitoring. The benthic environment surrounding the outfall has always been populated by an infaunal community dominated by pollution-sensitive suspension-feeding organisms.

Spatiotemporal analyses were also conducted on the large dataset of physicochemical properties determined from sediment samples that have been collected near the outfall since benthic monitoring began in 1986. None of these properties exhibited a relationship to the discharge in 2006, although the analyses did reveal a slight, but statistically significant increase in some of the bulk sediment chemical concentrations. The increases are clearly unrelated to effluent discharge, however, because they are evident at all monitoring stations, including the distant reference stations. In addition, the annual mass emission of trace metals discharged by the treatment plant is far too small to account for the observed increases in sediment concentrations.

In addition, trace-metal concentrations in Estero Bay sediment samples have been well below the concentrations found in the vast majority of samples collected offshore Southern California. This further attests to the pristine nature of the ocean environment in northern Estero Bay. Nickel and chromium were the only trace metals that exhibited comparatively elevated concentrations in Estero Bay sediments. However, these metals occur naturally in the mineralogy of the region. As a result, the Estero Bay sediment metal concentrations were comparable to those determined in nearby benthic environments, such as Port San Luis (NOAA 1991a), or within the Morro Bay Estuary (Tenera and Marine Research Specialists 1997). Accordingly, contaminant concentrations measured in bulk sediment samples collected within northern Estero Bay, both near and far from the outfall, have been below thresholds considered harmful to marine biota. This, along with the analysis of infaunal community structure, provides strong empirical evidence that the sediments surrounding the outfall, along with the organisms that reside within them, have not been perceptibly impacted by the discharge, even after more than two decades of operation and monitoring.

5.4 PUBLIC HEALTH

Water recreation is an integral part of the environment near the City of Morro Bay and Cayucos. The ocean waters within the surfzone along Atascadero State Beach are frequently utilized by the public. To ensure that the public health is not being adversely affected by wastewater discharge, the MBCSD regularly samples the surfzone for coliform bacteria. Over the years, this surfzone monitoring has detected many instances of elevated levels of indigenous and enteric bacteria. However, these instances of elevated bacteria were unrelated to effluent discharged from the treatment plant. The plant disinfects all wastewater before it is discharged. Consequently, instances of elevated coliform densities measured in surfzone samples were generally much higher than the total coliform levels measured concurrently in effluent samples at the treatment plant. Moreover, effluent is discharged through a diffuser structure that rapidly mixes with seawater immediately upon discharge. This results in seawater concentrations that are less than 0.75% of the original contaminant concentrations measured within effluent. This occurs within 15 m of the discharge, which lies 0.5 miles from shore. There is little likelihood that effluent impinges on the adjacent shoreline half a mile away, especially considering that the prevailing flow is along the shoreline rather than towards the adjacent shoreline. Finally, the disinfected effluent is devoid of other bacterial pathogens. Tissues from mussels that were collected close to the outfall in 2003 and 2004 have been tested for a broad suite of bacterial pathogens, of which none were detected.

Instead, decades of monitoring have clearly demonstrated that non-point sources of microbial contamination have been responsible for the occasional measurements of elevated surfzone bacteria. Terrestrial, non-point-source bacterial contamination from runoff is a well-recognized problem along the coast of central and southern California because infrequent rains allow contaminants to build up during long dry spells. Non-point bacterial sources on the beach cause surfzone coliform levels to elevate when high surf entrains fecal material from seabirds and other animals that has accumulated in the supratidal zone following an extended period of low tide and surf. Accordingly, consistently high levels (>1600 MPN/100-ml) of total and fecal coliform organisms have been detected at the mouth of Morro Creek during periods of river outflow. Other areas of the beach seldom show elevated coliform levels, except during periods of rainfall or high surf. These well-recognized sources of surfzone coliform far outweigh any conceivable contribution from point-source discharges.

5.5 RECOMMENDATIONS

This annual report summarizes more than two decades of monitoring data. These data consistently demonstrate that the MBCSD WWTP has been operating as it was designed, and that the discharge of effluent has not adversely impacted the marine environment within Estero Bay. Although marked improvements to the monitoring program have substantially increased its capacity to detect minute environmental impacts, conclusions concerning the lack of impacts have continued to hold true into 2006. Many of the monitoring improvements were based on recommendations in early annual reports that were ultimately incorporated in the current NPDES discharge permit. Also, the accuracy of flow measurements markedly improved after the new influent flow meter was commissioned in 2001. Additional improvements to flow measurements were realized in 2003, after implementation of a 2002 recommendation to use adjusted effluent flow measurements when the influent flow meter was compromised.

In contrast to prior annual reports, most of the recommendations listed below deal with potential improvements to the monitoring program rather than with improvements to plant performance. The efficacy of the treatment process was at an all-time high in 2006. Consequently, many of the recommendations listed below arise from a review of the monitoring program that was conducted in 2003 (MRS 2003a).

Analysis of 2006 monitoring data further strengthens and confirms the veracity of the previous recommendations.

- **Eliminate acute toxicity bioassays.** With the RWQCB-directed change in analysis protocols in April 2003, acute bioassays no longer accurately reflect the actual toxicity of the MBCSD effluent. This is due to toxic ammonia deionization that occurs in test chambers and artificially increases measured toxicity levels. This deionization does not occur in the open ocean environment. The current version of the California Ocean Plan recognizes this inherent flaw in acute toxicity testing, and no longer requires acute toxicity tests in lieu of the more accurate chronic toxicity tests that the MBCSD already conducts on its effluent.

- **Reduce the frequency of effluent chemical analyses.** Most effluent chemical concentrations measured over the last two decades have been consistently well below NPDES discharge requirements. Given the historically high level of compliance, sampling on an annual basis or at longer intervals will sufficiently demonstrate continued compliance. This conclusion was demonstrated by a quantitative statistical assessment of historical contaminant measurements based on a Reasonable Potential Analysis using the methodology that is currently recommended by the SWRCB (MRS 2004b, MBCSD 2004).

- **Revise the benthic sampling program.** Station 1 should be eliminated from the suite of benthic monitoring stations. Its current location is too far north of the other monitoring stations to provide a representative control. Also, sampling at cross-shore stations (8 and 9) should be eliminated. Variation due to the depth differences at these stations unnecessarily confounds impact assessments. Finally, chemical analyses for synthetic organic compounds should be eliminated or reduced to once in the life of the permit. After more than two decades of monitoring, these compounds have not been detected in benthic sediments, and are rarely if ever detected in effluent samples. When they are detected, they are at extremely low concentrations. Unlike trace metals, these volatile compounds are not likely to preferentially accumulate in benthic sediments. In lieu of eliminating sampling at Stations 1, 8, and 9, triplicate chemistry samples should be collected composited at each of the remaining stations, rather than the single sample that is currently collected. This will enhance the stability and reliability of the measured chemical concentrations.

- **Eliminate the requirement for sulfide analysis of benthic samples.** High-resolution sulfide analyses have been performed on porewater samples on four separate sampling occasions beginning with the 2003 survey. None of the 36 samples contained detectable sulfide concentrations. Elevated sulfide concentrations in porewater are usually restricted to sheltered harbor and estuarine environments, where there is a high fraction of organic constituents within the sediments. Often these benthic environments are also hypoxic. This is not the case for the coarse sand sediments surrounding the MBCSD outfall, which are intensively reworked by waves and currents in the open ocean.

- **Revise the water-column sampling program.** Collecting vertical CTD casts at discrete stations is time consuming and does not provide sufficient lateral resolution to delineate the extremely limited extent of the effluent plume. The traditional vertical sections generated by adjacent CTD casts are of comparatively little use because they do not accurately characterize the effluent discharge, and can provide misleading impressions of the lateral extent of the discharge footprint. Even the closely spaced stations used in the current monitoring design are located too far apart to adequately delineate the highly localized effluent plume. In the current design, the distance between adjacent stations is at

the limit of the accuracy of available DGPS navigation. In contrast, the advantages of continuous horizontal sampling using a towed CTD have been demonstrated in past surveys. Revisions to the upcoming NPDES monitoring and reporting program for the MBCSD permit should eliminate all vertical CTD casts except those associated with a single along-shore transect. Wastewater is preferentially transported in an along-shore direction, and a single along-shore transect will adequately define the ambient vertical structure. Instead, a towed-CTD survey should be an added requirement. The towed survey should be conducted at two depth levels. One survey should be conducted immediately above the benthic boundary layer, approximately 5 m above the bottom. The other towed survey should be conducted in the upper water column, near the base of the shallow thermocline. Each should include at least five passes over the diffuser structure. Vessel speed and sampling rates should be adjusted to collect at least one sample for every meter traversed.

- **Specify water-quality limits applicable to wastewater constituents.** Chapter 3 of this report demonstrates that most discharge-induced changes in seawater properties are the result of the upward displacement of ambient bottom water. Generally, these discharge-related changes are not the result of the presence of dilute effluent constituents. Waste discharge requirements that are to be specified in the upcoming revisions to the NPDES discharge permit should distinguish between these two processes, as does the COP. The same constraints and limitations that apply to wastewater contaminants should not apply to ambient seawater that is simply moved to a different location within the water column.

- **Conduct surfzone monitoring only when effluent coliform is elevated.** Surfzone samples are heavily confounded by bacterial contamination from non-point sources, and lend no insight into discharge-related impacts to seawater quality, the efficacy of the treatment process, or the operational performance of the diffuser structure. Because effluent is disinfected, coliform densities are rarely detected within effluent samples themselves. Even if viable bacteria were not totally eliminated by disinfection, dispersion within the 15-m ZID would be enough to reduce concentrations below the detection limit. This has been confirmed by the absence of bacterial pathogens within mussel tissue collected within the ZID during 2003 and 2004. Even without the confounding influence of non-point source contamination, surfzone stations are located too far from the discharge to provide any insight into discharge-induced bacterial levels within receiving waters.

- **Actively continue to identify and eliminate sources of I&I in the collection systems of both the City of Morro Bay and the Cayucos Sanitary District.** Although substantial progress has been made in this regard since 2001, I&I continued to represent a significant portion of the wastewater processed by the plant in 2006. The City of Morro Bay Sewer Master Plan, adopted in May 2006, contains recommendations for additional pipeline-replacement projects and collection-system repairs. These recommendations will continue to be prioritized based on site-specific I&I contributions determined from flow testing, video inspections, and smoke tests. Implementation of these I&I reduction programs will result in several benefits to the treatment plant. First, implementation of I&I programs has the advantage of reducing total flow through the plant. These reductions will result in a more cost-effective use of the treatment process. For example, large flow events, such as major rainstorms, often require diversion of flow around the secondary process. Not only is disinfection and dechlorination of large volumes of relatively ‘clean’ stormwater and groundwater within the treatment plant an unnecessary use of chemicals and resources, but the increased total flows associated with such I&I events effectively decrease the proportion of wastewater that can receive full secondary treatment. Secondly, collection-system repairs that reduce I&I will also reduce the introduction of

unwanted contaminants into the wastewater stream. A case in point was the infiltration of gasoline-contaminated groundwater in 1999. In that case, local sewer-line repairs were directly responsible for eliminating hydrocarbon contamination from entering the wastestream.

CHAPTER 6

Literature Cited

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6.0 LITERATURE CITED

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APPENDIX A

Wastewater Treatment Plant Specifications

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Table A.1 WWTP Specifications

Parameter	Quantity
Waste Loading	
Flow (MGD)	
Average dry-weather flow	2.06
PSDWF	2.36
Peak dry-weather flow	6.64
PWWF	6.60
Strength	
BOD_5 (mg/L)	280
Suspended solids (mg/L)	280
Grit (ft^3/mg)	10
Waste quantities at PSDWF	
BOD_5 (mt/day)	2.5
Suspended Solids (mt/day)	2.5
Grit (ft^3/day)	23.6
Preliminary Treatment	
Mechanically cleaned bar screen	
Number	1
Capacity (MGD)	8.2
Channel Monster	
Number	1
Capacity (MGD)	7.0
Influent pumps (variable speed)	
Number	3
Capacity each (MGD)	3.3
Total head (m)	9.6
Aerated grit removal tanks	
Number	1
Length (m)	9.1
Width (m)	4.9
Depth (m)	2.4
Detention time at PWWF (min)	6.3
Grit Pumps	
Number	2
Capacity (gpm)	250
Primary Treatment	
Sedimentation tanks	
Number	2
Diameter (m)	
Tank 1	15.2
Tank 2	12.2
Average side water depth (m)	
Tank 1	2.74
Tank 2	2.74
Surface loading rate PSDWF (10^3 L/m^2/day)	29.74
Detention time at PWWF (hr.)	2.2
Total Treatment	
Overall treatment efficiencies (%)	
BOD_5	57
Suspended solids	75
Expected effluent quality (mg/L)	
BOD_5	120
Suspended solids	70
Solids stabilization	
Anaerobic digester loading (mt/day)	
Primary solids	1.6
Secondary solids	0.4
Assumed sludge volatile content (%)	
Primary solids	70
Secondary solids	82
Sludge volume (m^3/day)	50.7
Digester 1 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	4.9
Volume (m^3)	629
Digester 2 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	5.8
Volume (m^3)	725
Digester 3 (new, floating cover)	
Diameter (m)	10.7
Side water depth (m)	6.9
Volume (m^3)	646
Hydraulic detention time based on net volume of digesters 2 and 3 (days)	23
Assumed volatile solids reduction (%)	55
Expected sludge gas production (m^3/day)	804

Parameter	Quantity
Sludge drying beds	
Number	12
Length each (m)	49.4
Width each (m)	9.8
Solids Loadings (kg ft^{-1} yr^{-1})	78.3
Assumed removal efficiency (%)	
BOD_5	35
Suspended solids	65
Primary effluent quality (mg/L)	
BOD_5	182
Suspended solids	98
Secondary treatment	
Biofilters (existing, in partial secondary treatment mode of operation)	
Flow distribution at PSDWF (MGD)	
Biofilter 1	0.39
Biofilter 2	0.58
Diameter (m)	
Biofilter 1	18.3
Biofilter 2	21.3
Net media surface area (m^2)	
Biofilter 1	262
Biofilter 2	350
Average media height (m)	
Biofilter 1	1.4
Biofilter 2	1.5
Media Volume (m^3)	
Biofilter 1	360
Biofilter 2	532
Specific organic loading rate (lbs BOD_5/day/1000 ft^3)	47
Circulated flow (MGD)	
Biofilter 1	1.37
Biofilter 2	2.04
Hydraulic loading rate (gpm/ft^2 media surface)	
Biofilter 1	0.34
Biofilter 2	0.38
Circulation pumps	
Biofilter 1	
Capacity (gpm)	950
Total head (m)	3.4
Biofilter 2	
Capacity (gpm)	1420
Total head (m)	4.3
Stand-by (2-speed)	
Capacity (gpm)	960 1660
Total head (m)	3.4 4.4
Interstage pumping	
Biofilter effluent pumps (variable speed)	
Number	2
Capacity each (gpm)	2300
Total head (m)	8.2
Secondary sedimentation tanks	
Number	1
Diameter (m)	16.8
Tank surface area (m^2)	221
Tank volume (m^3)	3125
Average water depth (m)	4.6
Overflow rate at PSDWF (10^3 L/m^2/day)	16.6
Expected secondary treatment effluent quality (mg/L)	
BOD_5	30
Suspended Solids	30
Chlorination	
Chlorine contact tank (existing)	
Number of passes	2
Length (m)	
Pass 1	16.8
Pass 2	22.9
Width each pass (m)	4.6
Average depth (m)	2.3
Total volume (m^3)	413
Detention time at PDWF (min)	24
Chlorinators	
Pre-chlorinator	
Number	1
Initial capacity (kg/day)	227.3
Ultimate capacity (kg/day)	909.1
RAS chlorinator	
Number	1
Capacity (kg/day)	227.3
Ultimate capacity (kg/day)	90.9
Sodium Hypochlorite Post Chlorinator	
Chemical feed pumps	3
Combined Capacity (kg/day)	5450
Dechlorination	
Sodium Bisulfite System	
Chemical feed pumps	3
Combined Capacity (kg/day)	1226

APPENDIX B

Quality Assurance and Quality Control Plans

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QUALITY ASSURANCE/QUALITY CONTROL

Government organizations and respected contract research facilities now require specific Quality Assurance Programs and Plans for all scientific research efforts. Marine Research Specialists (MRS), without exception, abides by these requirements and has integrated Quality Assurance procedures in their normal course of scientific investigations. We pride ourselves on excellence and objectivity in research, and we support that pride with Quality Assurance and Quality Control procedures, which are documented by SOP's. These procedures have been developed through the years in support of major environmental programs for clients such as the U.S. Environmental Protection Agency, U.S. Department of Commerce (NOAA), and the U.S. Department of the Interior (Minerals Management Service).

The quality assurance procedures for work undertaken in this program meet all MRS requirements for assuring the reliability of monitoring and measurement data. This level of QA/QC is also applicable to all subcontractors working on this monitoring program under the direction of MRS. The procedures form an integrated program for assuring complete, accurate, precise, and representative data under defined requirements. Our general quality assurance requirements are discussed below.

Program Management. The basis of any sound QA/QC program resides with the Program Manager. He ensures that monitoring program activities, client-approved changes in scope, and progress are well documented throughout the duration of the monitoring program. He also ensures that specific QA/QC documentation such as field observation logs, sampling logs (separate logs are maintained for water, sediment and infauna samples), and sample transfer forms are properly and accurately recorded and maintained. It is important to note that each and all samples maintain unique sample codes throughout the sample collection, analyses, and reporting phases of the monitoring program.

The Program Manager, Dr. Douglas A. Coats, also conducts QA/QC reviews of our subcontractors, BC Laboratories and Aquatic Testing Laboratories, to ensure that their QA/QC procedures, described on the following pages are adhered to. They are promptly notified of any deviation and the need for corrective action.

Field Sampling. All field sampling equipment is calibrated according to manufacturer's specifications. Logs are maintained for the Sea-Bird SBE-19 Seacat CTD Profiler with the number of casts and cast locations recorded. Calibration results are also recorded into the log. Periodically, the CTD is returned to the manufacturer for a complete bench testing and calibration. The CTD was factory calibrated and fully tested at the Sea Bird Testing Facility in November 1999 and again in October 2001.

The Van Veen sediment grab sampler and subsamplers are cleaned with noncontaminating solvents between all collections of sediment chemistry samples. The solvents include methanol for the removal of organics and de-ionized water and HCl for the removal of metals. The grab sampler and sediment subsamplers such as scoops, are coated with noncontaminating Dykor® to limit contamination of chemistry samples from the sampling equipment. Similarly, all sediment sample containers are pre-cleaned and acid washed accorded to USEPA specifications. The grab sampler was recoated with Dykor® in September 1999.

Laboratory Analysis. QA/QC procedures are also used in the laboratory for grain-size analysis and sorting benthic infauna samples. A minimum of 10 percent of all samples sorted by any one technician are resorted by another technician. The level of sorting error must not exceed five percent (i.e. the sample

residue that is resorted by another technician must not contain more than five percent of the total number of organisms contained in the original sample). Additionally, all samples sorted by a technician who is in the process of being trained are subject to quality control inspection. A technician is considered a trained sorter if they pass quality control inspection in five consecutive samples. Ms. Bonnie Luke is currently the lead technician for MRS for both grain-size analysis and benthic sample sorting.

Independent QA/QC Audit. In addition to the QA/QC auditing performed by the Program Manager, an independent semi-random audit on project performance is conducted by Ms. Bonnie Luke. Ms. Luke reviews all reports for completeness, thoroughness, accurateness, and errors. She also performs periodic unannounced audits on monitoring program status and additionally, calls or meets independently with the Public Works Department's project officer for an evaluation of our performance.

Subcontracted Laboratories. The following Quality Assurance guidelines and methods for subcontractor laboratories are excerpts from the full Quality Assurance Manuals of BC Laboratories and Aquatic Testing Laboratories. The full QA documents are too voluminous to provide in complete form in this annual report but are on file at MRS. BC Laboratories of Bakersfield California, performed the chemical analyses for treatment plant effluent and sludge and the offshore sediments. Aquatic Testing Laboratories of Ventura analyzed the effluent for acute and chronic toxicity levels.

2006

Morro Bay / Cayucos Wastewater Treatment Plant

LABORATORY QUALITY ASSURANCE MANUAL

Updated 3-30-06

Bruce Keogh, Lab Director_____Date:_____

Mydocuments/LabQCdocs/LabQCtitlepage.doc

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INTRODUCTION

The Morro Bay – Cayucos Wastewater Treatment Plant Laboratory provides analytical services for the Morro Bay – Cayucos Wastewater Treatment Plant located at 160 Atascadero Road, the mailing address is 955 Shasta, Morro Bay, CA.

The laboratory analyzes samples of wastewater effluent, influent, and sludges on a daily, weekly, or monthly basis for physical parameters. Microbiological samples are analyzed daily, weekly, and monthly.

The laboratory only analyzes samples from the Morro Bay – Cayucos Wastewater Treatment Plant. The laboratory does not accept samples for analysis from outside sources.

There are currently two positions in the laboratory, the Laboratory Director and the laboratory analyst.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION IX, SAN FRANCISCO, CA

MONITORING AND REPORTING PROGRAM NO. 98-15
FOR
CITY OF MORRO BAY AND CAYUCOS SANITARY DISTRICT
WASTEWATER TREATMENT PLANT
SAN LUIS OBISPO COUNTY

The monitoring program for a discharger receiving a 301(h) modified National Pollutant Discharge Elimination System (NPDES) permit is intended to: a) document short and long-term effects of the discharge on receiving waters, sediments, biota, and on beneficial uses of the receiving water; b) determine compliance with NPDES permit items and conditions; and c) assess the effectiveness of industrial pretreatment and toxics control programs.

The Regional Water Quality Control Board (Regional Board) and U.S. Environmental Protection Agency, Region IX (EPA) may revise revise the monitoring program presented herein, within the specified order and permit period. The program will be reviewed at annual intervals to assess its effectiveness at meeting the objectives stated above. If predictable relationships among effluent, water quality and biological monitoring variables can be clearly demonstrated, it may be appropriate to decrease certain elements of the monitoring program. Conversely, the monitoring program may be intensified if it appears that the above objectives cannot be achieved through the existing monitoring program.

INFLUENT MONITORING

Representative samples of influent to the treatment plant shall be collected (upstream of any in-plant return flows) and analyzed as follows:

Constituent	Units	Sample Type	Minimum Frequency Sampling/Analysis
BOD_5 (20°C)	mg/l	24-hr Composite	Weekly
Suspended Solids	mg/l	24-hr Composite	Weekly

Influent flow metering shall be required if the Executive Officer determines such monitoring is necessary to identify sources of noncompliance with this Order.

EFFLUENT MONITORING

Representative effluent samples shall be collected (downstream of any inplant return flows or disinfection units) and analyzed as follows:

Constituent	Units	Sample Type	Minimum Frequency Sampling/Analysis
Daily Flow	MG	Metered	Daily
Maximum Daily Flow	MGD	Metered	Daily
Mean Daily Flow	MGD	Calculated	Monthly
Total Chlorine Residual		Grab	Daily
Chlorine Used	lbs/day	Recorded	Daily
Total Coliform	MPN	Grab	5 days/week)[1]
Temperature	°C	Grab	5 days/week)
Turbidity	NTU	Grab	5 days/week)
BOD_5 (20°C)	mg/l	24-hr Composite	Weekly'
Suspended Solids	mg/l	24-hr Composite	Weekly'
pH	pH units	Grab	Weekly"
Settleable Solids	ml/l	Grab	Weekly
Grease and Oil	mg/l	Grab	Weekly
Acute Toxicity	TUa	Grab	Quarterly (Jan/Apr/July/Oct)
Chronic toxicity	TUc	24-hr Composite	Semi-annually (Jan/July)
Ammonia (as N)	mg/l	Grab	Monthly
Phenolic Compounds (non-chlorinated)	mg/l	Grab	Semi-annually
Chlorinated Phenolics	mg/l	Grab	Semi-annually

If results of monitoring a constituent appear to violate effluent limitations based on a weekly, monthly, 30-day, or six-month period, but compliance or non-compliance cannot be validated because sampling is too infrequent, the frequency of sampling shall be increased to validate the test within the next monitoring period. The increased frequency shall be maintained until the Executive Officer agrees the original monitoring frequency may be resumed, as stated in B.2 of the Standard Provisions and Reporting Requirements.

FOOTNOTES:

1. Sampling shall be arranged so that each *day* of the 7-day week is represented, at least once, each month, or every two (2) months for weekly sampling. For samples collected 5 times per month, at least one (1) sample shall be taken weekly, and sampling should be arranged so that each day of the 7-day week is represented, at least once, every two (2) months.

   Dischargers may at their option meet this limitation as total chromium limitation.

3. ENDOSULFAN shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

4. HCH shall mean the sum of the alpha, beta, gamma (lindane), and delta isomers of hexachlorocyclohexane.

5. DICHLOROBENZENES shall mean the sum of 1,2- and 1,3-dichlorobenzene.

6. CHLORDANE shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane.

7. DDT shall mean the sum of 4,4-DDT, 2,4-DDT, 2,4-DDE, 4,4-DDD, and 2.4-DDD.

8. HALOMETHANES shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride), chlorodibromomethane, and dichlorobromomethane.

9. HEPTACHLOR shall mean the sum of heptachlor and heptachlor epoxide.

10. PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene, and pyrene.

11. PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Ardor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Amlor-1260.

12. TCDD EQUIVALENTS shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors. as shown below:

Isomer Group	Toxicity Equivalent Factor	Isomer Group	Toxicity Equivalent Factor
2,3,7,8-tetra CDD	1.0	1,2,3,7,8-penta CDF	0.05
2,3,7,8-penta CDD	0.5	2,3,4,7,8-penta CDF	0.5
2,3,7,8-hexa CDDs	0.1	2,3,7,8-hexa CDR	0.1
2,3,7,8-hepta CDD	0.01	2,3,7,8-hepta CDFs	0.01
octa CDD	0.001	octa CDF	0.001
2,3,7,8-tetra CDF	0.1		

13. Mass emission based on detectable concentrations.

14. Mass emission based on Table B effluent limit concentrations listed in the Order No. 98-15.

This certifies that the foregoing is a full, true and correct copy of an order adopted by the California Regional Water Quality Control Beard, Central Coast Region, on December 11, 1998, and of a NPDES permit issued by the U.S. Environmental Protection Agency, Region IX, on 26 January, 1999

ROGER W. BRIGGS, Executive Officer
California Regional Water Quality Control Board
Central Coast Region

ALEXIS STRAUSS, acting Water Division Director for
FELICIA MARCUS, Regional Administrator
U.S. Environmental Protection Agency
Region IX

SJM\H:\npdes\mb301h.mrp

Quality Assurance Objectives

The role of the analytical laboratory is to provide qualitative and quantitative data to be used in decision making. To be valuable, the data must accurately describe the characteristics or the concentration of constituents in the sample submitted to the laboratory. In many cases, an approximate answer or incorrect result is worse than no answer at all, because it will lead to faulty interpretations.

Decisions made using data from water and wastewater are far reaching. Water quality standards are set to establish satisfactory conditions for a given water use. The laboratory data define whether that condition is being met, and whether the water can be used for its intended purpose. If the laboratory results indicate a violation of the standard, action is required on the part of pollution control authorities. With the present emphasis on legal action and social pressures to abate pollution, the analyst should be aware of his or her responsibility to provide laboratory results that are a reliable description of the sample. Furthermore, the analyst must be aware of his or her professional competence, the procedures he or she has used, and the reported values may be used and challenged in court. To satisfactorily meet this challenge, the laboratory data must be backed up by an adequate program to document the proper control and application of all of the factors which affect the result.

In wastewater analyses, the laboratory data define the treatment plant influent, the status of the steps in the treatment process, and the final load imposed upon the water resources. Decisions on process changes, plant modification, and even the construction of a new facility is based upon the results of laboratory analysis.

Research investigations in water pollution control rest upon a firm base of laboratory data. The final result sought can usually be described in numerical terms. The progress of the research and the alternative pathways available are generally evaluated on the basis of laboratory data. The value of the research effort will depend on the validity of laboratory results,

Because of the importance of laboratory analyses and the resulting actions that they produce, a program to ensure the reliability of the data is essential. It is recognized that all analysts practice quality control to varying degrees, depending somewhat upon their training, professional pride, and awareness of the importance of the work they are doing. An established, routine control program applied to every analytical test is important in assuring the reliability of the final results.

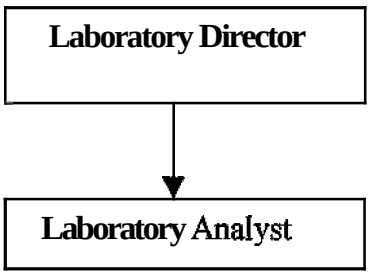
The Quality Control Program in the laboratory has two primary functions. First, the program should monitor the reliability or truth of the results reported. It should continually provide an answer to "How good or true are the results submitted?" This phase may be a "measurement of quality." The second function is the control of the quality in order to meet the program requirements for reliability. For example, the processing of spiked samples is the measurement of quality, while the use of analytical grade reagents is a control measure. Just as each analytical method has a rigid protocol, so the quality control associated with that test must also involve definite required steps to monitor and assure that the result is correct. Ideally, all of the variables, which can affect the final answer should be considered, evaluated, and controlled.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

PROGRAM ORGANIZATION AND RESPONSIBILITY

The responsibility for the Quality Control Program lies with the Laboratory Director who collects, interprets, and reviews all the data from various quality control measures taken in the laboratory. It is the responsibility of *this* Quality Control official to make sure that each analyst in the laboratory is performing their duties of quality control measures and proper documentation of sample collection, preservation and analyses. It is therefore requested that all laboratory employees read this Quality Assurance Manual and become familiar with all the quality control terminology, methodology, and procedures. Without exception, the final responsibility for the reliability of the analytical results rest with the Laboratory Director.

The Morro Bay – Cayucos Wastewater Treatment Plant Laboratory is organized as follows:



Responsibilities *for* each position in the Morro Bay – Cayucos Wastewater Treatment Plant Laboratory are as follows:

Laboratory **Director**

The managerial, administrative, and supervisory level position for the laboratory is responsible for the planning, implementation, and supervision of the laboratory testing and water quality control programs to comply with local, State, and Federal standards. Supervisory duties include making assignments of work, setting priorities, training and inspecting work, selection of employees, preparing performance evaluations and recommending recognition and disciplining of subordinates.

Laboratory Analyst

The chemist level position for the laboratory is responsible for the physical, chemical, and biological testing of water, wastewater, and sludges. Additional responsibilities include sampling and cleaning and preparing laboratory glassware. Analyses include pH, turbidity, total chlorine residual, suspended solids, BOD, oil & grease, volatile acids, alkalinity, and total and fecal coliforms. Assisting in the training and supervision of other laboratory analysts, assigning, instructing, monitoring, and correcting work.

Bruce **Keogh,** Lab Director Bruce Keogh Date: 1-31-05

LABORATORY GENERAL PROCEDURES

There are some standard operating procedures that all laboratories have to ensure that procedures are performed the same way by each analyst and are a form of Quality Control.

Glassware

1. After dumping sample, rinse with water and apply FL70 detergent located at sink. Scrub or brush unit until all of sample has been removed from glassware. Glassware should then be rinsed at least three times with hot water. After rinsing with tap water, rinse again with DI water. Dry glassware is ready for use. Note: If there is a change in the formulation used, or a change in the method of washing a glassware inhibitory residue test must be performed.
2. Broken, cracked, or chipped glassware is to be discarded.

Sample Custody

1. Sample bottles are labeled either prior to sampling by the lab or during sampling by the sampler.
2. Chain of Custody sheets, filled out completely, must accompany all samples sent to other laboratories for analysis.
3. A copy of Chain of Custody sheets are kept in a separate file in the laboratory file cabinet.

Quality Control

1. Use volumetric glassware and pipettes for all analyses.
2. Label all reagents with name, date, and expiration.
3. Record all temperatures of lab equipment on a daily basis.
4. Keep the laboratory benchtops, floors, and instruments neat and clean.
5. Double check your calculations or have them checked by another analyst.
6. Standards should reflect a high and low value, with the sample close to the middle standard.
7. Rerun any questionable sample results to verify your analyses.

Safety Practices

1. Be familiar with the Material Safety Data Sheets (MSDS) for my chemical you are working with.
2. Do not pipette liquids by mouth.
3. Wear safety glasses when working with strong acids or bases.
4. Wear a lab coat or apron when working in the lab.
5. Use the fume hood to vent hazardous materials.
6. Wipe up any spills on the floors or counter tops immediately.
7. If a large chemical spill occurs use the chemical spill kit.
8. Know where the fire blanket, extinguishers, and showers are located.
9. No eating, drinking, or smoking is allowed in the lab.

10. Wear gloves and then wash hands after working with sewage, sludge, coliform bacteria, or any chemical.
11. Clean up your glassware from your work area when done & wipe counters.
12. Return any chemicals used to the chemical storage area.
13. Try to predict any safety hazards you will encounter before performing a task.
14. Inform the supervisor of any accident or injury immediately.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

PREVENTATIVE MAINTENANCE

Since instrumentation is heavily relied upon in the laboratory it must be kept clean and well maintained. A computerized work order program, Datastream MP2 Access, is used to schedule and record all preventative maintenance procedures performed on turbidimeters, dissolved oxygen meters, composite samplers, ovens, autoclave, waterbaths, analytical balances, and pH meters. Calibration records of all instruments are also kept in the appropriate folders in the laboratory file cabinet.

Distilled Water: Distilled water is used in the laboratory for dilutions and final rinsing of glassware. We currently use bottled, distilled water from Arrowhead. The water quality is tested and assured from the distributor, a copy of the results are located in the laboratory file cabinet.

Analytical Balances: The laboratory balances are cleaned and serviced annually by a balance technician.

Temperature Logs: Temperature logs are kept on all ovens, incubators, refrigerators, and water baths. Temperatures are recorded twice daily or when in use. Thermometers are compared annually against a certified National Bureau of Standards thermometer and recorded on the temperature logs. Thermometers are also labeled with any corrective factor.

Composite Samplers: Composite samplers have tubing for the sample line and the peristaltic pump. This tubing needs to be cleaned every two weeks due to algae growth. The tubing must be replaced when cracked or worn. Dessicant, inside the control box of the sampler needs to be changed whenever indicator turns pink.

Turbidimeter: The Hach 2100N Turbidimeter needs to be cleaned and serviced per the manufacturers recommendations.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

SYSTEM AUDITS

The laboratory participates annually in the National Pollutant Discharge Elimination System (NPDES) DMR-QA Laboratory Performance Evaluation sponsored by the U.S. Environmental Protection Agency. The samples are purchased from a list of accredited providers and the samples are analyzed along with the lab's regular samples and the results are reported. The accredited provider submits a report to the laboratory and the USEPA that notes whether sample results were acceptable or unacceptable, Any sample result receiving a not acceptable report requires a letter of corrective action be submitted to the State coordinator for USEPA within the specified time period.

The laboratory applies for certification with the California State Department of Health Services every two years as part of their Environmental Laboratory Accreditation Program (ELAP). The laboratory participates in Water Pollution Laboratory Performance Evaluation Studies (WP) for chemistry and microbiological samples on an annual basis. The samples are purchased from a list of accredited providers and the samples are analyzed along with the lab's regular samples and the results are reported. The accredited provider submits a report to the laboratory and to ELAP that notes whether sample results were acceptable or unacceptable. Any sample result receiving a not acceptable report requires a letter of corrective action be submitted to ELAP within the specified time period.

An additional requirement for the State Department of Health Services ELAP certification is a site visit and inspection of the laboratory every two years. The results of the visit and any deficiencies noted are sent back to the lab to be corrected.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

SAMPLING POINTS AND TECHNIQUES

Sampling is a very important part of analysis. It should always be done with great consistency at the same point and the same technique should always be employed *to* insure a representative sample. Because of the importance of this subject sample, it is necessary to have outlined procedure and set points for obtaining various samples for analysis.

Sample containers can greatly affect the constituent to be determined. Cations can absorb readily on some plastics and glassware. Metal or aluminum foil cap liners can interfere with metals analyses. How the sample containers are washed and cleaned are also a significant factor in quality control.

All samples should be refrigerated while they are being transported to the laboratory. If the samples cannot be analyzed immediately they should be refrigerated and analyzed as soon as possible. The following page contains our guidelines for sample containers, preservative used and the holding times for most of the samples we pull for analysis by the Morro Bay – Cayucos Wastewater Treatment Plant laboratory or a contract laboratory.

It is essential to ensure sample integrity from collection to data reporting. This includes the ability to trace possession and handling of the sample from the time of collection through analysis and final disposition. This is referred to as chain of *custody* and is important in the event of litigation involving the analytical results. Where litigation is not involved, chain of custody procedures are useful for routine control of sample flow. Samples that come into the laboratory on a daily basis do not need a chain of custody, but are logged into the laboratory workbook.

A sample is considered to be under a person's custody if it is in the individual's physical possession, in the individual's sight, secured in a tamper proof way by that individual, or is secured in an area restricted to authorized personnel.

All composite samples of final effluent should be collected from the Sigma 900 refrigerated automatic composite sampler currently located on top of the chlorine contact chamber. The sampler should be pre-set according to manufacturer instructions located in the filing cabinet in the laboratory. The effluent grab samples are obtained from the air relief structure, located downstream from the chlorine contact chamber.

If bacteriological samples are needed from the plant final effluent then samples should be collected at the discharge end of the chlorine contact chamber, using sterile sample bottles containing sodium thiosulfate which de-chlorinates the sample.

Influent *samples* are taken at the headworks and again a Sigma 900 refrigerated automatic composite sampler is employed for obtaining composite samples.

Digester sludge samples are obtained at the valve manifold for each digester. They are all marked and samples can be obtained from any elevation desired. Close

attention should be given to flushing the line by opening the valve and letting the old sludge in the line to run for at least two minutes. Then grab the sample.

Grab samples of mixed liquor suspended solids and return activated sludge are obtained at the south end sf the solids contact channel and in the return sludge box respectively on the top of the secondary clarifier.

Samples of primary clarifiers are obtained by holding a beaker or container close to the weirs, where the primary process water is being discharged over the weirs. Samples of trickling filters are collected at the wet well next to them.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/samplepoints&techniques.doc

Sludge Monitoring

Maintain a record of the volume of solids generated and disposal sites used.

A. SURF ZONE MONITORING

Station Locations

(see attached Station Location Map)

Shore Stations	Description
A1	Surf, 1700 meters (5600') upcoast of Station C
A	Surf, 610 meters (2000') upcoast of Station C
B	Surf, 305 meters (1000') upcoast of Station C
C	Surf, at point closest to outfall diffuser
D	Surf, 305 meters (1000') downcoast of Station C
E	Surf, 610 meters (2000') downcoast of Station C
F	Surf, 1520 meters (5000') downcoast of Station

Grab samples shall be taken at all shore stations weekly during summer months (May-October) and monthly during winter months (November-April). Samples shall be analyzed for fecal and total coliform orgaaisms.

Monitoring shall include observations of wind (dircction and speed), weather (e.g., cloudy, sunny, rainy). waves, longshore currents (e.g., direction), and tidal conditions (e.g., high, slack, or low tide), Observations of water discoloration, floating oil and grease, turbidity, odor and materials of sewage origin in the water or on the beach shall be recorded. The water temperature (°C) shall also be recorded. The sample shall be collected as far seaward within the surf zone as possible,

CITY OF MORRO BAY WWTP
CHAIN OF CUSTODY

Project Name:	Date:
Project Mngr:	Page_____ Of_____
City of Morro Bay	Special Instruction's:
160 Atascadero Rd.	
Morro Bay, Ca. 93442	
Phone # *805-772-6273*	

Sample I.D.	Date	Time	Analysis Requested	Remark's

Relinquished/ Received By:	Date	Time	Firm/City	Signature:

SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT (1)

Measurement	Container	Preservative	Holding Time (6)
Acidity	P,G (2)	Cool, 4°C	24 Hours
Alkalinity	P,G	Cool, 4°C	24 Hours
BOD	P,G	Cool, 4°C	6 Hours (3)
COD	P,G	H_2SO_4 to pH 2	7 Days
Chloride	P,G	None Req.	7 Days
Chlorine Resid.	P,G	Det. on site	No Holding
Color	P,G	Cool, 4°C	24 Hours
Dissolved Oxygen			
Probe	G only	Det. on site	No Holding
Winkler	G only	Fix on site	No Holding
Hardness	P,G	Cool, 4°C	7 Days
MBAS	P,G	Cool, 4°C	24 Hours
Nitrogen			
Ammonia	P,G	Cool, 4°C H_2SO_4 to pH 2	24 Hours (4)
Kjeldahl	P,G	Cool, 4°C H_2SO_4 to pH 2	24 Hours (4)
Nitrate	P,G	Cool, 4°C H_2SO_4 to pH 2	24 Hours (4)
Nitrite	P,G	Cool, 4°C H_2SO_4 to pH 2	24 Hours (4)
Oil & Grease	G only	Cool, 4°C H_2SO_4 to pH 2	24 Hours
Organic Carbon	P,G	Cool, 4°C H_2SO_4 to pH 2	24 Hours
pH	P,G	Cool, 4°C Det. on site	6 Hours (3)

Measurement	Container	Preservative	Holding Time (6)
Residue			
Filterable	P,G	Cool, 4°C	7 Days
Non-filterable	P,G	Cool, 4°C	7 Days
Total	P,G	Cool, 4°C	7 Days
Volatile	P,G	Cool, 4°C	7 Days
Settleable-Matter	P,G	None Req.	*24* Hours
Specific-Conductance	P,G	Cool, 4°C	24 Hours (5)
Sulfide	P,G	2 ml zinc acetate	24 Hours
Temperature	P,G	Det. on site	No Holding
Threshold Odor	G only	Cool, 4°C	*24* Hours
Turbidity	P,G	Cool, 4°C	7 Days

1. A general discussion on sampling water and industrial wastewater may be found in ASTM, part; 23, p. *72-97* (1973)

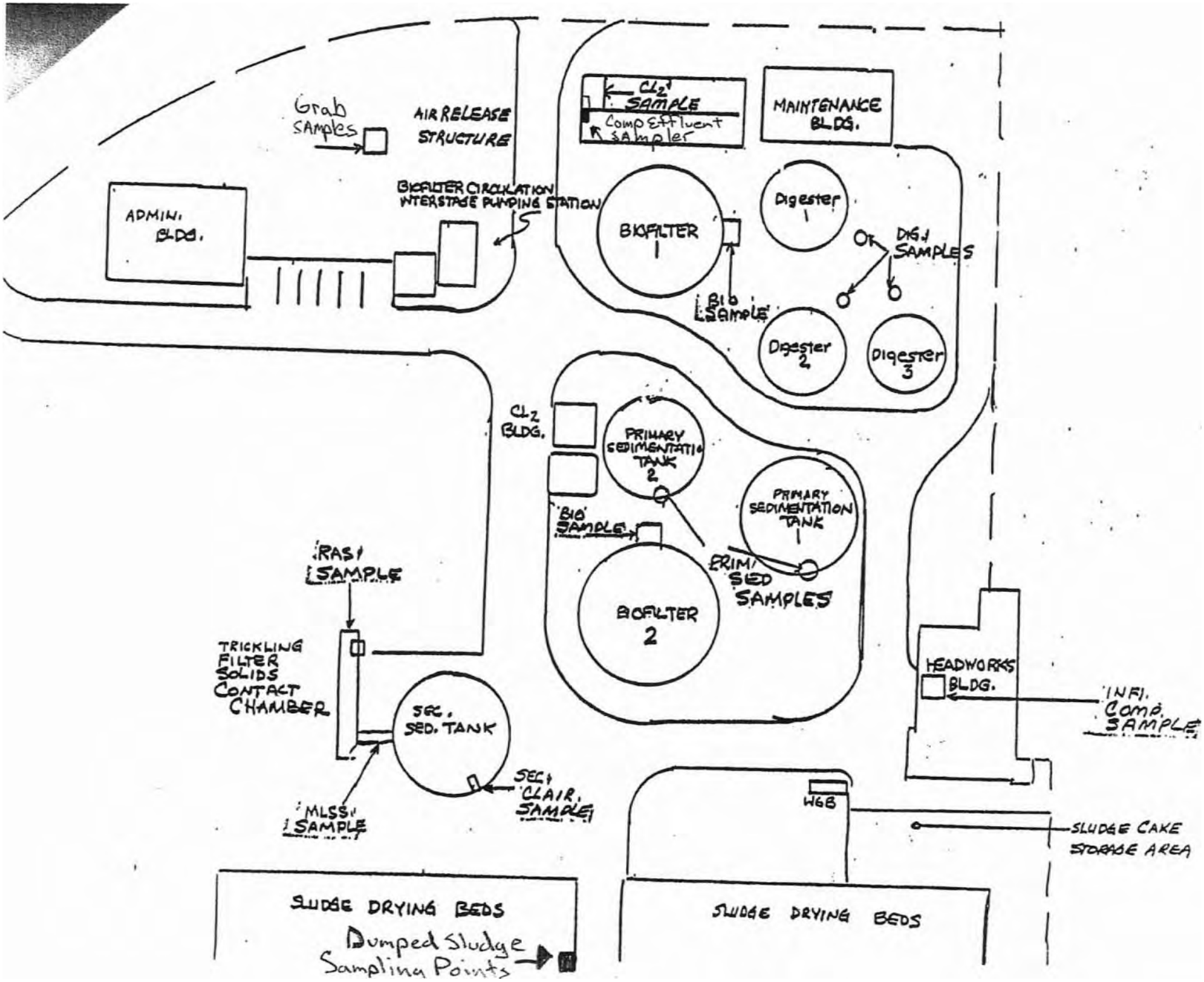
2. Plastic or Glass

3. If samples cannot be returned *to the* laboratory *in* less than *6* hours and holding time exceeds this limit; the final reported data should indicate the actual holding time.

4 Mercuric chloride may be used as an alternate preservative *at* a concentration *of* 40 mg/l, especially *if* a longer holding time is required*

5. If the sample is stabilized by cooling, it should *be* warmed *to* 25°C for reading, *or temperature* correction made and result reported *at* 25°C.

6. *It* has been shown that samples properly preserved may be held for extended periods beyond *the* recommended holding time.


Grab samples
AIR RELEASE STRUCTURE
Cl_2 SAMPLE
Comp Effluent Sampler
MAINTENANCE BLDG.
ADMIN. BLDG.
BIOFILTER CIRCULATION INTERSTAGE PUMPING STATION
BIOFILTER 1
Digester 1
DIG. SAMPLES
Bio Sample
Digester 2
Digester 3
Cl_2 BLDG.
PRIMARY SEDIMENTATION TANK 2
PRIMARY SEDIMENTATION TANK 1
Bio Sample
PRIM. SED SAMPLES
BIOFILTER 2
RAS SAMPLE
TRICKLING FILTER SOLIDS CONTACT CHAMBER
SEC. SED. TANK
SEC. CLAR. SAMPLE
MLSS SAMPLE
HEADWORKS BLDG.
INFL. Comp. SAMPLE
WGB
SLUDGE CAKE STORAGE AREA
SLUDGE DRYING BEDS
Dumped Sludge Sampling Points
SLUDGE DRYING BEDS

ANALYTICAL METHODS

The following methods are used by the Morro Bay – Cayucos Wastewater Treatment Plant Laboratory and taken from Standard Methods for *the* Examination of Water and Wastewater, 18th Edition.

Analysis	Method No.
pH	SM4500-H+B
Turbidity	SM2130B
Total Chlorine Residual	SM4500-Cl G
Total Suspended Solids	SMSM2540D
BOD	SMSM5210B
Oil & Grease	SM5520B
Total Coliform	SM9221B
Fecal Coliform	SM9221E
Volatile Acid	SM5560C
Alkalinity	SM2320A
Settleable Solids	SM2540F

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

CALIBRATION PROCEDURES AND FREQUENCY

All laboratory instruments are to be calibrated prior to or during use. Instruments require calibration, standardization and informed observation to work accurately.

The pH meter is calibrated daily during lab open up using pH 4, 7, and 10 buffers. Refer to the standard operating procedures (SOP) for pH.

The turbidimeter is checked daily against secondary standards, and calibrated quarterly using primary standards. Refer to the standard operating procedures (SOP) for the turbidimeter.

The analytical balances are calibrated annually by an independent company (Wine Country Balance, Sonoma, CA). Refer to the standard operating procedures (SOP) for the balances.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Lab/C/My Documents/Lab QC Docs/Lab QA Updates December 2004/Calibration Procedures and Frequency

Data Reduction, Validation, and Resorting

Significant Figures:

A significant figure is a digit that denotes the amount of *the* quantity in the particular decimal place in which it stands. Reported analytical values should contain only significant figures. A value is made up of significant figures when it contains all digits known to be true and on the last digit in doubt. For example, if a value is reported as 18.8 mg/L, the 18 must be firm while the 0.8 is somewhat uncertain, but presumably better than one of the values 0.7 or 0.9 would be.

The number zero may or may not be a significant figure depending on the situation. Final zeros after a decimal point are always meant to be significant figures. Zeros before a decimal point with non-zero digits preceding them are significant. With no preceding non-zero digit, a zero before the decimal point is not significant. If there are no non-zero digits preceding a decimal point, the zeros after the decimal point but preceding other non-zero digits are not significant. These zeros only indicate the position of the decimal point.

Rounding Off:

Round off by dropping digits that are not significant. If the digit 6, 7, 8, or 9 *is* dropped, increase the preceding digit by one unit. If the digit 1, 2, 3, or 4 is dropped, do not alter the preceding digit. If the digit 5 is dropped, increase the preceding digit by one if it is an odd number, or keep it unchanged if it is an even number.

Calculations:

As a practical operating rule, round off the result of a calculation in which several numbers are multiplied or divided to as few significant figures as are present in the factor with the fewest significant figures. When numbers are added or subtracted, the number that has the fewest decimal places, not necessarily the fewest significant figures, puts the limit on the number of places that justifiably may be carried in the sum or difference.

Data Reduction, Validation, and Reporting Cont

Data Validation:

The data is reviewed and checked by *the* analyst. The analyst will review all raw data and calculations to insure that the *QC* criteria has been met. The raw data, sample run sheet, and all other paperwork associated with the job are kept in the individual analyses notebooks for supervisor review. If the data is acceptable, then a report will be generated by the Laboratory supervisor.

The review of the data will include the following checks.

a. Were the correct samples analyzed for the correct analyses as documented on the chain of custody form?
b. Was the instrument properly calibrated?
c. Was the holding time of the samples prior to analysis within acceptable limits?
d. Are results calculated correctly after dilutions?

If there is a question to the validity of the analyses, then the sample is re-run by the analyst to verify. If the results are still in question after the second analyses, then they are declared invalid and the sampler is contacted to provide a second sample to the laboratory. All final reports are reviewed and signed by the Laboratory supervisor. All NPDES and EPA reports to the Regional Water Quality Control Board are also reviewed and signed by the Lab Manager. All lab data sheets and recorder charts are kept and stored at the wastewater treatment plant.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Maintenance of Laboratory Supplies

Standard Mdhods 18th Edition, Page 9-3 to 9-5 section 9020 B

Monitoring Pure Water Quality:

At this time, laboratory distilled water (DI water) is purchased from an independent company (Arrowhead). Copies of analysis of purchased water are requested from the company. Copies of the monthly and annual analytical results are on file in the laboratory file cabinet. To perform analysis for quality of purified water used in bacteriological testing, refer to Standard Methods 18th Edition, Page 1-32,33 section 1080 A, B, & C.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

Mydocuments/LabQCdocs/maintenanceoflabsupplies.doc

ARROWHEAD
MOUNTAIN SPRING WATER

ARROWHEAD DISTILLED WATER

QUALITY OF PURIFIED WATER USED IN MICROBIOLOGY TESTING

The Arrowhead distilled water described below meets all reagent grade water requirements by the California Department of Health Services as listed in Standard Methods for the Examination of Water and Wastewater. 19th Edition. 1995.

ANNUAL SUITABILITY - 2003

Production Location: Los Angeles **Production Date:** March 11, 2003

TEST DESCRIPTION	TEST RESULT
Conductivity	1.4 µmhos/cm
pH	5.60
Total Organic Carbon	< 0.5 mg/L
Heavy Metals:	
Cadmium, Cd	< 0.001 mg/L
Chromium, Cr	< 0.002 mg/L
Copper, Cu	< 0.005 mg/L
Nickel, Ni	< 0.002 mg/L
Lead, Pb	< 0.001 mg/L
Zinc, Zn	< 0.025 mg/L
Ammonia/Organic Nitrogen	Passes USP Standard
Total Chlorine Residual	<0.01 mg/L
Total Dissolved Solids	<1.0 mg/L
Heterotrophic Plate Count (HPC)	<1 cfu/ml
Water Bacteriological Quality Test	Growth ratio = 0.96
Oxidizable Substances	Passes USP Standard
Carbon Dioxide	Passes USP Standard

Arrowhead Distilled Water Specifications:
Total dissolved solids (TDS): < 2 mg/L; Total residual chlorine: ND (<0.01 mg/L); Ammonia, N: ND (<0.1 mg/L); pH: 5.0 – 7.0; Heterotrophic Plate Count (HPC): < 100 cfu/ml; Conductivity: < 4.0 µmhos/cm; Bacterial growth ratio: 0.3–3.0; Heavy metals: < 0.050 mg/L; Total organic carbon: <1.0 mg/L.

ND = None Detected.
Arrowhead Distilled Water also meets all USP Purified Water and ASTM Type IV Reagent Water specifications.

Quality Assurance Manager

Quality Assurance Laboratory, Los Angeles, CA 90021. Phone (213) 763-1350, Fax (213) 7493777

Glassware Cleaning

Standard Methods 18th Edition, Page 9-3 Section B-3

Procedure:

1. **After** dumping sample, rinse with water **and** apply FL70 detergent located **at** sink.
2. Scrub or brush **unit** until all of sample **has been** removed from **glassware.**
3. Glassware should then be rinsed **three times** with hot water.
4. After rinsing **with tap** water, **rinse** again with DI water.
5. **Dry** glassware is ready for ***use.***

Note: **A glassware inhibitory residue test will be performed** on initial use of **washing** compound, when there is **a** change in formulation used, or a change in **the method** of **washing** of reusable culture tubes, **pipettes,** flasks, graduated cylinders, **beakers,** blenders, funnels, etc.

A glassware inhibitory residue test **was** last performed on _____, by_____
Lab name

pH Spot Check:
Because some cleaning solutions are difficult to remove completely, spot check batches of clew glassware for pH **reaction,** especially if soaked in alkali **or** acid.

Procedure:
On **a** monthly **basis, test** clean glassware by adding **a** few **drops** of 0.04% bromthymol **blue** (BTB) or other pH indicator and observe **the** color reaction. BTB should be blue – green (in the neutral range). Record results on pH check form.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05
Mydocuments/LabQCdocs/glasswarecleaning.doc

PH Spot Check

Date	Beaker	Acid / Neutral / Base	Initials

Lab Equipment and Instrumentation

Standard Methods 18th Edition, Page 9 3, Section 9020 B

Analytical Balance & Top Load Balance

1. Balance must have a readability of 0.1g
2. Balance must be checked daily for accuracy using ASTM class I weights. Note: a minimum of 3 traceable weights that bracket our lab's weighing needs are to be used.
3. Data recording on daily scale record sheet located on the refrigerator.
4. All reference weights will be re-certified if damaged or corroded.
5. Service contract for internal maintenance control on the analytical and top load balance is completed annually by Wine Country Balance, Sonoma, CA.

Portable Balance

The portable top load balance (Sartorius 500.0g) will be checked at least monthly and before use, using ASTM 1, 10 and 100g weights (minimum of *three* traceable weights that bracket our labs weighing needs) and recorded on the portable balance calibration sheet.

Incubators

1. *Our* incubator is of sufficient size for our workload.
2. Our incubator unit has an internal temperature monitoring device and maintains a temperature of 35°C ± 0.5° C.
3. Any temperature corrections must be noted on the daily incubator record sheet located on the side of our unit and on the thermometers.
4. Temperatures must be recorded twice each day of use, with readings at least 4 hours apart.

Scale Calibration (s)

Class I Weights Used #1____#2____#3____#4____

Date	Scale off in g. (s) #1	#2	#3	#4	Operator	Date	Scale off in g.(s) #1	#2	#3	#4	Operator

EQUIPMENT TEMPERATURE RECORD
(C)

Month_____. **Year**_____

Equipment_____ **Certified Thermometer**_____. +/-_____.

Name	Time (s)		Temp C	Date	Name	Time (s)		Temp C	Date

Autoclave

Standard Methods 18th Edition, Page 9-4, Section 9020 b

1. Our autoclave is sufficient for our workload and pressure cookers are not being used.
2. Our autoclave has an internal heat source, temperature gauge with sensor in exhaust, pressure gauges, and an operational safety valve.
3. Our autoclave maintains sterilization temperature during cycle and completes the entire cycle within 45 minutes when 12 to 15 minute sterilization period is used.
4. For **quality** control, the automatic timing device is checked quarterly for accuracy with another accurate timing device. Results are recorded on the Control Test Data sheet in the lab data book and corrections are to be noted on log sheet and autoclave time temperature sheet.
5. For quality control, a maximum temperature registering device is used weekly to check the sterilization temperature of 121° ±2° C. Results are recorded on the Control Test data sheet in the lab data book.
6. A heat indicating tape is used to identify items that have been sterilized.
7. Routine maintenance of the autoclave includes cleaning of drain screen and visual inspection of the door seals on a weekly basis.
8. Spore ampules are used monthly as bioindicators to confirm sterilization. Results are recorded on the Control Test data sheet in the lab data book.
9. Contaminated test materials must be autoclaved at 121°C for at least 30 minutes.

