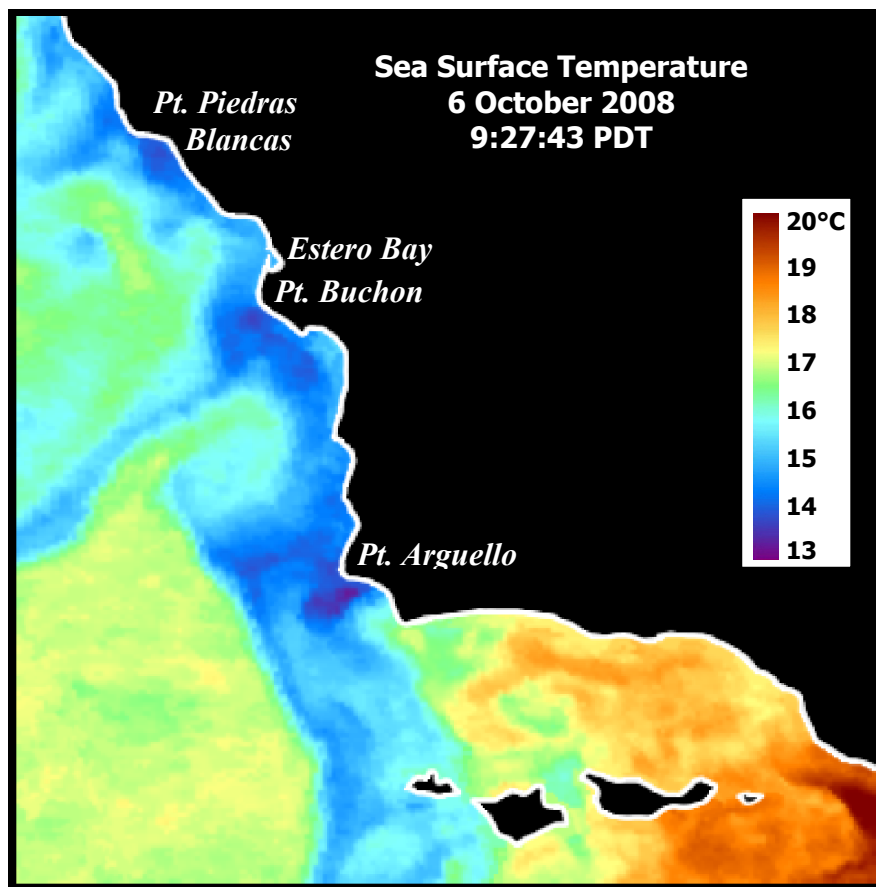


**City of Morro Bay and
Cayucos Sanitary District**

OFFSHORE MONITORING AND REPORTING PROGRAM

2008 ANNUAL REPORT



Marine Research Specialists

**3140 Telegraph Rd., Suite A
Ventura, California 93003**

Report to

**City of Morro Bay and
Cayucos Sanitary District**

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Morro Bay, California 93442
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**OFFSHORE MONITORING
AND
REPORTING PROGRAM**

2008 ANNUAL REPORT

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February 2009

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

26 February 2009

Reference: 2008 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

Enclosures (5)

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	An anomaly is 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 a given station and the mean of that property measured at all other stations at the same depth level or distance above the bottom.
Anthropogenic	Changes to the environment induced by human activities
BCCE	Brown and Caldwell Consulting Engineers
BEHP	Bis 2-Ethyl Hexyl Phthalate is a compound that leaches out of plastics and is ubiquitous in the environment.
BIP	A Balanced Indigenous Population is as an ecological community that exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted environmental conditions.
BBL	A benthic boundary layer is often synonymous with a bottom nepheloid layer (<i>see below</i> BNL) and is associated with increased turbulence and mixing caused by the decrease in current flow immediately above the seafloor that is required to meet the zero-velocity boundary condition at the seafloor.
BNL	The 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. Oscillatory bottom currents generated by passing surface gravity waves easily suspend these flocs.
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 the California Administrative Manual and CAM-17 refers to the list of 17 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), which has been revised but the 1997 edition was in force when the current NPDES discharge permit was issued to MBCSD.

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

CTD	CTD is an instrument package that continuously records conductivity, temperature, and depth, in addition to a number of other physical oceanographic parameters in the water column.
CV	A coefficient of variation is used to compare the relative amounts of variation in populations having different means. It is 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
DO	Dissolved Oxygen
ELAP	California Department of Health Services, Environmental Laboratory Accreditation Program
EQ	Exceptional Quality is a standard for compost that meets the Federal and State requirements for beneficial reuse in the local community.
ERL	Effects Range Low is a sediment toxicity concentration below which adverse biological effects are not expected to occur.
ERM	Effects Range Median is 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
LC₅₀	Lethal 50% Concentration is a toxicity endpoint where 50% of the specimens will die after a 96-hour exposure period.
MBCSD	The City of Morro Bay and Cayucos Sanitary District
MTBE	Methyl Tertiary Butyl Ether is 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 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.

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

MGD	Million Gallons per Day
mg/Kg	Milligrams per Kilogram = $\mu\text{g/g}$ dry weight = parts per million
mg/L	Milligrams per Liter = aqueous parts per million
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 is a measure of aqueous radioactivity.
Perturbation	A perturbation is 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

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

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
PQL	Practical Quantification Limit is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.
PSDWF	Peak seasonal dry-weather flow
<i>p</i>-value	Low <i>p</i> -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 continuously returned 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. The State of California classified biosolids with leachate concentrations exceeding the STLC as hazardous.
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 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.

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

TKN	Total Kjeldahl Nitrogen
TRC	Total Residual Chlorine in effluent is determined from grab samples collected beyond the chlorine contact chamber.
TSS	Total Suspended Solids
TTLC	Total Threshold Limit Concentration 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	United States Environmental Protection Agency
USGPO	United States Government Printing Office
USMMS	United States 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	A zeolite is 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	The 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 that evaluates short- and long-term effects of the effluent discharge on receiving waters, benthic sediments, and infaunal communities. This 2008 Annual Report partially satisfies those reporting requirements.

This document presents a comprehensive analysis of the extensive monitoring data collected over the last 23 years. Virtually every aspect of the treatment process, receiving waters, and seafloor sediments is 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 water-quality measurements indicate that the effluent plume was primarily restricted to a narrow 15-m zone of initial dilution (ZID) around the outfall. Measurements within the effluent plume collected a few feet from 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. Two independent reviews conducted by the United States Environmental Protection Agency supported these conclusions (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.

Effluent monitoring during 2008 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 they did in prior years. In fact, in 2008 key measures of treatment performance were the best recorded since monitoring began more than two decades ago. More importantly, the plant has consistently outperformed its historical efficiency for the past five years, with each successive year out-pacing the prior year. In 2008, average solids concentrations within effluent were the lowest on record, while the solids removal rate was the highest ever measured. Combined with the plant's low total flow, its solids-removal process resulted in the lowest annual solids emission recorded since monitoring began in 1986. Similarly, O&G and BOD concentrations and emissions in 2008 were record lows, despite higher than average influent concentrations.

A portion of the mass-emission reduction was attributable to the lower overall flow in 2008 compared to prior years. Some of the reduction in plant throughput was due to moderate-to-low rainfall accumulations in recent years, which generated less inflow and infiltration (I&I) into the collection system. However, in the past few years, repairs to the collection system also successfully eliminated some major sources of I&I. In addition, a more accurate flow meter was commissioned in 2002. As a result of these efforts, the average plant throughput in 2008 ranked among the lowest on record. However, even with the low flow in 2008, 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 contaminants 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 polychlorinated biphenyl (PCB), 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. A comprehensive industrial waste survey, maintained and periodically updated by collections system personnel, documents these sources. In addition, an ongoing public-outreach program and the convenience of an onsite household hazardous waste recycling facility further reduced the introduction of pollutants into the waste stream. Since 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 2008, the facility collected over 119 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.

Throughout the 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 the brief, unavoidable mechanical failure of a treatment-system component. In light of their diligent adherence to a program of preventative maintenance, the main challenge for plant personnel has been to respond quickly to unanticipated failures in system components or unforeseeable events.

Among the thousands of samples and measurements collected as part of the monitoring program during 2008, 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. Their knowledge and experience regularly enables them to enact appropriate proactive measures that ensure the smooth operation of this facility.

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, there was no evidence of adverse discharge-related marine impacts during 2008. 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).

Quarterly offshore water-column surveys evaluated receiving-water quality. The high-precision measurements collected during the surveys were capable of resolving minute changes in ambient water properties. These measurements detected and delineated 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 very close to the diffuser structure within the ZID. These highly localized anomalies were still within the limits specified in the NPDES permit, even those collected well within the ZID, where such limits do not apply. The high degree of effluent dilution observed close to a diffuser port attests 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 100 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 2.8 km to the south.

Sampling of the surfzone for coliform bacteria was another component of receiving-water monitoring during 2008. Surfzone samples were collected at seven locations along Atascadero State Beach. The few 2008 samples containing detectable quantities of coliform bacteria were associated with non-point source contamination rather than effluent discharge. Elevated surfzone coliform measurements have occasionally been observed over the 23 years since 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 were non-fecal coliform. The general absence of detectable coliform levels within discharged effluent during 2008 confirmed the effectiveness of the treatment plant's disinfection process at eliminating viable microbial contaminants from the waste stream. Regardless of the source, surfzone measurements along Atascadero State Beach met the stringent limitations governing shellfish harvesting during 2008.

The physics, chemistry, and biology of benthic sediments around the outfall have also been monitored for 23 years. 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 2008 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 2008, and in prior years of monitoring, were below thresholds identified as toxic to marine organisms. This includes samples collected close to the diffuser structure, as well as those collected more than 1 km away. In fact, measured concentrations were comparable to those found in benthic sediments collected throughout the region, but they were generally much less than those found within the Southern California Bight. Second, benthic samples collected during 2008 did not exhibit a gradient of 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 are regional in nature and unrelated to effluent discharge. Specifically, the volumes of metals discharged within the effluent were too small to account for the slight increases in sediment concentrations 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 its effect on marine organisms is minimal. 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 communities 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 157,000 infaunal organisms have been collected and examined since the beginning of the benthic monitoring program 23 years 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 environmental changes. For instance, 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. The infaunal trophic index independently measures the overall health of the benthic community. The index was among the highest measured during 2008 and, and it's consistently high value in prior years demonstrates that the sediments surrounding the outfall support an extraordinarily healthy marine community dominated by suspension-feeding organisms living in clean sediments.

1.0 INTRODUCTION

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) 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 MBCSD in March 1985 (Permit Number CA0047881). Region IX of the U.S. Environmental Protection Agency (USEPA) and the Central Coast California Regional Water Quality Control Board (RWQCB) jointly issued the permit. Following extensive evaluation processes, the USEPA and the RWQCB reissued the permit twice, once in March 1993 (RWQCB-USEPA 1993ab) and again in December 1998 (RWQCB-USEPA 1998ab). This report addresses compliance with the provisions of the most recent permit.

Marine Research Specialists began conducting the Offshore Monitoring and Reporting Program for the MBCSD in July 1993. Since then, the treatment plant staff, Marine Research Specialists, and subcontracted laboratories, which included BC Laboratories and Aquatic Testing Laboratories, collected and analyzed samples as part of the monitoring program.

1.1 REPORT ORGANIZATION

This 2008 annual report summarizes results from the four major monitoring components that analyze the treatment plant, receiving waters, marine sediments, and benthic biota. The organization of this document is similar to that of previous annual reports for continuity with these four 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 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 pertaining to the treatment process. It also describes sludge quality and the disposition of biosolids during 2008. Chapter 3 documents the four offshore surveys that were conducted during 2008 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 in October 2008. It places the chemical and biological measurements in historical context by incorporating time-series analyses of the entire 23-year database. Finally, Chapter 5 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 in the body of this report. Appendix A lists the design specifications of the wastewater treatment plant. The results of all major chemical analysis performed on effluent and biosolid samples collected during 2008 are tabulated in Appendix B. Appendix C details the biological analysis of the offshore sediment samples and contains information about the taxonomists who performed the species-level identification of the specimens. Appendices D and E summarize physicochemical data collected during the October benthic survey. Appendix D contains sample descriptions, including the location, depth, and grain-size characteristics of sediment samples. The original benthic chemistry report and quality assessment and quality control (QA/QC) analyses performed by BC Laboratories are provided in Appendix E, which is included on the compact disk (CD) attached to the cover of this report. QA/QC

procedures for the analytical laboratories are provided in Appendix F, which is also on the CD. It also contains a summary of the analytical methods used by BC Laboratories in their chemical analyses of the samples.

CHAPTER 2

Treatment Plant Performance

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2.0 TREATMENT PLANT PERFORMANCE

During 2008 and prior years, the treatment plant efficiently removed nearly all organics and other solids from the wastewater stream. The striking difference between influent and effluent loading of organic constituents attested to the plant's consistently high operational performance throughout the year. A proactive operation and maintenance program ensured that there were no exceptions to the limits specified in the NPDES discharge permit during 2008. Analyses of key diagnostic constituents, including suspended solids, biochemical oxygen demand (BOD), and oil and grease (O&G), demonstrated the high operational performance of the plant. Similarly, periodic analyses of effluent for trace metals, pesticides, priority pollutants, and toxicity demonstrated the benign environmental character of the effluent. 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).

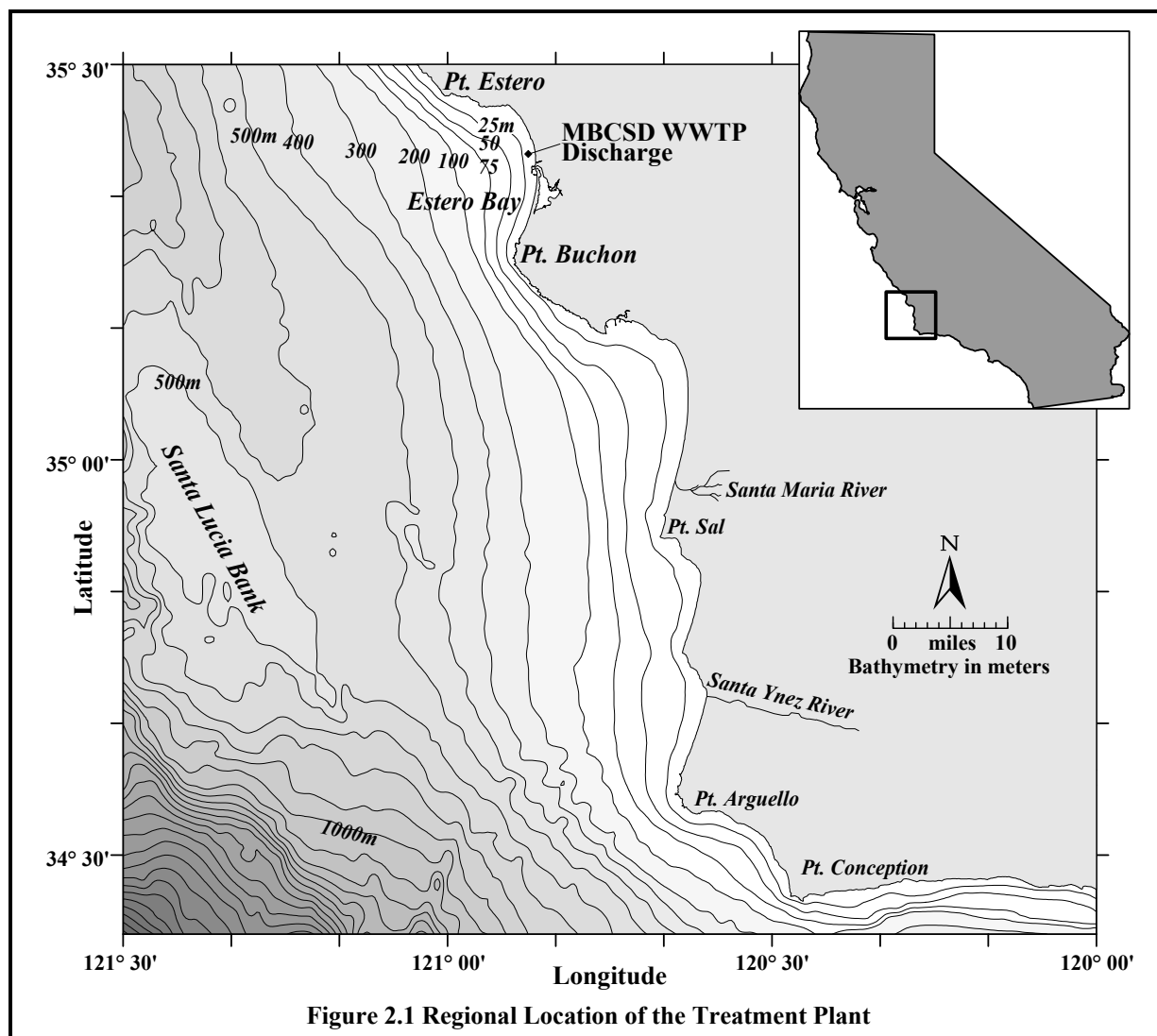
Data collected during 2008 augment 22 years of prior monitoring information. This extensive database chronicles the consistent high level of performance of the treatment process for more than two decades. As in previous years, removal of suspended solids and oxygen-demanding materials during 2008 consistently and substantially exceeded permit-required minimum limits. The treatment plant's performance routinely approached and exceeded the requirements for full secondary treatment; in fact, nearly all wastewater receives secondary treatment. Blending of primary- and secondary-treated wastewater is only required during infrequent periods of particularly high flow, such as during rainstorms. Consequently, the blending valve was rarely open during 2008.

Despite processing a large volume of sewage during 2008, the plant discharged only 15.1% of the allowed solids, while still attaining removal rates 19% higher than the permitted minimum. Throughout the year, the treatment plant removed solids at a rate significantly exceeding the 85% requirement for full secondary treatment. Additionally, the average effluent suspended solids concentrations during each of the 12 months remained well below the 30-mg/L criteria for full secondary treatment. The annual average effluent suspended-solids concentration (20 mg/L) was less than one-third of the permitted maximum (70 mg/L), and the total solids emission (30 MT¹) was only 15% of the allowed (199 MT).

During 2008, the treatment plant also removed the vast majority (88%) of oxygen-demanding material from the influent stream. The average BOD removal during 11 months exceeded the 85% monthly removal standard for full secondary treatment while the lowest monthly removal rate of 84.3% was nearly three times the minimum required rate of 30%. Because oxygen depletion is of little concern in the open ocean, technology-based requirements on BOD are generally unimportant for marine discharges (National Academy of Sciences 1993), so the MBCSD discharge was effectively meeting secondary treatment requirements for all of 2008. The annual average effluent BOD concentration (38 mg/L) was only about one-third of the permitted maximum (120 mg/L), and the total mass emission (58 MT) was only about one-sixth of the allowed BOD discharge (342 MT).

The general absence of industrial contaminants in the wastestream attests to the benign nature of the influent, which is almost entirely generated by nonindustrial residential sources. Chemical analyses for 13 trace metals and over 150 synthetic organic compounds quantified low-level concentrations of only six common wastewater constituents and three naturally occurring trace metals. All measured concentrations were well below permit limitations. Chronic bioassays conducted on effluent samples that were collected during 2008 determined that discharge had a very low toxicity to marine organisms, results that were consistent with the prior 15-years record of testing. In contrast to the chronic bioassays, ammonia

¹ Metric tons or 1,000 Kg (1.1 short tons)



interference confounded the 2008 acute toxicity bioassays; the ammonia interference is an artifact of revised bioassay protocols instituted in April 2003. Despite this artificial increase in reported acute toxicity, all toxicity endpoints were below permitted limits.

Finally, the treatment plant's ability to accommodate unusual flow events and unforeseen mechanical upsets demonstrated its effectiveness. The 2008 monitoring data contained ten anomalous plant conditions, none of which were related to random perturbations in the overall efficacy of the treatment process. On the contrary, all events were directly attributable to external events or necessary repairs to treatment-plant equipment. Four events were perceptible increases in plant inflow during rainstorms; two of these rainfall events coincided with slight but perceptible increases in plant throughput due to increased wastewater loading to the collection system during holidays. Three additional heightened flow events were solely associated with increased stay-at-home and tourist populations within the service area during holidays. The remaining three events occurred during repairs to treatment components both within and outside of the plant. Regardless, none of the events during 2008 caused an exceedance of the NPDES permit limits.

2.1 WASTEWATER TREATMENT PLANT

The Morro Bay/Cayucos Wastewater Treatment Plant (WWTP) is publicly owned and operated by the City of Morro Bay and the Cayucos Sanitary District (MBCSD). The WWTP is located in the City of Morro Bay, within San Luis Obispo County along the central coast of California (Figure 2.1). The plant serves the Morro Bay and Cayucos communities, which, according to the 2000 census, have a combined population of approximately 13,293 (10,350 in Morro Bay and 2,943 in Cayucos). The WWTP discharged, on average, 1.10 million gallons per day (MGD) during 2008. The plant was designed to accommodate an average dry-weather flow of 2.06 MGD, a peak seasonal dry-weather flow (PSDFW) of 2.36 MGD, and a peak wet-weather flow (PWWF) of 6.64 MGD. The plant's flow did not approach any of these design limits during 2008.

2.1.1 Operations

During 2008, eight trained personnel operated the WWTP (Table 2.1). Bruce Keogh served as both the Wastewater Division Manager and the Laboratory Director; Les Girvin continued to serve as WWTP Supervisor.

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 collected throughout the Morro Bay watershed.

WWTP personnel attended a number of workshops, seminars, and continuing education classes throughout 2008. Course topics included basic water analysis, confined space entry, chlorine dioxide disinfection, effective governing body and staff relations, snowy plover identification and training, front-end loader safety and operation, arc safety, water/wastewater design and construction, global climate issues, water distribution monitoring, dissolved oxygen and happy bugs, nutrient analysis, emergency bypass pumping procedures, and supervisory skills. WWTP personnel also conducted plant tours for the public, other public agencies (including the California Integrated Waste Management Board staff, the California Joint Powers Authority Insurance Agency, and Air Pollution Control District staff), equipment suppliers, and Regional Water Quality Control Board (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 2008, the WWTP laboratory, and the laboratories subcontracted to the WWTP, conducted mandatory tests intended to evaluate the accuracy of effluent measurements and assure the overall quality of the monitoring reports. The WWTP laboratory analyzes effluent parameters reported on a daily and weekly basis, including residual chlorine, suspended solids, turbidity, coliform, pH, and biochemical oxygen demand. Aquatic Testing Laboratories evaluates the toxicity of effluent to marine organisms with quarterly bioassay tests. BC Laboratories determines the concentration of a wide range of chemical compounds within effluent with semiannual chemical analyses. BC Laboratories also performs the annual analysis of biosolid samples. Finally, BC Laboratories performs the chemical analyses of benthic sediments described in Chapter 4 of this report. Each laboratory's quality assurance and control plan is included in Appendix F of this report.

**Table 2.1 Morro Bay/Cayucos
WWTP Personnel During 2008**

Name	Grade and Certification No.
Bruce Keogh	IV – 8978
Les Girvin	III – 8499
Steven Aschenbrenner	II – 7548
David Williams	II – 9601
John Gunderlock	III – 10500
Eric Zatt	III – 10621
Steve Sibley	I – 8005
George Helms	I – 28158

Several State and Federal laboratory performance evaluations were successfully completed during 2008. The regulatory agencies results from all of these studies to be within acceptable ranges. These included:

- The California Department of Health Services Environmental Laboratory Accreditation Program (ELAP) review of general laboratory protocols,
- The United States Environmental Protection Agency's (USEPA) Discharge Monitoring Report-Quality Assurance Study #28 (DMR-QA-28), 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 actively sought to identify and eliminate sources of inflow (rainwater runoff) and infiltration (of groundwater), known as I&I, within their respective collection systems. For example, in late 2000, a repair, using cured-in-place pipe-lining technology, of the 18-inch sewer line along Atascadero Road eliminated a major source of groundwater infiltration. This and other repair projects helped reduce the volume of groundwater infiltration entering the collection system, thereby minimizing the amount of nonwastewater throughput processed by the WWTP.

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 and replaced this leaking lateral in 2001. Additional laterals flowing into the Atascadero Road sewer line were sealed and grouted to reduce leakage where they connect to the new lining. At that time, pipe conditions in other areas were evaluated and prioritized for future repair. This process has continued in subsequent years by inspecting, pressure washing, and repairing, where necessary, 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 2008, the City's Public Works Department also continued to routinely clean and remove grit from the City's collection system. Over the course of the year, the City cleaned 209,141 feet (39.6 miles) of sewer line. A state-of-the-art hydrovac sewer cleaner, purchased in 2001, is the cornerstone of the City's program. This powerful truck is capable of removing a large volume of grit from sewer lines that would otherwise be washed down the line during standard cleaning operations. Grit removal reduces the potential for line blockage and spills, and it decreases the volume of solids that eventually enter the WWTP and needlessly abrade the plant's equipment.

In 2003, the City approved commissioning a Sewer Master Plan update, and, after an extended period of analysis, the City Council adopted the Sewer Master Plan in May 2006. Pursuant to the updated plan, the City temporarily installed flow meters to monitor wastewater flow at 11 drainage basins. These meters quantified flow during significant rainfall events, addressed site-specific I&I contributions, and evaluated the performance of individual lift stations. Upon completion of the studies, they were removed. The Sewer Master Plan revisions also included collection-system hydraulic modeling. Finally, it recommended a capital improvements program, including staffing and O&M budget analysis. During 2008, the City also began the process of redesigning and upgrading Lift Stations #2 and #3.

During 2008, 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 come from the CSD's five-year capital improvements program, which is re-budgeted on an annual basis.

During 2008, several significant improvements to the system exceeded 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 CSD replaced approximately 150 linear

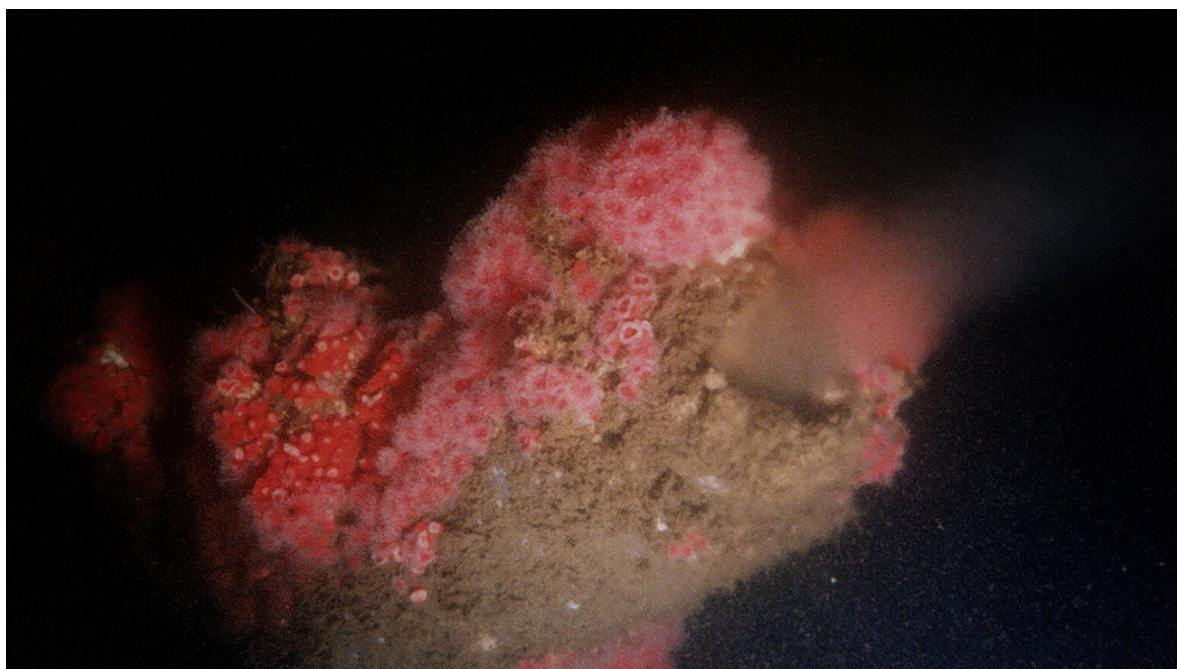


Figure 2.2 Photograph of a Diffuser Port Discharging Effluent

feet of damaged sewer lines and performed video inspections and cleaning of approximately half of the CSD's sewer lines. Staff combined this video information with recordings from previous years to earmark future replacement projects. CSD staff also performed video inspections on sewer laterals as a condition of the CSD's will-serve process. Property owners are required to replace defective laterals to prevent sewer spills and reduce infiltration to the collection system.

During 2007, the CSD, in conjunction with the City of Morro Bay, began preliminary analysis to study and address capacity concerns in the Main Street sewer lines. The CSD purchased six portable flow meters to continuously monitor, identify, and correct sources of I&I. Three data-logging rain gages were also purchased to correlate rainfall and elevated CSD sewer flows. Flow meter analysis of I&I continued into 2008 and follow-up smoke testing confirmed future-repair areas. The CSD also installed "sealing" manholes at locations historically prone to inflow and raised three additional manholes especially prone to inflow. Finally, the CSD continued to formulate a Sewer System Master Plan. At the end of 2007, the CSD was in the midst of acquiring a permit from the California Department of Transportation to repair broken and corroded pipe hangers that support two CSD force mains on the Toro Creek Bridge that convey sewage from Lift Station # 5 to the Main Street gravity line in Morro Bay. The CSD completed this project in the first quarter of 2008.

At the WWTP, personnel maintained a diligent, proactive preventative maintenance program that included major preemptive repairs of various components of the treatment process. The WWTP documented these activities in monthly operations summaries submitted to the RWQCB (MBCSD 2008a-l). As part of routine maintenance procedures, SCUBA divers inspected the ocean outfall's exterior and the diffuser structure for signs of damage on 12 December 2008. The outfall was in good condition, with no broken or plugged diffuser ports.

Figure 2.2 is a photograph of a diffuser port taken during a previous outfall inspection. It shows 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*), bright pinkish-red in color, covers the top surface of the port. The continued presence of these filter-feeding organisms attests to the benign nature of the effluent discharge and to the outfall's value as an artificial reef. Based on quantitative biological surveys conducted within the region, these anemones are typically observed on high-relief rock surfaces only occasionally found within Estero Bay, and then only in deeper water (>85 m) (Morro Group, Inc. 1999). Ostensibly, their susceptibility to elevated suspended sediment loads explains their rarity on nearshore, lower-relief rocks. The preponderance of anemones on the diffuser confirms the minimal negative impact of the outfall particulate discharge on marine organisms.

Other routine maintenance and minor repairs were regularly conducted on various treatment-plant components. For example, the emergency standby generator was regularly tested under full load. Every quarter, the standby generator was inspected, and a certified contractor performed scheduled maintenance. Annual inspections were also performed on the Plant's cathodic protection system and back-flow prevention devices.

In addition, the WWTP staff instituted several major repairs and preventative-maintenance measures during 2008. For example, after plant personnel noted all three variable frequency drives (VFD) operating erratically and shutting down after a short run time on 18 March 2008, the WWTP staff initiated the year's largest maintenance effort. The VFDs control the three main influent pumps at the headworks. Initially, the WWTP staff attempted a variety of emergency procedures, including operating the drives in automatic and manual modes. With the drives becoming increasingly unresponsive, they called in two electrical contractors to assist in troubleshooting. In conjunction with personnel from the City of Morro Bay's Collection System Department, they installed a bypass pump in the influent channel to maintain flow into the plant while work continued on the VFDs. Subsequently, all three VFDs were replaced, and as part of the upgrade, WWTP staff installed a new ultrasonic level controller in the influent channel at the headworks to replace the existing bubbler unit. In conjunction with these major maintenance efforts in 2008, WWTP staff performed the following maintenance actions:

- Repaired a water leak in the potable water system located adjacent to scum pump #2 and a faulty wire connection on secondary effluent pump #1 (January);
- Installed new cyclones on the grit dewaterer, as well as a new grit screw (February);
- Installed new motor starters and relays for both grit pumps and the waste-activated-sludge (WAS) pump #P6512 to replace units that were no longer cost-effective to repair (February);
- Repaired water leaks in the 6-inch water line, located between digester #1 and the primary clarifiers and behind the chlorine contact tank, for the potable water system (February);
- Repaired and replaced the muffin-monster cutter-cartridge assembly (March);
- Installed the spare motor-control-center main-breaker for the headworks in the breaker cabinet while the existing main breaker was sent to the factory for scheduled reconditioning (March);
- Replaced the drive belts on the WAS pump #6511 and replaced the bearings in the motor for the boiler fan assembly on boiler #1 (March);
- Performed repairs on the main influent pump #2 and u-joints on the drive shaft following repairs (April);
- Drained and inspected primary clarifier #2, removing one yard of rags (April);
- Installed a new chemical dosing pump on the sodium hypochlorite pumping system used for effluent disinfection and rebuilt the old pump for use as a spare (April);
- Installed a new motor on the bar screen and replaced faulty bearings on the existing (spare) motor (April);

- Replaced the support rods on the biofilter distribution arms on trickling filters #1 and #2 (May);
- Reinstalled aeration blower following manufacturer's installation of new bearings in the blower, a new motor, and realignment of the motor and blower on the frame (May);
- Installed new motor starters and relays for WAS pump #P6511 and the collector drive for primary clarifier #2 (May);
- Replaced faulty switches on primary scum pump #1 and collector drive for primary clarifier #2 (May);
- Drained and inspected primary clarifier #1, removing one yard of rags and replacing the sacrificial anodes on the piping supports within the clarifier (May);
- Completed installation of a new gas detection monitoring system at the headworks that began in May (June);
- Installed new motor starter and relays for the collector drive for the secondary clarifier and replaced a faulty local remote switch on the secondary clarifier drive unit (June);
- Disassembled scum pump #2, cleaned the check balls, and flushed the pump (June);
- Installed a new motor on WAS pump #P6511 (June);
- Installed a rebuilt sample supply pump on total chlorine residual analyzer #1 and a new sample cell assembly on total chlorine residual analyzer #2 (July);
- Installed a rebuilt chemical dosing pump on the sodium bisulfate pumping system used for dechlorination (July);
- Replaced the sludge recirculation pump on digester #2 with a rebuilt pump and installed new site lighting around primary clarifier #2 and the secondary clarifier (July);
- Installed new diaphragms on scum pump #1, cleaned the check balls, and flushed the scum pump (July);
- Replaced YSI 5100 dissolved oxygen (DO) meter with new Hach HQ40d LDO probe and requested USEPA Region IX approval to begin using the new probe following the interim Method 10360 for the determination of DO in BOD analysis (August);
- Reinstalled biofilter circulation pumps #P4503 and #P4501, and the secondary effluent pump #P4504 at the interstage pumping station that had been removed and sent to the manufacturer for inspection, reconditioning and balancing of the motors (September);
- Installed a new time clock to control pump run times for WAS pump #6512 and began installing a new pump to replace #6512 (September);
- Repaired a faulty oil fill tube on biofilter distribution assembly #1 (September);
- Calibrated the influent flow meter located in the metering manhole on the 30-inch influent trunk line to the plant and verified calibration of the electromagnetic flow meters for the primary sludge pumping line to the digesters and the return-activated sludge pumping line to the solids contact chamber (October);
- Reinstalled biofilter circulation pump #P4504 and secondary effluent pump #P4501 at the interstage pumping station following manufacturer repair and maintenance (October);
- Installed a new gasket between the motor and gear reducer on the muffin monster located in the influent channel after noticing a wobble in the motor and gear reducer assembly (October);
- Installed a new chemical dosing pump on the sodium hypochlorite pumping system used for effluent disinfection and replaced the time clock, associated contacts, and switches that control grit pump #2 (October);

- Installed a new bushing, pillow block bearing, and new bearing brackets of the adjusting plates for tensioning the drive shaft chain on the bar screen (October);
- Installed a new WAS sludge pump to replace a faulty one installed in September. (November);
- Replaced the existing incubator with a new incubator for bacterial analysis (December);
- Replaced the sludge recirculation pump on digester #3 with a rebuilt pump (December);
- Replaced a faulty hot water recirculation pump on boiler #2, and replaced the fill piping for the sodium hypochlorite storage tank (December);
- Replaced a faulty thermo unit on the tank heater that heats the sodium bisulfate storage tank by maintaining the sodium bisulfate within the tank at 65°F and preventing the bisulfate from crystallizing during periods of cold weather (December);
- Installed a pressure regulator on the potable water main, allowing staff to set the pressure throughout the plant, because staff believes that abnormally high water pressures caused the main line water failures earlier in the year (December); and
- Installed a rebuilt sample supply pump and a new sample cell assembly on the total residual chlorine analyzer #1 and rebuilt the existing pump and assembly for use as a spare (December).

During 2008, the MBCSD also continued its biosolids recycling program involving windrow composting to improve the quality of biosolids produced by the WWTP. Upgrading the current Class-B biosolids designation to Class-A biosolids (exceptional quality, composted) through composting makes the final product available to the public for beneficial reuse as a high-quality soil amendment.

2.1.2 Plant History

The original WWTP, built in 1954, had a nominal capacity of 0.7 MGD and a 1-MGD maximum throughput. 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.

In 1964 the plant upgraded to a nominal capacity of 1 MGD and a 1.3-MGD maximum throughput to meet the demands of the growing coastal community. 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 conversion of the existing digester 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 WWTP facilities intended to further augment the plant's capacity. In 1980, the City began designing these planned improvements, including construction of a new outfall to better protect the marine environment and facilities upgrade providing full secondary treatment.

Following a year-long study of oceanographic conditions within Estero Bay, design of the new outfall was completed in April 1981. The new outfall and diffuser system extended the discharge from the surfzone to a point far off shore. The deeper discharge increased dilution of wastewater within the open-ocean environment. The new outfall was complete and in service in June 1982.

The design of the facility improvements, completed in September 1981, called for a final effluent suspended-solids concentration of 30 mg/L and an equivalent limit on BOD. However, aid from state or federal agencies to finance the construction to meet these full-secondary treatment levels was not available. Since discharge through the new outfall was not causing any apparent adverse environmental impact and the projected future throughput was low, the State determined that additional financial aid for

upgrading the MBCSD WWTP to full secondary was not warranted. Instead, the City modified the design to provide secondary treatment to a majority (1 MGD) of the projected flow to comply with the state water-quality standards, set forth in the California Ocean Plan (COP) (SWRCB 1990). State officials agreed with this level of treatment, provided that the USEPA approved a 301(h)-modified NPDES discharge permit that adjusted secondary-treatment requirements on suspended-solid and BOD emissions.

In a 16 March 1983 letter, the staff of the RWQCB determined that the proposed discharge would comply with applicable state laws, including water-quality standards, and would not require additional treatment, pollution control, or other requirements on any other point or nonpoint source. This tentative determination was 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).

The treatment-plant upgrades between 1983 and 1985 increased the plant capacity to a 2.06-MGD average dry-weather flow and a peak 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, most of the flow (up to 1 MGD) can be diverted through a secondary treatment process of trickling filters, clarifiers, and a solids contact chamber. This removes at least 75% of the solids 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 where the primary and secondary effluents are mixed and disinfected prior to dechlorination and discharge through the ocean outfall.

On 29 March 1985, an NPDES permit based on the previously approved Section-301(h) modification established water-quality standards for the MBCSD WWTP. The permit required 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. The permit also required an extensive monitoring program to assure maintenance of environmental quality. The permit was valid for five years and expired on 8 March 1990; after an evaluation process, the permit was reissued in December 1992. During this period, improvements to the treatment facilities 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 and, after a system of high-pressure nozzles and scraper flights was installed, effluent BOD declined.

During the permit renewal process in 1992, the RWQCB expressed concerns that the discharge could affect the waters within Morro Bay, a newly designated national marine estuary located south of the discharge. In response, a shellfish-monitoring program was instituted. Subsequent analysis concluded that the distance between the discharge and the national marine estuary was too great for the discharge to materially affect the estuary waters. At a typical 1-cm/sec (0.02 mph) transport speed, it would take the effluent three days to reach the entrance to the Bay located 2.8 km (1.75 miles) to the south, assuming southward current direction was maintained throughout that time. Over a much shorter distance and durations, 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 effluent plume 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.

Anticipating permit expiration in early 1998, the MBCSD applied for renewal of their 301(h)-modified NPDES permit in May 1997. The MBCSD supported its application with an extensive technical review of more than ten years of monitoring data (MRS 1997a). An administrative extension until 11 December

1998 allowed regulatory agencies time to review and issue a new discharge permit (RWQCB 1998). Based on discussions between RWQCB, USEPA, and MBCSD staff and their consultants throughout 1998, revisions were implemented in the new permit that 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, USEPA Region IX issued a tentative decision granting MBCSD a permit that modifies secondary treatment requirements under Section 301(h) of the Clean Water Act. Then 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 complied with the California Coastal Zone Management Act. Finally, on 26 January 1999, the USEPA issued the latest NPDES permit, effective 1 March 1999.

The RWQCB approved the current NPDES permit with the proviso that a comprehensive water-reclamation feasibility study be conducted within the following year. A draft report 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) was subsequently submitted to the RWQCB on 7 October 1999. Staff of the RWQCB submitted comments on the feasibility study on 16 February 2000, and, after including these comments by reference, the report was finalized.

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 implementing a reuse project required upgrading the entire wastewater flow to full secondary treatment and that the portion of wastewater going to reuse needed upgrading to tertiary treatment. However, the study also determined that the existing water supply adequately met demand and that utilization of recycled water would be minimal.

The current NPDES permit was due to expire on 1 March 2004. Anticipating its expiration, the MBCSD submitted an application for a new discharge permit on 3 July 2003 (MBCSD 2003). The application included a supplemental report (MRS 2003a) providing an extensive technical review of monitoring data collected over the previous 15 years. Based on the historical absence of perceptible impacts and projected high effluent quality for the upcoming five-year permit term, the application requested continued 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 IX (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 reissuing the MBCSD permit, and the RWQCB voted to continue the hearing.

In April 2006, the MBCSD adopted an eight-year time schedule to rehabilitate and upgrade the treatment plant to tertiary treatment, including onsite composting, as the preferred alternative for upgrading the WWTP by 2014. In September 2007, the MBCSD adopted a draft facilities master plan that outlined the facilities necessary for a tertiary treatment capacity of 1.5 MGD. In August 2007, the City of Morro Bay and CSD individually adopted revenue programs that identified the sewer-rate fees required for each community to finance the plant upgrade and to provide revenue for needed sewer-system capital improvement projects. In July 2008, the City of Morro Bay implemented new residential and commercial water-use rates that increased the existing fees by 50%.

Around the same time, the USEPA issued an Endangered Species Act (ESA) biological evaluation of continued discharge under a 301(h) modified discharge permit and determined:

that the continued wastewater discharge from the Morro Bay/Cayucos facility is not likely to adversely affect the brown pelican or southern sea otter, both of which occur in the vicinity of the subject discharge. EPA finds that any potential direct or indirect effects of the continued wastewater discharge would be insignificant to the brown pelican and southern sea otter.

Pursuant to Section 7 of the ESA, the proposed action of the USEPA requires consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), which protect federally listed endangered species and designate critical habitat that may be affected by the proposed action. On 21 December 2007, the USFWS concurred with the USEPA “*determination that the proposed project is not likely to adversely affect the brown pelican or southern sea otter,*” while acknowledging a significant degree of uncertainty regarding potential mechanisms for impacts to otters, and that the MBCSD plan to upgrade to tertiary treatment “*has significant potential to minimize concerns regarding possible effects on otters.*”

The USEPA incorporated three conservation measures into the new NPDES discharge permit to address concerns about potential contributions to otter morbidity by cat litter disposed into the collection system and potential contributions to domoic acid poisoning by nutrients introduced into the marine environment. First, the MBCSD would implement a public outreach program to minimize the input of cat litter-box waste into the municipal sewer system. Second, the MBCSD would regularly monitor nutrient loading from the WWTP. Third, the facility would upgrade to at least full secondary treatment levels by 2014.

Based on the foregoing findings and the incorporated conservation measures, the RWQCB unanimously adopted the new discharge permit on 4 December 2008. Subsequently on 9 January 2009, the California Coastal Commission unanimously determined that the new discharge permit complied with the California Coastal Zone Management Act. And on 14 January 2009, the USEPA issued the new NPDES permit, effective 1 March 2009.

Since then, concern regarding the impact of the MBCSD discharge on otter morbidity has been proven groundless. On 21 January 2009, Johnson et al. (2009) published the results of a detailed field study of southern sea otter exposure to *Toxoplasma gondii*, a protozoan pathogen whose only definitive hosts are felids. The study confirmed findings previously documented by MRS (2006b) and USEPA (2007) disputing erroneous assertions by NRDC (2006) that northern Estero Bay is a “*hot spot*” for otter mortality and an epicenter of toxoplasmosis infection related to the disposal of domestic cat feces into the MBCSD collection system.

Johnson et al. demonstrated that the frequently cited study by Miller et al. (2002) was fatally flawed by spatial sampling bias. Specifically, Johnson et al. found that the epicenter of *T. gondii* infection in otters was along the rugged coastline to the north and not within Estero Bay. Miller et al. failed to account for the fact that infected otters that died along the coastline to the north were preferentially deposited along

the beaches within Estero Bay by the prevailing winds and currents. Moreover, the beach-cast carcasses were both more easily detected and more frequently reported within the bay than along the less-populated and less-accessible coastline to the north. Because the watershed to the north has comparatively few housecats, the authors of the new study hypothesized that instead of housecats “*a more important source of infection might be bobcats and mountain lions, which are abundant in the area [to the north].*”² This hypothesis is plausible given that the largest reported outbreak of human toxoplasmosis was linked to a municipal drinking-water reservoir in British Columbia contaminated by cougar feces (Bowie et al. 1997; Aramini et al. 1998).

2.1.3 Regulatory Setting

The 1972 Federal Clean Water Act and its 1977 amendments established national water-quality goals and created a national permit system (NPDES) of minimum standards for the quality of discharged waters (USGPO 1997a). Pursuant to the new system, states established 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 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 specifically address 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.
- **Noncontact 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, and oil well repressurization.
- **Navigation (NAV).** Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels. The RWQCB interprets NAV as being present within any natural body of water that has sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, and pleasure.

² <http://www.sanluisobispo.com/news/local/story/602717.html>

- **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 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%;
- 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 modify 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 the MBCSD satisfied the following additional conditions.

- Demonstrate 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 DO depression (SWRCB 1997). In January 1999, the California Coastal Commission determined that the discharge complies with the State Coastal Zone Program that incorporates COP standards.

- Demonstrate that 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 USFWS (USDOI 1998) and the NMFS (NOAA 1998 2004) determined that the discharge will not adversely impact threatened or endangered species, or critical habitats, pursuant to the ESA.
- Conduct a monitoring and reporting program capable of evaluating the effects of the discharge (40 CFR 125.63). The monitoring program in this report satisfies this requirement.
- Demonstrate that the discharge will not result in any additional treatment requirements on any other point or nonpoint source (40 CFR 125.64). The footprint of the MBCSD discharge does not overlap other discharges.
- Determine whether the WWTP is subject to pretreatment requirements. Since 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. And since the discharge is considered small, it is also exempt from the urban pretreatment requirement (40 CFR 125.65).
- Demonstrate whether the pollution-prevention program meets the requirement for a nonindustrial source control program (40 CFR 125.66). 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.
- Demonstrate that there will be no new, substantially increased discharges of BOD and TSS beyond those specified in the permit (40 CFR 125.67). The historically high performance of the plant process and the limited projected growth in population and industry within the service area, and the analyses provided in this report demonstrate this.
- Ensure that the WWTP exceeds the minimum requirements for primary treatment (40 CFR 125.60). The WWTP performs “*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).

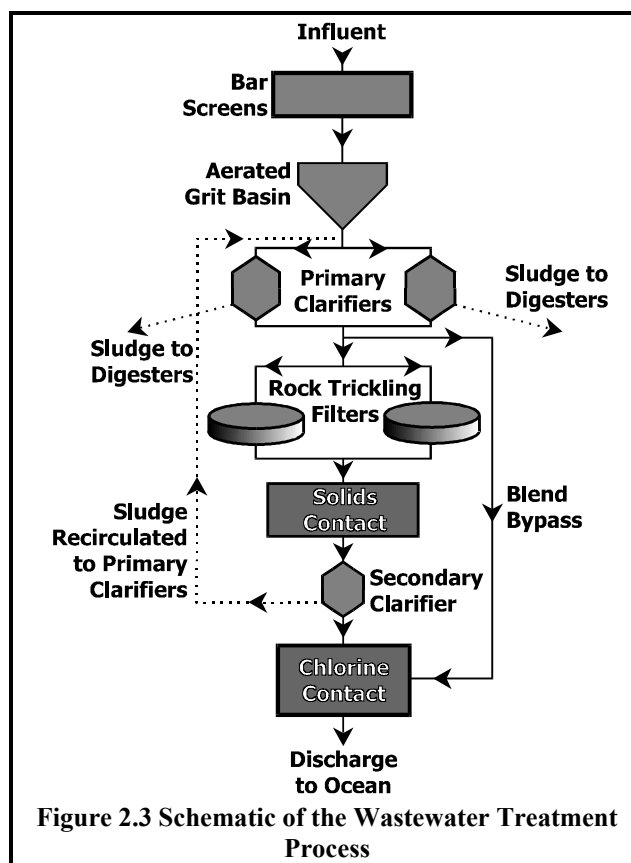
The MBCSD WWTP is categorized as a Class III wastewater treatment facility by the Office of Operator Certification within the California State Water Resources Control Board. The Board reclassified the facility in 2001 from a Class-IV facility based on the treatment process and volume of flow through the plant. A typical Class-IV facility treats more than 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 using 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 before the entire blend is chlorinated for disinfection and then dechlorinated. The disinfected and dechlorinated 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 and fertilizer. A schematic of the biosolid process is shown in Figure 2.16 on Page 2-48.

The location of the Morro Bay-Cayucos WWTP and outfall within Estero Bay is shown in Figure 2.4. The discharge is released 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 approximately 4,400 ft (1,341 m) in a northwesterly direction. The outfall terminates in a multi-port diffuser approximately 2,700 ft (827 m) from shore. The 170-ft (51.8 m) long diffuser lies in 50 ft (15.2 m) of water, referenced to mean lower low water. 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.



Because of its location, the MBCSD discharge does not interfere with maintenance of water quality and designated beneficial uses within Estero Bay (see Section 2.1.3 on Page 2-12). The discharge occurs in well-flushed, open coastal waters where re-entrainment or accumulation of effluent will not violate applicable water-quality standards, even if combined with pollutants from other sources. Intakes and outfalls from other publicly owned treatment works are distant from the MBCSD outfall. For example, water intake for the desalinization plant is from saltwater wells and not from the ocean environment where the MBCSD discharges. Similarly, surface discharge of water from the LS Power Group plant (formerly Duke Energy and PG&E), when it does occur, is far 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 2008. 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 2008. First, the comprehensive industrial waste survey completed in 1999 has been updated annually, including in 2008. Second, a public outreach program

initiated in 1999 continued in 2008. Finally, influent and effluent were diligently monitored for industrial contaminants.

Industrial Waste Survey

The local economy within the MBCSD service area relies on commercial fishing and tourism, with no heavy industry or manufacturing of any environmental significance. As evidence of the extent that the local economy relies on tourism, an average of slightly more than 50 restaurants are found in the service area during any given year. Accordingly, comprehensive monitoring for more than 15 years indicates that effluent discharged from the treatment plant consists primarily of benign constituents. Industrial waste surveys conducted during 2008 and prior years support these findings; they quantify a comparatively low volume of influent from light industrial sources containing nontoxic constituents typical of wastewater from domestic sources. Throughout the years of modern treatment-plant operation, the industrial base in the largely residential communities of Morro Bay and Cayucos has experienced virtually no expansion. During 2008, the absence of significantly elevated levels of industrial pollutants within the wastewater stream confirmed the continuous lack of substantive industrial input.



During 2008, industrial-waste survey activities relied heavily on a digital database developed by plant staff in 1999 and updated in 2005. The database includes business names, addresses, contacts, telephone numbers, inventories of chemicals, discharge volumes, and other pertinent information for all potential industrial users in the service area. Using this database expedites quantitative assessments of industrial usage and annual updates of contact information.

The master list of businesses in the database is adapted from business license applications filed with the City of Morro Bay and input provided by the CSD. The master list is subdivided into businesses with no potential for industrial discharges, such as offices and retail stores, and those with the potential for industrial waste discharge. All businesses with potential industrial discharges are either interviewed in person or asked to complete a Commercial User Questionnaire.

Based on the detailed information provided in the questionnaire, some businesses are excluded from classification as industrial dischargers because they either do not generate wastewater at all or they discharge only domestic wastewater. These businesses included theaters, beauty shops, barbershops, and various retail firms. For the remaining industries, waste discharge volumes are estimated proportionate to

water usage history from City Water Department billing records. Follow-up activities for these businesses include scheduled return visits, surprise onsite inspections, and formal tours of the facilities. Based on this phase of the survey, certain industrial dischargers are identified for continued close monitoring with scheduled, annual future site visits. These include commercial laundries, car washes, dry cleaners, print shops, and the oil-water separator maintained by the City of Morro Bay. A series of businesses were also targeted with unannounced inspections in 2008.

Overall water use within the communities has changed little between 1999 and 2008. Table 2.2 lists the ten largest water users in the service area during 2008. These large water users add compounds to the wastestream that are not particularly toxic to humans or aquatic organisms and do not generally interfere with the treatment process. In addition, commercial businesses and government agencies contributed approximately 0.15 MGD, 14% of the influent, to the wastewater processed by the WWTP in 2008. Domestic sources contributed the majority of wastewater processed by the plant.

The industrial-waste database divides these commercial and government entities into two groups depending on their type of discharge. Entities in the first group discharge wastewater 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. For example, the largest single user, offices and facilities of the City of Morro Bay, discharges wastewater substantially similar to that of residential users, albeit a greater volume. In addition, although the City is the largest water user in the service area, the entire volume does not flow to the collection system because some of the water is used for grounds maintenance.

The second-largest user of water, the Pacific Care Center, is a senior care facility that has also been known as the Bayside Care Center, Casa de Flores, and Seashell's Communities. The Pacific Care Center houses approximately 220 residents and has dining and laundry facilities on site. The Pacific Care Center launders approximately 4,000 pounds of laundry during a 20-hour daily operating schedule. Similar to the usage of the City of Morro Bay, the Care Center uses some water to irrigate the grounds, so the entire volume of used water does not flow to the collection system.

Mission Linen is the only large discharger with even a light industrial nature. However, Mission Linen's discharge constituted only 1.6% (0.018 MGD) of the wastewater processed by the treatment plant. Nevertheless, this commercial laundry uses several industrial-grade detergents, bleaches, surfactants, and brighteners that can harm bacteria within the secondary treatment system. In addition, solvents, oils, and other substances removed from soiled laundry can potentially contaminate the wastestream. To minimize this potential, Mission Linen pretreats its discharge before releasing it into the collection system. In 2002 Mission Linen installed a pretreatment system that includes pH buffering with phosphoric acid to neutralize excessive increases in wastewater alkalinity that can potentially interfere with the plant's treatment process. Although the system has been largely effective, on 7 January 2008 a faulty pH probe caused delivery of an erroneously low acid dosage by the pH-neutralization system, which noticeably

**Table 2.2 Entities with the Largest
Estimated Water Use**

Business	Water Use (gpd)¹	Fraction² (%)
City of Morro Bay	53,407	4.86
Pacific Care	20,108	1.83
Mission Linen	17,583	1.60
Inn at Morro Bay	16,495	1.50
Department of Parks	10,163	0.92
Morro Elementary	8,644	0.79
Morro Dunes Trailer Park	8,609	0.78
Coastal Unified School District	7,945	0.72
Blue Heron Terrace	5,900	0.54
Blue Sail Inn	4,549	0.41
Total Use	153,404	13.95

¹ Gallons per day ² Fraction of average WWTP flow for 2008
(1.100 MGD)

increased the plant's influent pH on that day. Fortunately, timely source-monitoring by MBCSD staff identified the anomalous influent property, and the staff worked with Mission Linen to identify and resolve the sensor-malfunction problem. Together, MBCSD staff and Mission Linen addressed the problem and prevented a deleterious impact on the treatment-plant process.

Hotels with onsite laundry facilities and two large RV park use large volumes of water, but their discharge wastewater is similar to that of residential users. Of these users, the 98-room Inn at Morro Bay used, by far, the most water. These facilities and public laundromats discharged detergents, similar to those of residential users, but in greater volume than their residential counterparts.

Other light industrial users with smaller discharges include car washes. Car wash discharge is considered industrial in nature because of the volume of solids, oils, and greases washed from vehicles. As mitigation, the car washes pretreat their wastewater with grease separators before discharging it into the collection system. The sewer-use ordinance of the City of Morro Bay municipal code prohibits smaller contributors, like gas stations and repair garages, from disposing known contaminants into the collection system. Similarly, the municipal code requires restaurants and self-service car washes to install and maintain grease traps within sewer line connections.

In addition to chemicals from the industrial sources that contributed to the influent, the WWTP intentionally introduced three chemicals, sodium hypochlorite, sodium bisulfite, and ferrous chloride, into the treatment process. The WWTP added sodium hypochlorite to disinfect the wastewater prior to discharge into the ocean. Wastewater facilities commonly disinfect with some form of chlorine. However, residual chlorine can react with organic matter in the wastewater, and even low concentrations of residual chlorine can be hazardous to aquatic life. To reduce effluent toxicity, treatment plants must dechlorinate to remove free and combined chlorine ions. The sodium bisulfite added to the MBCSD treatment process for dechlorination tracked the monthly sodium hypochlorite dose during 2008. Bisulfite usage was lowest in April (2,300 gallons), as was the sodium hypochlorite dose (2,800 gallons), largely because I&I was diluting wastewater of sewage origin (MBCSD 2008d). The highest monthly doses of both compounds occurred during the summer when organic loading and bacterial densities within the wastestream were largest. During that time, monthly bisulfite (2,600 gallons) and hypochlorite (3,600 gallons) dosage increased by 13% and 28%. The WWTP also adds ferrous chloride to the treatment process. The ferrous chloride primarily controls odor in the collection system, although it also reduces hydrogen sulfide emissions during flaring of digester gas and heating of the digesters at the WWTP, as required by the Air Pollution Control Board.

Public Outreach

The MBCSD reaches out to the public with education through literature, direct communication through presentations and talks, and resource availability, such as implementation and oversight of the on-site hazardous-waste disposal facility.

Public awareness literature pertaining to proper disposal of hazardous household chemicals is an integral part of the pollution prevention program by the MBCSD. In June 2008, water bills sent to residential users included a public-services newsletter. Traditionally, the newsletter has informed ratepayers about pending upgrades to the plant, addressed frequently asked questions about the plant and plant processes, educated the public about the plant's operating history, and shared proper waste-disposal techniques for substances like oil, grease, and insecticides. The newsletter has also supplied vital information to ratepayers concerning the plant's permit renewal status, upcoming public hearings, and topics of current biological interest, such as Toxoplasmosis and otters.

In 2008, the public outreach effort focused on best management practices for cat litter disposal to avoid introduction of cat litter into the collection system. This addressed one of three conservation measures recommended by the USEPA (2007) in the biological evaluation they conducted in preparation for issuance of a new NPDES discharge permit. They postulated that minimizing the input of cat litter-box waste into the municipal sewer system would help reduce the introduction of *T. gondii* into the marine environment, thereby mitigating a known disease vector affecting the southern sea otters.

However, the MBCSD began their public education effort about proper disposal of cat litter in 2006, well before the USEPA issued their biological evaluation. At that time, the MBCSD issued a Q&A sheet³ that discussed cat litter and also addressed questions about the WWTP upgrade. In the spring of 2008, the MBCSD engaged the advertising and public-relations firm of Barnett Cox & Associates to spearhead public education efforts regarding proper cat litter disposal. In collaboration with MBCSD staff, Barnett Cox & associates increased the efficacy of the outreach program with humorous brochures, flyers, and posters⁴ that emphasized the importance of proper litter disposal with the slogan, “Don’t flush the mush.” They also sent press releases to local media outlets, including TV, radio, and newspapers. Their efforts prompted an article, “City’s sewer manager warns about kitty litter,” in the Sun Bulletin on May 14 2008.

During the second phase of the outreach process, the MBCSD circulated mailers to all residents of Cayucos and Morro Bay with their water bills. The mailers encouraged residents and cat owners to properly dispose of cat litter and described the link between *T. gondii* and cats and its potential effects on marine organisms. In addition, the MBCSD created posters encouraging people not to “flush the mush.” They installed the posters at 22 locations throughout Morro Bay and Cayucos, including government buildings, pet supply stores, groomers, vet clinics in Morro Bay and Los Osos, the Morro Bay Chamber of Commerce, and the National Estuary Program, and at the San Luis Obispo County Animal Shelter and the Woods Humane Society. Electronic versions of the flyer and poster were also circulated to the Surfrider Foundation for distribution to their members and interested parties.

In the third phase of the outreach program, the MBCSD directly communicated with the public through realtor groups, Rotary club talks, and presentations at televised City Council and JPA⁵ board meetings. Topics at those meetings also included generalized discussions of proper disposal practices for a variety of household wastes, including pharmaceuticals, fats, oils, and grease, identification of the household hazardous-waste facility located at the treatment plant, and the availability of high-quality compost as a soil amendment produced by the plant’s onsite biosolids composting project.

In addition to public education, the MBCSD public-outreach program focused on improved disposal resources for residents. The public-outreach program reached a milestone in August 2000 when the MBCSD established a new household hazardous-waste disposal site at the WWTP. MBCSD partnered with the Integrated Waste Management Authority to establish a permanent collection facility at the treatment plant. Previously, household hazardous-waste could only be disposed at the distant Chicago Grade and Cold Canyon landfills on limited days. Since it opened to the public in August 2000, the facility at the WWTP has been open for free waste disposal to all residents of San Luis Obispo County every Saturday from 11:00 AM to 3:00 PM, except holiday weekends.

The ongoing public education campaign advertising the hazardous-waste disposal site has helped make the facility one of the top sites in the county in terms of the volume of collected material. Each year,

³ [Q&A Sheet: The Morro Bay-Cayucos WWTP Upgrade and What it Means for You](#)

⁴ http://www.cayucosd.org/documents/Kitty%20Litter/KittyLitter_Poster.pdf

⁵ Joint Powers Agreement between the City of Morro Bay and the Cayucos Sanitary District for the operation and funding of the MBCSD WWTP

between 20 and 50 individuals disposed of household hazardous waste at the facility each weekend and more than 1,500 people total disposed of waste at the facility. Between July 2007 and June 2008, the WWTP disposal facility processed more than 119 tons of household hazardous waste; a large portion of that waste was recycled. Collected material included more than 30,000 pounds of oil-based paint; 30,250 pounds of latex paint; 8,300 pounds of flammable liquids and solids; 10,148 pounds of aerosol containers; 6,900 pounds of antifreeze; 14,040 pounds of car batteries; 17,220 pounds of motor oil/oil products; 5,000 pounds of poisons; 2,600 pounds of acids and bases; and 14,040 pounds of compressed gas cylinders. Without the permanent hazardous waste facility, some of this material would have gone to a landfill or been discharged into the ocean.

In 2008, the hazardous-waste disposal site also collected 95,460 pounds of electronic waste (e-waste), including video display devices such as television and computer monitors, which the facility started accepting in 2004. Accepting these devices addressed the long-standing problem of proper disposal of e-waste. Cathode ray tubes (CRT), the picture tubes used in many older computer monitors and television screens, contain large quantities of five known toxic chemicals: cadmium, mercury, chromium, lead, and phosphorous. In fact, the EPA estimates that discarded CRT contribute at least 40% of the known lead in U.S. landfills. Flat panel monitors, cell phones, digital cameras, and computer hardware also contain hazardous waste elements. Although these pollutants are normally sealed within the finished product, heavy equipment that compacts 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 and leaching into groundwater occurs. Properly recycling these products can prevent this contamination.

Source Identification

Although measures have been implemented to reduce incompatible contaminants introduced into the wastestream, concentrations are occasionally elevated in the periodic chemical analysis of effluent. When this occurs, MBCSD personnel trace the contaminants to the source and work with the source owner to eliminate the contamination. However, in 2006 the State Water Resources Control Board adopted new statewide waste discharge requirements for sanitary sewer systems. These new requirements transferred responsibility for managing the introduction of fats, oils, grease, and other components from the WWTP to the City's Collection Department. Although no unusual contaminants were detected within the wastestream during 2008, WWTP personnel identified and tracked occasional excursions of influent properties with the established source-detection program.

For example, plant staff quickly identified an abnormal increase in the waste-stream's pH on 7 January 2008 with diligent monitoring. The elevated pH levels prompted a call to Mission Linen, a local commercial laundry facility whose discharge has influenced pH levels in the past. Mission Linen subsequently discovered and replaced a faulty pH probe in their neutralization system. Influent-pH values at the plant quickly returned to normal.

Ongoing source identification and resolution efforts in 2008 also included a grease-trap inspection program that started in 2002. This program manages the potentially damaging input of fats, oils, and grease into the WWTP. In 2002, 68 businesses in the City of Morro Bay were subject to grease-trap requirements. This number has fluctuated over the years and approximately 50 businesses were subject to the requirements in 2008. The MBCSD conducted spot checks at many of these establishments during the year; however, they did not find any concerns during these inspections.

2.2 WASTEWATER CHARACTERIZATION

Monthly wastewater characterizations documented a number of different aspects of the treatment plant's performance in 2008 (Table 2.3). Removal rates quantified the plant's ability to reduce major organic

constituents 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 introduced into the marine environment.

Table 2.3 Monthly Averages of Influent and Effluent Parameters

Month	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		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	1.248	301	19	93.7	92	334	38	89.3	151
February	1.216	317	14	94.4	66	294	30	89.6	145
March	1.110	358	25	93.2	102	365	37	90.0	152
April	1.062	382	22	93.5	85	320	37	88.3	146
May	1.062	402	26	95.6	104	338	34	90.2	144
June	1.102	394	25	94.1	101	341	49	84.3	199
July	1.214	317	22	91.7	100	365	47	86.9	235
August	1.196	330	20	94.2	89	336	42	87.5	182
September	1.063	305	16	94.7	65	272	32	88.3	129
October	0.988	302	16	94.7	61	329	39	88.1	145
November	0.974	320	15	95.1	55	333	31	90.6	117
December	0.967	318	19	94.7	70	335	44	86.8	156
Average	1.100	337	20	94.1	83	331	38	88.3	159
Monthly Limitation	≤2.36¹		≤70	≥75.0	≤546		≤120	≥30.0	≤936
Annual Total (MT)					30				58
Nominal Annual (MT/year)					≤199				≤342

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

Month	pH		Turbidity (NTU)	Settleable Solids (ml/L)	30-Day Median ² Total Coliform (MPN/100ml)	Oil and Grease		
	Influent	Effluent				Influent (mg/L)	Effluent (mg/L)	Mass Emissions (kg/day)
January	7.9	7.5	28	<0.1	<2	38	1.5	15
February	7.8	7.6	26	<0.1	<2	44	0.0 ³	0
March	7.9	7.6	32	<0.1	<2	55	4.5	19
April	7.9	7.6	30	<0.1	<2	71	2.3	9
May	7.8	7.6	32	<0.1	<2	77	5.0	19
June	7.7	7.6	36	<0.1	<2	130	3.7	14
July	7.8	7.5	32	<0.1	<2	210	2.4	10
August	7.8	7.5	29	<0.1	4	95	6.2	28
September	7.7	7.5	29	<0.1	2	24	0.0	0
October	7.7	7.5	27	<0.1	<2	64	0.0	0
November	7.8	7.6	28	<0.1	<2	140	7.0	27
December	7.7	7.5	28	<0.1	<2	60	15.1	57
Monthly Average	7.8	7.5	30	<0.1	<2	84	4.4	18
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)

³ Effluent O&G concentrations too low to be reliably quantified were considered zero in the averages.

Treatment-plant personnel collected and analyzed samples throughout 2008; those samples were then used to compute the monthly averages of the principal influent and effluent characteristics listed in Table 2.3. WWTP personnel regularly determined the principal physicochemical properties of the effluent, including suspended solids, BOD, pH, total residual chlorine (TRC), turbidity, settleable solids, and total coliform bacteria. The frequency and the duration of individual samples varied among the parameters. For example, average reductions in suspended solids and BOD were determined from 24-hour composite samples of influent and effluent 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 per week, whereas O&G concentrations were determined at least weekly. Effluent ammonia was determined from monthly grab samples.

Detailed analysis of 23 years of these measurements concluded that the plant consistently outperformed wastewater treatment expectations based on regulatory standards. Over the long plant history, nothing has indicated deteriorating plant performance, and effluent quality has consistently exceeded expectations based on the original design criteria. Rare exceptions to standards or criteria have been direct results of brief, unavoidable mechanical failures of a treatment-system component or the external introduction of a contaminant within the influent stream. Considering their diligent preventative maintenance program, plant personnel's primary challenge for has been quick response to unanticipated failures in system components.

Rain events, population fluctuations, and equipment-related incidents during 2008 are briefly described in Table 2.4 because of their potential impact on flow and effluent quality. As in past years, unusual measurements in plant parameters generally related to one or more identifiable incidents. The direct relationship between external events and effluent parameters demonstrated the overall effectiveness of the treatment process and plant personnel's high degree of control under normal operating conditions. If this were not the case, excursions in effluent properties would be random and uncorrelated with external events. During 2008, none of the ten notable events resulted in an exceedance of the discharge limits specified in the NPDES permit. In the following discussions of the various wastewater characteristics, the various events listed in Table 2.4 are referenced. Even the few events identified in the table were relatively unimportant with regard to the overall quality of the discharged wastewater.

Table 2.4 Events that Affected the Treatment Process during 2008

#	Date(s)	Event Description	Effect on Treatment Process
E1	1/2/08	• Temporary increase in population over the New Year's holiday • Influent grab sample collected rather than composite	a) 2 nd highest influent BOD (440 mg/L) b) Highest effluent BOD (71 mg/L) c) 2 nd highest BOD emission (278 kg/day) d) 3 rd highest effluent coliform density (80 MPN/100ml)
E2	1/3 & 1/7	• Malfunction of Mission Linen's pH-neutralization system	a) Highest and 2 nd highest influent pH (8.7 & 8.3)
E3	1/3-1/7	• Rainfall (2.2 inches) from a 6-day storm • Rainfall (1.3 inches) on 1/4	a) 1.1 MG of inflow into the collection system b) 3 rd highest daily flow on 1/4 (1.9 MGD)
E4	1/22-1/27	• Rainfall (4.9 inches) from a 6-day storm • Rainfall (3 inches) on 1/22; the highest daily accumulation of the year	a) 4 MG of inflow into the collection system b) Highest and 2 nd highest daily flows (2.6 & 2.1 MGD) c) 3 rd highest TSS emission (214 kg/day) d) Highest effluent coliform density (140 MPN/100ml)
E5	2/1-2/3	• Rainfall (1.2 inches) from a 3-day storm	a) 0.7 MG of inflow into the collection system b) 4 th highest daily flow (1.8 MGD) on 2/3

#	Date(s)	Event Description	Effect on Treatment Process
E6	3/18-3/21	Headworks bypassed to replace VFDs for influent channel pumps	a) Highest chlorine residual of the year (0.77) b) Flow totals determined from adjusted effluent flow meter
E7	5/20-5/27	Lingering effects from drying of trickling filters during replacement of support rods for spraying system on 5/6	a) Highest effluent TSS (52 mg/L) b) Five of the six highest effluent TSS (>39 mg/L) c) Highest TSS emission (249 kg/day) d) 2 nd highest effluent BOD (56 mg/L) e) 3 rd highest BOD emission (267 kg/day) f) Highest and 3 rd highest effluent turbidity (64 & 60 NTU) g) Highest 7-day average turbidity (53 NTU)
E8	7/4-7/6	Temporary increase in the tourist population during the week of the Independence Day holiday	a) 1.2 MG of increased flow processed by the plant b) Highest BOD emission (312 kg/day) c) 2 nd lowest BOD removal rate (82%) d) 4 th highest effluent O&G (6.6 mg/L) e) 3 rd highest O&G emission (32 kg/day) f) Highest influent O&G (210 mg/L on 2 July)
E9	11/25-11/30	- Temporary increase in the population during the Thanksgiving holiday - Rainfall (1 inch) from a 2-day storm after an extended dry period	a) 1.1 MG of increased flow processed by the plant b) 2 nd highest weekly effluent O&G (28 mg/L) c) 3 rd highest O&G emission (108 kg/day)
E10	12/25-12/31	Temporary increase in the population during Christmas and New Year's holidays	a) 0.2 MG of increased flow processed by the plant b) Highest and 3 rd highest weekly effluent O&G (32 mg/L & 17.8 mg/L) c) 2 nd highest O&G emission (134 kg/day) d) 2 nd highest coliform density (130 MPN/100ml) e) 2 nd highest effluent BOD (56 mg/L) f) 4 th highest BOD emission

2.2.1 Flow Rate

Flow through the plant in 2008 was far less than the plant's design capacity and the discharge limit in the NPDES discharge permit. The waste discharge requirements (RWQCB-USEPA 1998a) state that "*the peak seasonal dry weather flow shall not exceed a monthly average of 2.36 MGD.*" Plant throughput never approached this flow limitation during 2008, not even during winter when the limitation does not apply (Table 2.3). Two intense winter storms deposited seven inches of rain within the collection area during January and resulted in the highest monthly average flow of 1.25 MGD (Events E3 and E4 in Table 2.4 and Figure 2.5). Although not as intense, a February storm deposited another 1.2 inches of rain in the collection area (Event E5) and caused the second-highest monthly plant throughput of 1.22 MGD.

These events confirm that inflow of rainwater into the collection system can strongly influence the maximum monthly plant throughput in any given year. This may seem counterintuitive because of the relatively brief nature of the events (Figure 2.5), but the intensity of a single rainstorm (E3) can easily outweigh the impact of large population increases on major holidays such as Independence Day (E8). However, when totaled over a month, the influence of these two types of events is often only marginally different; for example, the July throughput (1.214 MGD) was only slightly less than the throughput in February (1.216 MGD, Table 2.3). Over holidays like Thanksgiving (E9) and Christmas/New Year's (E10), population increases from both people staying home and tourists entering the area, can perceptibly impact the daily flow, although rainfall also contributed to the flow around the time of those holidays (Figure 2.5).

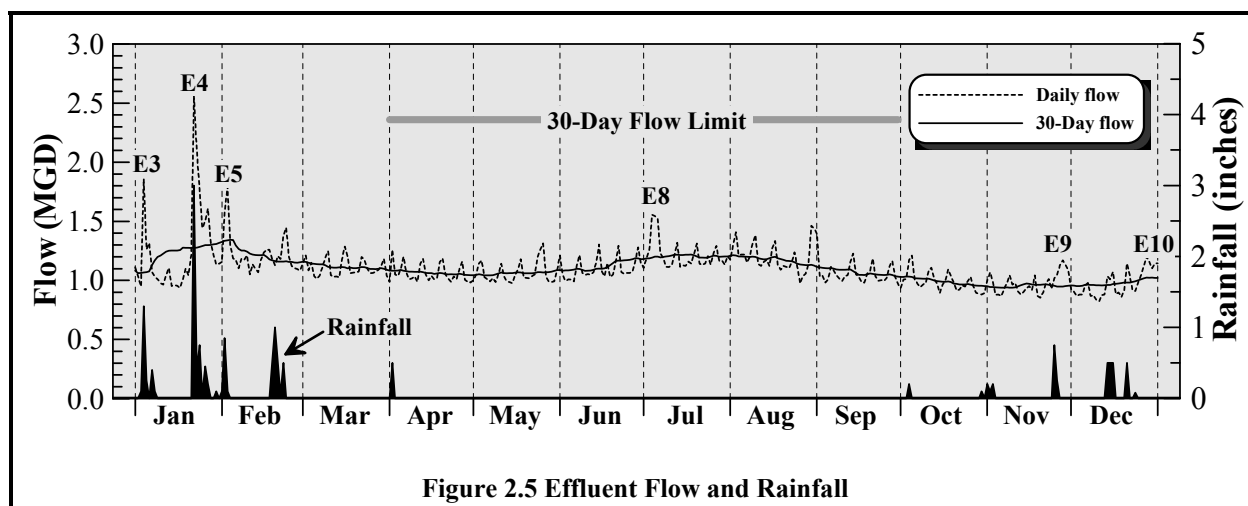


Figure 2.5 Effluent Flow and Rainfall

When viewed on an annual basis, holiday population increases and rainfall events only contributed 3.3% of the total plant throughput in 2008 (Table 2.5), although they can briefly influence other wastewater properties. The largest fluctuating contribution to the annual average flow of 1.1 MGD is from population increases by residents on weekends, which, at nearly 7%, was more than double the contribution of rainfall and seasonal tourism influences combined. However, population increases by residents on weekends, and tourists during the summer and various holidays collectively accounted for approximately 10.4% of the reported annual throughput. Regardless, this was substantially less than the flow from the infiltration of groundwater into the collection system, which accounted for at least 12.9% of the average flow in 2008.

Table 2.5 Contributions to
Annual Flow (MGD)

Source	Rate	Fraction
Total ¹	1.100	100.0%
Base	0.822	74.7%
Infiltration	0.142	12.9%
Weekends ²	0.076	6.9%
Seasonal Tourism ³	0.024	2.2%
Inflow	0.021	1.9%
Holiday Tourism ⁴	0.015	1.4%

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

The influence of long-term population increases, such as summer tourism, is visible in the 30-day running average flow (solid line in Figure 2.5). The running average distinctly increases in June and July, but the maximum flow of 1.22 MGD on 18 July was still only about half of the monthly permit limit for dry-season flow, which is indicated by the thick shaded line spanning the “dry” season (April through September) in Figure 2.5. The remaining 0.822 MGD of base flow was equal to the lowest reported daily flow, which was recorded in early December, well after the summer tourist season ended and before winter storms began increasing the water-table level. However, this estimated base flow probably does not represent wastewater purely of sewage origin that was generated by the full-time resident populations of Cayucos and Morro Bay. Instead, because base flow was computed from the lowest reported flow, it undoubtedly includes contributions from the ongoing infiltration of groundwater throughout the year. For example, a much lower flow of 0.741 MGD was recorded in 2002. This suggests that at least another 0.081 MGD of 2008 “base” 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, but a precise estimate of infiltration cannot be determined from an analysis of the time series of daily flow alone. At any rate, the 2008 infiltration contribution listed in Table 2.5 probably significantly underestimates the true level of infiltration.

Overtotalized Flow

In 2008, overtotalization of daily flow volumes was negligible compared to prior years. 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 was reported using the effluent meter. However, the meter routinely overestimated the discharge volume by at least 25%, so an influent flow meter was installed and tested in 2000. Although consistently more accurate than the effluent flow meter, the influent meter also overtotalized the flow on rare occasions when hydraulics in the influent flume were compromised. Beginning in 2002, 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 backed up in the 350 feet of pipe between the treatment plant and the metering flume. The ultrasonic depth transducer then misinterpreted the resulting increase in water level within the flume as increased flow.

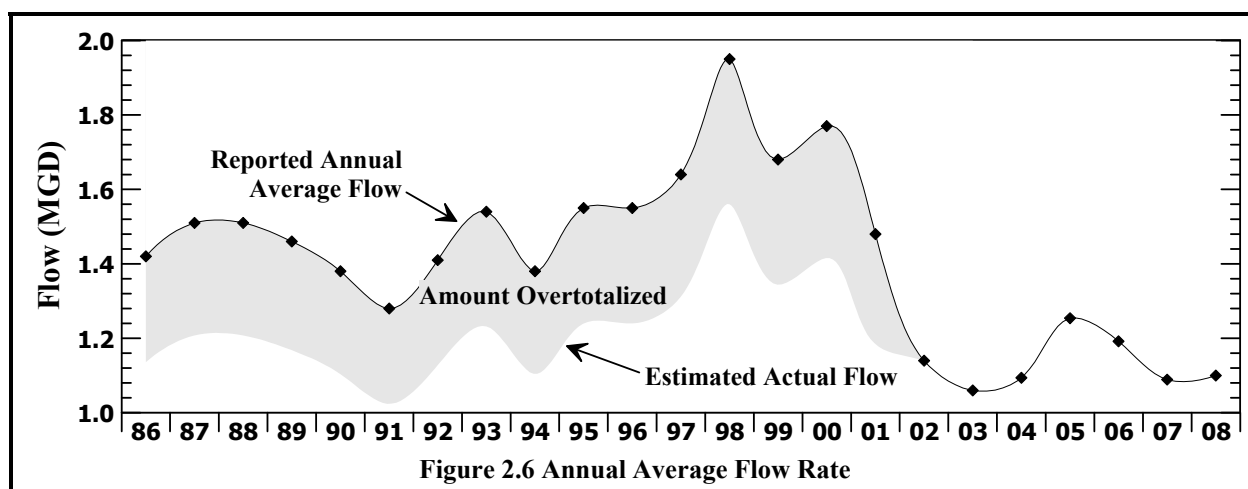


Figure 2.6 Annual Average Flow Rate

Based on recommendations from analyses performed on 2002 flow data (MRS 2003b), beginning in 2003 an adjusted effluent flow measurement was reported instead of the flow measured by the influent meter on occasions when the metering flume was surcharged. Since then, adjusted effluent measurements were reported in place of erroneous influent measurements only a few times. During 2008, reported flows were based on adjusted effluent-meter measurements once. Between March 18th and the 21st (E6), flow readings reported by the influent meter were erroneously elevated due to surcharging of the influent flume that was caused by ongoing repairs to the influent pumping system at the headworks. The repairs were prompted by the simultaneous failure of all three variable frequency drives (VFDs) that control the three main influent pumps (MBCSD 2008c). The repairs initially involved bypassing the headworks by pumping directly from the influent channel into the grit basin. This provided time to install a float system to measure water levels within the influent channel and trigger influent pumping cycles. The float system allowed the influent pumps to operate unattended for a brief three-day span while the VFDs were replaced. However, because the float system was unable to discern water-level gradients like the VFD's level-control device, the influent channel surcharged during each pumping cycle. This surcharged influent flume led to erroneously high flow readings during this time, so readings from the effluent flow meter, adjusted downward by 25% for overtotalization, were used instead. As a result, the reported daily flows

during this four-day period were consistent with the time series of flow measurements throughout the rest of the year (dashed line in Figure 2.5).

Inflow and Infiltration

Throughout 2008, 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), commonly referred to as I&I. Processing this relatively clean water does not tax the treatment capabilities of the plant as much as processing equivalent volumes of pure sewage. Municipal sewage is higher in TSS, BOD, and other organic substances customarily associated with wastewater. For this reason, NPDES maximum flow limits are typically applied to measurements collected during the “*dry season*,” when contributions from I&I are expected to be negligible. During the dry season, the treatment plant should be subjected to the greatest concentrations of organic particulates.

The flow recorded at the MBCSD WWTP throughout 2008 included measurable I&I. Consequently, it was not representative of a pure-sewage wastestream that challenges the treatment process. Without consideration of the I&I component, it may seem that the plant reached approximately 54% of its design capacity, namely, the measured flow averaged over the dry season (1.12 MGD) relative to the design capacity (2.06 MGD). However, at least 0.12 MGD, and probably more, of the reported average dry-weather flow arose from I&I, so realistically the plant remained below 50% 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, particularly during January and early February of 2008. The timing relative to major rainfall events (shown in solid black at the bottom of the Figure) demonstrates that surface runoff flowing into the collection system caused these spikes in plant flow. During 2008, 15.1 inches of rain fell and generated approximately 7.7 million gallons of additional flow through the collection system. This indicates that approximately 510,000 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 the equivalent of a 19-acre drainage area.

Additionally, one inflow event associated with a late-season rainstorm occurred at the beginning of April and contributed a small amount of inflow during the “*dry season*” (Figure 2.5). One-half inch of rain fell on April 2nd and introduced approximately 260,000 gallons of relatively clean water to the treatment plant.

In addition to contributing episodic inflow of rainwater into the collection system, rain also increases the infiltration of groundwater into the system. In contrast to inflow events, infiltration continues after the rainfall interval. Winter rainfall recharges the aquifer and raises the water table above the shallower sections of the collection system. As a result of the increased hydraulic head, groundwater infiltration increases. Without substantive aquifer recharging by rainstorms during the dry season, the contribution of groundwater infiltration declines as the water table drops. At the same time, seasonal increases in tourist populations increase the contribution of sewage-derived wastewater. As shown by the solid black line in Figure 2.5, these offsetting contributions to plant flow introduced a subtle trend in the 30-day running-mean flow after February. Average plant flow steadily declined through April and May due to the declining contribution from infiltration after the rainstorm input largely subsided. In June, increasing flow contributions from the burgeoning summer tourist population started overcoming this steady reduction, and plant throughput continued to increase into mid-July. Flow subsequently declined as the tourist season wound down, ultimately leading to a minimum average flow of 0.94 MGD in mid-November. Thereafter, flow increased slightly through the end of the year due to the combined contributions of aquifer recharging from rainstorms and increasing holiday populations. Analysis of these long-term

fluctuations in flow indicates that groundwater infiltration contributed at least 0.142 MGD (12.9%) to the plant throughput during 2008.