Autoclave records must include:

- Date
- Contents
  Time in and out
  Total exposure/cycle time
- Sterilization time
- Sterilization temperature
- Initial of technician

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/autoclave.doc

AUTOCLAVE RECORD SHEET

DATE	CONTENTS	TIME IN/OUT		TOTAL EXPOSURE/ CYCLE TIME	STERILIZATION TIME	TEMP	OPERATOR INITIALS

LAB OPEN UP

I. Procedures to open Lab:

A. Check Temp of Bac T Incubator. (35°C ± **0.5**°C)
B. Check Oven **Temp. (103- 105°C)**
C. Check BOD Incubator Temp. (20°C ± 1.0°C)
D. Check Refrigerator **Temp. (** < **5.0'** C)
E. Check the Calibration of Turbidimeter. (see chart)
F. Calibrate the PH. meter. (**see** Instructions)
G. Check the H20 Bath Temp. (44.5°C ± 0.2°C)

II. Other Open-up Duties:

A. Read Plant Bac T Test.
1. Monday – Friday
2. Saturday – Sunday (Once a month sliding schedule)

B. Set-up daily glassware
1. Two *250* ml. Graduated cylinders. (Comp Eff Susp Solids Test)
2. ***One*** *25* ml. Graduated cylinder. (MLSS)
3. One 250 ml. Graduated cylinder. (Secondary Susp Solids Test.)
4. One *250* ml. Beaker. (Inf PH. Test)
5. One 250 ml. Beaker. (Eff PH. Test)
6. One Imhoff Cone. (Settleable Solids Test)
7. Turbidity Tube. (NTU Test)
8. Glass Vial. (CL2 Test)

III. Weigh Suspended Solids Filters:
1. Two Comp EFF.
2. One MLSS.
3. One secondary Effluent
4. One RAS

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05
Mydocumnets/LabQCdocs/labopenup.doc

General scheme of laboratory testing for detection of COLIFORM group in water

Standard Methods 18th Edition, Page 9-45 to 9-53 Section 9221 A – E

Presumtive Test

Inoculation of lactose broth

Gas produced = presumed evidence of coliforms Examination continued	No Gas = coliform not present
CONFIRMED TEST – Transfer made from lactose broth tubes to the following:	
BGLB or Brilliant green lactose broth (this medium inhibits the growth of lactose fermenters other than colifom; thus gas formation in the BGLB medium constitutes a confirmed test: i.e coliforms present.	Eosin-mehylene agar (EMB). Coli-aerogenes organisms produce characteristic colonies; Escherichia: small colonies, dark, almost black centers, with greenish metallic sheen Enterobacter: large, pinkish colonies, dark centers, rarely show metallic sheen. Presence of typical colonies constitutes a confirmed test: i.e coliforms present.
The most typical colonies are selected from EMB plate. (if BGLB used in confirm test, it is first streaked to EMB) and inoculated into :	
Lactose broth (coliforms produce gas).	Ager slant (gram stain prepared from growth; coliforms are gram-negative, nonsporulating bacilli (rod shaped).

Fermentation of **lactose broth and demonstration of gram-negative,** nonsporulating bacilli constitutes a **positive** completed test demonstrating *the* presence of some **member** of coliform group in the volume of sample examined.

Note: Completed test must be run **quarterly,** and results are **to be logged in** Lab **log sheet.**

Bruce Keogh, Lab Directsr Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/coliformgrouptest.doc

Coliform

Standard Methods 18th Edition, Page 9-45 to 9-53 Section 9221 A – E

Equipment

Pipettes – 10ml, 5ml, and 1ml
Durham tube (glass viles)
Test tubes with aluminum caps
Wire loop
35° C inubator
44.5° C incubator
Broths (LTB, BGB, EC)

Procedure

1. Make up and sterilize as on label of broth. Note: make up 1 liter of broth for approx. 80 tubes.
2. Put 10ml of broth in a test tube containing inverted durham tube using the automatic dispenser.
3. Put aluminum caps on.
4. Sterilize using autoclave.

Sterilize capped test tubes containing the media for not more than 15 minutes. The **autoclave** is preset to maintain a temperature of 121° C at 15 lbs. of pressure. All that is required to operate the autoclave is to fill the chamber with DI water to the marked point, close the door and set the timer for the desired length of time. Make sure that when sterilizing the test tube containing broth media, the exhaust selector switch is in slow (liquid mode). To sterilize **pipettes,** after rinsing with DI water *and* drying, place them in the stainless steel cylindrical storage case by *the* oven. Close the top and **place** them in the autoclave. Sterilize for 30 minutes at 121°C and 15lbs of **pressure.**

The sample bottles are also sterilized in the same manner as for pippettes **except** for samples containing residual chlorine. 1ml = 2 drops of 1% sodium thiosulfate is placed in the jar prior to sterilization. At least one bottle from each batch or lot of bottles shall be tested for sterility with TSB media incubated at 35°C for 24 hours and checked for growth. The results will be recorded on a bottle sterility data sheet.

Store sterilized sample bottles in cabinet # 47 on the east wall.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/coliformgrouptest

Confirmed Test and EC
Brilliant Green Bile (BGB)

Standard Methods 18th Edition, Page 9-45 to 9-53 Section 9221 A – E

LTB broths plus the sample with dilution indicated are positioned in the tray (in the big incubator) as shown below:

10.0 ml LTB II	O	O	O	O	O
1.0 ml LTB	O	O	O	O	O
0.1 ml LTB	O	O	O	O	O

Any positive (gas production) LTB tube either at 24 hrs or 48 hrs **is** transferred **to** BGB. The BGB tubes replace the LTB tubes in the same spot.

Example:

1. Burn **loop** in bunsen burner flame till glowing orange.
2. Air cool 10-15 seconds.
3. Dip loop in a positive LTB tube about 3mls under surface and rotate tube. Pull out loop full of culture and transfer to BGB or BGLB. (try not to pick up scum off the surface **of** culture).
4. Repeat 1, 2, & 3.
5. Repeat 4 but transfer to EC broth for ocean sampling.

For technique please refer to Standard Methods 18'' edition page 9 – 45 sections 9221 a – ***e***.

Bruce Keogh, Lab Director Bruce Keogh **Date:** 1-31-05

Mydocuments/LabQCdocs/coliformgrouptest.doc

Media QC Positive/Negative Control

Standard Methods 18th Edition Page 9-3 Section 9020-9050 C

Rehydrate Culti – Loops: *E-coli*, *Enterobacter aerogenes*, *Staphylococcus aureus* using blood agar (TSA with sheep blood).

Procedure:

The film in each loop is made of a gelatin formulation. To rehydrate the film, the loop must come in contact with both warmth and moisture. To open: cut open the end of the foil packet as indicated on the label.

A: DIRECT STREAK METHOD

1. Warm appropriate plated media to 35° C.
2. Remove red sheath from the loop (*E-coli*, *E-aerogenes*, *staph*).
3. Lay the loop flat on the warm agar surface for 10 – 15 seconds, pressing gently onto the surface of the media. Rehydration of the loop will appear as a clear "bead of moisture" upon lifting the loop from the agar *surface.* Note: The black film does not have to completely dissolve from the loop for growth of the organism to occur.

After Incubation of 24 to 48 hours at 35°C the *E-aerogenes*, *S.Aureus*, *E-Coli* plates will be ready for use as positve/negative controls.

Using a steril innoculation loop transfer the appropriate bacteria to the prepared broths.

LTB/BGB: *E-Aerogenes* as a positive control
Staph aureus as a negative control

EC: *E-Coli* as a positive control
E-Aerogenes as a negative control

Once the bacteria are transferred, LTB and BGB broth will be incubated at 35° C ±0.5°C for 24 to 48 hours. Log results in lab book. EC broth will be incubated at 44.5' C ±0.2° C for 24 hours only. Log results in lab book.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/MediaQCPosNeg.doc

Morro Bay / Cayucos Wastewater Treatment Plant
Quality Controls

AutoClave Bacillus Stearothermophilus			Bact-T Bottle/Pipette Steril **Check** Media Type (TSB)			
Date	**Pos Control**	Neg Control	Date	Bottles by numbers	**Pipettes** Pos/Neg	**Bottles** Pos/Neg

Completed Test					Autoclave Timer/Temp		
Date	Growth Yes/No	LTB Pos/Neg	BGB Pos/Neg	EC Pos/Neg	Date	Temp	Time Corrections

Mydocuments/lab/controlchecks.doc

Water Bath Quality Control (EC Broth)

Date	Steril Yes / No	E-Coli Pos/Neg	E-Aerogenes Pos/Neg	Temperature	Initials

Ocean samples are examined as follows:

Standard Methods 18th Edition, Page 9-45 to 9-53 Section 9221 A – E

1. 5 double strength tubes of broth inoculated with 10.0ml of sample. (double strength = double in concentration).
2. 5 single strength tubes of broth inoculated with 1.0ml of sample.
3. 5 single strength tubes of broth inoculated with .1ml of sample.

These tubes are then incubated in 35° C incubator by the east wall and checked at the end of 24 hours and 48 hours. The results are entered in the laboratory log book. At the end of 24 hours, transfer with transfer loop the positive tubes (gas production constitutes a positive result) to BLGB broth and E.C. broth at the same time. Incubate BGLB medium in 35° C. Production of gas at the end of 24 hrs or 48 hrs constitutes a confirmed test, i.e. coliforms are present. Incubate the E.C. broth in water bath at 45° C for 24 hrs. Gas production constitutes a positive test, i.e. fecal coliform is present. If, at the end of 24 hrs, the E.C broth yields a negative result (no gas production), it constitutes a negative test, i.e fecal colifom is not present. The E.C. tubes are then discarded.

Positive (*Escherichia Coli*) and negative (*Enterobacter aerogenes*) controls must be run whenever sample tubes are placed in the water bath for determination of fecal Coliform. Results are to be recorded on the water bath positive / negative control data sheet and beach survey form.

Please note that the transfer loop is sterilized by heat (a bunsen burner); it is placed in the flame and needs to glow bright orange then taken out and air cooled before using it for transfer. If a sizzling sound is produced when dipping the loop in the medium, that is an indication that the loop has not been given enough time to cool.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/coliformgrouptest.doc

CITY OF MORRO BAY BEACH SURVEY

PLACE: Morro Strand Beach | **DATE:**

SAMPLER:

WEATHER: ☐ CLEAR ☐ CLOUDY ☐ FOG ☐ RAIN INCH:_____

TEMPERATURE: AIR_____WATER_____ | TIDE: ☐ Ebb ☐ Flood ☐ Slack

WIND: Direction_____Intensity_____ | BEACH USE: Swimmers____Spectators____

		STATION NUMBER:	A1	A	B	C	D	E	F	M/CRK
		TIME SAMPLE COLLECTED:								
RECEIVING WATERS	Non Sewage Debris	Marine Growth								
		Storm\Shipping								
		Garbage\Refuse								
		Tars\Oils								
		TOTAL COLIFORM								
	Sewage Debris	Soap\Grease balls								
		Rubber Goods								
		Fecal Material								
		FECAL COLIFORM								
BEACH AREA	Non Sewage Debris	Marine Growth								
		Storm\Shipping								
		Garbage\Refuse								
		Tars\Oils								
	Sewage Debris	Soap\Grease balls								
		Rubber Goods								
		Fecal Material								

PLANT OPERATION: ☐ Good ☐ Fair ☐ Poor ☐ Unknown

BYPASSING WHEN SAMPLING: ☐ Yes ☐ No ☐ Unknown

PREVIOUS DAY	AT TIME OF SAMPLING
Flow_____MGD Gal NaOCL used_____	Flow_____MGD Dosage Lbs \ day_____
Calculated NaOCL Dosage mg/L	Residual NaOCL in effluent_____mg/I

Suspended Solids

Standard Methods 18th Edition Page 2-56, Section 2540 D

Background:

Total suspended solid (nonfilterable residue) is the material retained on a standard glass fiber filter after filtration of a well-mixed sample.

Equipment:

Vacuum source (on the bench top).
- Buchner Funnel and 1000 ml. vacuum flask (by the north sink).
- Filter paper (glass microfibril) 9 cm (located in drawer).
- Oven 103°-105° C (north wall).
- Analytical Balance (north wall).
- Desicator (by oven).

Procedure:

The filtration is achieved by vacuum. The filter paper (located in **drawer)** is fist washed with distilled water (three 20 ml. portions) and **place** in the 103°-105°C oven for one hour to *dry,* **and** then transferred to the desicator to cool for 15-30 mins. (Use forceps for handling the filter paper). Weigh the filter paper and record in the lab log book. Measure the desired volume of sample with a graduated cylinder and pass through the filter (vacuum filtration). This is achieved with the use of a Hirsh Funnel. When washing the filter paper, a Buchner Funnel **is** employed.

Dry the filter paper in the oven (103°-105° C) for one how or more and cool in the desicator for 30 mins. Weigh as before and record the values in the lab log book. Composite influent and effluent samples must be averaged between the two samples (of the same kind) when weighed. A second weighing should be done on all samples tested. If a deviation **of 5%** or more from the previous weight is noted, than a third weighing is necessary. The weight measurements are done by the analytical balance and weights are **recorded** to the nearest .1 mg. i.e. 1.2345 gr.

Calculation:

Mg. total nonfilterable residue $PPM = \frac{(a-b) \times 1000}{\text{Sample volume, ml.}}$

A= weight **of** filter **paper +** residue in mg. and
B= **weight:** of filter **paper,** mg.

Note: **1.00** gr. = 1000mg

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05
Mydocuments/LabQCdocs/suspendedsolids.doc

Morro Bay / Cayucos WWTP

Suspended. Solids Record

Date	Sample I.D.	Volume	Tare WT.	Comb. WT. 1	Comb. WT. 2	1 & 2 Ave.	WT. Mg/L	Average Mg/L

Biochemical Oxygen Demand (BOD)

Standard Methods 18th Edition, Page 5-1 to 5-6, Sections 5010 ABC,5020, and 5210 A-B

Background:

Biochemical Oxygen Demand (BOD) is an empirical test that is used to determine the relative **oxygen** requirements of wastewater effluents and polluted waters. The test measures the oxygen required for the biochemical degradation (degradation by living organisms) of organic materials (pollutants that can be used as food for living organisms).

There are also some inorganic materials that would oxidize and therefore increase the oxygen consumption. These materials are mostly sulfides **(s-2)** and ferrous iron (Fe+2). A reduced form of nitrogen, like ammonia, would also use the oxygen to become oxidized (nitrogenous demand).

Nitrogenous demand can be prevented by the use of an inhibitor **such** as 2-chloro-6 (trichloromethlyle) pyridine (TCMP).

Equipment:

Dissolved oxygen meter YSI 5100 (on the bench top)
BOD bottles (cabinet under incubator)
Plastic caps (located in drawer)
Glass bottle caps (cabinet under incubator)

Reagents:

BOD nutrient buffer pillows (Hach, BOD nutrient buffer pillows)

Locations:

Compositor at headworks (influent) and upper chlorine contact chamber area (effluent).

Procedure:

Please note that these procedures are only applicable at Morro Bay/Cayucos WWTP lab.

A) Preparations of dilution water:

Use ***one*** BOD nutrient buffer pillow for three liters of water, usually six liters of dilution water is made. Aerate the dilution water by shaking the bottle for about five minutes or use filtered air.

BOD Cont.

Standard Methods 18th Edition, Page 5-1 to 5-6, Sections 5010 ABC,5020, and 5210 A-B

B) **Dilution Techniques:**

Note: Composite influent and effluent samples both need to be at a pH range between 6.5 and 7.5. This is accomplished by placing the samples on our pH meter and titrating the sample with either sulfuric acid concentrate to reduce the pH to 7.5, if pH is lower than 6.5, titrate with sodium hydroxide to increase pH to proper range.

Use two dilutions for each sample in duplicate (two of each) and a blank for each set of analyses. Composite final effluent samples usually require 20 and 10 ml. of sample per BOD bottle. Raw samples require 3 and 1 ml. per BOD bottle. Use a pipette for all measurements.

After all the samples are measured and put in BOD bottles fill the bottles with dilution water to the top and make sure that there are no air bubbles trapped in the bottles. The air bubbles can be withdrawn by tapping the side of the bottle with a glass or metal rod.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/labQCdocs/BOD&DOmeter.doc

YSI Dissolved Oxygen Electrode:
BOD TEST
How to Run

1. First you'll need to calibrate the BOD unit.
2. Turn the unit on (see the diagram).
3. Let the unit warm up at least *15* minutes.
4. The meter will have four choices at the bottom.
5. After the 15 minutes warm up choose the Calibrate button (see the diagram).
6. Four new choices will appear (see diagram).
7. Choose the AUTO CAL. Button (D.O. Calibration Saved will appear briefly).
8. Next push the mode button. This will change the screen to the operation ready mode (see the *diagram*).
9. Now you're ready to start your reads. Place the probe into Blank bottle # 122, wait 45 sec. Then read. Log *the* reading on BOD sheet.
10. Now do the rest of the BOD bottles the same way. In this order. Bottles # 137, # 130, # 110, # 127, # 123, # 104, # 126, # 135, # 98.
11. After your last bottle. Turn the unit off then rinse the probe CAREFULLY no higher the 1" from the bottom. Replace probe into holder.

Note: The oxygen content of all samples bottles (other than the blanks) should be at least 1 mg/L. Furthermore, a depletion of 2 mg/L of DO is desirable and the DO uptake in the blanks should not be more than 0.2 mg/L and preferably not more than 0.1 mg/L.

To prevent loss of oxygen during incubation, the DO must be reduced to saturation at 20° C by bringing the sample to about 20° C in partially filled bottle while agitating by vigorous shaking or by aerating with clean, filtered *compressed* air. During the BOD setup, initial DO should not be over 9.0mg/L.

Calculations:

By subtracting final DO from initial DO, the depletion of oxygen is obtained, and since there *are* duplicate bottles, this depletion is averaged.

$$\text{BOD mg/L} = \frac{\text{In} - \text{Out} \times 300\text{ml}}{\text{Ml of sample}}$$

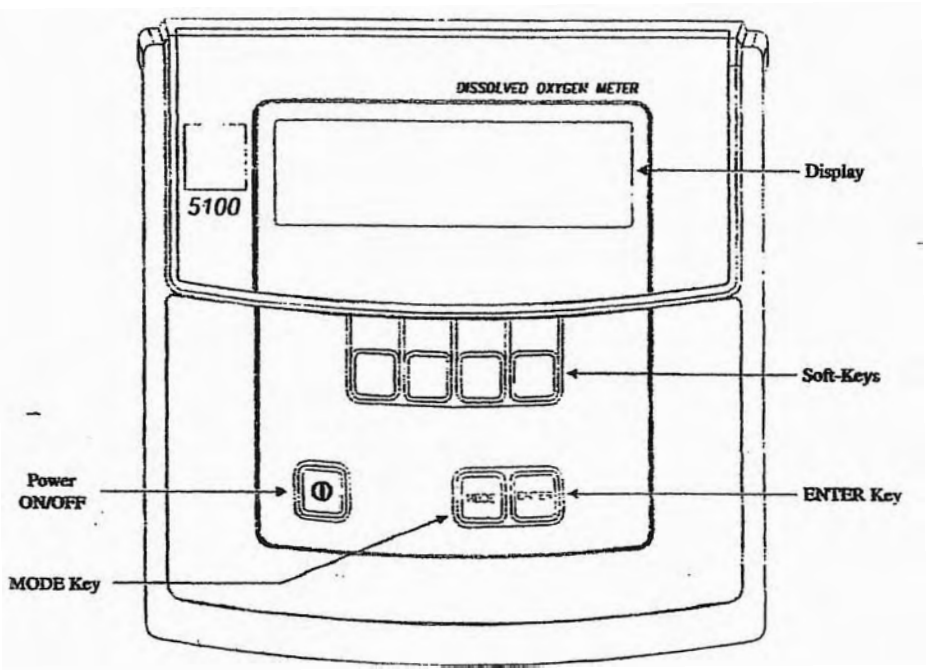
Bruce Keogh, Lab Director Bruce Keogh Date 1-31-05

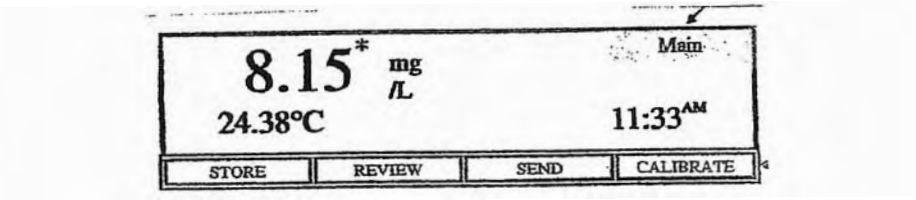
Mydocuments/LabQCdocs/BOD&Dometer.doc

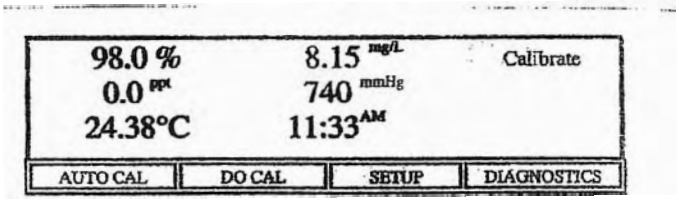
4. Controls

4.1 Front Panel

The front panel of the instrument contains the display and keypad as shown below. The front panel display and controls of the 5000 and 5100 are identical.







MORRO BAY / CAYUCOS WASTEWATER TREATMENT PLANT

BOD Record (mg/L, 5 *Day*, 20°C)

INITIALS[1] INITIALS	NUMBER NUMBER	DESCRIPTION DESCRIPTION	AMT mL	INITIAL DO (mL)	FINAL DO (mL)	DO (mL)	TOTAL TOTAL	BOD mg/L	REMARKS[2] REMARKS[2]

[1] Time at start of incubation

[2] Include Time Samples On and period of collection

pH

Please refer to Standard Methods 18th Edition Page 4-65 section 4500 A-B

Equipment: Orion model 310 **pH** meter

Procedure:

Before making measurements with a pH meter, one must make sure that the meter is calibrated. Each day of use, the pH will be calibrated with 2 buffers (4&7 or 7&10). The buffers must be dated and buffer type documented on our daily logs each time a calibration is made or changed. **Accuracy** and scale graduations must be within ±0.1 units and the electrode must be maintained as per manufacturer's instructions. The calibration procedure is in **the** LAB TEST PROCEDURES BOOK located on shelf above computers.

In general, three **types** of buffer are used (**pH** 7.00, **pH** 4.00, and pH 10 buffer, located in chemical cabinet). Fill one 50 ml beaker **with** pH 7.00 buffer and one with 10.0 **pH** buffer. Place the 7.00 buffer on the stirrer **and** stir. Insert the **pH** probe into the **beaker** then **press** the mode button to turn unit on. Next **press** the CAL. Button to start the calibration process. The meter will flash SLP (at this point the up arrow may need to be **pressed** to bring the slope to 7-10 range) then briefly a percentage number. After the slope **is** seen on the meter push the YES button to accept this range. The meter will show a reading ***at or near*** *7.00.* Log this reading on pH Calibration sheet located on BOD incubator. The meter will then lock onto the 7.00 reading and the ready light will be displayed. **At** this point, press the YES button locking in the 7.00 pH **part** of the CAL. Remove probe from 7.00 **pH** buffer beaker and replace with 10.0 pH buffer (on stirrer). Be sure to wipe the electrode with a clean Kim Wipe to remove 7.00 pH buffer. Insert probe into pH 10.00 and stir. Leave electrode in 10.0 pH buffer until the unit reads **exactly** 10.01 and the ready light is visible. Hit the Yes button, and a new SLP percentage will show (approx. **98%).** The **pH** meter is now ready for use.

pH meter Cont.

Please refer to Standard Methods 18th **Edition** Page **4-65 section 4500 A-B**

NOTES:

1. **Make sure** the electrode is thoroughly rinsed with DI water after each use or between measurements of different samples.
2. Do not touch ***or*** damage the electrode **tip.** It is very sensitive and great care should be taken when analysis is performed.
3. Record **all reading in** lab log book and initial the **entries.**
4. When testing a lower pH range, for instance, during a grease and oil test, the pH meter must be recalibrated to the 4-7 range by simply pressing the down arrow during initial calibration.
5. Always stir the sample during use of the pH meter.
6. For additional info refer to **pH** instruction handbook located above the computer desk. **Also refer** to Standard Method Handbook 18th ed. Page # 4 – 65 section 4500 A-B.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/PH.doc

PH. CALIBRATION

DATE	NAME	TEMP.	PH. WAS	CAL.TO PH.	BUFFER(S) USED

Determination of Residual Chlorine in Wastewater
(Simplified Field Test)

Refer to Standard Methods 18th Edition, page 4-45 section: 4500-ci

Equipment:

1. LaMotte 1200 Colorimeter
2. 10ml graduated cylinder
3. Sample bottle
4. DI water
5. DPD pillows (reagents)

Procedure:

To get an accurate reading a dilution may be necessary for this test. Collect a sample of the wastewater or water to be tested in a clean sample bottle. Add 2.5 ml of sample to your 10ml grad. cylinder. Then fill the rest of the cylinder with DI water up to 10ml.

NOTE: This is your diluted sample used for the test at a ratio of 4:1. In general, this dilution factor will change depending on the strength of CL2 in your sample as the residual meter does not exceed 9.9mg/l.

In the next step, pour your 10ml sample into the 10m. cylinder designed to fit into the meter. Upon insertion, close the hatch and turn the meter on. Then, hold the "zero*"button down until "BLA" appears. The meter is now zeroed. Remove sample and pour reagent (currently using DPD pillow) into sample. Allow reagent to dissolve completely, insert the sample into the machine and press read. The resulting display will show the CL2 concentration. This number would then be multiplied by 4 to counteract the dilution factor. Example: Meter reads .80mg/l so times by 4 = 3.2mg/l. Log all results in lab book.

For further information please look in the Lamonte 1200 colorimeter handbook located in the meter storage box or for more general info, Standard Methods 18th edition may be utilized page 4-45 section: 4500-ci.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Mydocuments/LabQCdocs/chlorineresid.doc

Turbidimeter

Standard Methods 18th edition page 2-8,9 sections 2130a-b.

Calibrating:

When data is used is used for USEPA reporting, recalibrate at least every 90 days or as stipulated by the regulating authority. Refer to section 3.2 "calibration" in the Hach 2100N Turbidimeter instrument manual. Furthermore, the turbidimeter will be calibrated using a primary or secondary standard before each use. A quarterly crosscheck should be made using a **primary** standard. Also, our turbidimeter is on a quarterly work order for calibration and we are using primaries for this check.

Calibration Procedure for the The Hach 2100N Turbidimeter:

1. Fill a clean sample cell to the line (approx 30 ml) with dilution water.
2. Wipe the cell clean and apply a thin film of silicone oil.
3. Place the sample cell into the cell holder and close the cell cover.
4. Press the **CAI,** key. The SO annunciator lights. The NTU value of the dilution water used in the previous water used in **the** pervious calibration is displayed.
   Press ENTER key. The instrument display **counts** down from *60* to 0, and then makes a measurement. This result is stored and used to compensate for the turbidity of the dilution water.
   The instrument automatically increments to the next standard, displays the expected NTU value, and the S1 annunciator lights.
   Remove the sample cell from the cell holder.
   Fill a clean sample **cell** to the line with well **mixed,** 20 NTU Formazin standard. Wipe the cell clean **and** apply **a** thin film of silicone oil to the surface. Place it into the cell holder, and close the cell cover.
   Press ENTER key. The instrument display counts down from *60* to 0, and then makes a measurement. The display automatically increments to the next standard, the display shows 200.0 NTU, and the S2 annunciator lights. Remove the sample cell from the instrument.
   Fill a clean sample cell to the Pine with well mixed 200 NTU Formazin standard, and complete the same steps used in # 7. This time the S3 light will show.
   Fill a clean sample cell to the line with well mixed 1000 NTU Formazin standard, and complete the same steps used in # 7. This time the S4 light will show.

Turbidimeter Calibration Cont.

10. Fill a clean sample cell to the line with well mixed 4000 NTU Formazin standard, and complete the same steps used in # 7. This time the SO light will show, and the previously measured value of the dilution water is displayed.
11. Press the CAL key. The instrument makes calculations based on the new calibration data, stores the new calibration and returns the instrument to the measurement mode.

Reviewing the calibration sequence

Press *the* CAL key and then use the UP ARROW key to scroll through the standard to review calibration data currently in effect. Press the UNITS/EXIT key to return to the operating mode without altering the current calibration data.

Note: Reassign new values to the Gelex standards each time the instrument is calibrated with Formazin. Formazin is the primary standard and Gelex is the secondary standard. Formazin is known to cause cancer so use extreme caution when handling.

***Error** Codes* are located on the Hach 2100N Turbidimeter Quick reference guide located in the drawer **under** the meter itself.

Hach 2100N Turbidimeter Test Procedure:

1. Collect a representative sample in a clean container. Fill the sample cell to the line. Take care to handle the sample cell by the top. Cap the sample cell. Our turbidimeter is designed to stay on 24hrs a day. If machine is ever turned off refer to Quick Reference Guide, **step 1 in procedures.**

Turbidimeter sample procedures cont.

2. Hold the sample by the cap, and wipe to remove water spots and finger prints with a clean Kim Wipe.
3. Apply a thin bead of silicone oil from the top to the bottom of the cell, just enough to coat the cell with a thin layer of oil. Using the oiling cloth provided, spread the oil uniformly. Then, wipe off the excess. The cell should appear nearly dry with little or no visible oil.
4. Place the sample cell in the instrument cell compartment and close the cell cover.
5. Select manual or automatic ranging by pressing the RANGE key.
6. Select the appropriate SIGNAL AVERAGING setting (on or off) by pressing the SIGNAL AVERAGE key.
7. Select the appropriate RATIO setting (on or off) by pressing RATIO key. NOTE: Values greater than 40 NTU require ratio on.
8. Select the appropriate measurement unit by pressing the UNITS/EXIT key (NTU is our standard).
9. Read and record the results in the lab book.

For any other references please look in the HACH 2100N Turbidimeter manual or Quick reference guide or Standard Methods 18'' edition page 2-8,9 sections 2130a-b.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05
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Turbidity Meter Calibration

Standards Used #1_____, #2_____.

#3_____, #4_____.

Date	Meter Off By NTU's				Operator	Date	Meter Off By NTU's				Operator	notes
	#1	#2	#3	#4			#1	#2	#3	#4		

Settleable *Solids*

Refer to Standard Methods 18" Edition, Page 2-57 section 2540 – F.

Description:

Settleable solids of sewage is the volume of suspended matter that settles to the bottom of a tank or compartment designed for the collection of the settleable material. The determination far settleable solids is made by allowing one liter of the sewage to stand for one hour in an Imhoff cone, and reading directly from the graduations of the cone the volume of the suspended matter that settled to the bottom. The result represents the settleable solids, in milliliters per liter.

Purpose:

The determination of settleable solids in sewage is valuable **as** showing **how** much suspended matter can be or has been removed by sedimentation. To measure visibly the efficiency of a sedimentation process, tests for settleable solids are made on the influent and effluent of the settling basin or compartment. The difference between the settleable solids of the influent and effluent gives the settleable solids removed. The percent of the solids removed may now be calculated by dividing the volume of the solids removed by the volume of the settleable solids of the influent and multiplying by 100.

Equipment:

Imhoff Cones.
Rack for holding Imhoff cones.
Glass stirring rod **or** wire.

Settleable Solids Cont.

Test Procedure:

1. Thoroughly mix the sewage sample by shaking and immediately fill an Imhoff cone to the Liter mark.
2. Record the time that the cone is filled. Time = _____
3. Allow the waste sample to settle for 45 minutes.
4. Gently spin the cone to facilitate settling of material adhering to the side of the cone.
5. After one hour, record the number of milliliters of settleable solids in the Ihmhoff cone. Make allowance for voids among the settled material.
6. Record the settleable solids as ml/L or milliliters per Liter

		Sample
Settleable solids, Influent =	_____ ml/L	10.0
Settleable solids, Effluent=	_____ ml/L	0.5
Settleable solids, Removal–	_____ ml/L	9.5

Example:

If one liter of raw sewage or influent contains 10.0 ml of settleable solids, it should be possible to remove most of this in the primary settling system. If the effluent contains 0.5 ml per liter, it is possible to calculate the efficiency of removal by using this formula:

$$\% \text{ Efficiency} = \frac{(\text{ml influent}) - (\text{ml effluent})}{(\text{ml influent})} \times 100$$

$$= \frac{10.0 - 0.5}{10.0} \times 100 = 95\% \text{ removal}$$

It should also be possible to check the maximum volume of sludge to be pumped out of settling tanks. For example, if one liter, equaling 1,000 ml of sewage, contains 10.0 ml of settleable solids, 1,000,000 gallons of sewage should not contain over 10,000 gallons of sludge. Generally, sludge compacts by a factor of two or three and therefore this volume will be smaller by half or more. Instead of pumping 10,000 gallons, then, the volume would probably be closer to 5,000 gallons or less.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

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Grease and Oil

Refer to Standard Methods 18th Edition, page *2-51* section 2530 –c

Background:

"Grease and Oil" is any material recovered as a substance soluble in trichlorotrifluoroethane (freon). Thus, in the determination of oil and grease on absolute quantity of a specific substance is not measured. The significance of this test arises from the fact that certain constituents measured by the oil and grease analysis may influence wastewater treatment systems. If present in **excessive** amounts, they may interfere with aerobic and anaerobic biological processes (digester and trickling filter) and can lead to decreased wastewater treatment efficiency. When discharged in wastewater or treated effluents, they may cause surface films and shoreline deposits leading to environmental degradations.

NOTE: **The effluent grab sample should be collected in a glass beaker (2000ml) at the air relief structure, Sample volume should be exactly 1000ml. The influent grab sample is taken directly from the main influent channel Iocated in the lower headworks.**

Method: Partition-GravimetricMethod

Apparatus:

1. Separatory funnel, I Liter with teflon stoplock
2. Distilling flask
3. Waterbath
4. Filter paper, 11cm diameter, Whatman # 40

Reagents:

1. Hydrochloric acid, Hcl 1+1
2. Trichlorotrifluoroethane
3. Sodium sulfate

Procedure:

Collect exactly 1 Liter (1000ml) of sample in your 2000ml beaker. Mark the sample level for later determination of sample volume. Acidify to pH 2.0 or lower (about 5ml of Hcl 1+1). Transfer to separatory funnel. Carefully rinse sample container with 30ml of trichlorotrifluoroethane and add solvent washing to separatory funnel. Shake vigorously for 2 minutes venting immediately and frequently to allow gas build up to be released. Place funnel in holder and allow the layers to separate for 10 mins.

Grease and Oil Cont.

Refer to Standard Methods 18th Edition, page 2-51 section 2530 –c

Procedure continued:

Adding two scoops of sodium sulfate to the filter paper assists in filter efficiency. Then, drain solvent layer through a funnel containing solvent-moistened filter paper into a clean, tared (pre weighed) distilling flask.

As mentioned above, if a clear solvent layer cannot be obtained (which is the case at this treatment plant), add 2 scoops of sodium sulfate to the filter paper cone and slowly drain emulsified solvent onto the crystals. Add more sodium sulfate if necessary.

Extract twice more with 30 ml of solvent each time, but first rinse sample container with each solvent portion. Combine extracts in tarred distilling flask and wash filter paper with an additional 10 to 20 ml solvent.

Evaporate freon from distilling flask in a water bath at 70° C for 15 minutes. Draw air through it with an applied vacuum for the final minute. Cool in a desicator for 30 minutes and weigh.

A blank shall be run on 90ml of trichlortrifluoroetane (FREON) for each new bottle of trichlorotrifluoroethane opened. The results will be recorded, and a corrective factor will be used for each test conducted.

Calculations:

$$\text{Mg oil and grease/L} = \frac{\text{(A-B) in ma} \times 1000}{\text{Ml sample}}$$

A = total gain in weight for the sample
B = total gain in weight for the blank

Enter all data collected and calculations in lab log book.

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Grease and Oil Cont.

Refer to Standard Methods 18th Edition, page *2-51* section 2530 -c

CAUTION !!!

Trichlorotrifluoroethane (FREON) is extremely flammable so handle with **care** and **keep** fire **or** sparks away from are while performing the analysis.

NOTES:

1. DO NOT **use** a bunsen burner for water bath.
2. Vent the seperatory funnel **properly.**
3. **Avoid** breathing the vapor of the solvent (freon).
4. **Avoid** getting solvent **on** the skin.
5. For additional information please refer **to** Standard Methods 18th edition book **page** 5-25.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

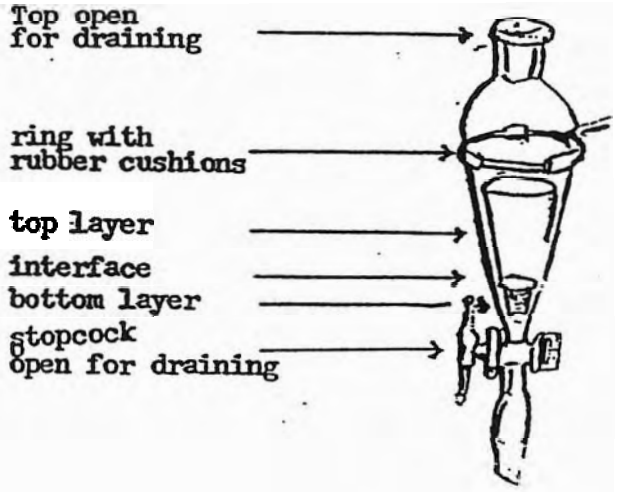
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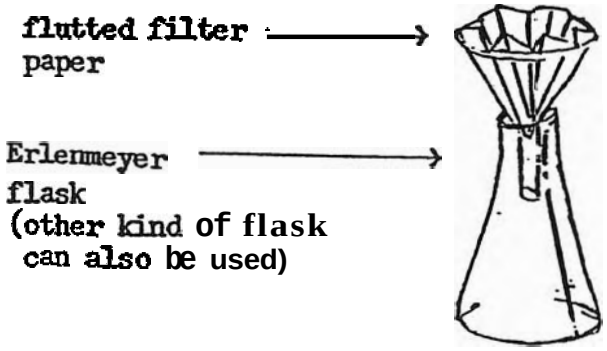
CAUTION:

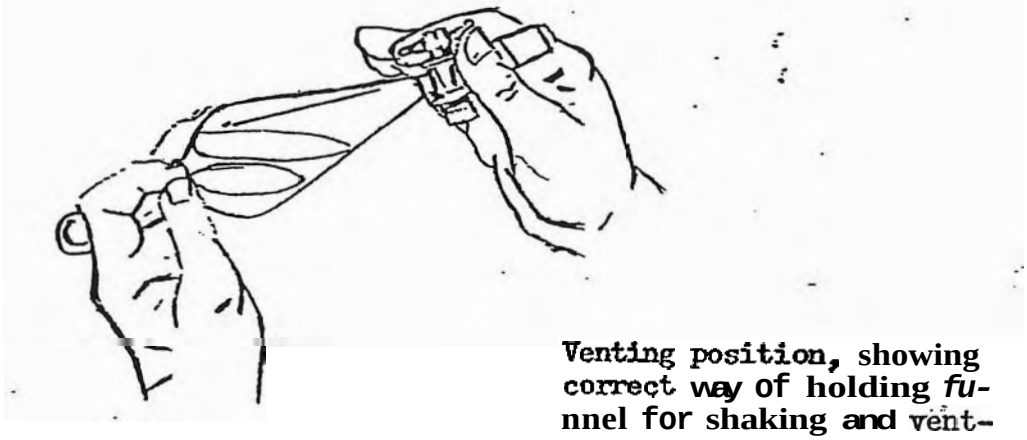
Trichlorotrifluoroethane (freon) is extremly flammable handle with great care and keep fire or sparks away from work area while performing the analysis.

DO NOT Use a bunsen burner for water bath.

- Vent the sepratory funnel properly.
- Avoid breathing the vapor of the solvent.
- Avoid getting the solvent on the skin.
- For additional informations refer to Standard Method 15th. edition, page 460.







Venting position, showing correct way of holding funnel for shaking and venting.

GREASE & OIL

NAME	DATE	TIME	SAMPLE DESCRXPE LOCATION	ANALYTICAL DATA	REMARK
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE: WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FUSK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	
				FLASK EXTRACT _____ GRMS FLASK TARE WT _____ GRMS NET WEIGHT _____ GRMS	

COMMENTS:

VOLATILE ACIDS TEST

DISTILLATION METHOD

Standard Methods 18th Edition, Page 5-42 Sections 5560 A-C

General Discussion:

Digestion is the process wherein anaerobic organisms, concentrated in a digester tank, decompose the waste organic materials in sludge into simple more stable and non-offensive compounds.

The groups of bacteria work to digest sludge. First, saprophytic bacteria will break down the large organic molecules present in the form of proteins, fats and carbohydrates into simpler organic acids, containing six atoms of carbon or less. Second, methane producing bacteria will further break down these acids, called volatile acids, into methane and carbon dioxide. When the rate of the acids produced equals the rate of acid breakdown with methane production, alkaline digestion progresses satisfactorily. When the process of digestion is upset, the volatile acid level rises rapidly. This condition is usually caused by the sudden inactivity of the methane producing bacteria and the continued production of volatile acids by the saprophytic bacteria. When this occurs, the volatile acid level. tends to climb by accumulation. Methane bacteria are much more sensitive to environmental changes in a digester. Sudden variations in digester temperature, pH, feed rate, or the introduction of undesirable waste material easily affect them, curtailing their normal functions.

Purpose:

The volatile acids test measures the acid content in sludge. This test measures the organic fatty acids produced during digestion which are water soluble and can be distilled, such as formic, acetic, propionic, butyric, valeric, and caproic acids. This information is valuable in maintaining digester control. Volatile acid levels below 300 ppm are desirable. Values greater than 1000 ppm are probably indicative of a serious problem. If the acids increase and continue to build up, this test will usually correct this condition, although other factor such as digester temperature, gas production and raw sludge solids concentration should also be checked.

Volatile Acids Test Cont.

Standard Methods 18th Edition, Page 5-42 Sections 5560 A-C

The straight distillation method will be described. This method is simple and requires little equipment. However, because of the continuously changing conditions in the distillation flask it may give slightly high results. Digested sludge liquor is separated from the solids by centrifugation; a measured volume of the supernatent liquor is then acidified to convert the buffered acids into an acid form. These acids are then distilled and titrated with 0.1 normal sodium hydroxide from which the acid content may be determined. If a centrifuge is not available, the liquor may be separated from the solids by filtering the sludge through coarse paper, such as a paper towel place in a funnel.

Equipment:

Glassware needed:
Graduated Cylinder 100 ml. (*2*)
Erlenmeyer flask 1000 ml.
Pipette 1 ml. 1/100
Flask *225* ml.
Filter w/ 90mm SS filter
Filter Flask w/ hose
Glass beads

Chemicals needed:
H2SO4 Sulfuric Acid Conc.
Phenol Indicator
Sodium Hydroxide
Celite Filter Aid

Procedure:

Place about 200 ml of sludge into a centrifuge bottle and centrifuge for about 15 minutes, or filter sample through coarse paper.
Measure 100 ml of the supernatent sludge liquor or filtrate into the distillation flask.

3. Add 5 ml concentrated sulfuric acid.
4. Add 150ml DI water to make a total volume of 250ml
5. Connect the flask to distillation apparatus.
6. Collect 100 ml of the distilled material in *an* Erlenmeyer flask which has been previously marked at the 100 ml level.
   Titrate distillate with 0.1 N Sodium Hydroxide (NaOH).
   a) Add several drops of phenolphthalein indicator.
   b) While stirring, add from a buret standard (0.1 N) sodium hydroxide until the pink color of the indicator solution first appears.

Volatile acid test Cont.

Standard Methods 18th Edition, Page 5-42 Sections 5560 A-C

Note: This color should disappear on standing **for several** mins.

Ml of NaOH used = _____

8. Calculation of the volatile acids = If 100 ml of sludge sample is taken, then Volatile acid in mg/L = (ml of standard NaOH used) x ***86.5.***
9. Record results of test. Volatile acids = _____ mg/L.
10. Sample calculation:
    Ml **of** Standard NaOH used = 2.0ml
    Volatile acids, mg/L = (ml Std. NaOH used) x ***86.5***
    Volatile acids, mg/L = **2.0** X **86.5** = 173 ppm

Precautions:

1. The sludge sample must be representative of the digester. The sample line should be allowed to run fur a few minutes **before the** sample Is taken. The sample temperature should be **as** warm as the digester itself.
2. The sample for the volatile acids test should not be taken immediately after charging the digester with raw sludge. Should this be done, the raw sludge may short circuit to the withdrawal point and result in the withdrawal of raw sludge rather than digested sludge. Therefore, after the raw sludge has been fed into the tank, the tank should be well mixed by re-circulation or other means before a sample is taken.
3. If a digester is performing well with low volatile acids and then if one sample should unexpectedly and suddenly give a **high** value, say **over** 1000 ppm of volatile acids, do not become alarmed. The high result may be caused by a poor, non-representative sample of raw sludge instead of digested sludge. Resample and retest. The second test will probably give a more normal value.
   However, continued high values of volatile acids will usually mean that corrective measures should be taken, such as reducing the feed rate, reseeding from another digester, maintaining optimum temperatures, or cleaning the tank of grit and scum.
4. Be sure that the cooling water is running through the condenser.
5. Be sure that the H_2SO_4 has been added before distillation begins. If the solution is alkaline, the volatile acids **exist** as ammonium salts and will not distill over.

6. Be certain to distill only 200 ml of condensate. Additional distilling beyond 200ml may cause **serious** errors and very high results, instead of correct **answers,** for the excess sulfuric acid may start to fume and distill over.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

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Alkalinity

Standard Methods 18th Edition, Page 2-25 Sections 2320 A-B

Equipment:

Graduated cylinder 50ml
Beaker 80ml
5ml Pipette
H_2SO_4 solution
PH meter
D.I water

For sampling points and techniques please refer *to* page _____

Procedure:

Note: The pH meter must be recalibrated to the proper range of 4-7 for this particular test. Refer to pH page for step by step instructions.

1. Take the 50ml graduated cylinder and add 45ml D.I. water.
2. Pow the 45ml D.I. water into 80ml beaker.
3. Take 5ml pipette and add 5ml of digester supernatent which has been seperated from the sludge sample during the volatile acid test (both tests are run at the same time). This will bring the total amount of sample in the beaker to 50ml (5ml of supernatent and 45ml D.I. water).
4. Grab another clean 5 ml pipette and fill with sulfuric acid solution to 5 ml. Place sample on stirrer and insert pH probe. While stirring, titrate the sample using your sulfuric acid solution until the pH meter reaches 4.30 pH, which usually requires multiple fillings of the pipette.
5. When 4.30 PH is reached, add up the total ml of sulfuric acid solution applied to reach 4.30 pH. Multiply the sulfuric acid used in ml by 200 and this is the alkalinity.
6. Log results in laboratory log sheet.

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

VOLATILE ACID & ALKALINITY

DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			
DATE	PH.	VA.	ALK.	RATIO.
DIGESTER #	TEMP.			

COMMENTS:

Volatile Matter / Moisture

Refer to Standard Methods 18th Edition Page 2-57 Section 2540 B,E

General Discussion:

A well mixed sample is evaporated in a weighed dish and dried to a constant weight in an oven at 103" to 105° C. The increase in weight *over* that **of** the empty dish represents the total solids. **The** results may not represent the weight of actual dissolved and suspended solids in wastewater samples.

Equipment:

Porcelain dish
Furnace
Desiccator
Drying oven
Analytical balance

Procedure:

Remove a crucible from the oven and allow it to cool to scale temperature in desiccator. Weigh the empty crucible to establish a tare weight and log on sheet. Pour a representative sample into pre weighed, fully cooled crucible approximately one third full and weigh immediately. Log weight on Sludge Moisture / Volatile Solids log sheet and place the crucible in the oven (103°-105°C). Allow crucible to stay in the oven overnight, thus removing *any* moisture from the sample. Remove and cool to scale temperature in desiccator. Sample is now ready to be placed in the muffle furnace at 500° ±50°C **for** 15 to 20 minutes thus burning off all volatile matter leaving only inorganic material. Remove carefully (HOT) and place in desiccator until it is cooled to scale temperature. Weigh and record results in log sheet. Perform calculations on log sheet to determine percent moisture and percent volatile solids.

Refer to Standard Methods 18'' Edition Page 2-57 Section 2540 B,E

Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05
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SLUDGE MOISTURE

DATE/ DIGESTER #			
WT OF DISH & WET SLDG			
WEIGHT OF DISH			
WT OF WET SLUDGE			
WT OF DISH & WET SLDG			
WT OF DISH & DRY SLDG			
LOSS IN WEIGHT			
MOISTURE (LOSS IN - WT MULTIPLIED BY 100 / WT OF WET SLUDGE			
SOLIDS (ZOO- MOISTURE)			

VOLATILE CONTENT

WT OF DISH & DRY SOLIDS			
WT OF DISH			
WT OF DRY SOLIDS			
WT OF DISH & DRY SOLIDS			
T OF DISH & ASH			
OSS IN WEIGHT			
OLATILE MATTER (LOSS- N WT MULTIPLIED BY 100 WT OF DRY SOLIDS			

COMMENTS:

1 OBJECTIVES

The primary objectives of the BC Laboratories, Inc. (BCL) Quality Assurance Program Plan (QAPP) are to provide QA/QC guidelines to 1) assure the data produced is of known quality, 2) ensure our organization is capable of providing results which are of value to our customers. 31 ensure the system can consistently perform under adverse conditions, and to 4) comply with quality goals and objectives as set forth in government and industry standards.

2.1 POLICY STATEMENT

B C Laboratories Inc. is an organization committed to providing legally defensible data that is technically valid and in accordance with professional standards, project goals, and government regulations. The management and staff at B C Laboratories, Inc. are committed to use all available resources to supply accurate, precise, timely and fully documented results, BCL's goal is to provide analytical results and services which are of value to our customers,

1.2 COMPONENTS OF THE QUALITY PROGRAM

Our overall program can be broken down into five essential parts: *1) Preclusion, 2) Assessment, 31 Validation, 4) Corrective Action, and 5) improvement.*

PRECLUSION: This Is comprised of an orderly program of positive actions taken before and during analyses to ensure that analytical systems are functioning properly. Components include quality control planning, training, documented and approved methodologies, calibration of instrumentation, instrument maintenance, comprehensivestandardization, control charting, internal and external monitoring.

ASSESSMENT: This includes all components of determining analytical performance. Components include matrix duplicates, matrix spikes, matrix spike duplicates, post spikes, blank spikes, blank spike duplicates, laboratory control samples, calibration checks, calibration blanks, method blanks and surrogate additions. Inclusion of all or some of these components and their frequencies are method dependent. B C Laboratories' standard operating procedures (SOP's) contain all pertinent information concerning respective QC criteria needed for assessment and approval of data.
The adequacy of the QC program is measured through internal and external auditing and client feedback on customer surveys.

VALIDATION: This consists of all the steps taken to ensure that generated analytical data is complete and correct, Steps include maintenance of sample tracking and data precessing *systems,* technical review of raw dara and final results review and approval by management staff,

CORRECTIVE ACTION: The actions rendered to determine the causes of quality defects and restore proper function of the analytical system. This includes troubleshooting techniques, re-evaluations of analyses and/or methodologies, dilution, calculation checks and continued training of analysts.

IMPROVEMENT: Actions taken to improve standard quality baselines. Steps include assessing windows of improved performance, total *quality* management training of personnel, and research / development.

1.3 OTHER SOURCES FOR QUALITY GUIDELINES

Since BCL's scope of work is very diversified, pertinent Standard Operating Procedures (SOP's) are used at the bench level to provide guidance and direction, Specific project plans are developed to narrow the scope of work, and thus provide QA/QC protocols on a limited scale and provide for possible modifications to standard practice. ,

1.4 REVISION PRACTICES

evi

The QA Officer is responsible for the maintenance of tha QAPP. R ewof this plan should take place by each department supervisor end President before the end of each calendar year. All revisions and additions are submitted to the word processing specialist for entry, then each revision is reviewed by pertinent personnel. Once final approval is granted, the revision number is sequentially increased by one and the date of approval is recorded. All revised sections are distributed to persons who have controlled copies of the QAPP.

3.0 QUALITY OBJECTIVES

Quality assurance objectives are set to provide the metrics necessary to assess and ensure the quality of generated data. Laboratory QA objectives will be accomplished by applying EPA method acceptance criteria and laboratory internal controls for QC parameters including preparation blanks, surrogates, spikes, duplicates and laboratory control samples. Participation in various audit studies, internal and external will be used to verify the adequacy of the quality objectives. Laboratory data quality will be quantitatively assessed through accuracy, precision and respective method limitations. Qualitative assessment will be conducted through comparability, representativeness and completeness studies.

Specific Parameters:

- **Accuracy** - Defined as the degree to which the analytical measurement reflects the true value present. Surrogate, ICV, CCV, RLS, LCS and matrix spike recoveries will be used to measure accuracy. See section 13.4 for the algorithm used to measure accuracy.

- **Precision** - Defined as the measure of mutual agreement among individual measurements of the same pollutant in a sample, secured under the same analytical protocols. Laboratory precision will be expressed as relative percent difference (RPD). The goals for precisian are related to the proximity of the sample to the detection limit. At or less than five (5) times the PQL, the precision goal will be axpressad in absolute concentration (quantitation limit) terms. See section 13.4 for the algorithm used to compute the relative percent difference.

- **Representativeness** - Dependent upon the sampling plan. Assessment of site and collection representativeness is done by subcontracted or laboratory field service personnel. Procedures to ensure representativeness will be determined prior to the initiation of individual projects,

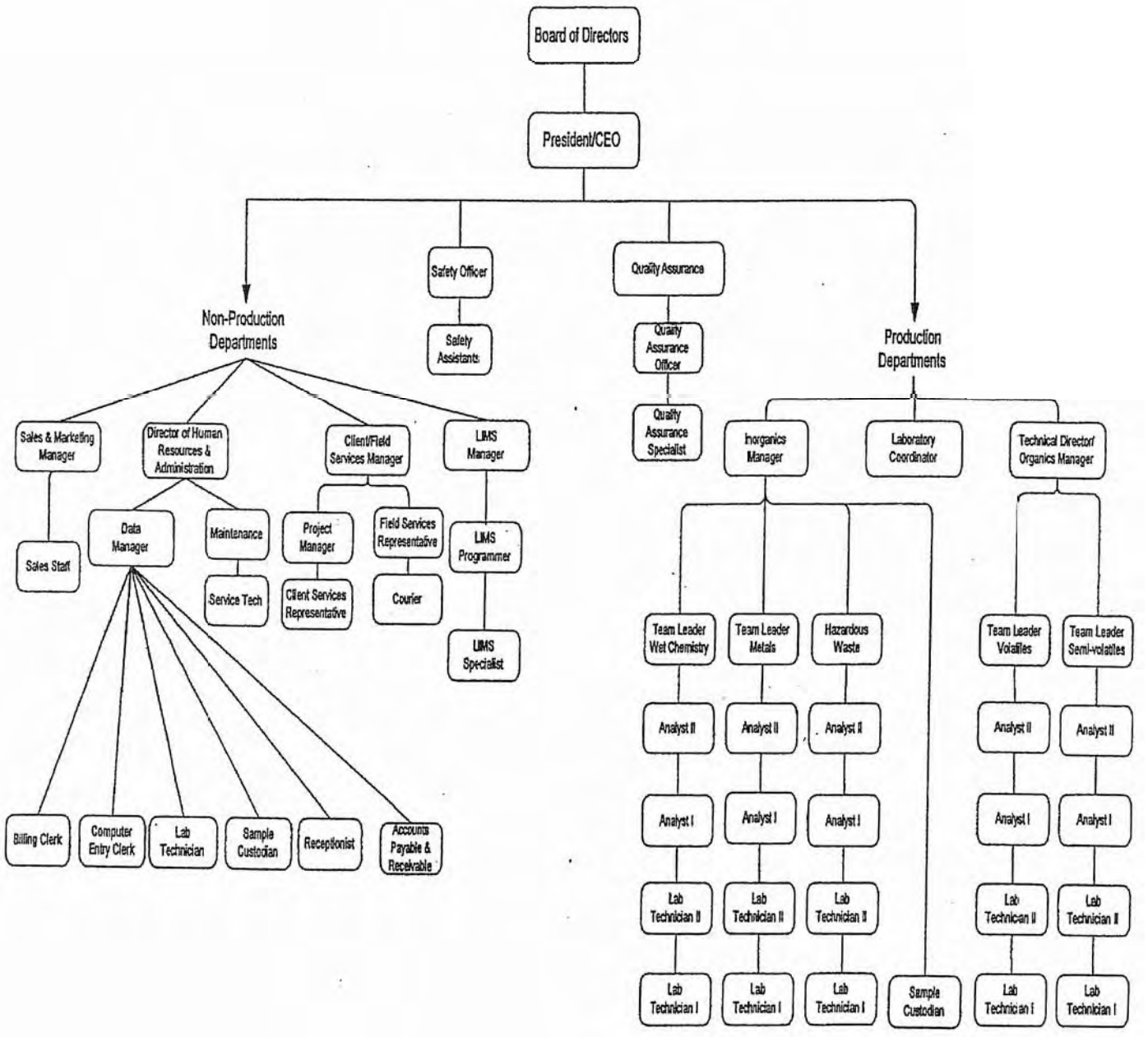
- **Comparability** - Defined as the extent *to* which samples can be verified or duplicated by another independent laboratory or compared against results previously found. Comparability will be assessed through parallel studies, round *robin* programs and internal and external audit results, Acceptable levels of comparability will be addressed in specific project plans.

- **Completeness** - Defined as the percentage of valid data obtained, as judged by objectives, compared to the total amount of data collected. QC parameters that shall be assessed far quantitative determinations of completeness shall include initial calibrations, continuing calibrations, surrogate percent recovery, RPD's of duplicates, percent recovery and RPD for matrix spike recoveries, percent recovery for laboratory control samples, and holding times. The requirement for the quantitative assessment of completeness is *90%.*

- **Sensitivity** - Established practical quantitation limits (PQL's) and method detection limits based on 'procedures outlined in Appendix B of 40 CFR Part 136, have been documented for analytes of interest. (See Appendix B). Please *note* that these detection limits are established under ideal conditions, i.e., matrices used for detection limit studies are "clean" soils and deionized laboratory water. MDL studies must be performed annually for each matrix type - water and soil. MDL's and PQL's must meet standards set in SW-846, EPA 500 series methods, EPA 600 series methods and standard methods 18th edition. Spacial provisions may be necessary in cases of project specific goals, which exceed the aforementioned standards. MDL/PQL derivation procedures are addressed in the QA Protocols Manual.

FIGURE 2

BC laboratories, inc.
Laboratory OrganizationalChart
Company Structure



4.0 SAMPLING PROCEDURES

Proper collection, preservation and storage of samples is needed to ensure sample integrity and representativeness. Samples are collected by trained, experienced field personnel according to guidelines established by Standard Methods for the Examination of Water and Wastewater, Test Methods for Evaluating Solid Waste (SW-846), and 40 CFR Pan 136. The Field Services Standard Operating Procedures (SOP] Index, displays the scope of capabilities of our Field Services Department. All protocols for proper sample collection and handling are addressed in respective Field Service SOP's.

4.1 DOCUMENTATION

Proper documentation, including use of Sampling Logs, Field togs and Chain-of-Custody forms are maintained throughout sampling procedures. field measurements are recorded in ink in bound field Logs with entries signed by respective fietd service personnel. Field sample information is entered directly into the LIMS upon receipt by a representative of the Sample Control Department. A chain of custody form must be properly completed to track samples in from the field.

4.2 SAMPLE CONTAINERS

All samples collected have proper containers and preservatives with which they are associated. Containers are monitored for artifacts an a quarterly basis or whenever new containers are used.

Table 1 displays information on proper containers, preservatives and holding times.

4.2.7 SAMPLE BOTTLE / CONTAINER PROCESSING

Preservatives are routinely analyzed before usage. Documentation exists to trace the preservative used for each sample submitted in a laboratory supplied containers.

1. Containers are prepared.
2. Preservatives are mads as needed.
   - A. Reagent - grade chemicals are used.
   - B. Once the preservative is made, it is given a batch ID.
   - C. The preservative is tested before use by testing an aliquot brought up to volume in a proper sample container.
   - D. The preservative test Is logged into the LIMS.
   - E. The preservative is analyzed for constituents of concern.
   - F. If all constituents of concern are not detected, the preservative can be used. If detections are found, the process must be reinitiated.
3. A reagent log is kept on file *to* record chemicals used.
4. Analytical records are kept by the Sample / Data Control Supervisor.

4.2.2 TRIP BLANKS

Trip blanks are used to identify the presence of volatile compound contamination attributable to transfer across a sample container septum during shipping and storage of samples. A trip blank is a sample of analyte-free matrix that is transported from *the* laboratory to the field with sample containers, then stored during sampling and finally transported back *to* the laboratory with the samples. The trip blank is then treated as an environmental sample In the laboratory with the following exceptions:

1. Analyze trip blanks only when detections are found in associated samples.
2. Analyze according to specific project protocols,

4.2.1.1 Trip blank Preparation

Trip blank matrix is prepared In the laboratory by purifying deionized water. Deionization of laboratory water can be broken into two major steps, macro and micro polishing. Tap water is passed through large resin beds then polished by being passed through a second set of micro resin beds and a carbon cartridge. After purification, the water is collected into a large glass bottle, which is fitted with a carbon filter. A sample, labeled with the batch

number and date, is then taken in a 40 ml VOA and analyzed for volatiles by GC/MS. If any analyte concentrations are found above 1 µg/L, the process *is* re-initiated.

4.2.1.2 Monitoring

Every week the stored trip blank water must be analyzed to assure integrity. A sample is taken and labeled with the dare and the batch number followed with a letter *from the* alphabet, which corresponds *to* the number of samplings after the initial sampling.

Example: Batch 215 initialized and sampled on 05/23/97.
Tho following weeks' sample is labeled - Batch 215A 05/30/97.

If any target analytes are quantified above 2.0 µg/L, a new trip blank batch should be processed.

4.2.3 EQUIPMENT BLANK

A sample of deionized watsr, which is poured over or through field sampling equipment. This water is processad as an environmental sample in *the* laboratory for the use of verifying whether or not the decontamination of field equipment was adequate.

4.3 HOLDING TIMES

Samples should be analyzed as soon as possible after collection. The times listed in Table 1 are the maximum time limits that the samples may be held before requested analyses are initiated. Analyses conductad beyond proper sample holding times are to be considered minimum values. Samples may be held *for* longer periods if the permittee, or monitoring laboratory has data on file to show that the specific types of samples under study are stable for a longer time, and has received a variance from the person in authority. A permittee, or monitoring laboratory is obligated to hold samples for shorter times if knowledge exists showing necessity of maintenance of sample stability. Our goal is to meet every holding *time.*

4.4 SAMPLE *I* CONTAINER ORDERING

Completing a bottle order Is the responsibility of Client Service personnel. An order is completed by entering ail pertinent information from the client into the LIMS. The bottle order form is generated and submitted to the bottle preparation technician. The bottle preparation technician completes the tasks listed on the bottle preparation form and acknowledges completion with the ordering party. Sample containers are now available for client pick up, shipping or courier submittal, A copy of the bottle order form Is included for each respective bottle order and should be submitted back to the laboratory after field activities. An example *of* a Bottle Order Form Is given in Figure 3. The bottle ordering process flow chart *is* located in Appendix E.

5.0 SAMPLE CUSTODY

All samples must remain under custody from the time of sample collection to the time of sample disposal. A sample is considered under custody if:

1) It is in one's or a team's possession verified by some form of documentation, or

2) it *was* in one's possession and he/she locked it or placed *it* in a sealed container to prevent tampering, or

3) It is within the laboratory grounds.

5.1 CHAIN-OF-CUSTODY PROCEDURES

5.1.1 Samples will be collected, transported, and received under Chain-Of-Custody (COC) protocols consistent with proceduresestablished by the EPA for litigation-related practices. The Chain-of-Custodyrecord will validate the transfer of samples among client personnel, BCL Field Personnel, and/or BCL Sample Control Personnel.

5.1.2 Upon receipt at the laboratory, the Sample Custodian is the primary person who will assume sample custody. If the Sample Custodian is not available, any person from the Sample Control Department will be able to handle initial or secondary *custody* procedures.

5.1.3 The COC record is the documentation supporting the integrity of a sample from data collection to data reporting. COC procedures must be followed for all samples from which analytical results may be obtained and introduced as evidence in litigation.

6.2 COOLER RECEIPT FORM

5.2.1 Cooler Receipt forms will be used to document the condition and availability of samples on arrival at the laboratory. The temperature of the air inside sample coolers and/or the temperature of samples is recorded on the Cooler Receipt Form. Sample shipping, type numbers, condition, and containment *is* also recorded on this form.

5.3 SAMPLE LABELS AND CUSTODY SEALS

5.3.1 If sample containers originated from the laboratory, the sample labels will include fields for the following information:

5.3.1.1 Laboratory Name (defaulted)

5.3.1.2 Sample ID

5.3.1.3 Sampler ID

5.3.1.4 Date and Time of sampling

5.3.1.5 Method (defaulted)

5.3.1.6 Preservative if applicable (defaulted)

5.3.1.7 Preservative batch number if applicable (entered by lab personnel prior to shipping to client)

5.3.2 Some sample labels are color coded to indicate preservative types:

5.3.2.1 Yellow - Sulfuric acid

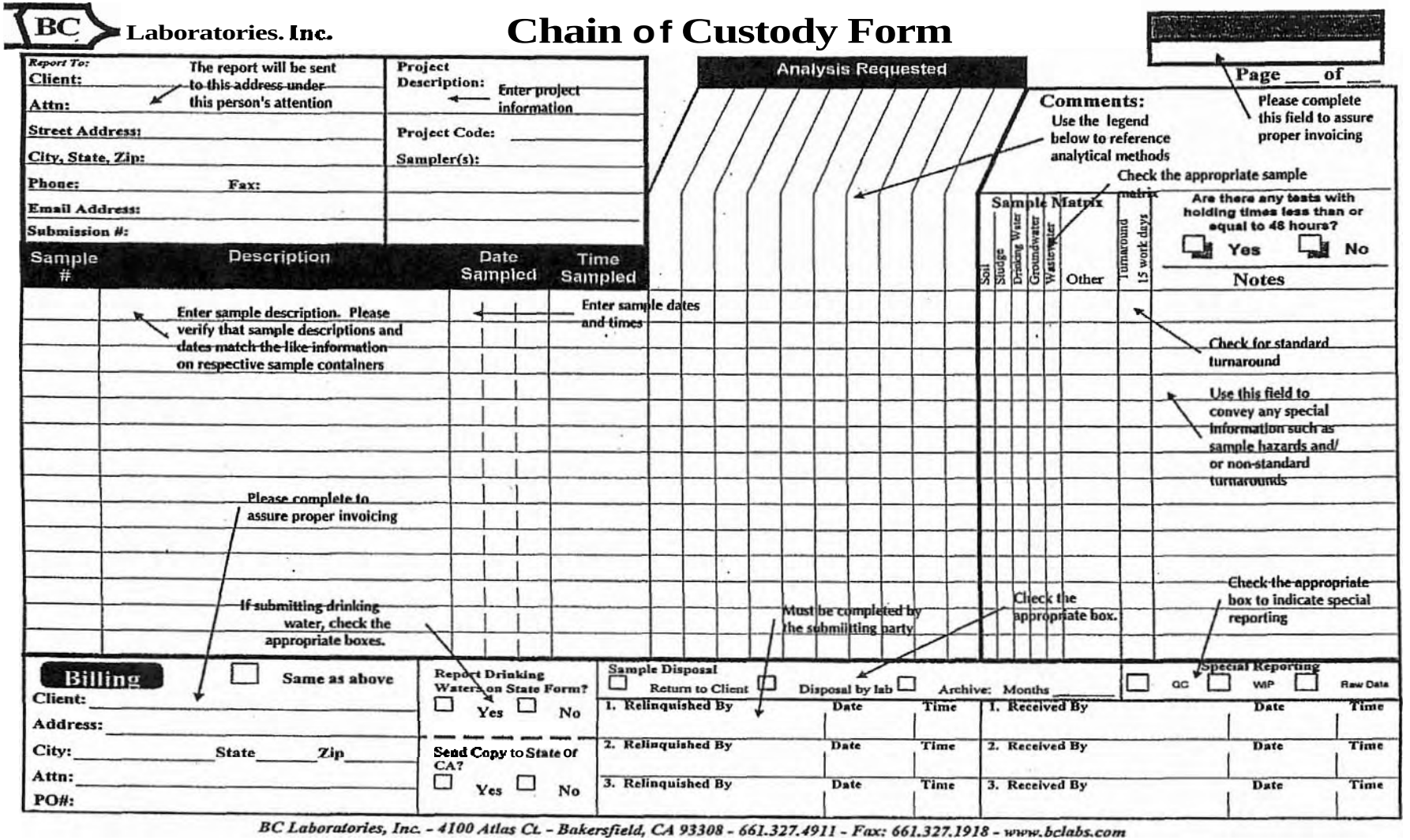
5.3.2.2 Red - Nitric acid

5.3.2.3 Green - Sodium Hydroxide

5.3.2.4 Blue - HCl

5.3.2.5 Brown - Zinc Acetate

FIGURE 4


BC Laboratories. Inc.
Chain of Custody Form
Page ___ of ___
Report To:
Client:
Attn:
The report will be sent to this address under this person's attention
Street Address:
City, State, Zip:
Phone: Fax:
Email Address:
Submission #:
Project Description:
Enter project information
Project Code:
Sampler(s):
Analysis Requested
Comments:
Use the legend below to reference analytical methods
Please complete this field to assure proper invoicing
Check the appropriate sample matrix
Sample Matrix
Soil
Sludge
Drinking Water
Groundwater
Wastewater
Other
Turnaround
15 work days
Are there any tests with holding times less than or equal to 48 hours?
Yes
No
Notes
Sample #
Description
Date Sampled
Time Sampled
Enter sample description. Please verify that sample descriptions and dates match the like information on respective sample containers
Enter sample dates and times
Check for standard turnaround
Use this field to convey any special information such as sample hazards and/ or non-standard turnarounds
Please complete to assure proper invoicing
If submitting drinking water, check the appropriate boxes.
Must be completed by the submitting party
Check the appropriate box.
Check the appropriate box to indicate special reporting
Billing
Same as above
Client:
Address:
City: State Zip
Attn:
PO#:
Report Drinking Waters on State Form?
Yes
No
Send Copy to State of CA?
Yes
No
Sample Disposal
Return to Client
Disposal by lab
Archive: Months
Special Reporting
QC
WIP
Raw Data
1. Relinquished By
Date
Time
2. Relinquished By
Date
Time
3. Relinquished By
Date
Time
1. Received By
Date
Time
2. Received By
Date
Time
3. Received By
Date
Time
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SAMPLING PROCEDURES

TABLE 1

GENERAL/INORGANIC CHEMISTRY

ANALYSIS	CONTAINER	PRESERVATIVE	CONTAINER	HOLDING TIME (FROM SAMPLING DATE)	
	WATER	WATER (2-6°C)	SOIL	WATER	SOIL
ALKALINITY	PT. PE	UNPRESERVED	N/A	14 DAYS	N/A
AMMONIA (NH_3)	PT. PE	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
BOD	QT. PE (HEADSPACE FREE)	UNPRESERVED	N/A	24 HR./ 48 HR.	N/A
BORON	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
BROMIDE	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
CHLORIDE	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
COD	PT. PE	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
COLOR	PT. AMBER GLASS	UNPRESERVED	N/A	48 HR.	N/A
CYANIDE (TOTAL AND/OR REACTIVE)	PT. PE	NAOH	8 OZ. JAR	14 DAYS	NO SPECIFIED TIME
EC (ELECTRICAL CONDUCTIVITY)	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
FLASHPOINT	PT. AMBER GLASS (GLASS ONLY)	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
FLUORIDE	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
GROSS ALPHA/BETA	1 L PLASTIC	UNPRESERVED	8 OZ. JAR	6 MOS.	6 MOS.
URANIUM	1 L PLASTIC	UNPRESERVED	8 OZ. JAR	6 MOS.	6 MOS.
HARDNESS	PT. PE	UNPRESERVED	N/A	28 DAYS	N/A
HEXAVALENT CHROMIUM ($Cr+^6$)	PT. PE	UNPRESERVED	8 OZ. JAR	24 HR.	30 DAYS TIL EXT/24 HR IN EXTRACT FORM
IODIDE	PT. PE	UNPRESERVED	8 OZ. JAR	24 HR.	28 DAYS
NITRATE/NITRITE (NO_3/NO_2)	2 OZ. PE	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
NITRITE/NO_2	PT. PE	UNPRESERVED	8 OZ. JAR	48 HR.	28 DAYS
NO_3 AS NO_3	2 OZ. PE	UNPRESERVED	8 OZ. JAR	48 HR.	28 DAYS
ODOR	PT. AMBER	UNPRESERVED	N/A	24 HR.	N/A
OIL & GREASE	1 L AMBER GLASS (GLASS ONLY)	HCl	8 OZ. JAR	28 DAYS	28 DAYS
418.1 (TPH BY IR)	1 L AMBER GLASS (GLASS ONLY)	HCl	8 OZ. JAR	28 DAYS	28 DAYS
PH	PT. PE	UNPRESERVED	8 OZ. JAR	IMMEDIATELY	IMMEDIATELY
PHENOLICS	4 OZ. AMBER GLASS (GLASS ONLY)	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
PHOSPHORUS - TOTAL (P)	PT. PE	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
PHOSPHORUS - ORTHO (PO_4)	PT. PE	UNPRESERVED	8 OZ. JAR	48 HR.	28 DAYS
SILICA	PT. PE (PLASTIC ONLY)	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
TDS	QT. PE	UNPRESERVED	N/A	7 DAYS	N/A
TSS	QT. PE	UNPRESERVED	N/A	7 DAYS	N/A
SS	QT. PE	UNPRESERVED	N/A	48 HR.	N/A
TOTAL SOLIDS	QT. PE	UNPRESERVED	N/A	7 DAYS	N/A
SPECIFIC GRAVITY	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
SULFATE	PT. PE	UNPRESERVED	8 OZ. JAR	28 DAYS	28 DAYS
SULFIDE, TOTAL	PT. PE	ZN ACETATE	8 OZ. JAR	7 DAYS	N/A
SURFACTANTS (MBAS)	QT. PE	UNPRESERVED	N/A	48 HR.	N/A
TOTAL COLIFORM	8 OZ. GLASS OR NALGENE	SODIUM THIOSULFATE	N/A	24 HR.	N/A
TKN (KJELDAHL NITROGEN)	PT. PE	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
TOTAL ORGANIC CARBON (TOC)	4 OZ. AMBER GLASS (GLASS ONLY)	H_2SO_4	8 OZ. JAR	28 DAYS	28 DAYS
TOTAL ORGANIC HALIDE (TOX)	PT. AMBER	H_2SO_4	8 OZ. JAR	7 DAYS	NO SPECIFIED TIME
TURBIDITY	PT. AMBER GLASS	UNPRESERVED	N/A	48 HR.	N/A

SAMPLING PROCEDURES

TABLE 1 (CONTINUED)

ORGANIC CHEMISTRY

ANALYSIS	CONTAINER	PRESERVATIVE	CONTAINER	HOLDING TIME		HOLDING TIME	
	WATER	WATER	SOIL	WATER		SOIL	
				EXTRACT	ANALYSIS	EXTRACT	ANALYSIS
• 601	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR	14 DAYS	14 DAYS	N/A	14 DAYS
• 602, 8021	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR	14 DAYS	14 DAYS	N/A	14 DAYS
• BTEX	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR	14 DAYS	14 DAYS	N/A	14 DAYS
• GASOLINE RANGE	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR	14 DAYS	14 DAYS	N/A	14 DAYS
• DIESEL RANGE	1 L AMBER GLASS W/TEFLON	UNPRESERVED	8 OZ. JAR	14 DAYS	40 DAYS	14 DAYS	40 DAYS
8240, 524.2/624/8260	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR	14 DAYS	14 DAYS	N/A	14 DAYS
504	3X VOA	UNPRESERVED	3X VOA	28 DAYS	1 DAY	N/A	N/A
531.1	4 OZ. AMBER GLASS	MONOCHLOROACETIC	8 OZ. JAR	FROZEN IN LAB, 28	N/A	N/A	N/A
547	4 OZ. AMBER GLASS	SODIUM THIOSULFATE	8 OZ. JAR	14 DAY	N/A	N/A	N/A
548	QT. AMBER GLASS	NONE	8 OZ. JAR	7 DAYS	14 DAYS	N/A	N/A
549	QT. AMBER PLASTIC	NONE	8 OZ. JAR	7 DAYS	21 DAYS	N/A	N/A
8080A, 608, 508, 8081, 8082	1 L GLASS AMBER W/TEFLON	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS/14**	14 DAYS	40 DAYS
8140/ 8141	1 L GLASS AMBER W/TEFLON	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS	14 DAYS	40 DAYS
8150, 615, 515.1, 8151	1 L GLASS AMBER W/TEFLON	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS	14 DAYS	40 DAYS
525.2/ 507	2X 1 L GLASS AMBER	SODIUM SULFITE & HCl	8 OZ. JAR	***14 DAYS	30 DAYS	14 DAYS	N/A
625, 8270C	2X 1 L GLASS AMBER	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS	14 DAYS	40 DAYS
MODIFIED 632, 632	1 L GLASS AMBER W/TEFLON	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS	14 DAYS	40 DAYS
TCLP • VOLATILES	2X VOA (HEADSPACE FREE)	HCl	8 OZ. JAR			14 DAYS	7 DAYS
• SEMI - VOLATILES	1 L AMBER GLASS (EACH TEST)	NONE	8 OZ. JAR			14 DAYS UNTIL TCLP LEACHING	

METALS

ANALYSIS	CONTAINER	PRESERVATIVE	HOLDING TIME (FROM SAMPLING DATE)
WATER			
METALS (1 OR MORE METALS) • TOTAL	QT. PE	HNO_3	6 MO. (28 DAYS-Hg)
• DISSOLVED • FILTERED IN FIELD	PT. PE	HNO_3	6 MO. (28 DAYS-Hg)
• NOT FILTERED	QT. PE	UNPRESERVED	6 MO. (28 days-Hg)
• ORGANIC LEAD	QT. AMBER GLASS	CHILL TO 2-6° C	14 DAYS UNTIL ANALYSIS
• HEXAVALENT CHROMIUM ($Cr+^6$)	PT. PE	UNPRESERVED	24 HOURS
SOIL			
METALS (1 OR MORE METALS) • TOTAL	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• SOLUBLE	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• EP TOXICITY	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• WET	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• TCLP (SEE ALSO ORGANIC CHEMISTRY)	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• SPLP	8 OZ. JAR	CHILL TO 2-6° C	6 MO. (28 days-Hg)
• HEXAVALENT CHROMIUM ($Cr+^6$)	8 OZ. JAR	CHILL TO 2-6° C	30 DAYS UNTIL EXTRACTION/24 HR. IN EXTRACT FORM
• ORGANIC LEAD	8 OZ. JAR	CHILL TO 2-6° C	14 DAYS UNTIL ANALYSIS

6.0 FACILITY

The facility was specially designed to alleviate those undesirable factors, which would affect quality in a detrimental way. Emphasis was placed on 1) minimizing cross contamination potentials, 2) providing extensive bench space and considerable refrigerated sample storage areas to ensure effective sample handling processes, 3) maximizing sample and data flow processes, and 41 ensuring a safe working environment.

Laboratory features:

1) (2) Walk-In and (4) large wall teach-in refrigerators
2) (6) Fire proof data storage rooms
3) chemical storage rooms
4) Two-ston/ Storage area
5) Hazardous Waste drum storage facility
6) (8) safety shower/eye stations
7) 131 hood rooms (24 hoods)
8) Conference room with reference library
9) Bottle preparation room
10) Automated sample submission *doors*
11) Sample split room
12) (3) Compressed Gas storage rooms
13) Kern Securities fire and security systems
14) On site maintenance department
15) Separate volatiles rooms: GC, GC/MS
16) (6) RAD Lab

The laboratory was built on a large lot which is company owned to accommodata expansion. Figure *6* displays the laboratory floor plan.

6.1 ORGANICS LABORATORY

6.1.1 Separate semi-volatiles and volatiles laboratories.

6.1.2 Semi- Volatiles .

6.1.2.1 Separate HPLC, and GC/MS Laboratories

6.1.2.2 Gases piped in from gas storage room.

6.1.2.3 1,600 sq. ft. of working area.

6.1.3 Volatiles

6.1.3.1 Located in the NW corner *of* the facility (Extractions located in the SE corner).

6.1.3.2 Two separate laboratories, *GGGCIMS.*

6.1.3.3 Maintained under positive pressure,

6.1.3.4 Special carbon filters are integrated into the ventilation systems.

6.1.3.5 *2,500* sq. ft. of working space.

6.1.4 Extractions

6.1.4.1 Laboratory equipped with 10 ventilated hoods.

6.1.4.2 400 cubic ft. refrigerator.

6.1.4.3 750 sq. ft. of working space.

6.2 WET CHEMISTRY LABORATORY

6.2.1 3,200 sq. ft. of laboratory space.

6.2.2 560 cubic ft. of refrigerator space.

6.2.3 Preparation area segregated from analytical laboratory.

6.2.4 Six (6) laboratory hoods.

6.3 METALS LABORATORY

6.3.1 Separate preparation areas (soil / water).

6.3.2 Two analytical laboratories (ICP, ICP-MS / GFAA-AA, CV)

6.3.3 Gases piped in from gas storage room.

6.3.4 2,200 sq. ft. of working space.

6.3.5 500 cubic ft. refrigerator.

6.3.6 Seven (7) laboratory hoods.

6.4 LOG-IN DEPARTMENT

6.4.1 1,000 sq. ft. of working space.

6.4.2 100 cubic ft. of refrigerator space.

6.4.3 One (1) laboratory hood.

6.5 RECORD KEEPING

6.5.1 Five (5) Sea - Trains for data and equipment storage.

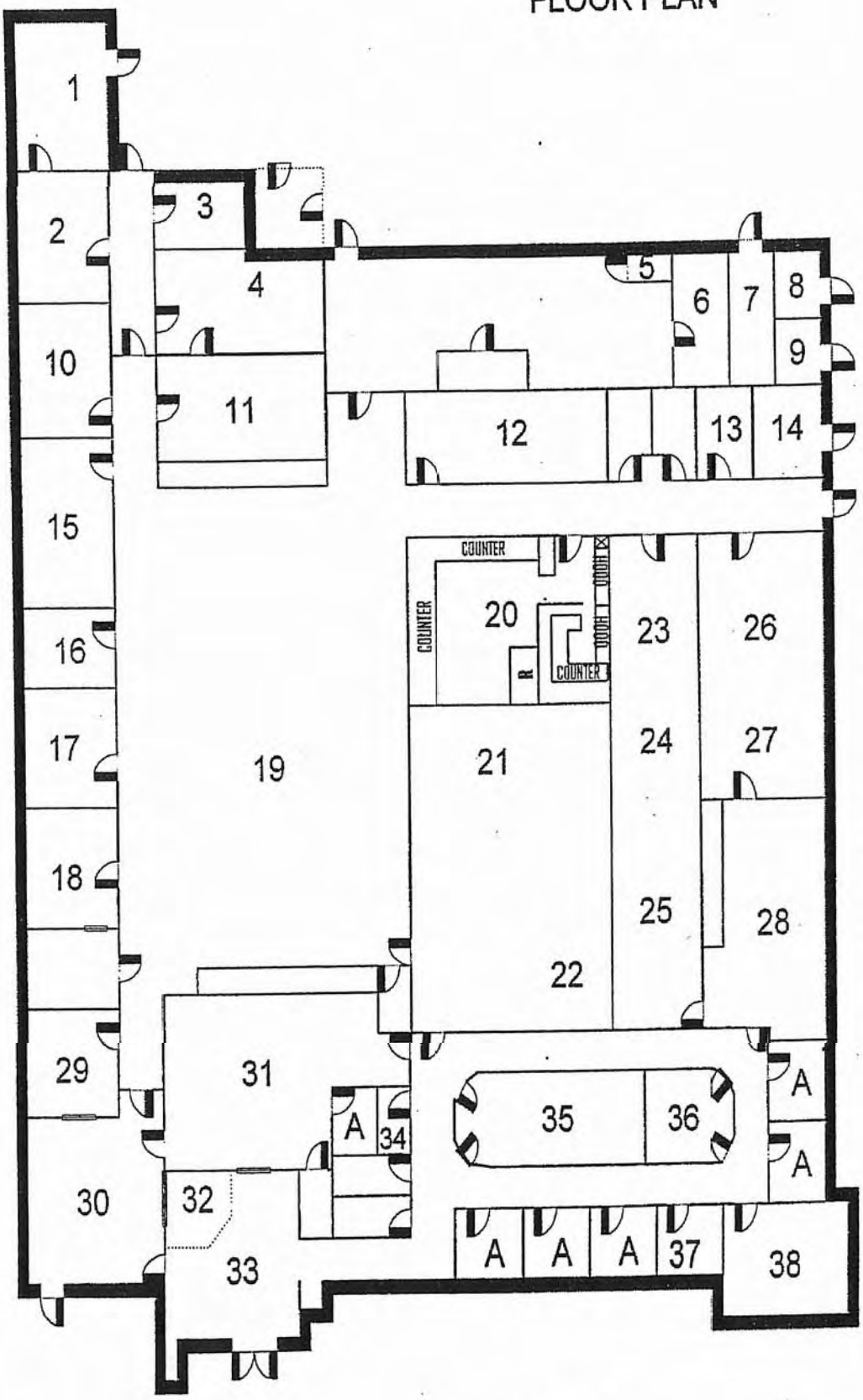
6.5.2 Fireproofed data storage room for temporary storage of data.

6.6 WASTE DISPOSAL AREA

6.6.1 Built from the ground up to be a waste disposal storage unit.

6.6.2 Secondary containment for individual waste containers.

BC LABORATORIES, INC.
4100 Atlas Court
Bakersfield, CA 93308
FLOOR PLAN



KEY

1	GC Volatiles
2	GC/MS Volatiles
3	Sample Splitting
4	GC/MS Volatiles
5	Compressed Air Dryer
6	Maintenance Office
7	Gas Storage
8	Gas Storage
9	Gas Storage
10	ICP Lab
11	GC/MS Volatiles
12	Metals Digestion (Solids)
13	Solvent Storage
14	Electrical Room
15	Atomic Absorption Lab
16	Bottle Prep
17	Metals Digestion Water)
18	Bacteriology
19	Wet Chemistry Department
20	RAD LAB
21	Metals / Misc. Department
22	QA/QC Department
23	GC/MS Semi-Volatiles Lab
24	TPH tab
25	Pesticides / PCB's Lab
26	GC Lab
27	HPLC Lab
28	Organic Extraction
29	Data Control Department
30	Sample Receiving Dept
31	Client Services/Log-in Dept
32	Reception
33	Lobby
34	Computer Room
35	Break Room
36	Conference Room
37	President's Office
38	Chairman of the Board
A	Administrative Office
H	Hazardous Waste Storage

Figure 6

7.0 PERSONNEL

BC Laboratories, Inc. is staffed by qualified, experienced and well-educated personnel. Brief résumés on key personnel are located in our Statement of Qualifications manual. Job descriptions have been finalized for all laboratory positions. Please refer to the Job Description manual for further details. Each position requires specific qualifications to be met. The training program is structured to ensure that curricula addresses specific needs of employees and the organization.

7.1 QUALIFICATIONS

Technical positions require minimum educational standards and experience to be met. These minimum requirements are documented in BC Laboratories, Inc. Job Description Manual. Each analyst must perform an initial demonstration of competency (IDC) before analyses solely generated by the concerned analyst can be reported to clients. These IDC's will follow guidance as listed in SW-846, Method for the Determination of Metals in Environmental Samples, Methods for the Determination of Organic Compounds in Drinking Water, and Standard Methods, 19th edition.

Training is conducted by persons with a solid background in respective subject matter. Module training is presented by individuals who are technically competent and qualified in instructional techniques.

7.2 INTERNAL TRAINING PROGRAM

Basic skills and training knowledge are conducted through in-house programs and/or subcontract programs. The in-house program includes an initial orientation, on the job training and a training module program, which covers various aspects of laboratory operations.

In House Training Modules (offered as needed and/or every other year). See the QAPM.

MODULE	TOPICS	JOB TITLES (numbers correspond to Job Titles)	TRAINER
1 SECONDARY	**Basic Laboratory Operations** Math and Science Basics Introduction to Quality Control Introduction to Laboratory Analyses Physical Properties	To Be Determined	Danette Bohm Marna Atencio
2 PRIMARY	**Laboratory Math I** Units of Measurement Significant Figures and Rounding Percents Exponential Numbers	13,21-I, 22-I, 23-I 21-O, 22-O, 23-O, 24-O	Danette Bohm Richard Penner
3 SECONDARY	**Laboratory Math II** Dilutions Percent Solutions Molar Solutions Normal Solutions	To Be Determined	Danette Bohm Richard Penner
4 PRIMARY	**Laboratory Math III** Basic Statistical Concepts SPC and Normal Distribution Control Charts	13,20-I, 21-I, 22-I, 23-I, 24-I, 20-O, 21-O, 22-O, 23-O, 24-O	Danette Bohm Richard Penner
5 PRIMARY	**Sample Containers, Preservation, Holding Times** Container types per respective analyses Preservatives Holding Times Restrictions References	9,10,13,14,17,21-I,22-I, 32	Karen Bonanno
6 SECONDARY	**Quality Assurance, Quality Control** Concepts Parameters Basic Tasks Measurement and Assessment Documentation and Audits Corrective Logic	7, 8, 9, 12, 13, 14, 21-I, 21-O, 29, 30, 32	Danette Bohm

7.3 ON THE JOB TRAINING

After the orientation is completed, the trainee will be directed to his/her respective department supervisor. The department supervisor will initiate on the job training procedures. (See the Training Procedures in the QAPM).

7.4 INITIAL DEMONSTRATION OF COMPETENCY

Each analyst must perform an initial demonstration of competency (IDC) before analyses solely generated by the concerned analyst can be reported to clients. These IDC's will follow guidance as listed in SW-846, Methods far the Determination of Metals in Environment Samples, Methods for the Determination of Organic Compounds in Drinking Water, and Standard Methods, 19th edition.

7.5 EXTERNAL TRAINING PROGRAM

External training is conducted through manufacturer's instrument training programs, various independent seminars, California State University at Bakersfield (CSUB), and Bakersfield College. External training is addressed under the Educational Assistance section of the Employee Policy Manual.

Each supervisor is encouraged to attend at least ens outside services seminar or training session, which would enhance his/her job performance or knowledge. In order to attend, supervisors must be granted an approval by the General Manager,

7.6 SAFETY

Safety training begins with the new employee orientation. Quarterly safety meetings are held to provide for continuing training regarding safety- related updates and to ensure safe working conditions by providing reiterated safety practice and policy Information. All employees,

unless absence is approved by the Safety Officer, are required to attend quarterly meetings. Meeting schedules can be found posted in the lunchroom or in the Injury and Illness Prevention Plan.

7.7 PERFORMANCE EVALUATIONS

To monitor employee progress and efficiency, department supervisors evaluate each specialist annually. These annual screenings are conducted on a one-on-one basis with supervisors rating employee performance on various job-related subjects. During these interviews, goals are set to provide for deficiencies, or to help employees further their training and skills. Evaluation forms used are exclusive far each laboratory department. (See Appendix C to see an example of an evaluation form.)

7.8 EMPLOYMENT

BC Laboratories, Inc. offers a comprehensive benefit package for each employee to ensure a productive and efficient work force. All agreements and particulars are addressed in tha BC Laboratories, Inc. Employee Policy Manual.

8.0 RECORDS

Documentation is the heart of every viable QA/QC Program. Without adequate documentation the ability to defend generated data is impossible. The purpose of documentation for viable QA/QC programs is to provide the ability to defend and recreate *steps* taken associated with each sample from sampling to final submittal and disposal. Documentation falls into two categories: 1) *documents* providing assurance *of* data quality objectives, and 2) documents providing information pertaining to contingent processes to support activities concerning sample and sample data handling. Necessary documentation includes:

8.1 SAMPLE CONTROL RECORDS

8.1.1 Chain of Custody - A record verifying the custody of samples and requested and associated analyses. The COC will be generated by the person(s) in the field. Completion *of* this record is addressed in the LOG-IN SOP.

8.1.2 Internal Sample Tracking Records

8.1.2.1 Refrigerator Logs - Logs which track internal sample custody used in the Organics's, Wet Chemistry, and Metals Departments.

8.1.2.2 Sample Split Log - Record of sample preparation of solid matrices prior to analytical manipulations.

8.1-2.3 Water Tracking Log - Used to track internal sample custody in the Metals Department.

8.1.2.4 Disposal Log - Tracks sample route from temporary storage *to* disposal.

8.1.2.5 Archive Refrigerator Log - Record of internal sample tracking for archived samples.

8.1.2.6 Internal Chain of *Custody Ledger* - Record of initial sarnple tracking record.

8.1.3 Sample Receipt Form - Record of samples submitted and their disposition, condition, and number.

8.1.4 Sample Control ApprovalForm - Provides a review of the log-in process an a submission basis. Also used to verify sample condition.

8.1.5 Preservative Reagent Log - Record *of* preservative preparation.

8.2 ANALYTICAL / INSTRUMENT RECORDS

8.2.1 Bench Worksheets (Analytical Data Forms) - Used to record analytical results and support information.

8.2.2 Extraction Lag - Record of sample extraction.

8.2.3 Digestion Log - Record of sample digestion.

8.2.4 Filtration Log - Used to document sample filtration.

8.2.5 Analysis Logs (Run Log) - Record of the sample analytical sequence on respective instrumentation. Can include other QC Information.

8.2.6 Maintenance Lag - Used to document routine maintenance and subcontract repair *of* Instrumentation.

8.2.7 Standards Log - *Record* of standards preparation.

8.2.8 Reagent tog - Record *of* reagent preparation and use.

8.2.9 Raw data - Printouts, charts, and chromatograms produced by instrumentation. Also will include handwritten records for Instrumentation without printing capabilities.

8.2.10 LIMS printouts - Records of Instrument processing and laboratory corrective activities.

8.2.11 *QC* Sheets - Used to document QC and batching capability.

8.3 QA/QC RECORDS

8.3.1 Technicat Review Sheets - Formatted sheets which guide reviewers re parameters of interest. Record of technical review.

8.3.2 Balance Monitoring Log - Used to document analytical and top-loading balance calibration on a daily basis.

8.3.3 Refrigerator Monitoring Log - Used to document refrigerator temperatures on a daily basis.

8.3.4 Oven Monitoring Log - Used to monitor ovsn temperatures on a work basis.

8.3.5 Thermometer Calibration Check Log - Record of thermometer external checks against a NIST reference thermometer.

8.3.6 Waterbath Logs - Record of waterbath temperature during analysis.

8.3.7 Auto-diluter Calibration Record - Gravimetric checks of auto-diluter volume deliveries,

8.3.8 Data Custody Ledger - Record of custody of data.

8.3.9 Spreadsheets - Used to track

8.3.9.1 SIF's

8.3.9.2 Altered Completed Forms

8.3.9.3 Logbooks

8.3.9.4 Instruments

8.3.9.5 Support Instruments

8.3.9.6 Audits

8.3.9.7 Sample Custody

8.3.9.8 Capacity

8.3.9.9 Data Custody

8.3.9.10 IDC - Initial Demonstration of Competency Forms

8.4 SUPPORT DOCUMENTATION

8.4,1 Phone Records - Record of phone correspondence between laboratory personnel and clients.

8.4.2 Sample Trackhg Logs - Record of sample tracking via project coordinators.

8.4.3 Archived Files Request Log - Used to document requests for archived *files*.

8.4.4 Subcontract COC Log - Record of sample tracking of submissions to a subcontractor.

8.4.5 Shipping Logs (Federal Express / UPS / DHL) - Used to track shipping of samples and/or data supplies.

8.4.6 Requisition Form - Procurement record.

8.4.7 Altered Completed Files Form - Record of modifications made to *records* which have been filed.

8.4.8 Maintenance Request Form - Record of scheduled maintenance.

9.0 INSTRUMENTATION

9.1 Wet Chemistry

9.1.1 Ion Chromatographs

Instrument	ID	Analysis	Year in Service	Method
Dionex Model 2000i A1450 Data Station GPM Pump CDM-1A Conductivity Detector	IC1	Chloride, Nitrate, Sulfate Bromide, Fluoride	1991	EPA-300.0
Dionex Model 2000i AI450 Data Station GPM Pump CDM-2 Conductivity Detector	IC2	Chloride, Nitrate, Sulfate Bromide, Fluoride	1994	EPA-300.0
Dionex Model DX500 A550 Autosampler LC20 CE CD20 Conductivity Detector IP25 Isocratic Pump Peak Net Software	IC1A/IC2A	Chloride, Nitrate, Sulfate Bromide, Ruorida	2000	EPA-300.0

9.1.2 Auto Analyzer Systems

Instrument	ID	Analysis	Year in Service	Method
Alpkem Rapid Flow Analyzer Total Kjeldahl Nitrogen Semi-automated, block digester	RFA-1	Total Kjeldahl Nitrogen	1989	EPA-351.2
Alpkem Rapid Flow Analyzer Nitrate/Nitrite, Cadmium reduction	RFA-3	Nitrate/Nitrite	1989	EPA-353.2
Technicon AAII Auto Analyzer Cyanide Automated Distillation/Colorimetric	AAII-1	Cyanide	1985-*current*	EPA-335.3 EPA-335.4
Technicon AAII Auto Analyzer Hexavalent Chromium Diphenylcarbazide	AAII-2	Hexavalent Chromium	1985-current	SW-7196
Technicon AAII Auto Analyzer Phenol Automated distillation/Colorimetric	AAII-3	Phenol	1985-current	EPA-420.2
Technicon AAII Auto Analyzer ortho-Phosphate Molybdenum blue	AAII-4	ortho-Phosphate	1985-current	EPA-365.1 EPA-365.2
Technicon AAII-5 Auto Analyzer NH_3-N Automated Colorimeric	AAII-5	NH_3-N	1977-current	EPA-350.1

9.1.3 *Other* Instruments

Instrument	ID	Analysis	Year in Service	Method
Spectronic 20 Genesys	Spec 05	COD MBAS Sulfide	2001	EPA-410.4 EPA-425.1 EPA-376.2
Altex 70	APH-70	pH in soil samples	1990	SW-9040
Beckman 360 pH/Temp/mv Meter	pH08	pH in water samples	2000	EPA-150.1
Orion Research 420A pH Meter	04202	pH in soil samples	1991	SW-9040 SW-9045
YSI Model 3100 Conductivity Meter	CND-3	Electrical Conductivity	1985	EPA-120.1 SW-9050
Hach Model 2100N Turbidimeter	T2100	Turbidity	1991	EPA-180.1
YSI Model 57 Oxygen Meter	YSI-57	BOD Dissolved O_2	1990	EPA-405.1 EPA-360.1
Brinkman Digital Buret	BDB	Alkalinity (HCO_3, CO_3, OH)	1995	EPA-310.1
Dohrmann Model DC80	**DCA-1**	**TOC Analysis**	1988	EPA-415.1 **SW-9060**

9.2 Metals

9.2.1 Inductively Coupled Argon Plasma / Mass Spectrometer

Instrument	ID	Analysis	Year in Service	Method
Perkin Elmer Elan 6100	PE-EL 1	16 Routine metals; Additional metals available upon request	2001	EPA-200.8

9.2.2 Inductively Coupled Argon Plasma

Instrument	ID	Analysis	Year in Service	Method
TJA Model 61E Trace Simultaneous Instrument	TJA61E	28 metals	1995	EPA-200.7 SW-6010A
TJA Model 36 Simultaneous Instrument	TJA36E	28 metals	1990	EPA-200.7 SW-6010A
Perkin Elmer Optima 4300	PE-OP1	30 Metals	2001	EPA-200.7 SW-6010A

9.2.3 Graphite Furnace Atomic Absorption Spectrophotometers

Instrument	ID	Analysis	Year in Service	Method
Varian SpectrAA 40Z Zeeman Background	V802	Antimony Arsenic Beryllium Cadmium Copper Chromium Lead Nickel Selenium Silver Tin Thallium	1989, 1990	EPA-200.9/7000A EPA-200.9/7000A EPA-200.9/7000A EPA-200.9/7000A EPA-220.2/7000 EPA-218.2/7000 EPA-200.9/7000A EPA-249.2/7000 EPA-200.9/7000A EPA-200.9/7000A EPA-282.2/7000 EPA-200.9/7000A
Varian Spectra 300/400Z Zeeman Background	V005	Beryllium Cadmium Copper Chromium Nickel Silver Tin Thallium	1996	EPA-200.9/7000A EPA-200.9/7000A EPA-220.2/7000 EPA-218.2/7000 EPA-249.2/7000 EPA-200.9/7000A EPA-282.2/7000 EPA-200.9/7000A
Perkin Elmer SIMAA 600 Zeeman Background AA Winlab Software	PE-1	Arsenic Selenium Lead Antimony Silver	2000	EPA-200.9/7000A

9.2.4 Mercury Analyzers

Instrument	ID	Analysis	Year in Service	Method
Leeman LDC Mercury Analyzer	LDC1	Mercury	1993, 1995	SW-7470/245.1 & 245.5 SW-7471
Thermo Separation Products Mercury Monitor 3200	TSP1	Mercury	1995	SW-7470/245.1 & 245.5 SW-7471

9.3 ORGANICS

9.3.1 GC/MS - Semi Volatiles

Instrument	ID	Analysis	Year in Service	Method
HP 5972 HP 5673 Autosampler HP Chemstation with Enviroquant	MS-B1	Semi-Volatiles	1994	EPA-625 EPA-8270C
HP 5972 HP 7673 Autosampler HP Chemstation with Enviroquant	MS-B2	Semi-Volatiles	1994	EPA-625 EPA-8270C

Varian Saturn Varian 8100 Autosampler Varian Enviropro	MS-B3	Synthetic Organic Compounds EPA-507	1995	EPA-525.5 EPA-507

9.3.2 GC/MS - Volatiles

Instrument	ID	Analysis	Year in Service	Method
HP 5970 Tekmar 3000 Concentrator Tekmar Precept II HP Chemstation with Enviroquant	MS-V1	Volatiles	1991	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B
HP 5970 Tekmar 3000 Concentrator Tekmar Precept II HP Chernstation with Enviroquant Tekmar Sample Heater	MS-V2	Volatiles	1991	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B
HP 5971 Tekmar 3000 Concentrator Tekmar Precept II HP Chemstation with Enviroquant	MS-V3	Volatiles	1993	EPA-524.2 EPA-624 EPA-8240B EPA-8260B
HP 5971 Tekmar 3000 Concentrator Tekmar Precept II HP Chemstation with Enviroquant	MS-V4	Volatiles	1993	EPA-524.2 EPA-624 EPA-8240B EPA-8260B
HP 5973 Tekmar 3000 Concentrator Precept II Autosampler HP Chemstation with Enviroquant	MS-V5	Volatiles	2000	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B
HP 5972 Tekmar Precept II Tekmar 3000 Concentrator HP Chemstation with Enviroquant	MS-V6	Volatiles	2000	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B

HP 5971 Takmar 3000 Concentrator Tekmar Solatek 72 HP Chemstation with Enviroquant	MS-V7	Volatiles	2001	EPA-524.2 €PA-601 EPA-824 EPA-8240B EPA-82608
HP 5971 Tekmar 3000 Concentrator Tekmar Precept II HP Chemstation with Enviroquant	MS-V8	Volatiles	2001	EPA-524.2 EPA-601 EPA-624 €PA-82408 EPA-8260B
HP 5972 Tekmar 3000 Concentrator Tekmar Solatek 72 HP Chemstation with Enviroquant	MS-V9	Volatiles	2001	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B

9.3.3 Gas Chromatography

Instrument	ID	Analysis	Year in Service	Method
Varian 3400 HP 3100 Autosampler HP Chemstation with GC-Enviroquant	GC-1	Organochlorine pesticides and PCB's	1994	EPA-508 EPA-608 EPA-8080 EPA-8081
Perkin Elmer Autosystem Autosystem Autosampler HP Chemstation with GC-Enviroquant	GC-2	Diesel Fuel Fingerprint Carbon Ranges	1991	8015M
Varian 3400 Dual ECD Varian 8100 Autosampler HP Chemstation with GC-Enviroquant	GC-3	Organochlorine Pesticides and PCB's	1989	EPA-508 EPA-608 EPA-8080 EPA-8081
Varian 3400 Dual ECD Varian 8100 Autosampler HP Chemstation with GC-Enviroquant	GC-4	DBCP and EDB	1989	EPA-504.1
Tekmar 2000 and 2032	MS-D1	DOE Room	2001	8260
Tekmar 2000 and 2032	MS-D2	DOE Room	2001	8260

HP 5890 Series II Dual FID Tekmar *2000* and 2016 HP Chemstation with GC-Enviroquant	GC-5	Gas	1992	8015M
HP 5890 Series II HP 7673 Autosampler HP Chemstation with GC-Enviroquant	GC-6	PCB's only	1989	EPA-8082
Dual TSD HP *5890* Series II HP 7673 Autosampler HP Chemstation with GC-Enviroquant	GC-7	Organophosphorus pesticides	1990	EPA-614 EPA-8140 EPA-8141
Varian 3400 Dual ECD Varian 8100 Autosampler HP Chemstation with GC-Enviroquant	GC-8	Chlorinated herbicides	1990	EPA-515.1 EPA-615 EPA-8150 EPA-8151
HP 5890 Series II Dual FID HP 7673 Dual Tower Autosampler HP Chemstation with GC-Enviroquant	GC-12	Diesel	1992	8015M
Perkin Elmer Autosystem Autosystem Autosampler HP Chemstation with GC-Enviroquant	GC-13	Diesel Fuel Fingerprint Carbon Ranges	1993	8015M

9.3.4 Gas Chromatography - Volatiles

Instrument	ID	Analysis	Year In Service	Method
Varian 3400 with PID and FID Tekmar *2000* Concentrator Tekmar 2018 Autosampler HP Chemstation with GC-Enviroquant	GC-V1	BTEX, MTBE, TPH (gas)	1989	EPA-8020, 8021 8015M
Varian 3400 with PID and FID Tekmar 2000 Concentrator Tekmar 2016 Autosampler Tekmar 2032 Autosampler HP Chemstation with GC-Enviroquant	GC-V2	BTEX, MTBE, TPH (gas)	1992	EPA-8020, 8021 8015M
Varian 3400 with PID and FID Tekmar Precept II Tekmar 3000 HP Chemstation with GC-Enviroquant	GC-V4	BTEX, MTBE, TPH (gas)	1992	EPA-8020, 8021 8015M

Varian 3400 with PID and FID Tekmar 2000 Concentrator Tekmar 2016 Autosampler HP Chernstation with GC-Enviroquant	GC-V5	BTEX, MTBE, TPH (gas)	1991	EPA-8020, 8021 8015M
Varian 3400 with PID and FID Tekrnar 2000 Concentrator Tekmar 2016 Autosampler Tekmar *2032* Autosampler HP Chernstation with GC-Enviroquant	GC-V6	BTEX, MTBE, TPM (gas)	1991	€PA-8020, 8021 8015M
HP 5890 Series II with PID and FID Tekmar *3000* Concentrator Tekmar 2016 Autosampler Tekrnar 2032 Autosampler HP Chemstation with GC-Enviroquant	GC-V7	BTEX, MTBE, TPH (gas)	1998	EPA-8020, 8021 8015M
HP 5890 Series II with PIP and FID Tekmar 3000 Concentrator Tekmar Precept II Autosampler HP Chernstation with GC-Enviroquant	GC-V8	BTEX, MTBE, TPH (gas)	1998	EPA-8020, 8021 8015M 5035

9.3.5 HPLCs

Instrument	ID	Analysis	Year in Service	Method
HP 1050 Model 79856A Quarternary Eluent Pump Autosampler Multiwavelength UV Detector HP Chemstation with GC-Enviroquant	LC-14	Polynuclear Aromatic Hydrocarbons Carbamate and Urea-containing *Pesticides*	1994	EPA-610 EPA-8310 EPA-632

9.3.6 Other Instruments

Instrument	ID	Analysis	Year in Service	Method
Foxboro Miran IFF (IR)	IR-1	TPH	1992	EPA-413.2 EPA-418.1
Foxboro Miran IFF (IR)	IR-2	TPH	1992	EFA-413.2 EPA-418.1

9.4 Microbiology

Instrument	ID	Analysis	Year In Service
Incubator - ASP Modal	IS-81	5.5.5 or 10 Tube	1989-1995
Incubator - VWR Model	1565	5.5.5 or 10 Tube	1989-1995
Incubator - ASP Model	IS41	Autoclave QC only	1989-1995
Autoclave Marketforge Sterilmatic (2)		1600 Tubes of media (3200)	1990
Waterbath - PS Coliform Incubator Bath		10 (10 tubes/samples)	1992
Waterbath - Precision Scientific Large		20 (10 tubes/samples)	1990
Waterbath - Precision Scientific Small	81, #2, #3	10 (10 tubes/samples)	1990
Quebec Colony Counter Capacity/100 Potential Capacity1200			1980
Dissection Microscope	Bausch & Lomb		1986
IDEX Spectroline	EA-160		1996

9.5 Sampling Equipment

9.5.1 Well Sampling

Instrument	ID	Year In Service
ISCO	2700	1994
Grundfos Rediflo	BMI	1992
Grundos Rediflo	MPI	1992
Solinst Water Depth Finder		1994
Generac 3500 XL Generator	3500	1994
Generac G1600 Generator	G1600	1994
Lamotte Turbidity Meter	2008	1994

9.5.2 Air Sampling

Instrument	ID	Year In Service
SKC Air Sampling Pump	Model 224-PCXR7	1992
Air Test Meters S-275 STD with Pressure Pot (2)		1992
Sensidyne pump	Gastec No. 800	1993

9.5.3 Instrumentation

Instrument	ID	Year In Service
Omega pH H60 and pH Conductivity Meter		1994
Myron Company pH & Conductivity Meter		1994
HNU Photoionizer	Model HW - 101	1994

9.8 Support Equipment and Supplies

9.6.1 Laboratory Information & Management System (LIMS)

Instrument	Year In Service
Novell Network Using Advanced Revelations	1990-1998
Pentium 60 40 GB hard drive 32 MB RAM Compaq DLT 15/30 GB Tape backup	1990-1998
Pentium 200 W/9.1 GC hard drive 128 MB RAM Mountain File Safe 1400 8 GB Tape backup	1990-1998
HP Laser Jet Printers (7)	1990-1998
PC's - 386 (13)	1990-1998
PC's - 486 (41)	1990-1998
PC's - Pentium (28)	1990-2000

9.6.2 Laboratory Water System

Instrument	Year In Service
Ionics Deionized Water System	1990-2000
Ionics Nanopure Water System	1990-2000

9.6.3 Glassware

Instrument	Year In Service
Class A for Reagent and Standard Preparation	1990-2000
Various Calibrated Units	1990-2000

Instrument	Year in Service
Northstar Walk-In	1987
Rancho Reach-In (4)	1990
Traulsen Reach-In (2)	1987-1995
GE Cold Spot: Nor lake (1), Whirlpool (1), Baxter (1)	1987-1995
GE Freezer (1) Montgomery Ward	

9.6.5 Ovens

Instrument	Year in Service
Precision Scientific (2)	1987-1994
Fisher (4)	1987-1994
VWR (3)	1987-1994
Manitowoc VWR (4)	

9.6.6 Misc Equipment

Instrument	Year in Service
Balance Analytical - Mettler H6 (2)	1987-1993
Balance Analytical - Mettler B5	1987-1993
Top-Loading OHAUS 1500, E4000d,TS400D, E120	1988-1994
Top-Loading DTL 4100S	1988-1994
Top-Loading Mettler PE3600, PL300	1988-1994
Top-Loading Mettler PB 3002-5, BD202	2000
Top-Loading Denver Model A160	2000

9.7 Safety

BC LABORATORIES, INC.

INSTRUMENTATION

Instrument	Qty
Laboratory Hoods	26
Fire Extinguishers Halon Combined Class ABC	35
Eye/Safety Showers	7
Spill Stations	3
First Aid Kits	5
Fire Blanket	1

11.0 ANALYTICAL PROCEDURES

BC Laboratories, Inc. conducts approved methodologies which have been promulgated by Federal and State legislators, and ASTM and in-house methods for non-regulated analyses.

References
Drinking Waters - 40 CFR Parts 131, 143 Methods for the Determination of Metals in Environmental Samples(EPA/600/R-94/111, May 1994, Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/August 1993), Methods for the Determination of Organic Compounds in Drinking Water (EPA/600/4-88/039, EPA/600/4-90/020), Methods for the Chemical Analyses of Water and Wastewater (EPA-600 4-79-020), and Standard Methods for the Examination of Water and Wastewater, 18th Edition (1992), Standard Methods for the Examination of Water and Wastewater, 19th Edition.

Waste waters - 40 CFR Part 136, Standard Methods for the Examination of Water and Wastewater, Methods for the Chemical Analyses of Water and Wastewater, Methods *for* the Determination of Metals in Environmental Samples (EPA/600/R-94/111, May 39941, Methods for the Organic Chemical Analysis of Municipal and Industrial Wastewater.

Soils, sludges, wastewater, hazardous waste ,and solids - SW-846 Federal Register Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition, Update 1, II, & III.

Fuels - LUFT Manual, State Water Resources Control Board and the SB 1764 (1994) Advisory Committee.

Each method has been outlined in respective laboratory standard operating procedures (SOP's). Information such as procedural steps for conducting analysis, standard and reagent preparation, documentation, safety, and quality control are included in each analytical SOP. Refer to Appendix A for listing of SOP's. Table 5-7 list methods conducted on-site.

11.1 SOP CREATION

Department Supervisor's, the Technical Director, and/or the QA Officer will determine the person(s) responsible for SOP creation, and then delegate *the* task. The template below will be used as guidance for analytical SOP's:

SOP TEMPLATE

1.0 SCOPE AND APPLICATION

2.0 SUMMARY OF METHOD

3.0 INTERFERENCE AND THEIR CORRECTIVE ACTION

4.0 APPARATUS AND MATERIALS

- 4.1 APPARATUS
- 4.2 INSTRUMENT PARAMETERS

5.0 REAGENTS AND STANDARD SOLUTIONS

- 5.1 REAGENTS - NAME AND SOURCE
- 5.2 SOLUTIONS - DILUTION SCHEMES
- 5.3 WORKING STANDARDS
- 5.4 SPIKES

6.0 SAMPLE COLLECTION, PRESERVATION AND HANDLING

7.0 PROCEDURE

8.0 QUALITY CONTROL

8.1 DETERMINATION OF IDL, MDL, AND PQL

8.2 METHOD BLANKS

8.3 QC SETS - DUPLICATES & SPIKES

8.4 CONTROL CHARTS

8.5 LOG BOOKS

9.0 CALCULATIONS

10.0 FORMS

I . QC SHEET

10.2 OTHER FORMS

11.0 METHOD PERFORMANCE

12.0 GENERAL MAINTENANCE

13.0 WASTE MANAGEMENT

14.0 POLLUTION PREVENTION

15.0 SAFETY

16.0 REFERENCES

Non-analytical SOP's do nat follow a standard format, however these documents should contain sufficient detail to ensure processes can be carried out completely and competently. When completed by *the* responsible party, the SOP is entered into the LIMS via the word processor. SOP identification will be by method number, technique, and a laboratory/department sequential numbering Identification (i.e., BCMET01, BCMET02 ...etc.). The word processing specialist will return the SOP to the author for corrections, When corrections are completed, the SOP will be reviewed by the Department Supervisor. When the supervisor review and correction phase is complete, the QA Officer will conduct a final review and approval. Further details of SOP creation can be found in the SOP QA/QC Protocols.

11.2 CONTROL Of SOP'S AND LOGBOOKS

In order to receive a copy of an SOP, a request must be made to the QA officer, Department Supervisor, or General Manager. One of these persons will inform the word processor specialist to generate the requested SOP. Records pertaining to SOP retrieval will be kept by the word processor.

Record:
SOP Number.
Date of regeneration,
Person receiving the document.
Purpose.
Number of Copies.
Total Number of copies (History).

The SOP will be generated with an approval by the word processing specialist. Logbooks requests are honored by the Word Processing Specialist. Logbook request sheets are located on a clip near the word processing station. Once a logbook is created, tha Word Processing Specialists records the following information:

Logbook ID

Logbook number
Number of copies
Person receiving the logbook
Date of generation

The Word Processing Specialist will then review the logbook and acknowledge final approval by initialing and dating the logbook cover.

11.3 DEPARTURE FROM SOP

In cases where *it* is necessary to depart from standard practice, approval must be granted by the department supervisor and the Quality Assurance Officer. Departures for standard procedures must be documented on all affecting final reports.

11.3.1 Documentation - Document nonstandard practice on affecting worksheet(s). Client notification must be made and documented before departure can be granted, Affected final reports most have a comment which alludes to the modification of method.

11.3.2 Approvals *from* the client must be verified in order to close the deviation af standard practice.

11.4 ASSESSMENT AND HANDLING OF NEW/ADDITIONAL WORK

11.4.1 Summary

Project information must be legible and obtained in a timely fashion to allow necessary modifications to be made prior to projects initiation. Information is obtained from QAPPs, SAPs, CDAPs, or subsets of the aforementionedformats, or from projects initiation forms completed by laboratory interviewers, The information is transfated into the appropriate language then discussed through supervisor meetings.

Discussion topics:

* Confirmation of amount of new/additional work
* Baseline capacities
* Potential capacities
* Labor
* Instrumentation
* Certification/Methods
* Materials
* Implementation
* Monitoring
* Responsibilities
* Deliverables

Once discussed, accommodations addressing pertinent concerns are made in each department. The Project Manager verifies that all project specific work requirements are secured; especially all non-routine tasks. Project Initiation Forms are then completed and distributed to affecting department supervisors, and if possible, to *pertinent* clients before initiation of sampling. Performance monitoring will be conducted by the QA/QC Department to measure compliance with project specifications and customer satisfaction.