Population-Related Flow Events

The economies of Morro Bay and Cayucos are heavily influenced by tourism and, consequently, so is the flow of sewage-derived wastewater through the treatment plant. The presence of over 50 restaurants in the small community of Morro Bay indicates the importance of tourism. The populations of Morro Bay and Cayucos increase during holidays and weekends, both because of added tourism and because residents stay at home rather than commuting to worksites outside of the MBCSD collection system. The wastewater output from the treatment plant reflects these population increases. 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 0.08 MGD throughout the flow record. On average, these weekend population increases account for approximately 0.076 MGD (6.9%) of the annual average flow.

Superimposed on these weekly oscillations are larger, episodic population increases that coincide with major holidays. The most significant population-related events were E1 (New Year's Day), E8 (Independence Day), E9 (Thanksgiving weekend), and E10 (Christmas) in Table 2.4 and Figure 2.5. Although inflow from rainstorms coincided with several of these holidays and confounded the flow analysis, historical rates of population-related flow increases during the same holiday periods provide a sound basis for apportioning plant flow during these events. On most major holidays, population increases added approximately 0.1 MGD to the flow. However, when averaged over the entire year, holiday tourism added only approximately 0.015 MGD, or 1.4%, to the annual flow in 2008.

Nevertheless, some of these short-term population increases stand out as brief increases in the daily flow totals in Figure 2.5. For example, increased tourist populations over the Independence Day holiday (E8) added approximately 1.2 MG of sewage to the collection system. In Cayucos, where a parade, barbecue, and fireworks display typically draw large crowds during the Independence Day holiday, the population increased by approximately 10,000 people. This is more than triple the estimated permanent resident population. Similarly, the population increase that coincided with Thanksgiving weekend (E9) generated somewhat smaller volume of wastewater (0.7 MG). This combined with a small rainstorm just before Thanksgiving Day that contributed an additional 0.3 MG to create the upward excursion in the flow record shown for E9 in Figure 2.5.

Over longer periods, the influence of increased tourist and resident populations in the summer is reflected by the perceptible increase in the 30-day average flow (solid line in Figure 2.5). As described above, long-term flow averages began to steadily increase in May relative to baseline levels, despite declining contributions from groundwater infiltration. This trend continued into mid-July, when long-term flow reached a local maximum of 1.22 MGD and then declined again until it reached a minimum of 0.94 MGD in November. Integrated over this time frame, and after accounting for infiltration, the total contribution of this seasonal tourist population to the annual average flow was approximately 0.024 MGD, approximately 2.2% of the influent processed by the treatment plant in 2008 (Table 2.5).

2.2.2 Suspended Solids, Turbidity, and Settleable Solids

Suspended solids, turbidity, and settleable solids measure the particulate load within the wastewater stream. One of the primary functions of the treatment process is removing organic particulates from the wastestream. The treatment plant's removal of nearly all (94%) of solids from influent (Table 2.3 on Page 2-21) indicates an exceptionally high overall performance during 2008. As such, the plant's solids

removal rate far exceeded the minimum required by the NPDES permit, which specifies removal of only 75% of the suspended solids on a monthly basis. In fact, during every month in 2008, the plant's removal rate far exceeded the rate (85%) established for full secondary treatment, even though this partial-secondary plant is not required to meet those standards.

All of the TSS data collected in 2008 demonstrate the treatment plant's routine performance levels exceed secondary treatment standards. The low average TSS concentration (20 mg/L) within the effluent discharged in 2008 measured only about one-fourth of the monthly permit limit of 70 mg/L, and was a direct consequence of the plant's high solids removal rate. Benchmark monthly TSS concentrations were also below the 30-mg/L maximum concentration required to meet full-secondary standards even though the average influent TSS concentration was 337 mg/L.

Regardless of the high influent solids load, the effluent TSS concentrations were so low in 2008 that the permit-required removal rate did not even apply. Regulators recognize that high removal rates are unnecessary when effluent already has 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). Monthly effluent concentrations at the WWTP remained at or below 26 mg/L throughout 2008 and the treatment process exceeded expectations by removing an additional 19% of the influent TSS above and beyond the 75% removal rate.

The diffuse particulate cloud in the photograph of the diffuser in Figure 2.2 on Page 2-5 reflects the light sediment loads in discharged wastewater. Over the entire year, the WWTP discharged approximately 30 metric tons of suspended solids to the ocean. This mass emission is only 15% of the projected 199 metric tons that would have been discharged if effluent reached the permitted TSS concentration of 70 mg/L and the nominal average dry-weather flow of 2.06 MGD.

The TSS timelines in Figure 2.7 reflect events that affected the solids-removal process in 2008. They demonstrate that the plant's overall performance was generally unaffected by both external events (population fluctuations and rain-induced flow increases) and events related to the treatment process, such as unexpected equipment malfunctions. Nevertheless, the influence of two discrete events (E4 and E7) is obvious; as is the longer-term increase in summer tourist populations. However, the magnitudes of the TSS increases related to these three events were negligible compared to permit limits.

A major storm (E4) dumped nearly five inches of rain on the service area over a period of six days (Table 2.4). Additionally, more than half of the rain associated with this storm was deposited in a single day. Inflow into the collection system caused the two highest daily flows, both of which exceeded 2 MGD, a dramatic increase over nominal flow rates (Figure 2.5). Despite these marked increases in flow, the increase in effluent TSS concentration was negligible (E4 in Figure 2.7e). However, when combined with the additional 4 million gallons of plant throughput, the increased flow caused the third-highest TSS emission (Figure 2.7a).

Given that rainwater is not high in organics and is not expected to tax the treatment process, it is not clear why increased TSS concentrations are associated with E4, a major storm. Nonetheless, storms can increase TSS concentrations. Although rainwater may not be high in organic loads, it does carry inorganic terrigenous particulates, which pass through the treatment process. More importantly, when the plant flow increases beyond 1 MGD, the flow exceeds the hydraulic capacity of the flow lines into secondary treatment process.

Normally, the blending valve, which diverts primary-treated wastewater around the secondary treatment process, remains closed, as it did throughout most of 2008. However, when flow is likely to significantly exceed the secondary treatment's hydraulic capacity and potentially backup flow throughout the plant, the blending valve is opened to allow a small fraction of primary-treated wastewater to blend with secondary-

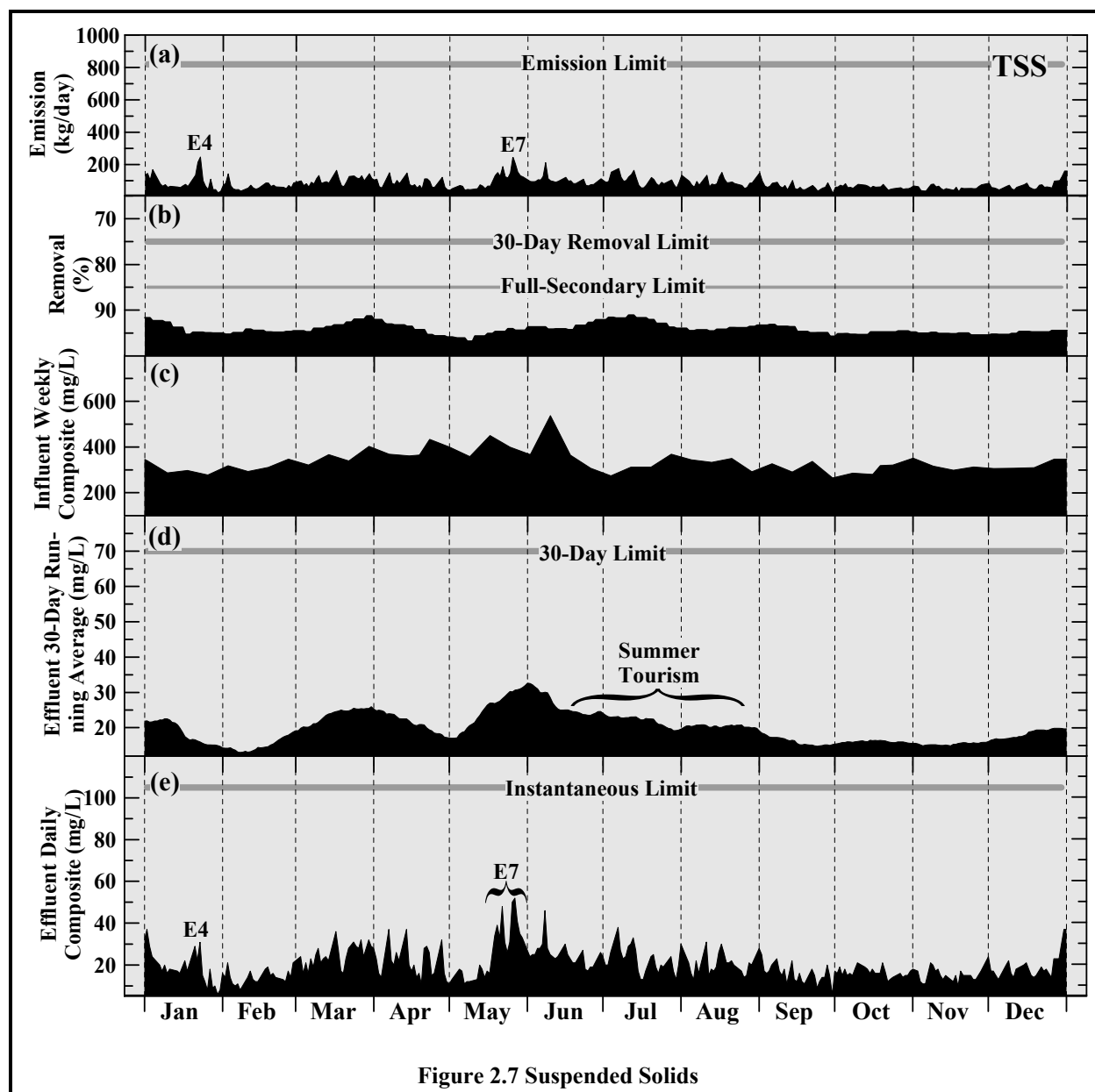
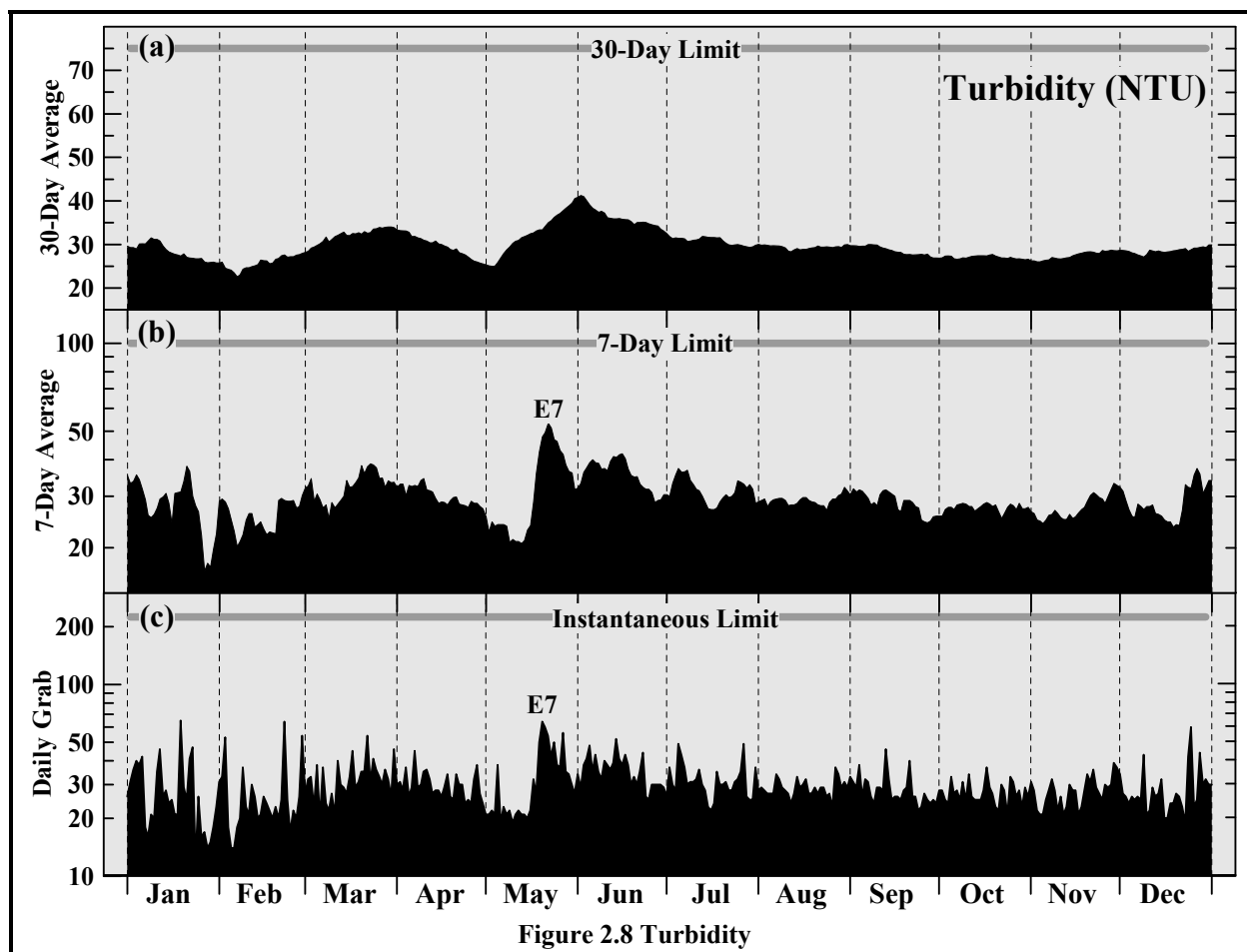


Figure 2.7 Suspended Solids

treated wastewater prior to disinfection and discharge. This happened during the high flows caused by E4. As a result of this reduced solids-removal capability, blended effluent generally exhibits elevated TSS concentrations compared to wastewater that receives full secondary treatment.

The importance of the secondary treatment process for removing solids was highlighted by E7. During that event, a week-long decline in the efficiency of the trickling filters increased TSS concentrations over an extended period and resulted five of the six highest daily concentrations of the year (Figure 2.7a). E7 also affected effluent turbidity, which measures visual clarity, rather than actual suspended solids loads within the effluent. The amplitude of the turbidity increase during the event was not particularly noteworthy compared to fluctuations throughout the year (Figure 2.8c). However, because they were consistently high for a week-long period, the 7-day average turbidity associated with E7 was markedly



higher than during other periods (Figure 2.8b). At 64 NTU, the highest 7-day average turbidity was more than half of the discharge-permit limit of 100 NTU.

The exact cause of marked decline in secondary treatment efficacy between May 20th and May 27th cannot be unequivocally determined because no obvious internal or external event coincided precisely with the performance decline. However, fluctuations in biofilter performance often lag weeks behind events that affect their performance because the assemblages of bacteria on the filters experience a complex evolution in response to external stressors. In the case of E7, an interruption in wastewater flow two weeks prior to the observed reduction in efficiency probably caused the decline in trickling-filter performance. This was the only known major stressor preceding the performance decline. On May 6th, wastewater flow to both trickling filters was briefly interrupted during replacement of rods that support the rotating-spray distributor arms. During the flow-interruption, the biofilm on the rock media was manually sprayed with water from hoses to keep it wet. However, inconsistent or insufficient water flow may not have prevented the media from drying. Additionally, insufficient nutrient loads in the substituted water may not have prevented deleterious impacts to the biofilm bacteria. Most likely, stress from the interrupted wastewater flow induced a loss of biofilm and potentially caused a slow conversion to less-efficient bacterial forms within the remaining biofilm. Sloughing of bacteria during this transition could explain the observed increases in turbidity and the observed reduction in solids-removal.

Despite this minor perturbation in the secondary process, the consistently low monthly averages for TSS, turbidity, and settleable solids demonstrate the overall effectiveness of the treatment plant's screening, grit removal, sedimentation, filtration, and clarifying processes (Table 2.3). None of the monthly averages even approached half of the permitted limits. Despite a low detection limit of 0.1 ml/L, none one of the 366 effluent samples contained a detectable amount of settleable solids.

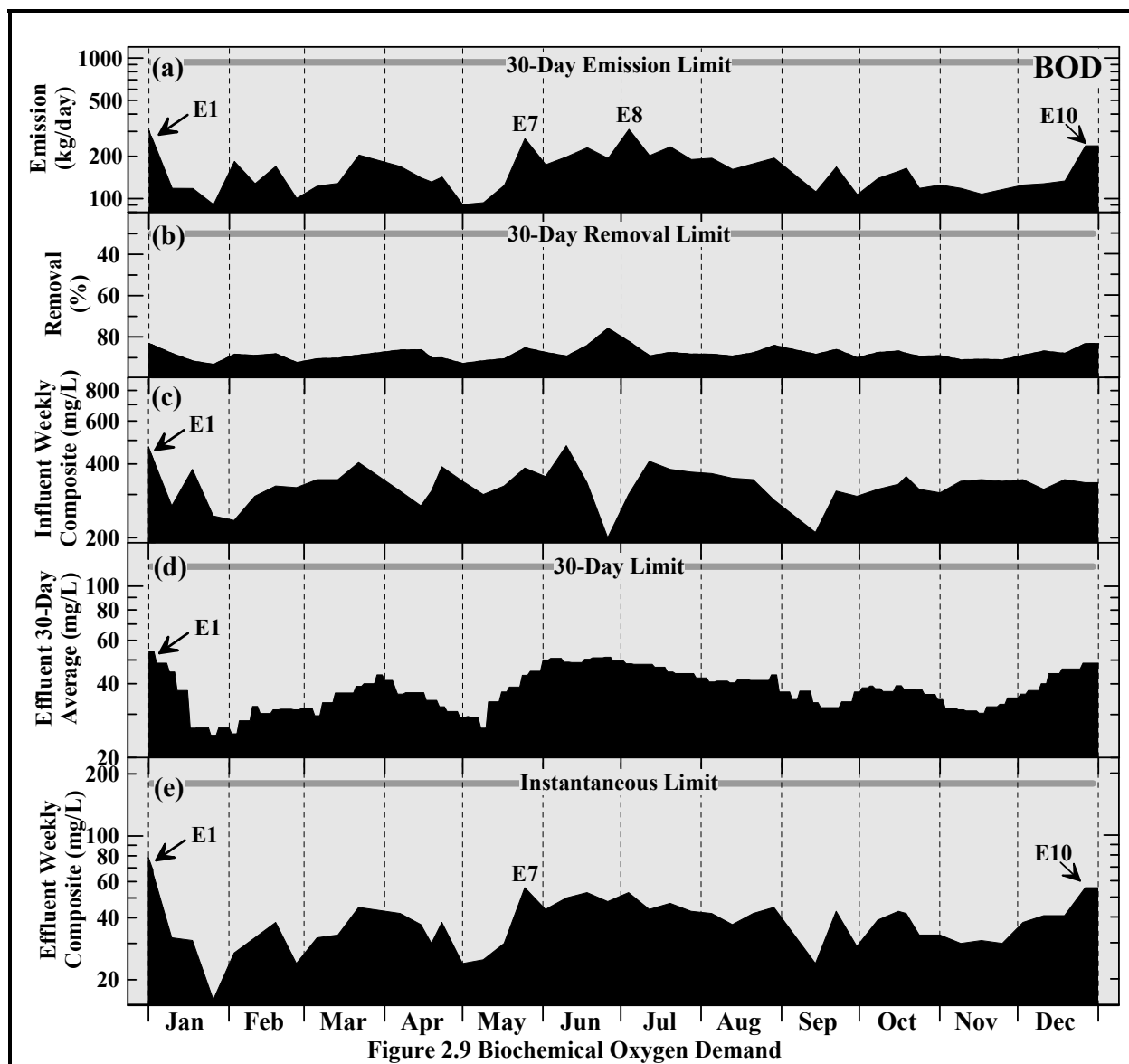
2.2.3 Biochemical Oxygen Demand

BOD measures 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 harm the environment if organic decomposition severely depleats DO within receiving waters. However, such occurrences are only of concern in semi-enclosed water bodies such as bays and estuaries. Their environments are vastly different from the highly oxygenated open-coastal marine environment of Estero Bay, where the MBCSD discharge is located. Because of higher oxygen-replenishment capabilities, an evaluation by the National Academy of Sciences (1993) questioned the environmental benefits of imposing pure technology-based BOD limits on open-ocean dischargers, namely, requiring secondary treatment-treatment standards for BOD.

Nevertheless, during 2008, the treatment process reduced influent organics by more than 88%, determined by the weekly composite samples analyzed for BOD (Table 2.3 on Page 2-21). Thus, the WWTP removed nearly three times as much organic material than the NPDES discharge permit requires, which only requires a 30% reduction in BOD for primary treatment (USGPO 1997a). Not only was the annual average BOD removal far higher than the required minimum, monthly removal rates consistently exceeded the 85% removal rate requirement for full secondary treatment. During June, the only month where removal fell below 85%, average BOD removal was only 0.7% below the secondary limit. Because of the high removal rates, the 58 MT of oxygen-demanding organic material discharged during 2008 was only one-sixth of the 342 MT allowed by the discharge permit.

Thus, the treatment plant routinely performed at secondary-treatment levels with respect to its removal of oxygen-demanding organics from the wastestream. Throughout 2008, the treatment process also maintained monthly effluent BOD concentrations at or below 49 mg/L. During 2008, BOD concentrations in the effluent never exceeded, or even approached, the 30-day limit of 120 mg/L (Figure 2.9d), much less the permitted instantaneous maximum of 180 mg/L (Figure 2.9e). As with TSS removal, regulators recognize that high BOD removal rates are not necessary when effluent has a low BOD concentration. Consequently, the NPDES discharge permit imposes the 30% minimum monthly removal rate only when effluent BOD levels exceed 60 mg/L. Nonetheless, although the plant was not subject to the 30% removal requirement during 2008, it consistently achieved far higher rates of BOD removal.

Although small fluctuations in effluent BOD occurred throughout the year, only four small increases were noteworthy (E1, E7, E8, and E10 in Figure 2.9 and Table 2.4). In contrast to TSS excursions, which are more susceptible to flow increases during intense rainstorms (E4), BOD emissions respond to population fluctuations (E1, E8, and E10) when increased organic loads within influent combine with increased plant throughput. However, increased organic loads from population fluctuations are not always accurately reflected in the reported influent BOD concentrations. For example, the second-highest influent concentration (440 mg/L for E1 in Figure 2.9c) may have partly been an artifact of the sampling method. During January 2008, influent grab samples were analyzed instead of the normal 24-hour composite samples because flow was being routed around the influent-channel sampling device because of problems with the muffin monster. Nonetheless, the highest effluent BOD concentration (71 mg/L in Figure 2.9e) and the second highest BOD emission (278 kg/day in Figure 2.9a) were also measured within effluent



composite samples during that population event. Similarly, although the influent BOD concentration did not appear to be particularly high during the Independence Day holiday (E8 in Figure 2.9a), the highest BOD emission was recorded during that event (312 kg/day). Lastly, increased organic loading from the stay-at-home population during the week of the Christmas and New Year's holidays (E10) resulted in the second-highest effluent BOD concentration (56 mg/L in Figure 2.9e).

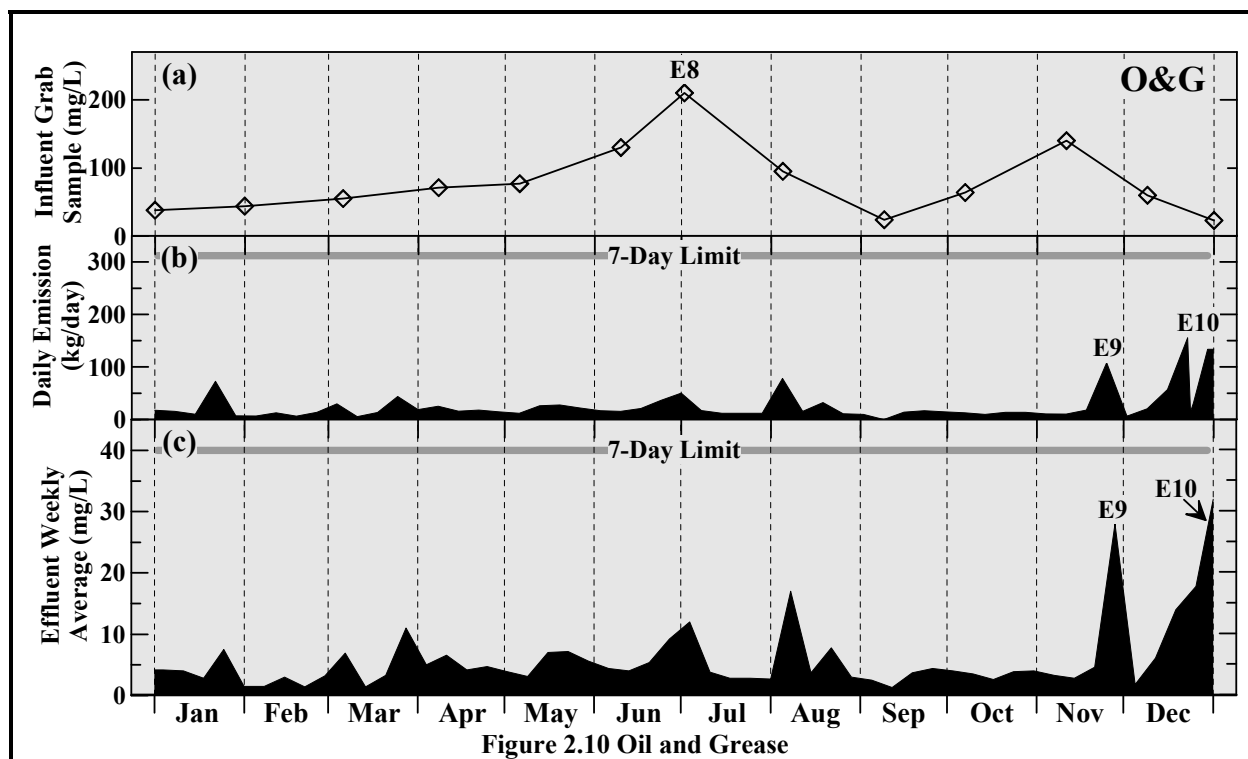
As with TSS and turbidity, the lingering effects from drying the trickling filters in May (E7) also slightly affected the plant's ability to process oxygen-demanding organics. As a result, the effluent BOD concentration tied with E10 was the second-highest (56 mg/L in Figure 2.9e), and caused an elevated BOD emission of 267 kg/day (Figure 2.9a).

2.2.4 Oil and Grease

During 2008, the treatment process reduced average O&G concentrations within the influent stream by a factor of almost twenty (Table 2.3). As a result, effluent O&G concentrations remained low throughout most of the year. During the first ten months of the year, individual weekly measurements remained below 20 mg/L (Figure 2.10c). In contrast to the solids and BOD excursions, however, O&G fluctuations are historically more difficult to correlate with specific events. One limitation is that influent measurements are only collected monthly, so it is difficult to associate external events, such as population increases, with the fluctuations in the effluent O&G record. Nevertheless, the high influent O&G concentration of 210 mg/L on July 2nd (E8 in Figure 2.10a) was nearly double the concentration measured at any other time and was undoubtedly associated with the Independence Day population increase.

It is much more difficult to determine the cause of the elevated O&G concentrations (Figure 2.10c) and the attendant high emissions (Figure 2.10b) measured at the end of November and December. Although both of these events coincided with holidays (E9 and E10), the magnitude of the O&G increases were substantially greater than those historically attributed to increased holiday populations. Moreover, there was no evidence that the increases were associated with declines in the efficacy of the treatment process. Instead, it is also possible that these marked concentration increases in effluent O&G concentration arose from slugs of O&G entering the plant from the collection system. However, it is also likely that such a large O&G event would have been visually apparent to the operators. Thus, it is also possible that the reported concentrations were the result of laboratory error, or a change in the analysis procedures or laboratory.

Treatment-plant personnel and their consultants recognized the unusual character of the 28-mg/L concentration measured in the single effluent sample collected on November 25th, even though it was during the week of the Thanksgiving holiday when elevated levels are expected (E9 in Figure 2.10c). In



an attempt to determine whether future, potentially elevated concentrations of effluent O&G might be related to isolated slugs of O&G entering the plant, WWTP staff began collecting and archiving daily effluent samples, in addition to the single sample normally analyzed. Accordingly, when another markedly high O&G concentration (45 mg/L) was reported on December 23rd, samples collected on the two following days were subsequently analyzed. The concentration in the first of those samples was too small to quantify (<5 mg/L on December 24th), while the sample collected the next day (December 25th) contained a nominal concentration of 8.4 mg/L. Given these measurements, the elevated O&G concentrations appear to represent isolated slugs of material intermittently entering the treatment plant. Furthermore, because the O&G concentration in the sample collected on the Christmas holiday was nominal, the fluctuations were unrelated to increases in the stay-at-home population within the service area.

On December 30th, another effluent sample contained an unusually elevated O&G concentration (32 mg/L; E10 in Figure 2.10c). However, both the influent and effluent samples collected during the following week had unusually low O&G concentrations (≈3.8 mg/L and 23 mg/L). Although the elevated O&G concentrations measured in November and December 2008 complied with their respective daily (75 mg/L), weekly (40 mg/L), and monthly (25 mg/L) discharge limits, they approached those limits (Figure 2.10c).

It is possible that the large fluctuations in the recently reported O&G concentrations are due in part, to a change in the analysis method or analytical laboratory. Prior to April 2007, the WWTP laboratory applied Method SM5520B to determine O&G concentrations based on a gravimetric procedure employing Freon-113, a Class I chlorofluorocarbon, as the extraction solvent. Because of that solvent's potential contribution to the depletion of the ozone layer, the method was phased out in favor of the new EPA Method 1664-HEM. The WWTP's subcontractor, BC Laboratories, was certified for the new method and has been conducting O&G analysis of the weekly effluent samples since April 2007. Without direct intercomparison of the results of the two methods, however, it is unclear whether the complex mix of constituents with the MBCSD wastewater matrix might occasionally cause a difference in reported results. For example, there is evidence that the presence of dissolved solids can affect measured O&G concentrations under the new method unless extra treatment of the sample is performed.⁶

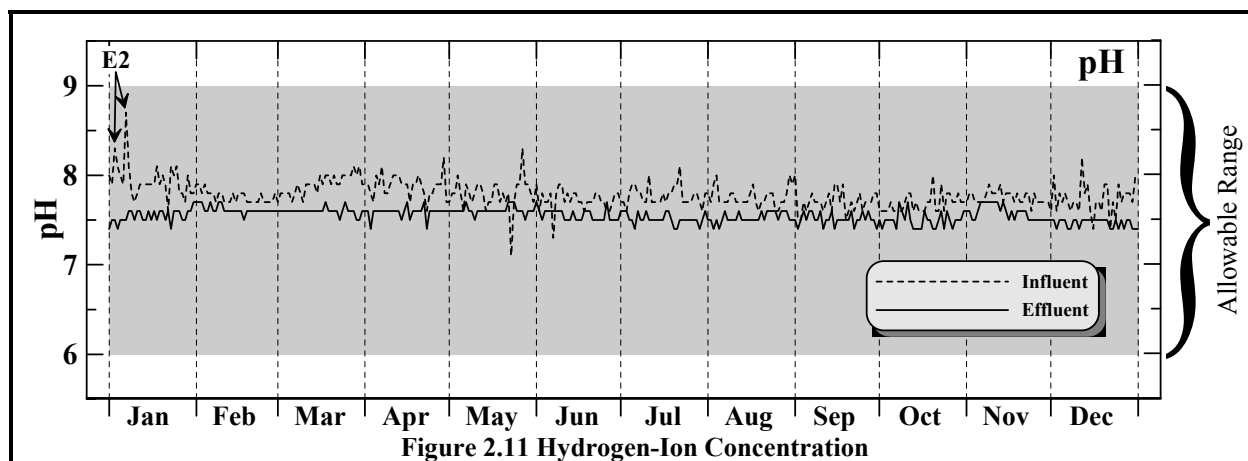
Plant personnel continue to closely monitor effluent O&G concentrations and investigate potential influent sources that could produce the fluctuations. However, the exact cause of these vagaries remains unknown as of the writing of this report.

2.2.5 pH

The MBCSD discharge permit requires that the hydrogen-ion concentration (pH) of the effluent remain within 6 to 9 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 MBCSD discharge permit does not allow this exception because the plant's partial secondary treatment can routinely treat wastewater to comply with the pH standards for full secondary treatment. Moreover, the general absence of heavy industrial input into the collection system creates an influent stream with a nominal pH that would meet the discharge requirement even without treatment.

Because influent pH (dashed line in Figure 2.11) remained within the discharge limits (shaded area), effluent pH measurements also remained within the allowable range by default (solid line). However, comparison of the two time histories demonstrates that the treatment process significantly moderated

⁶ [North Carolina Division of Water Quality \(2008\)](#)



short-term pH fluctuations within the influent. This is particularly true of the obviously elevated influent pH measurements that occurred in conjunction with a malfunction in Mission Linen's pH-neutralization system in early January 2008 (E2 in Figure 2.11 and Table 2.4). However, after processing through the treatment plant, there was no evidence of increased alkalinity within the effluent.

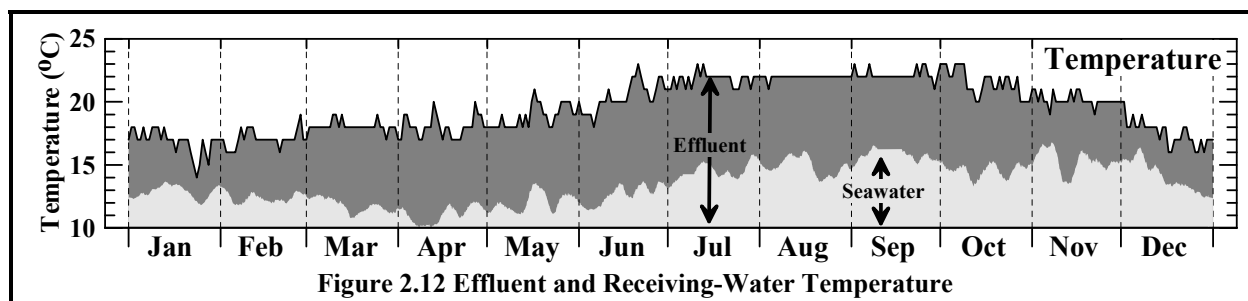
In addition to tempering these isolated pH excursions, treatment also reduced the overall average pH by 0.23 units, bringing it closer to neutral conditions (Table 2.3). In addition, dampening influent fluctuations reduced the coefficient of variation (CV) from 1.9% to 1.0%. Thus, the effluent was both less alkaline and more stable than the influent, being closer to the neutral hydrogen-ion concentration of pure water (pH=7.0), but increasing the difference with the more-alkaline seawater (pH=8).

Irrespective of the temporary problem with Mission Linen's pH-neutralization system, the average reported pH of 7.78 and its variability (CV=0.15) were higher in 2008 than in prior years when average pH was close to 7.74 and variability was substantially lower (CV=0.08). However, the change in 2008 was probably an artifact of a modification of the sampling protocol rather than a change in the properties of the influent itself. Beginning on 11 March 2008, pH was measured within influent grab samples rather than composite samples, which were historically used to report influent pH. Wastewater properties within grab samples are inherently more variable than composite samples. However, when the property of interest changes within a composite sample during the 24-hour compositing period, as is the case for pH, grab samples are preferable.

2.2.6 Temperature

Although the NPDES permit does not limit effluent temperature, it is an important physical property to document because the difference between effluent and receiving-water temperature dictates the amount of mixing that occurs shortly after the wastewater is discharged into the ocean. The warmer the effluent temperature compared to seawater, the greater the buoyancy of the plume and the more turbulence generated by its rise within the water column. Effluent temperature, shown by the dark shading in Figure 2.12, exhibits a distinct semi-annual cycle that tracks seasonal insolation, as does air temperature. Effluent temperatures begin increasing in spring (mid-May), peak in mid-to-late summer (July through September), and decline during the fall (October through December).

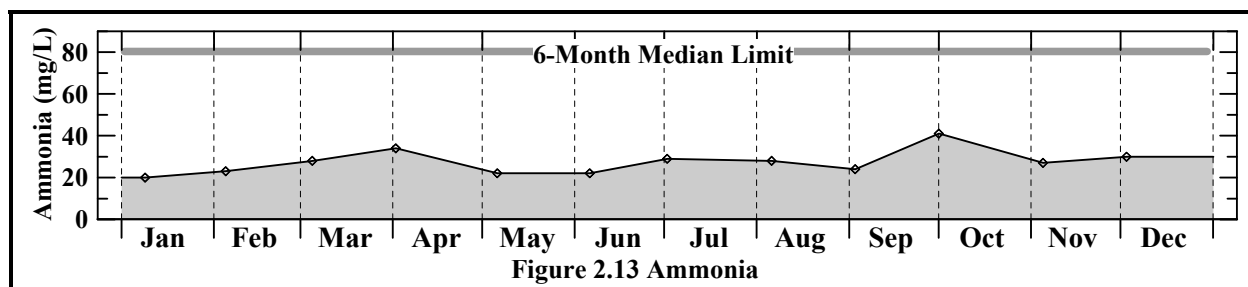
Because of the influence of upwelling, seawater temperatures, shown by the light shading, lag behind effluent temperature trends. In 2008, the lowest seawater temperature occurred in April, when thermal contrast with effluent was the greatest. As discussed in Chapter 3, upwelling was particularly sustained



and intense during the spring of 2008 and, consequently, some of the coldest sea-surface temperatures on record occurred in the outfall region. Maximum seawater temperatures also lagged behind effluent temperature, with their peak in November and December, when thermal contrasts with effluent were smallest. At that time, buoyancy-induced dispersion of the effluent plume was at its minimum.

2.2.7 Ammonia

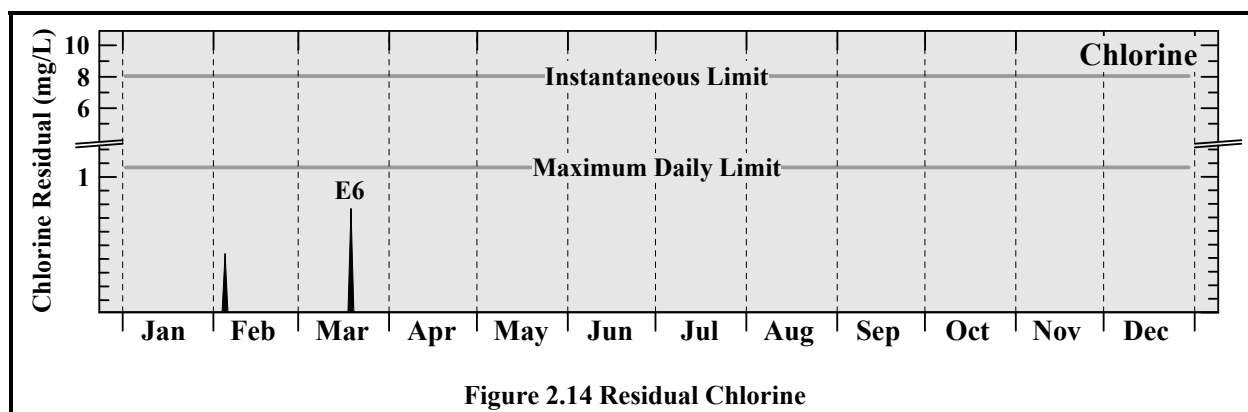
The concentration of ammonia as nitrogen ($\text{NH}_3\text{-N}$) was uniformly low throughout 2008. Grab samples analyzed for ammonia on a monthly basis had concentrations at or below 41 mg/L, approximately half of the 6-month median limit of 80.4 mg/L (Figure 2.13). This peak concentration was also approximately 20 times lower than the permitted instantaneous limit of 804 mg/L, which is imposed to protect marine aquatic life.



2.2.8 Residual Chlorine

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

Throughout 2008, treatment plant personnel maintained careful control over the disinfection and dechlorination processes. Only 2 of the 366 grab samples had detectable concentrations of TRC (Figure 2.14). TRC in the remaining samples never exceeded the 0.05-mg/L detection limit, which is five-times lower than the 6-month median limit of 0.27 mg/L specified in the discharge permit. Neither of the detected TRC concentrations, 0.44 mg/L on February 5th and 0.77 mg/L on March 19th (E6 in Table 2.4),



exceeded the maximum daily limit of 1.07 mg/L, which was established to protect marine aquatic life. Consequently, the 2008 discharge easily met the NPDES permit compliance requirements for chlorine. The largest and only noteworthy TRC measurement during 2008 was associated with E6. The failure and replacement of the VFDs required a combination of manual and float-triggered pumping of influent at the headworks. The temporarily irregular flows caused by these repair activities sent slugs of wastewater through the treatment plant and impacted the disinfection process, which relies on a complex interaction between automated flow-measuring devices, chlorine sensors, and the dosing apparatus. Changes in flow rate triggered adjustments in chlorine and bisulfite dose, but the finely tuned feedback system depends on only gradual trends in flow. With large slugs of water passing through the plant during the VFD repairs, the dosing system required manual intervention to adjust the timing and dosage of the disinfection process. However, before this could be accomplished, the grab sample used to report the TRC on March 19th had already been collected. The automated response to a slug of water that passed through the plant triggered a slightly elevated dose of chlorine that impacted the subject sample.

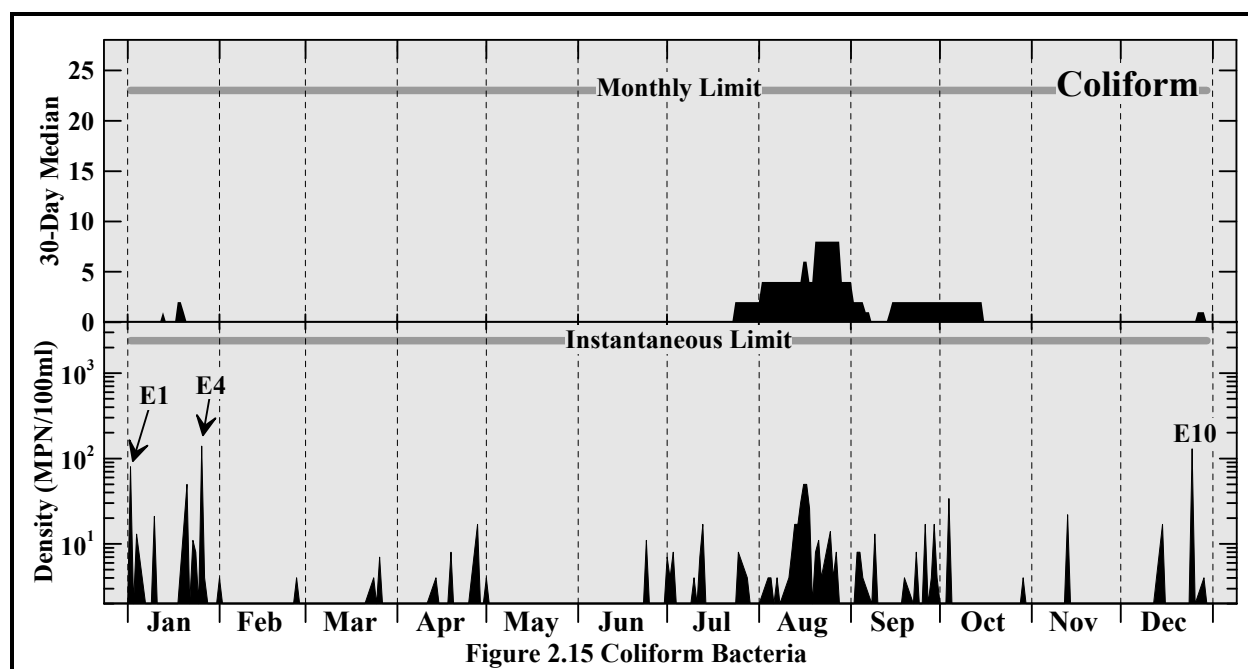
2.2.9 Coliform Bacteria

Effluent samples collected on five consecutive days each week were analyzed for the most probable number of total coliform organisms per 100 ml (MPN/100ml). The monthly median coliform densities (Table 2.3) were 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 less than the permitted instantaneous maximum of 2400 MPN/100ml. In fact, two-thirds of the 283 effluent samples analyzed in 2008 had no measurable coliform density. The three samples with the highest densities were associated with holidays (E1 and E10) and a major rainfall event (E4). The influence of summer population increases is apparent in the 30-day running mean shown in the top frame of Figure 2.15. For the most part, however, increased coliform densities were randomly scattered throughout the year, with no apparent relationship to events that otherwise affected the treatment processes.