The UMS will act as the tool used to confirm analytical capabilities.

11.4.2 Responsibilities

Sales and Marketing

1. Obtain project deliverables Information
2. Confirm the amount of work and compare to the capability/capacity of the laboratory
3. Confirm type of work (DOD, DOE, RCRA, CERLA, etc)
4. Monitor project quotes
5. Establish probabilities of project awards

6. Identify project initiation date
7. Qbtain project method specifications
8. Obtain quality goals
9. Act as liaison between laboratory *and* client until award is granted
10. Submit all pertinent information to Client Services Department

Project Coordinator
1. Obtain project information from Sales and Marketing of client,
2, Translate project information.
3. Assign projects to project managers.
4. Provide guidance in project handling.
5. Provide guidance on completing Project Checklist Form.

Project Manager
1. Gather project information into a Project Initiation Form.
2. Distribute project initiation forms.
3. Modify project initiation forms as needed.

President
1. Facilitate brainstorm sessions.
2. Allocate resources.
3. Approve laboratory system modifications:
4. Approve instrumentation purchases.
5. Approve labor allowances.
6. Secure and allocate resources.
7. Approve purchases of materials and instruments.

Department Manager
1. Assess department capacities.
2. Review and approve prospective work.
3. Coordinate with project coordinator.
4. Initiate IDCs or IDPs for new analysts and/or methods.

QA Officer
1. Monitor performance.
2. Provide method guidance.

LIMS Manager
1. Write programs to handle project specific requirements.
2. Update, Increase, and modify LIMS capabilities.

11.4.3 Procedure

Sales and Marketing representative produces bid packages then rates the probability of an award by obtaining Information through contracts and/or correspondence with bid proprietors. When awards are confirmed, a request for project information is made, if nor already available in RFPs or RFQs, by a representative of Sales *and* Marketing or the Project Coordinator, The Project Coordinator gathers all project information then translates this information into BC Laboratories' language. Translation will be discussed during weekly supervisor meetings and on a one-to-one basis. A project Quotation Form, which is completed through the LIMS or by hand, is created then distributed to all pertinent personnel.

11.5 CAPACITY

Capacities are functions based by method, # of instruments, # of analysts,. # of work shifts, potential # of samples analyzed per 8 hour *shifts*, sample matrix, and baseline levels of continueus work.

Daily capacity is figured by finding the number of samples which can be analyzed (excluding CCV's, Curve Stds, blanks, LCS's and MS's) on one Instrument by one analyst during an eight hour work *shift*. Actual capacity will vary based on

time of year, workload, analyst vacations, instrument configuration for multiple analyte analysis, instrument performance, and analyst performance. To adjust this daily capacity, take the average amount of samples analyzed per year and divide by the number of work days in a year, then subtract this number from the daily capacity. This will give us available capacity.

Quarterly capacity will be assessed more accurately detail available capacity during high workload periods. This can he found by finding the average daily workload during quarterly monitoring periods.

Projected workload is based on number of analyses and turnaround time.

$$\text{Projected workload} = \frac{\text{Number of analyses}}{\text{Turnaround Time (days)}}$$

In order to verify if additional workload can be handled, find the daily capacity and/or the quarterly capacity, projected workload {analyses per day} and place in the following algorithm:

Available capacity - projected workload

If this number Is positive, the additional workload can be approved. If nagativs, available capacity must be increased through more instrumentation, more labor, and/or modified system changes.

11.6 METHOD QUALIFICATION

Each new method must be pre-qualified prior to use. Prequalification entails meeting reporting and performance criteria outlined in the ELAP manual "Data Package Guidelines*. Further details can be fwnd in the QA Protocols Manual.

11.7 USE OF NON-STANDARD METHODS

In order to utilize methods which are non-referenceable or deviate significantly from referenced methods, we are required to obtain client and/or regulatory agency approval. If regulatory approval is needed, the QA Officer will initiate the process of obtaining method exceptions. Approvals by our clients must be documented in writing on a record which *is* recognized by our system. All data associated with non-standard methods should be flagged an affected final reports.

11.8 USE OF DIFFERENT METHOD VERSIONS

In cases of combined analytical methods, the most stringent requirements for each of the various calibration and quality control steps must be incorporated in the merged procedure. All Instruments are set up to accommodate the most stringent QC requirements for like methods so reporting can be a function of sample matrix or project method reporting protocol. Sample results reported under particular methods must be referenced correctly on final reports either in the heading or in a comments section.

TABLE 5 METAL METHODOLOGIES

Aluminum	EPA 200.7, 6010B			EPA 200.8
Antimony	EPA 200.7, 6010B		EPA 204.2, SW7041, 200.9	EPA 200.8
Arsenic	EPA 200.7, 6010B		EPA 206.2, SW7060, 200.9	EPA 200.8
Barium	EPR 200.7, 6010B			EPA 200.8
Beryllium	EPA 200.7, 6010B		EPA 210.2, SW7091, 200.9	EPA 200.8
Boron	EPA 200.7, 6010B			EPA 200.8
Cadmium	EPA 200.7, 6010B		EPA 213.2, SW7131, 200.9	EPA 200.8
Calcium	EPA 200.7, 6010B			EPA 200.8
Cobalt	EPA 200.7, 6010B		EPA 219.2, 200.9	EPA 200.8
Copper	EPA 200.7, 6010B		EPA 220.2, 200.9	EPA 200.8
Chromium	EPA 200.7, 6010B		EPA 218.2, SW7191,200.9	EPA 200.8
Iron	EPA 200.7, 6010B			EPA 200.8
Lead	EPA 200.7, 6010B		EPA 239.2, SW7421, 200.9	EPA 200.8
Lithium	EPA 200.7, 6010B			EPA 200.8
Magnesium	EPA 200.7, 6010B			EPA 200.8
Manganese	EPA 200.7, 6010B			EPA 200.8
Mercury		EPA 245.1, 0, SW7471		EPA 200.8
Molybdenum	EPA 200.7,6010B			EPA 200.8
Nickel	EPA 200.7,6010B		EPA249.2,EPA200.9	EPA 200.8
Potassium	EPA 200.7,6010B			EPA 200.8
Selenium	EPA 200.7,6010B		EPA 270.2, SW7740, EPA200.9	EPA 200.8
Silica	EPA 200.7,6010B			EPA 200.8
Silver	EPA 200.7,6010B		EPA272.2,EPA200.9	EPA 200.8
Sodium	EPA 200.7,6010B			EPA 200.8
Strontium	EPA 200.7,6010B			EPA 200.8
Tin	EPA 200.7,6010B		EPA 282.2	EPA 200.8
Titanium	EPA 200.7,6010B			EPA 200.8
Thallium	EPA 200.7,6010B		EPA 279.2, SW7841, EPA200.9	EPA 200.8
Vanadium	EPR 200.7,6010B			EPA 200.8
Zinc	EPA 200.7,6010B			EPA 200.8

TABLE 6 ORGANIC METHODOLOGIES

Purgeables (GC)	EPA 601, EPA 602	EPA 8020, EPA 8021A, EPA 8021B
Purgeables (GC / MS)	EPA 524.2, EPA 624, EPA 8240B, EPA 8260B, EPA 601/602 by GC/MS	EPA 8240B, EPA 8260B
EDB / DBCP	EPA 504	EPA 504M
Pesticides, Herbicides (GC)	EPA 608, EPA 614, EPA 619 EPA 515, EPA 508	EPA 8080A, EPA 8081A, EPA 8082, EPA 8141A, EPA 8140, EPA 525.2, EPA 8150B, EPA 8151A, 8081A
Gasoline Residue	LUFT Manual 8015M	LUFT Manual 8015M
Diesel Residue	LUFT Manual 8015M	LUFT Manual 8015M
PCB's	Modified 608, State Method	Modified 8080, State Method
Phenols	EPA 525.2	EPA 8270C
Title 22	State Method	
Priority Pollutants (GC/MS)	EPA 625, EPA 525.2, EPA 548.1	EPA 8270C
Oil and Grease	EPA 413.1, EPA 413.2, 1664	EPA 413.1, EPA 413.2, EPA 9071M
TPH	EPA 418.1	EPA 418.1
Pesticides, Herbicides (HPLC), Carbamates	EPA 632, EPA 531, EPA 547, EPA 549	632M
PAH's	EPA610	EPA 8310
Explosives	EPA8330	EPA8330

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TABLE 7 INORGANIC METHODOLOGIES

Alkalinity	EPA 310.1. SM2320B	EPA AVAC, 1.005
Chloride	SM407C, EPA 300.0, SM 4500 CLC	SM 4500CL D, EPA 300.0
Chromium VI	SW 7196A, SM 3500Cr D	SW7196A
Corrosivity	EPA 155.7	SW9040
Conductivity	EPA 320.1	SW9050
Cyanide	EPA 335.3, EPA 335.2, EPA 335.4	SW9012, SW9010
Flashpoint	SW1010	SW1010
Fluoride	EPA 340.2	EPA 340.2
Nitrogen Forms	EPA 350.1, EPA 353.2, EPA 300.0, EPA 351.2	EPA 350.1, EPA 353.2, EPA 300.0, EPA 351.2
Bacteriologicals	SM 9221B, 9221E, 9223B	SM 9221B, 9221E
D.O.	EPA 360.1	N/A
Bromide	EPA 300.0	N/A
Chlorate	EPA 300.0	N/A
Chlorine Residue	SM 4500 CL-B, F	
Color	EPA 110.2, 9215B (Hpc)	N/A
Organic Lead	LUFT Manual	LUFT Manual
pH	EPA 150.1, SW9040	SW9045, SW9040
Phenols	EPA 420.2, 5530D	SW9066
Phosphorous	EPA 365.1, EPA 365.4	SM424G, SM424C
Sulfur Forms	EPA 376.1, EPA 376.2, SW 9030	SW9030, SW 7.3.4.2
Sulfate	EPA 300.0	
BOD	EPA 405.1	
COD	EPA 410.2, EPA 410.4	
TOC	EPA 415.1	SW 9060
Residue	EPA 160.1 - EPA 160.5	
MBAS	EPA 425.1	
Odor	EPA 140.1	
Turbidity	EPA 180.1	

2.0 SUMMARY

It is the responsibility of the analyst to conduct initial data reduction procedures by using calculations referenced in State and Federally recognized methodologies and within respective SOP's. The tools used to reduce data include Excel spreadsheets, Dionex AI-450 software, HP Chemstation software, calculators, Enable database software, LIMS processing programs and instrument programs.

Validation and verification processes include analyst reviews, technical reviews, supervisor reviews, project management reviews, QA department reviews, data processing checks, and final approvals. See the appropriate flowcharts in Appendix D.

Results are entered onto laboratory bench worksheets, then introduced into *the* LIMs via data entry specialists. At present, a parallel data processing system is in place for QA/QC purposes only. The incorporation of this new reporting system will eventually replace the hand entry process.

12.1 REDUCTION

12.1.1 Organics Department

12.1.1.1 GC/HPLC

Data is processed via HP Chem software reduced by hand if necessary and recorded onto worksheets. The reduced data is electronically transferred to the LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

12.1.1.2. GC/MS

All data Is processed and reduced on manufacturer' 'software. Sample analyses are processed via data systems enviroquant and Varian's envipro. Results are then recorded onto worksheets, The reduced data Is electronically transferred to the LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sampls weights, extract volume and sample dilution.

12.1.1.3 TRPH

Data is recorded onto QC bench sheets, reduced by hand, then recorded onto worksheets. Calibration factors are used in the linear regression model which is used to reduce data. The reduced data is electronically transferred to the 'LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

12.1.2 Metals Department

12.1.2.1 ICP, ICP/MS, GFAA, AA

Instrument *data* is reduced on manufacturer's software. All dilutions are accounted for on laboratory worksheets, The reduced data is electronically transferred to the LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

12.1.2.2 Hg by cold vapor

The method of least squares, using chart line versus concentration, Is ussd as the linear regression model. Results are reduced onto a QC bench sheet then entered onto worksheet. The reduced data is electronically transferred to the LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations In test solutions sample weights, extract volume and sample dilution.

12.1.3 General Chemistries

12.1.3.1 IC

Data is reduced via the use of manufacturer'ssoftware. Values are recorded onto a QC bench sheet then transferred to worksheets. The reduced data is electronically transferred *to* tha LIMS.

The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

12.1.3.2 Meters, titrimetric and gravimetric tests.

Data is recorded onto QC benchsheets then transferred to worksheet. *The* reduced data is electronically transferred to the LIMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

12.1.3.3 Optical Analyses

The method of least squares, using chart line versus concentration, is ussd as the linear regression modal. Results are reduced *on* QC log sheets *then* transferred onto worksheets. The reduced data is electronically transferred *to* the UMS. The LIMS performs statistical calcultaions (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

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PQL/MDL DETERMINATIONS

Analyst Analyte: Method: Run Date: Instrument ID: Matrix: Units: Prep Date: MDL Study No: __/__/__-_____-___-___ DATE INSTR ID SEQ NO MATRIX (W,S)	Analyst: Analyte: Method: Run Date: Instrument ID: Matrix: Units: Prep Date: MDL Study No: __/__/__-_____-___-___ DATE INSTR ID SEQ NO MATRIX (W,S)	Analyst: Analyte: Method: Run Date: Instrument ID: Matrix: Units: Prep Date: MDL Study No: __/__/__-_____-___-___ DATE INSTR ID SEQ NO MATRIX (W,S)

MDL Std. ID	Response	Conc.
1		
2		
3		
4		
5		
6		
7		

MDL Std. ID	Response	Conc.
1		
2		
3		
4		
5		
6		
7		

MDL Std. ID	Response	Conc.
1		
2		
3		
4		
5		
6		
7		

MDL Std Concentration: $\bar{x}$ = s = 3.29(s) = $t_{(n-1, .99)}$s= MDL = 10s = PQL =	MDL Std concentration: $\bar{x}$ = s = 3.29(s) = $t_{(n-1, .99)}$s= MDL = 10s = PQL =	MDL Std Concentration: $\bar{x}$ = s = 3.29(s) = $t_{(n-1, .99)}$s= MDL = 10s = PQL =

Standard Curve r= r^2=

1st Order		2nd Order		3rd Order	
Stand. ID	Conc.	Response			

Standard Curve r= r^2=

1st Order		2nd Order		3rd Order	
Stand. ID	Conc.	Response			

Standard Curve r= r^2=

1st Order		2nd Order		3rd Order	
Stand. ID	Conc.	Response			

MDL/PQL DETERMINATIONS

Analyte: Study No:	Std Concentration Used:
Dates: Run No. 1	$\bar{x}$ = s = 3.29(s) =
Run No. 2	
Run No. 3	$t_{(n-1, .99)}s$= $t_{(n-1, .99)}$=
	10s =
Analyst:	Blank Response Data:
Instrument:	$\bar{x}$ = s = 3.29(s) =
Method:	
Matrix:	3s =
	10s=
Units:	STANDARD CURVE
Instrument Parameters:	
Standard Calibration Setting:	
Flowcell Length:	1st Order 2nd Order 3rd Order
Program Method ID:	Correlation Coefficient:
Date of Preparation:	PQL: MDL:

Standard ID	Conc.	Response

Run No. 1

MDL STD. ID	RESPONSE	CONC.
1.		
2.		
3.		
4.		
5.		
6.		
7		
8		

Run No. 2

MDL STD. ID	RESPONSE	CONC.
1.		
2.		
3.		
4.		
5.		
6.		
7		
8		

Run No. 3

MDL STD. ID	RESPONSE	CONC.
1.		
2.		
3.		
4.		
5.		
6		
7		
8		

Blank Determination

BLANK ID	RESPONSE	CONC.
1.		
2.		
3.		
4.		
5.		
6		
7		
8		

TABLE 8
LEVEL OF QC EFFORT

CRITERIA	MATRIX	FREQUENCY	CRITERIA	CHEMISTRY
Duplicate	Water	10% or 1 per batch, whichever is greater	<10% RPD above 5 times PQL, if <5 times PQL, ≤ PQL.	Inorganic
	Soil/ Wastewater	5% for solid and wastewater matrices	<20% RPD above 5 times PQL, If <5 times PQL, ≤ 2 x PQL.	
Matrix Spike, Matrix Spike Dupl.	Water	10% or 1 per batch, whichever is greater	Within defaulted Control Limits	Inorganic except TSS, TDS, Color, Odor, Turbidity, pH, Conductivity
	Soil/other	5% or 1 per batch, whichever is greater	Within defaulted Control Limits	Solid Matrix Metals, Solid Matrix Inorganics
		5% or 1 per batch, whichever is greater	Within Control Limits	Organic
LCS	NA	1 per batch	90 - 110% Recovery or Within Control Limits	Wet Chemistry
		1 per batch	85 - 115% Recovery or Within Control Limits	Metals, Wet Chemistry (Prepared Samples)
		1 per batch	Within Control Limits	Organic
ICV / CCV	NA	10%	90 - 110% Recovery, for CCV 95 - 105% Recovery, for ICV (See SOPs)	Inorganic, except Hg on solids 200.7, 7470, GFAA for waters
		Every 12 hours	See SOP	GC/MS
		10%	±15% diff	8000 Series except for GC/MS and 500/600 series
CCB	NA	Run after ICV and each CCV	<PQL	Inorganic, Organic
Preparation Blank	NA	1 per batch or 20 (whichever more frequent)	<PQL	Inorganic, Organic
Initial Calibration	NA	Before each sample run and/or when CCV unacceptable	>0.995 Corr. Coeff.	Inorganic
		When CCV unacceptable, when target compounds out	<20% RSD or regression model	Organic except GC/MS
			<15% RSD/If >15% RSD-use linear regression	GC/MS

14.0 PERFORMANCE AUDITS

In order to validate BC Laboratories, Inc. method performance accuracy and comparability to standards of the environmental laboratory industry, a program of external and internal performance evaluations must be incorporated info the Quality Program. Comparability studies are through external PE sample analyses, while internal assessments are conducted to validate and maintain control of the analytical system.

14.1 EXTERNAL PERFORMANCE EVALUATION SAMPLES

BC Laboratories, Inc. is involved in 1)the ERA Water Supply and Water Pollution performance evaluation studies, 2)the NPDES DMR PE studies, 3)a program of PE samples for scil matrices through ERA, 4)an internal PE sample assessment through purchased standards from ERA, 5)SLAP, the Shell Laboratory Audit Program, and 6) ELAP Microbiology Evaluation Study.

All performance sample studies are completed (i.e., we participate in every WS, WP and DMR PE Study). This is not a necessity since one compliant analyte result per PE study will validate that parameter tor one year, Each PE sample is analyzed to validate continuous control of *the* analytical system.

14.1.1 Scope of Analytical Parameters

14.1.1.1 Water Supply - TAL metals, minerals, Anions, Cations, EPA 507/8140, EPA 508/8080, EPA *52518270,* EPA 531.1, EPA 515.1/8150, EPA 801*018020,* EPA 824018260, EPA 300.0, Physical testing, residue EPA 160.1, EPA 335.3/9012, EPA 9040, alkalinity,

14.1.1.2 Water Pollution - TAL metals, alkalinity, EPA 9040, Cations, Anions, Demand, PCB's, EPA 8080, EPA 8010/8020, EPA 8240/8260, EPA 413.1, EPA 335.3/9012, EPA 420.2, Residue EPA 160.1, residual chlorine.

14.1.1.3 DMR - TAL metals, EPA 9040, EPA 1*80.2,* EPA 413.1. nitrogen forms (350.1, 353.2, 300.0, 351.1), EPA 366.4, EPA 365.1, Demand, EPA 335.3/9012, EPA 420.2, residual chlorine.

14.1.1.4 SLAP - EPA 8020, EPA 8270, TAL metals, EPA 415.1, Demand, EPA 351.1, EPA 413.1 .

14.1.1.5 ELAP Microbiology Study - Bacteriological Analyses

14.1.1.6 Internal Performance Evaluation - Parameters under investigation

14.1.1.7 Soil *Series* - 8015M purgeable and extractable, 8080, 8150, 8260, *8270,* TRPH, metals.

14.2 SYSTEMS AUDIT

14.2.1 Internal

Systems audits will be conducted on a annual basis and will cover 1) parameters outlined on the Internal Assessment Schedule (Figure 7), 2) clerical procedures, 31 Invoicing, 4) conformance to methodology and SOP procedural outline, and 5) other tasks with performance objectives. A completed Systems Audit Report will be submitted to the General Manager annually. Topics of concern which arise during the year will be addressed at the weekly Supervisor'sMeetings.

14.2.2 External

External based audits are conducted by representatives of the state of California, and other private or government entities.

14.3 ACTION

The QA Officer is responsible for completing annual systems audits and initiating subsequent corrective actions as needed. If corrective action is required, the QA Officer has the authority to delegate responsibilities and to initiate progressive discipline if tasks are not completed sufficiently to restore acceptable performance of the analytical system. Corrective action documentation will illustrate tasks, responsibilities, time frames, and will validate restoration of the process to a controlled status. Corrective action documentation and Quality Improvement Forms are stored in the QA/QC Department and in pertinent files.

13.0 QC PARAMETERS

Required QC parameters will vary according to method, specific project requirements, andiw sample matrices encountered. Table 5 illustrates generalized criteria. QC parameter requirements in specific SOP's supercede those listed in Table 5.

QC Parameters for Wet Chemistry testing

Sample/Sample Duplicate
Matrix Spike/Matrix Spike Duplieata
Laboratory Control Sample-Water or Solid
Method Blank

Exceptions:

pH, EC, TDS, Flashpoint

Sample/Sample Duplicate
Laboratory Control Sample

TSS, Settleable Solids

Sample/Sample Duplicate

QC Parameters for Metals testing

Sarnple/Sample Duplicate
Matrix Spike/Matrix Spike Duplicate
Laboratory Control Sample-Watsr or *Solid*
Method Blank
Post Spike

QC Parameters *for* Organics testing

Matrix Spike/Matrix Spike Duplicate
Laboratory Control Sample
Method Blank
Surrogate

Exceptions:

Oil and Grease, Total Recoverable Petroleum Hydrocarbons
Soil
Sample/Sample Duplicate
Matrix Spike/Matrix Spike Duplicate
Laboratory Control Sample
Method Blank
Water
Matrix Spike/Matrix Spike Duplicate
Laboratory Control Sample
Method Blank

13.1 BATCHING

A group of samples of similar matrix that behave similarly with respect to the procedures being employed. The number of samples in a batch may never exceed *20,* (consult SOP to verify maximum batch *size).* All samples in a batch must be processed as a unit with the same method sequence and *the* same lots of reagents and standards. The manipulations common to each sample *in* a batch must be performed simultaneously or in a continuous sequence without significant interruption. If an analytical sequence contains more than one distinct step, such as a preparation procedure, quality control samples required by the method for the batch must be assigned and prepared in the initial step. This group of samples is called a preparation batch, and must contain all quality control

samples required by the method, including (PB/MB, Dup, MS, MSD, LCS, other). A preparation batch must not contain more than twenty field samples. Laboratory QC samples processed in the preparation batch are not counted in the maximum batch *sire* of 20. If the instrumental analysis of the samples in one preparation batch is not performed In a continuous sequence, the method blank from the preparation batch must be analyzed with each set of samples from the same preparation batch. If re-analyses are required (e.g. to perform dilutions) it is not necessary to Include the method blank in the reanalysis.

13.2 LABELING CONVENTIONS

Unique batch identifiers are needed to property coordinate referencing of QC parameters to associated samples. Preparation sets which are processed *into the* LIMS are labeled by preparation code, date and set number. All prepared samples within the batch are associated automatically by the LIMS. If preparation tasks are not processed into the LIMS, preparation batches are labeled on individual preparation logs. QC parameters are labeled by a combination of 13 QC parameters type, 21 Method *coda,* 3) Sample number, 4) data and 5) extension.

13.3 QC PARAMETER CONTROL LIMITS

Control limits are calculated from recoveries of laboratory control samples and/or matrix spikes. A minimum of twenty observations should be used *t o* calculate control limits. 500 and *600* series methods mandate calculation of control limits with the statistical use of the word "control" in mind.

Control Limits = Mean Recovery ±3 s
s is the standard deviation of the recoveries

The SW-846 series calculation for control limits are as follows:

Control Limits {Matrix Spikes) = Mean Recovery ±3 s
s is the standard deviation of the recoveries

Control Limit (for surrogates] = Mean Recovery ±3 s
s Is the standard deviation of the recoveries

In order to monitor trends in the analytical process, the latest thirty to forty observations are used to calculate laboratory control sample control limits. New control limits are compared to previously calculated limits to track possible trends. Comparisons are mads on the means, UCL, LCL and numbers of outliers.

When calculating control limits for matrix spikes, the database will be continually added to until major modifications occur to a method.

There exists many variables that would cause new control limits to be Initiated.

Variables:
1. New Analyst
2. New Preparation Tech
3. Method Modification
4. Instrument Modification
5. Reagent and/or standard vendor change

Control limits are calculated by QA Department personnel and analysts using statistical software packages NWA Quality Analyst, Statistica and Excel.

13.4 CALCULATIONS

Precision

Precision is defined as the measure of mutual agreement among individual measurements of the same pollutant in a sample secured under the same analytical protocols. Field and lab precision will be expressed as relative percent difference where:

$$RPD = \frac{|x1 - x2|}{\overline{X}} \times 100$$

|| = Absolute value of the difference between duplicates X1 and X2
X = Mean value of duplicate results, X1 and X2

The goals for precision are related to the proximity of the sample value to the detection limit. At or lass than five times the practical quantitation limit, the precision goal will be expressed in absolute concentration (quantitation limit terms).

Accuracy

Accuracy is defined as the degree to which the analytical measurement reflects *the* true value present. Overall accuracy will be estimated by recovery performance of spiking events, internal standards and control samples. Accuracy will be measured as percent recovery where:

$$\%\ RECOVERY = \frac{X - B}{T} \times 100$$

X = measured concentration in sample after spiking
B = background concentration in sample
T = concentration of spike added to sample

If the sample concentration is below the MDL, zero(0) will be used in the calculation. In all other cases, *the* sample concentration must be used to calculate percent recovery. When the sample concentration is greater than four(4) times the spike level, the percent recovery result will be expressed as "High Mean". Percent recovery for selected inorganic method soil matrix samples may use the average of the sample and sample duplicate in the percent recovery equation.

13.5 COMPLETENESS

Completeness shall be evaluated qualitatively and quantitatively if necessary to meet specific project requirements. The qualitative evaluation of completeness shall be determined as a function of all events contributing to the sampling event including items such as correct handling of chain of custody forms, etc. The quantitative description of completeness shall be defined as the percentage of Contract controlled QC parameters that are acceptable.

QC parameters that shall be assessed for quantitative determinations of completeness shall include initial calibrations, continuing calibrations, surrogate percent recovery for organics analyses, analysis of laboratory duplicates for Relative Percent Difference (RPD), analysis of Matrix Spike/Matrix Spike Duplicate analyses far percent recovery and RPD, and analysis *of* Laboratory Control Samples for percent recovery, and holding times. The requirement for the quantitative assessment of completeness shall be 90%. The 90% standard shall be applied to the entire list of parameters described above such that a minimum of 90% of the data far each analytical method is associated with acceptable quality control criteria as described above and in other sections of this document. The quantitative assessment of completeness shall be calculated for each analytical method as the ratio of acceptable sample results to all sample results. For multi-analyte methods (organics analyses) each analysis of the aggregate of analytes shall be considered a single sample result, The requirement for holding times shall be 100%. If any sample exceeds the holding time specified by EPA SW 846 lor other guidance documents for other analyses), that sample should be resampled and reanalyzed, unless redirected by the client.

13.6 CORRECTIVE ACTION

Corrective Action will be initiated for instances of QC parameter Incompliance. The extent and steps of corrective action procedures will vary according to project requirements or individual client protocols.

16.0 SCOPE

Preventive maintenance is an orderly program of positive actions (equipment cleaning, lubricating, reconditioning, adjustment and/or testing) done to prevent the failure of measurement systems or support equipment. The goal is to ensure the analytical system is in control and to prevent any nonconformance from occurring before tasks are initialed. Use of preventive maintenance schedules for each analytical measurement system and support equipment type aids in the foretelling of possible problems. Documentation of preventive procedures is through Preventive Maintenance Logs.

Preventive Maintenance Logs are maintained for all instrumentation and equipment, These logs are stored near respective instrumentation and are maintained by responsible analysts or technicians. Figure 8 displays an example of a preventive maintenance schedule.

Service contracts are maintained for all major instrumentation Including:

Varian AAs and GFAAs
TJA36
Dionex ICs
Varian GCJMS
Varian GCs
Perkin Elmer GCs

All service calls will be documented In respective Preventive Maintenance Logs.

16.1 GENERAL PROCEDURES

Preventive maintenance will be performed by qualified personnel. Records of repairs, adjustments, and calibrations will be maintained and available for inspection. Periodic checks of Preventive Maintenance Logs and schedules will be performed by department supervisors. Documentation of these checks will consist of approval initials on pertinent logs.

If an instrument is not working properly and cannot be restored by laboratory personnel, a service call to the manufacturer will be made. Approval of a service call must *be made* by the concerned department supervisor or General Manager before initiation, Documentation of each service call will be maintained in respective Preventive Maintenance Logs.

16.2 TAGGING OUT

In cases whan Instrumentation or equipment is not operational, they must be labeled out of service. do not use. A sign with the aforementioned label will be affixed to non-operational instruments or equipment by department supervisors or the QA Officer. Responsibility of the removal of warning signs is designated to either department supervisors or the QA Officer.

16.3 GENERAL PREVENTIVE MAINTENANCE CHECKS

EQUIPMENT MONITORING

Equipment	Check	Acceptance Criteria	Frequency
Top-loading balances	Verify accuracy with weights calibrated against certified class-S weights	±0.02 g	Daily or with each use
Analytical balances	Verify accuracy with certified class-S weight using different weight each day over range of weights routinely determined. Calibration by outside source quarterly.	±0.0005g	Daily or with each use
Thermometers	Verify accuracy against NIST-certified thermometer, or if purchased with certificate of traceability, check for mercury separation daily.	±1.0°C	Annually
Temporary storage refrigerators	Verify temperature within range.	4°C±2°C	Daily
Long-term storage refrigerators	Verify temperature within range.	4°C±2°C	Daily
Freezers	Verify temperature within range.	<-10°C	Daily

17.0 DEFINITIONS

17.0.1 Corrective Action (CA)

A process by which a critical error Is corrected in such a way as to prevent future errors of the same nature or type.
Some examples of when to initiate corrective action:

- Calculation errors,
- Client Request.
- Out of control trend
- Significant QA/QC anomalies
- Unacceptable PE results.
- Poor curve linearity.
- Dilution error (if sample is diluted).
- Equipment malfunction.
- Improper methodology for sample matrix.
- Contamination.
- Incorrect report formatting.
- Clerical discrepancies.
- Invoicing problems.
- Field service problems.
- Inherent or chronic problems with methodology.

17.0.2 Quality Improvement (QI)

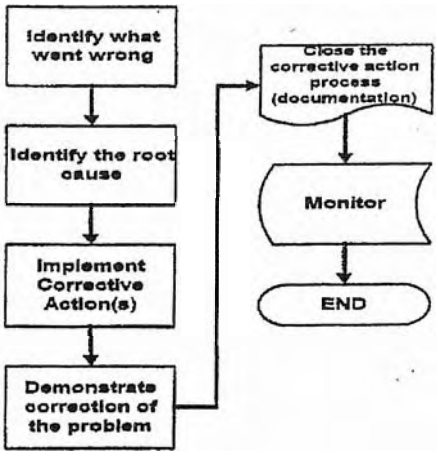
A term used to describe a preemptive positive action or process modification, which increases the level of quality and customer satisfaction.

17.1 PROCESS

Corrective steps for reporting and correcting problems for non-conforming measurements, equipment, or instruments:

1. Assign responsibility for investigating the problem
2. Determine the cause of the problem
3. Determine corrective action to eliminate the problem
4. Assign responsibility for implementing the corrective action
5. Verify that the corrective actian has eliminated the problem
6. Create a historical file for future problem solvers
7. Document the corrective action process.
8. Trend corrective action.

PROCESS



Please refer to Appendix D for background on initiation of analytically based corrective action,

Figure 8

MAINTENANCE LOG

MONTH_____

YEAR_____

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
INITIALS																															
DAILY																															
Clean Platens																															
Empty Waste Containers																															
Wipe Spills																															
Dispose of Sample Cups																															
WEEKLY																															
Wipe Pump Rollers																															
Clean Manifolds - KemWash																															
MONTHLY																															
Clean Wash Reservoir																															
160-200 HRS																															
Change Pump Tubing																															
400 HRS																															
Clean Pump Roller Cage																															
Clean Pump Fan																															
Lubricate Pump Gears																															
6 MONTHS																															
Replace Wash Res. Tubing																															
Replace Cart. Drain Tubing																															
Replace Transmission Tubing																															

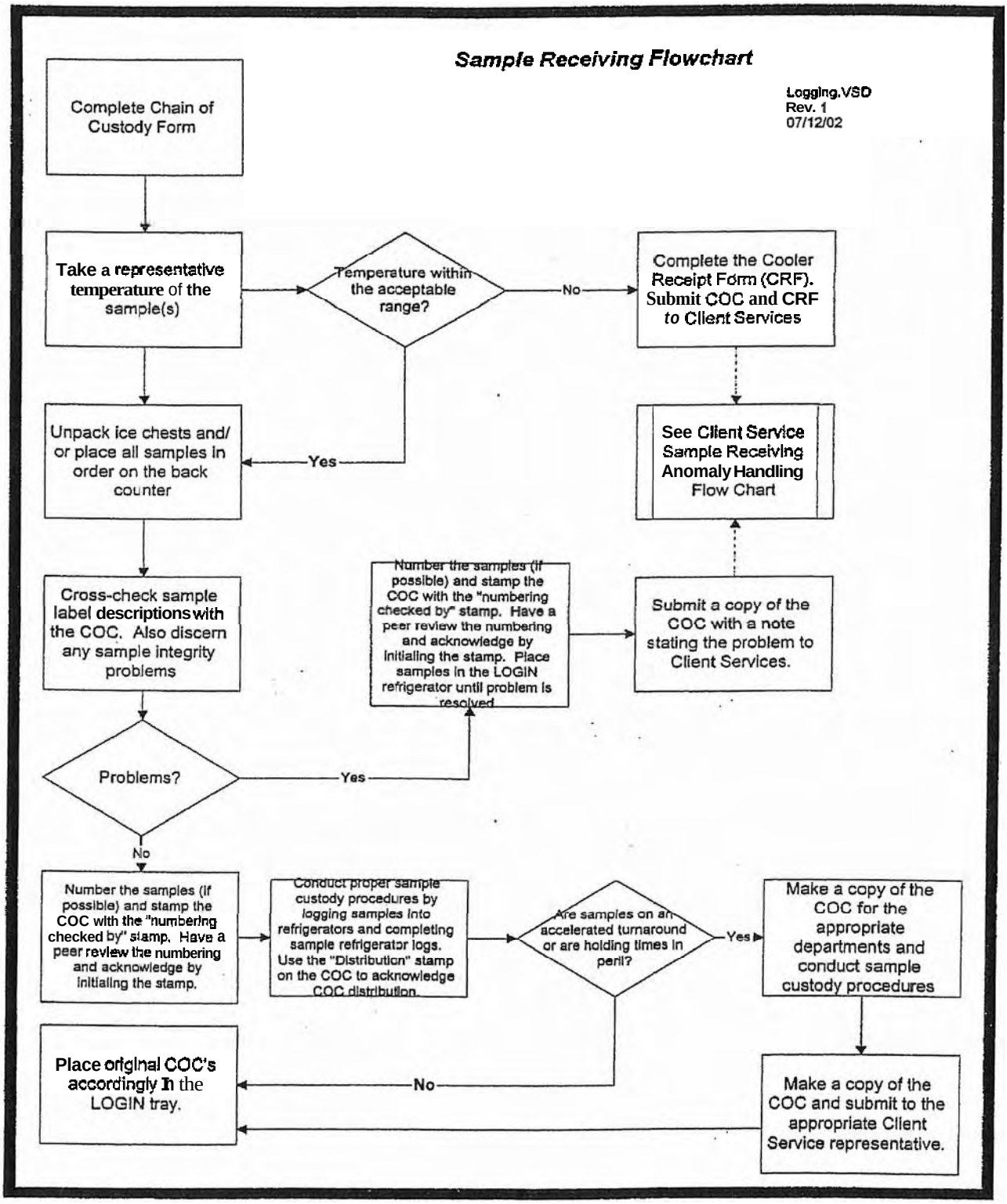
18.0 QUALITY ASSURANCE REPORTS

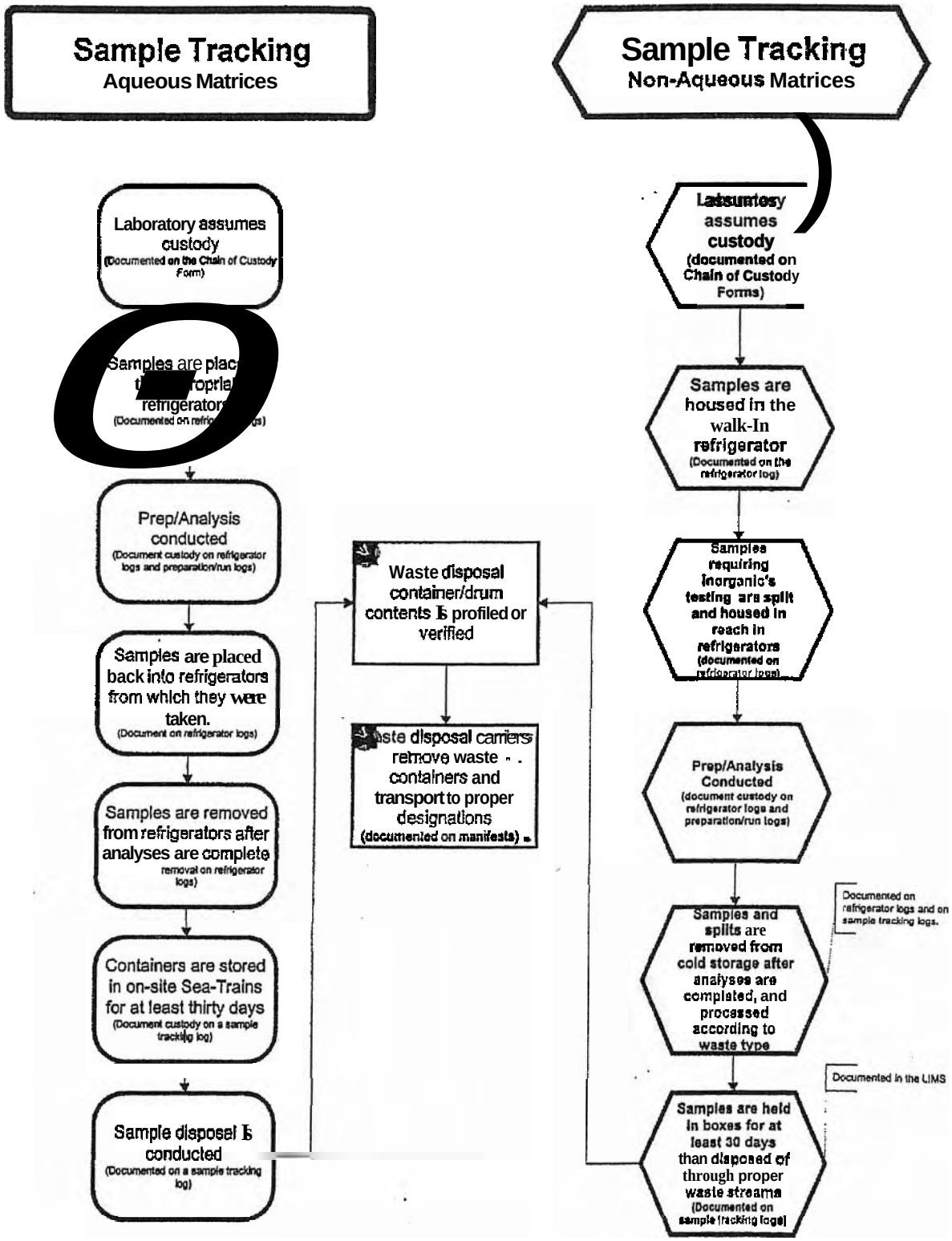
Quality Assurance reports, prepared by the Quality Assurance Officer, are issued on a quarterly basis. The purpose of these quarterly updates is to *give* an indication of overall laboratory performance and quality *of* work. These reports contain information pertaining to the overall performance of the laboratory. Annual internal audit reports are also completed to measure laboratory performance during the previous three month spans.

Information is gathered from internal and external audit results, control charts, monitoring programs and supervisor/analyst interviews. Situations such as equipment malfunctions, new or updated QC techniques, revised analytical procedures, corrective action activities, and any significant QC or performance evaluations will also be addressed in the report, Copies of these reports are available upon request.

The QA Officer maintains a direct line of communication with upper management *to* relay quality related information, therefore eliminating conflict of interest influence from concerned parties.

APPENDIX E


Sample Receiving Flowchart
Logging.VSD
Rev. 1
07/12/02
Complete Chain of Custody Form
Take a representative temperature of the sample(s)
Temperature within the acceptable range?
No
Complete the Cooler Receipt Form (CRF). Submit COC and CRF to Client Services
Yes
Unpack ice chests and/ or place all samples in order on the back counter
See Client Service Sample Receiving Anomaly Handling Flow Chart
Cross-check sample label descriptions with the COC. Also discern any sample integrity problems
Number the samples (if possible) and stamp the COC with the "numbering checked by" stamp. Have a peer review the numbering and acknowledge by initialing the stamp. Place samples in the LOGIN refrigerator until problem is resolved
Submit a copy of the COC with a note stating the problem to Client Services.
Problems?
Yes
No
Number the samples (if possible) and stamp the COC with the "numbering checked by" stamp. Have a peer review the numbering and acknowledge by initialing the stamp.
Conduct proper sample custody procedures by logging samples into refrigerators and completing sample refrigerator logs. Use the "Distribution" stamp on the COC to acknowledge COC distribution.
Are samples on an accelerated turnaround or are holding times in peril?
Yes
Make a copy of the COC for the appropriate departments and conduct sample custody procedures
Place original COC's accordingly in the LOGIN tray.
No
Make a copy of the COC and submit to the appropriate Client Service representative.


Sample Tracking
Aqueous Matrices
Laboratory assumes custody
(Documented on the Chain of Custody Form)
Samples are placed in appropriate refrigerators
(Documented on refrigerator logs)
Prep/Analysis conducted
(Document custody on refrigerator logs and preparation/run logs)
Samples are placed back into refrigerators from which they were taken.
(Document on refrigerator logs)
Samples are removed from refrigerators after analyses are complete
removal on refrigerator logs)
Containers are stored in on-site Sea-Trains for at least thirty days
(Document custody on a sample tracking log)
Sample disposal is conducted
(Documented on a sample tracking log)
Waste disposal container/drum contents is profiled or verified
Waste disposal carriers remove waste containers and transport to proper designations
(documented on manifests)
Sample Tracking
Non-Aqueous Matrices
Laboratory assumes custody
(documented on Chain of Custody Forms)
Samples are housed in the walk-In refrigerator
(Documented on the refrigerator log)
Samples requiring inorganic's testing are split and housed in reach in refrigerators
(documented on refrigerator logs)
Prep/Analysis Conducted
(document custody on refrigerator logs and preparation/run logs)
Samples and splits are removed from cold storage after analyses are completed, and processed according to waste type
Documented on refrigerator logs and on sample tracking logs.
Samples are held in boxes for at least 30 days than disposed of through proper waste streams
(Documented on sample tracking logs)
Documented in the LIMS

14.6 Working Standards

Internal audit standards are purchased from: ERA, 5540 Marshall Street, Arvada, CO 80002, 303-431-8454, 1-800-ERA-0122.
Catalog descriptions: WW-11: Wastewater, PP-41: PP/CLP Organic-water PW-31: Potablewater.
Optional purchases are made from: Ultra Scientific, 250 Smith Street, North Kingstown, RI 02852, 401-294-9400, Fax: 401-295-2330.

14.7 Sample Collection, Preservation and Handling

Audit samples should be prepared as soon as possible. If this is not practical, store samples or ampuls according to specifications included in respective preparation method instructions.

Preserve audit solutions according to method preparation instructions, and/or laboratory guidelines.

Handle concentrated ampul solutions with care. Read associated MSDS sheets for more information on safe handling of each material.

When analyses are completed, discard samples and remaining ampul contents according to laboratory waste disposal protocols.

14.8 Procedure

14.8.1 Internal Audits (conducted by the QA/QC Dept.)

Purchase audit samples from ERA or an as needed basis. When the audits samples arrive, prepare and process them immediately. If this cannot by done, store the samples inside the walk-in refrigerator. Follow preparation procedures and fill out chain-of-custody forms under fictitious client identifications. Document these sample identifications and notify the billing department of the audit samples so they are not billed. The most anonymous method of submitting samples is to pack the sample batch into an ice chest. Then leave it overnight in the walk-in refrigerator. The samples will be logged in the following morning. When analyses are completed, retrieve data from the billing department or client services. Process the results in report form as part of the quarterly report to upper management. List sample IDs, methods used, results, units, control limits and analytes. Process an unacceptable results section that includes: sample IDs, methods, analytes, reasons for discrepancies, and corrective action.

14.8.2 External Audits

Examine all aspects of sample condition when the audit arrives. If my discrepancies are found, contact the responsible parties for further instruction or action. After examination of samples and instructions, initiate the analytical process, Review all pertinent raw data after respective supervisor validations. If any discrepancies are found, allow the responsible supervisor to correct the problem. When all data is acceptable and complete, hand in the data package to the Data Control Department. Review of data

transferal is conducted by the Data Control Supervisor. When this checkpoint is cleared, the QA Officer reviews the results and clears the audit.

14.9 Forms

Preparation Forms
Sample Constituency Forms
Analyte Concentrations Reports
Chain-of-Custody

14.10 Safety

Follow any precautions listed in the MSDS associated for each sample. Always wear a labcoat, gloves and safety glasses.

1. INTRODUCTION

Aquatic Testing Laboratories (ATL) is dedicated to providing the highest quality aquatic toxicity testing available to its clients. This document describes ATL's Quality Assurance policies and procedures as they relate to biological monitoring for environmental pollutants.

Purpose of Document

This Quality Assurance Program Plan (QAPP) is intended to ensure that precision, accuracy, completeness, comparability, and representativeness of data are known and documented.

The QAPP presents an overview of the essential elements of ATL's QA program. This plan has been modeled along EPA guidelines as outlined in "Interim Guideline and Specifications for Preparing Quality Assurance Program Plans," QAMS-004/80, December 29,1980; "Interim Guideline and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, February 1983; "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms," EPA/600/4-89/001; and "Manual for the Evaluation of Laboratories Performing Aquatic Toxicity Tests," EPA/600/4-90/031. All of these documents have been issued by the Office of Monitoring Systems and Quality Assurance, *Office* of Research and Development, U.S. Environmental Protection Agency (U.S. EPA). Primary guidance was obtained from "Enseco Incorporate Quality Assurance Program Plan for Environmental Biology," Revision 3.1, July, 1988, written by Enseco Inc. with additional guidance provided from the Environmental Laboratory Accreditation Program, (State of California Department of Health Services and Department of Fish and Game).

QA Objectives

This QA Program Plan is designed *to* control and monitor the quality of data generated at MRS and by subcontractors. The described QA program is geared toward generating data that comply with federal regulatory requirements specified under the National Pollutant Discharge Elimination System (NPDES) as well as the State of California Department of Health Services Environmental Laboratory Accreditation Program (DOHS ELAP) and other state equivalents. Although the QC requirements of these various programs are not completely consistent, each of the programs base data quality judgements on two types of information:

1) Data that indicate the overall qualifications of the laboratory to perform environmental analyses;

2) Data that measure the laboratory's daily performance using a specific method.

The operational elements that are involved in making each of these assessments are described in TABLE 2.1 along with the pertinent section number from this document in which each is discussed.

TABLE 2.1
DATA QUALITY ASSESSMENT

Evaluation Criteria	Operational Elements	QA Plnn
LABORATORY QUALIFICATION	Facilities/Equipment/Staff	*SOQ**
	Written SOP's far all laboratory procedures	27
	Sample *custody*	8
	Calibration procedures	10
	Testing procedures	11
	Data validation	15
	Documented QA program	1-28
	Laboratory certifications	21
LABORATORY PERFORMANCE	Calibration data	10
	Check samples	21
	Reference toxicant data	19
	Control charts	19

* SOQ (Statement Of Qualifications) described in *a* separate document.

2. DEFINITIONS

Definition of Terms

Protocol: the *actual* plan for scientific testing. A protocol may refer to several SOP's to complete the plan.

Quality Assurance (QA): the total integrated program for assuring the reliability of data generated in the laboratory.

Quality Assurance Program Plan (QAPP): an assemblage of management policies, objectives, principles, and general procedures outlining the techniques by which the laboratory produces data of known and accepted quality.

Quality Assurance Project Plan (QAPjP): an assemblage of detailed SOP's describing how the laboratory will generate data that meet the data quality objective of a specific project.

Duality Control (QC): the routine application of specific, well documented procedures to ensure the generation of data of known and accepted quality, thus fulfilling *the* objectives of the QA program,

Quality Control Manual: an assemblage of detailed SOP's describing the laboratory implementation of the QAPP.

Standard Operating Procedure (SOP): a detailed, written description of a procedure designed to systematize and standardize the performance of the procedure.

3. ORGANIZATION, RESPONSIBILITIES AND AUTHORITIES

Executing an effective QA program demands the commitment and attention of both management and staff. The QA effort at ATL is managed by the Laboratory Director who serves as the QA Officer and as such, has the responsibility of overseeing and regulating all laboratory functions. The QA program operates independently of all areas, generating analytical data to ensure complete objectivity in the evaluation of laboratory operations,

QA Officer Responsibilities

The QA officer is responsible for:

* Developing and implementing a QA program that ensures that all data generated are scientifically sound, legally defensible, and of known precision and accuracy;
* Monitoring the QA Plan to ensure compliance with QA objectives;
* Ensuring that all employees are complying with the QA Plan;
* Developing and implementing new QA procedures to improve data quality;
* Conducting in-house audits and inspections of all laboratories on a regular basis and applying corrective actions as needed to ensure compliance with the QA Plan;
* Maintaining copies of all SQP'S;
* Assist in the writing of SOP's;
* Distributing current SOP's to the laboratory staff;
* Monitoring laboratory performance in the areas of holding times, turn-around times, and meeting contractual obligations;
* Performing statistical analyses of QC data and establishing data bases that accurately reflect the performance of the laboratory;
* Maintaining reference toxicant control charts on all testing done at ATL;

* Maintain records and archives of all QA/QC data, PE results, audit comments, and client inquiries concerning data quality;

* Conducting seminars on QA issues for both clients and laboratory staff; and

* Promoting sound QA practices within the environmental regulatory and analytical communities.

QA Officer Authority

The QA officer has the final authority on all issues dealing with data quality and has the authority to require that procedures be amended or discontinued, or analyses suspended or repeated. He also has the authority to suspend or terminate employees on the grounds of dishonesty, incompetence, or repeated non-compliance with QA procedures.

Laboratory Personnel Responsibilities

All laboratory personnel involved in the generation and reporting of data have a responsibility to understand and follow the ATL QA Plan. Laboratory personnel are responsible for:

* Have a working knowledge of the ATL QA Plan;

* Ensuring that all work is generated in compliance with the QA Plan;

* Performing all work according to written SOP's;

* Ensuring that all documentation related to their work is complete and accurate; and

* Providing management with immediate notification of quality problems.

Laboratory Personnel Authority

Laboratory personnel have the **authority** to **accept** or reject data based on compliance with well-defined **QC acceptance** criteria. **The** acceptance **of data** that fall **outside *QC*** criteria must **be approved by** laboratory management. The authority of the laboratory personnel **flows** from the Laboratory Director.

4. SAMPLING PROCEDURES

The generation of quality *data* begins with the collection of the effluent, water or sediment sample. Therefore the integrity of the sample collection process is of concern to the laboratory. Samples must be collected in such a way that no foreign material is introduced into the sample and no material of interest escapes from the sample prior to analysis. To ensure sample integrity, the following must be considered:

* Samples must be collected in appropriate containers. In general, glass containers are used for soils and solids, while plastic "cubitainers" are used for effluents and surface waters;

* The sample containers must be properly cleaned to ensure that the sample is not contaminated during *the* collection process;

* Appropriate volumes of sample must be collected to ensure that the required testing may completed and QC samples may be analyzed;

* Samples must be cooled to the appropriate holding temperature (4°C) prior to shipping;

* Samples must be properly shipped to the laboratory, in the appropriate time frame, to ensure that holding times *can* be met.

ATL can assist in the sample collection process by providing consultation and assistance *to* clients designing sampling programs and also by making available to the client a set *of* appropriate sample containers that are properly cleaned for use in sample collection.

The maximum holding times recommended by ATL, appropriate containers, and minimum sample volumes required for routine testing are given in Appendix I. These holding times are in general agreement with EPA and the State of California recommended holding times, as stated in the National Pollutant Discharge Elimination System (NPDES) and the California Environmental Laboratory Accreditation Program (ELAP) programs. Other holding times can be honored if special arrangements are made with the laboratory.

5. SAMPLE CUSTODY

Upon receipt by ATL, samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

All samples are received by ATL's sample control personnel and are carefully checked for label identification, and completed, accurate chain-of-custody records. Photographs may be used to document the condition of samples. Each sample is then assigned an unique laboratory identification number. The date received, the condition upon receipt, the new laboratory identification number, as well as the client and the client's sample identification are recorded in the sample control log book, A sample file is then generated in which all documentation, including testing results, are kept. The sample itself is labeled with the laboratory identification number and stored in a secured refrigerated *storage* facility with temperature maintained at 4°C until analysis. Any unused sample is returned to refrigerated storage until all analyses are complete. Samples are then either returned to the client, properly disposed of, or at the request of the client, stored for an extended length of time.

An example of ATL's chain-of-custody record form is given in Figure 5.1.

CHAIN OF CUSTODY

Client:

Address:

Project Manager:

Phone:

Purchase Order/Quote No.:

Aquatic Testing Laboratories

"dedicated to providing quality aquatic toxicity testing"

2810 Bunsen Ave., Unit A
Ventura, CA 93003
(805) 650-OM6 FAX (805) 650-0756

SAMPLE ID/DESCRIPTION	SAMPLE DATE	SAMPLE TIME	SAMPLE TYPE*	NUMBER OF CONTAINERS	TESTING REQUESTED	REMARKS

Special Instructions:

* L = Liquid, S = Solid, SS = Semi-Solid, WW = Waste Water, RW = Receiving Water

CUSTODY TRANSFERS

RELINQUISHED BY (SIGNED)	RECEIVED BY (SIGNED)	DATE	TIME
Sampler:			

Shipping Company: Airbill No:

Received far Laboratory by: Date: Time:

Received Chilled: Yes No Seals Intact: Yes No None

Figure 5.1 **Sample** Chain **Of** Custody Form

6. CALIBRATION PROCEDURES AND FREQUENCY

Standard/Reagent Preparation

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical and/or biological operations. ATL continually monitors the quality of reagents and standard solutions through a series of well-documented procedures.

To ensure the highest purity possible, all primary reference standards and standard solutions are obtained from the EPA laboratory in Cincinnati, Ohio, or other reliable commercial sources. All standards and standard solutions are recorded into a log book that identifies the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information.

Care is exercised in the proper storage and handling of standard solutions, and all containers are labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation).

Instrument Calibration and Tuning

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity. Instruments used for routine measurements of chemical and physical parameters such as pH, DO, temperature, conductivity, salinity, alkalinity, and hardness, must be calibrated and standardized according to the instrument manufacturer's procedures prior to any uninterrupted use.

Dissolved oxygen probes can be calibrated daily by use of the moist air technique, however, comparison to the Winkler titrimetric method must be performed at least once per week.

Wet chemical methods used to measure hardness and alkalinity must be standardized according to EPA Methods 130.2 and 310.1.

7. TESTING PROCEDURES

Test Organisms

The fish and invertebrates used in toxicity testing should appear healthy, behave normally, feed well, and have low mortality in cultures, holding tanks, and test controls. Test organisms should be disease-free and should be positively identified to species.

The sensitivity (quality) of *test* organisms obtained from an outside of the laboratory source is to be tested by conducting a reference toxicant *test* on organisms from each batch received by the laboratory. The sensitivity of test organisms obtained from an in-lab breeding culture is to be tested by conducting *a* reference toxicant test on the cultured organisms on a monthly basis. Reference toxicant tests may be performed concurrently with an effluent toxicity *test.*

Facilities. Equipment, and Test Chambers

Laboratory and bioassay temperature control equipment must be adequate to maintain recommended test water temperatures. Surfaces that come in contact with the sample, such as test chambers, must be made of recommended materials. See individual testing SOP's and protocols for recommended materials and testing regimes.

Dilution Water

The dilution water used in toxicity tests will depend on the objectives of *the* study and client requirements. Hazardous waste testing utilize synthetic, soft (hardness: 40-48 mg/l $CaCO_3$) water. EPA NPDES toxicity test utilizes synthetic, moderately hard water or 20% diluted mineral water (DMW). Some tests will required the use of client-supplied dilution water.

The dilution water used for internal quality assurance tests with organisms, food, and reference toxicants should be water routinely used with success in the laboratory.

Testing Conditions

Water temperature must be maintained within the limits specified for each test. Dissolved oxygen (DO) concentration and pH in fish and invertebrate *test* chambers should be checked daily throughout the test period, as described in the test SOP,

Food Quality

The quality *of the* food for fish and invertebrates *is* an important factor in toxicity tests. Suitable fish food flakes, brine shrimp *cysts,* and other foods must be obtained as described in *the* test SOP's and protocols. The suitability of each new supply of food must be determined in a side-by-side test, using two treatments with four replicates per treatment. In this *test,* the response of control test organisms fed with the new food *is* compared with the response of organisms fed a reference food or a previously used, satisfactory food.

Test Methods

Most *tests* performed by ATL are driven by regulatory concerns. Therefore, methods used at ATL predominately originate from regulatory agencies. Generally the methods used are those specified by the U.S. EPA and other federal agencies, state agencies, and professional organizations, as provided in the following references:

* American Society for Testing Materials (ASTM). 1989. Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos *of* Four Species of Saltwater Bivalve Molluscs. Procedure E *724-89.* ASTM, Philadelphia, PA.

* California Department *of* Health Services. 1988. Static Acute Bioassay Procedures for Hazardous Waste Samples. Prepared by J.M. Polisini and R.G. Millet. California Department of Fish and Game Water Pollution Control Laboratory.

* California State Water Resources Control Board (CSWRCB). 1989. Experimental Evaluation of Effluent Toxicity Testing Protocols with Giant Kelp, Mysids, Red Abalone, and Topsmelt. CSWRCB, Sacramento, CA.

* Dinnel, P., J.M. Link and Q.J. Stober. 1987. Improved Methodology for a Sea Urchin Sperm Cell Bioassay for Marine Waters. Arch. Environ. Contam. Toxicol. 16: 23-32.

* Kopperdahl, F. 1976. Guidelines for Performing Static Acute Toxicity Fish Bioassays in Municipal and Industrial Wastes. Calif. Dept. of Fish and Game.

* Machuzak, M.J. and T.K. Mikel, Jr. 1988. Drilling Fluid Bioassays Using Pacific Ocean Mysid Shrimp, Acanthomysis sculpta, a Preliminary Introduction. ASTM STP 971. ASTM, Philadelphia, PA.

* U.S.ACE/HD. 1990. Dredged Material Bioassay/Bioaccumulation Testing Manual for Hawaii. U.S. Army Corps of Engineers, Honolulu District, Fort Shafter, Hawaii.

* U.S.ACE/NYD. 1984. Guidance for Performing Tests on Dredged Material to be Disposed of in Ocean Waters. U.S. Army Corps of Engineers, Regulatory Branch, Water Compliance Section, New York, NY.

* U.S.EPA. 1985. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. EPA/600/4-85/013.

* U.S.EPA. 1985. Proposed Regulations for Offshore, Oil and Gas Extraction Point Source Category. Appendix 3. Drilling Fluids Toxicity Tests. Federal Register, Vol. 50, No. 165. Washington DC.

* U.S.EPA. 1988. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. EPA/600/4-87/028.

* U.S.EPA. 1989. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. EPA/600/4-89/001.

* U.S.EPA/CE. 1977. Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters. Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

* U.S.EPA/CE. *1990,* Draft Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters. EPA-503-8-90/002. Office of Marine and Estuarine Protection, Washington, DC 20460.

9. INTERNAL *QC* CHECKS

The QA/QC program monitors data quality with internal *QC* checks which are used to determine if all laboratory operations are "in control," (i.e., operating within acceptable QC guidelines), during data generation.

Responsibility for internal QC checks rests with the QA Officer and with the individual analyst. These QC checks include instrument calibration checks, chemical monitoring of dilution waters, specific *test* validity requirements, and a reference toxicant monitoring program which includes Me generation of test control charts.

Instrument QC Checks

All analytical instruments will be calibrated prior to use as set forth in ATL SOP's. Whenever calibration cannot be achieved or measurement of a calibration standard *is* not within specified limits, the instrument will be considered malfunctioning and will be reported to the Laboratory Director. Any malfunctioning instrument will not be used until appropriate maintenance or repairs are performed and documented.

Chemical Monitoring Of Dilution Waters

In order to establish and continuously monitor the acceptability of the dilution waters utilized in toxicity tests, the dilution waters will be monitored continuously, for deionized water, or at least twice per year for field collected seawater. Dilution waters are to be analyzed to the parameters listed in *the* appropriate SOP. Results *of* such analyses are to be maintained in appropriate dilution log books.

Test Validity Requirements

Due to *the* wide range of test guidelines utilized in toxicity testing, *the* requirements to determine the validity of any *test* conducted will be stated in the appropriate SOP. Generally, all acute toxicity tests will be required to meet the following criteria for acceptability:

* No more than a total of 10 percent of the control organisms may appear *to* be diseased, stressed, or die in a test.

* **Appropriate** testing conditions, (i.e., temperature, light/dark cycles), are maintained during *the* course of testing.

Reference Toxicant Monitoring Program

The QA Officer will obtain reference toxicants from the EPA Environmental Monitoring and Support Laboratory in Cincinnati, Ohio, (Telephone No.: (513) 569-7325), or from another reputable commercial supplier. Generally, sodium dodecylsulfate (SDS) will be the reference toxicant of choice, however, in some instances or for certain species other reference toxicants may be utilized.

Reference toxicant tests will be performed on each new batch of test organisms received at the laboratory or on a monthly basis for organisms cultured in-house. Appropriate reference toxicant testing will be conducted concurrently with sample testing when required by test methodology or by the client.

Control Charts

Control charts are to be established and continuously maintained for each organism and test conducted at ATL. Control charts should monitor appropriate test endpoints such as LC50 and NOEC values obtained from the reference toxicant testing program. The control chart is used to evaluate the cumulative trend of the statistics from a series of tests. For point estimation techniques, the mean and upper and lower control limits (+/- 2 times the mean toxicity value standard deviation) me re-calculated with each successive point, until the statistics stabilize. Outliers, which are values which fall outside the upper and lower control limits, and trends of increasing or decreasing sensitivity are readily identified. Note: at the 0.05 probability level, one in 20 tests would be expected to fall outside of the control limits by chance alone. For hypothesis testing results, the same concentrations of reference toxicants are used for each toxicity test. The NOEC from each successive test is entered on the control chart, and the values should fall within one concentration interval above or below the central tendency.

Control charts are to be established based on five successfully completed reference toxicant tests with control limits recalculated with each successive valid reference toxicant test data endpoint. Control charts are used to monitor test organism sensitivity for both commercially obtained and in-house cultured test organisms. If a control chart data point falls outside the established control limits, corrective action must be taken to determine the cause of the discrepancy.

Laboratory Performance QC Program

Laboratory Performance QC is provided as a standard part of every analysis. The main elements of Laboratory Performance QC are:

* Organism survival and reproduction;
* The analysis of reference toxicants
* The generation of daily calibration data.

Satisfactory laboratory performance is demonstrated by performing at least one acceptable reference toxicant test per month for each of the toxicity test methods commonly used in the laboratory. Reference toxicant tests are to be conducted concurrently with less frequently performed tests. If the toxicity value from a given test with the reference toxicant does not fall in the expected range for the test organisms when using the standard dilution water, the sensitivity of the organisms and the overall credibility of the test system are suspect. In this case, the test procedure should be examined for defects and should be repeated with a different batch of test organisms.

Please refer to section 6 of this manual for a discussion of calibration procedures.

10. PERFORMANCE AND SYSTEM AUDITS

ATL participates in a variety of federal and state certification programs, (i.e., EPA's DMR study and California's ELAP program), that subject the laboratory to stringent system and performance audits on a regular basis. A system audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data. A performance audit verifies the ability of the laboratory to correctly identify toxicity in blind check samples submitted by the auditing agency. The purpose of these audits is to identify those laboratories that are capable of generating scientifically sound data. A list of current ATL certifications is available upon request.

In addition to external audits conducted by certifying agencies or by clients, the QA Officer periodically conducts system and performance audits of the laboratory to verify that only quality, scientifically sound, data are being generated.

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APPENDIX C

Effluent and Biosolids Chemistry

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APPENDIX C

Analytical Results for Effluent and Biosolid Samples Collected during 2006

Table C.1 Effluent Monitoring Results

Constituent	Units	Method	Concentration			Mass Emission	
			Permit Limit[a]	January-June[b]	July-December[c]	Loading (kg)	Goal (kg/yr)
Miscellaneous Parameters							
Flow (quarterly)	Mega-L/Qtr	NA[d]	712	**416.5** **442.8**	**421.9** **366.4**	NA	NA
Acute Toxicity (quarterly): *Pimephales promelas*	TUa	EPA-821-R-02-012	1.5	**1.41**[e] **1.41**[e]	**1.41**[e] **1.41**[e]	NA	NA
Methyl tert-butyl ether (MTBE)	µg/L (ppb)	624	NA	<0.5[f]	<0.5	<0.8	NA
Asbestos (>10 µm & Total)	MFL	100.2	NA	—[g]	<0.2	NA	NA
Acenaphthene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
Aniline	µg/L (ppb)	625	NA	<5	<50	<43.7	NA
Benzoic Acid	µg/L (ppb)	625	NA	<10	<100	<87.4	NA
Benzyl Alcohol	µg/L (ppb)	625	NA	**2.3**	<20	<17.7	NA
Butylbenzyl Phthalate	µg/L (ppb)	625	NA	≅**1.5**[h]	<20	<17.1	NA
4-Bromophenyl phenyl ether	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Chloroaniline	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2-Chloronaphthalene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Chlorophenyl phenyl ether	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2,6-Dinitrotoluene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
Di-n-octylphthalate	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
Endrin Aldehyde	µg/L (ppb)	608	NA	<0.01	<0.01	<0.0165	NA
2-Methylnaphthalene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
Naphthalene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2-Naphthylamine	µg/L (ppb)	625	NA	<20	<200	<174.9	NA
2-Nitroaniline	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
3-Nitroaniline	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Nitroaniline	µg/L (ppb)	625	NA	<5	<50	<43.7	NA
N-Nitrosodi-n-propylamine	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
1,2,4-Trichlorobenzene	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Chloro-3-methylphenol	µg/L (ppb)	625	NA	<5	<50	<43.7	NA
2-Chlorophenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2,4-Dichlorophenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2,4-Dimethylphenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA

[a] Sampling statistic associated with lowest permitted limit, *viz.* either six-month median or 30-day average

[b] Chemical samples were collected on 11 January 2006, the chronic bioassay sample was collected on 16 January 2006, and four daily acute bioassay samples were collected on 16 January through 19 January 2006 and another four were collected on 10 April through 13 April 2006.

[c] Chemical samples were collected on 12 July 2006, the chronic bioassay sample was collected on 17 July 2006, and four daily acute bioassay samples were collected on 17 July through 20 July 2006 and another four were collected on 2 October through 5 October 2006.

[d] Not applicable or not specified in NPDES discharge permit

[e] Test results were artificially elevated by ammonia interference

[f] "<" indicates the substance was not detected. The Practical Quantification Limit (PQL) is listed after the "<" symbol.

[g] Analysis not required

[h] "≅" indicates the substance was detected above the method detection limit but could not be accurately quantified because it was below the PQL

Table C.1 Effluent Monitoring Results

Constituent	Units	Method	Concentration			Mass Emission	
			Permit Limit[a]	January-June[b]	July-December[c]	Loading (kg)	Goal (kg/yr)
2-Methylphenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Methylphenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2-Nitrophenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
4-Nitrophenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
Pentachlorophenol	µg/L (ppb)	625	NA	<10	<100	<87.4	NA
Phenol	µg/L (ppb)	625	NA	<2	<20	<17.5	NA
2,4,5-Trichlorophenol	µg/L (ppb)	625	NA	<5	<50	<43.7	NA
Chloroethane	µg/L (ppb)	624	NA	<0.5	<0.5	<0.824	NA
1,1-Dichloroethane	µg/L (ppb)	624	NA	<0.5	<0.5	<0.824	NA
trans-1,2-Dichloroethene	µg/L (ppb)	624	NA	<0.5	<0.5	<0.824	NA
1,2-Dichloropropane	µg/L (ppb)	624	NA	<0.5	<0.5	<0.824	NA
Trichlorofluoromethane	µg/L (ppb)	624	NA	<0.5	<0.5	<0.824	NA
Total Xylenes	µg/L (ppb)	624	NA	**≅0.48**	<1	<1.20	NA
Methoxychlor	µg/L (ppb)	608	NA	<0.005	<0.0051	<0.0083	NA
Azinphos Methyl	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Bolstar	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Chlorpyrifos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Coumaphos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Demeton	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Diazinon	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Dichlorvos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Disulfoton	µg/L (ppb)	8140	NA	—	<0.5	<0.824	NA
Ethoprop	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Fensulfothion	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Fenthion	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Merphos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Mevinphos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Naled (Dibrom)	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Parathion Methyl	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Phorate	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Ronnel	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Stirophos	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Tokuthion	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Trichloronate	µg/L (ppb)	8140	NA	—	<0.2	<0.330	NA
Objectives for the Protection of Marine Aquatic Life							
Arsenic	µg/L (ppb)	200.8	670	**≅1.8**	**≅1.9**	≅3.04	17
Cadmium	µg/L (ppb)	6010/200.7	130	<10	<10	<16.5	88
Chromium (Hexavalent)[i]	µg/L (ppb)	6010/200.7	270	<10	<10	<16.5	93
Copper	µg/L (ppb)	6010/200.7	140	**14**	**20**	27.8	690
Lead	µg/L (ppb)	200.8	270	**2.2**	**2.1**	3.55	465
Mercury	µg/L (ppb)	7470/245.1	5	**≅0.03**	<0.2	<0.183	1.4
Nickel	µg/L (ppb)	6010/200.7	670	<10	**≅4.4**	<12.1	142
Selenium	µg/L (ppb)	200.8	2010	**≅0.99**	**≅1.9**	≅2.35	65
Silver	µg/L (ppb)	6010/200.7	70	<10	<10	<16.5	28
Zinc	µg/L (ppb)	6010/200.7	1620	**61**	**60**	99.7	244
Cyanide, Total	µg/L (ppb)	335.3	130	<20	**30**	<40.8	57
Total Residual Chlorine[j]	µg/L (ppb)		270				

[i] Measured as total chromium

[j] Daily measurements are discussed in Chapter 2 of this report

Table C.1 Effluent Monitoring Results

Constituent	Units	Method	Concentration			Mass Emission	
			Permit Limit[a]	January-June[b]	July-December[c]	Loading (kg)	Goal (kg/yr)
Ammonia as N (monthly)	mg/L (ppm)	350.1	80.4	**19** **33** **26** **15** **26** **29**	**32** **35** **27** **30** **33** **33**	NA	NA
NonChlorinated Phenolics	µg/L (ppb)	625	4020	<10	<100	<87.4	NA
Chlorinated Phenolics	µg/L (ppb)	625	130	<10	<100	<87.4	NA
Endosulfan	µg/L (ppb)	608	1.21	<0.005	<0.0051	<0.0083	3
Endrin	µg/L (ppb)	608	0.27	<0.005	<0.0051	<0.0083	1
HCH	µg/L (ppb)	608	0.54	<0.005	<0.0051	<0.0083	228
Toxicity-Chronic: *M. pyrifera* germination	TUc	CSWRCB	134	**5.6**	**3.12**	NA	NA
Toxicity-Chronic: *M. pyrifera* growth	TUc	CSWRCB	134	**5.6**	**3.12**	NA	NA
Radioactivity Gross α	pCi/L	7110C	15[k]	—	**0.26± 0.55**	NA	NA
Radioactivity Gross β	pCi/L	900.0	50[k]	—	**17.4 ± 4.01**	NA	NA
Objectives for the Protection of Human Health: Non-Carcinogens							
Acrolein	µg/L (ppb)	624	29500	<50	<50	<82.4	NA
Antimony	µg/L (ppb)	6010/200.7	160800	**≅21**	**≅11**	≅26.7	285
bis-(2-chloroethoxy) methane	µg/L (ppb)	625	590	<2	<20	<17.5	142
bis(2chloro-1methylethyl) ether	µg/L (ppb)	625	160800	<2	<20	<17.5	NA
Chlorobenzene	µg/L (ppb)	624	76400	<0.5	<0.5	<0.824	NA
Chromium III[i]	mg/L (ppm)	6010/200.7	25500	<10	<10	<16.5	NA
Di-n-butyl phthalate	µg/L (ppb)	625	469000	<2	<20	<17.5	142
Dichlorobenzene	µg/L (ppb)	624	683000	<0.5	<0.5	<0.824	5.7
1,1-Dichloroethene	µg/L (ppb)	624	951000	<0.5	<0.5	<0.824	3
Diethyl phthalate	µg/L (ppb)	625	4420000	**≅0.82**	<20	<16.5	191
Dimethyl phthalate	mg/L (ppb)	625	109900	<2	<20	<17.5	142
2-Methyl-4,6-dinitrophenol	µg/L (ppb)	625	29500	<10	<100	<87.4	142
2,4-Dinitrophenol	µg/L (ppb)	625	540	<10	<100	<87.4	342
Ethylbenzene	µg/L (ppb)	624	549000	<0.5	<0.5	<0.824	3
Fluoranthene	µg/L (ppb)	625	2000	<2	<20	<17.5	142
Hexachlorocyclopentadiene	µg/L (ppb)	625	7800	<2	<20	<17.5	NA
Isophorone	µg/L (ppb)	625	20100000	<2	<20	<17.5	142
Nitrobenzene	µg/L (ppb)	625	660	<2	<20	<17.5	142
Thallium	µg/L (ppb)	200.8	1880	<1	<1	<1.65	285
Toluene	µg/L (ppb)	624	11400000	**≅0.16**	**≅0.15**	≅0.256	4
1,1,2,2-Tetrachloroethane	µg/L (ppb)	624	160800	<0.5	<0.5	<0.824	3
Tributyltin[l]	µg/L (ppb)	—	0.19	—	—	NA	NA
1,1,1-Trichloroethane	µg/L (ppb)	624	72400000	<0.5	<0.5	<0.824	3
1,1,2-Trichloroethane	µg/L (ppb)	624	5760000	<0.5	<0.5	<0.824	3
Objectives for the Protection of Human Health: Carcinogens							
Acrylonitrile	µg/L (ppb)	624	13.4	<20	<20	<33.0	NA
Aldrin	µg/L (ppb)	608	0.003	<0.005	<0.0051	<8.32E-3	0.01[m]
Benzene	µg/L (ppb)	624	790	<0.5	<0.5	<0.824	3

[k] Drinking-water limit
[l] Tributyltin analysis is not required under the current Monitoring and Reporting Program
[m] Mass-emission goal computed from permit limit because historically, the limit has been below the PQL

Table C.1 Effluent Monitoring Results

Constituent	Units	Method	Concentration			Mass Emission	
			Permit Limit[a]	January-June[b]	July-December[c]	Loading (kg)	Goal (kg/yr)
Benzidine	µg/L (ppb)	625	0.009	<20	<200	**<175**[n]	0.03[m]
Beryllium	µg/L (ppb)	200.7/6010	4.42	<10	<10	<16.5	28[m]
bis-(2-chloroethyl) ether	µg/L (ppb)	625	6.03	<2	<20	**<17.5**[n]	17[m]
bis-(2-ethylhexyl) phthalate	µg/L (ppb)	625	470	**16**	**≅22**	≅31.1	320
Carbon Tetrachloride	µg/L (ppb)	624	120	<0.5	<0.5	<0.824	3
Chlordane	µg/L (ppb)	608	0.0031	<0.5	<0.51	**<0.832**[n]	0.0088[m]
Chloroform	µg/L (ppb)	624	17400	**1.2**	**0.83**	1.69	5
DDT	µg/L (ppb)	608	0.0228	<0.005	<0.0051	<8.32E-3	0.06
1,4-Dichlorobenzene	µg/L (ppb)	624	2410	<0.5	<0.5	<0.824	57
3,3-Dichlorobenzidine	µg/L (ppb)	625	1.09	<10	<100	**<87.4**[n]	3.1[m]
1,2-Dichloroethane	µg/L (ppb)	624	17400	<0.5	<0.5	<0.824	3
Methylene chloride	µg/L (ppb)	624	60300	<1	<1	<1.65	NA
1,3-Dichloropropene	µg/L (ppb)	624	1190	<0.5	<0.5	<0.824	NA
Dieldrin	µg/L (ppb)	608	0.0054	<0.005	<0.0051	<8.32E-3	0.02[m]
2,4-Dinitrotoluene	µg/L (ppb)	625	350	<2	<20	<17.5	142
1,2-Diphenylhydrazine	µg/L (ppb)	625	21	<2	<20	<17.5	60[m]
Halomethanes	µg/L (ppb)	624	17400	**≅0.26**	**0.85**	≅0.89	25
Heptachlor	µg/L (ppb)	608	0.0965	<0.005	<0.0051	<8.32E-3	0.27[m]
Hexachlorobenzene	µg/L (ppb)	625	0.0281	<2	<20	**<17.5**[n]	0.08[m]
Hexachlorobutadiene	µg/L (ppb)	625	1880	<2	<20	<17.5	142
Hexachloroethane	µg/L (ppb)	625	340	<2	<20	<17.5	142
N-Nitrosodimethylamine	µg/L (ppb)	625	980	<2	<20	<17.5	342
N-Nitrosodiphenylamine	µg/L (ppb)	625	340	<2	<20	<17.5	142
PAHs	µg/L (ppb)	625	1.18	<3	<30	**<26.2**[n]	3.4[m]
PCBs	µg/L (ppb)	608	0.0026	<0.2	<0.2	**<0.330**[n]	0.0073[m]
Dibenzofuran	µg/L (ppb)	625	NA	<2	<20	<17.5	57
Dioxin (Total TCDD)	pg/L	8280	0.52	—	<6	**<9.89E-6**[n]	1.42E-06[m]
Tetrachloroethene	µg/L (ppb)	624	13300	<0.5	<0.5	<0.824	4
Toxaphene	µg/L (ppb)	608	0.0281	<2	<2	**<3.30**[n]	0.08[m]
Trichloroethene (TCE)	µg/L (ppb)	624	3620	<0.5	<0.5	<0.824	3
2,4,6-Trichlorophenol	µg/L (ppb)	625	40	<5	<50	<43.7	114[m]
Vinyl chloride	µg/L (ppb)	624	4820	<0.5	<0.5	<0.824	3

[n] Comparison of loading and emission goal is indeterminate because maximum loading computed from PQL exceeds the emission goal

Table C.2 Biosolids Monitoring Results

Constituent	Units[o]	Method Number	Concentration[p]
Percent Solids	%	SM-2540G	**79.9**
Oil and Grease	mg/Kg (ppm)	1664	**64,000**
Inorganic Parameters			
pH	pH units	9045	**15.28**
Cyanide, Total	mg/Kg (ppm)	9010/9014	**1.5**
Nitrogen as NO_3	mg/Kg (ppm)	300.0	**140**
Nitrogen, Total Kjeldahl (TKN)	mg/Kg (ppm)	351.3	**20,000**
Ammonia as N	mg/Kg (ppm)	350.2	**4,400**
Organic Nitrogen[q]	mg/Kg (ppm)	—	**15,600**
Phosphate, Total	mg/Kg (ppm)	365.2	**57,000**
Total Dissolved Solids STLC[r]	mg/L (ppm)	160.1	**4,400**
Metals			
Antimony	mg/Kg (ppm)	6010	≅4.8[s]
Arsenic	mg/Kg (ppm)	6010	≅2.2
Barium	mg/Kg (ppm)	6010	**450**
Beryllium	mg/Kg (ppm)	6010	<0.19[t]
Boron	mg/Kg (ppm)	6010	≅15
Cadmium	mg/Kg (ppm)	6010	**4.2**
Chromium	mg/Kg (ppm)	6010	**57**
Hexavalent Chromium	mg/L (ppm)	7196	<0.13
Cobalt	mg/Kg (ppm)	6010	≅5.3
Copper	mg/Kg (ppm)	6010	**560**
Copper STLC Waste Extraction	mg/L (ppm)	6010	**6.1**
Lead	mg/Kg (ppm)	6010	**68**
Lead STLC Waste Extraction	mg/L (ppm)	6010	**0.74**
Mercury	mg/Kg (ppm)	7471	**0.77**
Molybdenum	mg/Kg (ppm)	6010	**37**
Nickel	mg/Kg (ppm)	6010	**47**
Selenium	mg/Kg (ppm)	6010	**6.1**
Silver	mg/Kg (ppm)	6010	**4.9**
Thallium	mg/Kg (ppm)	6010	<4.1
Vanadium	mg/Kg (ppm)	6010	**26**
Zinc	mg/Kg (ppm)	6010	**1,100**
Organochlorine Pesticides and PCBs			
Aldrin	mg/Kg (ppm)	8080	<0.0016
Alpha-BHC	mg/Kg (ppm)	8080	<0.0017
Beta-BHC	mg/Kg (ppm)	8080	<0.0084
Gamma-Chlordane	mg/Kg (ppm)	8080	<0.9
4,4'-DDD	mg/Kg (ppm)	8080	<0.0025
4,4'-DDE	mg/Kg (ppm)	8080	<0.002
4,4'-DDT	mg/Kg (ppm)	8080	<0.0023

[o] Bulk (wet) weight concentration
[p] Sample collected on 20 September 2006
[q] Organic Nitrogen is a Total Kjeldahl Nitrogen minus Nitrogen as Ammonia
[r] Modified STLC extraction
[s] "≅" indicates the substance was detected but could not be accurately quantified because it was below the PQL
[t] "<" indicates the substance was not detected. The Method Detection Limit (MDL) is listed after the "<" symbol.

Table C.2 Biosolids Monitoring Results

Constituent	Units[o]	Method Number	Concentration[p]
Delta-BHC	mg/Kg (ppm)	8080	<0.0026
Dieldrin	mg/Kg (ppm)	8080	<0.0013
Endosulfan I	mg/Kg (ppm)	8080	≅0.023
Endosulfan II	mg/Kg (ppm)	8080	<0.0019
Endosulfan Sulfate	mg/Kg (ppm)	8080	<0.0023
Endrin	mg/Kg (ppm)	8080	<0.0014
Endrin Aldehyde	mg/Kg (ppm)	8080	<0.0029
Gamma-BHC (Lindane)	mg/Kg (ppm)	8080	<0.0031
Heptachlor	mg/Kg (ppm)	8080	<0.0016
Heptachlor Epoxide	mg/Kg (ppm)	8080	<0.0026
Methoxychlor	mg/Kg (ppm)	8080	<0.0037
Toxaphene	mg/Kg (ppm)	8080	<0.44
PCB-1016	mg/Kg (ppm)	8080	<0.11
PCB-1221	mg/Kg (ppm)	8080	<0.3
PCB-1232	mg/Kg (ppm)	8080	<0.072
PCB-1242	mg/Kg (ppm)	8080	<0.097
PCB-1248	mg/Kg (ppm)	8080	<0.072
PCB-1254	mg/Kg (ppm)	8080	<0.047
PCB-1260	mg/Kg (ppm)	8080	<0.084
Organophosphorus Pesticides			
Azinphos methyl	mg/Kg (ppm)	8140	<0.011
Bolstar	mg/Kg (ppm)	8140	<0.0084
Chlorpyrifos	mg/Kg (ppm)	8140	<0.0048
Coumaphos	mg/Kg (ppm)	8140	<0.013
Demeton O/S	mg/Kg (ppm)	8140	<0.009
Diazinon	mg/Kg (ppm)	8140	<0.0036
Dichlorvos	mg/Kg (ppm)	8140	<0.037
Disulfoton	mg/Kg (ppm)	8140	<0.0066
Ethoprop	mg/Kg (ppm)	8140	<0.0048
Fensulfothion	mg/Kg (ppm)	8140	<0.032
Fenthion	mg/Kg (ppm)	8140	<0.006
Merphos	mg/Kg (ppm)	8140	<0.0066
Mevinphos	mg/Kg (ppm)	8140	<0.0084
Naled	mg/Kg (ppm)	8140	<0.01
Methyl parathion	mg/Kg (ppm)	8140	<0.012
Phorate	mg/Kg (ppm)	8140	<0.0036
Ronnel (Fenchlorphos)	mg/Kg (ppm)	8140	<0.0096
Stirophos (Tetrachlorvinphos)	mg/Kg (ppm)	8140	<0.015
Tokuthion (Prothiofos)	mg/Kg (ppm)	8140	<0.006
Trichloronate	mg/Kg (ppm)	8140	<0.0066
Volatile Organic Compounds			
Benzene	mg/Kg (ppm)	8240	<0.0015
Bromodichloromethane	mg/Kg (ppm)	8240	<0.00076
Bromoform	mg/Kg (ppm)	8240	<0.00084
Bromomethane	mg/Kg (ppm)	8240	<0.0014
Carbon tetrachloride	mg/Kg (ppm)	8240	<0.0016
Chlorobenzene	mg/Kg (ppm)	8240	<0.0011
Chloroethane	mg/Kg (ppm)	8240	<0.0012
Chloroform	mg/Kg (ppm)	8240	<0.001
Chloromethane	mg/Kg (ppm)	8240	<0.002

Table C.2 Biosolids Monitoring Results

Constituent	Units[o]	Method Number	Concentration[p]
Dibromochloromethane	mg/Kg (ppm)	8240	<0.00095
1,2-Dichlorobenzene	mg/Kg (ppm)	8240	<0.0011
1,3-Dichlorobenzene	mg/Kg (ppm)	8240	≦0.0049
1,4-Dichlorobenzene	mg/Kg (ppm)	8240	≦0.0051
1,1-Dichloroethane	mg/Kg (ppm)	8240	<0.0011
1,2-Dichloroethane	mg/Kg (ppm)	8240	<0.0006
1,1-Dichloroethene	mg/Kg (ppm)	8240	<0.0014
trans-1,2-Dichloroethene	mg/Kg (ppm)	8240	<0.0011
1,2-Dichloropropane	mg/Kg (ppm)	8240	<0.00066
cis-1,3-Dichloropropene	mg/Kg (ppm)	8240	<0.00087
trans-1,3-Dichloropropene	mg/Kg (ppm)	8240	<0.00093
Ethylbenzene	mg/Kg (ppm)	8240	<0.0012
Methylene chloride	mg/Kg (ppm)	8240	≦0.0031
1,1,2,2-Tetrachloroethane	mg/Kg (ppm)	8240	<0.00054
Tetrachloroethene	mg/Kg (ppm)	8240	<0.0013
Toluene	mg/Kg (ppm)	8240	≦0.0031
1,1,1-Trichloroethane	mg/Kg (ppm)	8240	<0.0013
1,1,2-Trichloroethane	mg/Kg (ppm)	8240	<0.0013
Trichloroethene	mg/Kg (ppm)	8240	<0.0011
Trichlorofluoromethane	mg/Kg (ppm)	8240	<0.002
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/Kg (ppm)	8240	<0.0021
Vinyl chloride	mg/Kg (ppm)	8240	<0.0022
Total Xylenes	mg/Kg (ppm)	8240	**0.012**
p- & m-Xylenes	mg/Kg (ppm)	8240	**0.01**
o-Xylene	mg/Kg (ppm)	8240	≦0.0015
Methyl t-butyl ether	mg/Kg (ppm)	8240	<0.00053
Base Neutral and Acid Organic Compounds			
Acenaphthene	mg/Kg (ppm)	8270C	<9.8
Acenaphthylene	mg/Kg (ppm)	8270C	<8.7
Aniline	mg/Kg (ppm)	8270C	<3.4
Anthracene	mg/Kg (ppm)	8270C	<10
Benzidine	mg/Kg (ppm)	8270C	<220
Benzo[a]anthracene	mg/Kg (ppm)	8270C	<8.6
Benzo[b]fluoranthene	mg/Kg (ppm)	8270C	<9.2
Benzo[k]fluoranthene	mg/Kg (ppm)	8270C	<9.6
Benzo[a]pyrene	mg/Kg (ppm)	8270C	<8
Benzo[g,h,i]perylene	mg/Kg (ppm)	8270C	<6.9
Benzoic acid	mg/Kg (ppm)	8270C	<5.2
Benzyl alcohol	mg/Kg (ppm)	8270C	<8.1
Benzyl butyl phthalate	mg/Kg (ppm)	8270C	<9
bis(2-Chloroethyl) ether	mg/Kg (ppm)	8270C	<7.4
bis(2-Chloroethoxy)methane	mg/Kg (ppm)	8270C	<7.4
bis(2-Chloroisopropyl)ether	mg/Kg (ppm)	8270C	<7.4
bis(2-Ethylhexyl)phthalate	mg/Kg (ppm)	8270C	**150**
4-Bromophenyl phenyl ether	mg/Kg (ppm)	8270C	<10
4-Chloroaniline	mg/Kg (ppm)	8270C	<5.5
2-Chloronaphthalene	mg/Kg (ppm)	8270C	<8.8
4-Chlorophenyl phenyl ether	mg/Kg (ppm)	8270C	<9.2
Chrysene	mg/Kg (ppm)	8270C	<9.4
Dibenzo[a,h]anthracene	mg/Kg (ppm)	8270C	<8.7

Table C.2 Biosolids Monitoring Results

Constituent	Units[o]	Method Number	Concentration[p]
Dibenzofuran	mg/Kg (ppm)	8270C	<9.3
Di-n-butyl phthalate	mg/Kg (ppm)	8270C	<1.3
3,3-Dichlorobenzidine	mg/Kg (ppm)	8270C	<6.6
Diethyl phthalate	mg/Kg (ppm)	8270C	<12
Dimethyl phthalate	mg/Kg (ppm)	8270C	<9.2
2,4-Dinitrotoluene	mg/Kg (ppm)	8270C	<6.9
2,6-Dinitrotoluene	mg/Kg (ppm)	8270C	<7.8
Di-n-octyl phthalate	mg/Kg (ppm)	8270C	<12
1,2-Diphenylhydrazine	mg/Kg (ppm)	8270C	<1.4
Fluoranthene	mg/Kg (ppm)	8270C	<9.9
Fluorene	mg/Kg (ppm)	8270C	<6.6
Hexachlorobenzene	mg/Kg (ppm)	8270C	<9.6
Hexachlorobutadiene	mg/Kg (ppm)	8270C	<7.5
Hexachlorocyclopentadiene	mg/Kg (ppm)	8270C	<5.1
Hexachloroethane	mg/Kg (ppm)	8270C	<6.9
Indeno[1,2,3-cd]pyrene	mg/Kg (ppm)	8270C	<11
Isophorone	mg/Kg (ppm)	8270C	<7
2-Methylnaphthalene	mg/Kg (ppm)	8270C	<8.4
Naphthalene	mg/Kg (ppm)	8270C	<7
2-Naphthylamine	mg/Kg (ppm)	8270C	<7
2-Nitroaniline	mg/Kg (ppm)	8270C	<8
3-Nitroaniline	mg/Kg (ppm)	8270C	<7.5
4-Nitroaniline	mg/Kg (ppm)	8270C	<7.8
Nitrobenzene	mg/Kg (ppm)	8270C	<6.9
N-Nitrosodimethylamine	mg/Kg (ppm)	8270C	<5.7
N-Nitrosodiphenylamine	mg/Kg (ppm)	8270C	<9.2
N-Nitrosodi-N-propylamine	mg/Kg (ppm)	8270C	<7.8
Phenanthrene	mg/Kg (ppm)	8270C	<10
Pyrene	mg/Kg (ppm)	8270C	<9
1,2,4-Trichlorobenzene	mg/Kg (ppm)	8270C	<7.5
4-Chloro-3-methylphenol	mg/Kg (ppm)	8270C	<8
2-Chlorophenol	mg/Kg (ppm)	8270C	<7.8
2,4-Dichlorophenol	mg/Kg (ppm)	8270C	<8.1
2,4-Dimethylphenol	mg/Kg (ppm)	8270C	<7
2,4-Dinitrophenol	mg/Kg (ppm)	8270C	<33
4,6-Dinitro-2-methylphenol	mg/Kg (ppm)	8270C	<4.2
2-Methylphenol	mg/Kg (ppm)	8270C	<7.8
3- & 4-Methylphenol	mg/Kg (ppm)	8270C	<18
2-Nitrophenol	mg/Kg (ppm)	8270C	<7
4-Nitrophenol	mg/Kg (ppm)	8270C	<8.1
Pentachlorophenol	mg/Kg (ppm)	8270C	<9.3
Phenol	mg/Kg (ppm)	8270C	<8.6
2,4,5-Trichlorophenol	mg/Kg (ppm)	8270C	<9.4
2,4,6-Trichlorophenol	mg/Kg (ppm)	8270C	<11
Other Parameters			
Asbestos	%	600/R-93/116	ND[u]

[u] None detected

APPENDIX D

Sediment Physicochemistry: October 2006 Survey

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Table D.1 Description of the Sediment Grab Samples Collected in October 2006 aboard the F/V *Bonnie Marietta*

Station	Sample	Date	Time[a]	Penetration Depth (cm)	Latitude	Longitude	Sediment Type	Sediment Color	Comments/ Observations[b]
1	Bio 1	10/03/2006	12:47:24	7.5	35° 23.737' N	120° 52.670' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	12:49:52	10.0	35° 23.738' N	120° 52.672' W	Sand	Lt. Brown	1 large *A. labrops*
	Bio 3	10/03/2006	12:52:26	9.5	35° 23.737' N	120° 52.671' W	Sand	Lt. Brown	1 large *A. labrops*
	Bio 4	10/03/2006	12:54:57	7.5	35° 23.738' N	120° 52.672' W	Sand	Lt. Brown	
	Bio 5	10/03/2006	12:57:18	10.0	35° 23.738' N	120° 52.673' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	07:05:26	N/A	35° 23.732' N	120° 52.681' W	Sand	Lt. Brown	
2	Bio 1	10/03/2006	09:08:56	10.0	35° 23.281' N	120° 52.497' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	09:13:59	8.0	35° 23.280' N	120° 52.497' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	09:16:19	9.0	35° 23.280' N	120° 52.497' W	Sand	Lt. Brown	
	Bio 4	10/03/2006	09:21:53	11.0	35° 23.280' N	120° 52.497' W	Sand	Lt. Brown	
	Bio 5	10/03/2006	09:24:11	7.0	35° 23.279' N	120° 52.497' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	07:17:44	N/A	35° 23.280' N	120° 52.507' W	Sand	Lt. Brown	
3	Bio 1	10/03/2006	09:34:31	8.0	35° 23.227' N	120° 52.503' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	09:36:49	7.0	35° 23.226' N	120° 52.501' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	09:39:43	8.0	35° 23.226' N	120° 52.501' W	Sand	Lt. Brown	
	Bio 4	10/03/2006	09:42:30	8.0	35° 23.226' N	120° 52.501' W	Sand	Lt. Brown	
	Bio 5	10/03/2006	09:49:01	9.0	35° 23.225' N	120° 52.501' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	07:29:16	N/A	35° 23.231' N	120° 52.505' W	Sand	Lt. Brown	
4	Bio 1	10/03/2006	10:06:05	7.0	35° 23.211' N	120° 52.506' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	10:08:28	11.0	35° 23.213' N	120° 52.504' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	10:13:21	8.0	35° 23.214' N	120° 52.505' W	Sand	Lt. Brown	
	Bio 4	10/16/2006	07:17:01	10.0	35° 23.213' N	120° 52.502' W	Sand	Lt. Brown	Resampled
	Bio 5	10/03/2006	10:19:57	7.0	35° 23.216' N	120° 52.505' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	07:39:52	N/A	35° 23.211' N	120° 52.503' W	Sand	Lt. Brown	
5	Bio 1	10/03/2006	10:30:06	7.0	35° 23.192' N	120° 52.510' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	10:32:42	7.0	35° 23.195' N	120° 52.508' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	10:46:30	7.0	35° 23.188' N	120° 52.505' W	Sand	Lt. Brown	
	Bio 4	10/03/2006	10:57:18	7.5	35° 23.190' N	120° 52.505' W	Sand	Lt. Brown	
	Bio 5	10/03/2006	10:59:46	7.0	35° 23.191' N	120° 52.502' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	07:51:02	N/A	35° 23.190' N	120° 52.503' W	Sand	Lt. Brown	
6	Bio 1	10/03/2006	11:19:14	13.0	35° 23.168' N	120° 52.502' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	11:22:21	9.5	35° 23.170' N	120° 52.499' W	Sand	Lt. Brown	
	Bio 3	10/16/2006	07:26:40	9.0	35° 23.166' N	120° 52.500' W	Sand	Lt. Brown	Resampled
	Bio 4	10/03/2006	11:27:04	8.5	35° 23.167' N	120° 52.496' W	Sand	Lt. Brown	
	Bio 5	10/16/2006	07:31:16	11.0	35° 23.166' N	120° 52.502' W	Sand	Lt. Brown	Resampled
	Chem 1	10/04/2006	08:04:00	N/A	35° 23.165' N	120° 52.504' W	Sand	Lt. Brown	

[a] Time when the sediment grab was collected (trip time of the grab).

[b] No odors emanating from the sediment samples were noted at any station.

Table D.1 Description of the Sediment Grab Samples Collected in October 2006 aboard the F/V *Bonnie Marietta*

Station	Sample	Date	Time[a]	Penetration Depth (cm)	Latitude	Longitude	Sediment Type	Sediment Color	Comments/ Observations[b]
7	Bio 1	10/03/2006	11:37:55	12.0	35° 23.121' N	120° 52.507' W	Sand	Lt. Brown	
	Bio 2	10/16/2006	07:45:28	7.0	35° 23.121' N	120° 52.505' W	Sand	Lt. Brown	Resampled
	Bio 3	10/03/2006	11:43:17	8.0	35° 23.121' N	120° 52.501' W	Sand	Lt. Brown	
	Bio 4	10/16/2006	07:53:37	12.0	35° 23.119' N	120° 52.501' W	Sand	Lt. Brown	Resampled
	Bio 5	10/03/2006	11:48:25	9.5	35° 23.121' N	120° 52.499' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	08:15:44	N/A	35° 23.118' N	120° 52.502' W	Sand	Lt. Brown	
8	Bio 1	10/03/2006	11:58:08	10.5	35° 23.206' N	120° 52.537' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	12:00:35	9.5	35° 23.206' N	120° 52.535' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	12:03:00	9.0	35° 23.207' N	120° 52.534' W	Sand	Lt. Brown	
	Bio 4	10/03/2006	12:05:22	10.0	35° 23.207' N	120° 52.535' W	Sand	Lt. Brown	1 large crab
	Bio 5	10/03/2006	12:07:49	7.5	35° 23.207' N	120° 52.535' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	08:28:09	N/A	35° 23.198' N	120° 52.545' W	Sand	Lt. Brown	
9	Bio 1	10/03/2006	12:20:53	16.0	35° 23.204' N	120° 52.452' W	Sand	Lt. Brown	
	Bio 2	10/03/2006	12:24:30	9.0	35° 23.209' N	120° 52.453' W	Sand	Lt. Brown	
	Bio 3	10/03/2006	12:26:51	8.5	35° 23.209' N	120° 52.453' W	Sand	Lt. Brown	
	Bio 4	10/03/2006	12:29:13	7.0	35° 23.209' N	120° 52.453' W	Sand	Lt. Brown	
	Bio 5	10/03/2006	12:31:15	7.0	35° 23.208' N	120° 52.455' W	Sand	Lt. Brown	
	Chem 1	10/04/2006	08:40:40	N/A	35° 23.203' N	120° 52.465' W	Sand	Lt. Brown	

Table D.2 Summary of Analytical Methods Used for Physicochemical Determinations of Sediment

Parameter	Method	Description	Reference
Biochemical Oxygen Demand 5-Day	5210B	Dissolved Oxygen Probe	6
Total Kjeldahl Nitrogen (TKN)	351.2	Block Digestion/Colorimetry	1
Dissolved Sulfides	376.2	Spectrophotometric	1
Total Volatile Solids	160.4	Dry ashing/Gravimetry	1
Moisture	160.3	Evaporation/Gravimetry	1
Sediment Grain Size	MRS, 1998	Sieve/Pipette without salt	2,3,4
Aluminum	6010	ICP	5
Arsenic	7060	GFAAS	5
Cadmium	6010	ICP	5
Chromium	6010	ICP	5
Copper	6010	ICP	5
Iron	6010	ICP	5
Lead	7421	CVAAS	5
Mercury	7471	CVAAS	5
Nickel	6010	ICP	5
Silver	272.2	GFAAS	1
Zinc	6010	ICP	5
Organochlorine Pesticides	8080	GC	5
PCBs	8080	GC	5
Phenolic Compounds	8270	GC/MS	5
Oil and Grease	1664	Extraction/Gravimetry	7

CVAAS = Cold Vapor Atomic Absorption Spectrometry
ICP/MS = Inductively Coupled Plasma/Mass Spectrometry
GC = Gas Chromatography
GC/MS = Gas Chromatography/Mass Spectrometry
GFAAS = Graphite Furnace Atomic Absorption Spectrometry

References:

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Table D.3 Grain-Size Distribution in Samples Collected during the October 2006 Benthic Survey

Phi	-2 to -1	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 9	>9
Size (µm)	2000	1000	500	250	125	62.5	62.5 to 2	<2
Class	Gravel	Vry Crs Snd	Crs Sand	Med Snd	Fine Snd	Vry Fine Snd	Silt	Clay
Station 1	0.012%	0.044%	0.395%	0.930%	72.354%	25.839%	0.417%	0.010%
Station 2	0.000%	0.066%	0.296%	2.232%	82.203%	14.660%	0.328%	0.215%
Station 3	0.020%	0.108%	0.777%	3.086%	82.742%	12.701%	0.280%	0.286%
Station 4	0.005%	0.040%	0.305%	1.930%	85.399%	11.881%	0.351%	0.088%
Station 5	0.004%	0.065%	0.164%	1.300%	87.016%	11.028%	0.300%	0.123%
Station 5 (dup)	0.015%	0.074%	0.332%	1.935%	86.020%	11.204%	0.227%	0.192%
Station 6	0.002%	0.020%	0.084%	1.116%	79.975%	18.241%	0.392%	0.171%
Station 7	0.042%	0.106%	0.273%	0.965%	81.568%	16.636%	0.224%	0.186%
Station 8	0.000%	0.252%	0.913%	3.848%	74.704%	19.508%	0.413%	0.362%
Station 9	0.008%	0.023%	0.108%	1.798%	85.888%	11.768%	0.231%	0.175%

	Dry Weight (grams)			Percentage Summary		
Phi	<-1 to 4	>4		-2 to -1	-1 to 4	4 to >9
Size (µm)	2000 to 62.5	<62.5		2000	1000 to 62.5	<62.5
Class	Coarse	Fine	Total	Gravel	Sand	Mud
Station 1	114.714	0.491	**115.205**	0.012%	99.562%	0.426%
Station 2	121.166	0.661	**121.827**	0.000%	99.457%	0.543%
Station 3	113.691	0.647	**114.338**	0.020%	99.414%	0.566%
Station 4	113.790	0.502	**114.292**	0.005%	99.556%	0.439%
Station 5	119.344	0.508	**119.852**	0.004%	99.572%	0.424%
Station 5 (dup)	122.172	0.515	**122.687**	0.015%	99.565%	0.420%
Station 6	121.730	0.689	**122.419**	0.002%	99.436%	0.563%
Station 7	124.598	0.513	**125.111**	0.042%	99.548%	0.410%
Station 8	125.156	0.977	**126.133**	0.000%	99.225%	0.775%
Station 9	121.017	0.494	**121.511**	0.008%	99.585%	0.407%

Table D.4 Grain-Size Statistics for the October 2006 Survey

Station	Mean (ϕ)	σ (ϕ)	Skewness (ϕ)	Mean (μm)	Percent Coarser than Listed Diameter (μm)				
					5%	16%	50%	84%	95%
1	2.81	0.337	0.09	143	206	178	144	113	93
2	2.67	0.329	0.09	157	225	193	158	126	100
3	2.63	0.341	0.06	162	239	200	162	129	102
4	2.65	0.305	0.09	159	223	193	160	131	105
5	2.66	0.284	0.11	158	215	190	160	132	107
5(Dup)	2.64	0.300	0.08	160	223	194	161	132	107
6	2.74	0.321	0.13	150	210	184	152	121	97
7	2.72	0.305	0.11	152	210	184	153	123	100
8	2.69	0.404	0.04	155	250	200	156	119	93
9	2.65	0.301	0.09	159	221	193	160	131	106

APPENDIX D.1

Sediment Physicochemistry
October 2006 Survey: Chemical Analysis Results

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Marine Research Specialists
3140 Telegraph Road. Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	3.6	2.7	mglkg	0.50	0.17	EPA-7060A	10/09/06	10110106 14:54	DIW	PE1	0.97	BPJ0480	ND	
Cadmium	ND	ND	mg/kg	0.50	0.073	EPA-6010B	10109106	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	
Chromium	69	53	mglkg	0.50	0.17	EPA-6010B	10109106	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	
Copper	3.3	2.6	mglkg	1.0	0.090	EPA-6010B	10/09/06	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	
Lead	2.4	1.9	mg/kg	0.50	0.082	EPA-7421	10109106	10/12/06 18:02	DIW	PE1	0.97	BPJ0480	ND	
Mercury	ND	ND	mg/kg	0.16	0.041	EPA-7471A	10106106	10/13/06 10:39	PRA	CETAC1	1.01	BPJ0395	ND	
Nickel	49	38	mg/kg	0.50	0.25	EPA-6010B	10109106	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	
Silver	ND	ND	mglkg	0.25	0.052	EPA-272.2	10109106	10111106 15:34	DIW	PE1	0.97	BPJ0480	ND	
Zinc	21	16	mglkg	2.5	0.31	EPA-6010B	10109106	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	0.41	
Aluminum	7300	5600	mg/kg	5.0	3.0	EPA-6010B	10/09/06	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	
Iron	12000	9000	mglkg	5.0	2.0	EPA-6010B	10109106	10110106 18:46	JCC	TJA61E	0.97	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	23.4	%	0.05	0.05	Calc	10106106	10111106 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	120	95	mglkg	40	20	EPA-351.2	10106106	10109106 09:30	VC1	RFA-1	1	BPJ0383	ND	A01
Total Volatile Solids	1.85	1.42	%	0.200	0.200	SM-2540G	10109106	10109106 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	44	33	mg O/kg	10	10	SM17-52101	10105106	10105106 16:00	HPR	YSI-57	0.33	BPJ0596	ND	
Solids	100	76.6	%	0.05	0.05	SM-2540G	10109106	10109106 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Venmra CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	22.5	%	0.05	0.05	Calc	10106106	10111106 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	100	78	mg/kg	40	20	EPA-351.2	10/06/06	10109106 09:30	VC1	RFA-1	1	BPJ0383	ND	A01
Total Volatile Solids	2.12	1.64	%	0.200	0.200	SM-2540G	10109106	10109106 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	43	34	mg Olkg	10	10	SM17-5210I	10105106	10105106 16:00	HPR	YSI-57	0.33	BPJ0596	ND	
Solids	100	77.5	%	0.05	0.05	SM-2540G	10109106	10/09/06 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	4.0	3.1	mg/kg	0.50	0.17	EPA-7060A	10109106	10110106 15:00	DIW	PE1	0.96	BPJ0480	ND	
Cadmium	ND	ND	mglkg	0.50	0.073	EPA-6010B	10/09/06	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	ND	
Chromium	53	41	mg/kg	0.50	0.17	EPA-6010B	10/09/06	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	ND	
Copper	3.2	2.5	mglkg	1.0	0.090	EPA-6010B	10109106	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	ND	
Lead	2.3	1.7	mglkg	0.50	0.082	EPA-7421	10/09/06	10112106 18:08	DIW	PE1	0.96	BPJ0480	ND	
Mercury	0.15	0.12	mglkg	0.16	0.041	EPA-7471A	10/06/06	10/13/06 10:41	PRA	CETAC1	1.01	BPJ0395	ND	J
Nickel	48	37	mg/kg	0.50	0.25	EPA-6010B	10/09/06	10/10/06 19:03	JCC	TJA61E	0.96	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10/09/06	10/11/06 15:41	DIW	PE1	0.96	BPJ0480	ND	
Zinc	18	14	mglkg	2.5	0.31	EPA-6010B	10109106	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	0.40	
Aluminum	6200	4800	mglkg	5.0	3.0	EPA-6010B	10109106	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	ND	
Iron	10000	7900	mg/kg	5.0	2.0	EPA-6010B	10109106	10110106 19:03	JCC	TJA61E	0.96	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	21.9	%	0.05	0.05	Calc	10/06/06	10/11/06 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	95	75	mg/kg	40	20	EPA-351.2	10/06/06	10/09/06 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	2.37	1.85	%	0.200	0.200	SM-2540G	10/09/06	10/09/06 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	43	34	mg O/kg	10	10	SM17-52101	10/05/06	10/05/06 16:00	HPR	YSI-57	0.33	BPJ0596	ND	
~;~ids	100	78.1	%	0.05	0.05	SM-2540G	10109106	10/09/06 09:50	VBA	MANUAL	▮	BPJ0450		

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	4.0	3.1	mg/kg	0.50	0.17	EPA-7060A	10109106	10110106 15:18	DIW	PE1	0.99	BPJ0480	ND	
Cadmium	ND	ND	mg/kg	0.50	0.073	EPA-6010B	10109106	10110106 19:07	JCC	TJA61E	0.99	BPJ0428	ND	
Chromium	51	40	mg/kg	0.50	0.17	EPA-6010B	10109106	10/10/06 19:07	JCC	TJA61E	0.99	BPJ0428	ND	
Copper	3.2	2.5	mg/kg	1.0	0.090	EPA-6010B	10/09/06	10/10/06 19:07	JCC	TJA61E	0.99	BPJ0428	ND	
Lead	2.1	1.6	mg/kg	0.50	0.082	EPA-7421	10/09/06	10/12/06 18:27	DIW	PE1	0.99	BPJ0480	ND	
Mercury	0.059	0.046	mg/kg	0.16	0.041	EPA-7471A	10/06/06	10113106 10:43	PRA	CETAC1	0.95	BPJ0395	ND	J
Nickel	51	40	mg/kg	0.50	0.25	EPA-6010B	10109106	10110106 19:07	JCC	TJA61E	0.99	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10/09/06	10111106 15:47	DIW	PE1	0.99	BPJ0480	ND	
Zinc	18	14	mg/kg	2.5	0.31	EPA-6010B	10/09/06	10110106 19:07	JCC	TJA61E	0.99	BPJ0428	0.41	
Aluminum	6000	4700	mg/kg	5.0	3.0	EPA-6010B	10109106	10110106 19:07	JCC	TJA61E	0.99	BPJ0428	ND	
Iron	10000	7900	mg/kg	5.0	2.0	EPA-6010B	10109106	10110106 19:07	JCC	TJA61E	0.99	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	25.3	%	0.05	0.05	Calc	10106106	10111106 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	120	86	mglkg	40	20	EPA-351.2	10106106	10/09/06 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	2.05	1.53	%	0.200	0.200	SM-2540G	10109106	10109106 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	50	37	mg O/kg	10	10	SM17-52101	10105106	10105106 16:00	HPR	YSI-57	0.33	BPJ0596	ND	
Solids	100	74.7	%	0.05	0.05	SM-2540G	10109106	10109106 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	4.2	3.1	mglkg	0.50	0.17	EPA-7060A	10109106	10110106 15:25	DIW	PE1	0.99	BPJ0480	ND	
Cadmium	ND	ND	mg/kg	0.50	0.073	EPA-6010B	10109106	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	
Chromium	51	38	mg/kg	0.50	0.17	EPA-6010B	10109106	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	
Copper	3.0	2.2	mg/kg	1.0	0.090	EPA-6010B	10109106	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	
Lead	2.2	1.6	mglkg	0.50	0.082	EPA-7421	10109106	10112106 18:33	DIW	PE1	0.99	BPJ0480	ND	
Mercury	0.050	ND	mglkg	0.16	0.041	EPA-7471A	10106106	10113106 10:45	PRA	CETAC1	1.04	BPJ0395	ND	J
Nickel	46	35	mglkg	0.50	0.25	EPA-6010B	10109106	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	
Silver	ND	ND	mglkg	0.25	0.052	EPA-272.2	10109106	10111106 16:05	DIW	PE1	0.99	BPJ0480	ND	
Zinc	18	13	mglkg	2.5	0.31	EPA-6010B	10109106	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	0.43	
Aluminum	6100	4500	mglkg	5.0	3.0	EPA-6010B	10/09/06	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	
Iron	10000	7500	mg/kg	5.0	2.0	EPA-6010B	10/09/06	10110106 19:12	JCC	TJA61E	0.99	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	3.7	2.9	mglkg	0.50	0.17	EPA-7060A	10/09/06	10/10/06 15:31	DIW	PE1	0.98	BPJ0480	ND	
Cadmium	ND	ND	mglkg	0.50	0.073	EPA-6010B	10/09/06	10/10/06 19:16	JCC	TJA61E	0.98	BPJ0428	ND	
Chromium	49	37	mglkg	0.50	0.17	EPA-6010B	10/09/06	10/10/06 19:16	JCC	TJA61E	0.98	BPJ0428	ND	
Copper	3.0	2.3	mglkg	1.0	0.090	EPA-6010B	10/09/06	10/10/06 19:16	JCC	TJA61E	0.98	BPJ0428	ND	
Lead	2.0	1.5	mg/kg	0.50	0.082	EPA-7421	10/09/06	10/12/06 18:39	DIW	PEI	0.98	BPJ0480	ND	
Mercury	ND	ND	mg/kg	0.16	0.041	EPA-7471A	10/06/06	10/13/06 10:47	PRA	CETAC1	0.95	BPJ0395	ND	
Nickel	49	37	mg/kg	0.50	0.25	EPA-60106	10/09/06	10110106 19:16	JCC	TJA61E	0.98	BPJ0428	ND	
Silver	ND	ND	mglkg	0.25	0.052	EPA-272.2	10/09/06	10/11/06 16:12	DIW	PE1	0.98	BPJ0480	ND	
Zinc	17	13	mg/kg	2.5	0.31	EPA-6010B	10/09/06	10/10/06 19:16	JCC	TJA61E	0.98	BPJ0428	0.42	
Aluminum	5700	4400	mg/kg	5.0	3.0	EPA-6010B	10/09/06	10110106 19:16	JCC	TJA61E	0.98	BPJ0428	ND	
Iron	9600	7400	mg/kg	5.0	2.0	EPA-6010B	10/09/06	10/10/06 19:16	JCC	TJA61E	0.98	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	23.4	%	0.05	0.05	Calc	10/06/06	10/11/06 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	97	75	mglkg	40	20	EPA-351.2	10106106	10/09/06 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	2.28	1.75	%	0.200	0.200	SM-2540G	10/09/06	10109106 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	57	44	mg O/kg	15	15	SM17-52101	10/05/06	10/05/06 16:00	HPR	YSI-57	0.50	BPJ0596	ND	
Solids	100	76.6	%	0.05	0.05	SM-2540G	10/09/06	10109106 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	3.7	2.8	mglkg	0.50	0.17	EPA-7060A	10109106	10110106 15:37	DIW	PE1	0.96	BPJ0480	ND	
Cadmium	ND	ND	mglkg	0.50	0.073	EPA-6010B	10109106	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	ND	
Chromium	57	44	mglkg	0.50	0.17	EPA-6010B	10109106	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	ND	
Copper	3.2	2.5	mglkg	1.0	0.090	EPA-6010B	10/09/06	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	ND	
Lead	2.2	1.7	mglkg	0.50	0.082	EPA-7421	10/09/06	10/12/06 18:45	DIW	PE1	0.96	BPJ0480	ND	
Mercury	ND	ND	mglkg	0.16	0.041	EPA-7471A	10106106	10113106 10:50	PRA	CETAC1	0.98	BPJ0395	ND	
Nickel	50	39	mg/kg	0.50	0.25	EPA-6010B	10/09/06	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10109106	10111106 16:18	DIW	PE1	0.96	BPJ0480	ND	
Zinc	19	15	mg/kg	2.5	0.31	EPA-6010B	10/09/06	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	0.41	
Aluminum	6400	4900	mg/kg	5.0	3.0	EPA-6010B	10/09/06	10110106 19:20	JCC	TJA61E	0.96	BPJ0428	ND	
Iron	11000	8300	mglkg	5.0	2.0	EPA-6010B	10/09/06	10/10/06 19:20	JCC	TJA61E	0.96	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	23.3	%	0.05	0.05	Calc	10/06/06	10/11/06 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	120	89	mg/kg	40	20	EPA-351.2	10/06/06	10/09/06 09:30	VC1	RFA-1	1	BPJ0383	ND	A01
Total Volatile Solids	2.11	1.62	%	0.200	0.200	SM-2540G	10/09/06	10/09/06 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	57	44	mg O/kg	7.5	7.5	SM17-5210I	10/05/06	10105106 16:00	HPR	YSI-57	0.25	BPJ0596	ND	
Solids	100	76.7	%	0.05	0.05	SM-2540G	10/09/06	10/09/06 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-07 | **Client Sample Name:** **STATION** 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	3.9	3.0	mg/kg	0.50	0.17	EPA-7060A	10109106	10110106 15:43	DIW	PE1	0.97	BPJ0480	ND	
Cadmium	ND	ND	mglkg	0.50	0.073	EPA-6010B	10/09/06	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	
Chromium	53	41	mg/kg	0.50	0.17	EPA-6010B	10109106	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	
Copper	3.1	2.4	mg/kg	1.0	0.090	EPA-6010B	10109106	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	
Lead	2.2	1.7	mg/kg	0.50	0.082	EPA-7421	10109106	10112106 18:52	DIW	PE1	0.97	BPJ0480	ND	
Mercury	ND	ND	mglkg	0.16	0.041	EPA-7471A	10/06/06	10113106 10:52	PRA	CETAC1	0.92	BPJ0395	ND	
Nickel	47	37	mglkg	0.50	0.25	EPA-6010B	10109106	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10109106	10/11/06 16:24	DIW	PE1	0.97	BPJ0480	ND	
Zinc	18	14	mslks	2.5	0.31	EPA-6010B	10109106	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	0.40	
Aluminum	6300	4900	mglkg	5.0	3.0	EPA-6010B	10109106	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	
Iron	10000	8200	mg/kg	5.0	2.0	EPA-6010B	10/09/06	10110106 19:25	JCC	TJA61E	0.97	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quais
Moisture	0	21.8	%	0.05	0.05	Calc	10106106	10111106 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	110	86	mglkg	40	20	EPA-351.2	10106106	10109106 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	1.91	1.49	%	0.200	0.200	SM-2540G	10/09/06	10/09/06 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	49	38	mg Olkg	7.5	7.5	SM17-5210	10/05/06	10/05/06 16:00	HPR	YSI-57	0.25	BPJ0596	ND	
Solids	100	78.2	%	0.05	0.05	SM-2540G	10/09/06	10109106 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	4.2	3.1	mg/kg	0.50	0.17	EPA-7060A	10109106	10110106 15:50	DIW	PE1	0.99	BPJ0480	ND	
Cadmium	ND	ND	rnglkg	0.50	0.073	EPA-6010B	10109106	10110106 19:29	JCC	TJA61E	0.99	BPJ0428	ND	
Chromium	60	45	mg/kg	0.50	0.17	EPA-6010B	10/09/06	10110106 19:29	JCC	TJA61E	0.99	BPJ0428	ND	
Copper	4.0	3.0	mg/kg	1.0	0.090	EPA-6010B	10109106	10/10/06 19:29	JCC	TJA61E	0.99	BPJ0428	ND	
Lead	2.5	1.9	mglkg	0.50	0.082	EPA-7421	10109106	10112106 18:58	DIW	PE1	0.99	BPJ0480	ND	
Mercury	ND	ND	mg/kg	0.16	0.041	EPA-7471A	10/06/06	10113106 10:58	PRA	CETAC1	1.04	BPJ0395	ND	
Nickel	59	44	rnglkg	0.50	0.25	EPA-6010B	10109106	10/10/06 19:29	JCC	TJA61E	0.99	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10109106	1011110616~30	DIW	PE1	0.99	BPJ0480	ND	
Zinc	21	15	mglkg	2.5	0.31	EPA-6010B	10/09/06	10/10/06 19:29	JCC	TJA61E	0.99	BPJ0428	0.43	
Aluminum	7000	5200	mg/kg	5.0	3.0	EPA-6010B	10109106	10/10/06 19:29	JCC	TJA61E	0.99	BPJ0428	ND	
Iron	12000	8800	mg/kg	5.0	2.0	EPA-6010B	10109106	10110106 19:29	JCC	TJA61E	0.99	BPJ0428	ND	