2.2.10 Toxicity

Effluent samples were tested quarterly and semiannually 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 bioassays were conducted on effluent grab samples collected in January, April, July, and October (Table 2.7).

The chronic bioassays found consistently low effluent toxicity, with levels much less than the discharge permit limits. Although the acute bioassays also measured toxicity levels consistently below permit limits,



the tests were confounded by ammonia interference, which artificially elevated the reported results compared to earlier tests, when ammonia interference was mitigated.

The chronic toxicity tests 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 the chronic bioassays in 2008 confirm the effluent's continued low chronic toxicity. Both chronic-toxicity endpoints were more than one order of magnitude less than the applicable permit limitation of 134 chronic toxic units (TUC) for the daily maximum toxicity. The reported TUC were based on a "No Observable Effects Concentration" (NOEC), which is the highest effluent concentration that does not cause an adverse effect statistically different from a control sample. They indicate that the chronic bioassays only found adverse effects in marine organisms exposed to effluent concentrations above 18%, whereas the permit allows adverse effects in concentrations as low as 0.75%.

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

Criteria	Duration	NOEC (%)	TUC	Permit Limit TUC
8 January 2008				
Germination	48 hour	18	5.56	134
Growth	48 hour	18	5.56	134
15 July 2008				
Germination	48 hour	18	5.56	134
Growth	48 hour	18	5.56	134

The semiannual effluent reports contain raw test data, pertinent quality assurance/quality control (QA/QC) data, and chains of custody for the chronic bioassays (MRS 2008gh). 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 (*M. pyrifera*) sporophylls to toxins. QC results demonstrated that the kelp specimens were susceptible to toxic exposure because they experienced significant reductions in germination and growth in reference-toxicant concentrations as low as 32 µg/L. The concomitant germination and growth NOEC for the reference toxicant exceeded 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 the bay mussel (*Mytilus edulis*) (MRS 1994). Nevertheless, chronic bioassays conducted during 2008 demonstrated that giant kelp was only minimally affected by exposure to treatment plant effluent.

Although chronic bioassays are more sensitive and accurate than acute tests, the current NPDES discharge permit requires both acute and chronic bioassays. However, when chronic bioassays are performed, the COP no longer requires acute tests on effluent from ocean dischargers with a dilution ratio comparable to that of the MBCSD discharge (SWRCB 2001). Moreover, the latest COP sets much higher limits for acute bioassays than those specified in the current NPDES permit. For the MBCSD discharge, the new limit of 4.29 acute toxicity units (TUa) is almost three times higher than the 30-day average limitation (1.5 TUa) specified in the current NPDES discharge permit. In accordance with the current COP, the new MBCSD discharge permit, effective 1 March 2009, eliminates acute bioassay testing requirements entirely.

More importantly, one of the major drawbacks to acute bioassays conducted on wastewater samples is that they are easily confounded by the presence of ammonia. Ammonia interference strongly skewed the results of the acute bioassays conducted in 2008 (Table 2.7). The acute bioassays examine the mortality of fathead minnows (*Pimephales promelas*) exposed to various concentrations of effluent. However, fathead minnows are particularly sensitive to moderate levels of ammonia. Ammonia interference caused artificially high acute toxicities (TUa>1) prior to 1995 and after 2003, as discussed in Chapter 5. From 1995 through 2002, acute toxicity was reliably measured by reducing ammonia levels in effluent samples prior to testing by treating the effluent samples with a zeolite ion-exchange resin. However, this practice was discontinued in April 2003.

Because of ammonia interference, acute bioassays of the January, April, July, and October 2008 effluent grab samples erroneously indicated that the projected lethal concentration (LC₅₀), when 50% of the specimens die after a 96-hour exposure period, was a low 68.3% (Table 2.7). In terms of toxicity units, this yields 1.46 TUa, which is only slightly less than the permit-specified toxicity limit of 1.5 TUa. However, the measured acute toxicity in recent years was artificially inflated in comparison to assays conducted between 1995 and 2002. This apparent increase in toxicity was not caused by any change in the characteristic toxicity of the effluent; instead, it was an artifact of changes in the protocols used to assess acute toxicity. In contrast, the protocols for chronic bioassays and the measured chronic toxicity remained the same throughout the monitoring program.

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

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

Date 2008	LC ₅₀ (%)	Toxicity Concentration (TUa) ²	Permit Limitations (TUa) ¹		
			30-day Average	7-day Average	Instantaneous Maximum
07-10 January	70.7	1.41	1.5	2.0	2.5
07-10 April	70.7	1.41			
14-17 July	70.7	1.41			
20-23 October	68.3	1.46			

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)

discharge, so marine organisms are not exposed to the same levels of toxicity measured in the 2008 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 (41 mg/L) measured in the MBCSD effluent was almost 20-times less than the instantaneous limit (804 mg/L) imposed to protect marine life (see Section 2.2.7). 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 present in acute bioassays is not representative of conditions in marine receiving waters.

Various methods have been developed over the years to reduce the recognized artifactual toxicity from ammonia deionization in wastewater during bioassays. Aeration, addition of acid, and pretreatment of the effluent with zeolite are common practices that have effectively reduced ammonia interference in tests for decades. In the past, ammonia interference in the acute bioassays of MBCSD effluent was eliminated using zeolite pretreatment. Prior to that, the previous NPDES discharge permit required the Kopperdahl (1976) bioassay protocol and CO₂ and O₂ enrichment mitigated the pH drift.

However, after January 2003 the RWQCB (2003ab) mandated a new USEPA test protocol (USEPA 2002) that recommends reduction of artifactual ammonia toxicity solely through renewal methods, where test chambers are periodically refreshed with new effluent samples. RWQCB staff further directed that there should be no other manipulation of the effluent sample prior to testing. However, implementing daily static renewal of test solutions is significantly more complicated and costly than previous bioassay procedures. More importantly, the 2008 bioassay results confirm that daily static renewal does not reduce 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, MBCSD staff and their consultants expended significant effort attempting to reduce impacts from ammonia during the tests. They implemented the new bioassay protocols using daily deliveries of fresh effluent samples from the MBCSD WWTP. They used extra care 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, laboratory personnel exercised care during renewal to avoid physical impacts to the larval fish specimens within the test chambers. 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, significant ammonia interference continued during the acute bioassays in 2008. The pH and dissolved-oxygen concentrations measured in the test chambers throughout the assays reflect the undue influence of the ammonia. 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 all four of the 2008 effluent tests was only 0.04 TUa below the permitted limit, or 97% of the permitted toxicity. In reality, the effluent discharge does not cause 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 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 COP implicitly acknowledges problems associated with ammonia interference and the inconsistency in acute toxicity limits imposed at the point of discharge rather than at the margin of the initial dilution zone.

When much more sensitive chronic bioassays are available, the COP no longer requires acute bioassays of discharges with dilution ratios less than 1000:1. Because the critical initial dilution of the discharge is 133:1, the MBCSD will not be required to conduct acute bioassays under its new permit. Even if the MBCSD were required to conduct these tests, the revised acute toxicity limits in the current COP establish a daily maximum acute toxicity concentration of 4.3 TUa, which is nearly three-times higher than the current limit of 1.5 TUa (Table 2.7). Under this revised limit, the acute toxicities reported in 2008 (1.46 TUa), despite artificially inflation due to ammonia interference, would still be less than the new limit. It is incongruous to require new bioassay protocols that were not in place when the NPDES discharge permit was issued without applying improved toxicity limits that are specified in the current COP. Regardless, the actual toxicity marine organisms is far less than is indicated by a comparison of reported and permitted toxicity concentrations in Table 2.7.

2.2.11 Chemical Compounds

Effluent composite samples were analyzed in January and July 2008 for the presence of 145 chemical compounds, including trace metals, chlorinated and nonchlorinated phenolic compounds, volatile organic compounds, organochlorine pesticides, PCBs, cyanide, and base-neutral compounds. Chemical analysis of the July sample also tested for an additional 20 compounds, including radionuclides, organophosphorus pesticides, asbestos, and dioxins. The analyses confirmed only nine of the total 165 compounds were present in quantifiable amounts within the 2008 effluent samples. The measured concentrations for all nine compounds were less than the permitted limits. Annual mass emissions of these compounds also met the goals in the discharge permit reporting provisions.

The analyses detected ten additional compounds in the semiannual effluent samples, but at concentrations that were too low for reliable quantification. Specifically, the concentrations of these compounds were more than the method detection limit (MDL)⁷ but less than the practical quantification limit (PQL).⁸ Reporting of these detected-but-not-quantified concentrations began in July 2005; analysis of prior samples only reported quantifiable concentrations above the PQL. The current NPDES discharge permit issued to the MBCSD does not require reporting detected-but-not-quantified concentrations. However, the most recent COP (SWRCB 2001) expands the chemistry reporting requirements, and the subsequent discharge permit recently issued to the MBCSD requires reporting detectable concentrations even though they cannot be reliably quantified.

Table B.1 in Appendix B summarizes of the chemical analyses conducted on the effluent samples, along with the corresponding concentration limits in the current 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 2008gh). Concentrations for detected compounds are highlighted in bold in the Table. The Table also reports quarterly flow totals, bioassay results, radioactivity

⁷ The method detection limit is the lowest concentration that can be reported under ideal conditions, when the sample contains only the compound of interest in a concentration within an optimal calibration range and within a medium that does not interfere with the performance of the analytical instrument.

⁸ The practical quantification limit is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.

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, a nonchlorinated phenolic compound (3&4 methylphenol), a halomethane (chloroform), xylene, 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

Most metals were not found in the effluent samples despite low detection limits. In Table 2.8, metal concentrations too low for detection are indicated with “less-than” symbols (<) preceding their respective detection limits. Five of the thirteen metals were not detected in either semiannual effluent samples, while an additional three metals were not detected in one of the semiannual samples. Detectable metal concentrations that were too low to be accurately quantified are indicated by an “approximation” symbol ($\approx$) preceding the estimated concentrations. Only three metals were present in high enough concentrations to be quantified. These same metals have been found in at least half of the effluent samples collected over the last fifteen years. In all cases, the concentrations measured in 2008 were significantly less than maximum concentrations measured in the past. Therefore, their presence in the 2008 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 (Section 4.2). All three of the metals detected in quantifiable amounts in the effluent (see Table 4.6 in Section 4.2.1) are present in seafloor sediments. Therefore, the presence of detectable concentrations of these

Table 2.8 Effluent Trace-Metal Concentrations

Metal	Concentration (µg/L)			Mass Emission (kg/yr)	
	Limit^a	January	July	Goal	Measured
Antimony	160,800 ^b	<16 ^c	<14	285	<22.9
Arsenic	670	$\approx$ 1.2 ^d	<0.82	17	<1.6
Beryllium	4.42 ^b	<0.72	<1.1	28	<1.4
Cadmium	130	<3.3	<1.4	88	<3.6
Chromium	270	$\approx$ 1.1	<2.3	93	<2.6
Copper	140	16	14	690	22.9
Lead	270	2.1	1.1	465	2.5
Mercury	5	$\approx$ 0.025	<0.016	1.4	<0.031
Nickel	670	$\approx$ 4.7	$\approx$ 5.0	142	$\approx$ 7.4
Selenium	2,010	$\approx$ 0.91	$\approx$ 1.8	65	$\approx$ 2.05
Silver	70	<9.4	<2.5	28	<9.20
Thallium	1,880 ^b	<0.016	<0.054	285	<0.05
Zinc	1,620	60.	58.	244	90.

^a 6-month median unless otherwise indicated

^b 30-Day Average

^c The “less-than” symbol (<) indicates that the substance was not detected at a concentration above the MDL, which is listed after the “<” symbol.

^d The “approximation” symbol ($\approx$) indicates an estimated concentration too low to be reliably quantified because it was below the PQL.

metals within effluent samples is not unexpected because they can arise from the inflow of naturally occurring sediments into the collection system. 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 much less than the limitations in the NPDES discharge permit. Estimated mass emissions for these trace metals were also less than their respective emission goals. Detectable concentrations of copper have been found in more than 85% of the effluent samples collected over the last fifteen years, and two-thirds of those samples had higher copper concentrations than those measured in the 2008 samples. The occurrence of detectable lead and zinc concentrations is somewhat less frequent; about half the past samples contained measureable amounts. However, the low historical occurrence of measurable lead concentrations is partially due to a change in the analytical method implemented in July 2003. An accompanying reduction in the MDL and PQL resulted in quantifiable lead concentrations detected within almost all the effluent samples collected since that time. Thus, although the analytical method was previously unable to quantify them, lead may have always been present in effluent samples at concentrations comparable to those in 2008.

Synthetic Compounds

Table 2.9 summarizes the remaining pertinent analytical results for tests performed on the two effluent samples collected in 2008. As with the trace metals, the measured concentrations for these substances were below applicable NPDES discharge limits; in most cases, they were several orders of magnitude less than the limit. Nevertheless, all of these compounds have occasionally been detected in effluent and biosolids samples collected in prior years, and some discussion of potential sources is warranted.

Nonchlorinated Phenolic Compounds

3&4 methylphenol (m&p cresol) is a nonchlorinated phenolic compound that is a natural product in many foods, as well as in crude oil and coal tar. It is also detected in animal and human urine. In addition to its industrial uses, cresol is used as an antiseptic and disinfectant because of its bactericidal and fungicidal properties. While 3&4 methylphenol is not a contaminant of concern in the NPDES discharge permit and the list of compounds to be analyzed in effluent composite samples does not specify a limit, it is one of the nonchlorinated phenolic compounds whose combined concentration is limited in grab samples of effluent. As such, the detection of 3&4 methylphenol in the July composite sample does not count toward the nonchlorinated limit that is applied to grab samples (Table 2.9). However, a quantifiable 3&4 methylphenol concentration was also found in the grab sample of effluent collected in July 2008. Because there were no other phenolic compounds detected, the total nonchlorinated phenol concentration was equal to the measured level of 3&4 methylphenol (4.9 µg/L). That concentration was still more than 820-times lower than the allowed concentration of 4020 µg/L specified in the NPDES discharge permit to protect marine life.

BTEX

The gasoline-related compounds toluene and xylene are two of the four aromatic hydrocarbon compounds collectively known as BTEX (benzene, toluene, ethyl benzene, and xylene). BTEX compounds are primarily associated with contamination from distilled hydrocarbon products such as gasoline and are frequently detected at very low levels in MBCSD effluent. Xylene concentrations were quantified in the January 2008 effluent sample at 0.79 µg/L, slightly more than its PQL of 0.5 µg/L, while the July effluent sample contained 0.47 µg/L, slightly less than the quantifiable level. Similarly, although the presence of toluene was detected in both the January and July 2008 effluent samples, the concentrations were minute and unquantifiable. While the presence of both of these BTEX compounds in the effluent points to the input of very small amounts of gasoline into the collection system, their concentrations are far too small

Table 2.9 Concentrations of Other Detected Chemicals within Effluent Samples

Constituent	Limit ^b	Concentration ^a (µg/L)		Mass Emission (kg/vr)	
		January	July	Goal	Measured
3&4 Methylphenol	NA ^c	<0.83	≈1.8	— ^d	<2.0
Total Xylenes	NA	0.79	≈0.47	—	≈0.97
Cyanide	130. ^e	<3.2	5.8	57.	<6.8
Phenolic Compounds ^f	4020. ^e	<0.37	4.9	—	<3.9
Toluene	11,400,000.	≈0.24	≈0.27	4.	≈0.39
Bis 2-Ethylhexyl Phthalate	470.	12.	18.	320.	22.8
Chloroform	17,400.	0.93	1.0	5.	1.5
1,4-Dichlorobenzene	2,410.	≈0.16	≈0.43	57.	≈0.45
Methylene Chloride	60300.	≈0.19	<0.16	—	<0.27
Halomethanes	17,400.	≈0.13	<0.12	25.	<0.2
Radioactivity - α (pCi/L)	15. ^g	— ^h	≈0.448 ± 0.562	—	—
Radioactivity - β (pCi/L)	50. ^g	— ^h	12 ± 0.52	—	—

^a Within a 24-hour composite sample unless otherwise indicated ^b Limit on 30-day average

^c “NA” indicates that the NPDES permit does not specify a limit for this constituent.

^d Goal not specified

^e Limit on six-month median

^f Total nonchlorinated phenolic compounds measured in a grab sample

^g Drinking water limit

^h Testing not required

to be of any environmental or human-health concern. Toluene concentrations would have to be 10 million times larger to approach the discharge limit, and xylene limits are not even specified because it volatilizes so rapidly in the marine environment.

Bis 2-Ethylhexyl Phthalate (DEHP)

This common phthalate compound has been detected in more than 85% of the effluent samples collected over the last decade and was present in quantifiable amounts in both the 2008 January and July effluent samples. Phthalate esters, such as DEHP, are components of synthetic dyes, resins, plasticizers, insecticides, and pharmaceuticals. DEHP is a physical plasticizer 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 through evaporation and dissolution over time.

The annual production of DEHP is estimated at nearly 4 million tons worldwide. Plastics may contain from 1 to 40% DEHP by weight; the plastics are widely used in consumer products such as imitation leather, rainwear, footwear, upholstery, flooring, tablecloths, shower curtains, food packaging materials, and children's toys. Plastics containing DEHP are also used for tubing and containers for blood transfusions and blood products, as a hydraulic fluid, and as a dielectric fluid (a nonconductor of electric current) for electrical capacitors.

Because of their mobility, high vapor pressure, and massive production scale, phthalate esters, and DEHP in particular, have become pervasive in the environment. However, in order to negatively affect human health, DEHP concentrations would have to be 26-times greater than measured in July 2008.

Halomethanes

Chloroform and dibromochloromethane are part of a group of compounds known as halomethanes. Common by-products of wastewater and drinking water chlorination, they form when organic substances are present during the chlorine disinfection process. Chloroform has been detected in 60% of the effluent

samples collected over the last decade. Although it is a trihalomethane, it is regulated independently from the other halomethanes in the discharge permit; its reported concentrations and associated limit are listed separately in Table 2.9.

In contrast, other halomethanes, such as dibromochloromethane, are only rarely detected at quantifiable levels. In 2008, dibromochloromethane was the only other halomethane detected in effluent samples, but only at an unquantifiable level.

It is not clear whether wastewater disinfection within the treatment plant or drinking-water chlorination within the portion of the municipal water supply that is disposed of into the collection system caused the low concentrations reported for all halomethane compounds in 2008. Although these compounds can negatively affect human health, the highest concentrations detected in 2008 were more than four orders of magnitude less than the permitted limit for the combined concentration of halomethanes. Because chloroform and other halomethanes rapidly volatilize in water, low concentrations are not of ecological concern in the marine environment. In addition, the human-health limit was established with drinking water as the primary exposure pathway, so it is conservative when applied to marine discharges because there is little risk to groundwater or drinking water supplies that could conceivably result from this discharge. The discharge is located far offshore where turbulent oceanic processes rapidly reduce effluent concentrations to undetectable levels close to the diffuser. Also, semi-volatile organic compounds, such as halomethanes, are even more rapidly eliminated by physicochemical processes within seawater that break down the compounds into inert forms. As a result, tangible concentrations of effluent chemicals are dispersed long before they could impinge on the recreational activities along the adjacent shoreline.

Cyanide

Cyanide was quantified in the July 2008 effluent sample at a concentration only slightly greater than its PQL of 5.0 µg/L. The measured concentration was twenty-two times less than the permit limitation and, therefore, not of ecological concern. Cyanide has been detected in one-third of the effluent samples collected throughout the last ten years and low concentrations are commonly found in biosolids. Although there are many natural sources of cyanide, it is also 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.

In addition to these sources, a growing body of evidence indicates that most, if not all, treatment plants produce cyanide in their treatment process (WERF 2003). Until recently, much of the chemistry surrounding the formation and degradation of cyanide in treatment plant processes was largely unknown. The Water Environment Research Foundation (WERF) is currently exploring the production of cyanide within treatment plants in a national research study. Previous WERF studies indicated that cyanide levels can be increased by chlorination during the disinfection process. Although cyanide formation patterns varied significantly among treatment plants, the chlorination of thiocyanate seemed to be the most significant mechanism for the formation of cyanide in wastewater treatment processes. Also, some elevated cyanide in effluent may be an artifact of the analytical protocol used for the analysis (Khoury et al. 2005). In addition, cyanide is also a byproduct of other disinfection procedures, for example, those employing ultraviolet irradiation (Zheng et al. 2004ab).

Regardless of its provenance, cyanide concentrations within the MBCSD effluent samples collected in 2008 were low, below detection levels in the January 2008 sample, and only slightly above the quantification limit in the July 2008 sample. At the 2008 flow rate, the mass emission of less than 6.8 kg of cyanide was well below the stringent mass-loading goal of 57 kg/yr identified in the NPDES permit.

Methylene Chloride

Methylene chloride has only been detected in two other effluent samples collected throughout the last fifteen years. In the January 2008 sample, as in the two prior samples, its estimated concentration (0.19 µg/L) was close to the detection limit of the method (0.16 µg/L) and four orders of magnitude less than the permitted limit. This compound is used as a solvent in paint strippers, a propellant in aerosols, and as a post-harvest fumigant for grains and strawberries. It is also a solvent commonly used by laboratories to analyze water samples. Although laboratory blanks tested in conjunction with the January 2008 effluent sample did not detect its presence, it is likely that detection of this compound at the very low concentration reported for the effluent sample was the result of laboratory contamination.

Radionuclides

Low-level radioactivity is ubiquitous in effluent samples. The July 2008 effluent samples reflect very low alpha (α) and beta (β) decay levels typical of most prior effluent samples and of naturally occurring sediments of the region. Thus, the presence of radionuclides within effluent samples is not unusual since they occur naturally within the mineralogy of the region. Accordingly, the levels of gross α and β radioactivity in the July 2008 effluent sample were well below drinking water standards, as has been the case for all past samples. 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 man-made materials.

2.2.12 Mass Loading

The NPDES Monitoring and Reporting Program identifies goals for limiting the mass emission of chemical compounds 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 permit requires the MBCSD to report mass-emission for all effluent chemicals that have goals in the permit. As required, emission rates for 2008, along with the flow used in the computations, are provided in Table B.1 of Appendix B.

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 appear in high enough concentrations in the effluent to be detected, much less quantified. Consequently, most of the goals were established using PQLs, rather than actual measurements or toxicity thresholds of regulatory criteria. Therefore, most emission goals reflect the detection capabilities of historical chemical analyses, rather than the target compound's actual potential for environmental impact or even its historical effluent concentration. Thus, for many compounds, almost any measured quantifiable concentration would automatically exceed the emission goal, even if the measured concentration remained less than the maximum concentration allowed by the permit's Waste Discharge Requirements. Although this has occasionally happened in prior years, it did not occur during 2008.

The mass-emission goals are further complicated by the differing computational methods that established goals for different compounds. The method used depends on whether the constituent had a quantifiable concentration in samples collected between 1994 and 1998. Only 6 of the 78 compounds listed in the Waste Discharge Requirements had quantifiable concentrations in effluent samples collected during that period. Their computed mass emissions have the greatest credibility because they were based on actual

discharges, namely, the 99th percentile of their historical concentrations and a design flow of 2.06 MGD. These compounds are identified with footnote “13” in the emission-goals listed in the permit’s Monitoring and Reporting Program (RWQCB-USEPA 1998b). The goals are still problematic, however, because they were based on past effluent concentrations, not on their potential environmental impact. 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 2008, none of these compounds exceeded its emission goal, even if it is assumed that undetected concentrations were equal to the MDL (see Table B.1)

The mass-emission goals for the remaining compounds, in particular those with historical concentrations too low for quantification, were established using either the maximum allowed concentration listed in the permit’s Waste Discharge Requirements (RWQCB-USEPA 1998a) or the historical PQL, whichever was lower. 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, the PQL of 15 of these compounds were greater than the maximum permitted concentrations listed in the Discharge Requirements. These compounds are denoted with a footnote “m” in Table C.1. For these compounds, the effluent discharge limitation was too low for measurement by standard analytical techniques available when the goals were established. As a result, almost any detectable concentration will exceed 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, five of the 15 compounds had maximum estimated emissions, computed from the MDL, 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 ambiguous because the goals were established using unattainable detection limits. Thus, for these five substances, a comparison between the computed maximum possible emission and the goal is indeterminate, because their reported maximum emission does not indicate treatment-plant performance or potential marine impacts. Therefore, as described in the Monitoring and Reporting Program requirements, these five instances are not subject to antidegradation analyses.

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 2008. Part of this discussion also addresses the major compounds within the sludge produced by the plant, because they determine the suitability of biosolids for future composting and land application.

In 2008 the WWTP produced approximately 196.2 dry metric tons of biosolids. Approximately 52.5 dry metric tons, 27% of the 2008 production, was transported to McCarthy Family Farm’s San Joaquin Composting facility on November 5 and 6, 2008. The treatment plant composted 95.8 dry metric tons. The WWTP was storing 47.9 metric tons of biosolids at the time of this report.

Solids removed by the primary clarifiers (Figure 2.3 on Page 2-15) are processed as shown in the schematic of Figure 2.16. Sludge is stabilized using two mixed-primary digesters heated to 97°F (36°C). Heated sludge is transferred to a secondary digester with heat exchange from the primary digesters. Solids

settle in the secondary digester and the supernate is returned to the wastewater treatment process. The primary digester's capacities are 192,000 gallons and 170,544 gallons, and the secondary digester's capacity is 166,000 gallons, giving a total capacity of 528,000 gallons (2 megaL). The clarifiers pump an average of 9,250 gallons of sludge per day to the primary digesters. Average detention times are 57 days. Digester temperature and flow are recorded daily.

Stabilized sludge drawn from the secondary digester is transferred to one of 12 sludge-drying beds, each with a capacity of 5,200 ft² (483 m²). Each of these beds has an under-drain and decanting system that recirculates runoff through the treatment process. Twelve to 14 inches (33 cm) of sludge is applied to the beds. 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 is generally less than one year.

In the past five years, treatment-plant personnel developed a beneficial-reuse program for biosolids. The program's goal was to implement a cost-effective technique for producing compost that meets the Federal and State Class-A standards for metals, pathogen reduction, and vector-attraction reduction. As a result of their efforts, the plant regularly produces exceptional-quality (EQ) compost. The EQ compost is now 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.

Biosolids removed from the WWTP in November 2008 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 to further reduce 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 three days before pathogen reduction is considered complete. After maintaining 40°C for 14 days, reduction of vector attraction is also considered complete.

On 5 and 6 November 2008, the treatment plant sent a portion of the stored, dried biosolids to the composting facility. 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 10th from the biosolids that were ready for shipment from the treatment plant at the time. Complying with the Monitoring and Reporting Program, the analyses were conducted on a composite of biosolid samples collected from the drying beds.

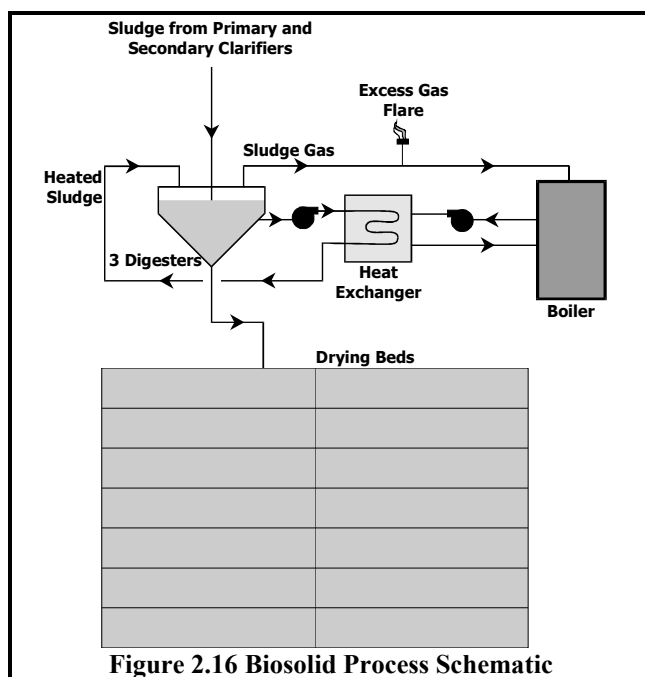


Figure 2.16 Biosolid Process Schematic

The full laboratory results, including chains of custody, instrument calibration reports, and analyses of method blanks and spikes, were reported by MRS (2008b). The results of those chemical analyses are detailed in Table B.2 of Appendix B. They are compared with regulatory limits in Table 2.10.

The data in the tables show that biosolid contaminant concentrations were significantly less than 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), which were not tested prior to 2003, were included in the analyte list to provide a complete suite of CAM-17 analytes, even though the current NPDES discharge permit does not require their analysis. Of the 167 potential contaminants, only 19 chemicals were detected and 17 of those were naturally occurring trace metals.

All trace-metal concentrations were below the total threshold limit concentrations (TTLC) that would designate the biosolids as hazardous. One metal, copper, had a bulk wet-weight concentration that exceeded ten-times the soluble threshold limit concentration (STLC). Accordingly, a waste extraction test (WET) assessed its water solubility. This elutriate test demonstrated copper's low solubility and dissolved concentrations less than STLC levels, where leaching into groundwater may be of concern. The low solubility shows that the copper was tightly bound into a mineral matrix, with little bioavailability. The insolubility of copper is further confirmed by the low concentrations found in effluent samples (14 µg/L and 16 µg/L; Table 2.8), which are comparable to the WET concentration (10 µg/L). Copper occurs naturally in the mineralogy of ambient sediments in the coast region and, as a result, its presence in biosolids is not unexpected. In any regard, the dry-weight concentrations for all detected metals in the biosolid sample were less than half of the federally mandated limits, including the monthly limit for materials suitable for agricultural land application (three right-most columns of Table 2.10).

Only one synthetic organic contaminant, DEHP, was detected at quantifiable concentrations within the biosolids sample. As discussed in Section 2.2.11, DEHP has been consistently detected at low levels in effluent and biosolids samples collected throughout the past decade. There is no limit on this compound in State and Federal regulations governing biosolids. Because of its mobility, high vapor pressure, and the massive scale of production, DEHP has become pervasive in the environment.

The other compounds listed in Table 2.10 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, a modified WET test (STLC) for total dissolved solids (TDS) was conducted in response to a request from the composter.

Table 2.10. Comparison between Measured Biosolid Concentrations and State and Federally Mandated Limits for Hazardous-Waste Designation

Constituent	Units	Wet Weight				Dry Weight		
		Measured		Limit		Measured	Limit	
		Bulk	WET ^a	STLC ^b	TTLC ^c	Bulk	Monthly ^d	Ceiling ^e
Solids	%	87.7	— ^f	—	—	—	—	—
Cyanide	ppm	3.5	—	—	—	4.0	—	—
Antimony	ppm	ND	—	15.	500.	ND	—	—
Arsenic	ppm	4.0	—	5.	500.	4.5	41.	75.
Barium	ppm	400.	—	100.	10,000.	450.	—	—
Beryllium	ppm	≈0.16 ^g	—	0.75	75.	≈0.18	—	—
Boron	ppm	12.	—	—	—	14.	—	—
Cadmium	ppm	3.5	—	1.	100.	4.0	39.	85.
Chromium (Total)	ppm	46.	—	560.	2,500.	52.	—	—
Chromium (Hexavalent)	ppm	0.79	<0.10	5.	500.	0.90	—	—
Cobalt	ppm	4.7	—	80.	8,000.	5.3	1,500.	4,300.
Copper	ppm	470. ^h	10.0	25.	2,500.	530.	1,500.	4,300.
Lead	ppm	45.	0.78	5.	1,000.	52.	300.	840.
Mercury	ppm	1.2	—	0.2	20.	1.4	17.	57.
Molybdenum	ppm	20.	—	350.	3,500.	22.	—	—
Nickel	ppm	36.	—	20.	2,000.	42.	420.	420.
Selenium	ppm	7.8	—	1.	100.	8.9	100.	100.
Silver	ppm	3.6	—	5.	500.	4.1	—	—
Thallium	ppm	≈2.1	—	7.	700.	≈2.4	—	—
Vanadium	ppm	25.	—	24.	2,400.	29.	—	—
Zinc	ppm	1,100.	—	250.	5,000.	1,200.	2,800.	7,500.
Asbestos	%	ND	—	—	1.	ND	—	—
Bis(2-ethylhexyl) phthalate	ppm	82.	—	—	—	93.	—	—
Hydrogen-Ion	pH	6.43	—	—	—	—	—	—
Phosphate	mg/kg	79,000.	—	—	—	90,000.	—	—
Ammonia	mg/kg	5,600.	—	—	—	6,400.	—	—
Nitrate (NO ₃)	mg/kg	2,400.	—	—	—	2,700.	—	—
TDS	ppm	—	5,600.	—	—	—	—	—
TKN	mg/kg	29,000.	—	—	—	34,000.	—	—
Organic Nitrogen	mg/kg	23,400.	—	—	—	27,600.	—	—
Oil & Grease	ppm	54,000.	—	—	—	62,000.	—	—

^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 and represent estimated concentrations because they were reported below the PQL but above the MDL.

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

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 2008. The first section presents the details of the monitoring program that assesses 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 of this chapter provides a synopsis of the offshore measurements collected during the four water column surveys conducted in 2008 (MRS 2008cdef) and compares them with the waste discharge requirements specified in the NPDES permit. 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 by efficiently diluting treated wastewater within the zone of initial dilution (ZID) that surrounds the outfall.

During all four of the 2008 offshore water-quality 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 rapidly mixed upon discharge, and all of the observed perturbations were small compared to the natural variability in seawater properties observed along this portion of the central California Coast. Projected contaminant concentrations were far below the receiving-water limitations specified in the NPDES permit, and the discharge fully complied with the objectives of the COP. In summary, the highly localized, transient seawater perturbations associated with the effluent discharge were too small to be of environmental significance.

3.1 MONITORING PROGRAM

Monitoring 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 2008 and the past 22 years, water-quality monitoring 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 visual observations of beneficial uses.

3.1.1 Objectives of Sampling

Receiving-water monitoring 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.

3.1.2 Scope of Monitoring

One goal of the monitoring program is to assess whether the water-quality objectives of the COP are being met. These objectives are summarized in Table 3.1, and apply to samples collected beyond the zone of initial dilution, where initial dilution of the wastewater has been completed. Initial dilution is the rapid, turbulent mixing of wastewater and seawater in the area immediately 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 effluent. Additional turbulent mixing occurs as the warm, buoyant effluent-seawater mixture rises through the water column. This buoyancy-induced entrainment causes the density of the effluent plume to approach that of ambient seawater (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 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 its lateral extent was largely indeterminate when it was observed. This was partially due to the wide spacing of water-sampling stations that, at that time, coincided with the benthic sampling pattern. Additionally, the earlier permit required collection of discrete water samples for suspended solids, coliform, and oil and grease. 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 and the lateral extent of the survey was reduced from 1000 m to 100 m, while the number of sampling stations was doubled from eight to 16. Rapid instrumental sampling within this 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 40 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 in 2008, 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.

In addition to the quarterly sampling used to delineate the plume, regular 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, near-shore water samples were collected and analyzed for total and fecal coliform densities.

Other beneficial uses, such as fishing and non-water-contact recreation, including beachcombing, boating, and picnicking, were addressed by observations of aesthetic conditions noted during the surfzone surveys. These auxiliary 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

During 2008, water sampling was conducted at eight surfzone stations and 16 offshore stations (Figure 3.1). The surfzone stations are located at gradient distances upcoast and downcoast relative to Station C, which is positioned at the onshore site closest to the offshore discharge location. Historically, the locations of these sampling sites were determined by visual landmarks along the shoreline; however, on 6 July 2005, a high-resolution navigational survey using a handheld GPS device was conducted to benchmark the actual locations of the surfzone stations for comparison with the target distances specified in the NPDES discharge permit (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 of surfzone Station C (Figure 3.1).

Throughout 2008, seven of the eight surfzone stations were regularly sampled at the fixed locations documented in Table 3.2. The sampling location of the eighth station, at Morro Creek Station G, varied

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.

⁴ Location varies with the along-shore migration of the mouth of Morro Creek.

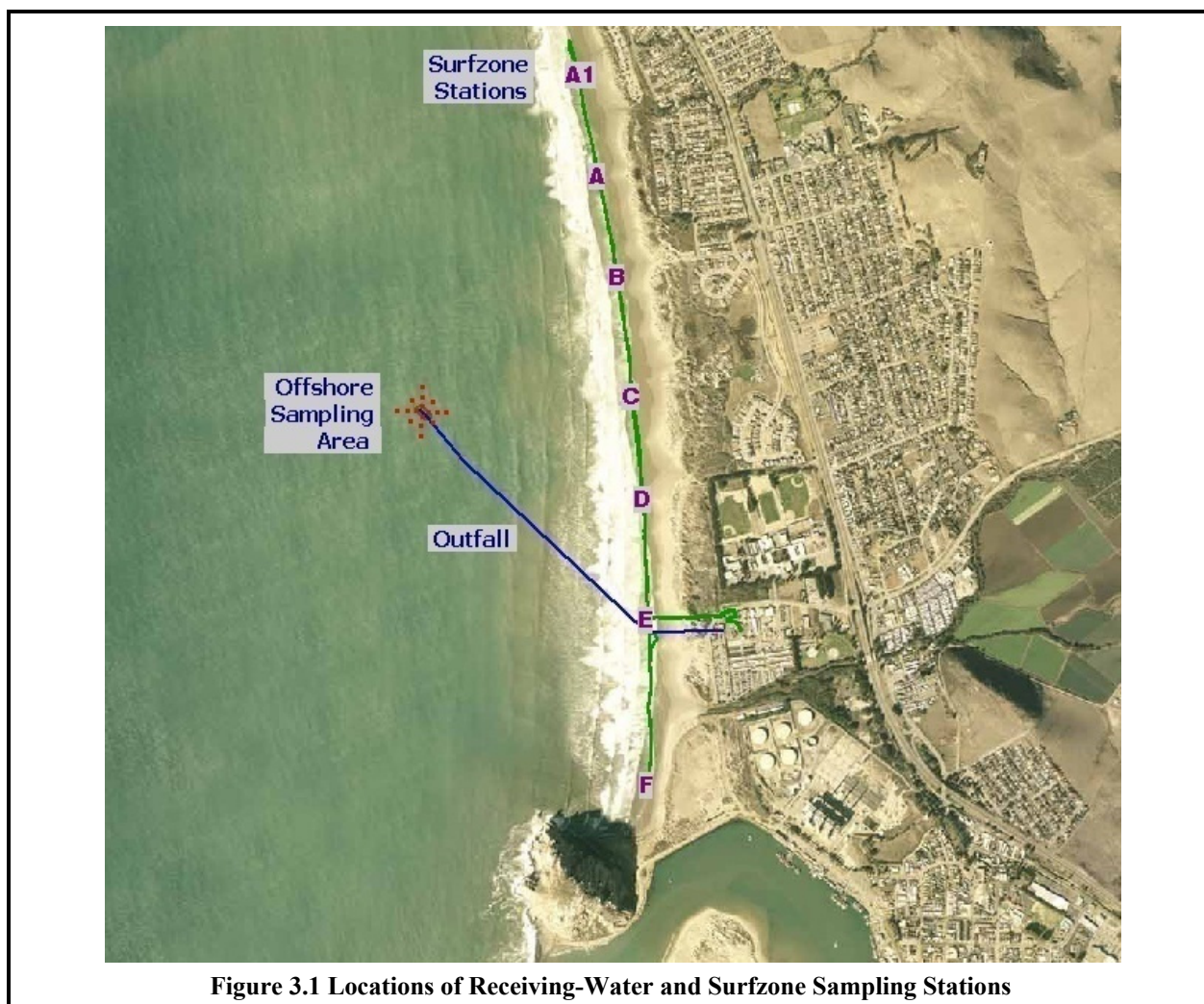


Figure 3.1 Locations of Receiving-Water and Surfzone Sampling Stations

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 2008, samples were only collected at Station G from February through mid-May, when surface outflow from the creek was observed. Bacterial levels within the creek outflow are monitored because it is a known source of elevated coliform densities unrelated to the discharge of treated wastewater offshore.