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	25.7	%	0.05	0.05	Calc	10/06/06	10/11/06 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	130	97	mg/kg	40	20	EPA-351.2	10/06/06	10/09/06 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	2.23	1.66	%	0.200	0.200	SM-2540G	10/09/06	10/09/06 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	52	39	mg O/kg	7.5	7.5	SM17-5210	10/05/06	10/05/06 16:00	HPR	YSI-57	0.25	BPJ0596	ND	
Solids	100	74.3	%	0.05	0.05	SM-2540G	10/09/06	10/09/06 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Arsenic	4.1	3.1	mg/kg	0.50	0.17	EPA-7060A	10109106	10/10/06 15:56	DIW	PE1	0.99	BPJ0480	ND	
Cadmium	ND	ND	mg/kg	0.50	0.073	EPA-6010B	10109106	10/10/06 19:33	JCC	TJA61E	0.99	BPJ0428	ND	
Chromium	44	33	mg/kg	0.50	0.17	EPA-6010B	10109106	10110106 19:33	JCC	TJA61E	0.99	BPJ0428	ND	
Copper	2.9	2.2	mglkg	1.0	0.090	EPA-6010B	10109106	10/10/06 19:33	JCC	TJA61E	0.99	BPJ0428	ND	
Lead	2.0	1.5	mglkg	0.50	0.082	EPA-7421	10/09/06	10/12/06 19:04	DIW	PE1	0.99	BPJ0480	ND	
Mercury	ND	ND	mg/kg	0.13	0.034	EPA-7471A	10106106	10/13/06 11:00	PRA	CETAC1	0.82	BPJ0395	ND	
Nickel	42	32	mg/kg	0.50	0.25	EPA-6010B	10/09/06	10110106 19:33	JCC	TJA61E	0.99	BPJ0428	ND	
Silver	ND	ND	mg/kg	0.25	0.052	EPA-272.2	10/09/06	10/11/06 16:36	DIW	PE1	0.99	BPJ0480	ND	
Zinc	16	12	mg/kg	2.5	0.31	EPA-6010B	10109106	10110106 19:33	JCC	TJA61E	0.99	BPJ0428	0.43	
Aluminum	5500	4100	mg/kg	5.0	3.0	EPA-6010B	10109106	10/10/06 19:33	JCC	TJA61E	0.99	BPJ0428	ND	
Iron	9200	6900	mg/kg	5.0	2.0	EPA-6010B	10/09/06	10110106 19:33	JCC	TJA61E	0.99	BPJ0428	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Moisture	0	24.5	%	0.05	0.05	Calc	10106106	10111106 09:42	TMS	Calc	1	BPJ0341	ND	
Total Kjeldahl Nitrogen	91	69	mglkg	40	20	EPA-351.2	10106106	10/09/06 09:30	VC1	RFA-1	0.96	BPJ0383	ND	A01
Total Volatile Solids	2.03	1.53	%	0.200	0.200	SM-2540G	10/09/06	10/09/06 11:00	VEL	MANUAL	1	BPJ0676	ND	
Biochemical Oxygen Demand	48	37	mg Olkg	10	10	SM17-5210I	10/05/06	10/05/06 16:00	HPR	YSI-57	0.33	BPJ0596	ND	
Solids	100	75.5	%	0.05	0.05	SM-2540G	10/09/06	10/09/06 09:50	VBA	MANUAL	1	BPJ0450		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10/16/06 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-02 | **Client Sample Name:** **STATION 2,** 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10/16/06 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10116106	10116106 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-rnent ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10116106	10116106 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road. Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10116106	10116106 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10/16/06 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists 3140 Telegraph Road. Suite A Ventura CA, 93003-3238	Project: Annual Benthis Sediment Sampling for MBTP Project Number: Yearly Benthic Survey Project Manager: Doug Coats	**Reported:** 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10116106 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10/16/06 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Oil and Grease	ND	ND	mg/kg	50	27	EPA-1664H	10/16/06	10/16/06 09:00	JAK	MAN-SV	1	BPJ0871	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mglkg	0.00050	0.000027	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mg/kg	0.00050	0.00014	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mglkg	0.00050	0.000044	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10107106	10/13/06 16:57	hks	GC-I	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10107106	10/13/06 16:57	hks	GC-I	0.99	BPJ0784	ND	V11
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10107106	10113106 16:57	hks	GC-I	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10113106 16:57	hks	GC-I	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mglkg	0.00050	0.000038	EPA-8080	10/07/06	10113106 16:57	hks	GC-I	0.99	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10/13/06 16:57	hks	GC-I	0.99	BPJ0784	ND	
Heptachlor	ND	ND	mg/kg	0.00050	0.000026	EPA-8080	10107106	10/13/06 16:57	hks	GC-I	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.00050	0.000043	EPA-8080	10107106	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mg/kg	0.00050	0.000061	EPA-8080	10/07/06	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mglkg	0.050	0.0074	EPA-8080	10107106	10113106 16:57	hks	GC-I	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10107106	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10113106 16:57	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-rnent ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10/13/06 16:57	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	67.4	67.4	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10/13/06 16:57	hks	GC-1	0.99	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	72.7	72.7	%	79 - 136	(LCL - UCL)	EPA-8080	10/07/06	10/13/06 16:57	hks	GC-1	0.99	BPJ0784		S09

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mglkg	0.00050	0.000027	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mglkg	0.00050	0.00014	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mglkg	0.00050	0.000044	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mglkg	0.00050	0.000051	EPA-8080	10107106	10/13/06 18:30	hks	GC-1	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mglkg	0.050	0.015	EPA-8080	10107106	10/13/06 18:30	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	V11
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.00050	0.000038	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Endrin	ND	ND	mglkg	0.00050	0.000023	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10113106 18:30	hks	GC-I	0.99	BPJ0784	ND	
Heptachlor	ND	ND	mglkg	0.00050	0.000026	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mglkg	0.00050	0.000043	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mglkg	0.00050	0.000061	EPA-8080	10/07/06	10/13/06 18:30	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mglkg	0.050	0.0074	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10113106 18:30	hks	GC-I	0.99	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10/07/06	10/13/06 18:30	hks	GC-1	0.99	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	82.6	82.6	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10113106 18:30	hks	GC-1	0.99	BPJ0784		
Dibutyl chlorendate (Surrogate)	112	112	%	79 - 136	(LCL - UCL)	EPA-8080	10107106	10/13/06 18:30	hks	GC-1	0.99	BPJ0784		

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3140 Telegraph Road. Suite A
Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mglkg	0.00050	0.000027	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
alpha-BHC	ND	ND	mglkg	0.00050	0.000029	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mglkg	0.00050	0.00014	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mg/kg	0.00050	0.000044	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10/15/06 15:16	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10/07/06	10/15/06 15:16	hks	GC-1	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.00050	0.000038	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	V11
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor	ND	ND	mglkg	0.00050	0.000026	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mglkg	0.00050	0.000043	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mglkg	0.00050	0.000061	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mglkg	0.050	0.0074	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10107106	10115106 15:16	hks	GC-I	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10/15/06 15:16	hks	GC-1	0.99	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10115106 15:16	hks	GC-I	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10/15/06 15:16	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10107106	10/15/06 15:16	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mglkg	0.010	0.0050	EPA-8080	10/07/06	10115106 15:16	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	61.7	61.7	%	70 - 120	(LCL - UCL)	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	74.6	74.6	%	79 - 136	(LCL - UCL)	EPA-8080	10107106	10115106 15:16	hks	GC-1	0.99	BPJ0784		S09

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3140 Telegraph Road, Suite A
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benrhic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mglkg	0.00050	0.000027	EPA-8080	10107106	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10107106	10115106 15:31	hks	GC-I	1	BPJ0784	ND	
beta-BHC	ND	ND	mglkg	0.00050	0.00014	EPA-8080	10107106	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
delta-BHC	ND	ND	mglkg	0.00050	0.000044	EPA-8080	10/07/06	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mglkg	0.00050	0.000051	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mglkg	0.050	0.015	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	I	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10107106	10115106 15:31	hks	GC-I	1	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10107106	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10/07/06	10115106 15:31	hks	GC-I	1	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mglkg	0.00050	0.000038	EPA-8080	10107106	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Endrin aldehyde	ND	ND	mglkg	0.00050	0.000048	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Heptachlor	ND	ND	mglkg	0.00050	0.000026	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.00050	0.000043	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
Methoxychlor	ND	ND	mglkg	0.00050	0.000061	EPA-8080	10107106	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
Toxaphene	ND	ND	mg/kg	0.050	0.0074	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10/15/06 15:31	hks	GC-I	1	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
PCB-I242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10115106 15:31	hks	GC-1	I	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10/07/06	10115106 15:31	hks	GC-1	1	BPJ0784	ND	

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3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10/15/06 15:31	hks	GC-1	1	BPJ0784	ND	
TCMX (Surrogate)	69.3	69.3	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10/15/06 15:31	hks	GC-1	1	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	84.5	84.5	%	79 - 136	(LCL - UCL)	EPA-8080	10/07/06	10/15/06 15:31	hks	GC-1	1	BPJ0784		

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mg/kg	0.00050	0.000027	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
beta-BHC	ND	ND	mg/kg	0.00050	0.00014	EPA-8080	10/07/06	10/15/06 15:47	hks	GC-1	1.00	BPJ0784	ND	
delta-BHC	ND	ND	mg/kg	0.00050	0.000044	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10/07/06	10/15/06 15:47	hks	GC-1	1.00	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.00050	0.000038	EPA-8080	10/07/06	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	V11
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10115106 15:47	hks	GC-I	1.00	BPJ0784	ND	
Heptachlor	ND	ND	mg/kg	0.00050	0.000026	EPA-8080	10107106	10/15/06 15:47	hks	GC-1	1.00	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.00050	0.000043	EPA-8080	10107106	10/15/06 15:47	hks	GC-1	1.00	BPJ0784	ND	
Methoxychlor	ND	ND	mg/kg	0.00050	0.000061	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Toxaphene	ND	ND	mg/kg	0.050	0.0074	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10115106 15:47	hks	GC-1	1.00	BPJ0784	ND	
TCMX (Surrogate)	57.4	57.4	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10115106 15:47	hks	GC-1	1.00	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	56.2	56.2	%	79 - 136	(LCL - UCL)	EPA-8080	10107106	10115106 15:47	hks	GC-1	1.00	BPJ0784		S09

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mg/kg	0.00050	0.000027	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
alpha-BHC	ND	ND	mglkg	0.00050	0.000029	EPA-8080	10/07/06	10/15/06 16:02	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mg/kg	0.00050	0.00014	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mg/kg	0.00050	0.000044	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mglkg	0.00050	0.000022	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10/07/06	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	rnglkg	0.00050	0.000038	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Endrin	ND	ND	malka	0.00050	0.000023	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	V11
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor	ND	ND	mg/kg	0.00050	0.000026	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mglkg	0.00050	0.000043	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mglkg	0.00050	0.000061	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mglkg	0.050	0.0074	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10107106	10115106 16:02	hks	GC-I	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
PCB-I232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10115106 16:02	hks	GC-I	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	

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3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mglkg	0.010	0.0050	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	43.5	43.5	%	70 - 120	(LCL - UCL)	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	52.4	52.4	%	79 - 136	(LCL - UCL)	EPA-8080	10107106	10115106 16:02	hks	GC-1	0.99	BPJ0784		S09

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Ventura CA, 93003-3238

Project: Annual Benthis Sedimenr Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mg/kg	0.00050	0.000027	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
beta-BHC	ND	ND	mg/kg	0.00050	0.00014	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
delta-BHC	ND	ND	mg/kg	0.00050	0.000044	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-I	I	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-I	I	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	I	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10~07106	10/15/06 16:17	hks	GC-I	1	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Endosulfan I	ND	ND	mglkg	0.00050	0.000028	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10/07/06	10115/06 16:17	hks	GC-1	1	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mglkg	0.00050	0.000038	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	I	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10/07/06	10115/06 16:17	hks	GC-1	1	BPJ0784	ND	V11
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Heptachlor	ND	ND	mg/kg	0.00050	0.000026	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.00050	0.000043	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Methoxychlor	ND	ND	mglkg	0.00050	0.000061	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
Toxaphene	ND	ND	mg/kg	0.050	0.0074	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-I232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10/07/06	10115106 16:17	hks	GC-1	1	BPJ0784	ND	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10115106 16:17	hks	GC-1	1	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mglkg	0.010	0.0050	EPA-8080	10107106	10115106 16:17	hks	GC-1	1	BPJ0784	ND	
TCMX (Surrogate)	53.9	53.9	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10115106 16:17	hks	GC-1	1	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	53.6	53.6	%	79 - 136	(LCL - UCL)	EPA-8080	10/07/06	10/15/06 16:17	hks	GC-1	1	BPJ0784		S09

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mglkg	0.00050	0.000027	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
alpha-BHC	ND	ND	mglkg	0.00050	0.000029	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mglkg	0.00050	0.00014	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mglkg	0.00050	0.000044	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mglkg	0.00050	0.000051	EPA-8080	10107106	10/15/06 16:33	hks	GC-1	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10/07/06	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
44'-DDE	ND	ND	mglkg	0.00050	0.000034	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10/07/06	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mglkg	0.00050	0.000038	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Endrin	ND	ND	mglkg	0.00050	0.000023	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	V11
Endrin aldehyde	ND	ND	mglkg	0.00050	0.000048	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor	ND	ND	mglkg	0.00050	0.000026	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mglkg	0.00050	0.000043	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mg/kg	0.00050	0.000061	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mg/kg	0.050	0.0074	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mglkg	0.010	0.0018	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10115106 16:33	hks	GC-I	0.99	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10/15/06 16:33	hks	GC-1	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10/15/06 16:33	hks	GC-1	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-rnent ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10/07/06	10115106 16:33	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10/07/06	10/15/06 16:33	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	56.3	56.3	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10/15/06 16:33	hks	GC-1	0.99	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	72.6	72.6	%	79 - 136	(LCL - UCL)	EPA-8080	10/07/06	10/15/06 16:33	hks	GC-1	0.99	BPJ0784		S09

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-09 | **Client Sample Name:** **STATION** 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Aldrin	ND	ND	mg/kg	0.00050	0.000027	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	V01
alpha-BHC	ND	ND	mg/kg	0.00050	0.000029	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
beta-BHC	ND	ND	mg/kg	0.00050	0.00014	EPA-8080	10/07/06	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
delta-BHC	ND	ND	mg/kg	0.00050	0.000044	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.00050	0.000051	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
Chlordane (Technical)	ND	ND	mg/kg	0.050	0.015	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDD	ND	ND	mg/kg	0.00050	0.000041	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
4,4'-DDE	ND	ND	mg/kg	0.00050	0.000034	EPA-8080	10107106	10118106 18:43	hks	GC-I	0.99	BPJ0784	ND	
4,4'-DDT	ND	ND	mg/kg	0.00050	0.000039	EPA-8080	10107106	10/18/06 18:43	hks	GC-I	0.99	BPJ0784	ND	
Dieldrin	ND	ND	mg/kg	0.00050	0.000022	EPA-8080	10/07/06	10118106 18:43	hks	GC-I	0.99	BPJ0784	ND	
Endosulfan I	ND	ND	mg/kg	0.00050	0.000028	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan II	ND	ND	mg/kg	0.00050	0.000032	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.00050	0.000038	EPA-8080	10/07/06	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
Endrin	ND	ND	mg/kg	0.00050	0.000023	EPA-8080	10/07/06	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
Endrin aldehyde	ND	ND	mg/kg	0.00050	0.000048	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	V11
Heptachlor	ND	ND	mglkg	0.00050	0.000026	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.00050	0.000043	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
Methoxychlor	ND	ND	mg/kg	0.00050	0.000061	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
Toxaphene	ND	ND	mg/kg	0.050	0.0074	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1016	ND	ND	mg/kg	0.010	0.0018	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1221	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1232	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10/07/06	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1242	ND	ND	mg/kg	0.010	0.0016	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1248	ND	ND	mg/kg	0.010	0.0012	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
PCB-1254	ND	ND	mg/kg	0.010	0.00078	EPA-8080	10107106	10/18/06 18:43	hks	GC-1	0.99	BPJ0784	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
PCB-1260	ND	ND	mg/kg	0.010	0.0014	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
Total PCB's (Summation)	ND	ND	mg/kg	0.010	0.0050	EPA-8080	10107106	10118106 18:43	hks	GC-1	0.99	BPJ0784	ND	
TCMX (Surrogate)	63.2	63.2	%	70 - 120	(LCL - UCL)	EPA-8080	10/07/06	10115106 16:48	hks	GC-I	0.99	BPJ0784		S09
Dibutyl chlorendate (Surrogate)	86.9	86.9	%	79 - 136	(LCL - UCL)	EPA-8080	10/07/06	10115106 16:48	hks	GC-1	0.99	BPJ0784		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	0.70	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	ND	ND	mg/kg	0.20	0.068	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	0.070	
4-Brornophenylphenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Chrysene	ND	ND	mglkg	0.10	0.063	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Dieldrin	ND	ND	mglkg	0.10	0.022	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mglkg	0.10	0.0088	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan I	ND	ND	mglkg	0.20	0.049	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Fluoranthene	ND	ND	mglkg	0.10	0.066	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mglkg	0.10	0.064	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mglkg	0.10	0.034	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachloroethane	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mglkg	0.10	0.056	EPA-8270C	I0107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	I0107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	I0107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4-Nitroaniline	ND	ND	mglkg	0.20	0.052	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	I0107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mglkg	0.10	0.038	EPA-8270C	10/07/06	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mglkg	0.10	0.050	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mglkg	0.20	0.053	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-01 | **Client Sample Name:** Station 1, 10/4/2006 7:05:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	V11
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
Phenol	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mg/kg	0.20	0.071	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669	ND	
2-Fluorophenol (Surrogate)	90.5	90.5	%	47 - 120	(LCL - UCL)	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669		
Phenol-d5 (Surrogate)	86.7	86.7	%	41 - 116	(LCL - UCL)	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669		
Nitrobenzene-d5 (Surrogate)	82.6	82.6	%	50 - 115	(LCL - UCL)	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669		
2-Fluorobiphenyl (Surrogate)	72.9	72.9	%	49 - 125	(LCL - UCL)	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	92.3	92.3	%	47 - 144	(LCL - UCL)	EPA-8270C	10107106	10/13/06 03:21	SKC	MS-B2	1.00	BPJ0669		
p-Terphenyl-d14 (Surrogate)	128	128	%	43 - 157	(LCL - UCL)	EPA-8270C	10107106	10113106 03:21	SKC	MS-B2	1.00	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-02 | **Client Sample Name:** **STATION** 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Benzidine	ND	ND	mglkg	3.0	1.5	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzo[a]anthracene	ND	ND	mglkg	0.10	0.057	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	0.68	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
alpha-BHC	ND	ND	mglkg	0.10	0.060	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
delta-BHC	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mglkg	0.10	0.058	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mglkg	0.10	0.049	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	ND	ND	mg/kg	0.20	0.068	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	0.068	
4-Bromophenylphenyl ether	ND	ND	mglkg	0.10	0.067	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4-Chloroaniline	ND	ND	mglkg	0.10	0.037	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Chrysene	ND	ND	mg/kg	0.10	0.063	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
▮,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mglkg	0.10	0.0088	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Endosulfan I	ND	ND	mglkg	0.20	0.049	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-02 | **Client Sample Name:** **STATION** 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mglkg	0.10	0.064	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Hexachloroethane	ND	ND	mglkg	0.10	0.046	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270~10107106		10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Pyrene	ND	ND	mglkg	0.10	0.060	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mglkg	0.10	0.050	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10107106	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10/07/06	10113106 03:50	SKC	MS-B2	0.98	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-02 | **Client Sample Name:** STATION 2, 10/4/2006 7:18:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mglkg	0.50	0.028	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Methylphenol	ND	ND	mglkg	0.10	0.052	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	V11
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
Phenol	ND	ND	mglkg	0.10	0.057	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mglkg	0.20	0.063	EPA-8270C	10107106	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mglkg	0.20	0.071	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669	ND	
2-Fluorophenol (Surrogate)	94.2	94.2	%	47 - 120	(LCL - UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		
Phenol-d5 (Surrogate)	88.0	88.0	%	41 - 116	(LCL- UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		
Nitrobenzene-d5 (Surrogate)	84.2	84.2	%	50 - 115	(LCL - UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		
2-Fluorobiphenyl (Surrogate)	83.3	83.3	%	49 - 125	(LCL - UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	95.1	95.1	%	47 - 144	(LCL - UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	142	142	%	43 - 157	(LCL - UCL)	EPA-8270C	10/07/06	10/13/06 03:50	SKC	MS-B2	0.98	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	l0107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Acenaphthylene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzidine	ND	ND	mglkg	3.0	1.5	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mglkg	0.10	0.061	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	l0107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Benzyl alcohol	ND	ND	mglkg	0.10	0.054	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	0.68	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
alpha-BHC	ND	ND	mglkg	0.10	0.060	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mglkg	0.10	0.058	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mglkg	0.10	0.049	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mglkg	0.10	0.049	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mglkg	0.10	0.049	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.16	0.12	mglkg	0.20	0.068	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	0.068	J
4-Bromophenyl phenyl ether	ND	ND	mglkg	0.10	0.067	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloroaniline	ND	ND	mglkg	0.10	0.037	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
Chrysene	ND	ND	mglkg	0.10	0.063	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzofuran	ND	ND	mglkg	0.10	0.062	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mglkg	0.20	0.044	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
Dieldrin	ND	ND	mglkg	0.10	0.022	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan I	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin aldehyde	ND	ND	mglkg	0.50	0.054	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachloroethane	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10/07/06	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10/07/06	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-03 | **Client Sample Name:** STATION 3, 10/4/2006 7:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mglkg	0.10	0.047	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mglkg	0.50	0.22	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylphenol	ND	ND	mglkg	0.10	0.052	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mglkg	0.20	0.12	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Pentachlorophenol	ND	ND	mglkg	0.20	0.062	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
Phenol	ND	ND	mglkg	0.10	0.057	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mglkg	0.20	0.071	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669	ND	
2-Fluorophenol(Surrogate)	93.7	93.7	%	47 - 120	(LCL - UCL)	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669		
Phenol-d5 (Surrogate)	88.9	88.9	%	41 - 116	(LCL - UCL)	EPA-8270C	10107106	10/16/06 13:15	SKC	MS-B2	0.99	BPJ0669		
Nitrobenzene-d5 (Surrogate)	78.5	78.5	%	50 - 115	(LCL - UCL)	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669		
2-Fluorobiphenyl(Surrogate)	68.3	68.3	%	49 - 125	(LCL - UCL)	EPA-8270C	10/07/06	10116106 13:15	SKC	MS-B2	0.99	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	91.8	91.8	%	47 - 144	(LCL - UCL)	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	93.8	93.8	%	43 - 157	(LCL - UCL)	EPA-8270C	10107106	10116106 13:15	SKC	MS-B2	0.99	BPJ0669		

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	0.72	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.15	0.11	mg/kg	0.20	0.068	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	0.072	J
4-Bromophenylphenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	

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BC LABORATORIES, INC.

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenyl phenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
Chrysene	ND	ND	mg/kg	0.10	0.063	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan I	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Hexachloroethane	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-04 | **Client Sample Name:** STATION 4, 10/4/2006 7:40:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mglkg	0.10	0.047	EPA-8270C	10107106	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mglkg	0.50	0.22	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mglkg	0.20	0.12	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Nitrophenol	ND	ND	mglkg	0.10	0.047	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
Phenol	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mg/kg	0.20	0.071	EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669	ND	
2-Fluorophenol (Surrogate)	102	102	%	47 - 120 (LCL - UCL)		EPA-8270C	10/07/06	10116106 13:45	SKC	MS-B2	1.00	BPJ0669		
Phenol-d5 (Surrogate)	91.7	91.7	%	41 - 116 (LCL - UCL)		EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669		
Nitrobenzene-d5 (Surrogate)	92.8	92.8	%	50 - 115 (LCL - UCL)		EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669		
2-Fluorobiphenyl (Surrogate)	89.4	89.4	%	49 - 125 (LCL - UCL)		EPA-8270C	10/07/06	10116/06 13:45	SKC	MS-B2	1.00	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	98.4	98.4	%	47 - 144 (LCL - UCL)		EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	110	110	%	43 - 157 (LCL - UCL)		EPA-8270C	10/07/06	10/16/06 13:45	SKC	MS-B2	1.00	BPJ0669		

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Project: Annual Benrhis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 82706)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	0.69	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.17	0.13	mg/kg	0.20	0.068	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	0.069	J
4-Bromophenylphenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenyl phenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
Chrysene	ND	ND	mg/kg	0.10	0.063	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzofuran	ND	ND	mglkg	0.10	0.062	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10107106	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10107106	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mglkg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan I	ND	ND	mglkg	0.20	0.049	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan II	ND	ND	mglkg	0.20	0.049	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mglkg	0.10	0.055	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-05 | **Client Sample Name:** **STATION** 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mglkg	0.10	0.044	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mglkg	0.10	0.050	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mglkg	0.10	0.034	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachloroethane	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Isophorone	ND	ND	mglkg	0.10	0.047	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mglkg	0.10	0.056	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Naphthalene	ND	ND	mglkg	0.10	0.047	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Naphthylamine	ND	ND	mglkg	3.0	0.047	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Nitrobenzene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mglkg	0.10	0.052	EPA-8270C	10/07/06	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Pyrene	ND	ND	mglkg	0.10	0.060	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mglkg	0.10	0.050	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mglkg	0.20	0.053	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chlorophenol	ND	ND	mglkg	0.10	0.052	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 14:14	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 82706)

BCL Sample ID: 0610354-05 | **Client Sample Name:** STATION 5, 10/4/2006 7:51:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
Phenol	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mg/kg	0.20	0.071	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669	ND	
2-Fluorophenol (Surrogate)	104	104	%	47 - 120	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		
Phenol-d5 (Surrogate)	102	102	%	41 - 116	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		
Nitrobenzene-d5 (Surrogate)	89.7	89.7	%	50 - 115	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		
2-Fluorobiphenyl (Surrogate)	70.1	70.1	%	49 - 125	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	123	123	%	47 - 144	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	123	123	%	43 - 157	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:14	SKC	MS-B2	0.99	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	0.69	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.16	0.12	mg/kg	0.20	0.068	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	0.069	J
4-Bromophenyl phenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-06 | **Client Sample Name:** **STATION** 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	rnglkg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
Chrysene	ND	ND	rnglkg	0.10	0.063	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan I	ND	ND	rnglkg	0.20	0.049	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Fluoranthene	ND	ND	rnglkg	0.10	0.066	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachloroethane	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-06 | **Client Sample Name:** STATION 6, 10/4/2006 8:04:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylphenol	ND	ND	mglkg	0.10	0.052	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
Phenol	ND	ND	mglkg	0.10	0.057	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mglkg	0.20	0.063	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mglkg	0.20	0.071	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669	ND	
2-Fluorophenol(Surrogate)	113	113	%	47 - 120	(LCL - UCL)	EPA-8270C	10107106	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669		
Phenol-d5 (Surrogate)	104	104	%	41 - 116	(LCL - UCL)	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669		
Nitrobenzene-d5(Surrogate)	101	101	%	50 - 115	(LCL - UCL)	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669		
2-Fluorobiphenyl(Surrogate)	87.6	87.6	%	49 - 125	(LCL - UCL)	EPA-8270C	10107106	10116106 14:43	SKC	MS-B2	0.99	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	119	119	%	47 - 144	(LCL - UCL)	EPA-8270C	10/07/06	10116106 14:43	SKC	MS-B2	0.99	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	113	113	%	43 - 157	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 14:43	SKC	MS-B2	0.99	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	0.68	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.11	0.088	mg/kg	0.20	0.068	EPA-8270C	10107106	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	0.068	J
4-Bromophenyl phenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenyl phenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
Chrysene	ND	ND	mg/kg	0.10	0.063	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan I	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road. Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mglkg	0.10	0.044	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor	ND	ND	mglkg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mglkg	0.10	0.060	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachloroethane	ND	ND	mglkg	0.10	0.046	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Isophorone	ND	ND	mglkg	0.10	0.047	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
3-Nitroaniline	ND	ND	mglkg	0.10	0.050	EPA-8270C	10107106	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Nitrobenzene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mglkg	0.10	0.061	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mglkg	0.20	0.053	EPA-8270C	10107106	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 82706)

BCL Sample ID: 0610354-07 | **Client Sample Name:** STATION 7, 10/4/2006 8:16:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitrophenol	ND	ND	mg/kg	0.20	0.054	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
Phenol	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mg/kg	0.20	0.071	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669	ND	
2-Fluorophenol (Surrogate)	106	106	%	47 - 120	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669		
Phenol-d5 (Surrogate)	102	102	%	41 - 116	(LCL - UCL)	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669		
Nitrobenzene-d5 (Surrogate)	97.4	97.4	%	50 - 115	(LCL - UCL)	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669		
2-Fluorobiphenyl (Surrogate)	81.9	81.9	%	49 - 125	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 15:12	SKC	MS-B2	0.99	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	111	111	%	47 - 144	(LCL - UCL)	EPA-8270C	10107106	10116/06 15:12	SKC	MS-B2	0.99	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	120	120	%	43 - 157	(LCL - UCL)	EPA-8270C	10107106	10116106 15:12	SKC	MS-B2	0.99	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-08 | **Client Sample Name: STATION 8, 10/4/2006 8:29:00AM, Jerry Mason**

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Acenaphthylene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	▮	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Anthracene	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzidine	ND	ND	mg/kg	3.0	1.5	EPA-8270C	10107106	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	▮	BPJ0669	ND	
Benzoic acid	ND	ND	mg/kg	0.50	0.035	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Benzyl alcohol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	0.72	
Benzyl butyl phthalate	ND	ND	mglkg	0.10	0.060	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
alpha-BHC	ND	ND	mglkg	0.10	0.060	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
beta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
delta-BHC	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	▮	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.12	0.087	mg/kg	0.20	0.068	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	0.072	J
4-Bromophenylphenyl ether	ND	ND	mg/kg	0.10	0.067	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	

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Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 82706)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	mglkg	0.10	0.061	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
Chrysene	ND	ND	mglkg	0.10	0.063	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Dibenzofuran	ND	ND	mg/kg	0.10	0.062	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mg/kg	0.10	0.042	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
Dieldrin	ND	ND	mglkg	0.10	0.022	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mglkg	0.10	0.061	EPA-8270C	10107106	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mglkg	0.10	0.0088	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mglkg	0.10	0.052	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mg/kg	0.10	0.0090	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Endosulfan I	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Endosulfan II	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mglkg	0.10	0.055	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Endrin	ND	ND	mglkg	0.20	0.047	EPA-8270C	10107106	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Endrin aldehyde	ND	ND	mglkg	0.50	0.054	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
Fluoranthene	ND	ND	mg/kg	0.10	0.066	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Hexachloroethane	ND	ND	mglkg	0.10	0.046	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mglkg	0.10	0.075	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Isophorone	ND	ND	mglkg	0.10	0.047	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mglkg	0.10	0.038	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
N-Nitrosodi-N-propylarnine	ND	ND	mglkg	0.10	0.052	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mglkg	0.10	0.061	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-08 | **Client Sample Name:** STATION 8, 10/4/2006 8:29:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mg/kg	0.50	0.028	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mg/kg	0.50	0.22	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mg/kg	0.20	0.12	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Nitrophenol	ND	ND	mglkg	0.10	0.047	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
4-Nitrophenol	ND	ND	mglkg	0.20	0.054	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Pentachlorophenol	ND	ND	mg/kg	0.20	0.062	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
Phenol	ND	ND	rnglkg	0.10	0.057	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mg/kg	0.20	0.071	EPA-8270C	10/07/06	10/16/06 15:42	SKC	MS-B2	1	BPJ0669	ND	
2-Fluorophenol (Surrogate)	99.4	99.4	%	47 - 120	(LCL - UCL)	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669		
Phenol-d5 (Surrogate)	101	101	%	41 - 116	(LCL - UCL)	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669		
Nitrobenzene-d5 (Surrogate)	88.1	88.1	%	50 - 115	(LCL - UCL)	EPA-8270C	10107106	10116/06 15:42	SKC	MS-B2	1	BPJ0669		
2-Fluorobiphenyl (Surrogate)	81.3	81.3	%	49 - 125	(LCL - UCL)	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	104	104	%	47 - 144	(LCL - UCL)	EPA-8270C	10/07/06	10116106 15:42	SKC	MS-B2	1	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	131	131	%	43 - 157	(LCL - UCL)	EPA-8270C	10107106	10116106 15:42	SKC	MS-B2	1	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	ND	mg/kg	0.10	0.065	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Acenaphthylene	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Aldrin	ND	ND	mg/kg	0.10	0.057	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Aniline	ND	ND	mg/kg	0.20	0.023	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Anthracene	ND	ND	mglkg	0.10	0.067	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzidine	ND	ND	mglkg	3.0	1.5	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
Benzo[a]anthracene	ND	ND	mglkg	0.10	0.057	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[b]fluoranthene	ND	ND	mglkg	0.10	0.061	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[k]fluoranthene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[a]pyrene	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzo[g,h,i]perylene	ND	ND	mglkg	0.10	0.046	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzoic acid	ND	ND	mglkg	0.50	0.035	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Benzyl alcohol	ND	ND	mglkg	0.10	0.054	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	0.71	
Benzyl butyl phthalate	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
alpha-BHC	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
beta-BHC	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
delta-BHC	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
gamma-BHC (Lindane)	ND	ND	mg/kg	0.10	0.058	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
bis(2-Chloroethoxy)methane	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroethyl) ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Chloroisopropyl)ether	ND	ND	mg/kg	0.10	0.049	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
bis(2-Ethylhexyl)phthalate	0.12	0.089	mg/kg	0.20	0.068	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	0.070	J
4-Bromophenyl phenyl ether	ND	ND	mglkg	0.10	0.067	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloroaniline	ND	ND	mg/kg	0.10	0.037	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chloronaphthalene	ND	ND	mg/kg	0.10	0.059	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Chlorophenylphenyl ether	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
Chrysene	ND	ND	mg/kg	0.10	0.063	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
4,4'-DDD	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDE	ND	ND	mg/kg	0.10	0.055	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4,4'-DDT	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzo[a,h]anthracene	ND	ND	mglkg	0.10	0.058	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Dibenzofuran	ND	ND	mglkg	0.10	0.062	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Dichlorobenzene	ND	ND	mglkg	0.10	0.042	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
1,3-Dichlorobenzene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
1,4-Dichlorobenzene	ND	ND	mg/kg	0.10	0.051	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
3,3-Dichlorobenzidine	ND	ND	mg/kg	0.20	0.044	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
Dieldrin	ND	ND	mg/kg	0.10	0.022	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Diethyl phthalate	ND	ND	mg/kg	0.10	0.080	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Dimethyl phthalate	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-butyl phthalate	ND	ND	mg/kg	0.10	0.0088	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrotoluene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,6-Dinitrotoluene	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Di-n-octyl phthalate	ND	ND	mg/kg	0.10	0.081	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
1,2-Diphenylhydrazine	ND	ND	mglkg	0.10	0.0090	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan I	ND	ND	mg/kg	0.20	0.049	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan II	ND	ND	mglkg	0.20	0.049	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Endosulfan sulfate	ND	ND	mglkg	0.10	0.055	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin	ND	ND	mg/kg	0.20	0.047	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Endrin aldehyde	ND	ND	mg/kg	0.50	0.054	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Fluoranthene	ND	ND	mglkg	0.10	0.066	EPA-8270C	10107106	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Fluorene	ND	ND	mg/kg	0.10	0.044	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Heptachlor epoxide	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	V11
Hexachlorobenzene	ND	ND	mg/kg	0.10	0.064	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorobutadiene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachlorocyclopentadiene	ND	ND	mg/kg	0.10	0.034	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Hexachloroethane	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Indeno[1,2,3-cd]pyrene	ND	ND	mg/kg	0.10	0.075	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Isophorone	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylnaphthalene	ND	ND	mg/kg	0.10	0.056	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Naphthalene	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Naphthylamine	ND	ND	mg/kg	3.0	0.047	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitroaniline	ND	ND	mg/kg	0.10	0.053	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
3-Nitroaniline	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitroaniline	ND	ND	mg/kg	0.20	0.052	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Nitrobenzene	ND	ND	mg/kg	0.10	0.046	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodimethylamine	ND	ND	mg/kg	0.10	0.038	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodi-N-propylamine	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
N-Nitrosodiphenylamine	ND	ND	mg/kg	0.10	0.061	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Phenanthrene	ND	ND	mg/kg	0.10	0.070	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Pyrene	ND	ND	mg/kg	0.10	0.060	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
1,2,4-Trichlorobenzene	ND	ND	mg/kg	0.10	0.050	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4-Chloro-3-methylphenol	ND	ND	mg/kg	0.20	0.053	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Chlorophenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dichlorophenol	ND	ND	mg/kg	0.10	0.054	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0610354-09 | **Client Sample Name:** STATION 9, 10/4/2006 8:41:00AM, Jerry Mason

Constituent	Dry Basis Result	As Recvd Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
2,4-Dimethylphenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4,6-Dinitro-2-methylphenol	ND	ND	mglkg	0.50	0.028	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,4-Dinitrophenol	ND	ND	mglkg	0.50	0.22	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Methylphenol	ND	ND	mg/kg	0.10	0.052	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
3- & 4-Methylphenol	ND	ND	mglkg	0.20	0.12	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Nitrophenol	ND	ND	mg/kg	0.10	0.047	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
4-Nitrophenol	ND	ND	mglkg	0.20	0.054	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Pentachlorophenol	ND	ND	mglkg	0.20	0.062	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
Phenol	ND	ND	mglkg	0.10	0.057	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,5-Trichlorophenol	ND	ND	mg/kg	0.20	0.063	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2,4,6-Trichlorophenol	ND	ND	mglkg	0.20	0.071	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669	ND	
2-Fluorophenol (Surrogate)	99.8	99.8	%	47 - 120	(LCL - UCL)	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669		
Phenol-d5 (Surrogate)	96.2	96.2	%	41 - 116	(LCL - UCL)	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669		
Nitrobenzene-d5 (Surrogate)	95.5	95.5	%	50 - 115	(LCL - UCL)	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669		
2-Fluorobiphenyl (Surrogate)	84.3	84.3	%	49 - 125	(LCL - UCL)	EPA-8270C	10107106	10116106 16:10	SKC	MS-B2	0.99	BPJ0669		
2,4,6-Tribromophenol (Surrogate)	115	115	%	47 - 144	(LCL - UCL)	EPA-8270C	10/07/06	10/16/06 16:10	SKC	MS-B2	0.99	BPJ0669		
p-Terphenyl-dl4 (Surrogate)	122	122	%	43 - 157	(LCL - UCL)	EPA-8270C	10/07/06	10116106 16:10	SKC	MS-B2	0.99	BPJ0669		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-10 | **Client Sample Name:** STATION 1, 10/4/2006 8:00:00AM

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-11 | **Client Sample Name:** STATION 2, 10/4/2006 8:00:00AM

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved **Sulfide**	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10/27/06 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-12 | **Client Sample Name:** STATION 3, 10/4/2006 8:00:00AM

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
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Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10/27/06 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-13 | **Client Sample Name:** STATION 4, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-14 | **Client Sample Name:** STATION 5, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10110106	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-15 | **Client Sample Name:** STATION 6, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved **Sulfide**	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-16 | **Client Sample Name:** STATION 7, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10/27/06 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-17 | **Client Sample Name:** STATION 8, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10110106	10110106 14:00	MV1	SPEC05	1	BPJ0688	ND	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

BCL Sample ID: 0610354-18 | **Client Sample Name:** STATION 9, 10/4/2006 8:00:00AM, Jerry Mason

Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Sulfide	ND	mg/L	0.10	0.050	EPA-376.2	10/10/06	10/10/06 14:00	MV1	SPEC05	1	BPJ0688	ND	

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APPENDIX D.2

Sediment Physicochemistry
October 2006 Survey: Laboratory QC Results

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BC Laboratories, Inc

Date of Report: I012712006

Doug Coats

Marine Research Specialists

3140 Telegraph Road, Suite A
Suite A
Ventura, CA 93003-3238

RE: Annual Benthis Sediment Sampling for MBTP

BC Lab Number: 0610354

Enclosed are the results of analyses for samples received by the laboratory on 10/04/06 19:35. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Contact Person: Tina Green
Client Services Manager

Authorized Signature

All results listed in this report are for the exclusive use of the submitting party. BC Laboratories, Inc. assumes no responsibility for report alteration, separation, detachment or third party interpretation.

4100 Atlas Court • Bakersfield, CA 93308 • (661) 327-4911 • FAX (661) 327-1918 • www.bclabs.com

BC LABORATORIES, INC.

Date of Report: 11/02/2006

Doug Coats
Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura, CA 93003-3238

RE: Annual Benthis Sediment Sampling for MBTP

BC Lab Number: 0610354

Enclosed are the results of analyses for samples received by the laboratory on 10/04/06 19:35. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Contact Person: Tina Green

Client Services Manager

Authorized Signature

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4100 Atlas Court • Bakersfield, CA 93308 • (661) 327-4911 • FAX (661) 327-1918 • www.bclabs.com

Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Mercury	BPJ0395	Duplicate	0610361-02	0.076000	0.065312		mglkg	15.1		20		J
		Matrix Spike	0610361-02	0.076000	0.98065	0.80645	mglkg		112		85-115	
		Matrix Spike Duplicate	0610361-02	0.076000	0.88924	0.75758	mglkg	4.57	107	20	85-115	
Cadmium	BPJ0428	Duplicate	0610188-03	ND	ND		mg/kg			20		
		Matrix Spike	0610188-03	ND	11.777	9.9010	mglkg		119		75 - 125	
		Matrix Spike Duplicate	0610188-03	ND	11.990	9.9010	mglkg	1.67	121	20	75 - 125	
Chromium	BPJ0428	Duplicate	0610188-03	11.485	13.554		mglkg	16.5		20		
		Matrix Spike	0610188-03	11.485	122.33	99.010	mglkg		112		75 - 125	
		Matrix Spike Duplicate	0610188-03	11.485	123.96	99.010	mglkg	1.77	114	20	75-125	
Copper	BPJ0428	Duplicate	0610188-03	6.1287	6.2822		mglkg	2.47		20		
		Matrix Spike	0610188-03	6.1287	117.33	99.010	mglkg		112		75 - 125	
		Matrix Spike Duplicate	0610188-03	6.1287	118.12	99.010	mglkg	0.889	113	20	75 - 125	
Nickel	BPJ0428	Duplicate	0610188-03	11.188	12.540		mglkg	11.4		20		
		Matrix Spike	0610188-03	11.188	128.96	99.010	mglkg		119		75 - 125	
		Matrix Spike Duplicate	0610188-03	11.188	130.40	99.010	mg/kg	0.837	120	20	75 - 125	
Zinc	BPJ0428	Duplicate	0610188-03	22.158	23.545		mglkg	6.07		20		
		Matrix Spike	0610188-03	22.158	140.54	99.010	mglkg		120		75 - 125	
		Matrix Spike Duplicate	0610188-03	22.158	142.72	99.010	mglkg	1.65	122	20	75-125	
Aluminum	BPJ0428	Duplicate	0610188-03RE2	6698.0	7618.8		mglkg	12.9		20		
		Matrix Spike	0610188-03RE2	6698.0	8633.7	495.05	mglkg		391		75 - 125	A03
		Matrix Spike Duplicate	0610188-03RE2	6698.0	8599.0	495.05	mglkg	1.81	384	20	75 - 125	A03
Iron	BPJ0428	Duplicate	0610188-03RE2	10762	11906		mglkg	10.1		20		
		Matrix Spike	0610188-03RE2	10762	12059	495.05	mglkg		262		75 - 125	A03
		Matrix Spike Duplicate	0610188-03RE2	10762	11802	495.05	mglkg	22.0	210	20	75 - 125	A03, Q02
Arsenic	BPJ0480	Duplicate	0610188-03	2.8997	2.9739		mglkg	2.53		20		
		Matrix Spike	0610188-03	2.8997	8.0385	4.9505	mglkg		104		75 - 125	
		Matrix Spike Duplicate	0610188-03	2.8997	7.8482	4.9505	mglkg	3.92	100	20	75-125	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Lead	BPJ0480	Duplicate	0610188-03	4.1360	4.4412		mg/kg	7.12		20		
		Matrix Spike	0610188-03	4.1360	113.17	99.010	mg/kg		110		75 - 125	
		Matrix Spike Duplicate	0610188-03	4.1360	111.74	99.010	mglkg	0.913	109	20	75-125	
Silver	BPJ0480	Duplicate	0610188-03	ND	ND		mg/kg			20		
		Matrix Spike	0610188-03	ND	9.2906	9.9010	mglkg		93.8		75 - 125	
		Matrix Spike Duplicate	0610188-03	ND	9.4524	9.9010	mglkg	1.80	95.5	20	75 - 125	

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Total Kjeldahl Nitrogen	BPJ0383	Duplicate	0610354-01	124.46	116.74		mglkg	6.40		20		
		Matrix Spike	0610354-01	124.46	658.51	522.19	mglkg		102		80 - 120	
		Matrix Spike Duplicate	0610354-01	124.46	650.78	522.19	mglkg	0.985	101	20	80-120	
Solids	BPJ0450	Duplicate	0610354-01	100.00	100.26		%	0.260		20		
Biochemical Oxygen Demand	BPJ0596	Duplicate	0610354-01	43.534	35.935		mg Olkg	19.1		20		
Total Volatile Solids	BPJ0676	Duplicate	0610354-01	1.8538	1.8668		%	0.699		20		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

EPA Method 1664

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Oil and Grease	BPJ0871	Duplicate	0610354-01	ND	ND		mg/kg			30		
		Matrix Spike	0610354-01	ND	870.76	1015.7	mg/kg		85.7		56 - 111	
		Matrix Spike Duplicate	0610354-01	ND	937.34	1015.7	mglkg	7.42	92.3	30	56 - 111	

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3140 Telegraph Road, Suite A
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Aldrin	BPJ0784	Matrix Spike	0606841-97	ND	0.0081625	0.0083333	mg/kg		98.0		48 - 139	
		Matrix Spike Duplicate	0606841-97	ND	0.0086191	0.0082781	mg/kg	5.94	104	30	48-139	
gamma-BHC (Lindane)	BPJ0784	Matrix Spike	0606841-97	ND	0.0068912	0.0083333	mg/kg		82.7		43 - 113	
		Matrix Spike Duplicate	0606841-97	ND	0.0032135	0.0082781	mg/kg	72.3	38.8	30	43 - 113	Q03
4,4'-DDT	BPJ0784	Matrix Spike	0606841-97	ND	0.0080955	0.0083333	mg/kg		97.1		44 - 124	
		Matrix Spike Duplicate	0606841-97	ND	0.0080592	0.0082781	mg/kg	0.308	97.4	30	44-124	
Dieldrin	BPJ0784	Matrix Spike	0606841-97	ND	0.0081625	0.0083333	mg/kg		98.0		50 - 135	
		Matrix Spike Duplicate	0606841-97	ND	0.0088680	0.0082781	mg/kg	8.78	107	30	50-135	
Endrin	BPJ0784	Matrix Spike	0606841-97	ND	0.0082713	0.0083333	mg/kg		99.3		47 - 143	
		Matrix Spike Duplicate	0606841-97	ND	0.0085366	0.0082781	mg/kg	3.66	103	30	47-143	
Heptachlor	BPJ0784	Matrix Spike	0606841-97	ND	0.0081264	0.0083333	mg/kg		97.5		59 - 133	
		Matrix Spike Duplicate	0606841-97	ND	0.000059272	0.0082781	mg/kg	197	0.716	30	59 - 133	Q02, J
TCMX (Surrogate)	BPJ0784	Matrix Spike	0606841-97	ND	0.0084103	0.010000	mg/kg		84.1		70 - 120	
		Matrix Spike Duplicate	0606841-97	ND	0.0013982	0.0099338	mg/kg		14.1		70 - 120	S09
Dibutyl chlorendate (Surrogate)	BPJ0784	Matrix Spike	0606841-97	ND	0.022562	0.025000	mg/kg		90.2		79 - 136	
		Matrix Spike Duplicate	0606841-97	ND	0.011648	0.024834	mg/kg		46.9		79 - 136	S09

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 82706)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Acenaphthene	BPJ0669	Matrix Spike	0608879-55	ND	2.1321	2.6316	mglkg		81.0		39 - 137	
		Matrix Spike Duplicate	0608879-55	ND	2.0028	2.6316	mglkg	6.24	76.1	21	39 - 137	
1,4-Dichlorobenzene	BPJ0669	Matrix Spike	0608879-55	ND	2.1518	2.6316	mglkg		81.8		40 - 113	
		Matrix Spike Duplicate	0608879-55	ND	2.0367	2.6316	mglkg	5.53	77.4	18	40 - 113	
2,4-Dinitrotoluene	BPJ0669	Matrix Spike	0608879-55	ND	2.0611	2.6316	mglkg		78.3		48 - 107	
		Matrix Spike Duplicate	0608879-55	ND	1.9568	2.6316	mglkg	5.11	74.4	24	48-107	
Hexachlorobenzene	BPJ0669	Matrix Spike	0608879-55	ND	2.5864	2.6316	mglkg		98.3		48 - 121	
		Matrix Spike Duplicate	0608879-55	ND	2.3969	2.6316	mglkg	7.60	91.1	26	48-121	
Hexachlorobutadiene	BPJ0669	Matrix Spike	0608879-55	ND	1.8155	2.6316	mglkg		69.0		29 - 118	
		Matrix Spike Duplicate	0608879-55	ND	1.7206	2.6316	mg/kg	5.36	65.4	27	29-118	
Hexachloroethane	BPJ0669	Matrix Spike	0608879-55	ND	2.1329	2.6316	mglkg		81.0		36 - 104	
		Matrix Spike Duplicate	0608879-55	ND	1.9991	2.6316	mglkg	6.37	76.0	21	36 - 104	
Nitrobenzene	BPJ0669	Matrix Spike	0608879-55	ND	2.0971	2.6316	mglkg		79.7		43 - 119	
		Matrix Spike Duplicate	0608879-55	ND	2.0278	2.6316	mglkg	3.32	77.1	24	43 - 119	
N-Nitrosodi-N-propylamine	BPJ0669	Matrix Spike	0608879-55	ND	1.8654	2.6316	mglkg		70.9		41 - 103	
		Matrix Spike Duplicate	0608879-55	ND	1.7667	2.6316	mglkg	5.51	67.1	21	41 - 103	
Pyrene	BPJ0669	Matrix Spike	0608879-55	ND	2.5812	2.6316	mglkg		98.1		43 - 145	
		Matrix Spike Duplicate	0608879-55	ND	2.5528	2.6316	mglkg	1.13	97.0	24	43-145	
1,2,4-Trichlorobenzene	BPJ0669	Matrix Spike	0608879-55	ND	1.9762	2.6316	mglkg		75.1		37 - 124	
		Matrix Spike Duplicate	0608879-55	ND	1.8726	2.6316	mg/kg	5.33	71.2	24	37-124	
4-Chloro-3-methylphenol	BPJ0669	Matrix Spike	0608879-55	ND	1.8189	2.6316	mglkg		69.1		49 - 130	
		Matrix Spike Duplicate	0608879-55	ND	1.7537	2.6316	mglkg	3.68	66.6	24	49-130	
2-Chlorophenol	BPJ0669	Matrix Spike	0608879-55	ND	1.5729	2.6316	mg/kg		59.8		42 - 101	
		Matrix Spike Duplicate	0608879-55	ND	1.4982	2.6316	mglkg	4.97	56.9	22	42 - 101	
2-Methylphenol	BPJ0669	Matrix Spike	0608879-55	ND	1.6319	2.6316	mglkg		62.0		17 - 132	
		Matrix Spike Duplicate	0608879-55	ND	1.4986	2.6316	mglkg	8.58	56.9	29	17-132	

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Marine Research Specialists
3140 Telegraph Road, Suite A
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
3- & 4-Methylphenol	BPJ0669	Matrix Spike	0608879-55	ND	3.2048	2.6316	mg/kg		122		48 - 190	
		Matrix Spike Duplicate	0608879-55	ND	3.1356	2.6316	mg/kg	2.49	119	23	48 - 190	
4-Nitrophenol	BPJ0669	Matrix Spike	0608879-55	ND	1.9711	2.6316	mg/kg		74.9		35 - 144	
		Matrix Spike Duplicate	0608879-55	ND	1.9793	2.6316	mg/kg	0.400	75.2	22	35 - 144	
Pentachlorophenol	BPJ0669	Matrix Spike	0608879-55	ND	1.8488	2.6316	mg/kg		70.3		26 - 117	
		Matrix Spike Duplicate	0608879-55	ND	1.7502	2.6316	mg/kg	5.56	66.5	22	26 - 117	
Phenol	BPJ0669	Matrix Spike	0608879-55	ND	1.4248	2.6316	mg/kg		54.1		32 - 98	
		Matrix Spike Duplicate	0608879-55	ND	1.4099	2.6316	mg/kg	0.929	53.6	20	32 - 98	
2,4,6-Trichlorophenol	BPJ0669	Matrix Spike	0608879-55	ND	1.7029	2.6316	mg/kg		64.7		51 - 114	
		Matrix Spike Duplicate	0608879-55	ND	1.6346	2.6316	mg/kg	4.10	62.1	26	51 - 114	
2-Fluorophenol (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	2.4862	2.6316	mg/kg		94.5		47 - 120	
		Matrix Spike Duplicate	0608879-55	ND	2.5125	2.6316	mg/kg		95.5		47 - 120	
Phenol-d5 (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	2.3237	2.6316	mg/kg		88.3		41 - 116	
		Matrix Spike Duplicate	0608879-55	ND	2.3039	2.6316	mg/kg		87.5		41 - 116	
Nitrobenzene-d5 (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	2.3431	2.6316	mg/kg		89.0		50 - 115	
		Matrix Spike Duplicate	0608879-55	ND	2.3286	2.6316	mg/kg		88.5		50 - 115	
2-Fluorobiphenyl (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	2.1289	2.6316	mg/kg		80.9		49 - 125	
		Matrix Spike Duplicate	0608879-55	ND	2.1339	2.6316	mg/kg		81.1		49 - 125	
2,4,6-Tribromophenol (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	2.9605	2.6316	mg/kg		112		47-144	V11
		Matrix Spike Duplicate	0608879-55	ND	2.9342	2.6316	mg/kg		111		47 - 144	V11
p-Terphenyl-dl4 (Surrogate)	BPJ0669	Matrix Spike	0608879-55	ND	1.2513	1.3158	mg/kg		95.1		43 - 157	
		Matrix Spike Duplicate	0608879-55	ND	1.2520	1.3158	mg/kg		95.2		43 - 157	

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Marine Research Specialists
3140 Telegraph Road, Suite A
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10/27/06 11:05

Water Analysis (General Chemistry)

Quality Control Report - Precision & Accuracy

Constituent	Batch ID	QC Sample Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Dissolved Sulfide	BPJ0688	Duplicate	0610354-10	ND	ND		mg/L			10		
		Matrix Spike	0610354-10	ND	0.49195	0.50000	mg/L		98.4		80 - 120	
		Matrix Spike Duplicate	0610354-10	ND	0.49348	0.50000	mg/L	0.304	98.7	10	80-120	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

Total Concentrations (TTLC)

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Mercury	BPJ0395	BPJ0395-BS1	LCS	1.3523	1.5000	0.16	mg/kg	90.2		75 - 125		
Cadmium	BPJ0428	BPJ0428-BS1	LCS	5.6200	5.3530	0.50	mg/kg	105		75 - 125		
Chromium	BPJ0428	BPJ0428-BS1	LCS	13.270	13.356	0.50	mg/kg	99.4		75 - 125		
Copper	BPJ0428	BPJ0428-BS1	LCS	11.935	13.727	1.0	mg/kg	86.9		75 - 125		
Nickel	BPJ0428	BPJ0428-BS1	LCS	11.435	11.183	0.50	mg/kg	102		75 - 125		
Zinc	BPJ0428	BPJ0428-BS1	LCS	36.815	34.291	2.5	mg/kg	107		75 - 125		
Aluminum	BPJ0428	BPJ0428-BS1	LCS	7295.0	7314.0	5.0	mg/kg	99.7		75 - 125		
Iron	BPJ0428	BPJ0428-BS1	LCS	10210	9752.0	5.0	mg/kg	105		75 - 125		
Arsenic	BPJ0480	BPJ0480-BS1	LCS	10.736	10.070	1.0	mg/kg	107		75 - 125		
Lead	BPJ0480	BPJ0480-BS3	LCS	10.969	9.3810	1.0	mg/kg	117		75 - 125		
Silver	BPJ0480	BPJ0480-BS2	LCS	4.8701	5.1251	1.0	mg/kg	95.0		75 - 125		

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Total Kjeldahl Nitrogen	BPJ0383	BPJ0383-BS1	LCS	362.14	400.00	40	mg/kg	90.5		85-115		
Biochemical Oxygen Demand	BPJ0596	BPJ0596-BS1	LCS	190.02	198.00	30	mg O/kg	96.0		85-115		

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Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

EPA Method 1664

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Oil and Grease	BPJ0871	BPJ0871-BS1	LCS	729.00	778.00	50	mg/kg	93.7		59 - 117		

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Aldrin	BPJ0784	BPJ0784-BS1	LCS	0.0080786	0.0082508	0.00050	mg/kg	97.9		61 - 122		
gamma-BHC (Lindane)	BPJ0784	BPJ0784-BS1	LCS	0.0069285	0.0082508	0.00050	mg/kg	84.0		37 - 117		
4,4'-DDT	BPJ0784	BPJ0784-BS1	LCS	0.0078258	0.0082508	0.00050	mg/kg	94.8		58 - 116		
Dieldrin	BPJ0784	BPJ0784-BS1	LCS	0.0091957	0.0082508	0.00050	mg/kg	111		61 - 126		
Endrin	BPJ0784	BPJ0784-BS1	LCS	0.0080282	0.0082508	0.00050	mg/kg	97.3		62 - 128		
Heptachlor	BPJ0784	BPJ0784-BS1	LCS	0.0080945	0.0082508	0.00050	mg/kg	98.1		58 - 134		
TCMX (Surrogate)	BPJ0784	BPJ0784-BS1	LCS	0.0088279	0.0099010		mg/kg	89.2		70 - 120		
Dibutyl chlorendate (Surrogate)	BPJ0784	BPJ0784-BS1	LCS	0.023356	0.024752		mg/kg	94.4		79 - 136		

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Acenaphthene	BPJ0669	BPJ0669-BS1	LCS	2.2563	2.6403	0.10	rnglkg	85.5		40 - 134		
1,4-Dichlorobenzene	BPJ0669	BPJ0669-BS1	LCS	2.0592	2.6403	0.10	rnglkg	78.0		44 - 110		
2,4-Dinitrotoluene	BPJ0669	BPJ0669-BS1	LCS	2.3512	2.6403	0.10	rnglkg	89.1		50 - 106		
Hexachlorobenzene	BPJ0669	BPJ0669-BS1	LCS	2.3265	2.6403	0.10	rnglkg	88.1		46 - 125		
Hexachlorobutadiene	BPJ0669	BPJ0669-BS1	LCS	1.9402	2.6403	0.10	mg/kg	73.5		33 - 115		
Hexachloroethane	BPJ0669	BPJ0669-BS1	LCS	1.9603	2.6403	0.10	rnglkg	74.2		37 - 107		
Nitrobenzene	BPJ0669	BPJ0669-BS1	LCS	2.1464	2.6403	0.10	rnglkg	81.3		46 - 121		
N-Nitrosodi-N-propylamine	BPJ0669	BPJ0669-BS1	LCS	1.7764	2.6403	0.10	rnglkg	67.3		38 - 109		
Pyrene	BPJ0669	BPJ0669-BS1	LCS	2.6823	2.6403	0.10	rnglkg	102		46 - 137		
1,2,4-Trichlorobenzene	BPJ0669	BPJ0669-BS1	LCS	2.0067	2.6403	0.10	rnglkg	76.0		41 - 120		
4-Chloro-3-methylphenol	BPJ0669	BPJ0669-BS1	LCS	1.6805	2.6403	0.20	rnglkg	63.6		46 - 134		
2-Chlorophenol	BPJ0669	BPJ0669-BS1	LCS	1.4671	2.6403	0.10	rnglkg	55.6		41 - 103		
2-Methylphenol	BPJ0669	BPJ0669-BS1	LCS	1.5920	2.6403	0.10	mglkg	60.3		33 - 115		
3- & 4-Methylphenol	BPJ0669	BPJ0669-BS1	LCS	3.0220	2.6403	0.20	rnglkg	114		43 - 190		
4-Nitrophenol	BPJ0669	BPJ0669-BS1	LCS	1.8365	2.6403	0.20	rnglkg	69.6		33 - 147		
Pentachlorophenol	BPJ0669	BPJ0669-BS1	LCS	1.5468	2.6403	0.20	rnglkg	58.6		27-116		
Phenol	BPJ0669	BPJ0669-BS1	LCS	1.3553	2.6403	0.10	rnglkg	51.3		35 - 98		
2,4,6-Trichlorophenol	BPJ0669	BPJ0669-BS1	LCS	1.6059	2.6403	0.20	mg/kg	60.8		46 - 121		
2-Fluorophenol (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	2.4406	2.6403		mglkg	92.4		47 - 120		
Phenol-d5 (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	2.2700	2.6403		mg/kg	86.0		41 - 116		
Nitrobenzene-d5 (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	2.3020	2.6403		mg/kg	87.2		50 - 115		
2-Fluorobiphenyl (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	2.4343	2.6403		rnglkg	92.2		49 - 125		
2,4,6-Tribromophenol (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	2.5535	2.6403		mg/kg	96.7		47 - 144		V11
p-Terphenyl-dl4 (Surrogate)	BPJ0669	BPJ0669-BS1	LCS	1.3601	1.3201		mglkg	103		43 - 157		

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Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

Quality Control Report - Laboratory Control Sample

Constituent	Batch ID	QC Sample ID	QC Type	Result	Spike Level	PQL	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
Dissolved Sulfide	BPJ0688	BPJ0688-BS1	LCS	0.50872	0.50000	0.10	mg/L	102		90-110		

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3140 Telegraph Road. Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

Total Concentrations (TTLC)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Mercury	BPJ0395	BPJ0395-BLK1	ND	mg/kg	0.16	0.041	
Cadmium	BPJ0428	BPJ0428-BLK1	ND	mg/kg	0.50	0.073	
Chromium	BPJ0428	BPJ0428-BLK1	ND	mg/kg	0.50	0.17	
Copper	BPJ0428	BPJ0428-BLK1	ND	mg/kg	1.0	0.090	
Nickel	BPJ0428	BPJ0428-BLK1	ND	mg/kg	0.50	0.25	
Zinc	BPJ0428	BPJ0428-BLK1	0.32500	mg/kg	2.5	0.31	J
Aluminum	BPJ0428	BPJ0428-BLK1	ND	mg/kg	5.0	3.0	
Iron	BPJ0428	BPJ0428-BLK1	ND	mg/kg	5.0	2.0	
Arsenic	BPJ0480	BPJ0480-BLK1	ND	mg/kg	0.50	0.17	
Lead	BPJ0480	BPJ0480-BLK3	ND	mg/kg	0.50	0.082	
Silver	BPJ0480	BPJ0480-BLK2	ND	mg/kg	0.25	0.052	

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Marine Research Specialists
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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Chemical Analysis

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Moisture	BPJ0341	BPJ0341-BLK1	ND	%	0.05	0.05	
Total Kjeldahl Nitrogen	BPJ0383	BPJ0383-BLK1	ND	mg/kg	40	20	
Biochemical Oxygen Demand	BPJ0596	BPJ0596-BLK1	ND	mg O/kg	0.98	0.98	
Total Volatile Solids	BPJ0676	BPJ0676-BLK1	ND	%	0.200	0.200	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats
Reported: 11/02/06 09:39

EPA Method 1664

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Oil and Grease	BPJ0871	BPJ0871-BLK1	ND	mg/kg	50	27	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Aldrin	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000027	
alpha-BHC	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000029	
beta-BHC	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.00014	
delta-BHC	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000044	
gamma-BHC (Lindane)	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000051	
Chlordane (Technical)	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.050	0.015	
4,4'-DDD	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000041	
4,4'-DDE	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000034	
4,4'-DDT	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000039	
Dieldrin	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000022	
Endosulfan I	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000028	
Endosulfan II	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000032	
Endosulfan sulfate	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000038	
Endrin	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000023	
Endrin aldehyde	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000048	
Heptachlor	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000026	
Heptachlor epoxide	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000043	
Methoxychlor	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.00050	0.000061	
Toxaphene	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.050	0.0074	
PCB-1016	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0018	
PCB-1221	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0050	
PCB-1232	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0012	
PCB-1242	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0016	
PCB-1248	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0012	
PCB-1254	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.00078	

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Marine Research Specialists
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Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Organochlorine Pesticides and PCB's (EPA Method 8080)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
PCB-1260	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0014	
Total PCB's (Summation)	BPJ0784	BPJ0784-BLK1	ND	mg/kg	0.010	0.0050	
TCMX (Surrogate)	BPJ0784	BPJ0784-BLK1	81.0	%	70 - 120 (LCL - UCL)		
Dibutyl chlorendate (Surrogate)	BPJ0784	BPJ0784-BLK1	91.3	%	79 - 136 (LCL - UCL)		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA. 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Acenaphthene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.065	
Acenaphthylene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.058	
Aldrin	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.057	
Aniline	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.023	
Anthracene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.067	
Benzidine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	3.0	1.5	
Benzo[a]anthracene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.057	
Benzo[b]fluoranthene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.061	
Benzo[k]fluoranthene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.064	
Benzo[a]pyrene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.053	
Benzo[g,h,i]perylene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
Benzoic acid	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.50	0.035	
Benzyl alcohol	BPJ0669	BPJ0669-BLK1	0.53141	mg/kg	0.10	0.054	M01
Benzyl butyl phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.060	
alpha-BHC	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.060	
beta-BHC	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.058	
delta-BHC	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.058	
gamma-BHC (Lindane)	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.058	
bis(2-Chloroethoxy)methane	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.049	
bis(2-Chloroethyl) ether	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.049	
bis(2-Chloroisopropyl)ether	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.049	
bis(2-Ethylhexyl)phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.068	
4-Bromophenyl phenyl ether	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.067	
4-Chloroaniline	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.037	
2-Chloronaphthalene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.059	

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3140 Telegraph Road, Suite Λ
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
4-Chlorophenyl phenyl ether	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.061	
Chrysene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.063	
4,4'-DDD	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.052	
4,4'-DDE	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.055	
4,4'-DDT	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
Dibenzo[a,h]anthracene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.058	
Dibenzofuran	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.062	
1,2-Dichlorobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.051	
1,3-Dichlorobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.051	
1,4-Dichlorobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.051	
3,3-Dichlorobenzidine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.044	
Dieldrin	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.027	
Diethyl phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.080	
Dimethyl phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.061	
Di-n-butyl phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.0088	
2,4-Dinitrotoluene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
2,6-Dinitrotoluene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.052	
Di-n-octyl phthalate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.081	
1,2-Diphenylhydrazine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.0090	
Endosulfan I	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.049	
Endosulfan II	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.049	
Endosulfan sulfate	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.033	
Endrin	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.047	
Endrin aldehyde	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.054	
Fluoranthene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.066	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Fluorene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.044	
Heptachlor	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
Heptachlor epoxide	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.060	
Hexachlorobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.064	
Hexachlorobutadiene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.050	
Hexachlorocyclopentadiene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.034	
Hexachloroethane	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
Indeno[1,2,3-cd]pyrene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.075	
Isophorone	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.047	
2-Methylnaphthalene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.056	
Naphthalene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.047	
2-Naphthylamine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	3.0	0.047	
2-Nitroaniline	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.053	
3-Nitroaniline	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.050	
4-Nitroaniline	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.052	
Nitrobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.046	
N-Nitrosodimethylamine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.038	
N-Nitrosodi-N-propylamine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.052	
N-Nitrosodiphenylamine	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.061	
Phenanthrene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.070	
Pyrene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.060	
1,2,4-Trichlorobenzene	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.050	
4-Chloro-3-methylphenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.053	
2-Chlorophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.052	
2,4-Dichlorophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.054	

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
2,4-Dimethylphenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.047	
4,6-Dinitro-2-methylphenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.50	0.028	
2,4-Dinitrophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.50	0.22	
2-Methylphenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.052	
3- & 4-Methylphenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.12	
2-Nitrophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.047	
4-Nitrophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.054	
Pentachlorophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.062	
Phenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.10	0.057	
2,4,5-Trichlorophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.063	
2,4,6-Trichlorophenol	BPJ0669	BPJ0669-BLK1	ND	mg/kg	0.20	0.071	
2-Fluorophenol (Surrogate)	BPJ0669	BPJ0669-BLK1	95.5	%	47 - 120 (LCL - UCL)		
Phenol-d5 (Surrogate)	BPJ0669	BPJ0669-BLK1	91.6	%	41 - 116 (LCL - UCL)		
Nitrobenzene-d5 (Surrogate)	BPJ0669	BPJ0669-BLK1	88.5	%	50 - 115 (LCL - UCL)		
2-Fluorobiphenyl (Surrogate)	BPJ0669	BPJ0669-BLK1	80.7	%	49 - 125 (LCL - UCL)		
2,4,6-Tribromophenol (Surrogate)	BPJ0669	BPJ0669-BLK1	103	%	47 - 144 (LCL - UCL)		V11
p-Terphenyl-dl4 (Surrogate)	BPJ0669	BPJ0669-BLK1	104	%	43 - 157 (LCL - UCL)		

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Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Water Analysis (General Chemistry)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Dissolved Sulfide	BPJ0688	BPJ0688-BLK1	ND	mg/L	0.10	0.050	

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3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Notes and Definitions

V11	The Continuing Calibration Verification (CCV) recovery is not within established control limits.
V01	The Initial Calibration Verification (ICV) recovery is not within established control limits.
S09	The surrogate recovery on the sample for this compound was not within the control limits
Q03	Matrix spike recovery(s) is(are) not within the control limits.
Q02	Matrix spike precision is nor within the control limits.
M01	Analyte detected in the Method Blank at or above the PQL.
J	Estimated value
A03	The sample concentration is more than 4 times the spike level.
A01	PQL's and MDL's are raised due to sample dilution.
ND	Analyte NOT DETECTED at or above the reporting limit
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10/27/06 11:05

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
dry	Sample results reported on a *dry* weight basis
RPD	Relative Percent Difference

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BC Laboratories, Inc. — Chain of Custody Form

PLEASE COMPLETE BCL QUOTE ID.

33804

Page ____ of ____

Report To:
Client: Marine Research
Attn: DR. Doug Coats
Street Address: 3140 Telegraph Road Suite A
City, State, Zip: Ventura Ca 9330
Phone: Fax:
Email Address:
Submittal #: 06-10354

Project #: Yearly Benthic
Project Name: Survey
Project Code:
Sampler(s): Jerry Mosr

Analysis Requested

Please refer to the back of this page for completion instructions and method codes.

Comments: Samples Homogenize In Lab Dissolved sulfide was flocculated in field & Transferred into Total sulfide BOTTLE

Sample #	Description	Date Sampled	Time Sampled	Moisture	Total Volatile solids	BOD	TKN	Dissolved sulfide	Cold extractable petroleum waste	Al, Fe, Mn, Sb, Se	Total Cr, Cu, Pb, Hg	Ni, Ag, Zn	8270	Soil	Sludge	Drinking Water	Ground Water	Waste Water	Other	Turnaround # of work days*	Notes
-1	Station 1	10/4/06	0705	X	X	X	X	X	X	X	X	X	X	X						N	1-32oz Jar 250mL sulfide bottle
-2	Station 2		0718	X	X	X	X	X	X	X	X	X	X	X							
-3	Station 3		0729	X	X	X	X	X	X	X	X	X	X	X							
-4	Station 4		0740	X	X	X	X	X	X	X	X	X	X	X							
-5	Station 5		0751	X	X	X	X	X	X	X	X	X	X	X							
-6	Station 6		0804	X	X	X	X	X	X	X	X	X	X	X							
-7	Station 7		0816	X	X	X	X	X	X	X	X	X	X	X							
-8	Station 8		0829	X	X	X	X	X	X	X	X	X	X	X							
-9	Station 9		0841	X	X	X	X	X	X	X	X	X	X	X							

Sample Matrix

Are there any tests with holding times less than or equal to 48 hours? ☐ Yes ☐ No

* Standard Turnaround = 15 work days

Notes

CHK BY: AMM

DISTRIBUTION: MARGIN NF ☐ ☐ SUB-OUT ☐

Billing ☐ Same as above

Client: ____
Address: ____
City: ____ State ____ Zip ____
Attn: ____
PO#: ____

Report Drinking Waters on State Form? ☐ Yes ☐ No

Send Copy to State of CA? ☐ Yes ☐ No

Sample Disposal ☐ Return to Client ☐ Disposal by lab ☐ Archive: Months ____

Special Reporting ☐ QC ☐ WIP ☐ Raw Data

	Relinquished By	Date	Time	Received By	Date	Time
1.		10-4-06	1715		10-4-06	1725
2.		10-4-06	1935	Jeri Obafemi	10/4/06	1935
3.						

marine research specialists

06-1085 140 Telegraph Road.. Suite A · Ventura, CA 93003 · (805) 644-1180

Morro Bay Sediment Sampling at 9 Offshore Stations on Wednesday, 4 October 2006

The following analyses should be conducted on the soil matrix using procedures and a QC Level identical to analyses conducted in 2004 on BC Laboratory Sample Number 05-09920. Prior to analysis, macrofauna and large remnants greater than 0.25 inches should be removed, taking care to avoid contamination. All results should be reported on an as-received (raw) basis and where appropriate, on a **dry-weight basis.** In addition, perform a dissolved sulfide analysis on porewater to be extracted and processed onboard the survey vessel. The required analyses are:

Constituent	Samples	Method
Moisture	9	160.3 or BC
Total Volatile Solids	9	160.4
Biochemical Oxygen Demand	9	405.1 or SM17-5210B
Total Kjeldahl Nitrogen	9	351.2
Dissolved Sulfide	9	376.2 See note below[1]
Oil and Grease	9	413.2 or EPA-1664HEM
Metals (11)		
Aluminum	9	SW-6010
Iron	9	SW-6010
Arsenic	9	SW-7060
Cadmium	9	SW-6010
Total Chromium	9	SW-6010
Copper	9	SW-6010
Lead	9	SW-7421
Mercury	9	SW-7471
Nickel	9	SW-6010
Silver	9	EPA-272.2
Zinc	9	SW-6010
Pesticides and PCBs	9	8080
Base Neutral and Acid Extractables	9	8270

Questions can be directed to Bonnie Luke at Marine Research Specialists at (805) 289-3926.

[1] Please provide Mr. Jerry Mason with the appropriate sample containers and equipment for conducting flocculation and adding fixative to porewater samples onboard the survey vessel. 250 ml porewater samples will be extracted by Marine Research personnel from the benthic grab.

BC LABORATORIES INC. | SAMPLE RECEIPT FORM | Rev. No. 10 | 01/21/04 | Page ___ Of ___

Submission #: 06-10354 | Project Code: | TB Batch #

SHIPPING INFORMATION

Federal Express ☐ UPS ☐ Hand Delivery q
BC Lab Field Service ☑ Other ☐ (Specify)_____

SHIPPING CONTAINER

Ice Chest ☑ None ☐
Box ☐ Other ☐ (Specify)_____

Refrigerant: Ice ☑ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ | Containers ☐ Intact? Yes ☐ No ☐ | None ☑ Comments:

All samples received? Yes ☑ No ☐ | All samples containers intact? Yes ☑ No ☐ | Description(s) match COC? Yes ☑ No ☐

COC Received ☑ YES ☐ NO

ice Chest ID RW | Temperature: 3.0 °C | Thermometer ID: #48

Emissivity .98 | Container 32ozjar

Date/Time 10/4/06 | Analyst Init OTO

SAMPLE CONTAINERS	SAMPLE NUMBERS 1	2	3	4	5	6	7	8	9	10
QT GENERAL MINERAL/ GENERAL PHYSICAL										
PT PE UNPRESERVED										
QT INORGANIC CHEMICAL METALS										
PT INORGANIC CHEMICAL METALS										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE 8oz pe	B	B	B	B	B	B	B	B	OTO 10/4 B	A
2oz. NITRATE / NITRITE										
100ml TOTAL ORGANIC CARBON										
QT TOX										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL	( )	( )	( )	( )	( )	( )	( )	( )		)
QT EPA 413.1, 413.2, 418.1										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608/8080										
QT EPA 515.1/8150										
QT EPA 525										
QT EPA 525 TRAVEL BLANK										
100ml EPA 547										
100ml EPA 531.1										
QT EPA 548										
QT EPA 549										
QT EPA 632										
QT EPA 8015M										
QT QA/QC										
QT AMBER										
8 OZ. JAR										
32 OZ. JAR	A	A	A	A	A	A	A	A	A	
SOIL SLEEVE										
PCB VIAL										
PLASTIC BAG										
FERROUS IRON										
ENCORE										

Comments:_____

Sample Numbering Completed By: OTO Date/Time: 10/4/06 2200

[H:\DOCS\WP80\LAB_DO .WPD]

BC LABORATORIES INC. **SAMPLE RECEIPT FORM** Rev. No. 10 01/21/04 Page __ Of __

Submission #: 06-10354 | Project Code: | TB Batch #

SHIPPING INFORMATION

Federal Express ☐ UPS ☐ Hand Delivery ☐
BC Lab Field Service ☑ Other ☐ (Specify)_____

SHIPPING CONTAINER

Ice Chest ☑ None ☐
Box ☐ Other ☐ (Specify)_____

Refrigerant: Ice ☑ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ | Containers ☐ Intact? Yes ☐ No ☐ | None ☑ Comments:

All samples received? Yes ☑ No ☐ All samples containers intact? Yes ☑ No ☐ Description(s) match COC? Yes ☑ No ☐

COC Received ☑ YES ☐ NO

Ice Chest ID RW Emissivity 0.98 Date/Time 10/4/06
Temperature: 3.0 °C Container 32oz jar
Thermometer ID: #48 Analyst Init OTO

SAMPLE CONTAINERS	SAMPLE NUMBERS 1	2	3	4	5	6	7	8	9	10
QT GENERAL MINERAL/ GENERAL PHYSICAL										
PT PE UNPRESERVED										
QT INORGANIC CHEMICAL METALS										
PT INORGANIC CHEMICAL METALS										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE 802 pe	A	A	A	A	A	A	A	A		
2oz. NITRATE / NITRITE										
100ml TOTAL ORGANIC CARBON										
QT TOX										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
QT EPA 413.1, 413.2, 418.1										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608/8080										
QT EPA 515.1/8150										
QT EPA 525										
QT EPA 525 TRAVEL BLANK										
100ml EPA 547										
100ml EPA 531.1										
QT EPA 548										
QT EPA 549										
QT EPA 632										
QT EPA 8015M										
QT QA/QC										
QT AMBER										
8 OZ. JAR										
32 OZ. JAR										
SOIL SLEEVE										
PCB VIAL										
PLASTIC BAG										
FERROUS IRON										
ENCORE										

Comments:_____
Sample Numbering Completed By: OTO Date/Time: 10/4/06 2200

[H:\DOCS\WP80\LAB_DOCS\FORMS\SAMREC2.WPD]

BC LABORATORIES, INC.

Marine Research Specialists	Project:	Annual Benthis Sediment Sampling for MBTP
3140 Telegraph Road, Suite A	Project Number:	Yearly Benthic Survey
Ventura CA, 93003-3238	Project Manager:	Doug Coats
	Reported:	11/02/06 09:39

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0610354-01	**COC** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 07:05
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station I	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-02	**COC** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 07:18
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 2	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-03	**COC** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 07:29
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 3	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-04	**COC** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 07:40
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 4	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-05	**COC** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 07:51
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 5	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 11/02/06 09:39

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0610354-06	COC Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:04
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 6	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-07	COC Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:16
	Sampling Location:	—	Sample Depth:	---
	Sampling Point:	STATION 7	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-08	COC Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:29
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 8	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0610354-09	COC Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:41
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 9	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0610354-10	COC Number:	33804	Receive Date:	10104106 19:35
	Project Number:	---	Sampling Date:	10104106 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 1	Sample Matrix:	Water
	Sampled By:	---		
0610354-11	COC Number:	33804	Receive Date:	10104106 19:35
	Project Number:	---	Sampling Date:	10104106 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 2	Sample Matrix:	Water
	Sampled By:	---		
0610354-12	COC Number:	33804	Receive Date:	10104106 19:35
	Project Number:	---	Sampling Date:	10104106 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 3	Sample Matrix:	Water
	Sampled By:	---		
0610354-13	COC Number:	33804	Receive Date:	10104106 19:35
	Project Number:	---	Sampling Date:	10104106 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 4	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0610354-14	COC Number:	33804	Receive Date:	10104106 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 5	Sample Matrix:	Water
	Sampled By:	Jerry Mason		

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Marine Research Specialists
3140 Telegraph Road, Suite A
Ventura CA, 93003-3238

Project: Annual Benthis Sediment Sampling for MBTP
Project Number: Yearly Benthic Survey
Project Manager: Doug Coats

Reported: 10127106 11:05

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0610354-15	***COC*** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 6	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0610354-16	***COC*** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 7	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0610354-17	***COC*** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 8	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0610354-18	***COC*** Number:	33804	Receive Date:	10/04/06 19:35
	Project Number:	---	Sampling Date:	10/04/06 08:00
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	STATION 9	Sample Matrix:	Water
	Sampled By:	Jerry Mason		

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APPENDIX E

Infaunal Biology

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APPENDIX E.1

Qualifications of Taxonomists

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ROY K. KROPP
Senior Research Scientist
Pacific Northwest National Laboratory
Battelle Marine Sciences Laboratory
Sequim, Washington

Education

Ph.D.	Zoology, University of Maryland, 1988
M.S.	Biology, University of Guam, 1982
B.S.	Zoology, San Diego State University, 1978

Qualifications

Dr. Kropp is a specialist in benthic marine ecology, toxicology, and the systematics of crustaceans and mollusks with 21 years of experience. He has served as the principal investigator for or participated in marine environmental surveys in the tropical and boreal Pacific, off California, the Gulf of Mexico, along the Atlantic Coast of the United States, and in the Mediterranean. Currently, Dr. Kropp is the Senior Scientist for Benthic Biology for the Massachusetts Water Resources Authority Monitoring Program. Since matriculating to the Marine Sciences Laboratory from Battelle's Duxbury facility, Dr. Kropp has continued benthic ecological studies, recently completing studies of infaunal communities associated with dredged material disposal sites in Rhode Island Sound and Long Island Sound. He was the technical project manager for the preparation of the Final Environmental Impact Statement being prepared for the Providence River dredging project by the U.S. Army Corps of Engineers and is participating as a benthic ecologist on similar EISs for the designation of disposal sites in Rhode Island Sound and Long Island Sound. Dr. Kropp designed and directed a study to examine the effects of increased summer nutrient loads on nearshore seagrass beds in NW Sardinia by examining changes in plant phenology, motile epifaunal communities, and plant epiphyte loads. Dr. Kropp is a recognized authority on crustacean systematics. He was the crustacean taxonomist for the Sardinian study and served as the crustacean and mollusk taxonomist for studies conducted off California and New England. He was the crustacean taxonomist for the Gulf of Thailand and Sea of Okhotsk programs and has extensive experience in the systematics of Indo-Pacific crustaceans. Dr. Kropp is a Research Associate with the Smithsonian Institution and a Research Affiliate of the University of Guam Marine Laboratory. He has authored or coauthored many journal publications and technical reports.

Project Experience

- **Soft-Bottom Monitoring Study conducted for Massachusetts Water Resources Authority (MWRA)**. Senior Scientist responsible for technical oversight of benthic monitoring tasks, including directing data analyses and report preparation for study of the response of the Boston Harbor benthos to the abatement of sludge discharge, and for the eventual diversion of effluent to Massachusetts Bay. Assisted in the design and performance of the rapid assessment technique used in the study. Co-principal Investigator of a study to determine the importance of the new outfall site as a recruitment area for juvenile lobsters.
- **Piscataqua River, New Hampshire 301(h) waiver Water Quality and Benthic Community Study**. Principal investigator for the study performed to fulfill requirements of a 301(h) waiver application. Designed the sampling scheme for the study, analyzed ecological and water-quality data, and prepared the interpretive report.
- **Rhode Island Sound and Long Island Sound Infaunal Community Analyses**. Co-Principal Investigator for two studies of infaunal communities in and near dredged material disposal sites for the U.S. Army Corps of Engineers. Performed benthic data analyses and coauthored the technical reports.
- **Effect of Water-Column Nutrients on Seagrass Epifaunal Communities in NW Sardinia, Italy**. Principle Investigator responsible for study design, staff training, study implementation, data analysis and interpretation, and preparation of interpretive report. Study examining the effects of increased summer nutrient loads (related to increased tourism) on nearshore seagrass beds by examining changes in plant phenology, motile epifaunal communities, and epiphyte loads.
- **Environmental Studies in the Gulf of Thailand, Phase I and II** Biology Task Leader for project that investigated the impacts of drilling activities on the benthos. Performed ecological data analysis, wrote biological characterization chapters of the resulting reports.

Roy K. Kropp (Continued)

Other Experience

Monitoring Studies.

Task Leader for a study to determine the abundance of ocean quahogs (*Arctica islandica*) at proposed dredged material disposal sites in Rhode Island Sound. Designed and directed the study. Analyzed quahog abundance and size-frequency data, and prepared an interpretive report.

Biology Task Leader for the Sediment Survey at the (New York) Mud Dump Site and Environs. Responsible for analysis and interpretation of infaunal data collected during 1994. Prepared sections on the benthic community for the draft final report. Contributed sections on the infaunal community and trophic relationships for the draft SEIS.

Task Leader. Statistical design of field sampling and data analysis, interpretation, and write-up for program involving lead shot remediation at Remington Gun Club site.

Biology Task Leader for Environmental Studies in the Sea of Okhotsk. Analyzed infaunal data collected from proposed drilling platform sites. Prepared an interpretive report on the infaunal communities in the study area.

Biology Task Leader for the Region VI (EPA) contaminated sediment study. Analyzed infaunal data from seven ocean dredged material disposal sites in the Gulf of Mexico. Prepared interpretive reports on the communities at each site and provided recommendations for improving the study design.

Scientist for the New York Bight Rapid Benthic Assessment project that concerned the selection of a new site for the disposal of dredge spoils. Conducted epibenthic trawls and sediment grab sampling. Analyzed trawl catches, fish stomach contents, and infauna collected in sediment grabs.

Assistant Program Manager for California OCS Phase II Monitoring Program (CAMP) that established baseline conditions in the Santa Maria Basin prior to the installation of a drilling platform. Principal Investigator studying the life histories of several key infaunal species. Conducted independent study on the incidence of repaired shell damage to gastropods and scaphopods in the study area.

Beach Replenishment Dredging Studies. Principal Investigator for three USACE sand borrow area studies. Responsible for design and ecological analysis for three projects establishing baseline conditions or investigating the effects of dredging in sand borrow areas at Broadkill Beach in Delaware Bay and off Absecon Inlet and Great Egg Harbor, New Jersey.

***Toxicological Studies*.** Project Manager or Senior Scientist for toxicological testing of sediments from the Providence River, New Haven, and Boston Harbor/Weymouth Fore River. These tests were conducted fro the New England Division, Army Corps of Engineers and involved marine species, including *Americamysis bahia* and *Ampelisca abdita*. Responsibilities included overall test planning and supervision, data analyses, and report preparation.

Project Manager for toxicological testing of sediments from Pistol Pont Bar, CT. These tests were conducted fro the New England Division, Army Corps of Engineers and involved freshwater species including *Hyalella azteca, Chironomus tentans,* and *Lumbriculus variegatus*.

Project Manager for toxicological testing of synthetic-based drilling muds from the Gulf of Mexico. These tests were conducted fro the American Petroleum Institute and involved a marine species, *Leptocheirus plumulosus*.

Environmental Impact Statements. Project Manager for the preparation of the Final Environmental Impact Statement being prepared for the Providence River dredging project by the US Army Corps of Engineers. Coordinator for activities including response to public comments, re-analysis of fish trawl data to evaluate fishery value of potential disposal sites, directed the development of a statistically valid design of study on lobster populations at disposal sites, directing implementation of the study, designed a dredge survey to sample northern quahog populations in the area to be dredged and wrote the interpretive report, monitored project budgets and tracked deliverable preparation. Information will be used to assist the government in deciding the most appropriate disposal alternative.

Artificial Reef Studies. Benthic Infauna/Epifauna Task Leader for 5-year study for U.S. Army Corps of Engineers (USACE) and Environmental Protection Agency (EPA) Delaware Artificial Reef Study that investigated the feasibility of using artificial reef as compensation for shallow- and deep-water habitat loss. Performed ecological

Roy K. Kropp (Continued)

data analysis of epifaunal communities on the reefs and infaunal communities surrounding the reefs, wrote sections of the report. Designed portions of a study to examine the effects of artificial reef units on the infauna.

NOAA Hydrolab Aquanaut and field assistant for study of artificial reef colonization at Salt River Canyon, St. Croix, U.S. Virgin Islands.

Taxonomist. Crustacean taxonomist for benthic studies conducted in NW Sardinia, Italy.

Identified crustaceans and mollusks collected from Boston Harbor, Massachusetts Bay, and Cape Cod Bay for the MWRA Harbor and Outfall Monitoring Program.

Chief taxonomist for the Environmental Studies in the Gulf of Thailand, Phase I and II project. Identified the crustaceans collected during the study. Directed the establishment of a project-specific voucher collection and edited the documentation for the voucher collection.

Identified crustaceans and mollusks collected from off California for the CAMP program and the Morro Bay/Cayucos Sanitation District 301(h) monitoring program.

Specialist on benthic invertebrates for several baseline monitoring studies conducted in the western Pacific (Micronesia).

Professional Affiliations

Biological Society of Washington
Crustacean Society
Estuarine Research Federation
Pacific Science Association

Technical Reports

Kropp RK, Diaz RJ, Dahlen DT, Boyle JD. 2002. *2001 Harbor Benthic Monitoring Report.* MWRA Environmental Quality Department Technical Report Series 2002-19. Prepared for the Massachusetts Water Resources Authority, Boston, Massachusetts.

Kropp R, Diaz R, Hecker B, Dahlen D, Boyle J, Abramson S, Emsbo-Mattingly S. 2002. *2001 Outfall Benthic Monitoring Report.* MWRA Environmental Quality Department Technical Report Series 2002-15. Prepared for the Massachusetts Water Resources Authority, Boston, Massachusetts.

Kohn NP, and RK Kropp. 2002. *Year 5 Post-Remediation Biomonitoring of Pesticides and other Contaminants in Marine Waters near the United Heckathorn Superfund Site, Richmond, California.* Prepared for the U.S. Environmental Protection Agency, Region 9.

Kropp RK, Diaz RJ, Dahlen DT, Boyle JD, Hunt, CD. 2002. *2000 Harbor Benthic Monitoring Report.* MWRA Environmental Quality Department Technical Report Series 2002-02. Prepared for the Massachusetts Water Resources Authority, Boston, Massachusetts.

Kropp R, Diaz R, Hecker B, Dahlen D, Boyle J, Abramson S, Emsbo-Mattingly S. 2002. *2000 Outfall Benthic Monitoring Report.* MWRA Environmental Quality Department Technical Report Series 2001-11. Prepared for the Massachusetts Water Resources Authority, Boston, Massachusetts.

Kohn, NP, and RK Kropp. 2001. *Year 4 Postremediation Biomonitoring of Pesticides and Other Contaminants in Marine Waters Near the United Heckathorn Superfund Site, Richmond, California.* PNNL-13632. Prepared for the U.S. Environmental Protection Agency, Region 9.

Kropp RK, RJ Diaz, D Dahlen, JD Boyle, CD Hunt. 2001. *1999 Harbor Benthic Monitoring Report.* MWRA Environmental Quality Department Technical Report Series 01-03. Prepared for the Massachusetts Water Resources Authority, Boston, Massachusetts.

Williams, G. D., R. M. Thom, J. E. Starkes, J. S. Brennan, J. P. Houghton, D. Woodruff, P. L. Striplin, M. Miller, M. Pedersen, A. Skillman, R. Kropp, A. Borde, C. Freeland, K. McArthur, V. Fagerness, S. Blanton, and L. Blackmore. 2001. *Reconnaissance Assessment of the State of the Nearshore Ecosystem: Eastern Shore of Central Puget Sound, Including Vashon and Maury Islands (WRIAs 8 and 9).* Ed., J. S. Brennan. PNNL-14055. Report prepared for King County Department of Natural Resources, Seattle, Washington. 353 pp. http://dnr.metrokc.gov/wlr/watersheds/puget/nearshore/sonr.htm.

Roy K. Kropp (Continued)

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SUSAN J. WILLIAMS
Marine Biologist

Education

1972 B.S. Marine Biology, California State University, Long Beach
1975 Certificate in Environmental Studies, California State University, Long Beach
1979 M.S. Biology, California State University, Long Beach

Credentials

Instructor, California Community Colleges
Subjects: Biological Sciences, Marine Sciences, Ecology

Qualifications

Sue Williams is a marine biologist with over twenty-five years experience in benthic invertebrate systematics. She is a recognized specialist in the taxonomy of the polychaetous annelids and is also proficient in the systematics of echinoderms. She has an extensive background in infaunal collecting techniques and laboratory methodology. Ms. Williams has identified the infauna from numerous shallow and deepwater benthic programs in California, Alaska, the Eastern U.S. Coast, Antarctica, Japan, and Thailand.

Professional Employment:

1990-present. Interpretive specialist with the Ventura Community Services District. Coastal Ecosystems outreach.

1989-present. Director, Williams Consulting, Ventura, California
Taxonomic consulting for a variety of marine environmental programs around the country.

1993-1994. Interpretive Ranger, National Park Service, Channel Islands National Park

1989-1994. Part-time Instructor; Oxnard College. Topics taught include Principles of Microbiology, Principles of Biology, Environmental Sciences.

1986-1989. Researcher; Battelle Ocean Sciences, Ventura. Laboratory supervisor, technician training, taxonomist, task leader for monitoring program, safety officer.

1984-1986. Research Scientist; Harbors Environmental Project, University of Southern California. Assessment of the marine environment of Marina Del Rey, monitoring the disposal of cannery waste.

1980-1986. Assistant Curator; Allan Hancock Foundation, University of Southern California. Responsible for maintaining museum collection of marine animals, processing loans, training student assistants, conducting independent research.

1979-1981. Research Associate; Applied Ecology Program, Institute for Marine and Coastal Studies.
Investigated impacts of storms on sandy beaches, monitored benthic impacts of electrical generating station, supervised laboratory, trained technicians.

1975-1978. Associate Marine Scientist: Department of Biological Sciences, University of Southern California. As part of the Outer Continental Shelf Program. collected and analyzed benthic samples prior to offshore oil exploration.

1973-1975. Teaching Assistant; Biology Department, California State University, Long Beach. Laboratory Instructor in general biology, general zoology, invertebrate zoology, human anatomy.

1973-1974. Consultant; Harbors Environmental Project, University of Southern California. Benthic ecology of Los Angeles-Long Beach Harbors.

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1972 -1973. Marine Technician; Marine Biological Consultants, Costa Mesa, CA.
Identified benthic invertebrates and zooplankton from several surveys assessing thermal effects of electrical generating stations.

1970 -1973. Laboratory Assistant; St. Joseph Hospital, Orange, CA. Preparation of samples in bacteriology, hematology, and chemistry.

Professional Associations

Biological Society of Washington
Sea of Cortez Institute for Biological Research
Southern California Academy of Sciences
Southern California Association of Marine Invertebrate Taxonomists - Charter Member
Western Society of Naturalists

Publications and Technical Reports

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APPENDIX E.2

Infaunal Indices

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INFAUNAL INDICES

E.1 SPECIES DIVERSITY

The Shannon diversity index (*H'*) (Shannon and Weaver 1949) is the most common diversity index used in 301(h) programs. It measures the relative distribution of individual organisms among the species present in the sample. *H'* increases for broader distributions of individuals among species. If all individuals are of one species then *H'* is 0.00. If each individual organism is a separate species then *H'* is determined by the logarithm of the total number of organisms collected. For other distributions, the diversity index is given by: $H' = -\sum_{j=1}^{S}\left[\left(\frac{n_j}{N}\right)\ln\left(\frac{n_j}{N}\right)\right]$; where: S = total number of species, n_j = number of individuals in the jth species, N = total number of individuals, and ln = natural logarithm (base e). The value of the Shannon index usually falls between 1.5 and 3.5 and only rarely surpasses 4.5 (Margalef 1972).

Some studies have found a decrease in this index in response to pollutant stress in benthic communities. However, this index is ambiguous because it depends on how evenly the organisms are distributed among the species. Consequently, a statistically significant reduction in this index can occur in the absence of anthropogenic (human-induced) stresses.

When randomness in the sample cannot be guaranteed, then the Brillouin index (*h*) is a more appropriate measure of diversity (Pielou 1977). It is calculated using the formula: $h = \frac{\ln(N!) - \sum_{j=1}^{S}\left[\ln(n_j!)\right]}{N}$. It gives a similar measure of diversity although it produces a slightly lower value than the Shannon index when applied to the same data. In contrast to the Shannon index, the Brillouin will vary between samples although the number of species and their proportional abundance remain the same. Because of its dependence on sample size and the increased complexity of its computation, the Brillouin index is more rarely used than the Shannon index.

E.1.1 Evenness

The Pielou evenness index (*J'*) (Pielou 1977) measures how evenly the individual organisms are distributed among the species present in the sample. *J'* increases for more even distributions of individuals among species. If all individuals belong to a single species, then *J'* is indeterminate. If each species is represented by a single organism, then *J'* will be equal to 1.00. For other distributions, the evenness index is given by: $J' = \frac{H'}{\ln S}$; where: S = total number of species, and H' = Shannon-Wiener diversity index. Because this index is derived from the Shannon-Wiener diversity index (*H'*), it is subject to the same limitations.

E.1.2 Species Dominance

Dominance indices increase with decreasing diversity and are heavily weighted toward the most common species in a sample. The best known of these measures is Simpson's index (*C'*) (Simpson 1949; Wittaker

1965). It is related to other diversity and evenness indices but increases with increasing proportions of individuals associated with a few species. If all individuals are of one species, then *C'* is maximum and equal to the maximum dominance of 1.00. If individual organisms are evenly distributed among species (*J'*=1.00), then *C'* asymptotically approaches 0.00 with increasing numbers of individuals. The Simpson dominance measure is given by: $C' = \sum_{j=1}^{S}\left(\frac{n_j}{N}\right)^2$ but for finite communities, the unbiased form is: $C' = \sum_{j=1}^{S}\left(\frac{n_j(n_j-1)}{N(N-1)}\right)$ (Magurran 1988).

An unrelated measure of dominance has been ascribed to Swartz et al. (1985). The Swartz dominance index (*Sw*) is defined as the minimum number of species that account for 75% of all individual organisms collected in a sample. In this dominance measure, species are first ranked by the number of individual organisms before establishing the cumulative percent equal to or exceeding 75%. This is an inverse measure because higher dominance is reflected in a lower number of species accounting for 75% of the individual organisms. Despite this, it is not subject to many of the limitations that plague the other univariate indices. It is a non-parametric measure that does not assume an underlying distribution of individuals among species.

E.1.3 Infaunal Trophic Index

The Infaunal Trophic Index (*ITI)* (Word 1978) compares the abundance of four soft-bottom benthic assemblages distinguished by feeding behavior. Because the sensitivity or tolerance to organic enrichment in particulate matter differs among the four groups, shifts in group dominance, as reflected in a changing infaunal index, can be indicative of changed or degraded environmental conditions. The *ITI* ranges between 0 and 100. When species in Group I (suspension feeders) and Group II (surface-detritus feeders) dominate, index values are above 58 and sediments are relatively clean. Lower infaunal indices occur when species in Group III (surface deposit feeders) and Group IV (sub-surface detritus feeders) dominate and sediments are high in organics. The *ITI* is computed from: $ITI = 100 - 33.3\left[\frac{G_2 + 2G_3 + 3G_4}{G_1 + G_2 + G_3 + G_4}\right]$; where:

G_i = number of individual organisms within the i^{th} trophic group.

E.1.4 Species Richness

The Margalef species richness index (*d*) (Margalef 1951) measures the number of species in a sample relative to the number of individual organisms. *d* strongly increases for increasing number of species and increases only logarithmically for decreasing number of individuals. If only one species is present then *d* is 0.00. For other distributions, the richness index is given by: $d = \frac{S-1}{\ln N}$. Its applicability to biological communities is dependent on whether specimens are log-normally distributed among the species in a given sample. Such an assumption is not globally applicable to benthic marine communities, and without testing each data set, the richness index is of questionable value.

Table E.1 Species Abundance Totaled among Replicate Samples Collected at Benthic Stations in October 2006

Taxonomic Group	Taxon	Station 1	2	3	4	5	6	7	8	9	Station Total	Percent of Total	Cumulative %
Bivalvia	*Tellina bodegensis*	9	29	56	49	39	37	32	37	61	349	9.99	9.99
Echinodermata	*Dendraster excentricus*	13	65	21	13	2	53	52	46	32	297	8.50	18.49
Crustacea	*Rhepoxynius abronius*	42	20	15	29	35	32	40	46	18	277	7.93	26.42
Nemertea	*Carinoma mutabilis*	53	35	22	21	8	31	35	33	17	255	7.30	33.72
Crustacea	*Eohaustorius sencillus*	7	21	10	41	23	21	30	32	25	210	6.01	39.74
Annelida	*Scoloplos armiger*	34	21	11	20	24	23	29	12	32	206	5.90	45.63
Annelida	*Chaetozone setosa*	11	18	8	24	31	13	22	20	37	184	5.27	50.90
Crustacea	*Rhepoxynius menziesi*	3	10	10	34	20	11	16	17	43	164	4.70	55.60
Crustacea	*Majoxiphalus major*	2	7	16	15	29	19	18	7	40	153	4.38	59.98
Crustacea	*Tecticeps convexus*	5	21	12	4	13	1	7	7	32	102	2.92	62.90
Annelida	*Apoprionospio pygmaea*	5	5	13	18	11	10	18	5	16	101	2.89	65.79
Annelida	*Magelona sacculata*	8	12	9	7	4	14	18	9	20	101	2.89	68.68
Crustacea	*Pacifoculodes spinipes*	16	14	11	10	10	5	8	12	15	101	2.89	71.57
Annelida	*Nephtys caecoides*	11	5	13	15	14	10	8	8	13	97	2.78	74.35
Annelida	*Glycinde armigera*	8	5	7	13	8	11	12	15	7	86	2.46	76.81
Crustacea	*Photis macinerneyi*	6	15	21	3	12	5	4	5	10	81	2.32	79.13
Bivalvia	*Tellina modesta*	15	3	9	6	2	8	6	7	4	60	1.72	80.85
Annelida	*Lumbrineris californiensis*	2	6	3	6	6	12	7	11	5	58	1.66	82.51
Annelida	*Glycera convoluta*	11	7	4	3	2	9	3	6	6	51	1.46	83.97
Crustacea	*Americhilidium shoemakeri*	5	11	4	3	8	4	2	2	11	50	1.43	85.40
Nemertea	*Cerebratulus californiensis*	1	3	5	3	6	3	7	5	5	38	1.09	86.49
Annelida	*Onuphis iridescens*	8	7	5	1	1	8	2	2	2	36	1.03	87.52
Bivalvia	*Siliqua lucida*	5	3	1	1	–	5	4	8	5	32	0.92	88.43
Crustacea	*Anchicolurus occidentalis*	2	–	4	2	11	5	2	–	4	30	0.86	89.29
Annelida	*Spiophanes missionensis*	2	4	1	2	2	6	2	6	1	26	0.74	90.04
Annelida	*Ampharete labrops*	6	–	2	3	4	2	2	4	1	24	0.69	90.72
Bivalvia	*Chione*	–	1	2	1	–	5	5	5	2	21	0.60	91.33
Annelida	*Sigalion spinosa*	2	2	1	2	3	1	2	6	1	20	0.57	91.90
Crustacea	*Foxiphalus xiximeus*	1	1	3	7	4	1	1	–	–	18	0.52	92.41
Echinodermata	*Amphiodia*	1	1	8	1	4	–	1	1	1	18	0.52	92.93
Crustacea	*Mesolamprops dillonensis*	3	2	–	–	3	1	1	2	–	12	0.34	93.27
Mollusca	*Turbonilla*	–	2	–	–	1	1	3	4	1	12	0.34	93.62
Bivalvia	*Nuculana*	–	1	–	2	–	3	1	2	2	11	0.31	93.93
Crustacea	*Photis brevipes*	1	2	–	–	–	1	4	1	1	10	0.29	94.22
Nemertea	*Tubulanus*	1	–	–	–	–	–	1	7	1	10	0.29	94.50
Annelida	*Sthenelais verruculosa*	1	2	–	3	1	1	1	–	–	9	0.26	94.76
Nemertea	*Paranemertes sp. A*	1	–	–	–	–	2	1	2	3	9	0.26	95.02
Crustacea	*Bathycopea daltonae*	–	–	3	2	1	1	2	–	–	9	0.26	95.28
Annelida	*Armandia bioculata*	3	–	1	1	1	1	1	–	–	8	0.23	95.51
Annelida	*Phyllodoce*	2	1	1	1	1	–	–	1	–	7	0.20	95.71
Bivalvia	*Cooperella subdiaphana*	2	–	–	2	–	1	1	1	–	7	0.20	95.91
Mollusca	*Nassarius fossatus*	–	1	3	2	1	–	–	–	–	7	0.20	96.11
Crustacea	*Tiron tropakis*	1	–	–	–	2	–	3	–	–	6	0.17	96.28
Annelida	*Podarkeopsis glabra*	4	–	–	–	1	–	1	–	–	6	0.17	96.45
Annelida	*Pectinaria californiensis*	–	1	1	1	1	–	–	1	1	6	0.17	96.62

Table E.1 Species Abundance Totaled among Replicate Samples Collected at Benthic Stations in October 2006

Taxonomic Group	Taxon	Station 1	2	3	4	5	6	7	8	9	Station Total	Percent of Total	Cumulative %
Echinodermata	*Leptosynapta*	–	2	–	2	1	1	–	–	–	6	0.17	96.79
Crustacea	*Cancer*	1	1	1	–	1	–	1	–	–	5	0.14	96.94
Bivalvia	*Pandora bilirata*	1	1	–	1	–	–	–	2	–	5	0.14	97.08
Crustacea	*Diastylopsis tenuis*	2	–	1	–	1	–	1	–	–	5	0.14	97.22
Crustacea	*Gibberosus myersi*	2	–	–	–	1	–	–	–	2	5	0.14	97.37
Crustacea	*Synidotea bicuspida*	–	–	–	2	3	–	–	–	–	5	0.14	97.51
Annelida	*Spiophanes bombyx*	–	–	–	–	–	2	1	2	–	5	0.14	97.65
Annelida	*Magelona hartmanae*	2	–	1	1	–	–	–	–	–	4	0.11	97.77
Annelida	*Typosyllis farallonensis*	3	–	–	–	–	1	–	–	–	4	0.11	97.88
Crustacea	*Leuroleberis sharpei*	1	–	–	1	1	–	–	–	–	3	0.09	97.97
Crustacea	*Aoroides inermis*	1	–	–	–	2	–	–	–	–	3	0.09	98.05
Phoronida	*Phoronis*	1	–	–	–	–	–	2	–	–	3	0.09	98.14
Echinodermata	*Amphiodia digitata*	1	–	–	–	–	–	–	2	–	3	0.09	98.23
Nemertea	Lineidae	–	1	–	–	–	1	–	1	–	3	0.09	98.31
Annelida	*Polycirrus californicus*	–	1	–	–	–	–	1	1	–	3	0.09	98.40
Bivalvia	*Rochefortia tumida*	–	–	1	–	–	–	–	2	–	3	0.09	98.48
Annelida	*Eteone*	–	–	–	–	–	–	2	1	–	3	0.09	98.57
Annelida	*Axiothella rubrocincta*	1	–	–	–	–	–	1	–	–	2	0.06	98.63
Crustacea	Isaeidae	2	–	–	–	–	–	–	–	–	2	0.06	98.68
Annelida	*Phyllodoce multipapillata*	–	1	–	–	–	–	1	–	–	2	0.06	98.74
Annelida	*Scalibregma californicum*	–	1	–	–	–	–	–	1	–	2	0.06	98.80
Crustacea	*Isocheles pilosus*	–	1	–	–	–	–	–	–	1	2	0.06	98.85
Annelida	*Chone mollis*	–	–	1	1	–	–	–	–	–	2	0.06	98.91
Crustacea	*Listriella goleta*	–	–	–	–	1	1	–	–	–	2	0.06	98.97
Echinodermata	Molpadiidae	–	–	–	–	1	–	1	–	–	2	0.06	99.03
Annelida	*Platynereis bicanaliculata*	–	–	–	–	2	–	–	–	–	2	0.06	99.08
Nemertea	Anopla	–	–	–	–	2	–	–	–	–	2	0.06	99.14
Bivalvia	*Macoma acolasta*	–	–	–	–	–	–	1	1	–	2	0.06	99.20
Mollusca	*Cadulus tolmiei*	1	–	–	–	–	–	–	–	–	1	0.03	99.23
Crustacea	*Lepidepecreum sp. A*	1	–	–	–	–	–	–	–	–	1	0.03	99.26
Annelida	*Mediomastus*	1	–	–	–	–	–	–	–	–	1	0.03	99.28
Annelida	*Paraprionospio pinnata*	1	–	–	–	–	–	–	–	–	1	0.03	99.31
Annelida	*Poecilochaetus johnsoni*	1	–	–	–	–	–	–	–	–	1	0.03	99.34
Hemichordata	Hemichordata	–	1	–	–	–	–	–	–	–	1	0.03	99.37
Annelida	*Scolelepis*	–	1	–	–	–	–	–	–	–	1	0.03	99.40
Crustacea	*Mandibulophoxus gilesi*	–	–	1	–	–	–	–	–	–	1	0.03	99.43
Crustacea	Amphipoda	–	–	1	–	–	–	–	–	–	1	0.03	99.46
Mollusca	*Olivella pedroana*	–	–	1	–	–	–	–	–	–	1	0.03	99.48
Bivalvia	Pectinidae	–	–	1	–	–	–	–	–	–	1	0.03	99.51
Crustacea	*Pinnixa franciscana*	–	–	1	–	–	–	–	–	–	1	0.03	99.54
Annelida	*Travisia gigas*	–	–	–	1	–	–	–	–	–	1	0.03	99.57
Cnidaria	Actiniaria	–	–	–	–	1	–	–	–	–	1	0.03	99.60
Crustacea	*Ericthonius brasiliensis*	–	–	–	–	1	–	–	–	–	1	0.03	99.63
Crustacea	*Callianassa*	–	–	–	–	1	–	–	–	–	1	0.03	99.66
Bivalvia	*Nuculana pernula*	–	–	–	–	1	–	–	–	–	1	0.03	99.69

Table E.1 Species Abundance Totaled among Replicate Samples Collected at Benthic Stations in October 2006

Taxonomic Group	Taxon	Station 1	2	3	4	5	6	7	8	9	Station Total	Percent of Total	Cumulative %
Annelida	*Eteone fauchaldi*	–	–	–	–	1	–	–	–	–	1	0.03	99.71
Cnidaria	*Urticina coriacea*	–	–	–	–	1	–	–	–	–	1	0.03	99.74
Bivalvia	*Solen sicarius*	–	–	–	–	–	1	–	–	–	1	0.03	99.77
Crustacea	*Cancer gracilis*	–	–	–	–	–	1	–	–	–	1	0.03	99.80
Echinodermata	*Astropecten verrilli*	–	–	–	–	–	1	–	–	–	1	0.03	99.83
Annelida	Nereidae	–	–	–	–	–	–	1	–	–	1	0.03	99.86
Annelida	*Polydora*	–	–	–	–	–	–	–	1	–	1	0.03	99.89
Annelida	Spionidae	–	–	–	–	–	–	–	1	–	1	0.03	99.91
Crustacea	*Edotia sublittoralis*	–	–	–	–	–	–	–	–	1	1	0.03	99.94
Bivalvia	*Pandora punctata*	–	–	–	–	–	–	–	–	1	1	0.03	99.97
Mollusca	*Nassarius perpinguis*	–	–	–	–	–	–	–	–	1	1	0.03	100.00
Total Number of Individuals		**336**	**375**	**326**	**380**	**371**	**386**	**428**	**410**	**481**	**3493**		