In contrast to the more than 3km extent covered by the surfzone monitoring, offshore water-quality sampling focused on the water column close to the discharge location (Figure 3.1). 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). 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

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

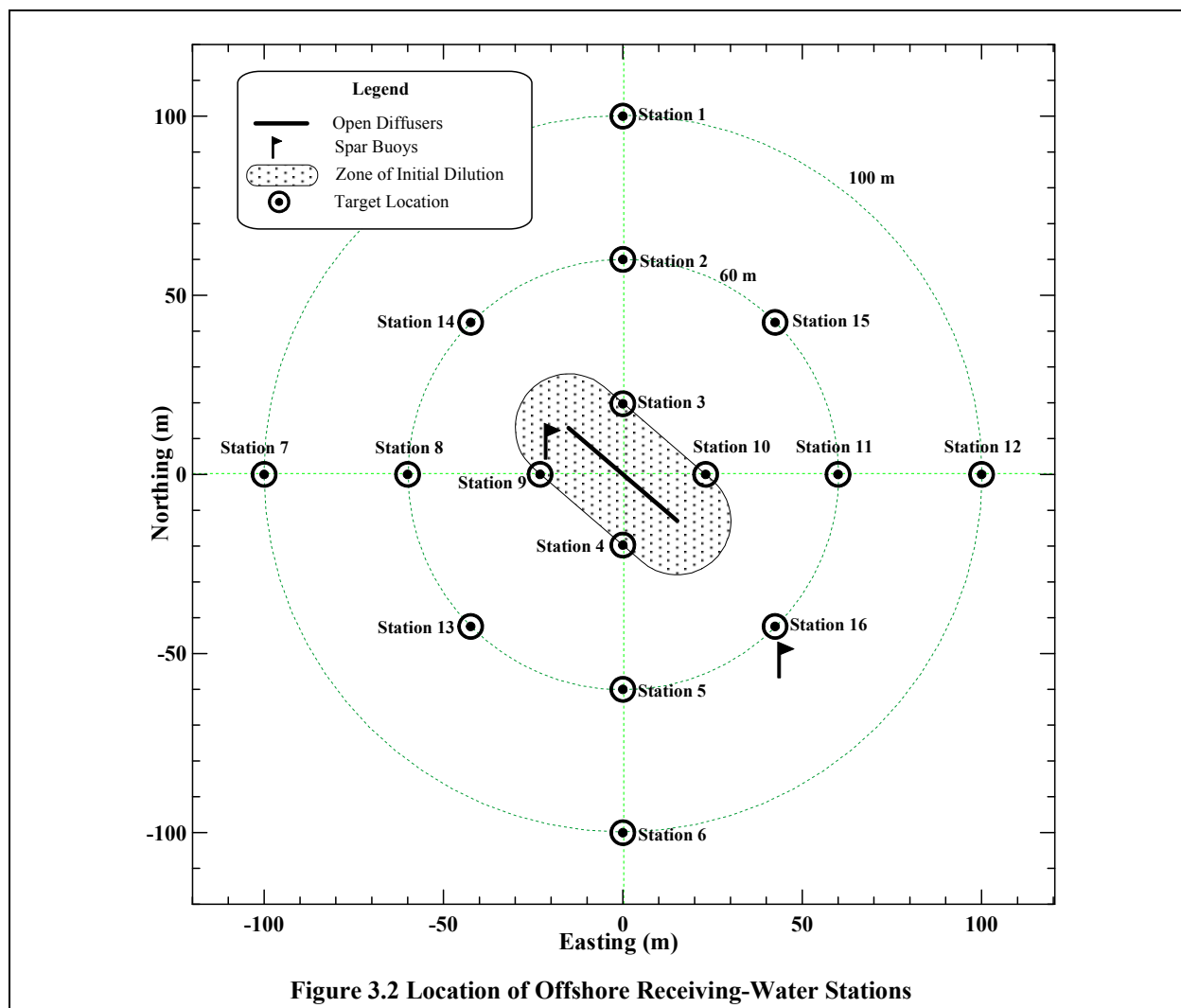
¹ Distance from the closest open diffuser port

² Distance to the center of the open diffuser section

estuaries are too distant to be materially affected by the treated wastewater discharge. For example, the southern boundary of the Monterey Bay National Marine Sanctuary is located 38 km to the north, while 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; however, because of its distance from the discharge, incursion of unmixed wastewater into the Bay is highly unlikely. Direct seawater exchange between the discharge point and Morro 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 2008, the discharge's region of influence was evaluated quarterly using water-quality data collected at 16 offshore stations (Table 3.3; Figure 3.2 on Page 3-7). The stations were situated at three gradient distances from the ZID 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.

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 actual distance to the center of the diffuser structure (Table 3.3 and Figure 3.2). As such, it would be unsuitable 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 influenced by wastewater 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 m 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 to evaluate compliance with the NPDES discharge permit. 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 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 m, although it altered most measurements by less than 30 m. 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 refract the signal ray-paths, leading to additional errors in position beyond those that were introduced by SA. These other errors are greatly reduced with DGPS 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 at any given time. 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 then 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. The combined influences of winds, waves, and currents can induce offsets of up to 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 2008 surveys, the actual sampling locations were precisely determined throughout the vertical profiling conducted at each station. This is an important consideration because, during three of the four surveys during 2008, station offsets and vessel drift caused some measurements to be collected within the ZID (see shaded entries in Table 3.4).

Table 3.4 also lists the closest-approach distance for the average station locations during each quarterly survey. These closest-approach distances can be compared with the target offsets listed in Table 3.3 to assess the fidelity of the sampling locations with respect to diffuser-structure proximity. 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 the first three quarterly surveys, portions of at least one vertical profile were sampled close (<15 m) to a diffuser port. These measurements captured the signature of wastewater while it underwent rapid initial mixing, and the dilution rates determined from these near-diffuser measurements were compared with the critical initial dilution ratio that is expected based on modeling that was conducted during the design of the outfall. Because tests for compliance with

Table 3.4 Closest Approach Distance between the Diffuser Structure and Actual Sampling Locations during the 2008 Water-Quality Surveys

Station	Description	Closest-Approach Distance ¹ (m)				
		Target	January	May	July	October
3	Upcoast ZID	15.0	25.4	21.1	23.4	22.6
4	Downcoast ZID	15.0	7.2²	3.5	14.8	21.3
9	Offshore ZID	15.0	12.6	21.2	22.0	28.1
10	Shoreward ZID	15.0	13.0	23.7	18.5	21.7
14	Northwest Nearfield	40.2	33.2	45.5	34.3	24.5
16	Southeast Nearfield	40.2	55.2	46.6	42.0	66.5
8	Offshore Nearfield	46.7	51.6	47.6	37.7	61.5
11	Shoreward Nearfield	46.7	55.6	45.3	50.0	59.7
2	Upcoast Nearfield	49.4	54.1	46.9	54.9	48.5
5	Downcoast Nearfield	49.4	44.8	45.8	54.6	58.1
13	Southwest Nearfield	59.8	66.1	51.9	51.0	50.5
15	Northeast Nearfield	59.8	59.2	71.5	56.7	62.9
7	Offshore Midfield	85.8	88.2	80.9	80.3	108.4
12	Shoreward Midfield	85.8	85.5	76.2	93.6	107.5
1	Upcoast Midfield	88.4	80.9	93.9	79.0	99.7
6	Downcoast Midfield	88.4	95.9	86.0	96.5	103.2

¹ Average distance to the closest open diffuser port.

² All or portions of the profiles highlighted in bold typeface with shading were sampled within the ZID.

the receiving-water limitations in the NPDES permit do not apply within this initial 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 remained well 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, when currents were particularly strong during the January survey, the instrument package moved as much as 23.7 m laterally during its descent through the water column. This magnitude of 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, which border the ZID, often cross the ZID boundary. Vertical profiles which contained measurements collected within the ZID during 2008 are indicated by shaded, bold typeface in Table 3.4. To be consistent with historical data, where a single location was reported at each station, average positions listed in Table 3.4 are based on the surface and bottom position fixes measured at the beginning and end of the vertical profile. However, reliance on these average positions to estimate outfall proximity can be misleading. For example, the average 13-m offset reported for Station 10 during the January survey would suggest that all of the associated water-quality data were collected within the 15-m ZID, where the water-quality limitations do not apply. In reality, nearly all of the data collected in the bottom half of the downcast were located beyond the ZID boundary, and therefore, were subject to receiving-water limitations specified in the NPDES discharge permit and the COP.

Detailed knowledge of CTD drift during each downcast is also important for interpreting effluent dilution levels, irrespective of where regulatory limits apply. For example, the average 3.5 m offset reported for

Station 4 during the May survey does not reflect the 12.1 m of lateral drift experienced by the CTD as it was lowered to the seafloor. In that case, the CTD traversed most of the width of the ZID, passing within 1 m of the diffuser structure shortly before encountering the seafloor. Consequently, the closest-approach distances that are listed in Table 3.4 can both underestimate and grossly overestimate the actual proximity of the CTD to the outfall during a given hydrocast.

3.1.5 Sampling Equipment and Methodology

During 2008, the 38-ft F/V *Bonnie Marietta*, owned and operated by Captain Mark Tognazzini of Morro Bay, provided vessel support for all four of the offshore surveys. Dr. Douglas Coats, Ms. Bonnie Luke, and Mr. Tyler Eck 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 conducted at each station using the CTD instrument package.

Auxiliary Measurements

As vertical CTD profiles were 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, Secchi depth is a measure of 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 caused by upwelling-induced primary productivity within the near-surface 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 the CTD.

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 CTD⁹ instrument package collected 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

⁹ CTD stands for Conductivity-Temperature-Depth

transmissivity, DO, and pH sensors were calibrated. The pre-cruise calibration for DO saturation 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 a series of separate, buffered solutions of known pH. Buffering solutions with a pH of 4 ± 0.01 , 6 ± 0.01 , 7 ± 0.01 , 8 ± 0.01 , 9 ± 0.01 and 10 ± 0.02 were variously 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 2008. 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 ($^{\circ}\text{C}$) 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 determined the character and dynamics of wastewater as it mixed with ambient seawater within the ZID.

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	$^{\circ}\text{C}$	-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. 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, and to a lesser extent, the DO 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 distributions of seawater properties that were measured during each survey are 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 path 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 vertical 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 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 (see Figure 3.2), contours in the vertical sections cannot delineate the sharp lateral discontinuities that define the limits of the discharge's perceptible influence. Instead, each 0.5-m standard measurement was quantitatively assessed for compliance with the applicable receiving-water limitations using statistical hypotheses 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 two of the quarterly surveys. This easily identifiable drift has been present in measurements collected in prior years, and it is due to ongoing sensor-equilibration (MRS 2001 through 2008a). Fortunately, the drift can be accurately removed using regression analysis during post-processing of the data. The pH adjustments applied to individual, vertical profiles measured during the January and October surveys were less than 0.15 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, described in Section 3.3.2, would not have been evident.

Adjustments for slight temporal drifts in the DO sensor were made to the data collected during the January, July, and October surveys as well. However, in contrast to the pH detrending, most of the adjustments to the DO measurements (<0.76 mg/L) were only required at a few stations occupied at the beginning of these three surveys. This slight drift in the DO sensor is normally imperceptible except when the overall range in the ambient DO field is small.

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 3.3.2 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 ZID. The second subsection describes the dynamics of the rapid mixing that occurs within the ZID immediately after discharge from the diffuser.

The last two subsections detail 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 1,450-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.

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 m³/s (7.76 MGD). The outfall design capacity is 0.358 m³/s (8.17 MGD).

The current level of discharge from the WWTP only requires the use of 28 of the 34 available ports.

A 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 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 the 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 m².

In reality, at any given time the actual initial dilution zone departs markedly from the idealized vertical cylinder described above. On a regular basis, 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 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. The most 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:

$$C_e \equiv C_o + D (C_o - C_s) \quad \text{Equation 3.1}$$

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 3.3.2, direct observations collected close to the diffuser during the 2008 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 3-13 lists the other hydraulic properties of the outfall that were used in the initial dilution model.

In the case of the MBCSD outfall, the critical initial dilution computed by modeling was conservative because the assumed stratification was unduly strong. The density profile used to establish the MBCSD critical initial dilution was collected at a now-abandoned monitoring station located 1 km south of the diffuser structure. When 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 Dynegy power plant (formerly owned at various times by Pacific Gas and Electric, Duke Energy, and LS Power Group). At the time the “critical” density profile was measured, the energy plant was discharging heated water to the ocean surface near Station F next to Morro Rock (see 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 temperatures 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 current 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

A broad 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

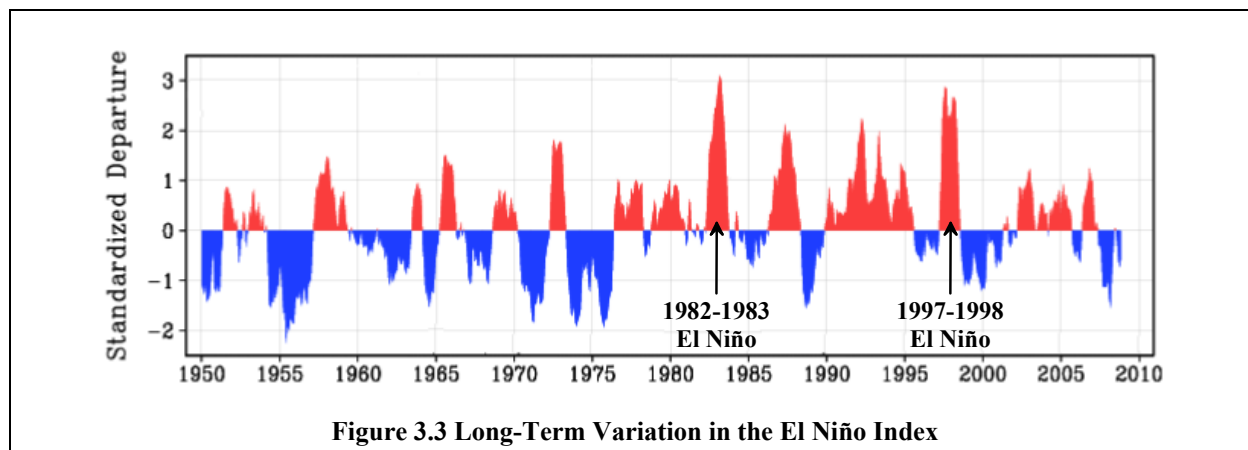
oceanographic conditions along this section of the central California coast. This wave energy increases the turbulence within nearshore waters and causes significant sediment resuspension and sand transport along the outfall corridor. Farther offshore, bands of counter currents move ocean waters in alternating 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 they are repeatedly observed extending from upwelling centers located south of major coastal headlands in satellite imagery, as 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 this stabilizing effect, seawater off the central-coast 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 countercurrent that carries water northward 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 locations 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 variations in oceanographic and marine biological properties also occur along the central California coast, and strongly influence the waters of Estero Bay (Figure 3.3). 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 between 1982 and 1983, and between 1997 and 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. For example, the relatively strong El Niño condition that was present during the latter half of 1997 and the beginning of 1998 resulted in a substantial increase in rainfall during the early part of 1998, and heavily impacted central-coast ocean waters and associated biota.

Superimposed on these large-scale oceanic flows are a variety of transient phenomena including intense eddies, swirls, filaments, meanders, and narrow jets of flow. Many of these cross-shore turbulent features are evident in the complex surface flow pattern depicted in satellite image on the cover of this report. For



example, the series of upwelling-induced cold-water jets emanating from major coastal promontories are delineated in shades of blue and purple, and contrast with warmer offshore waters delineated in yellow and orange. Some of these jets, such as those near Pt. Sur and Pt. Arguello, extend far offshore, while others, such as those near Pt. Buchon and Pt. Piedras Blancas, form recirculating eddy-like features closer to shore. Embedded in these large-scale features are smaller filaments of flow that add further complexity to the surface flow pattern. All of these cross-shore flow features are capable of transporting significant quantities of coastal 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 at the outfall site is approximately 1 m between mean high and low water.

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 (Figure 2.1). The wave-generated littoral cell can extend well offshore into Estero Bay, encompassing 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 to upwelling conditions, 3) tropical disturbances off shore of 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 swells from the south, which are diminished near the outfall site by the sheltering effects of Point Buchon.

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 they 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 ($H_s > 4$ 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 near the outfall. 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. Although the 22-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, 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 3.6 (Page 3-20) and Figure 3.7 (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 portions of 2008.

Upwelling is an important feature of this coastal region and is largely responsible for the region's productive fishery. Upwelling moves nutrient-rich water to the sea surface, significantly enhancing primary productivity (in the form of 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 they can reduce dilution of contaminants introduced by seafloor point sources (e.g., ocean outfalls).

Vertical stratification varies seasonally as shown in Figure 3.4. 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. Accordingly, as shown by the relatively straight black line in Figure 3.4, the

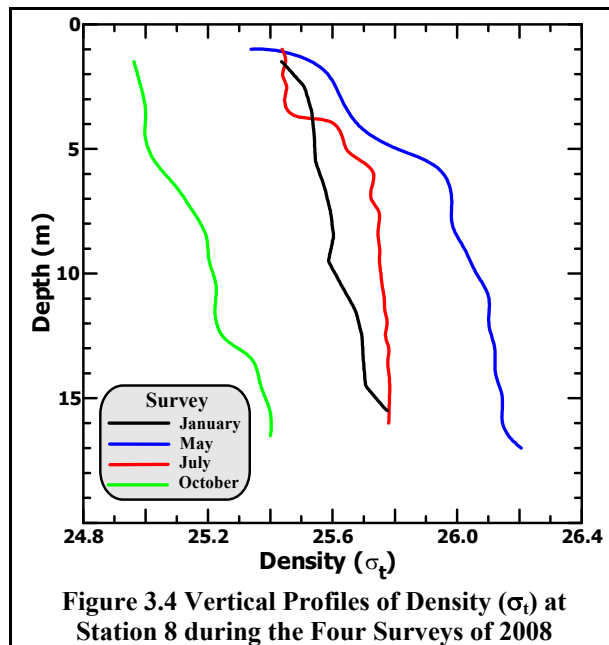
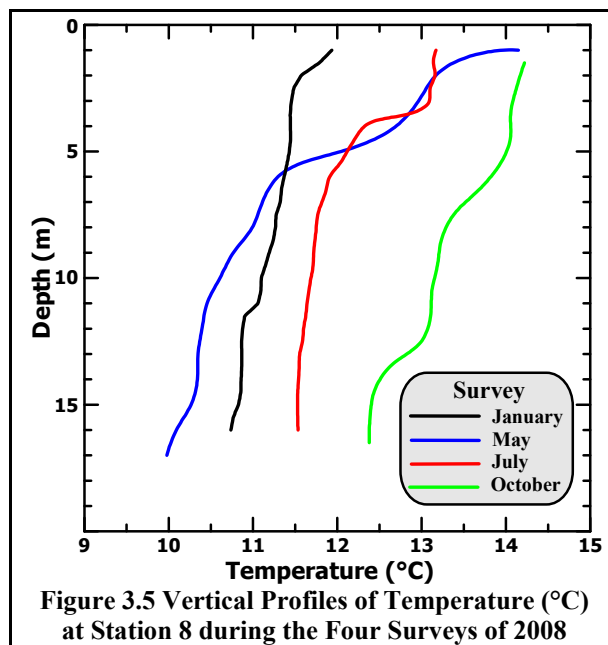


Figure 3.4 Vertical Profiles of Density (σ_t) at Station 8 during the Four Surveys of 2008

water column was only weakly stratified during the survey conducted in January 2008.

Conversely, the October (green line) survey was conducted during a period of moderate upwelling, while the May (blue line) and July (red line) surveys were conducted during periods of more intense upwelling, which resulted in strong vertical stratification of the water column. For example, the vertical density structure during the July survey (red line) emphasized a contrast between a shallow mixed layer that extended down to 3 m and a dense water mass below 5 m, with a sharp pycnocline in between. The vertical structure during the May survey (blue line), when upwelling was most intense, was even more complex, and resulted in multiple layers distributed through the water column. Also, during the May survey, the overall difference in surface and seafloor density was about twice as large as during the other surveys.



Because salinity exerts little influence on density, stratification in marine waters along the central coast is largely determined by temperature structure. Accordingly, Figure 3.5 shows that the vertical temperature structure closely mirrors the density structure shown in Figure 3.4, particularly with regard to the greater vertical range evident during the spring (blue line), and the sharp thermocline present during the summer (red line).

The seasonal trends in deep seawater temperatures confirm upwelling's role in controlling stratification as compared to short-term meteorological processes. For example, the lowest temperatures measured at depth were recorded during the May survey (blue line), which runs contrary to seasonal variation in air temperature, which is lowest in January. The lower May seawater temperatures are diagnostic of intense upwelling conditions where shoreward transport of deep, cool seawater results in lower seawater temperatures near the outfall. The upwelling-induced shoreward movement of cold, dense seawater is also delineated in Figure 3.6a by the dark blue shading that extends upslope near the seafloor.

Figure 3.6a exhibits another characteristic of upwelling, namely the presence of a sharp thermocline as reflected by the crowding of isotherms, which are evident between 20 and 60 m. This sharp thermocline resulted from the shoreward transport of cool water near the seafloor. It was created when 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 four hours. Along the transect, the upwelling-induced thermocline also sloped upward towards the shoreline, tracking the movement of deep water.

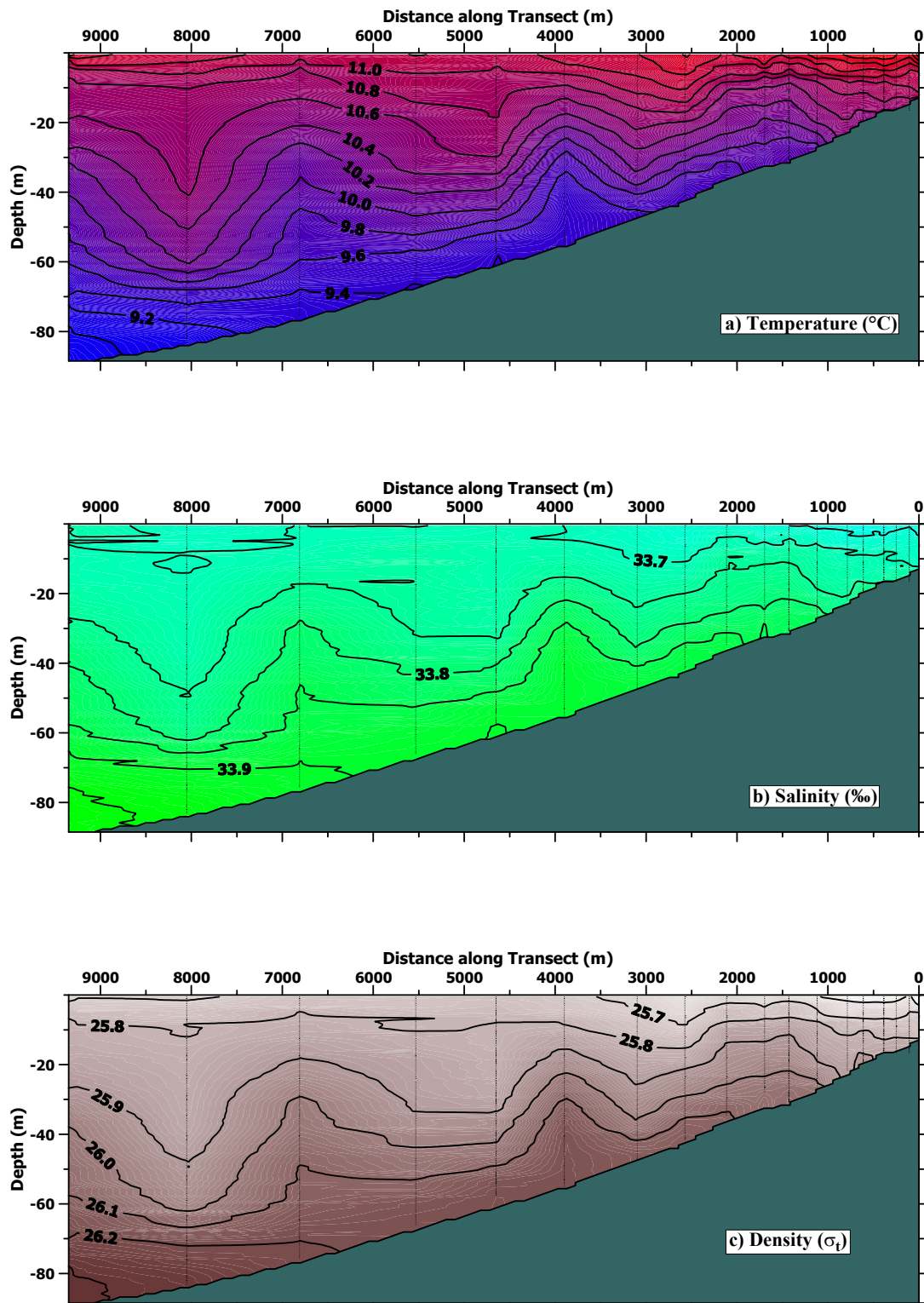


Figure 3.6 Cross-Shore Vertical Sections of a) Temperature, b) Salinity, and c) Density Collected across Estero Bay on 15 April 1999

The shoreward movement of deep, cool water during upwelling is also reflected in the salinity and density sections shown in Figure 3.6bc (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 central coast 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 apparent as the thermal contrast.

Dissolved Oxygen

In combination with nutrients, dissolved oxygen (DO) is necessary for a healthy marine ecosystem. However, pollutants that are high in organic compounds can locally deplete oxygen levels and have a deleterious effect 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. 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, however, DO levels steadily decrease with depth due to natural losses from biotic respiration and decomposition, and from the lack of exchange with the atmosphere. 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 that occur during upwelling, DO levels decrease rapidly with depth and decline to 5 mg/L in as little as 50 m (Figure 3.7a, top frame on Page 3-22). These low oxygen concentrations are a consequence of the shoreward movement of deep, oxygen-poor waters that have not been in recent contact with the atmosphere, and where ongoing respiration and decomposition have extracted much of the available dissolved oxygen.

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 (CO₂) and produces oxygen near the sea surface. As the ratio of respiration to photosynthesis increases with depth, there is an increase in CO₂ and a corresponding decline in pH (more acidic).

Although the overall range is small, this vertical decrease in pH is evident in Figure 3.7b (middle frame on Page 3-22). Seawater alkalinity can also be temporarily affected by the 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.

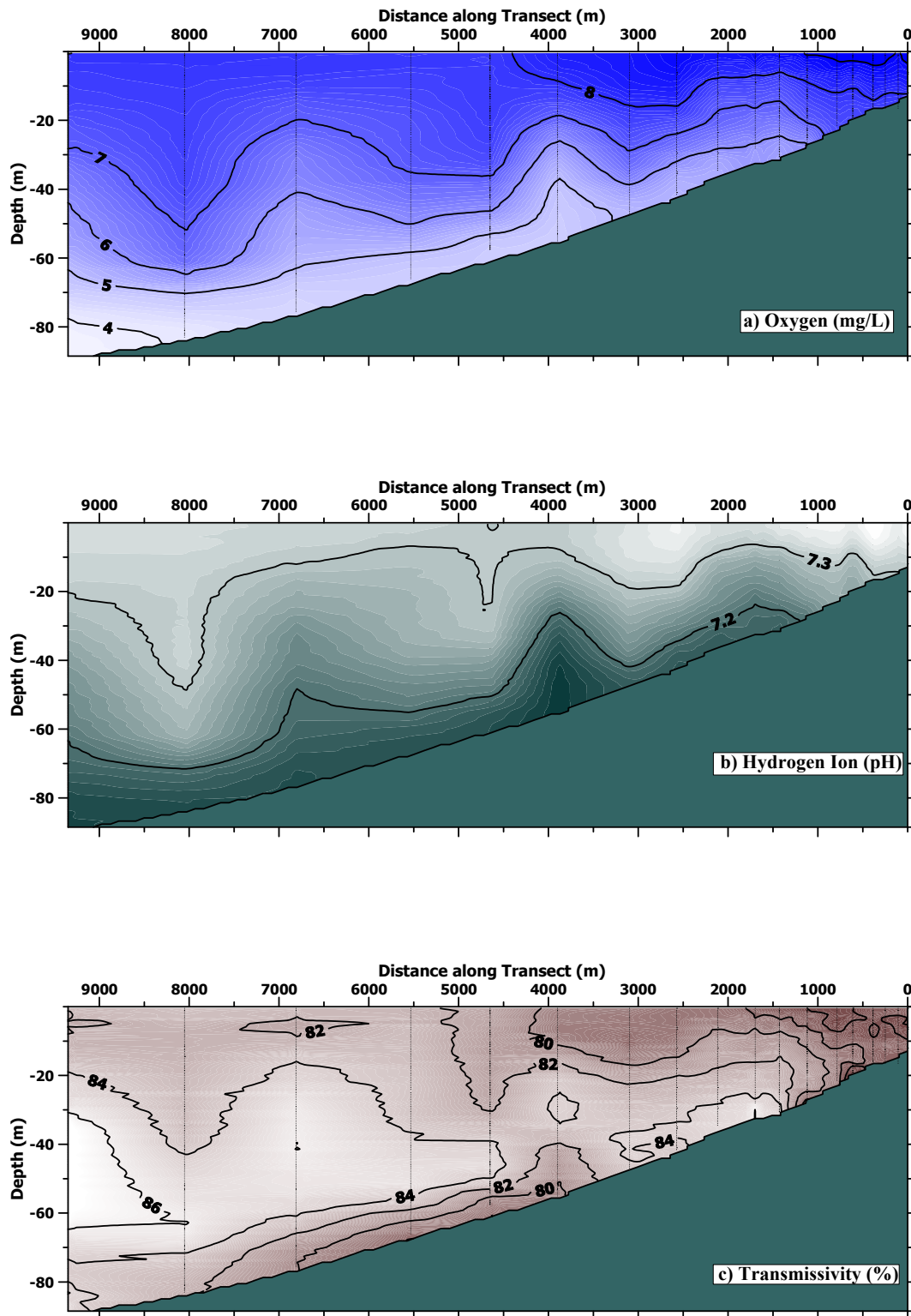


Figure 3.7 Cross-Shore Vertical Sections of: a) Oxygen, b) pH, and c) Transmissivity Collected across Estero Bay on 15 April 1999

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 and freshwater runoff, sediment resuspension, and discharge of wastewater from municipal outfalls. Along the central California coast, substantial sediment input from rivers and runoff generally 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.

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, where turbidity is high at the surface from the presence of biogenic particulates, a mid-depth maximum in transmissivity (water clarity) can occur (Figure 3.7c, bottom frame on Page 3-22; Figure 3.13b, second frame on Page 3-42). This vertical distribution differs from that of the other seawater properties described above, which tend to steadily increase or decrease with depth.

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. During the 2008 surveys, measured Secchi depths ranged from 5 m (May and July) to 12 m (January). As the euphotic zone extends to approximately twice the Secchi depth, it consistently spanned more than half of the water column throughout 2008. With the exception of isolated stormy periods, the greatest coastal water clarity in the upper water column, and therefore, the greatest Secchi depths, generally occur during winter months, when upwelling-induced planktonic blooms are absent. That was the case during the January 2008 survey when the euphotic zone extended throughout the water column, reaching the seafloor at nearly every station.

3.3 DISCHARGE EFFECTS

This section describes discharge-related trends in seawater properties observed during the four quarterly surveys conducted in 2008. In particular, it evaluates compliance of the 2008 wastewater discharge with the NPDES permit limitations on water quality. 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 provide benchmarks for determining whether discharges cause significant impacts on water quality beyond the 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 collected on a quarterly basis. For timely reporting of water-quality status, a receiving-water report was

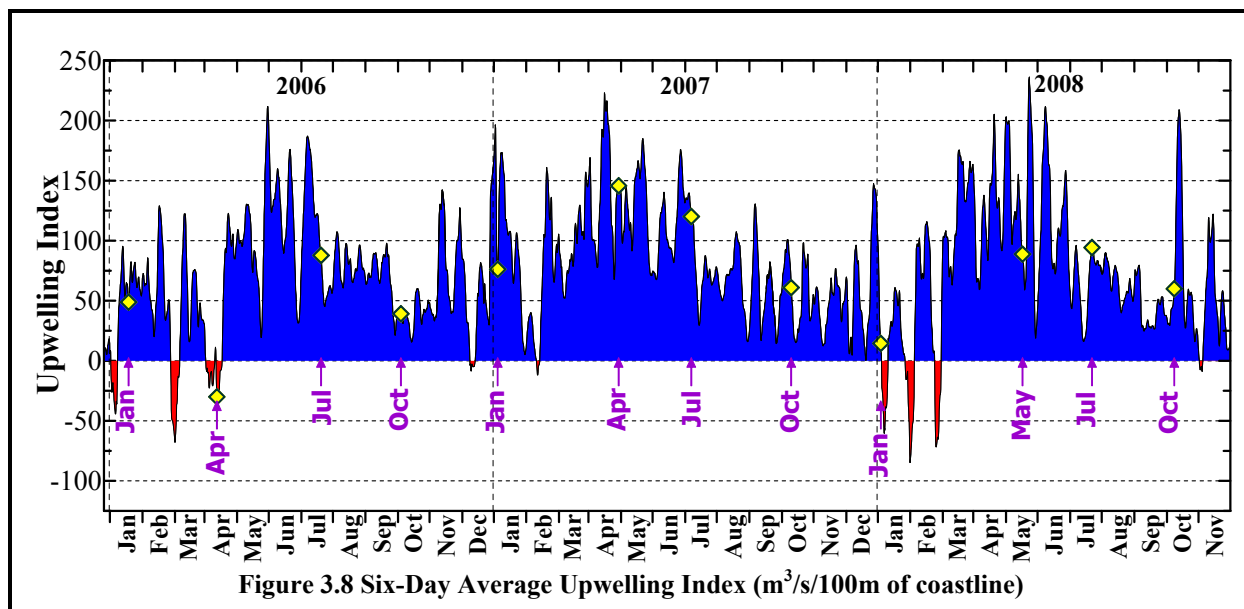
Table 3.7 Oceanographic Conditions during the Four Quarterly Receiving-Water Surveys

Conditions	January (winter)	May (spring)	July (summer)	October (fall)
Tide	Flood	Ebb	Flood	Flood
Wave Height	<1 /NNW	2-4 /WNW	2-4 /NW	4-6 /WNW
Flow Direction	S	NE	SE	SE
Stratification	Weak	Strong	Strong	Moderate
Water Clarity	High	Moderate	Moderate	Moderate
Upwelling	Absent	Intense	Intense	Mild
Plume Visible	Yes	No	No	No
Plume Signature	Yes	Yes	Yes	Yes

prepared after each quarterly survey (MRS 2008cdef). Those reports include comprehensive listings of raw data that are not provided in this annual report. They also include more detailed discussions of vessel offset and perturbations observed in the instrumental measurements.

In contrast to the quarterly reports, 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 following subsections. As described above, the ambient receiving-water conditions are largely dictated by the strength of upwelling processes that prevail at the time of each survey. The relative strength of upwelling can be gauged from indices determined from wind measurements collected along the central coast (Figure 3.8 on Page 3-24).

As shown in Figure 3.8, the May, July, and October 2008 surveys were conducted on days when there was some degree of upwelling. The blue areas in Figure 3.8 show the strength of upwelling when southeastward-directed winds prevailed near Estero Bay. These winds drive offshore surface flow,



thereby inducing upwelling near the coast. Conversely, the sharp, red spikes in January and February reflect downwelling events when passing storms generated winds in the opposite direction (toward the northwest) creating an onshore surface flow. Downwelling associated with this onshore flow displaces deep watermasses offshore, where they no longer provide a nearshore vertical contrast in seawater properties, and a uniform water column is produced within the survey area.

On average, the strongest and most persistent upwelling conditions occur during spring. The spring upwelling conditions in 2008 were particularly sustained and intense. The average seawater temperature measured near the upwelling center at Pt. Buchon during April was 9.7°C, which was the coldest for any month since 1976, when the Diablo Canyon Ocean Lab began regular measurements (Lindsey 2008). Because of the sustained winds, both the March and April 2008 mean monthly temperatures were 1.4°C below the historic averages (Table 3.8). The spring 2008 survey was conducted in mid-May, during a brief relaxation of the winds following this period of sustained upwelling (Figure 3.8). As a result, the sharply-defined thermocline that was likely generated by the upwelling had begun to erode, leaving only a large difference between surface and bottom seawater temperatures but no single distinct interface (blue line in Figure 3.5 on Page 3-19). This contrasts with the sharp thermocline seen in the July survey (red line in Figure 3.5), which was conducted shortly after the onset of a large upwelling event (Figure 3.8).

Table 3.8 Comparison of Monthly Average Seawater Temperatures (°C) near Point Buchon in 2008 with Historic Means

Month	Average	
	1976-2008	2008
January	13.2	11.9
February	12.8	11.7
March	12.1	10.6
April	11.1	9.7
May	11.2	10.7
June	11.8	11.6
July	12.9	13.3
August	13.7	14.3
September	14.2	14.6
October	14.3	14.0

The high winds which continued into May 2008 contributed to a delay in the second-quarter water-quality survey by complicating the selection of a suitable weather window. Additionally, the survey vessel was detained in dry dock for an unexpectedly long period awaiting spray application of bottom paint, which requires calm atmospheric conditions. As a result, the second-quarter survey was conducted in mid-May, rather than during April, which is when it traditionally takes place. Though delayed, the timing of the survey still conformed to the second-quarter Monitoring and Reporting requirements of the NPDES discharge permit.

The temperature profile from the October survey (green line in Figure 3.5) is markedly warmer at all depths than the other surveys. This seasonal temperature increase reflects the decline in the number and intensity of upwelling events as the summer progressed (Figure 3.8), and the increased influence of heating from solar insolation. Surface temperatures above 14°C are consistent with historical average temperatures for October (Table 3.8). It is noteworthy that the water column exhibited some degree of stratification during the October survey, albeit absent a single, sharply defined thermocline.

The fall survey was conducted on October 7th, just as a major upwelling event was developing (Figure 3.8). As shown in the satellite image on the cover of this report, taken just two days after the survey was conducted, the intensity of the northwesterly winds¹⁰ increased sharply following the survey, and involved the entire central California coastline in a late-season upwelling event. With an upwelling index exceeding 200 m³/s/100 m of coastline, the intensity of this upwelling event was unusually strong compared to previous fall upwelling events, when indices were less than 150 m³/s/100m of coastline.

¹⁰ Northwesterly winds refer to winds blow from the northwest toward the southeast.

The clear skies on the days following the survey permitted infrared sensors on one of NOAA's polar orbiting satellites to measure sea-surface temperatures throughout the entire central coast region. The presence of cooler upwelled seawater (<14°C) near the coast is delineated in the cover image by dark blue and purple shading, while the ambient offshore waters were generally 3°C warmer, as delineated by the yellow and orange shading. It is likely that if the October survey had been conducted two days later, at the time the satellite image was recorded, the vertical temperature profiles would have appeared similar to those of the July survey, with a sharply defined thermocline and surface water temperatures declining into the 13°C range.

The foregoing discussion on upwelling is relevant to the evaluation of discharge impacts because the degree of vertical stratification determines the disposition of the effluent plume within receiving waters. Upwelling results in a stratified water column within Estero Bay, and reduces the buoyancy of the mixture of effluent and deep seawater as the plume rises through the upper water column. When the water column is strongly stratified during intense upwelling conditions, the effluent plume can reach neutral buoyancy at a subsurface level and become trapped below the thermocline, rather than reaching the sea surface as it does under weakly stratified conditions. Also, during intense upwelling, nutrients carried into the upper water column can enhance phytoplanktonic blooms, which reduce seawater clarity. Both the reduced water clarity and the trapping of the effluent plume beneath the sea surface make it far less likely to visually observe the plume when upwelling conditions prevail.

Consequently, there was no visual manifestation of the plume during three of the four water-quality surveys, when upwelling had produced some degree of stratification (Table 3.7 on Page 3-24). Although the plume signature was detected by instrumental observations in all four surveys, only the January survey had high enough seawater clarity to visually observe the plume deep below the sea surface within the ZID at Station 9. It appeared as a diffuse light-green discoloration against the white background of the Secchi disk as it reached mid-depths in the water column, and just before it disappeared at a depth of 7.5 m. This station was located entirely within the ZID, and was undoubtedly influenced by an increase in turbidity due to the presence of the wastewater particulates within receiving waters that otherwise had extraordinarily high ambient visibility. Accordingly, the measurement at Station 9 stood out against the Secchi depths recorded at most other stations, which were 3.5 m deeper on average.

Despite visual and instrumental manifestation of dilute effluent within receiving waters during the 2008 surveys, neither odors nor debris of sewage origin were observed at the sea surface. In fact, all of the instrumental data indicated that water properties beyond the ZID were typical of natural background conditions in coastal waters. As described in the following subsections, only slight discharge-related anomalies were observed near and just beyond the ZID boundary. These anomalies indicated the presence of exceedingly dilute wastewater that was continuing to undergo a minor amount of initial mixing. These observations attest to the continued effectiveness and efficiency of the outfall and diffuser structure. Qualitative observations of aesthetic characteristics and beneficial uses also documented the lack of impacts from wastewater discharge. These aesthetic observations demonstrated compliance with Section C (Physical Characteristics) of the COP (Table 3.1). The few incidents of high coliform densities in the surf zone were correlated with non-point source (onshore) runoff and not with the discharge of 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 four of 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 only two of the six seawater properties and documented the intense mixing and rapid dilution experienced by wastewater shortly after

discharge. 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 2008 water-quality surveys. There was no evidence indicating that 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, kayakers, 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 2008 water-quality surveys. These included large numbers of California brown pelicans (*Pelecanus occidentalis californicus*), western gulls (*Larus occidentalis*), and Heermann's gulls (*Larus heermanni*) which were generally observed transiting through the survey area during the surveys. Pelagic and Brandt's cormorants (*Phalacrocorax*), which nest on Morro Rock, were also frequently observed. Pigeon Guillemots (*Cepphus Columba*) were documented within the confines of the harbor during the May survey.

In addition to avian fauna, juvenile sea lions (*Zalophus californianus*), harbor porpoises (*Phocoena phocoena*), and southern sea otters (*Enhydra lutris nereis*) were observed during several of the surveys. Higher numbers of sea lions, porpoises, and otters were typically observed near the Morro Bay harbor entrance during transit to and from the survey site, than at the survey site itself. For example, during the July survey, although no otters were seen at the survey site, southern sea otters were observed rafted within the confines of the harbor channel, while a small pod of harbor porpoises were observed transiting to the south of the harbor entrance. Two juvenile sea lions were observed just inside the harbor entrance, hauled out on one of the buoys that mark the navigational channel.

Pieces of detached bull kelp (*Nereocystis luetkeana*) were noted drifting in the survey area and during transit to the survey area during most surveys. Also, during the January survey, substantial numbers of both solitary and colonial salps (Salpidae spp.) were visually observed floating in the water column (Figure 3.9). Entrainment of salps into the ducted portion of the CTD may have compromised the measurements at one or more of the stations during this survey. Salps are barrel-shaped, free-floating tunicates that move by pumping water through their gelatinous bodies. They feed on the phytoplankton filtered from the pumped seawater. Though widespread throughout the world's oceans, they are not often encountered during the surveys. Recent studies have found that salps are effective at moving carbon dioxide from the ocean surface to the deep sea, thereby sequestering it in the ocean and preventing it from re-entering the atmosphere.

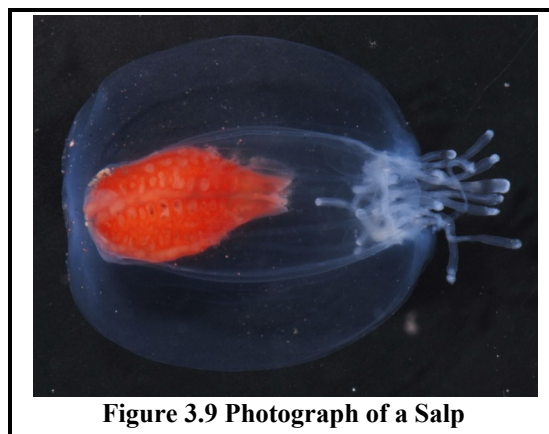


Figure 3.9 Photograph of a Salp

Recreational (*REC*) beneficial uses were also in evidence during the 2008 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. During the May survey, a large group of twenty or more students appeared to gather and walk, as a group, along a portion of 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 also regularly observed during the course of the quarterly surveys, demonstrating the area's ocean-fishing (*COMM*) usage.

3.3.2 Instrumental Observations

The signature of the effluent plume was detected in all four surveys conducted during 2008. Table 3.9 and Table 3.10 summarize the twelve identifiable perturbations in seawater properties that were associated with the wastewater discharge. Perturbations 1 and 4 were confined entirely within the ZID, where receiving-water limitations do not apply. Eight of the twelve perturbations were associated with anomalies in the salinity field that arose because of the presence of dilute wastewater constituents. Salinity anomalies in three of the four remaining perturbations (P2, P11, P12) were confounded by salinity spiking, so it was not clear whether dilute wastewater contributed materially to the anomalies (*cf.* Footnote 5 in Table 3.9).

Wastewater was too dilute within Perturbation 7 to discern a discharge-induced reduction in salinity. Most 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. Additionally, all of the perturbations except P4 were associated with anomalies in one or more of the three properties related to water quality, namely, transmissivity, DO, and pH (Table 3.10).

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 is mixed with effluent in the turbulent discharge jet shortly after discharge.

Although the character of the seawater anomalies differentiates the two types of discharge-related processes, both processes usually act in concert to form a series of vertical anomalies created by slugs of partially mixed ambient bottom water that are carried upward by the buoyant effluent plume. This upward transport locally displaces water-quality contours and distorts their normally horizontal structure in a stratified water column.

All but two of the non-salinity anomalies listed in Table 3.9 and Table 3.10 were created by the entrainment and upward displacement of ambient seawater, rather than the presence of wastewater constituents. In contrast, all of the salinity anomalies listed in Table 3.9 were artifacts of spiking, or they were induced by the presence of dilute wastewater constituents. Wastewater-induced anomalies tend to be spatially isolated from the properties of ambient seawater near the seafloor.

Table 3.9 Perturbations in Dynamical Seawater Properties Associated with Effluent Discharge

Perturbation	Survey	Station	Dilution ⁴	Anomaly ¹			Depth (m)	Height of Rise (mab) ²	Diffuser Distance ³ (m)	Figure
				Salinity (‰)	Temperature (°C)	Density (σ _t)				
P1	January	9	348	-0.10	-0.4	—	5.0	11.5	12.3	Figure 3.10a Figure 3.11a
P2	May	1	— ⁵	-0.16⁶	—	-0.12	6.5	9.5	93.2	Figure 3.10b
P3	May	3	404	-0.09	—	—	9.0	7.0	20.4	Figure 3.10b
P4	May	4	>123	-0.27	—	-0.24	15.0	2.0	0.1	Figure 3.10b
P5	July	3	462	-0.07	-1.1	+0.23	5.5	10.5	21.5	Figure 3.10c Figure 3.12ab
P6	July	4	341	-0.10	-1.5	+0.22	1.0	15.5	20.1	Figure 3.10c Figure 3.12ab
P7	July	5	— ⁷	—	-1.4	+0.24	1.0	15.0	55.2	Figure 3.12ab
P8	July	9	614	-0.06	-1.3	+0.24	4.0	12.5	20.2	Figure 3.10d
P9	July	16	407	-0.08	-1.3	+0.24	6.5	9.5	40.2	—
P10	October	4	597	-0.06	-0.2	—	10.0	6.0	23.5	Figure 3.10e Figure 3.13a
P11	October	9	— ⁵	-0.10	—	—	13.0	3.5	29.4	Figure 3.10f
P12	October	13	— ⁵	-0.06	—	—	12.0	5.0	48.9	—

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 Dilution could not be computed because the salinity anomaly was confounded by a salinity spike in the instrumental measurements (see the discussion in the text)

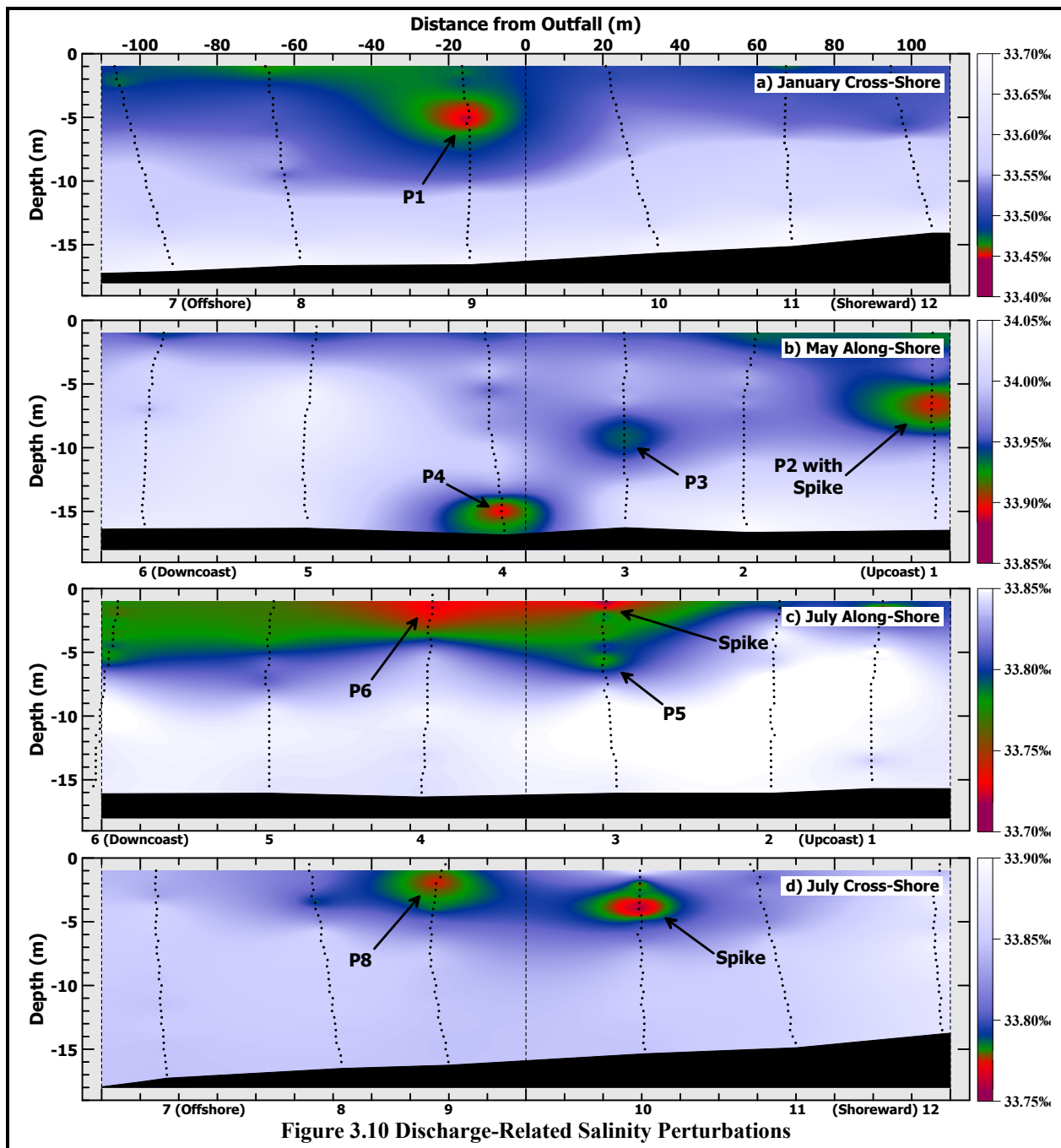
⁶ Anomalies highlighted with bold typeface and shading were found to be statistically significant at the 95% confidence level.

⁷ Wastewater within this perturbation was too dilute to exhibit a discernable salinity anomaly from which dilution could be computed.

Table 3.10 Perturbations in Water-Quality Parameters Associated with Effluent Discharge

Perturbation	Survey	Station	Dilution	Anomaly			Depth (m)	Figure
				Transmissivity (%)	DO (mg/L)	pH		
P1	January	9	≥348	-9.1	-1.2	-0.05	2.0–13.5	Figure 3.11bcd
P2	May	1	—	-16.2	-3.0	-0.19	7.0–9.5	—
P3	May	3	≥404	-21.2	-3.7	-0.22	5.5–11.5	—
P5	July	3	≥462	+14.5	-1.5	—	1.5–4.5	Figure 3.12cde
P6	July	4	≥341	+16.8	-2.7	-0.21	1.0–5.0	Figure 3.12cde
P7	July	5	—	+16.3	-2.5	-0.18	1.0–4.5	Figure 3.12cde
P8	July	9	≥614	+15.7	-2.4	-0.19	1.0–4.5	—
P9	July	16	≥407	+15.9	-2.3	-0.18	1.0–4.5	—
P10	October	4	≥597	-1.5	-0.2	-0.02	6.0–12.0	Figure 3.13bcd
P11	October	9	—	-2.5	—	—	12.5–15.0	—
P12	October	13	—	-1.4	—	—	11.0–12.5	—

This isolation is apparent in the salinity anomalies shown in Figure 3.10. Salinity provides a powerful tracer of dilute wastewater because of the large difference between the nearly fresh wastewater and the saltier receiving waters. Other properties do not exhibit such a large contrast and, as such, their signature dissipates rapidly upon discharge with very little mixing. In the case of salinity, however, wastewater's lack of salinity provides a powerful marker that allows the presence of effluent constituents to be identified even after dilution of as much as 600-fold (*cf.* the 614:1 dilution of P8 in Table 3.9).



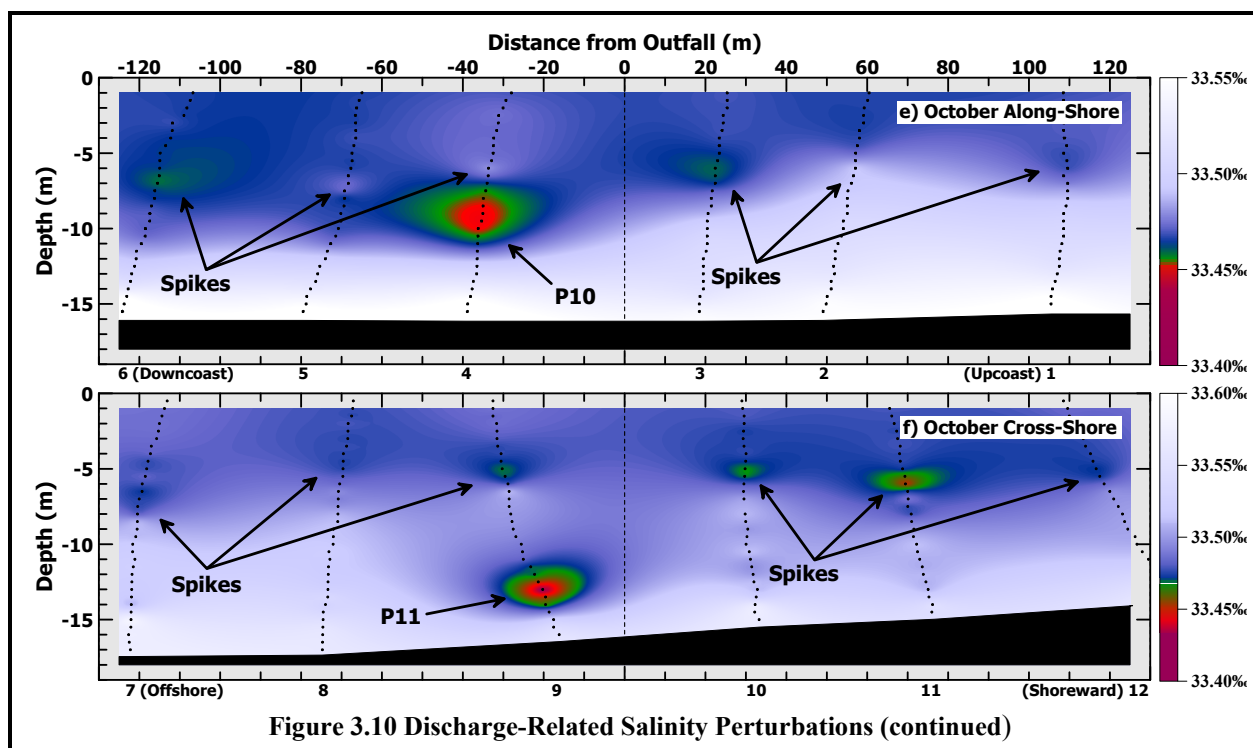


Figure 3.10 Discharge-Related Salinity Perturbations (continued)

Unfortunately, the interpretation of salinity anomalies is occasionally complicated by an instrumental phenomenon known as salinity spiking. As described in greater detail in the following section, large erroneous excursions (spikes) in salinity measurements are often recorded within sharply defined thermoclines present when the water column is stratified. For example, a series of salinity spikes recorded during the October survey within the 7-m thermocline are apparent in Figure 3.10ef. However, these salinity artifacts were clearly unrelated to the discharge because they did not coincide with anomalies in other seawater properties.

On occasion, spiking can be amplified when the rising effluent plume compresses the vertical thermal gradient within the thermocline. For example, during the May survey, a salinity spike coincided with Perturbation 2 at Station 1 (Figure 3.10b). The salinity anomaly was located near weak entrainment-generated anomalies in water-quality parameters (Table 3.10), so the presence of dilute wastewater at that location is plausible. However, instrumental spiking prevents the accurate determination of how much of the localized decrease in salinity, if any, was due to the presence of dilute wastewater constituents, and how much was artificially generated by instrumental spiking.

It is probable that wastewater constituents did not contribute to the anomaly observed at Station 1 to any tangible degree. Both Stations 2 and 3 lie closer to the outfall in the path of plume trajectory, but the closest Station (3) only had a very weak anomaly (-0.09‰), while Station 2 did not exhibit any salinity anomaly. Instead, the anomaly at Station 1 likely resulted entirely from entrainment. Entrainment-generated anomalies in water-quality parameters, such as those observed at Station 1, can be much longer-lived than wastewater-induced anomalies. Having been generated by the upward displacement of ambient seawater, their contrast with shallow seawater properties can be large and not easily dissipated by natural oceanic turbulence. Because of the confounding influence of salinity spiking, dilution levels could not be reliably computed for Perturbations 2, 9, and 10 (Table 3.9). Similarly, the absence of a perceptible

salinity anomaly within Perturbation 7 indicates that the wastewater constituents had dissipated beyond recognition, even though entrainment-generated anomalies in all the other seawater properties remained evident.

Anomalies Unrelated to Discharge

In addition to salinity spikes, a number of other statistically significant anomalies identified within the 2008 water-quality database were unrelated to the discharge. There were a total of 11,484 water-quality observations reported at standard 0.5 m intervals during 2008. 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 water properties at depth 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. 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 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 strongly stratified (May), than when the water column was relatively unstratified (January). That is why, for example, the pH anomaly of -0.05 associated with Perturbation 1 was determined to be a statistically significant departure from the uniform conditions during the January survey (listed with bold typeface and shading in Table 3.10), yet the much larger pH anomaly (-0.22) identified in the May survey (Perturbation 3) was not determined to be materially different given the highly stratified conditions (and the resulting greater overall variability) that prevailed at that time.

Two-thirds of the 53 discharge-related anomalies listed in Table 3.9 and Table 3.10 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, their location in the path of the plume trajectory, 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 3.11 lists the 21 statistically significant anomalies that were not included in Table 3.9 and Table 3.10 because they were unrelated to the discharge of wastewater.

Table 3.11 Inventory of Statistically Significant Anomalies that were Unrelated to Effluent Discharge

Survey	Cause	Station	Depth (m)	Property	Magnitude
January	Spike	5	4.0	Salinity	-0.13 ‰
	Fouling	14	1.0-16.0	DO, Density, Salinity	—
May	Spike	4	5.5	Salinity	-0.14 ‰
	Spike	5	5.5-6.0	Salinity	+0.11 ‰
	Spike	7	6.0	Salinity	-0.09 ‰
	Spike	11	1.0-2.0	Salinity	+0.13 ‰
	Spike	13	3.0	Salinity	-0.10 ‰
	Spike	13	7.5	Salinity	-0.10 ‰
	Spike	14	6.5	Salinity	-0.10 ‰
	Spike	1	1.5	Salinity	-0.10 ‰
July	Spike	10	1.0	Salinity	+0.17 ‰
	Spike	10	1.0	Density	+0.19 σ_t
	Spike	12	3.5	Salinity	+0.09 ‰
	Spike	13	3.0-3.5	Salinity	-0.15 ‰
	Spike	16	6.5	Salinity	-0.08 ‰
	Spike	5	8.0	Salinity	-0.07 ‰
October	Spike	6	14.5	Salinity	+0.07 ‰
	Spike	7	15.0	Salinity	+0.11 ‰
	BBL	8	15.0-16.0	Transmissivity	-3.1 %
	Spike	14	14.5	Salinity	-0.07 ‰
	Spike	16	14.0	Salinity	-0.09 ‰

Nearly all of these non-discharge-related anomalies were the result of instrumental artifacts, and their statistical significance was happenstance. Even in the absence of effluent discharge or instrumental artifacts, 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 1,900 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, over 95 significant departures could be expected to occur by chance alone. The origins of these significant, non-discharge-related anomalies are connected to one or more of the following specific causes.

Benthic Boundary Layer (BBL): A sharply defined, turbid layer of seawater often resides immediately above the seafloor. Oscillations in the thickness of this benthic boundary layer (BBL), or differences in the height of the CTD measurement within this layer, can result in lateral anomalies in water properties that are perceived 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 BBL was present during the October 2008 survey. During this survey, 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 slight variations in the location of the near-bottom CTD measurements relative to the BBL interface resulted in a lateral variation in transmissivity that appears as the statistically “significant” lateral difference at Station 8 in Table 3.11.

Salinity Spiking: Salinity spikes are artificially introduced when the CTD instrument package crosses a sharp thermocline, which is present when the water column is well stratified. Salinity is not measured

directly, but is computed from conductivity and temperature readings. These two probes 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 through regions of sharp temperature gradients, the mismatch between the recorded conductivity and temperature measurements results in erroneous spikes in computed salinity. This was particularly the case during the May, July, and October surveys, when stratified conditions caused spikes large enough to be statistically significant (Table 3.11).

Salinity spikes are particularly apparent in the vertical sections from the October survey (Figure 3.10ef). They formed a series of salinity anomalies within the upper thermocline that was present between 6 m and 8 m at the time of the survey. Although only one of these shallow salinity spikes was deemed to be statistically significant, their influence at nearly every station is visually apparent in the vertical sections. A larger number of statistically significant spikes were also found along the deep thermocline that formed along the boundary layer near 15 m (Table 3.11). Some of these spikes formed positive salinity anomalies, indicating that the observed salinity was higher than surrounding waters and therefore could not have been induced by the presence of lower-salinity wastewater. As with the deep transmissivity anomaly at Station 8 that was previously described, it is likely that the statistical significance of the deep salinity spikes were enhanced by random fluctuations along the BBL interface. When salinity spikes are large enough, such as at Station 10 during the July survey, they also manifest themselves as statistically significant density anomalies (Table 3.11).

Fouling: On rare occasions, debris becomes entangled in the CTD package as it is towed between stations, or is lowered or raised through the water column at each station. If it goes unnoticed, it can comprise the sensor readings. Past instances of fouling that have affected CTD readings resulted from interactions with drifting kelp when the attached fronds intermittently blocked the transmissometer path and caused unrealistically low transmissivity readings. However, during the January 2008 survey, readings from the conductivity and DO sensors were compromised at the last station surveyed (Station 14). Consequently, the derived estimates of salinity, density, and DO were unrealistically low at that station, while temperature, pH, and transmissivity readings were normal. The conductivity and DO sensors are contained within the ducted portion of the CTD through which seawater is pumped. It is likely that a gelatinous salp encountered the intake and was circulated through the duct, and resulted in the erroneous readings (Figure 3.9). Numerous solitary and colonial salps (*Salpidae* sp.) were visually observed drifting at mid-depth in the water column throughout the survey. The isolated erratic measurements in salinity, density, and DO that resulted from the fouling were so anomalous that they did not warrant reporting, and as such, they were not included in the statistical analysis for the January survey.

Wastewater-Induced Anomalies

As discussed above, negative salinity anomalies are the only consistent indicator of the presence of wastewater constituents within receiving water. Salinity in wastewater is negligible compared to that of the receiving seawater, so the presence of a distinct salinity minimum provides *de facto* evidence of the presence of wastewater constituents. Accordingly, 11 of the 12 discharge-related perturbations were associated with salinity anomalies, and 6 of those 11 anomalies were statistically significant (Table 3.9). However, 3 of those statistically significant salinity anomalies were enhanced by spiking related to compression of the thermocline caused by the rising effluent plume. For those anomalies, the discharge-related reduction in salinity could not be reliably determined, and wastewater dilution ratios were not estimated.

For the remaining 8 perturbations, salinity provided a particularly useful tracer of wastewater constituents because it directly quantified the amount of dilution that had 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:

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

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 3.9 on Page 3-29 were computed using each respective salinity anomaly in Equation 3.2. The computed dilution factors ranged from 123:1 for the largest salinity anomaly measured within a discharge jet during the May survey (Perturbation 4) to 614:1 for the weak anomaly (Perturbation 8) measured near the surface during the July survey. Based on the smallest statistically significant salinity anomaly (Perturbation 9), wastewater-induced salinity anomalies with amplitudes less than approximately $|-0.08\text{‰}|$ cannot be reliably discerned against the backdrop of ambient salinity variability. Accordingly, wastewater diluted more than approximately 400-fold 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 3-11).

The salinity anomalies measured during 2008 demonstrate that the outfall was performing far better than designed. The turbulent discharge jet was rapidly diluting effluent more than 100-fold within as little as 1 m of the discharge point (P4 in Table 3.9). Thus, the dilution levels achieved by the momentum of the jet alone were close to that predicted by modeling for the entire dilution process. With the addition of buoyant mixing, and after completion of the initial mixing process, effluent was diluted more than 340-fold (Perturbation 6). This is more than two-and-one-half times the 133:1 critical dilution used to establish end-of-pipe permit limitations on contaminant concentrations within wastewater discharged from the MBCSD treatment plant. Consequently, the COP receiving-water objectives were easily met by the chemical concentration limits promulgated by the NPDES discharge permit issued to the MBCSD. All of these observations confirmed that the diffuser structure was operating better than would be expected from the original modeling used to design the outfall. Some of the noteworthy wastewater-induced perturbations are discussed below in more detail.

May Perturbation 4. Equation 3.2 occasionally underestimates the dilution level that will ultimately be achieved upon completion of the initial-dilution process. This was the case at Station 4 during the May survey, when the CTD passed within 1 m of the diffuser structure during the hydrocast. During that downcast, the vessel drifted toward the northeast and the CTD traversed a large portion of the ZID, eventually passing directly over the diffuser structure shortly before encountering the seafloor. A very low dilution level was measured within the turbulent discharge jet emanating from one of the 28 diffuser ports (P4 in Table 3.9). The measured dilution within this discharge jet (123:1) was close to the final dilution (133:1) predicted by modeling, but the modeling included substantial additional dilution predicted to occur after a 9-m rise through the water column. This demonstrates that the momentum of the discharge jet alone was capable of achieving dilution levels close to the permit-specified dilution ratio, without even considering the additional dilution achieved as the plume reaches equilibrium within the water column.

The salinity anomaly within Perturbation 4 was associated with an extremely low density ($-0.24\sigma_t$), indicating that the plume was highly buoyant, and would rise rapidly through the water column as it mixed further with the surrounding seawater. Because buoyancy-induced turbulence appreciably contributes to initial dilution, seafloor diffuser structures are designed to be placed as deep as possible to increase overall dilution. The negative density anomaly associated with Perturbation 4 indicates that the plume would ultimately achieve a higher dilution because it had yet to rise through the water column. Thus, the reported dilution level is qualified with a “*greater-than*” symbol ($>$) in Table 3.9, indicating that the actual dilution ultimately achieved when the plume extended beyond the ZID would be substantially higher than where the salinity anomaly was observed. This was confirmed by the 404-fold dilution that was measured after the plume had risen an additional 5 m in the water column, as it was transported close to the ZID boundary (Perturbation 3 at Station 3).

Despite the very low dilution of Perturbation 4, and its close proximity to the discharge, it is noteworthy that no wastewater-induced anomalies were apparent in the water-quality parameters for this perturbation (Table 3.10). One might incorrectly assume that so close to the discharge point, the unique characteristics of wastewater would be readily apparent against the backdrop of ambient seawater characteristics. However, wastewater properties, other than their low salinity, do not exhibit much of a contrast with the receiving-seawater properties. As a result, the signature of wastewater particulates dissipates rapidly with very little mixing, and in this case, mixing within the turbulent discharge jet diluted wastewater characteristics beyond recognition. Subsequently, only the entrainment-generated anomalies in transmissivity, DO, and pH became clear as the plume moved upward through the water column during its northward transit to Station 1 (P2 and P3 in Table 3.10).

January Perturbation 1. Under rare circumstances, wastewater-induced anomalies are observed within the upper water column in the density and transmissivity fields. Such was the case in the January 2008 survey when the extraordinarily high ambient seawater visibility allowed the detection of reduced water clarity at Station 9 that was caused by the presence of wastewater particulates (-9.1% within P1 in Table 3.10).

The discharge plume was also visually apparent in the water column at Station 9 as a diffuse light-green discoloration of the Secchi disk as it reached mid-depths in the water column, just before it disappeared at a depth of 7.5 m. The measurement at Station 9 stood in stark contrast against the average Secchi depth of 11.0 m that was measured at most other stations (Table 3.12). This reduced water clarity was large enough to generate a statistically significant difference in nearfield and reference Secchi depths during the January survey ($p=0.002$), whereas during all the other surveys, the difference between averaged Secchi depths measured near the diffuser were not significantly different ($p>0.16$). The observed reductions in light transmissivity and Secchi depth at Station 9, although statistically significant, were measured at a location well within the ZID, and thus they were not subject to the limits specified in the discharge permit.

Secchi depths recorded during the January 2008 survey were among the deepest ever measured during the MBCSD monitoring program, exceeding 10 m at most stations and reaching 12 m at Station 14. The extraordinarily high seawater clarity that was present at the time of the survey reflected a euphotic zone that extended to the seafloor at all of the stations, with the exception of Station 9. There, the presence of

**Table 3.12 Average Secchi Depths (m)
measured near the Diffuser and at Distant
Locations**

Survey	Nearfield ¹	Reference
January	9.8	11.0
May	5.9	6.0
July	6.2	5.5
October	7.0	7.0

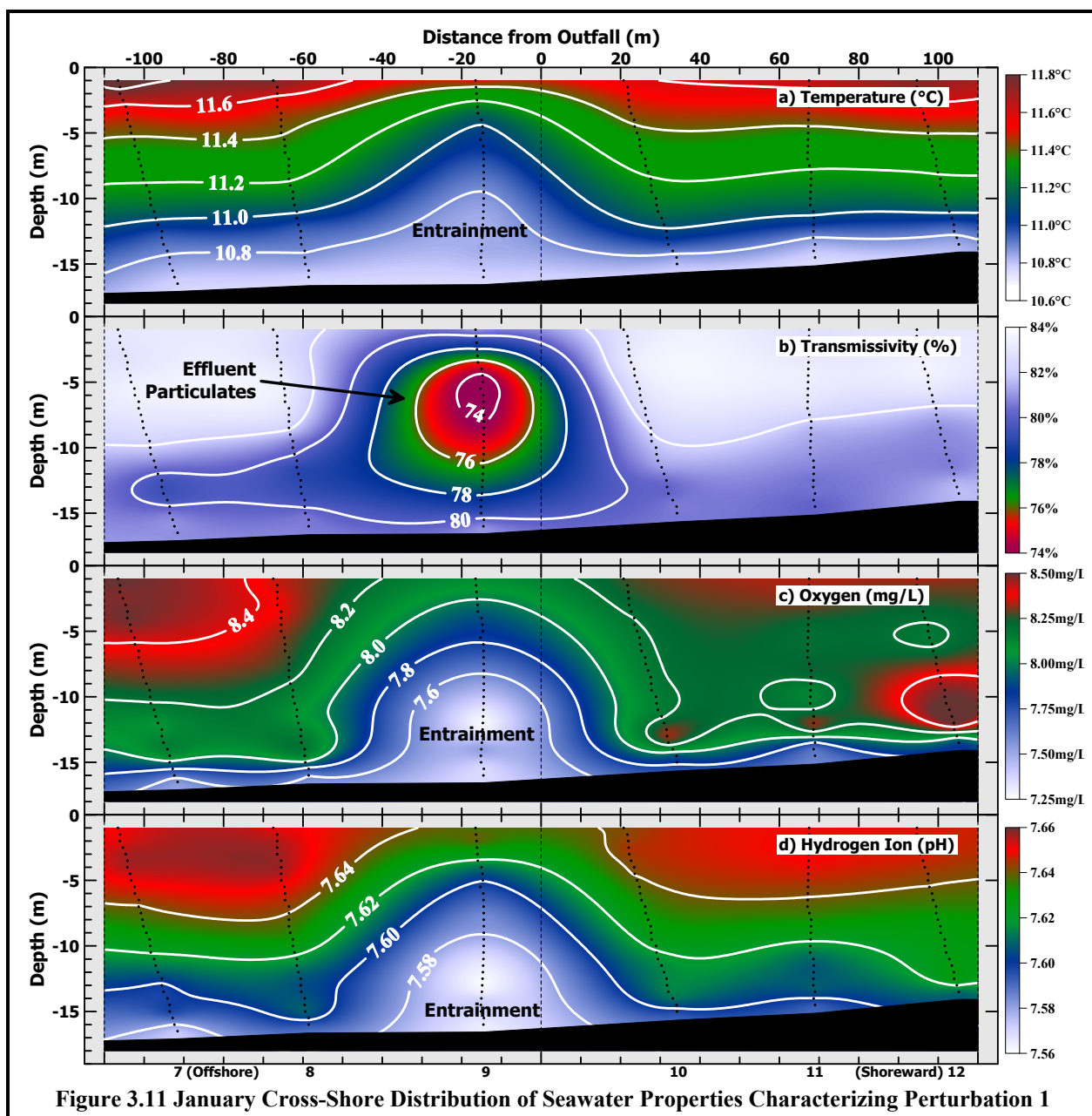
¹ Within 30 m of the diffuser structure

the discharge plume perceptibly reduced light penetration, but only because seawater clarity was so exceptionally high. A deeper-than-usual euphotic zone is typical of downwelling conditions when unstratified conditions and decreased primary production, namely, decreased phytoplankton density, increases the transmission of ambient light throughout the water column. The seawater clarity during the January 2008 survey was also unusually high because other confounding factors, such as high onshore runoff, strong winds, and high waves, were absent prior to the survey. Thus, the quiescent oceanographic conditions, along with the onset of downwelling, were responsible for the unusually deep euphotic zone.

The striking difference between wastewater-induced and entrainment-generated anomalies is readily apparent in the vertical cross-sections that encompass Perturbation 1 (Figure 3.11). The localized reductions in salinity (Figure 3.10a) and transmissivity (Figure 3.11b) were disconnected from the ambient seawater properties at depth. Accordingly, these vertically isolated extrema could only have been induced by the presence of dilute wastewater constituents, and not the movement of natural seawater. The reduced transmissivity at Station 9 was undoubtedly caused by the presence of particulate loads within the effluent plume, because the measured levels were perceptibly lower than measurements recorded at any other location. In contrast, the associated entrainment-generated anomalies confirm their connection to deep seawater with a distinctive upward excursion in the contour lines (at Station 9 in Figure 3.11acd). Each of the anomalies in temperature, DO, and pH have the same characteristics as ambient seawater at depth because they were generated by the upward displacement of that seawater. As a result, these entrainment-generated anomalies also span a broader depth range, one that extended throughout most of the water column during the January survey (2 m to 13.5 m in Table 3.10). Entrainment-generated anomalies are discussed further in the next section.

July Perturbations 5 through 9. During the July survey, the thermocline was well-defined but exceptionally shallow, beginning only 3 m below the sea surface (red line in Figure 3.5 on Page 3-19). As a result, the effluent plume achieved comparatively high dilution levels (>340-fold in Table 3.9) as it rose unimpeded all the way to the sea surface. Additionally, because of the sharp shallow interface, all of the July perturbations were distinguished by shallow, entrainment-generated anomalies in almost all seawater properties (Table 3.9 and Table 3.10). Salinity was the only property to exhibit wastewater-induced anomalies during the July survey.

The sequence of increasing dilution levels among the five perturbations was a function of both outfall proximity and location relative to plume transport. Based on the amplitudes of the salinity anomalies, the lowest dilution was recorded 20 m to the southeast of the diffuser structure at Station 4 (341:1 for Perturbation 6). Although Stations 3 and 9 were comparably distant from the diffuser structure, they were not located directly in the path of plume transport, and their salinity anomalies reflected correspondingly higher dilution levels consistent with measurements on the margin of the effluent plume (462:1 and 614:1 for Perturbations 5 and 8). Station 16, though nearly twice as far away from the diffuser, lay directly in the southeasterly path of the effluent plume and, consequently, effluent was less dilute (407:1 for Perturbation 9) than the closer stations on the margin of the plume. Lastly, Station 5 was located at the greatest distance (55 m) from the diffuser structure, at which point wastewater dilution was too great to discern the presence in the salinity field (Perturbation 7). Entrainment-generated anomalies were evident in all the other seawater properties at this location, however, and the amplitudes of the anomalies were comparable among all five perturbations, regardless of location. This attests to the long-lived nature of the entrainment-generated anomalies.



Entrainment-Generated Anomalies

In contrast to the wastewater-induced anomalies described above, all of the remaining water-quality anomalies were generated by the upward displacement of ambient seawater that was entrained in the buoyant effluent plume. In particular, all of the anomalies listed in Table 3.10, with the exception of the transmissivity anomaly within Perturbation 1, were caused by the movement of ambient seawater rather than by the presence of wastewater constituents. This was also the case for all of the negative thermal and positive density anomalies listed in Table 3.9. These anomalies were generated when ambient bottom water was entrained within the rising effluent plume. This upward displacement juxtaposed bottom-water

properties and shallow-water properties, causing the contrast to become apparent as a lateral anomaly, similar to those shown at Station 9 in Figure 3.11acd. Thus, the anomalies only arose because of a difference in the properties of the ambient water near the seafloor, and the ambient seawater properties in the upper water column. Generally, seawater immediately above the seafloor tends to be naturally lower in temperature, water clarity, DO, and pH. Consequently, upward movement of these waters often results in negative anomalies, such as those found within most of the perturbations listed in Table 3.9 and Table 3.10.

January Perturbation 1. Because of their dependence on ambient seawater stratification, entrainment-generated anomalies usually appear at the base of the thermocline and extend into the upper mixed layer. Although there was no well-defined thermocline present during the January survey, the gradual decrease in temperature, DO, and pH with increasing depth was enough to create entrainment-generated anomalies that spanned almost the entire water column (P1 in Table 3.10 and Figure 3.11acd). As a result, their 12-m vertical extent was much larger than the 5-m deep anomalies generated within the shallow, sharply defined mixed layer during the July survey (P5 through P9 in Table 3.10 and Figure 3.12).

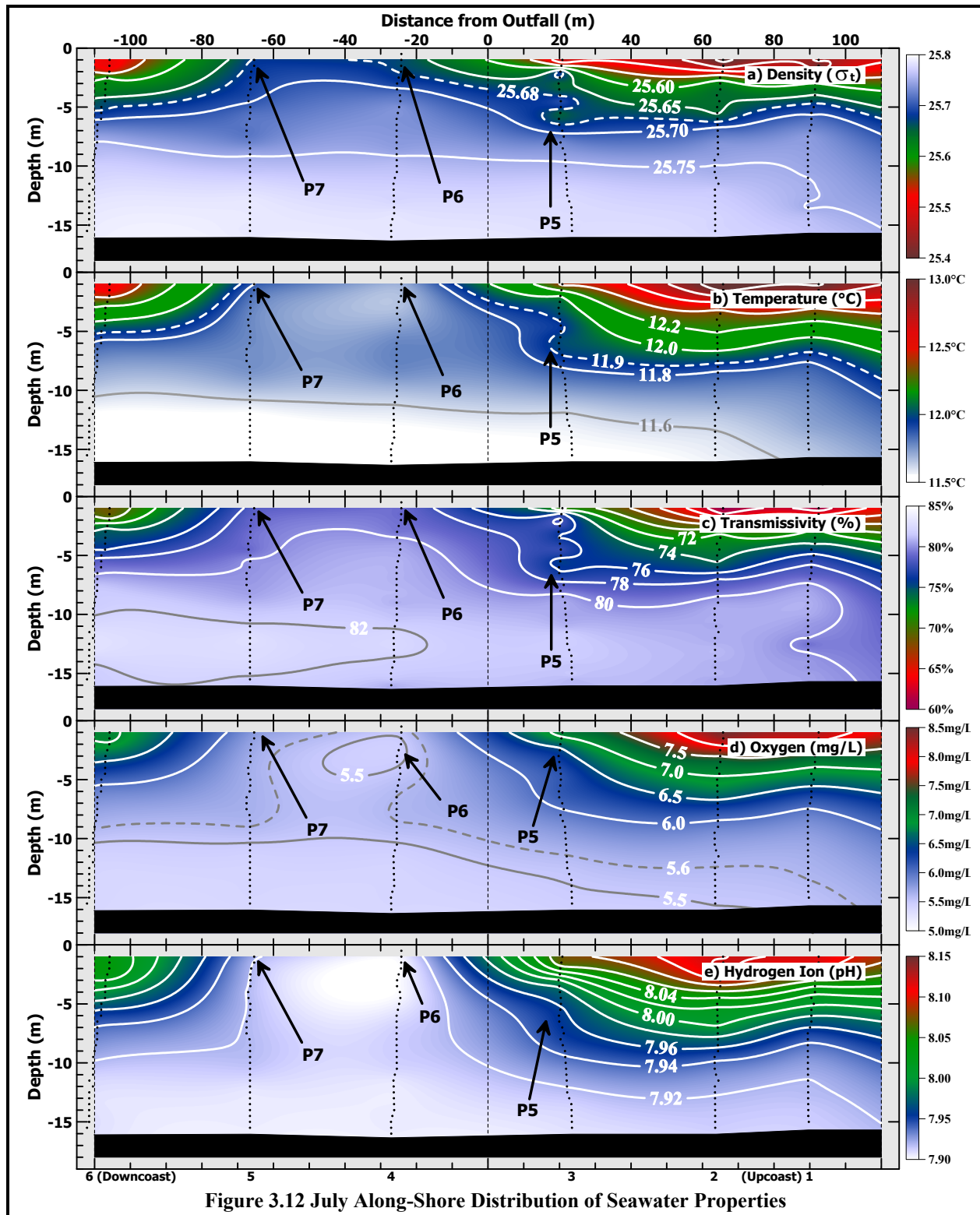
July Perturbations 5 through 9. At Stations 4 and 5 during the July survey, a combination of buoyancy and upward momentum was great enough to allow the plume to breach the shallow thermocline and reach the sea surface, thereby generating anomalies in five seawater properties (P6 and P7 in Figure 3.12). The absence of entrainment-generated anomalies within the uniform layer below the 5-m base of the shallow thermocline attests to the fact that vertical stratification is necessary for these anomalies to become apparent.

The shallow July thermocline appears in Figure 3.12 as a bunching of isopleths in the upper reaches of the water column at Stations 1, 2, 3, and 6, with comparatively little variation at depth as reflected by the widely-spaced isopleths. However, at Stations 4 and 5, the upward movement of the plume carried the uniform properties of the mid-depth seawater all the way to the sea surface, effectively eliminating the thermocline and creating a strong lateral contrast with ambient seawater at the surface.

Because the amplitudes of entrainment-generated anomalies are dictated by the vertical difference in ambient seawater properties rather than the wastewater characteristics, July anomalies for a given water-quality parameter tend to be similar at all affected stations, regardless of diffuser proximity or dilution level. All five perturbations tend to reflect the same 1.4°C drop in temperature across the thermocline, as well as the 2.5 mg/L decline in DO and the 0.2 difference in pH (P5 through P9 in Table 3.10).

Declines of this magnitude occur naturally because DO is depleted at depth due to natural losses from biotic respiration and decomposition, and from the lack of atmospheric exchange. Similarly, the pH decreases with depth as the ratio of respiration to photosynthesis increases dissolved CO₂ (carbonic acid) with its concomitant decline in pH (more acidic).

While this explains the observed thermal, DO, and pH anomalies, additional insights into the entrainment process are provided by the transmissivity and density anomalies. As with the other anomalies, the respective 15% and 0.24σ_t amplitudes of the shallow July transmissivity and density anomalies are not only consistent laterally among the affected stations (P5 through P9 in Table 3.9 and Table 3.10), but with the vertical differences seen in ambient seawater properties across the thermocline at unaffected stations (Figure 3.12ac). Moreover, in the case of these two anomalies, their positive direction demonstrates that they were generated by entrainment rather than by the presence of dilute wastewater constituents. Wastewater is less dense than receiving waters, and its particulate load would normally be expected to reduce water clarity, not increase it.



As with DO and pH, reductions in transmissivity within the surface mixed layer at stations unaffected by the discharge were probably related to primary productivity, namely increased particulate loads from increased planktonic densities. However, at stations where the rising effluent plume carried the less-turbid mid-depth water to the sea surface, the penetration of natural light was actually enhanced relative to ambient conditions. Accordingly, during the July survey, the greatest Secchi depths (7 m) were measured at Stations 4, 5, and 16, while Secchi depths at most other stations were closer to 5 m.

As with the transmissivity measurements, the positive density anomalies lend further insight into the entrainment process (Figure 3.12a). Above a depth of approximately 5 m, densities measured within Perturbations 5, 6, and 7 were greater than densities measured at the same depth at adjacent stations. From the figure, it is clear that the effluent plume reached the sea surface at Stations 4 and 5. There, significantly higher densities, delineated in light blue, were measured at the sea surface as compared to the adjacent stations where lower densities were delineated in green and red. The presence of denser water at the sea surface is a transient feature, and it would be expected to rapidly dissipate as the heavier seawater descends to its buoyant equilibrium depth. As part of the transitory dynamics of effluent dispersion, it is not unusual for the momentum of the rising effluent plume to cause the plume to overshoot its equilibrium point, temporarily causing positive density anomalies. The heavier watermass will subsequently sink and again overshoot the equilibrium point. This phenomenon generates a buoyancy oscillation whose frequency is given by the Väisälä- Brunt equation. The Väisälä- Brunt overturning period reflects the time scale of the mixing process, which, for the July stratification, is seven to ten minutes.