Table E.2 Species Abundance within Replicate Samples Collected at Benthic Station 1 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Nemertea	*Carinoma mutabilis*	4	15	11	14	9	53	15.77	15.77
Crustacea	*Rhepoxynius abronius*	12	9	9	7	5	42	12.50	28.27
Annelida	*Scoloplos armiger*	4	4	7	8	11	34	10.12	38.39
Crustacea	*Pacifoculodes spinipes*	6	–	4	4	2	16	4.76	43.15
Bivalvia	*Tellina modesta*	1	1	6	5	2	15	4.46	47.62
Echinodermata	*Dendraster excentricus*	3	3	1	4	2	13	3.87	51.49
Annelida	*Glycera convoluta*	1	3	1	1	5	11	3.27	54.76
Annelida	*Nephtys caecoides*	2	4	2	2	1	11	3.27	58.04
Annelida	*Chaetozone setosa*	3	2	–	3	3	11	3.27	61.31
Bivalvia	*Tellina bodegensis*	3	2	1	3	–	9	2.68	63.99
Annelida	*Glycinde armigera*	1	2	1	4	–	8	2.38	66.37
Annelida	*Onuphis iridescens*	4	2	1	1	–	8	2.38	68.75
Annelida	*Magelona sacculata*	–	3	–	4	1	8	2.38	71.13
Crustacea	*Eohaustorius sencillus*	2	–	–	4	1	7	2.08	73.21
Crustacea	*Photis macinerneyi*	2	1	2	1	–	6	1.79	75.00
Annelida	*Ampharete labrops*	4	1	1	–	–	6	1.79	76.79
Crustacea	*Americhilidium shoemakeri*	1	–	–	1	3	5	1.49	78.27
Crustacea	*Tecticeps convexus*	2	–	–	3	–	5	1.49	79.76
Annelida	*Apoprionospio pygmaea*	–	1	1	1	2	5	1.49	81.25
Bivalvia	*Siliqua lucida*	–	1	3	–	1	5	1.49	82.74

Table E.2 Species Abundance within Replicate Samples Collected at Benthic Station 1 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Podarkeopsis glabra*	1	1	1	1	–	4	1.19	83.93
Crustacea	*Rhepoxynius menziesi*	1	–	1	1	–	3	0.89	84.82
Crustacea	*Mesolamprops dillonensis*	–	1	2	–	–	3	0.89	85.71
Annelida	*Typosyllis farallonensis*	–	1	–	1	1	3	0.89	86.61
Annelida	*Armandia bioculata*	–	1	–	–	2	3	0.89	87.50
Crustacea	*Anchicolurus occidentalis*	1	1	–	–	–	2	0.60	88.10
Crustacea	Isaeidae	1	1	–	–	–	2	0.60	88.69
Annelida	*Phyllodoce*	1	–	–	1	–	2	0.60	89.29
Crustacea	*Diastylopsis tenuis*	1	–	–	1	–	2	0.60	89.88
Crustacea	*Gibberosus myersi*	2	–	–	–	–	2	0.60	90.48
Bivalvia	*Cooperella subdiaphana*	–	1	1	–	–	2	0.60	91.07
Annelida	*Lumbrineris californiensis*	–	1	–	–	1	2	0.60	91.67
Annelida	*Magelona hartmanae*	–	2	–	–	–	2	0.60	92.26
Annelida	*Sigalion spinosa*	–	–	–	1	1	2	0.60	92.86
Crustacea	*Majoxiphalus major*	–	–	–	1	1	2	0.60	93.45
Annelida	*Spiophanes missionensis*	–	–	–	2	–	2	0.60	94.05
Crustacea	*Photis brevipes*	1	–	–	–	–	1	0.30	94.35
Crustacea	*Aoroides inermis*	1	–	–	–	–	1	0.30	94.64
Crustacea	*Cancer*	1	–	–	–	–	1	0.30	94.94
Crustacea	*Tiron tropakis*	1	–	–	–	–	1	0.30	95.24
Phoronida	*Phoronis*	–	1	–	–	–	1	0.30	95.54
Nemertea	*Paranemertes sp. A*	–	1	–	–	–	1	0.30	95.83
Echinodermata	*Amphiodia digitata*	–	1	–	–	–	1	0.30	96.13
Crustacea	*Lepidepecreum sp. A*	–	1	–	–	–	1	0.30	96.43
Annelida	*Mediomastus*	–	1	–	–	–	1	0.30	96.73
Annelida	*Paraprionospio pinnata*	–	1	–	–	–	1	0.30	97.02
Crustacea	*Foxiphalus xiximeus*	–	–	1	–	–	1	0.30	97.32
Annelida	*Sthenelais verruculosa*	–	–	1	–	–	1	0.30	97.62
Mollusca	*Cadulus tolmiei*	–	–	1	–	–	1	0.30	97.92
Annelida	*Axiothella rubrocincta*	–	–	1	–	–	1	0.30	98.21
Bivalvia	*Pandora bilirata*	–	–	–	1	–	1	0.30	98.51
Echinodermata	*Amphiodia*	–	–	–	1	–	1	0.30	98.81
Nemertea	*Tubulanus*	–	–	–	1	–	1	0.30	99.11
Crustacea	*Leuroleberis sharpei*	–	–	–	1	–	1	0.30	99.40
Nemertea	*Cerebratulus californiensis*	–	–	–	–	1	1	0.30	99.70
Annelida	*Poecilochaetus johnsoni*	–	–	–	–	1	1	0.30	100.00
Total Number of Individuals		**67**	**70**	**60**	**83**	**56**	**336**		

Table E.3 Species Abundance within Replicate Samples Collected at Benthic Station 2 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Echinodermata	*Dendraster excentricus*	22	20	9	5	9	65	17.33	17.33
Nemertea	*Carinoma mutabilis*	19	3	2	5	6	35	9.33	26.67
Bivalvia	*Tellina bodegensis*	10	5	4	4	6	29	7.73	34.40
Crustacea	*Eohaustorius sencillus*	5	2	5	6	3	21	5.60	40.00
Crustacea	*Tecticeps convexus*	6	3	9	1	2	21	5.60	45.60
Annelida	*Scoloplos armiger*	6	5	–	2	8	21	5.60	51.20
Crustacea	*Rhepoxynius abronius*	6	3	4	4	3	20	5.33	56.53
Annelida	*Chaetozone setosa*	8	4	–	4	2	18	4.80	61.33
Crustacea	*Photis macinerneyi*	5	4	–	–	6	15	4.00	65.33
Crustacea	*Pacifoculodes spinipes*	2	3	5	–	4	14	3.73	69.07
Annelida	*Magelona sacculata*	2	2	4	3	1	12	3.20	72.27
Crustacea	*Americhilidium shoemakeri*	1	4	3	–	3	11	2.93	75.20
Crustacea	*Rhepoxynius menziesi*	2	2	2	3	1	10	2.67	77.87
Annelida	*Onuphis iridescens*	1	1	4	1	–	7	1.87	79.73
Annelida	*Glycera convoluta*	1	3	1	2	–	7	1.87	81.60
Crustacea	*Majoxiphalus major*	–	5	1	–	1	7	1.87	83.47
Annelida	*Lumbrineris californiensis*	–	–	1	3	2	6	1.60	85.07
Annelida	*Glycinde armigera*	2	3	–	–	–	5	1.33	86.40
Annelida	*Apoprionospio pygmaea*	–	3	1	1	–	5	1.33	87.73
Annelida	*Nephtys caecoides*	–	–	2	1	2	5	1.33	89.07
Annelida	*Spiophanes missionensis*	–	–	1	2	1	4	1.07	90.13
Bivalvia	*Siliqua lucida*	2	1	–	–	–	3	0.80	90.93
Nemertea	*Cerebratulus californiensis*	–	–	1	–	2	3	0.80	91.73
Bivalvia	*Tellina modesta*	–	–	2	–	1	3	0.80	92.53
Crustacea	*Mesolamprops dillonensis*	2	–	–	–	–	2	0.53	93.07
Annelida	*Sthenelais verruculosa*	–	1	–	1	–	2	0.53	93.60
Mollusca	*Turbonilla*	–	1	–	–	1	2	0.53	94.13
Crustacea	*Photis brevipes*	–	2	–	–	–	2	0.53	94.67
Echinodermata	*Leptosynapta*	–	2	–	–	–	2	0.53	95.20
Annelida	*Sigalion spinosa*	–	–	–	2	–	2	0.53	95.73
Annelida	*Pectinaria californiensis*	1	–	–	–	–	1	0.27	96.00
Crustacea	*Foxiphalus xiximeus*	1	–	–	–	–	1	0.27	96.27
Annelida	*Phyllodoce*	–	1	–	–	–	1	0.27	96.53
Crustacea	*Cancer*	–	1	–	–	–	1	0.27	96.80
Crustacea	*Isocheles pilosus*	–	1	–	–	–	1	0.27	97.07
Nemertea	Lineidae	–	1	–	–	–	1	0.27	97.33
Echinodermata	*Amphiodia*	–	–	1	–	–	1	0.27	97.60
Bivalvia	*Chione*	–	–	1	–	–	1	0.27	97.87
Mollusca	*Nassarius fossatus*	–	–	1	–	–	1	0.27	98.13
Annelida	*Phyllodoce multipapillata*	–	–	1	–	–	1	0.27	98.40

Table E.3 Species Abundance within Replicate Samples Collected at Benthic Station 2 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Scolelepis*	–	–	–	1	–	1	0.27	98.67
Bivalvia	*Pandora bilirata*	–	–	–	–	1	1	0.27	98.93
Bivalvia	*Nuculana*	–	–	–	–	1	1	0.27	99.20
Annelida	*Scalibregma californicum*	–	–	–	–	1	1	0.27	99.47
Hemichordata	Hemichordata	–	–	–	–	1	1	0.27	99.73
Annelida	*Polycirrus californicus*	–	–	–	–	1	1	0.27	100.00
Total Number of Individuals		**104**	**86**	**65**	**51**	**69**	**375**		

Table E.4 Species Abundance within Replicate Samples Collected at Benthic Station 3 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Bivalvia	*Tellina bodegensis*	13	14	8	9	12	56	17.18	17.18
Nemertea	*Carinoma mutabilis*	7	5	4	5	1	22	6.75	23.93
Crustacea	*Photis macinerneyi*	2	15	–	–	4	21	6.44	30.37
Echinodermata	*Dendraster excentricus*	3	11	6	1	–	21	6.44	36.81
Crustacea	*Majoxiphalus major*	2	2	2	4	6	16	4.91	41.72
Crustacea	*Rhepoxynius abronius*	5	4	2	1	3	15	4.60	46.32
Annelida	*Apoprionospio pygmaea*	1	3	1	7	1	13	3.99	50.31
Annelida	*Nephtys caecoides*	2	3	2	5	1	13	3.99	54.29
Crustacea	*Tecticeps convexus*	1	2	2	2	5	12	3.68	57.98
Annelida	*Scoloplos armiger*	–	1	4	2	4	11	3.37	61.35
Crustacea	*Pacifoculodes spinipes*	–	5	3	2	1	11	3.37	64.72
Crustacea	*Rhepoxynius menziesi*	1	3	2	4	–	10	3.07	67.79
Crustacea	*Eohaustorius sencillus*	–	1	–	4	5	10	3.07	70.86
Bivalvia	*Tellina modesta*	1	3	–	2	3	9	2.76	73.62
Annelida	*Magelona sacculata*	2	–	3	4	–	9	2.76	76.38
Echinodermata	*Amphiodia*	1	4	1	1	1	8	2.45	78.83
Annelida	*Chaetozone setosa*	–	1	3	2	2	8	2.45	81.29
Annelida	*Glycinde armigera*	–	2	–	4	1	7	2.15	83.44
Nemertea	*Cerebratulus californiensis*	2	1	2	–	–	5	1.53	84.97
Annelida	*Onuphis iridescens*	4	–	–	–	1	5	1.53	86.50
Annelida	*Glycera convoluta*	2	–	1	1	–	4	1.23	87.73
Crustacea	*Americhilidium shoemakeri*	–	1	1	–	2	4	1.23	88.96
Crustacea	*Anchicolurus occidentalis*	–	1	–	2	1	4	1.23	90.18
Crustacea	*Bathycopea daltonae*	1	1	1	–	–	3	0.92	91.10
Mollusca	*Nassarius fossatus*	1	1	–	–	1	3	0.92	92.02

Table E.4 Species Abundance within Replicate Samples Collected at Benthic Station 3 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Lumbrineris californiensis*	–	1	–	–	2	3	0.92	92.94
Crustacea	*Foxiphalus xiximeus*	–	3	–	–	–	3	0.92	93.87
Annelida	*Ampharete labrops*	–	1	–	–	1	2	0.61	94.48
Bivalvia	*Chione*	–	–	–	–	2	2	0.61	95.09
Annelida	*Spiophanes missionensis*	1	–	–	–	–	1	0.31	95.40
Crustacea	Amphipoda	1	–	–	–	–	1	0.31	95.71
Crustacea	*Cancer*	1	–	–	–	–	1	0.31	96.01
Crustacea	*Diastylopsis tenuis*	1	–	–	–	–	1	0.31	96.32
Bivalvia	Pectinidae	1	–	–	–	–	1	0.31	96.63
Annelida	*Phyllodoce*	–	1	–	–	–	1	0.31	96.93
Annelida	*Armandia bioculata*	–	1	–	–	–	1	0.31	97.24
Mollusca	*Olivella pedroana*	–	1	–	–	–	1	0.31	97.55
Annelida	*Magelona hartmanae*	–	1	–	–	–	1	0.31	97.85
Annelida	*Sigalion spinosa*	–	–	1	–	–	1	0.31	98.16
Bivalvia	*Siliqua lucida*	–	–	–	1	–	1	0.31	98.47
Annelida	*Chone mollis*	–	–	–	1	–	1	0.31	98.77
Bivalvia	*Rochefortia tumida*	–	–	–	1	–	1	0.31	99.08
Annelida	*Pectinaria californiensis*	–	–	–	–	1	1	0.31	99.39
Crustacea	*Mandibulophoxus gilesi*	–	–	–	–	1	1	0.31	99.69
Crustacea	*Pinnixa franciscana*	–	–	–	–	1	1	0.31	100.00
Total Number of Individuals		**56**	**93**	**49**	**65**	**63**	**326**		

Table E.5 Species Abundance within Replicate Samples Collected at Benthic Station 4 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Bivalvia	*Tellina bodegensis*	7	7	12	13	10	49	12.89	12.89
Crustacea	*Eohaustorius sencillus*	12	8	2	9	10	41	10.79	23.68
Crustacea	*Rhepoxynius menziesi*	12	12	4	4	2	34	8.95	32.63
Crustacea	*Rhepoxynius abronius*	4	4	3	12	6	29	7.63	40.26
Annelida	*Chaetozone setosa*	5	4	7	5	3	24	6.32	46.58
Nemertea	*Carinoma mutabilis*	4	8	3	4	2	21	5.53	52.11
Annelida	*Scoloplos armiger*	7	5	3	2	3	20	5.26	57.37
Annelida	*Apoprionospio pygmaea*	5	6	2	3	2	18	4.74	62.11
Crustacea	*Majoxiphalus major*	3	4	3	3	2	15	3.95	66.05
Annelida	*Nephtys caecoides*	3	4	4	2	2	15	3.95	70.00

Table E.5 Species Abundance within Replicate Samples Collected at Benthic Station 4 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Echinodermata	*Dendraster excentricus*	2	1	6	–	4	13	3.42	73.42
Annelida	*Glycinde armigera*	6	2	2	3	–	13	3.42	76.84
Crustacea	*Pacifoculodes spinipes*	3	4	–	3	–	10	2.63	79.47
Annelida	*Magelona sacculata*	2	2	–	1	2	7	1.84	81.32
Crustacea	*Foxiphalus xiximeus*	2	–	–	3	2	7	1.84	83.16
Bivalvia	*Tellina modesta*	1	2	1	2	–	6	1.58	84.74
Annelida	*Lumbrineris californiensis*	1	–	2	2	1	6	1.58	86.32
Crustacea	*Tecticeps convexus*	1	1	–	1	1	4	1.05	87.37
Nemertea	*Cerebratulus californiensis*	1	–	1	–	1	3	0.79	88.16
Crustacea	*Americhilidium shoemakeri*	2	–	1	–	–	3	0.79	88.95
Annelida	*Glycera convoluta*	–	1	1	1	–	3	0.79	89.74
Annelida	*Sthenelais verruculosa*	–	1	1	–	1	3	0.79	90.53
Crustacea	*Photis macinerneyi*	–	1	–	1	1	3	0.79	91.32
Annelida	*Ampharete labrops*	–	–	–	1	2	3	0.79	92.11
Crustacea	*Bathycopea daltonae*	1	–	1	–	–	2	0.53	92.63
Bivalvia	*Nuculana*	–	1	–	1	–	2	0.53	93.16
Crustacea	*Anchicolurus occidentalis*	–	1	–	1	–	2	0.53	93.68
Mollusca	*Nassarius fossatus*	–	2	–	–	–	2	0.53	94.21
Annelida	*Sigalion spinosa*	–	–	1	1	–	2	0.53	94.74
Crustacea	*Synidotea bicuspida*	–	–	1	1	–	2	0.53	95.26
Echinodermata	*Leptosynapta*	–	–	1	–	1	2	0.53	95.79
Bivalvia	*Cooperella subdiaphana*	–	–	–	2	–	2	0.53	96.32
Annelida	*Spiophanes missionensis*	–	–	–	–	2	2	0.53	96.84
Annelida	*Chone mollis*	1	–	–	–	–	1	0.26	97.11
Annelida	*Phyllodoce*	–	–	1	–	–	1	0.26	97.37
Bivalvia	*Pandora bilirata*	–	–	–	1	–	1	0.26	97.63
Echinodermata	*Amphiodia*	–	–	–	1	–	1	0.26	97.89
Bivalvia	*Chione*	–	–	–	1	–	1	0.26	98.16
Crustacea	*Leuroleberis sharpei*	–	–	–	1	–	1	0.26	98.42
Annelida	*Onuphis iridescens*	–	–	–	1	–	1	0.26	98.68
Annelida	*Magelona hartmanae*	–	–	–	1	–	1	0.26	98.95
Annelida	*Travisia gigas*	–	–	–	1	–	1	0.26	99.21
Annelida	*Pectinaria californiensis*	–	–	–	–	1	1	0.26	99.47
Bivalvia	*Siliqua lucida*	–	–	–	–	1	1	0.26	99.74
Annelida	*Armandia bioculata*	–	–	–	–	1	1	0.26	100.00
Total Number of Individuals		**85**	**81**	**63**	**88**	**63**	**380**		

Table E.6 Species Abundance within Replicate Samples Collected at Benthic Station 5 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Bivalvia	*Tellina bodegensis*	7	13	19	–	–	39	10.51	10.51
Crustacea	*Rhepoxynius abronius*	7	10	4	6	8	35	9.43	19.95
Annelida	*Chaetozone setosa*	5	3	11	6	6	31	8.36	28.30
Crustacea	*Majoxiphalus major*	2	5	4	9	9	29	7.82	36.12
Annelida	*Scoloplos armiger*	4	4	7	3	6	24	6.47	42.59
Crustacea	*Eohaustorius sencillus*	5	–	1	6	11	23	6.20	48.79
Crustacea	*Rhepoxynius menziesi*	5	1	4	4	6	20	5.39	54.18
Annelida	*Nephtys caecoides*	1	2	2	5	4	14	3.77	57.95
Crustacea	*Tecticeps convexus*	1	1	1	5	5	13	3.50	61.46
Crustacea	*Photis macinerneyi*	3	5	–	4	–	12	3.23	64.69
Annelida	*Apoprionospio pygmaea*	3	1	5	1	1	11	2.96	67.65
Crustacea	*Anchicolurus occidentalis*	–	–	2	9	–	11	2.96	70.62
Crustacea	*Pacifoculodes spinipes*	2	3	–	4	1	10	2.70	73.32
Crustacea	*Americhilidium shoemakeri*	1	2	–	1	4	8	2.16	75.47
Nemertea	*Carinoma mutabilis*	2	–	3	3	–	8	2.16	77.63
Annelida	*Glycinde armigera*	3	1	2	1	1	8	2.16	79.78
Nemertea	*Cerebratulus californiensis*	1	1	2	2	–	6	1.62	81.40
Annelida	*Lumbrineris californiensis*	1	1	2	2	–	6	1.62	83.02
Crustacea	*Foxiphalus xiximeus*	1	1	–	1	1	4	1.08	84.10
Annelida	*Magelona sacculata*	1	2	1	–	–	4	1.08	85.18
Echinodermata	*Amphiodia*	–	1	1	–	2	4	1.08	86.25
Annelida	*Ampharete labrops*	–	–	4	–	–	4	1.08	87.33
Crustacea	*Mesolamprops dillonensis*	1	1	1	–	–	3	0.81	88.14
Annelida	*Sigalion spinosa*	2	1	–	–	–	3	0.81	88.95
Crustacea	*Synidotea bicuspida*	–	–	3	–	–	3	0.81	89.76
Annelida	*Spiophanes missionensis*	1	–	1	–	–	2	0.54	90.30
Annelida	*Glycera convoluta*	1	–	1	–	–	2	0.54	90.84
Nemertea	Anopla	–	–	1	–	1	2	0.54	91.37
Bivalvia	*Tellina modesta*	–	–	2	–	–	2	0.54	91.91
Echinodermata	*Dendraster excentricus*	–	–	2	–	–	2	0.54	92.45
Crustacea	*Aoroides inermis*	–	–	2	–	–	2	0.54	92.99
Annelida	*Platynereis bicanaliculata*	–	–	–	–	2	2	0.54	93.53
Crustacea	*Tiron tropakis*	–	–	–	–	2	2	0.54	94.07
Annelida	*Pectinaria californiensis*	1	–	–	–	–	1	0.27	94.34
Cnidaria	Actiniaria	1	–	–	–	–	1	0.27	94.61
Annelida	*Podarkeopsis glabra*	1	–	–	–	–	1	0.27	94.88
Mollusca	*Turbonilla*	1	–	–	–	–	1	0.27	95.15
Crustacea	*Diastylopsis tenuis*	1	–	–	–	–	1	0.27	95.42
Mollusca	*Nassarius fossatus*	1	–	–	–	–	1	0.27	95.69
Crustacea	*Callianassa*	1	–	–	–	–	1	0.27	95.96

Table E.6 Species Abundance within Replicate Samples Collected at Benthic Station 5 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Eteone fauchaldi*	1	–	–	–	–	1	0.27	96.23
Echinodermata	Molpadiidae	1	–	–	–	–	1	0.27	96.50
Cnidaria	*Urticina coriacea*	1	–	–	–	–	1	0.27	96.77
Annelida	*Phyllodoce*	–	1	–	–	–	1	0.27	97.04
Echinodermata	*Leptosynapta*	–	1	–	–	–	1	0.27	97.30
Crustacea	*Bathycopea daltonae*	–	1	–	–	–	1	0.27	97.57
Crustacea	*Leuroleberis sharpei*	–	1	–	–	–	1	0.27	97.84
Annelida	*Armandia bioculata*	–	–	1	–	–	1	0.27	98.11
Annelida	*Sthenelais verruculosa*	–	–	1	–	–	1	0.27	98.38
Crustacea	*Cancer*	–	–	1	–	–	1	0.27	98.65
Crustacea	*Ericthonius brasiliensis*	–	–	1	–	–	1	0.27	98.92
Bivalvia	*Nuculana pernula*	–	–	1	–	–	1	0.27	99.19
Annelida	*Onuphis iridescens*	–	–	–	1	–	1	0.27	99.46
Crustacea	*Listriella goleta*	–	–	–	1	–	1	0.27	99.73
Crustacea	*Gibberosus myersi*	–	–	–	–	1	1	0.27	100.00
Total Number of Individuals		**70**	**63**	**93**	**74**	**71**	**371**		

Table E.7 Species Abundance within Replicate Samples Collected at Benthic Station 6 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Echinodermata	*Dendraster excentricus*	10	16	3	12	12	53	13.73	13.73
Bivalvia	*Tellina bodegensis*	11	13	6	5	2	37	9.59	23.32
Crustacea	*Rhepoxynius abronius*	10	9	4	5	4	32	8.29	31.61
Nemertea	*Carinoma mutabilis*	9	5	6	4	7	31	8.03	39.64
Annelida	*Scoloplos armiger*	6	–	2	7	8	23	5.96	45.60
Crustacea	*Eohaustorius sencillus*	7	2	2	4	6	21	5.44	51.04
Crustacea	*Majoxiphalus major*	2	4	8	3	2	19	4.92	55.96
Annelida	*Magelona sacculata*	7	2	3	1	1	14	3.63	59.59
Annelida	*Chaetozone setosa*	3	2	1	5	2	13	3.37	62.95

Table E.7 Species Abundance within Replicate Samples Collected at Benthic Station 6 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Lumbrineris californiensis*	–	3	6	1	2	12	3.11	66.06
Annelida	*Glycinde armigera*	2	4	1	3	1	11	2.85	68.91
Crustacea	*Rhepoxynius menziesi*	4	–	–	5	2	11	2.85	71.76
Annelida	*Apoprionospio pygmaea*	3	4	2	–	1	10	2.59	74.35
Annelida	*Nephtys caecoides*	4	–	1	5	–	10	2.59	76.94
Annelida	*Glycera convoluta*	–	5	1	1	2	9	2.33	79.27
Bivalvia	*Tellina modesta*	2	1	2	–	3	8	2.07	81.35
Annelida	*Onuphis iridescens*	2	6	–	–	–	8	2.07	83.42
Annelida	*Spiophanes missionensis*	1	1	–	2	2	6	1.55	84.97
Crustacea	*Anchicolurus occidentalis*	1	1	–	3	–	5	1.30	86.27
Bivalvia	*Siliqua lucida*	1	–	–	3	1	5	1.30	87.56
Bivalvia	*Chione*	2	3	–	–	–	5	1.30	88.86
Crustacea	*Photis macinerneyi*	–	2	1	1	1	5	1.30	90.16
Crustacea	*Pacifoculodes spinipes*	–	–	1	2	2	5	1.30	91.45
Crustacea	*Americhilidium shoemakeri*	3	–	–	1	–	4	1.04	92.49
Bivalvia	*Nuculana*	1	1	–	–	1	3	0.78	93.26
Nemertea	*Cerebratulus californiensis*	–	–	2	–	1	3	0.78	94.04
Annelida	*Spiophanes bombyx*	–	–	2	–	–	2	0.52	94.56
Annelida	*Ampharete labrops*	–	–	–	–	2	2	0.52	95.08
Nemertea	*Paranemertes sp. A*	–	–	–	–	2	2	0.52	95.60
Annelida	*Sigalion spinosa*	1	–	–	–	–	1	0.26	95.85
Annelida	*Typosyllis farallonensis*	1	–	–	–	–	1	0.26	96.11
Echinodermata	*Leptosynapta*	1	–	–	–	–	1	0.26	96.37
Crustacea	*Listriella goleta*	1	–	–	–	–	1	0.26	96.63
Annelida	*Sthenelais verruculosa*	–	1	–	–	–	1	0.26	96.89
Echinodermata	*Astropecten verrilli*	–	1	–	–	–	1	0.26	97.15
Crustacea	*Photis brevipes*	–	–	1	–	–	1	0.26	97.41
Crustacea	*Foxiphalus xiximeus*	–	–	1	–	–	1	0.26	97.67
Crustacea	*Cancer gracilis*	–	–	1	–	–	1	0.26	97.93
Bivalvia	*Solen sicarius*	–	–	–	1	–	1	0.26	98.19
Crustacea	*Tecticeps convexus*	–	–	–	1	–	1	0.26	98.45
Annelida	*Armandia bioculata*	–	–	–	1	–	1	0.26	98.70
Mollusca	*Turbonilla*	–	–	–	1	–	1	0.26	98.96
Crustacea	*Bathycopea daltonae*	–	–	–	1	–	1	0.26	99.22
Bivalvia	*Cooperella subdiaphana*	–	–	–	–	1	1	0.26	99.48
Crustacea	*Mesolamprops dillonensis*	–	–	–	–	1	1	0.26	99.74
Nemertea	Lineidae	–	–	–	–	1	1	0.26	100.00
Total Number of Individuals		**95**	**86**	**57**	**78**	**70**	**386**		

Table E.8 Species Abundance within Replicate Samples Collected at Benthic Station 7 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Echinodermata	*Dendraster excentricus*	9	6	12	13	12	52	12.15	12.15
Crustacea	*Rhepoxynius abronius*	11	10	10	5	4	40	9.35	21.50
Nemertea	*Carinoma mutabilis*	2	4	8	9	12	35	8.18	29.67
Bivalvia	*Tellina bodegensis*	6	4	7	3	12	32	7.48	37.15
Crustacea	*Eohaustorius sencillus*	4	8	2	6	10	30	7.01	44.16
Annelida	*Scoloplos armiger*	1	4	8	6	10	29	6.78	50.93
Annelida	*Magelona sacculata*	5	1	6	4	2	18	4.21	55.14
Crustacea	*Majoxiphalus major*	5	1	2	4	6	18	4.21	59.35
Annelida	*Chaetozone setosa*	4	2	6	7	3	22	5.14	64.49
Annelida	*Apoprionospio pygmaea*	–	–	5	6	7	18	4.21	68.69
Crustacea	*Rhepoxynius menziesi*	3	2	4	5	2	16	3.74	72.43
Crustacea	*Pacifoculodes spinipes*	2	–	2	2	2	8	1.87	74.30
Annelida	*Glycinde armigera*	2	3	2	3	2	12	2.80	77.10
Nemertea	*Cerebratulus californiensis*	1	2	1	3	–	7	1.64	78.74
Annelida	*Nephtys caecoides*	–	3	1	4	–	8	1.87	80.61
Crustacea	*Tecticeps convexus*	2	1	2	–	2	7	1.64	82.24
Annelida	*Lumbrineris californiensis*	–	2	3	1	1	7	1.64	83.88
Bivalvia	*Tellina modesta*	2	1	–	2	1	6	1.40	85.28
Crustacea	*Photis macinerneyi*	1	–	–	–	3	4	0.93	86.21
Bivalvia	*Chione*	1	2	1	–	1	5	1.17	87.38
Crustacea	*Photis brevipes*	1	–	2	–	1	4	0.93	88.32
Bivalvia	*Siliqua lucida*	–	2	1	1	–	4	0.93	89.25
Mollusca	*Turbonilla*	2	–	1	–	–	3	0.70	89.95
Crustacea	*Tiron tropakis*	–	–	1	1	1	3	0.70	90.65
Annelida	*Glycera convoluta*	–	–	2	1	–	3	0.70	91.36
Annelida	*Onuphis iridescens*	1	1	–	–	–	2	0.47	91.82
Annelida	*Ampharete labrops*	–	–	2	–	–	2	0.47	92.29
Annelida	*Eteone*	1	–	1	–	–	2	0.47	92.76
Phoronida	*Phoronis*	2	–	–	–	–	2	0.47	93.22
Annelida	*Spiophanes missionensis*	–	1	1	–	–	2	0.47	93.69
Annelida	*Sigalion spinosa*	–	1	–	1	–	2	0.47	94.16
Crustacea	*Americhilidium shoemakeri*	–	1	1	–	–	2	0.47	94.63
Crustacea	*Anchicolurus occidentalis*	–	–	1	1	–	2	0.47	95.09
Crustacea	*Bathycopea daltonae*	–	–	–	2	–	2	0.47	95.56
Annelida	*Spiophanes bombyx*	1	–	–	–	–	1	0.23	95.79
Nemertea	*Paranemertes sp. A*	1	–	–	–	–	1	0.23	96.03
Annelida	*Podarkeopsis glabra*	1	–	–	–	–	1	0.23	96.26
Crustacea	*Foxiphalus xiximeus*	1	–	–	–	–	1	0.23	96.50
Annelida	*Sthenelais verruculosa*	1	–	–	–	–	1	0.23	96.73
Echinodermata	Molpadiidae	1	–	–	–	–	1	0.23	96.96

Table E.8 Species Abundance within Replicate Samples Collected at Benthic Station 7 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Annelida	*Axiothella rubrocincta*	–	–	–	1	–	1	0.23	97.20
Crustacea	*Cancer*	–	–	1	–	–	1	0.23	97.43
Echinodermata	*Amphiodia*	–	–	–	1	–	1	0.23	97.66
Nemertea	*Tubulanus*	–	–	–	1	–	1	0.23	97.90
Bivalvia	*Cooperella subdiaphana*	–	–	–	1	–	1	0.23	98.13
Crustacea	*Diastylopsis tenuis*	–	–	–	1	–	1	0.23	98.36
Annelida	*Armandia bioculata*	–	–	–	–	1	1	0.23	98.60
Bivalvia	*Macoma acolasta*	–	–	–	–	1	1	0.23	98.83
Annelida	*Phyllodoce multipapillata*	1	–	–	–	–	1	0.23	99.07
Crustacea	*Mesolamprops dillonensis*	–	–	–	1	–	1	0.23	99.30
Annelida	*Polycirrus californicus*	–	–	–	1	–	1	0.23	99.53
Bivalvia	*Nuculana*	–	–	–	–	1	1	0.23	99.77
Annelida	Nereidae	–	–	–	–	1	1	0.23	100.00
Total Number of Individuals		**75**	**62**	**96**	**97**	**98**	**428**		

Table E.9 Species Abundance within Replicate Samples Collected at Benthic Station 8 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Echinodermata	*Dendraster excentricus*	7	4	12	3	20	46	11.22	11.22
Crustacea	*Rhepoxynius abronius*	8	9	14	6	9	46	11.22	22.44
Bivalvia	*Tellina bodegensis*	6	13	4	9	5	37	9.02	31.46
Nemertea	*Carinoma mutabilis*	5	5	7	6	10	33	8.05	39.51
Crustacea	*Eohaustorius sencillus*	3	7	4	12	6	32	7.80	47.32
Annelida	*Chaetozone setosa*	2	2	9	2	5	20	4.88	52.20
Crustacea	*Rhepoxynius menziesi*	1	4	7	4	1	17	4.15	56.34
Annelida	*Glycinde armigera*	1	2	3	3	6	15	3.66	60.00
Annelida	*Scoloplos armiger*	1	–	2	5	4	12	2.93	62.93
Crustacea	*Pacifoculodes spinipes*	2	3	4	1	2	12	2.93	65.85
Annelida	*Lumbrineris californiensis*	3	3	3	1	1	11	2.68	68.54
Annelida	*Magelona sacculata*	1	1	2	2	3	9	2.20	70.73
Annelida	*Nephtys caecoides*	1	4	–	1	2	8	1.95	72.68
Bivalvia	*Siliqua lucida*	–	–	3	2	3	8	1.95	74.63
Crustacea	*Majoxiphalus major*	2	1	3	1	–	7	1.71	76.34

Table E.9 Species Abundance within Replicate Samples Collected at Benthic Station 8 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Nemertea	*Tubulanus*	–	1	2	2	2	7	1.71	78.05
Crustacea	*Tecticeps convexus*	–	3	2	1	1	7	1.71	79.76
Bivalvia	*Tellina modesta*	–	–	–	3	4	7	1.71	81.46
Annelida	*Glycera convoluta*	2	–	2	1	1	6	1.46	82.93
Annelida	*Sigalion spinosa*	–	1	3	–	2	6	1.46	84.39
Annelida	*Spiophanes missionensis*	–	–	2	2	2	6	1.46	85.85
Annelida	*Apoprionospio pygmaea*	2	–	1	1	1	5	1.22	87.07
Bivalvia	*Chione*	2	–	1	1	1	5	1.22	88.29
Crustacea	*Photis macinerneyi*	2	–	2	1	–	5	1.22	89.51
Nemertea	*Cerebratulus californiensis*	–	2	1	–	2	5	1.22	90.73
Annelida	*Ampharete labrops*	2	1	1	–	–	4	0.98	91.71
Mollusca	*Turbonilla*	–	1	1	–	2	4	0.98	92.68
Bivalvia	*Nuculana*	1	–	–	1	–	2	0.49	93.17
Crustacea	*Mesolamprops dillonensis*	2	–	–	–	–	2	0.49	93.66
Nemertea	*Paranemertes sp. A*	–	1	1	–	–	2	0.49	94.15
Echinodermata	*Amphiodia digitata*	–	–	1	1	–	2	0.49	94.63
Bivalvia	*Pandora bilirata*	–	–	1	–	1	2	0.49	95.12
Annelida	*Spiophanes bombyx*	–	–	1	–	1	2	0.49	95.61
Annelida	*Onuphis iridescens*	–	–	1	–	1	2	0.49	96.10
Crustacea	*Americhilidium shoemakeri*	–	–	2	–	–	2	0.49	96.59
Bivalvia	*Rochefortia tumida*	–	–	–	1	1	2	0.49	97.07
Crustacea	*Photis brevipes*	1	–	–	–	–	1	0.24	97.32
Bivalvia	*Macoma acolasta*	–	1	–	–	–	1	0.24	97.56
Bivalvia	*Cooperella subdiaphana*	–	1	–	–	–	1	0.24	97.80
Annelida	*Eteone*	–	–	1	–	–	1	0.24	98.05
Nemertea	Lineidae	–	–	1	–	–	1	0.24	98.29
Annelida	*Polycirrus californicus*	–	–	1	–	–	1	0.24	98.54
Echinodermata	*Amphiodia*	–	–	–	1	–	1	0.24	98.78
Annelida	*Scalibregma californicum*	–	–	–	1	–	1	0.24	99.02
Annelida	*Pectinaria californiensis*	–	–	–	–	1	1	0.24	99.27
Annelida	*Phyllodoce*	–	–	–	–	1	1	0.24	99.51
Annelida	*Polydora*	–	–	–	–	1	1	0.24	99.76
Annelida	Spionidae	–	–	–	–	1	1	0.24	100.00
Total Number of Individuals		**57**	**70**	**105**	**75**	**103**	**410**		

Table E.10 Species Abundance within Replicate Samples Collected at Benthic Station 9 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Bivalvia	*Tellina bodegensis*	11	13	11	11	15	61	12.68	12.68
Crustacea	*Rhepoxynius menziesi*	5	7	21	1	9	43	8.94	21.62
Crustacea	*Majoxiphalus major*	15	9	2	3	11	40	8.32	29.94
Annelida	*Chaetozone setosa*	11	11	2	5	8	37	7.69	37.63
Echinodermata	*Dendraster excentricus*	1	6	9	7	9	32	6.65	44.28
Crustacea	*Tecticeps convexus*	3	2	16	8	3	32	6.65	50.94
Annelida	*Scoloplos armiger*	13	4	7	4	4	32	6.65	57.59
Crustacea	*Eohaustorius sencillus*	5	5	8	2	5	25	5.20	62.79
Annelida	*Magelona sacculata*	3	6	8	1	2	20	4.16	66.94
Crustacea	*Rhepoxynius abronius*	3	5	4	3	3	18	3.74	70.69
Nemertea	*Carinoma mutabilis*	5	5	6	–	1	17	3.53	74.22
Annelida	*Apoprionospio pygmaea*	–	2	8	4	2	16	3.33	77.55
Crustacea	*Pacifoculodes spinipes*	1	–	7	2	5	15	3.12	80.67
Annelida	*Nephtys caecoides*	5	3	1	2	2	13	2.70	83.37
Crustacea	*Americhilidium shoemakeri*	–	–	3	2	6	11	2.29	85.65
Crustacea	*Photis macinerneyi*	1	1	–	3	5	10	2.08	87.73
Annelida	*Glycinde armigera*	1	2	2	–	2	7	1.46	89.19
Annelida	*Glycera convoluta*	1	1	3	1	–	6	1.25	90.44
Annelida	*Lumbrineris californiensis*	1	2	–	1	1	5	1.04	91.48
Nemertea	*Cerebratulus californiensis*	1	–	2	2	–	5	1.04	92.52
Bivalvia	*Siliqua lucida*	3	1	1	–	–	5	1.04	93.56
Crustacea	*Anchicolurus occidentalis*	1	1	1	1	–	4	0.83	94.39
Bivalvia	*Tellina modesta*	1	1	2	–	–	4	0.83	95.22
Nemertea	*Paranemertes sp. A*	–	–	2	–	1	3	0.62	95.84
Bivalvia	*Chione*	1	–	1	–	–	2	0.42	96.26
Bivalvia	*Nuculana*	1	–	–	–	1	2	0.42	96.67
Annelida	*Onuphis iridescens*	–	–	–	1	1	2	0.42	97.09
Crustacea	*Gibberosus myersi*	–	–	–	2	–	2	0.42	97.51
Annelida	*Pectinaria californiensis*	1	–	–	–	–	1	0.21	97.71
Annelida	*Spiophanes missionensis*	1	–	–	–	–	1	0.21	97.92
Mollusca	*Turbonilla*	1	–	–	–	–	1	0.21	98.13
Crustacea	*Edotia sublittoralis*	–	1	–	–	–	1	0.21	98.34
Bivalvia	*Pandora punctata*	–	1	–	–	–	1	0.21	98.54
Nemertea	*Tubulanus*	–	1	–	–	–	1	0.21	98.75
Annelida	*Ampharete labrops*	–	–	1	–	–	1	0.21	98.96

Table E.10 Species Abundance within Replicate Samples Collected at Benthic Station 9 in October 2006

Taxonomic Group	Taxon	Replicate 1	2	3	4	5	Total	Percent of Total	Cumulative Percent
Crustacea	*Photis brevipes*	–	–	–	1	–	1	0.21	99.17
Echinodermata	*Amphiodia*	–	–	–	1	–	1	0.21	99.38
Annelida	*Sigalion spinosa*	–	–	–	–	1	1	0.21	99.58
Crustacea	*Isocheles pilosus*	–	–	–	–	1	1	0.21	99.79
Mollusca	*Nassarius perpinguis*	–	–	–	–	1	1	0.21	100.00
Total Number of Individuals		**96**	**90**	**128**	**68**	**99**	**481**		

Table E.11 Infaunal Indices in Sediment Samples Collected in October 2006

	Parameter[a]	Total Organisms	Identified Organisms	Number of Species	Organisms per Species	Diversity (H')	Brillouin Index	Dominance (C')	Dominance (75)	Species Richness (d)	Evenness (J')	Infaunal Index
Station 1	Replicate 1	67	64	25	2.56	2.92	2.45	0.07	12	5.77	0.91	86
	Replicate 2	70	67	28	2.39	2.89	2.42	0.09	12	6.42	0.87	77
	Replicate 3	60	60	23	2.61	2.70	2.27	0.09	9	5.37	0.86	83
	Replicate 4	83	80	27	2.96	2.94	2.52	0.07	11	5.93	0.89	77
	Replicate 5	56	56	21	2.67	2.67	2.24	0.10	9	4.97	0.88	69
Station 2	Replicate 1	104	104	20	5.20	2.53	2.26	0.11	8	4.09	0.84	76
	Replicate 2	86	80	22	3.64	2.77	2.40	0.10	12	4.79	0.90	77
	Replicate 3	65	63	21	3.00	2.77	2.36	0.08	10	4.83	0.91	83
	Replicate 4	51	50	18	2.78	2.73	2.29	0.07	10	4.35	0.95	78
	Replicate 5	69	66	22	3.00	2.81	2.40	0.07	10	5.01	0.91	73
Station 3	Replicate 1	56	52	19	2.74	2.56	2.14	0.11	9	4.56	0.87	83
	Replicate 2	93	88	27	3.26	2.82	2.44	0.09	11	5.81	0.85	77
	Replicate 3	49	48	18	2.67	2.69	2.24	0.08	10	4.39	0.93	78
	Replicate 4	65	64	21	3.05	2.82	2.41	0.07	10	4.81	0.93	77
	Replicate 5	63	60	23	2.61	2.79	2.34	0.08	10	5.37	0.89	81
Station 4	Replicate 1	85	85	22	3.86	2.79	2.45	0.08	10	4.73	0.90	83
	Replicate 2	81	80	21	3.81	2.77	2.42	0.08	10	4.56	0.91	79
	Replicate 3	63	61	21	2.90	2.73	2.32	0.09	10	4.87	0.90	79
	Replicate 4	88	85	29	2.93	2.97	2.55	0.07	12	6.30	0.88	84
	Replicate 5	63	62	23	2.70	2.81	2.37	0.08	12	5.33	0.90	80
Station 5	Replicate 1	70	66	29	2.28	3.09	2.59	0.06	13	6.68	0.92	79
	Replicate 2	63	60	21	2.86	2.62	2.21	0.10	8	4.88	0.86	83
	Replicate 3	93	90	28	3.21	2.90	2.51	0.08	12	6.00	0.87	76
	Replicate 4	74	74	20	3.70	2.77	2.41	0.07	10	4.41	0.92	81
	Replicate 5	71	68	16	4.25	2.50	2.19	0.10	7	3.55	0.90	87
Station 6	Replicate 1	95	91	22	4.14	2.79	2.46	0.08	10	4.66	0.90	80
	Replicate 2	86	82	19	4.32	2.58	2.27	0.10	8	4.08	0.88	83
	Replicate 3	57	57	22	2.59	2.83	2.37	0.07	11	5.19	0.91	83
	Replicate 4	78	77	24	3.21	2.91	2.51	0.07	11	5.29	0.91	76
	Replicate 5	70	68	24	2.83	2.84	2.42	0.08	12	5.45	0.90	77
Station 7	Replicate 1	75	68	24	2.83	2.83	2.41	0.08	10	5.45	0.89	88
	Replicate 2	62	60	21	2.86	2.75	2.33	0.08	10	4.88	0.90	85
	Replicate 3	96	92	25	3.68	2.90	2.54	0.07	10	5.31	0.90	79
	Replicate 4	97	95	28	3.39	3.02	2.64	0.06	12	5.93	0.91	78
	Replicate 5	98	95	21	4.52	2.67	2.37	0.09	8	4.39	0.88	74
Station 8	Replicate 1	57	54	20	2.70	2.75	2.31	0.08	11	4.76	0.92	81
	Replicate 2	70	68	20	3.40	2.67	2.30	0.09	9	4.50	0.89	89
	Replicate 3	105	99	29	3.41	3.01	2.63	0.07	13	6.09	0.90	86
	Replicate 4	75	70	24	2.92	2.82	2.41	0.08	10	5.41	0.89	80
	Replicate 5	103	95	26	3.65	2.82	2.47	0.09	10	5.49	0.87	77
Station 9	Replicate 1	96	93	23	4.04	2.68	2.37	0.09	8	4.85	0.86	79
	Replicate 2	90	89	22	4.05	2.77	2.44	0.08	9	4.68	0.90	81
	Replicate 3	128	127	23	5.52	2.78	2.51	0.08	10	4.54	0.89	83
	Replicate 4	68	67	22	3.05	2.80	2.39	0.08	11	4.99	0.91	76
	Replicate 5	99	98	23	4.26	2.79	2.47	0.08	10	4.80	0.89	82

Table E.11 Infaunal Indices in Sediment Samples Collected in October 2006

Parameter[a]		Total Organisms	Identified Organisms	Number of Species	Organisms per Species	Diversity (H')	Brillouin Index	Dominance (C')	Dominance (75)	Species Richness (d)	Evenness (J')	Infaunal Index
Mean	Station 1	67	65	24.8	2.6	2.82	2.38	0.09	10.6	5.69	0.88	78
	Station 2	75	73	20.6	3.5	2.72	2.34	0.09	10.0	4.61	0.90	78
	Station 3	65	62	21.6	2.9	2.74	2.32	0.09	10.0	4.99	0.89	79
	Station 4	76	75	23.2	3.2	2.82	2.42	0.08	10.8	5.16	0.90	81
	Station 5	74	72	22.8	3.3	2.77	2.38	0.08	10.0	5.10	0.89	81
	Station 6	77	75	22.2	3.4	2.79	2.41	0.08	10.4	4.93	0.90	80
	Station 7	86	82	23.8	3.5	2.83	2.46	0.08	10.0	5.19	0.90	81
	Station 8	82	77	23.8	3.2	2.81	2.42	0.08	10.6	5.25	0.89	83
	Station 9	96	95	22.6	4.2	2.76	2.44	0.08	9.6	4.77	0.89	80
Standard Deviation	Station 1	10	9	2.9	0.21	0.13	0.12	0.01	1.5	0.55	0.02	6.6
	Station 2	20	21	1.7	0.99	0.11	0.06	0.02	1.4	0.38	0.04	3.8
	Station 3	17	16	3.6	0.28	0.11	0.12	0.01	0.7	0.59	0.03	2.5
	Station 4	12	12	3.3	0.55	0.09	0.09	0.01	1.1	0.70	0.01	2.6
	Station 5	11	11	5.5	0.76	0.23	0.18	0.02	2.5	1.25	0.03	4.1
	Station 6	15	13	2.0	0.78	0.12	0.09	0.01	1.5	0.56	0.02	3.1
	Station 7	16	17	2.9	0.70	0.13	0.13	0.01	1.4	0.58	0.01	5.6
	Station 8	21	19	3.9	0.39	0.13	0.14	0.01	1.5	0.63	0.02	4.8
	Station 9	22	22	0.5	0.88	0.05	0.06	0.01	1.1	0.17	0.02	2.5
Station Total	Station 1	336	327	49	6.67	3.18	2.96	0.07	14	8.29	0.82	79
	Station 2	375	363	36	10.08	3.00	2.84	0.07	12	5.94	0.84	77
	Station 3	326	312	39	8.00	3.12	2.92	0.07	14	6.62	0.85	79
	Station 4	380	373	40	9.32	3.06	2.89	0.07	12	6.59	0.83	81
	Station 5	371	358	46	7.78	3.19	2.99	0.06	13	7.65	0.83	81
	Station 6	386	375	41	9.15	3.10	2.92	0.06	13	6.75	0.83	80
	Station 7	428	410	43	9.53	3.08	2.91	0.06	11	6.98	0.82	80
	Station 8	410	386	38	10.16	3.07	2.91	0.07	12	6.21	0.84	83
	Station 9	481	474	35	13.54	3.00	2.87	0.06	11	5.52	0.84	80
Survey	**Total**	**3493**	**3378**	**77**	**43.87**	**3.26**	**3.21**	**0.05**	**14**	**9.35**	**0.75**	**80**

[a] Except for Total Organisms and the Infaunal Index, all parameters are computed using only those organisms identified to species level. One specimen of *Pisaster brevispinus* collected in Replicate Sample 5 at Station 2 was excluded from the infaunal analysis because it is undersampled epifauna.

Table E.12 Infaunal Indices without *D. excentricus* in Sediment Samples Collected in October 2006

	Parameter	Total Organisms	Identified Organisms	Number of Species	Organisms per Species	Diversity (H')	Brillouin Index	Dominance (C')	Dominance (75)	Species Richness (d)	Evenness (J')	Infaunal Index
Station 1	Replicate 1	64	61	24	2.54	2.86	2.40	0.08	11	5.59	0.90	86
	Replicate 2	67	64	27	2.37	2.83	2.36	0.10	11	6.25	0.86	77
	Replicate 3	59	59	22	2.68	2.66	2.24	0.10	9	5.15	0.86	83
	Replicate 4	79	76	26	2.92	2.88	2.47	0.08	11	5.77	0.89	77
	Replicate 5	54	54	20	2.70	2.61	2.19	0.10	9	4.76	0.87	69
Station 2	Replicate 1	82	82	19	4.32	2.55	2.24	0.11	8	4.08	0.87	76
	Replicate 2	66	60	21	2.86	2.94	2.49	0.06	12	4.88	0.97	77
	Replicate 3	56	54	20	2.70	2.75	2.31	0.08	10	4.76	0.92	83
	Replicate 4	46	45	17	2.65	2.68	2.22	0.08	9	4.20	0.95	78
	Replicate 5	60	57	21	2.71	2.79	2.35	0.08	10	4.95	0.92	73
Station 3	Replicate 1	53	49	18	2.72	2.49	2.07	0.12	8	4.37	0.86	83
	Replicate 2	82	77	26	2.96	2.79	2.39	0.09	10	5.76	0.86	77
	Replicate 3	43	42	17	2.47	2.64	2.17	0.09	10	4.28	0.93	78
	Replicate 4	64	63	20	3.15	2.79	2.38	0.07	10	4.59	0.93	77
	Replicate 5	63	60	23	2.61	2.79	2.34	0.08	10	5.37	0.89	81
Station 4	Replicate 1	83	83	21	3.95	2.75	2.41	0.08	10	4.53	0.90	83
	Replicate 2	80	79	20	3.95	2.74	2.40	0.08	10	4.35	0.91	79
	Replicate 3	57	55	20	2.75	2.68	2.25	0.09	10	4.74	0.89	79
	Replicate 4	88	85	29	2.93	2.97	2.55	0.07	12	6.30	0.88	84
	Replicate 5	59	58	22	2.64	2.75	2.31	0.09	11	5.17	0.89	80
Station 5	Replicate 1	70	66	29	2.28	3.09	2.59	0.06	13	6.68	0.92	79
	Replicate 2	63	60	21	2.86	2.62	2.21	0.10	8	4.88	0.86	83
	Replicate 3	91	88	27	3.26	2.86	2.48	0.09	12	5.81	0.87	76
	Replicate 4	74	74	20	3.70	2.77	2.41	0.07	10	4.41	0.92	81
	Replicate 5	71	68	16	4.25	2.50	2.19	0.10	7	3.55	0.90	87
Station 6	Replicate 1	85	81	21	3.86	2.74	2.40	0.08	9	4.55	0.90	80
	Replicate 2	70	66	18	3.67	2.59	2.24	0.10	8	4.06	0.90	83
	Replicate 3	54	54	21	2.57	2.77	2.31	0.08	10	5.01	0.91	83
	Replicate 4	66	65	23	2.83	2.93	2.49	0.06	11	5.27	0.93	76
	Replicate 5	58	56	23	2.43	2.89	2.41	0.07	13	5.47	0.92	77
Station 7	Replicate 1	66	59	23	2.57	2.81	2.36	0.08	11	5.40	0.90	88
	Replicate 2	56	54	20	2.70	2.70	2.26	0.09	10	4.76	0.90	85
	Replicate 3	84	80	24	3.33	2.89	2.51	0.07	11	5.25	0.91	79
	Replicate 4	84	82	27	3.04	3.04	2.62	0.06	12	5.90	0.92	78
	Replicate 5	86	83	20	4.15	2.62	2.31	0.09	8	4.30	0.88	74
Station 8	Replicate 1	50	47	19	2.47	2.72	2.25	0.08	11	4.68	0.92	81
	Replicate 2	66	64	19	3.37	2.60	2.23	0.10	8	4.33	0.88	89
	Replicate 3	93	87	28	3.11	3.01	2.60	0.07	13	6.05	0.90	86
	Replicate 4	72	67	23	2.91	2.76	2.35	0.09	10	5.23	0.88	80
	Replicate 5	83	75	25	3.00	2.92	2.51	0.07	11	5.56	0.91	77
Station 9	Replicate 1	95	92	22	4.18	2.65	2.34	0.09	8	4.64	0.86	79
	Replicate 2	84	83	21	3.95	2.70	2.37	0.08	9	4.53	0.89	81
	Replicate 3	119	118	22	5.36	2.71	2.44	0.09	9	4.40	0.88	83
	Replicate 4	61	60	21	2.86	2.76	2.33	0.08	10	4.88	0.91	76
	Replicate 5	90	89	22	4.05	2.74	2.41	0.08	9	4.68	0.89	82

Table E.12 Infaunal Indices without *D. excentricus* in Sediment Samples Collected in October 2006

	Parameter	Total Organisms	Identified Organisms	Number of Species	Organisms per Species	Diversity (H')	Brillouin Index	Dominance (C')	Dominance (75)	Species Richness (d)	Evenness (J')	Infaunal Index
Mean	Station 1	65	63	23.8	2.6	2.77	2.33	0.09	10.2	5.50	0.88	78
	Station 2	62	60	19.6	3.0	2.74	2.32	0.08	9.8	4.57	0.92	78
	Station 3	61	58	20.8	2.8	2.70	2.27	0.09	9.6	4.87	0.89	79
	Station 4	73	72	22.4	3.2	2.78	2.38	0.08	10.6	5.02	0.90	81
	Station 5	74	71	22.6	3.3	2.77	2.37	0.08	10.0	5.07	0.89	81
	Station 6	67	64	21.2	3.1	2.78	2.37	0.08	10.2	4.87	0.91	80
	Station 7	75	72	22.8	3.2	2.81	2.41	0.08	10.4	5.12	0.90	81
	Station 8	73	68	22.8	3.0	2.80	2.39	0.08	10.6	5.17	0.90	83
	Station 9	90	88	21.6	4.1	2.71	2.38	0.09	9.0	4.63	0.88	80
Standard Deviation	Station 1	9	8	2.9	0.20	0.12	0.12	0.01	1.1	0.57	0.02	6.6
	Station 2	13	14	1.7	0.72	0.14	0.11	0.02	1.5	0.40	0.04	3.8
	Station 3	15	13	3.7	0.27	0.13	0.14	0.02	0.9	0.66	0.04	2.5
	Station 4	14	14	3.8	0.65	0.11	0.12	0.01	0.9	0.78	0.01	2.6
	Station 5	10	11	5.3	0.76	0.23	0.17	0.02	2.5	1.22	0.03	4.1
	Station 6	12	11	2.0	0.65	0.13	0.10	0.01	1.9	0.57	0.02	3.1
	Station 7	13	14	2.9	0.63	0.16	0.15	0.01	1.5	0.61	0.02	5.6
	Station 8	16	15	3.9	0.33	0.16	0.16	0.01	1.8	0.68	0.02	4.8
	Station 9	21	21	0.5	0.89	0.04	0.05	0.00	0.7	0.18	0.02	2.5
Station Total	Station 1	323	314	48	6.54	3.14	2.92	0.07	14	8.17	0.81	79
	Station 2	310	298	35	8.51	3.08	2.89	0.06	12	5.97	0.87	77
	Station 3	305	291	38	7.66	3.08	2.88	0.07	13	6.52	0.85	79
	Station 4	367	360	39	9.23	3.01	2.84	0.07	11	6.46	0.82	81
	Station 5	369	356	45	7.91	3.17	2.98	0.06	13	7.49	0.83	81
	Station 6	333	322	40	8.05	3.13	2.94	0.06	13	6.75	0.85	80
	Station 7	376	358	42	8.52	3.09	2.91	0.06	11	6.97	0.83	80
	Station 8	364	340	37	9.19	3.07	2.89	0.07	13	6.18	0.85	83
	Station 9	449	442	34	13.00	2.95	2.82	0.07	11	5.42	0.84	80
Survey	**Total**	**3196**	**3081**	**76**	**40.54**	**3.25**	**3.20**	**0.06**	**14**	**9.34**	**0.75**	**80**