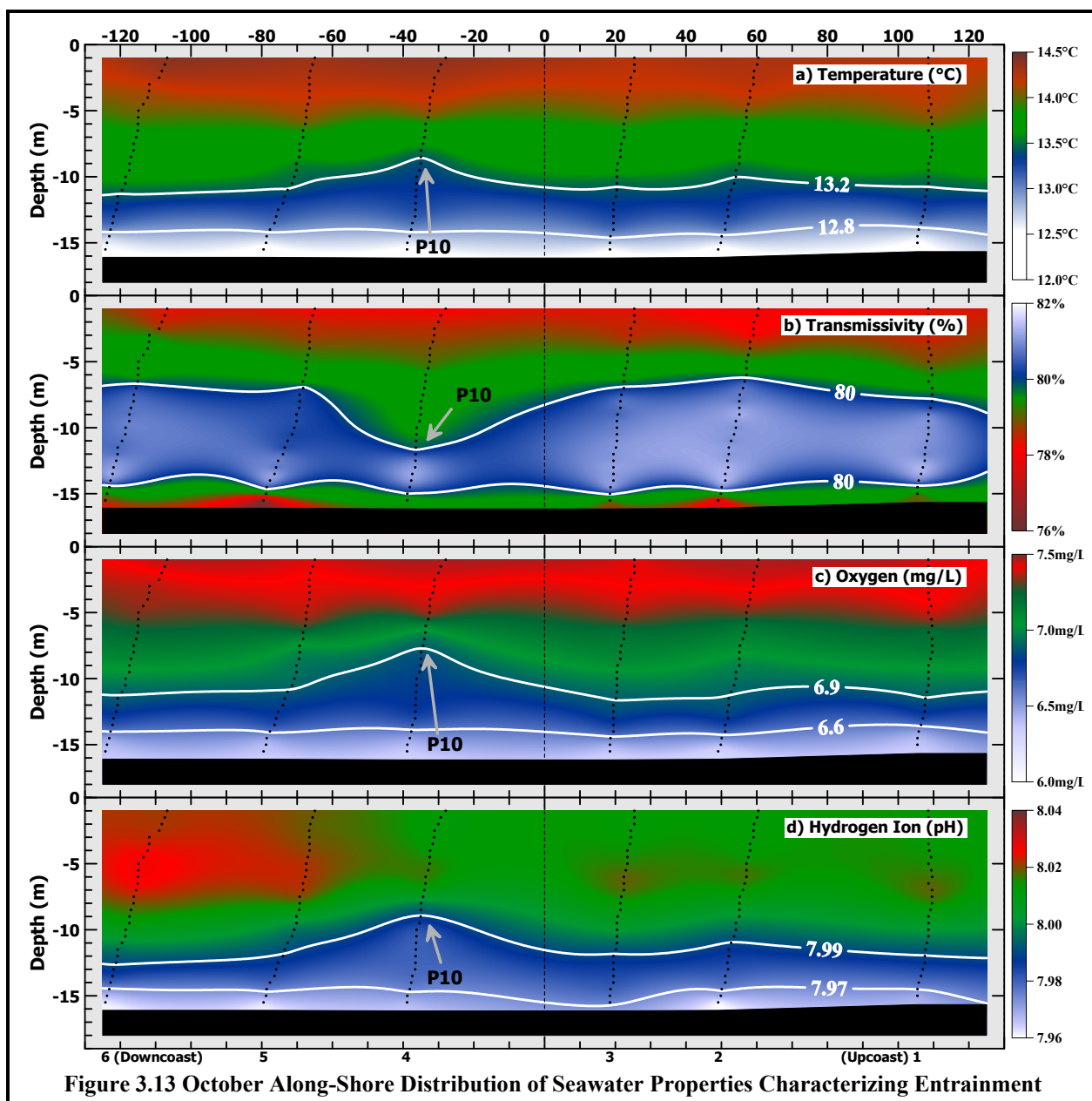
This brief dynamic process can lead to observations of unstable stratification wherein heavier water parcels overly lighter water, as depicted in Perturbation 5 at Station 3. As described in the previous section, this station was located on the margin of the plume as it spread laterally upon encountering the thermocline. This unusual circumstance created distinctive S-shaped contours in density, temperature, and transmissivity at Station 3, where layers of entrained seawater were temporarily sandwiched between ambient seawater (P5 in Figure 3.12abc) as the plume continued to rise. These instabilities demonstrate that the effluent was continuing to experience buoyant mixing within the shallow mixed layer at Station 3. These fleeting vertical instabilities are rarely observed under natural oceanic conditions. Seawater overturn occurs rapidly and the associated vertical mixing quickly generates a stable water column with steadily increasing density with depth. Thus, the density instability at Station 3 fortuitously captured the mixing process while it was still in progress.

October Perturbations 10 through 12. The presence of a dual thermocline in the October survey caused additional complexity in the vertical distribution of the effluent plume. The two distinct thermoclines during the October survey are evident in the vertical temperature profile shown by the green line in Figure 3.5 on Page 3-19. The shallow thermocline was typical of those observed below the mixed layer during most other 2008 surveys. However, a second thermocline was also apparent 2 m above the seafloor during the October survey. This thermocline delineated the sharp transition between a thin benthic nepheloid layer (BNL) present just above the seafloor and a mid-depth watermass. Because of the presence of the deep thermocline, entrainment-generated anomalies were located at greater depths, near 10 m (P10, P11, and P12 in Table 3.9 and Table 3.10), as compared to other surveys when the anomalies extended farther upward in the water column.

Double thermoclines are rare in the monitoring area, and they usually arise when an especially cold and dense watermass moves shoreward within a thin layer above the seafloor. Typically, this benthic watermass is turbid due to the presence of light-weight flocs of detritus that are resuspended by the turbulence generated by bottom currents. The particle-rich BNL is a widespread phenomenon on

continental shelves (Kuehl et al. 1996) and is occasionally observed during the offshore water-quality surveys conducted for the MBCSD. Because it is so thin, it is difficult to resolve the details of this layer with CTD measurements nominally separated by 0.5 m. As a result, significant lateral differences in transmissivity can be created that are unrelated to the discharge (*cf.* the BBL anomaly generated at Station 8 in Table 3.11 on Page 3-33). However, when the turbid seawater within the BNL is entrained within the rising effluent plume, it generates a group of deep anomalies, as exemplified by Perturbation 10 in Figure 3.13.

The seawater within the BNL was dense enough to cause the effluent plume to reach buoyant equilibrium at mid-depth, rather than at the sea surface. This is apparent from the absence of entrainment-generated



anomalies in the upper water column during the October survey and the lack of negative density anomalies within P10, P11, and P12 (Table 3.9). Nevertheless, the effluent achieved high dilution levels of nearly 600-fold, just 23.5 m from the discharge (P10). That was the only location where weak mid-depth anomalies were apparent as distortions in the isopleths of all four seawater properties (Figure 3.13).

At greater distances from the diffuser, only a slightly elevated turbidity remained as a signature of BNL origin within the deep thermocline (P11 and P12 in Table 3.10). Also, because of the unique vertical structure in transmissivity, the character of the turbidity anomaly (Figure 3.13b) differed from that of the other anomalies (Figure 3.13acd). Just above the seafloor, temperature, DO, and pH steadily increased and the upward displacement of deep seawater appears as an upward bowing in isopleths at Station 4. In contrast, ambient transmissivity exhibited a mid-depth maximum sandwiched between the turbid BNL and the euphotic zone where reductions in water clarity were caused by primary production (Figure 3.13b). The reduced transmissivity within the thin BNL is delineated below 14 m with red and green shading. Higher transmissivity, exceeding 80%, is delineated in blue at mid-depth. Because the effluent plume was located at a depth of 10 m, within the upper reaches of this high-transmissivity layer at Station 4, the contouring algorithm represented its decreased transmissivity as a downward excursion of the upper 80% contour rather than an upward displacement of the low transmissivity within the BNL.

3.3.3 Compliance with Receiving-Water Limitations

As in prior years, measurements collected during the 2008 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, many discharge-related anomalies were too small to be reliably detected at the 95% confidence level. In general, only slight salinity and density anomalies and one transmissivity observation 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 3.9 and Table 3.10 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, there were 18 statistically-significant discharge-related anomalies recorded beyond the ZID during the 2008 surveys (P5, P6, P7, P8, and P9). However, all of these anomalies were measured during the July survey when ambient seawater entrained within the effluent plume became apparent near the sea surface at five different stations. Given the small amplitudes of the anomalies that were associated with

these perturbations, their transient nature, and their origin in ambient seawater at depth, these discharge-related alterations of receiving water would not have affected any of the designated beneficial uses. In addition to these entrainment-generated anomalies, there were statistically significant anomalies in transmissivity, DO, and pH measured within the ZID (P1) 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 four discharge-related thermal anomalies identified in Table 3.9 were less than 1.5°C. Thermal anomalies this small would not tangibly affect beneficial uses such as water-contact sports or marine habitat especially considering that they were highly localized within a restricted depth range, and they occurred in an area well offshore where few water-contact activities take place. Additionally, thermal fluctuations of this magnitude commonly occur throughout Estero Bay on a daily basis. The discharge-related reductions in near-surface temperature are particularly negligible when compared to the 7°C range in ambient sea surface temperatures that commonly occurs off the central California coast at any given time. Such a range in sea-surface temperatures is evident in the satellite image on the cover of this report.

Although five of the thermal anomalies were found to be statistically significant compared to natural fluctuations in seawater at the same depth level, the observed reductions in temperature were due to the upward displacement of ambient bottom water, and not the presence of effluent itself. Thus, because they were generated by the upward displacement of cool deep seawater, the anomalies represent 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 as a result of the discharge of waste.*” This requirement stems from COP Objective C.3 in Table 3.1. There were no exceptions to this requirement in the water-quality data collected during 2008, even though discharge-related changes in transmissivity (water clarity) were detected in 11 of the 12 perturbations (Table 3.10).

Transmissivity reductions in 5 of the 11 perturbations were too small to be statistically significant. In addition, discharge-related changes in transmissivity within 10 of the 11 perturbations were caused by entrainment and upward displacement of naturally turbid seawater, rather than “*as a result of the discharge of waste.*” Most importantly, however, the most significant entrainment-generated transmissivity anomalies observed in 2008, all of which were recorded during the July survey (P5 through P9 in Table 3.10), did not result in a “*reduction in the transmittance of natural light.*” Instead, because subsurface waters were less turbid, their upward movement significantly *increased* surficial light penetration, as was also reflected in increased Secchi depths at nearfield stations during the July survey (Table 3.12).

The only statistically significant reduction in light transmission that resulted from the presence of wastewater particulates was recorded within the ZID during the January survey, when ambient water

clarity was unusually high (P1 in Table 3.10). The significant reduction in transmissivity extended over most of the water column, from 2.0 m to 13.5 m, at Station 9. The accompanying reduction in the penetration of ambient light was quantified by a marked reduction in the Secchi depths measured at Station 9. Compared to the 11-m average depth measured at other stations, that station had a Secchi depth of 7.5 m. However, the measurements collected at this station were all located well within the ZID, where the COP limitation on water clarity does not apply. Moreover, while a 7.5-m Secchi depth measurement was considered anomalously shallow during the January survey, that same depth measurement exceeded the average Secchi depths measured during each of the other three surveys.

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.”* De facto compliance with these receiving-water limitations on pH is easily demonstrated because the wastewater itself had a pH that remained between 7.4 and 7.7 throughout 2008 (see Chapter 2). Consequently, the presence of wastewater constituents could not conceivably have induced an excursion below 7.0 or above 8.3 within the receiving waters. Accordingly, none of the 1940 pH measurements recorded during the four offshore surveys dropped below 7.56, or exceeded 8.30 during 2008.

Furthermore, the difference between the average pH of discharged wastewater (7.55) and receiving waters (8.02) was negligible after dilution. Because of the well-buffered nature of the carbonate system in seawater, the slightly increased acidity of the wastewater, averaging only 0.65 pH units less than that of receiving waters, was quickly assimilated after discharge. As a result, there were no wastewater-induced pH anomalies recorded during the 2008 surveys, not even within Perturbation 4, which was strongly influenced by effluent constituents because it was recorded within the turbulent discharge jet shortly after ejection from a diffuser port.

The only discharge-related pH anomalies that were observed during the 2008 surveys occurred when ambient seawater near the seafloor, which is naturally low in pH, was displaced upward in the water column by the rising effluent plume. In addition, these pH anomalies were relatively small, ≤ 0.21 pH units (Table 3.10). All of these anomalies were negative, indicating a localized reduction in pH, because seawater at depth is naturally lower in pH (more acidic) due to the increased concentration of carbonic acid (dissolved carbon dioxide CO_2) from biotic respiration and decomposition. Accordingly, the largest amplitude pH anomalies were recorded during the May and July surveys when stratification was moderately strong, and when the naturally occurring vertical difference in pH between seafloor and surface waters was particularly evident (Figure 3.12e on Page 3-40). Because the pH anomalies originated from ambient seawater that was naturally low in pH, they cannot be considered to be a change of *“...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 2008 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 discharges into semi-enclosed water bodies. In some cases, the seafloor accumulation of oxygen-demanding waste materials can deplete the receiving water of its oxygen content, and can impact marine and estuarine organisms. Oxygen depletion, however, is rarely a problem with open-ocean discharges, such as the treatment plant’s discharge into Estero Bay. 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 wastewater’s biochemical oxygen demand (BOD₅) has remained far below the permitted maximum, not only in 2008 but throughout the past two decades of operation (See Section 5.1). In addition to its low BOD₅, the MBCSD discharge occurs in a particularly well-flushed, open-ocean environment where wastewater particulates are rapidly dispersed shortly after discharge. As a result, they neither accumulate on the seafloor nor impose an oxygen demand on ambient seawater (see Chapter 4).

The general lack of oxygen-demanding materials in treated wastewater discharged by the MBCSD is reflected in the absence of wastewater-induced DO anomalies within the receiving waters. All nine of the discharge-related DO anomalies listed in Table 3.10 were generated by the entrainment of ambient seawater (Figure 3.11c, Figure 3.12d, and Figure 3.13c). As such, they were not produced “as a result of the discharge of oxygen demanding waste materials.” Additionally, because DO anomalies were created by the upward movement of ambient seawater that was naturally depleted in oxygen, the measured values were comparable to background concentrations observed elsewhere in the water column, namely close to the seafloor where the ambient seawater was entrained. As a result, none of the discharge-related anomalies can be considered “to be depressed more than 10 percent from that which occurs naturally.”

Regardless of their provenance, all nine DO anomalies still met the numerical limits specified in the permit. Specifically, none of the anomalous DO concentrations fell below 5.37 mg/L, which is above the minimum 5 mg/L specified in the Basin Plan and the NPDES discharge permit. Similarly, the average DO concentration within the 1,918 seawater measurements collected in 2008 was 8.03, which is above the basin-plan limit that states an “annual dissolved oxygen concentration shall not be less than 7.0 mg/L.”

3.3.4 Coliform Bacteria

The surfzone along Atascadero State Beach was monitored throughout 2008 to assess bacteriological levels, aesthetic conditions, and compliance with the NPDES permit and the COP. MBCSD WWP personnel monitored the eight 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 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 2008, 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 from the treatment plant.

The small creeks feeding into northern Estero Bay have long been identified as major, non-point sources of coliform contamination within the surfzone along Atascadero State Beach. Because the mouth of Morro Creek lies close to the treatment plant, beginning in 1993 the creek’s outflow (Station G) 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 the samples collected at the regularly sampled surfzone stations (Stations A1 through F).

During 2008, Morro Creek was lagooned for most of the year, with outflow occurring only from the mid-January through mid-May. (Table 3.13 on Page 3-49). As a result, samples were only collected at Station G on five occasions during 2008. Three of the five Morro Creek samples were heavily contaminated, with total coliform densities at or above 500 MPN/100 ml. A fourth sample had an elevated total and fecal coliform density of 300 MPN/100 ml, which was equal to the highest density measured at the regularly sampled stations. Fecal coliform densities within most of the creek samples were also elevated, confirming that the origin of the bacterial contamination in the creek was largely fecal rather than vegetative. Herds of grazing cattle within the Morro Creek watershed may have contributed to the creek contamination.

Despite significant bacterial input from creek outflow and other non-point sources in the region, roughly three-quarters (74%) of the surfzone samples had fecal coliform densities at or below the detection limit of 2 MPN/100 ml. Fecal coliform organisms were not detected in half of the 229 surfzone samples, and when they were detected, densities near the minimum detection limit of 2 MPN/100 ml. Similarly, most of the 224 shoreline samples collected at the regular surfzone monitoring stations during 2008 contained total coliform densities that were below the most stringent bacteriological standard specified in the NPDES discharge permit. Only five samples had total coliform densities equal to or exceeding 70 MPN/100 ml. These elevated measurements are highlighted in bold typeface in Table 3.13. All were demonstrably unrelated to effluent discharge for the following three reasons.

First, three of the five elevated coliform densities were measured in samples collected at reference Station F (Table 3.2 on Page 3-4). Stations A1 and F were selected as control stations because they were considered too distant from the offshore discharge to be influenced by it. Additionally, none of the intervening surfzone stations (D and E) exhibited similarly elevated densities on the days when elevated densities were detected at Station F, nor was there any indication of a gradient of increased coliform density related to outfall proximity.

Second, there was no temporal correlation between surfzone samples with elevated coliform densities and densities within the wastewater discharged by the treatment plant. On each of the five days that elevated total coliform densities were measured in surfzone samples, the corresponding effluent coliform density was less than one-seventh of the maximum density measured in the surfzone samples. Considering that wastewater is diluted by at least two orders of magnitude immediately after discharge, it is inconceivable that coliform densities measured in the effluent would have materially contributed to the elevated surfzone densities.

Third, the elevated total coliform density measured at Station F on 19 August (80 MPN/100 ml) was associated with a markedly lower fecal coliform density (27 MPN/100 ml). Prior to disinfection, active coliform bacteria within wastewater consist almost entirely of fecal coliform. Because the elevated total coliform density arose largely from vegetative rather than animal sources, it could not be ascribed to the discharge. Instead, decay of kelp and other plant material along the beach was probably largely responsible for the elevated non-fecal coliform densities observed in that surfzone sample.

Regardless of their origin, the five isolated surfzone samples containing coliform densities at or exceeding 70 MPN/100 ml still met the stringent requirement for areas where shellfish is harvested for human consumption (see Standard A.2 in Table 3.1 on Page 3-3). This is because the limit applies to a thirty-day median rather than to isolated measurements. All instances of elevated coliform measurements were the only elevated measurements recorded at a given station within any individual month. Thus, all of the

surfzone measurements met 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. Although two of the 224 individual surfzone samples collected at the regular monitoring stations exceeded that standard, their required averages over time remained far below the standard.

In 2008, 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 a dilution of more than 100-fold achieved within a few meters of the discharge, any potential coliform densities that might occasionally remain within the wastewater are diluted beyond perception by the time the plume reaches the ZID boundary. Because the discharge occurs well offshore and prevailing currents are rarely directed toward the shoreline, it is inconceivable that the discharge contributes coliform to the surfzone. In contrast, onshore non-point sources have been repeatedly identified as responsible for contamination events occasionally observed in the surfzone over the past decade.

Table 3.13 Effluent and Surfzone Coliform Bacteria (MPN/100 ml), and Rainfall (inches) during 2008

Date	Total Coliform Bacteria									Fecal Coliform Bacteria									Rainfall ¹
	Effluent	A1	A	B	C	D	E	F	G	A1	A	B	C	D	E	F	G		
02-Jan	80	2	2	4	8	2	<2	2	—	2	<2	4	8	2	<2	2	—	0.02	
06-Feb	<2	4	<2	9	<2	4	14	22	500	<2	<2	<2	<2	<2	4	7	80	0.95	
05-Mar	<2	4	2	2	<2	2	4	4	300	2	<2	2	<2	2	<2	4	300	0.00	
04-Apr	<2	<2	<2	2	2	2	2	80	30	<2	<2	2	2	2	2	80	30	0.50	
06-May	<2	2	<2	<2	2	2	<2	2	1600	2	<2	<2	2	2	<2	<2	900	0.00	
12-May	2	<2	<2	<2	<2	<2	<2	26	≥1600	<2	<2	<2	<2	<2	<2	26	≥1600	0.00	
19-May	—	2	<2	<2	4	<2	<2	50	—	2	<2	<2	2	<2	<2	30	—	0.00	
27-May	<2	2	<2	<2	<2	4	<2	8	—	2	<2	<2	<2	4	<2	8	—	0.00	
02-Jun	<2	4	<2	2	<2	<2	2	<2	—	4	<2	2	<2	<2	2	<2	—	0.00	
09-Jun	<2	<2	2	4	2	4	13	23	—	<2	2	4	2	2	13	23	—	0.00	
16-Jun	<2	<2	<2	2	27	<2	<2	70	—	<2	<2	<2	27	<2	<2	70	—	0.00	
23-Jun	<2	<2	<2	<2	<2	<2	<2	2	—	<2	<2	<2	<2	<2	<2	2	—	0.00	
30-Jun	<2	<2	<2	<2	<2	<2	<2	<2	—	<2	<2	<2	<2	<2	<2	<2	—	0.00	
07-Jul	<2	<2	<2	2	<2	2	<2	2	—	<2	<2	2	<2	2	<2	2	—	0.00	
14-Jul	<2	<2	<2	<2	<2	<2	23	<2	—	<2	<2	<2	<2	<2	23	<2	—	0.00	
21-Jul	<2	<2	<2	<2	<2	<2	<2	<2	—	<2	<2	<2	<2	<2	<2	<2	—	0.00	
28-Jul	4	2	2	2	4	4	4	14	—	2	2	2	2	4	4	14	—	0.00	
04-Aug	4	<2	4	<2	<2	<2	<2	2	—	<2	4	<2	<2	<2	<2	2	—	0.00	
11-Aug	4	<2	<2	<2	13	2	300	2	—	<2	<2	<2	13	2	300	2	—	0.00	
19-Aug	<2	<2	4	4	4	8	17	80	—	<2	4	4	4	8	8	27	—	0.00	
25-Aug	14	<2	<2	<2	110	<2	<2	<2	—	<2	<2	<2	110	<2	<2	<2	—	0.00	
02-Sep	<2	7	23	2	4	<2	2	23	—	<2	23	2	4	<2	2	23	—	0.00	
08-Sep	2	30	<2	2	<2	2	<2	8	—	30	<2	2	<2	2	<2	4	—	0.00	
15-Sep	<2	7	2	11	<2	<2	2	22	—	7	<2	7	<2	<2	2	22	—	0.00	
22-Sep	<2	7	<2	2	2	2	<2	<2	—	7	<2	2	2	2	<2	<2	—	0.00	
29-Sep	17	4	8	<2	2	<2	8	8	—	4	8	<2	<2	<2	2	8	—	0.00	
06-Oct	2	<2	<2	4	13	2	<2	2	—	<2	<2	4	13	2	<2	2	—	0.20	
15-Oct	<2	2	2	2	2	2	2	4	—	2	2	2	2	2	<2	4	—	0.00	
20-Oct	2	<2	4	<2	<2	<2	<2	2	—	<2	4	<2	<2	<2	<2	2	—	0.00	
27-Oct	2	4	<2	7	4	2	4	50	—	4	<2	4	4	<2	4	50	—	0.00	
12-Nov	<2	8	<2	<2	7	2	2	13	—	8	<2	<2	7	2	2	13	—	0.00	
08-Dec	2	2	2	30	<2	<2	<2	<2	—	2	2	30	<2	<2	<2	<2	—	0.00	

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 and the infaunal community near the outfall. Benthic environments are important indicators of the presence of marine pollution because 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 23 years of benthic monitoring around the MBCSD outfall. This includes the October 2008 survey described in this chapter.

In the marine ecosystem, organic and inorganic matter are dynamically interrelated, and the quality of the material deposited on the seafloor directly affects the health of infaunal communities. Therefore, both the physicochemical and biological properties of the benthos are described in this chapter. 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 are observed extending from a pollutant source to more distant, unaffected areas.

This chapter presents results from a benthic survey conducted in October 2008. Over the 13 years of benthic monitoring prior to 1999, both winter and summer (semiannual) benthic surveys were conducted. However, after 1998, the winter survey was eliminated because seasonal variability had already been well determined. In lieu of two surveys each year, spatial resolution was increased around the outfall by the addition of 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 2008 benthic survey are presented in this annual report. Physical properties of sediments are tabulated in Appendix D and chemical data from the survey are tabulated in Appendix E of this report, while benthic biological data are provided in Appendix C. 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 2008.

4.1 MONITORING PROGRAM

As with the 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, as well as at gradient stations in between.

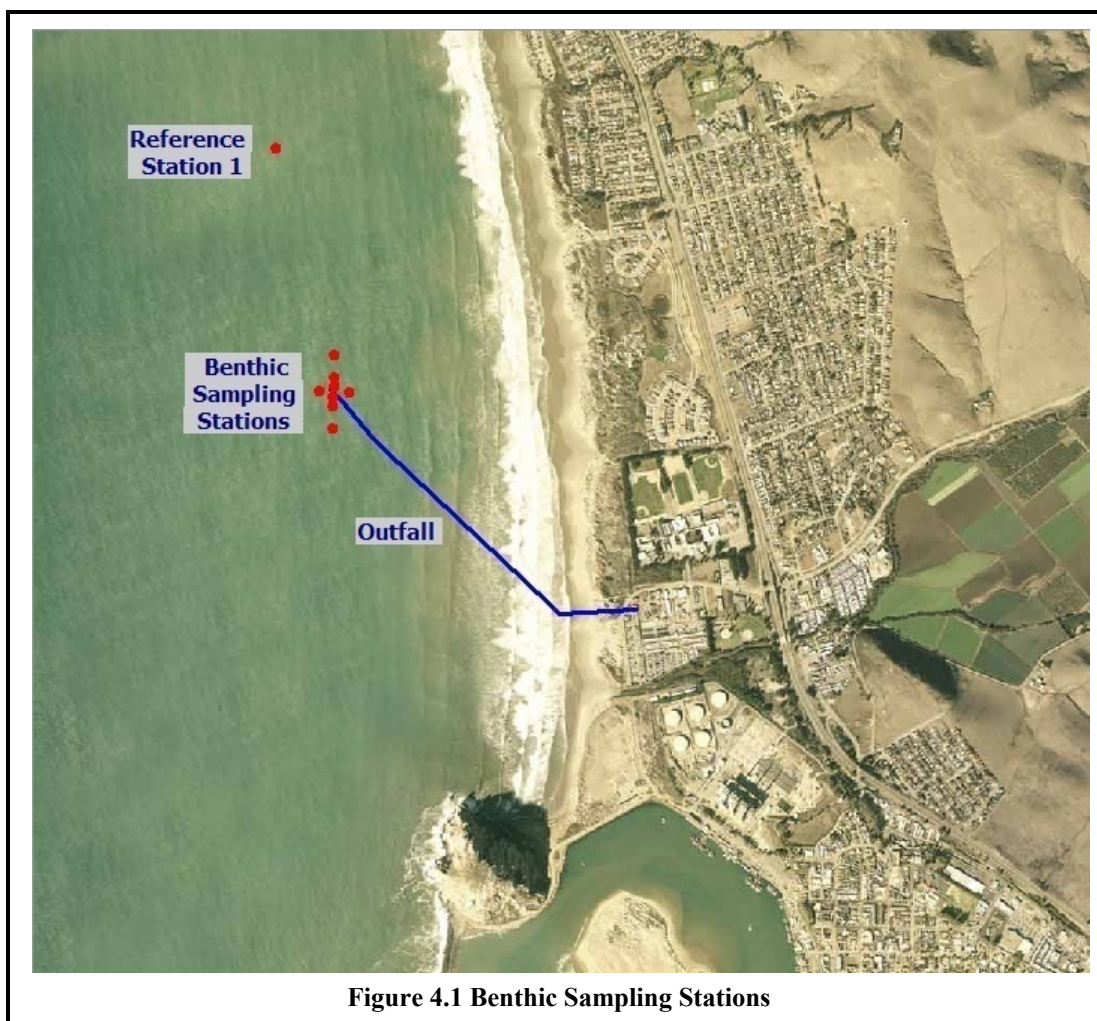


Figure 4.1 Benthic Sampling Stations

4.1.1 Scope of Monitoring

On the 7th and 8th of October 2008, 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). 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 found to be unrepresentative of the benthic environment near the outfall.

The discharge permit that was reissued 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 annual basis using samples collected during the October survey.

Based on an analysis of the previous 13 years of benthic data, 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 are now performed on a single grab sample collected at each of the nine stations.

4.1.2 Sampling Station Design

Regular benthic sampling is 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 are specified in the current NPDES permit and are summarized in Table 4.1. Eight of the nine stations are located within 150 m of the diffuser structure. The remaining station (1) is 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 ZID¹¹ stations (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) are located along the 15-m isobath, whereas the other two (8 and 9) are equidistant from the center of the diffuser structure in a cross-shore direction.

Table 4.1 Target Locations of Benthic-Sediment Sampling Stations

Station	Description	Latitude	Longitude	Distance (m)	
				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

¹¹ The ZID is the “zone of initial dilution” as defined in the list of acronyms at the beginning of this report.

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 the 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 potential impacts, 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 earlier warning of any potential expansion of the discharge footprint. The existing “*gradient*” stations (2 and 7) are separated by three diffuser lengths from the discharge (150 m), and consequently, are 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 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 and assisted Mr. Jerry Mason of BC Laboratories with the collection of the sediment subsamples for chemical assay. Mr. Tyler Eck, of MRS, and Mr. William Skok were also present, and assisted with benthic grab operations.

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 pair of jaws on the grab acquires sediments from a 0.1-m² area of the seafloor. The stainless-steel grab is coated with Dykor[®] and is equipped with a frame that enhances its penetration, stability, and proficiency in collecting a level, undisturbed sample. Dykor[®] has properties similar to Teflon[®]; it improves the chemical inertness of the grab sampler, limiting contamination of the sediment chemistry samples by the grab itself, particularly from trace metals. At each of the nine monitoring stations during the October 2008 survey, a single grab sample was collected for analyses of sediment chemistry and bulk properties, and five replicate grab samples were collected for benthic infaunal analyses (Table D.1). Pore water was also extracted from the chemistry grab sample collected at each of the stations.

During an unrelated survey in early 1999, rocks damaged the jaws of the benthic grab (Morro Group 1999). Therefore, prior to conducting the 1999 October field survey, the grab was completely refurbished by sandblasting and recoating with Dykor[®]. A stainless steel lip was also welded to the mouth of the jaw to improve the seal, which aids in sample retention during ascent.

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 non-sediment 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 4°C prior to analysis. Chain of custody forms accompanied all sample shipments from the field and between laboratories. Appendix E on the CD ROM included with this report contains the chains of custody, laboratory QA/QC analysis, and the chemical results as reported by the laboratory, while Appendix D includes a physical description of the samples.

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 Appendix E. Analyses for hexachlorocyclohexane (HCH) isomers, cyanide, methylene chloride, and other pesticides and 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 ¹²	• PCBs ¹³	• 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, each sample was inspected for acceptability. Acceptance criteria are based on penetration depth, surface condition, and overall sample integrity and are reported in Table D.1 in Appendix D of this report. Sediment samples

¹² Polynuclear Aromatic Hydrocarbons

¹³ Polychlorinated Biphenyl

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. 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, crustacea, 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 23-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 C.

Sampling Location Offsets

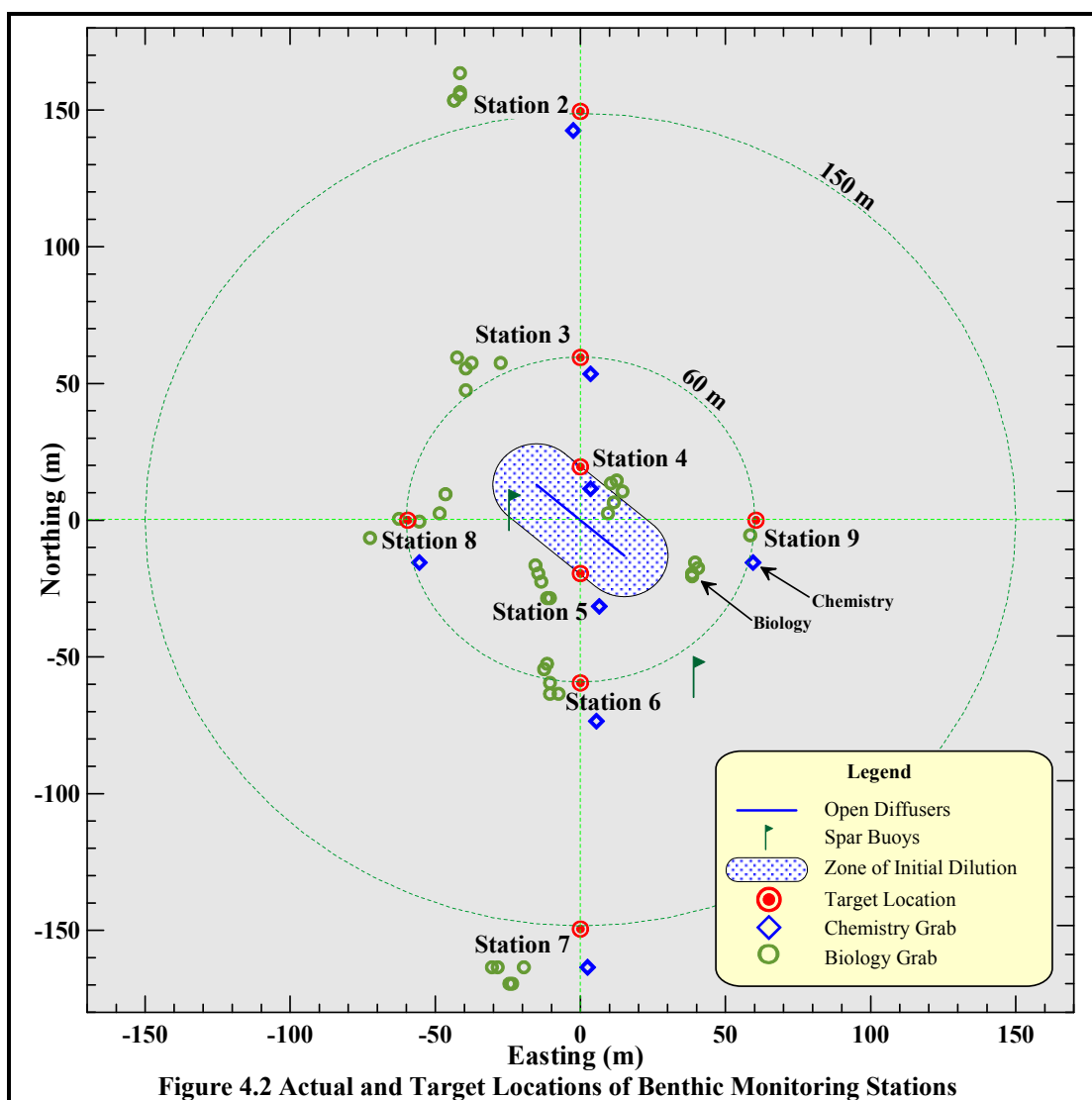
As described in Chapter 3, there are a number of unavoidable factors that prevent collection of offshore samples at the exact target locations listed in Table 4.1 on Page 4-3. Figure 4.2 shows the actual position of the chemistry (blue) and infaunal (green) grabs, relative to each target location (red)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

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 arise because of these changing conditions, and because of anchor drag. These within-station position changes are most evident as dispersion among the five infaunal grab locations shown in Figure 4.2. Position differences between the locations of the infaunal (green) grabs and the chemistry (blue) grabs also exist because they were collected on two 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 generally 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 33 m at Station 2; offsets of a similar magnitude occurred at Stations 3 and 7. For most of the stations however, the average offset was less than 25 m. Without the benefit of differential GPS navigation, most of these offsets would never have been resolved.

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 2008 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 2008 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 for 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 TVS concentration quantifies the amount of organic matter in the solid fraction of bottom sediments. It is reported as percentage of dry-sample weight. TKN measures the amount of organic nitrogen present as ammonia, as well as that bound into organic compounds 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).

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

Station	Description	Latitude	Longitude	Distance (m)		
				Closest ^a	Center ^b	Offset ^c
1	Upcoast Reference	35° 23.720' N	120° 52.688' W	989	1003	25
2	Upcoast Midfield	35° 23.283' N	120° 52.526' W	132	158	33
3	Upcoast Nearfield	35° 23.229' N	120° 52.524' W	53	63	30
4	Upcoast ZID	35° 23.204' N	120° 52.497' W	27	14	15
5	Downcoast ZID	35° 23.186' N	120° 52.511' W	17	26	11
6	Downcoast Nearfield	35° 23.166' N	120° 52.510' W	44	62	9
7	Downcoast Midfield	35° 23.110' N	120° 52.520' W	144	167	29
8	Offshore Nearfield	35° 23.199' N	120° 52.542' W	54	57	3
9	Onshore Nearfield	35° 23.190' N	120° 52.474' W	53	48	23

^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

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 wastewater 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 several previous surveys, particularly prior to 1992 (Figure 4.9b on Page 4-28). More recently, BOD analysis of the sediment sample collected at Station 9 during the October 2000 survey exhibited marked interference, resulting in an erroneously high BOD (MRS 2001). Because of persistent interference during 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 (H₂S), 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 that may occur in areas with undisturbed fine-grained sediments and those with a high organic content. Such conditions are often present within enclosed waterways. Hydrogen sulfide (H₂S), the toxicologically important form of sulfide, is produced when bacteria within those sediments reduce sulfates and putrefy proteins. H₂S is rarely observed, however, within the oxygenated environment of coarser-grained sediments present along open coastal reaches such as those that occur within Estero Bay.

The analytical approaches used to measure sulfide levels within benthic sediments have evolved considerably over time. Consequently, long-term trends in sulfide concentration cannot be reliably determined from the dataset. In particular, there were a variety of limitations associated with the analytical approaches used to measure sulfide in samples collected prior to 2003.

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

most samples. Conversely, comparatively high sulfide concentrations would be reported in isolated random samples, probably as a result of laboratory error, or the presence of errant organic matter, such as a piece of detached kelp or sea grass that happened to reside within 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 differ markedly from the purely dissolved fraction addressed by the COP¹⁴. Because a large portion of the total sulfide concentration arises from acid-soluble metallic sulfides associated with particulate matter, reported concentrations were much higher than those of dissolved sulfide. More importantly, they failed to track trends in dissolved sulfide concentrations, making evaluation of the dissolved-sulfide standard in the COP impossible. A slight difference in laboratory digestion techniques used in 2001 versus 2002 also resulted in a marked increase in the sulfide concentrations reported in 2002 compared to those reported in 2001. The increase was purely artifactual, as 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 pore water samples collected during 2003 and subsequent surveys. Moreover, because of limitations in analytical approaches used prior to 2003, compliance with the sulfide standards specified in the COP 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. Dissolved sulfide concentrations determined with EPA method 376.2 have a very low MDL¹⁵ of 0.05 mg/L. Nevertheless, dissolved sulfide has not been detected in any of the 54 samples collected since 2003 when the improved sampling technique was first implemented.

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 require preservation shortly after collection. However, suspended particulates in the sediment samples also have to be removed as part of EPA Method 376.2. Consequently, the pore-water samples are treated with sodium hydroxide (HNaO) immediately after collection onboard the vessel and left to stand for approximately ten minutes with zero headspace in 250-mL containers while the suspended flocculate

¹⁴ The 1997 edition of the California Ocean Plan Plan (SWRCB 1997) that applies to the current discharge permit for the MBCSD

¹⁵ Method Detection Limit

settles out. The supernate is then transferred to another container holding zinc acetate [$\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2$] as a preservative. In rough seas, this sampling procedure can be compromised, however, because excessive vessel motion hampers both the timely settling of suspended particulates and the ability to accurately detect the presence of the light flocculate.

Synthetic Organic Compounds

The presence of synthetic organic compounds within sediment samples is often indicative of anthropogenic input. In high concentrations, these compounds can be deleterious to the marine ecosystem. Phenolic compounds, which are used in plastics, adhesives, and coatings, are among the most common synthetic organic compounds measured in effluent. As such, benthic sediment samples were analyzed for phenolic compounds as well as for the pesticides aldrin, dieldrin, chlordane, DDT, endrin, and toxaphene. During the October 2008 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 detected, 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 in these compounds over time, with sediment concentrations eventually reaching detectable levels. However, none of these synthetic organic compounds were detected in sediment samples collected at any of the stations during 2008, nor have any been detected in the sediment samples collected over the previous 22 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 specified 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. This 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 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 chemical concentrations associated with bulk sediments by eliminating variations in sample mass that arise from 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.

Grain-size distribution is important to quantify because an increase in fine sediments near a municipal ocean outfall can be indicative of excessive effluent-solids deposition. In addition, the amount of fine sediment directly affects the composition of the infaunal community that resides within the sediments; although the precise mechanism for this relationship is rarely clear (Snelgrove and Butman 1994). Finally, for reasons described in greater detail below, 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).

Accurate measurement of the fine sediment fraction is also important for use in the interpretation of the marine biological data. Otherwise, variability in a 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) fraction exceeds the next largest (silt) fraction.

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). The refined analysis method that is now in use accounts for the presence of dissolved solids by correcting for the measured salinity in the pipette fractions (MRS 1998i and Coats et al. 1999). This 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

Determining 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 environmental conditions beyond the influence of the discharge. Certain biological characteristics of the community are examined in a BIP evaluation, including spatial and temporal distributions of species composition, abundance, biomass, dominance, and diversity. Other overall biological indicators of a BIP include 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. First, infauna are relatively easy to collect in numbers large enough for reliable statistical testing. Second, they have limited mobility and cannot easily escape exposure to pollutants. Finally, decades of 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 severely skews the 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 23 years of MBCSD monitoring, more than 145,000 individual organisms representing 350 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, in part because it has two major components: species richness and evenness. Species richness measures the variety (number) of species, while evenness measures the distribution of individuals (abundance) 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 than are individual indices.

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, and are difficult to interpret ecologically (Goodman 1975, Washington 1984, Green 1979). As a result, ambiguous or biased estimates of diversity often occur. Therefore, 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 C.

Table 4.4 List of Infaunal Parameters

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

4.2 MARINE SEDIMENT QUALITY

The quality of marine sediments surrounding the MBCSD outfall provides a definitive measure of potential marine impacts caused by wastewater discharge. Specifically, discharge-related impacts have been demonstrated in outfall monitoring programs offshore both central and southern California, wherein marked changes in the benthic environment have been observed surrounding the discharge locations (Phillips and Hershelman 1996, Stull et al. 1986b). Discharge-related impacts have also been observed on the continental shelf south of Estero Bay, where sediments were found to exhibit small but statistically significant chemical signatures indicative of drilling mud discharges over widespread areas (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 to distinguish 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 contaminants because they cannot easily escape the source of pollution. If seafloor sediments or pore waters become polluted, 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 2008, as it has in the previous 22 years of monitoring. The lack of negative benthic impacts is largely due to the comparatively low mass-emission of anthropogenic chemicals 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 during the October 2008 survey. Each of these analyses is discussed in the following subsections. First, concentrations of potential contaminants measured in sediment samples were below levels that have been reliably linked to toxicity in marine organisms. Second, sediment concentrations do not exhibit any long-term trends that would suggest a buildup of contaminants close to the outfall. Third, the spatial pattern of sediment concentrations near the outfall during 2008 bore no consistent relation to outfall proximity.

4.2.1 Concentrations below Toxic Levels

In keeping with the COP, narrative receiving-water limitations contained within MBCSD's Waste Discharge Requirements (RWQCB-USEPA 1998a) 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 23 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 chemical 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 reliably determined to be 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 chemical concentrations measured within marine sediment samples at any location. Specifically, these biological benchmarks can be used to assess whether the chemical 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 chemical concentrations measured in the field.

The toxicological benchmarks advanced by NOAA (Long and Morgan 1991) are used in this report to evaluate sediment chemical concentrations measured during 2008. These guidelines are based on a correlation between chemical concentrations and observed biological effects in numerous modeling, laboratory, and field studies (Long et al. 1995). The studies identify 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 chemical concentrations that were measured within Estero Bay during 2008. These benchmarks provide a reliable screening tool for most, but not all sediment contaminants. For example, the relationship between nickel concentrations and the incidence of effects in the toxicological database is very weak. Consequently, even the upper (ERM) benchmark for nickel is a poor predictor of levels where biological effects might be expected.

Both trace-metals 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 organic constituents that can have the most significant anthropogenic impact if found in sufficient concentrations. However, in this and many other marine sediment studies, their concentrations are less than detection limits. In contrast, trace metals occur naturally in the marine environment and are commonly detected in sediment samples. Because of this, trace metals 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 divide (normalize) trace metal concentrations by the mud fraction, or as described above, iron or aluminum concentrations. Normalization is intended to reduce inherent natural variability and, as a result, reveal anthropogenic contaminant patterns normally masked by the natural association between metals and fine particulates (Dossis and Warren 1980).

While this approach works well in deep quiescent basins, 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 their surfaces, as is the case with silts and clays. Therefore, metals are less likely to dissolve and become assimilated by marine organisms residing within 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 (>97%, Table 4.5), and mud normalization grossly overemphasizes small inherent differences due to vagaries in the fine-particulate distribution (MRS 1998bh). Consequently, the monitoring requirements specified in the current NPDES permit no longer specify normalization of chemical concentrations by fine sediment fractions (RWQCB-USEPA 1998b). In keeping with this, mud-normalized concentrations are not reported here, and instead, iron- and aluminum-normalized concentrations are assessed in detail.

Irrespective of trace-metal normalization, grain-size distributions can be indicative of a buildup of effluent particulates within the surficial sediments if, for example, there is an increase in fine fractions close to the discharge point. Although this was not the case around the MBCSD outfall, the overall character of the grain-size distribution is indicative of the dynamics within a particular benthic environment. Higher mud fractions reflect quiescent depositional environments, while well-sorted sands result from energetic wave environments that winnow fine particulates as they constantly rework the surficial sediments.

Accordingly, statistical analyses of grain-size distributions within the 2008 sediment samples show that sediments within the high-energy environment near the outfall consist of well-sorted fine sands with a distribution skewed slightly toward the finer fractions (Table 4.5; Appendix Table D.4). During 2008, mean particle diameters

Table 4.5 Grain-Size Distribution (%) within Sea-floor Sediment Samples Collected on 8 October 2008

	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	0.14	0.34	97.28	1.01	1.19	0.03
Station 2	0.00	0.43	99.37	0.11	0.08	0.00
Station 3	0.12	0.31	97.99	0.89	0.69	0.00
Station 4	0.12	0.12	98.09	0.97	0.65	0.05
Station 5	0.17	0.23	98.42	0.56	0.52	0.10
Station 6	0.02	0.39	98.34	0.79	0.45	0.00
Station 7	0.10	0.34	98.68	0.61	0.27	0.00
Station 7^a	0.06	0.34	98.76	0.62	0.22	0.00
Station 8	0.16	0.34	98.95	0.41	0.14	0.00
Station 9	0.01	0.35	98.37	0.68	0.60	0.00
Mean^b	0.08	0.31	98.47	0.63	0.48	0.02

^a Duplicate analysis of Station-7 sediment sample

^b Mean computed after arc-sine transformation

ranged from 154 to 164 μm , lying in the middle of the fine-sand portion of the grain-size distribution. The high degree of sorting is reflected by low standard deviations ($\sigma < 0.41$). The small, but consistently positive skew to the distribution reflects a slight excess in the finer fractions relative to larger fractions in the tails of the distributions. 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 1.2% of the total sample weight (Table 4.5). These largest fractions consist 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 2008, trace-metal concentrations within sediment samples were either not detected or were below levels that are potentially toxic to marine organisms (*cf.* mean, ERL, and ERM concentrations in Table 4.6). The only exception was nickel, which is described in more detail below. Cadmium and silver were not detected within the 2008 sediment samples, as has been the case in most prior monitoring surveys. Their respective detection levels, 0.05 and 0.07 mg/Kg-dry, were far lower than the lowest toxic-effects level (ERL=1.0 mg/Kg for silver). Thus, even if these two metallic elements were present in Estero Bay sediments at concentrations less than their respective detection limits, they would not be likely to affect marine organisms. Similarly, although mercury was detected at all nine of the stations, it was detected in concentrations too low to be quantified. Regardless, its estimated concentrations (≤ 0.04 mg/Kg-dry) were below the concentration where mercury's biological effects first become noticeable (ERL=0.15 mg/Kg), and well below mercury's 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. As described previously, these two metals were added to the monitoring program to track natural variations in concentrations of other trace metals that occur 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 with the exception of nickel, below (ERM) levels likely to be toxic to marine organisms. In 2008, 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, and at Station 2, above the ERM. Each of the six detected metals is described below.

Arsenic

Although present in measurable amounts (≤ 3.8 mg/Kg), the mean arsenic concentration in Estero Bay sediments was less than half of the lowest toxicity level (8.2 mg/Kg) where adverse biological impacts would first begin to appear, and 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 (SCB) has arsenic concentrations exceeding the mean level measured in Estero Bay during 2008 (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 = 6.0 mg/Kg in Table 4.6).

Table 4.6 Metal Concentrations (mg/Kg-dry) within Seafloor Sediment Samples Collected on 8 October 2008

Station	Aluminum	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Silver	Zinc
1	6,300	3.0	<0.05 ^a	60	3.2	9,100	2.8	≈0.04 ^b	37	<0.07	14
2	5,800	3.6	<0.05	48	3.7	9,300	2.2	≈0.04	52	<0.07	15
3	5,600	3.7	<0.05	44	3.3	8,800	2.1	≈0.02	45	<0.07	15
4	5,100	3.6	<0.05	36	2.9	7,900	2.0	≈0.03	38	<0.07	13
5	5,600	3.6	<0.05	47	3.3	8,900	2.1	≈0.03	45	<0.07	15
6	5,600	3.6	<0.05	45	3.3	9,100	2.1	≈0.02	47	<0.07	15
7	5,700	3.5	<0.05	47	3.2	8,900	2.1	≈0.03	43	<0.07	14
8	6,300	3.8	<0.05	53	3.9	10,000	2.3	≈0.03	51	<0.07	16
9	5,200	3.7	<0.05	41	3.1	8,400	2.0	≈0.04	42	<0.07	14
Mean ^c	5,700	3.6	<0.05	46	3.3	8,900	2.2	≈0.03	44	<0.07	15
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	—	6.0	0.2	26	11.1	—	9.9	—	28	0.2	42

^a “<” indicates that the metal was not detected above the MDL, which is reported after the “<” symbol.

^b “≈” indicates that the reported concentration exceeded the method detection limit (MDL) but was not quantified because it was below the PQL.

^c After logarithmic transformation

^d Guideline not specified

^e Concentration that would be considered enriched (99th percentile) relative to background concentrations in the Southern California Bight after normalization by iron (Schiff and Weisberg 1997).

Although arsenic is widely distributed throughout nature, pure arsenic is a highly poisonous metallic element used in insecticides, herbicides, solid-state doping agents, and various alloys. However, these anthropogenic sources of arsenic are not a significant source within the wastewater processed by the MBCSD. Instead, most of the arsenic present in the Estero Bay sediments probably derives from erosion of enriched onshore mineral deposits. Although arsenic occurs naturally in central-coast sediments, mine tailings may contain higher residual levels due to the increased presence of arsenopyrites in the ore, overburden, and soil. Arsenic from mine tailings may be released into surface and ground waters through erosion, and reach Estero Bay through runoff within the adjacent watershed.

Chromium

Chromium is enriched within the sediments throughout Estero Bay, and the entire south central-coast region. This enrichment is reflected in the 46-mg/Kg mean chromium concentration within samples collected near the outfall in 2008, which is far above the 26-mg/Kg that would be considered impaired for sediments within the SCB (Table 4.6). However, chromium concentrations within all the 2008 sediment samples remained below the lowest toxicity benchmark where biological effects might first be observed. The highest concentration (60 mg/Kg-dry) measured at Station 1 was still below the ERL of 81 mg/Kg. More importantly, the maximum concentration was one-sixth of the level where biological effects become probable (ERM=370 mg/Kg). Even at that, the potential for marine effects is probably overstated, given 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” (Long et al. 1995).

The presence of hexavalent and metallic oxidation states of chromium generally arises from anthropogenic sources, particularly industrial processes; however, the trivalent form of chromium found within the Estero Bay sediment samples occurs naturally in chromite ore. This is evident from the lack of measurable levels in sediment samples collected prior to 1999, when chromium speciation was performed (MRS 1996, 1997c, 1998bi, and 1999b). The elevated chromium levels within Estero Bay sediments originate in naturally occurring chromite minerals that are 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. Thus, although chromite ore is a widely distributed mineral deposit, it is more prevalent along the south-central coast of California than in most other areas (SAIC 1986).

Nevertheless, the presence of higher chromium concentrations within central-coast sediments often leads to misinterpretation by regulators and scientists unfamiliar with the local mineralogy. Only around 25% of the SCB had sediments with chromium concentrations higher than those of Estero Bay. Most of this area was within Santa Monica Bay, where a high mass-emission of contaminants from publicly-owned treatment works occurred before 1988. Similarly elevated chromium levels were observed within the Santa Barbara Basin in the northern reaches of the SBC, which led to speculation that those sediments were impaired as well, even though they can be also be ascribed to the presence of naturally occurring chromite ore in the region (Chow and Earl 1978). The erroneous characterization of an impaired condition in the northern SCB was furthered by an incorrect assertion by Schiff and Gossett (1998) that the elevated chromium concentrations were “*highly predictive of adverse biological effects*” in their review of contaminant concentrations within the SCB. That assertion was in direct conflict with published findings by the developers of the biological-effects levels, who stated that the chromium effect levels were exaggerated (Long et al. 1995).

While erosion of naturally occurring chromite ore along the central coast explains its overall enrichment within the marine sediments of northern Estero Bay, ordinary erosional processes may not be able to account for the trend of increasing chromium concentrations that has been observed over the last two decades. Long-term increases in chromium, arsenic, copper and nickel are documented 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 eroding 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 accelerated trends observed in the marine sediments of Estero Bay.

Copper

As with arsenic and chromium, copper commonly occurs within the minerals found along the central coast. However, the 3.3-mg/Kg average copper concentration within marine sediments collected at the nine benthic-monitoring stations in 2008 is well below the 11.1-mg/Kg concentration considered enriched relative to background levels within the SCB sediments. Approximately 90% of the SCB sediments have higher copper concentrations than those measured in Estero Bay. All of the sediment samples collected within Estero Bay during 2008 had 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. Consequently, biological impacts from the observed copper levels within Estero Bay sediments are highly unlikely given that the highest measured copper concentration (3.9 mg/Kg) was 70-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. Additionally, they are low compared to concentrations within the SCB, where approximately 95% of the area has higher concentrations. Most of the elevated lead and zinc concentrations offshore southern California were measured within Santa Monica Bay and on the Palos Verdes Shelf, where large wastewater treatment plants have discharged for many decades. However, most of the metal emissions from these treatment plants occurred prior to the substantial improvements in effluent quality that were realized in 1988. Unfortunately, the historical discharges from these outfalls accumulated within adjacent sediments and have persisted for decades (Stull et al. 1986b). In contrast, the historically low emission of chemicals 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 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 2008, the 52-mg/Kg nickel concentration at Station 2 even exceeded the 51.6-mg/Kg ERM level where adverse effects are normally considered probable, while the 51-mg/Kg measured at Station 8 was only slightly below the ERM level. Despite measured nickel concentrations that exceed marine-toxicological benchmarks, no apparent deleterious impacts to infaunal organisms living within northern Estero Bay sediments have been detected. 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 portion of the 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, if there is a slightly higher dissolved-phase nickel concentration within the pore waters of Estero Bay, it has probably been present for epochs and benthic organisms in the region may have adapted accordingly.

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 also plainly evident in the SCB database where

“background” nickel concentrations steadily increase from south to north. As with chromium, Schiff and Gossett (1998) did not account for this natural variability in ore deposits and erroneously ascribed observed nickel trends to anthropogenic contamination within the SCB.

Organic Pollutants

In addition to trace metals, 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 E). Additionally, 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 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 2008 were comparable to levels measured over the last decade. As described in Section 4.1.4 on Page 4-6, the dissolved-sulfide analyses conducted on pore-water samples in 2008 represent a significant improvement over previous sulfide analyses. As a result, the 2008 measurements provide the best evaluation of compliance with the sulfide limitation in the COP. No dissolved sulfide was detected in the 2008 survey, even though the detection limit was very low (MDL=0.05 mg/L).

Table 4.7 Non-metal Concentrations (mg/Kg-dry)^a within Seafloor Sediment Samples Collected on 8 October 2008

Station	Moisture (%)	Dissolved Sulfides (mg/L)	BOD	Oil & Grease	TKN	Volatile Solids (%)
1	23.9	<0.05	43	<28	127	1.71
2	27.1	<0.05	36	<29	151	2.00
3	25.1	<0.05	35	<28	134	1.66
4	23.1	<0.05	36	<27	105	1.51
5	25.0	<0.05	36	<28	133	1.67
6	24.9	<0.05	41	<28	123	1.82
7	22.8	<0.05	31	<27	168	1.55
8	25.9	<0.05	40	<28	135	1.73
9	23.8	<0.05	42	<28	106	1.40
Mean ^b	24.6	<0.05	38	<28	130	1.67

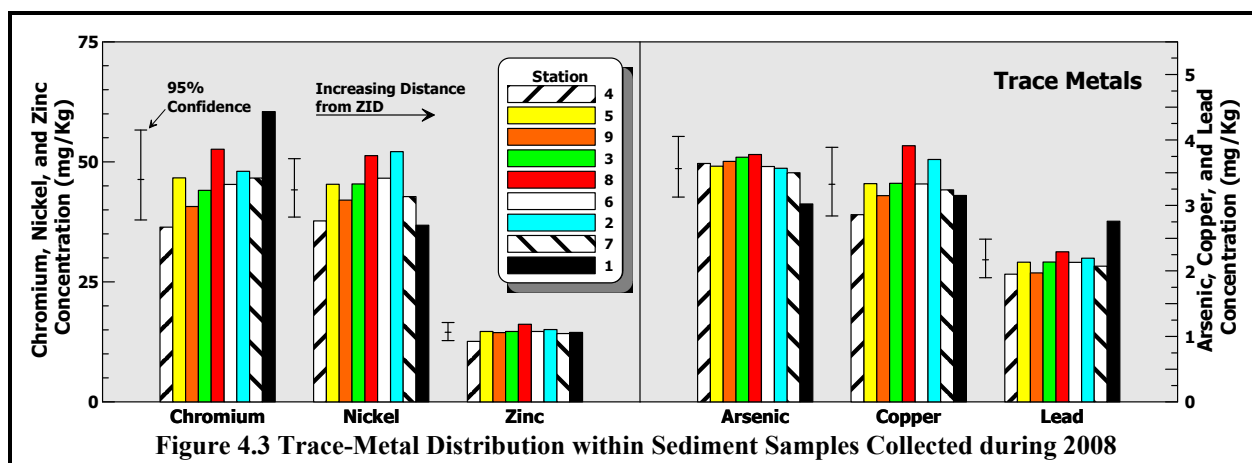
^a Unless otherwise indicated

^b Arc-sine transformation for % and logarithmic transformation for mg/Kg

4.2.2 Distribution Unrelated to Outfall Proximity

In 2008, as in previous years, the spatial distribution of sediment chemicals did not exhibit a spatial pattern indicative of a benthic environment impaired by wastewater discharge. Specifically, there was no consistent evidence that sediment chemical concentrations near the diffuser structure were elevated relative to distant sites. A gradient of steadily increasing contaminant concentrations with increasing outfall proximity would provide *prima facie* evidence of discharge-related impacts to 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 visual comparisons of concentrations ranked by distance from the diffuser structure

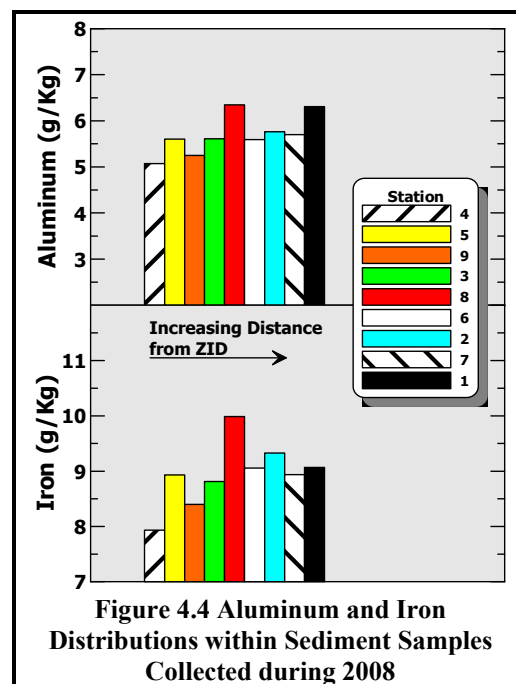
During any given year, a sediment constituent may exhibit an anomalous concentration at one or more stations that results in a spatial trend that appears to be related to outfall proximity. Occasionally, that trend is determined to be statistically “significant” at the 95% confidence level. However, 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 reflect decreasing



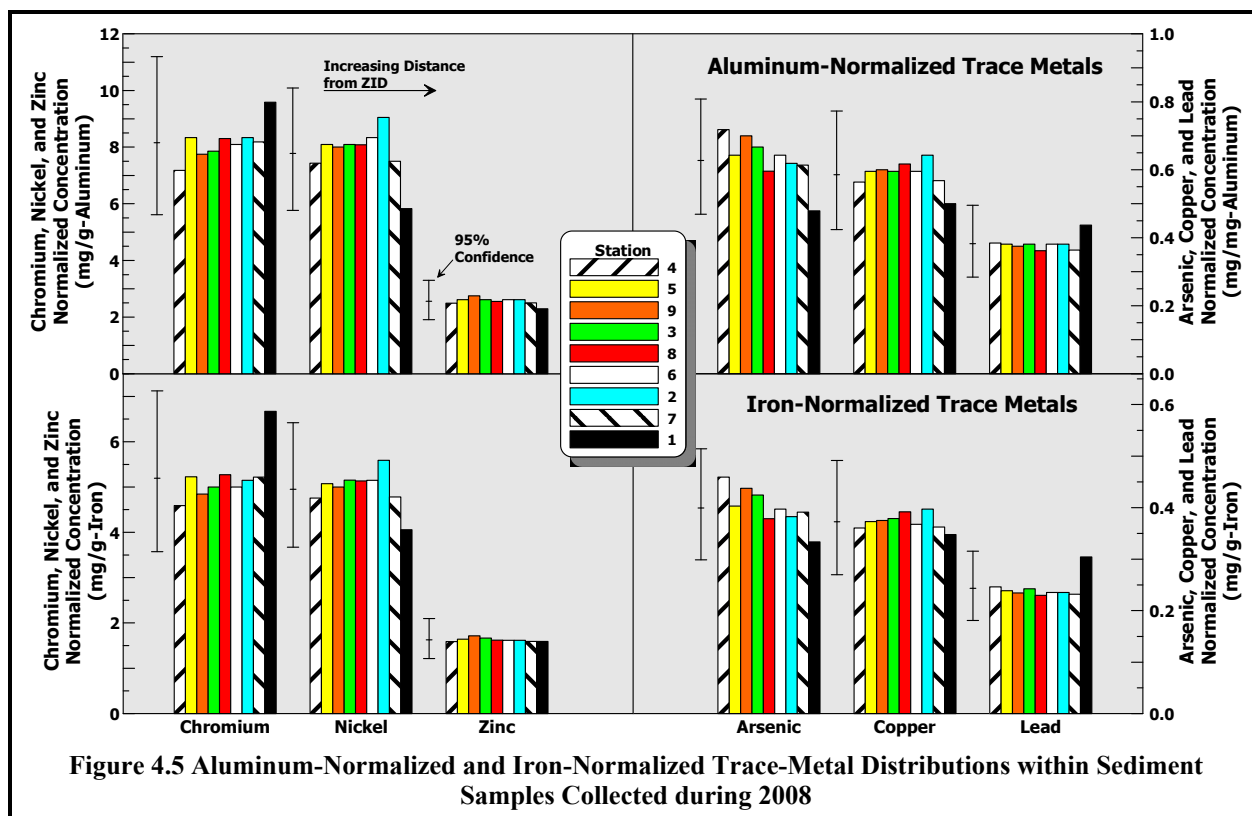
concentrations with increasing proximity to the outfall, which is opposite of the spatial trend expected from impacts associated with effluent discharge.

The bar graphs in Figure 4.3 show trace-metal concentrations ranked by distance from the diffuser. Consistent spatial gradients are not readily apparent in the bar graphs. Outfall-related impacts would appear as bar heights decreasing from left to right in many, if not all of the trace metals. Instead, concentrations vary randomly about the survey mean, decrease with outfall proximity, or lie within the 95% confidence interval, shown to the left of each bar graph. Consequently, the observed concentration differences among stations can be ascribed to inherent sampling variability rather than to actual differences in the chemical loads within the sediments. The confidence limits reflect the variability in concentrations found among replicate samples collected at an individual station.¹⁶ Perceived differences between stations smaller than this inherent sampling error, as reflected by the 95% confidence interval, have, by definition, a low degree of confidence. Thus, Figure 4.3 shows that, in 2008, most of the concentration differences among the stations can be ascribed to measurement uncertainty rather than actual spatial differences.

The elevated chromium and lead concentrations at (reference) Station 1 (black bars), and the nickel and copper concentrations at Station 8 (red bars) extend well beyond the upper confidence bound. 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 aluminum was comparatively abundant at Stations 1 and 8 (top frame of Figure 4.4), while iron was also elevated at Station 8 (bottom frame). As described above, both aluminum and iron are good indicators of natural trace-metal variability because anthropogenic activities have little influence on them, and they are not enriched in the MBCSD discharge.



¹⁶ The confidence intervals were determined from three replicate chemistry samples that were collected and separately analyzed at each station in 1993 and 1994.



Instead, increased concentrations in these two metals at Stations 1 and 8 reflect the presence of a more quiescent depositional environment where fine sediments are preferentially deposited by natural processes.

The elevated aluminum and iron concentrations at Station 8, shown by the red bars in Figure 4.4, are consistent with this station's deeper locale. Surface gravity waves are less effective at winnowing fine particulates in deeper water. Similarly, reference Station 1 is located well north of the diffuser structure, in a location more protected from winds and waves. Finer particulates containing naturally higher metal concentrations are preferentially deposited at Station 1, and account for its elevated aluminum concentration, as well as its higher amounts of chromium and lead.

As described previously, 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 temper spatial trends in raw concentrations that are related to natural processes, as was the case here. The elevated chromium, nickel, and copper concentrations at Station 8, shown by the red bars in Figure 4.3, were substantially reduced after normalization by both iron and aluminum (Figure 4.5). Normalization was less effective at tempering the elevated chromium and lead concentrations at Station 1 (black bars), and appears to have introduced an arsenic trend with higher concentrations near the outfall (Figure 4.5). However, added variability within the aluminum and iron measurements produced wider confidence intervals in Figure 4.5, which encompassed the normalized metal values at all the stations.

Although confidence intervals provide a useful visualization of departures from mean conditions, statistical hypothesis tests provide a more rigorous assessment of the significance of any perceived spatial differences. The results of these tests are shown in Table 4.8. The hypothesis tests evaluate whether mean

Table 4.8 Tests for Significantly Higher Contaminant Concentrations near the Diffuser

Parameter	Mean (mg/Kg)				Iron-normalized p^e	Aluminum-normalized p
	Near ^a	Distant ^b	t^c	p^d		
Aluminum (g/Kg)	5.56	5.92	-1.37	[0.11]	[0.24]	NA
Arsenic	3.67	3.35	1.71	0.11	0.06	0.10
Chromium	44.0	51.3	-1.60	[0.10]	[0.15]	[0.12]
Copper	3.31	3.36	— ^f	—	0.38	0.24
Iron (g/Kg)	8.8	9.1	-0.91	[0.20]	NA	—
Lead	2.10	2.32	-1.12	[0.19]	[0.25]	[0.27]
Nickel	44.5	43.4	0.22	0.42	0.33	0.31
Zinc	14.5	14.6	—	—	—	0.15
BOD	38.4	36.4	0.53	0.33		
TKN	122	148	-2.06	[0.07]		
TVS (%)	1.63	1.75	-0.85	[0.23]		
Mud (%)	0.39	0.45	-1.59	[0.08]		

^a Mean concentration computed among Stations 3, 4, 5, 6, 8, and 9, which lie within 62 m of a diffuser port (the closest approach of chemistry grabs in Figure 4.2). For percent concentrations, an arc-sine transform was applied to the concentrations prior to hypothesis testing. For other units, a logarithmic transform was applied.

^b Mean concentration computed among Stations 1, 2, and 7, which lie at a distance of more than 130 m from 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.

^f The difference in the averages was smaller than precision of concentrations reported by the chemistry laboratory, and therefore, was not significant by definition.

concentrations at the six stations within 62 m of the discharge differ significantly from three distant stations (Stations 1, 2, and 7), which are located more than 130 m away. The tests evaluate whether this difference is large enough to be considered relevant (95% confidence), given the inherent variability in the individual measurements. The ratio of difference in average concentrations relative to their variability is represented by the “ t ” statistic listed in the fourth column of the table. If “ t ” is large, then the difference in mean concentrations is large compared to the scatter in individual observations, and it is less likely that the perceived difference occurred by chance. The probability that the difference occurred by chance is given by the “ p ” value listed in the fifth column of the table. When $p < 0.05$, there is less than a 5% risk that the difference was due to random fluctuations, and thus would be deemed significant using the 95%-confidence criterion specified in the COP and used throughout this report.

Six of the eight trace metals had average raw concentrations near the diffuser that were lower than distant stations (Figure 4.3 and Figure 4.4). The presence of lower chemical concentrations near the diffuser is a pattern opposite of that produced by a buildup of benthic contaminants from wastewater discharge. These inapplicable cases are indicated in Table 4.8 with negative “ t ” statistics, and p -values enclosed in

brackets. The two remaining metals, arsenic and nickel, exhibited a spatial trend in average raw concentrations that were potentially consistent with effluent impacts; namely higher average concentrations close to the diffuser structure. However, the differences were exceedingly small, particularly when compared with the scatter in the data. This is reflected in their large respective *p*-values (0.11 and 0.42), indicating an 11% and 42% probability that the difference was due to chance alone.

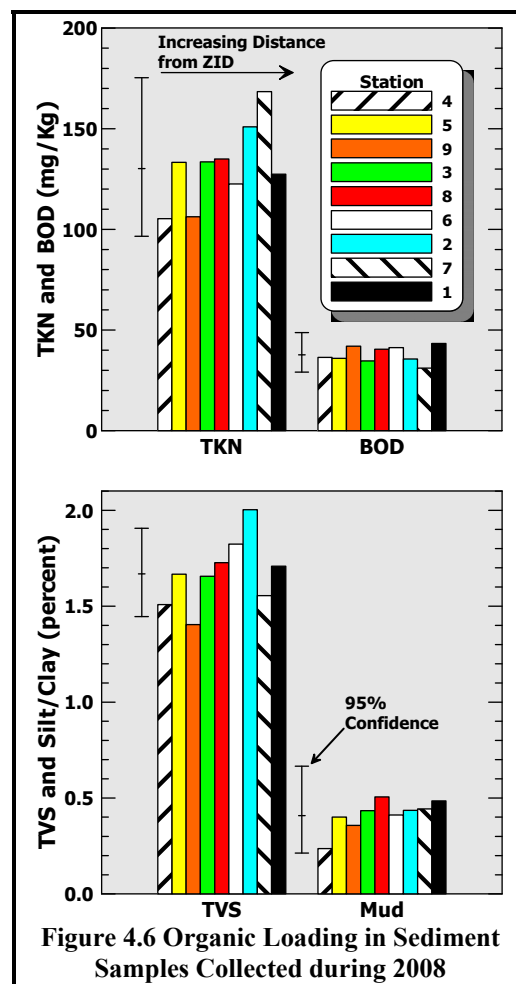
Although the perceived 0.32-mg/Kg increase in mean arsenic concentrations near the discharge was associated with the smallest *p*-value (0.11) of any un-normalized compound, the difference was actually due to a single low concentration at Station 1, rather than a buildup in arsenic concentrations at the stations near the diffuser (Figure 4.3). Arsenic variations among the remaining eight other stations were not statistically significant, as demonstrated by the all-encompassing 95% confidence interval in the figure. As described above, the low arsenic concentration at Station 1, as well as its elevated chromium, lead, and aluminum concentrations, resulted because Station 1 lies in a distant depositional regime that appears to differ markedly from the other monitoring stations. However, as described below, the current permit's decade of monitoring has demonstrated that the sediment characteristics at Station 1 are unrepresentative of conditions near the outfall. For that reason, monitoring at that station will no longer be required under the new discharge permit effective in 2009.

Table 4.8 also provides hypothesis tests for significant differences in near- and far-field concentrations for the four organic loading parameters. Only BOD had higher average nearfield concentrations relative to distant sites, but the difference was not large enough to be considered statistically significant (*p*=0.33). Accordingly, Figure 4.6 shows that concentrations reported at individual stations were within the measurement error given by the 95% confidence interval that reflects inherent sampling uncertainty at any given station. Moreover, none of the organic loading parameters exhibit a consistent spatial trend where concentration steadily increases with discharge proximity (increase from right to left).

Although the spatial variation in mud content among the stations was not statistically significant, it is noteworthy that the highest fine fractions were found at Stations 1 and 8. Increased fine fractions are consistent with the depositional regimes postulated for these stations, and with the increased metals concentrations found there as well.

4.2.3 Buildup Unrelated to Wastewater Discharge

The previous section examined the spatial distribution of constituents at a single point in time, namely, during the October 2008 survey. However, as described above for Stations 1 and 8, the characteristics of ambient sediments at individual stations can be inherently different because of their water depth or the depositional characteristics of their geographic location. These factors complicate 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 be masked in a spatial analysis applied to a single survey.

As revealed by the temporal analyses described in this section, long-term increases in certain chemical concentrations have been observed within the Estero Bay sediments. However, these increases have occurred consistently at all stations. Consequently, large-scale processes unrelated to effluent discharge are driving the temporal trends in ambient chemical distributions within the sediments of Estero Bay.

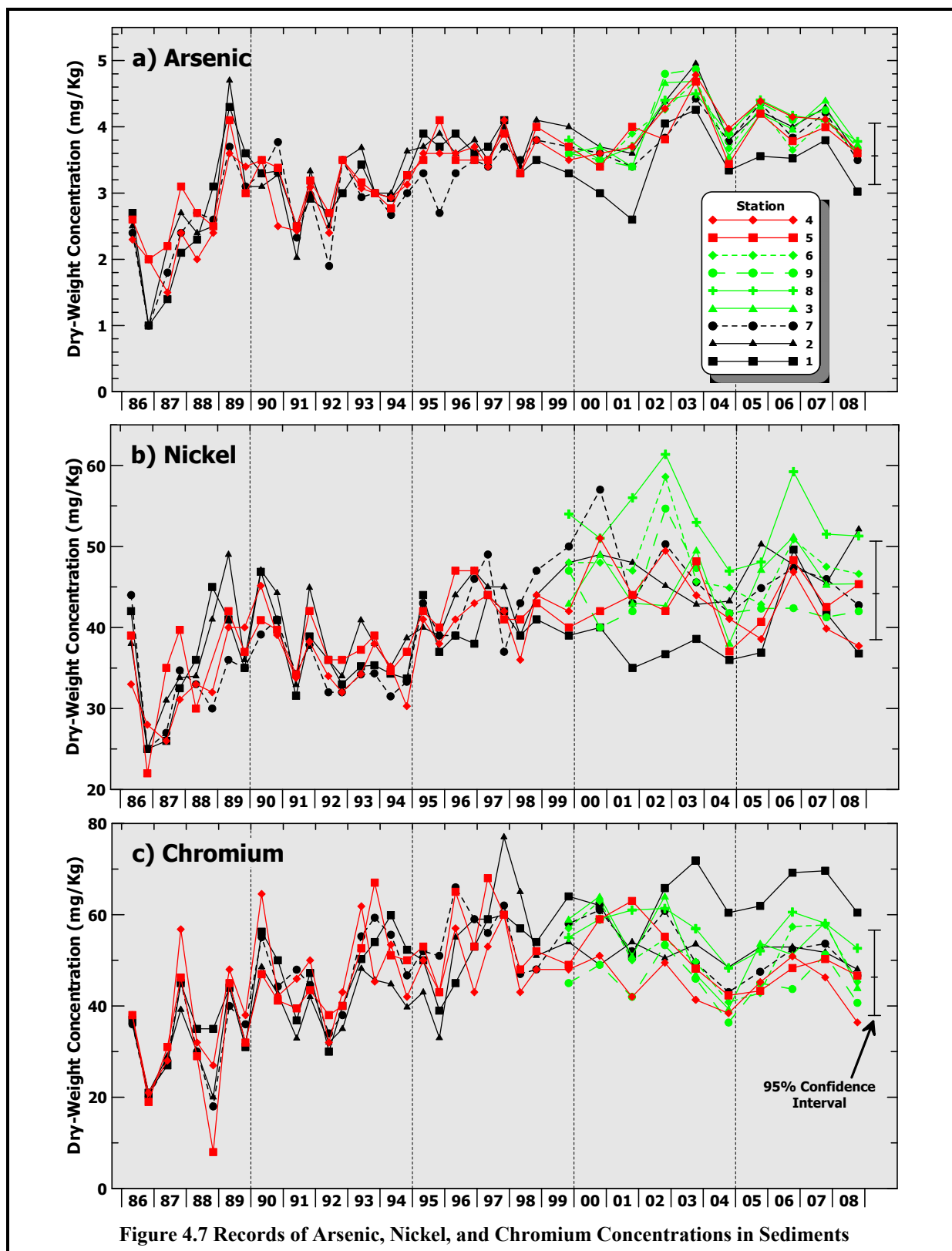
Temporal Trends Independent of Outfall Proximity

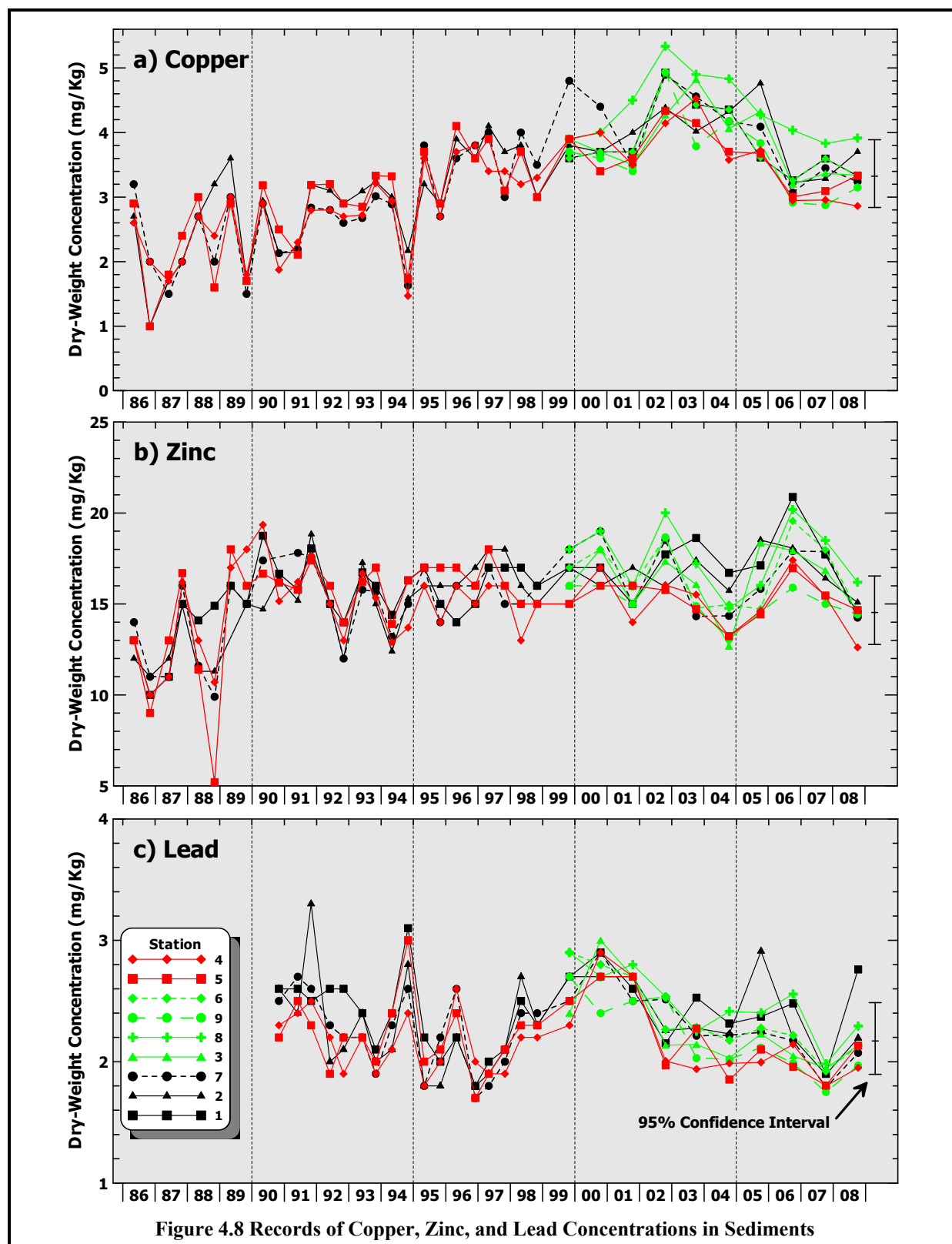
As suggested above, time histories of chemical concentrations within sediments are a powerful tool for discerning the fate of contaminants within the marine environment. A buildup over time indicates that contaminants are accumulating within benthic sediments. Differences in the rate of buildup at various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

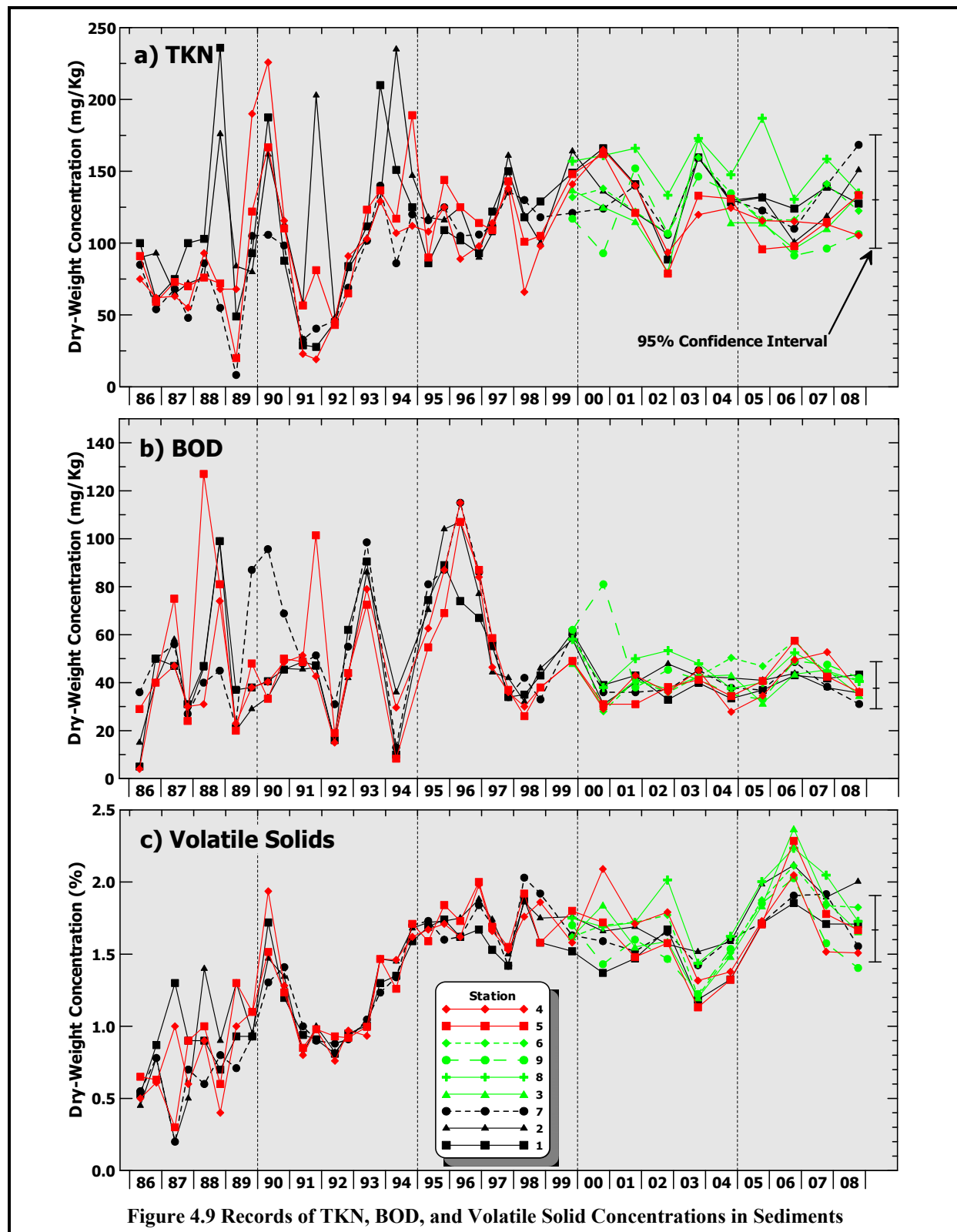
Detailed analyses of sediment time histories have never revealed a buildup of contaminants related to the discharge of wastewater from the MBCSD outfall. This is largely due to the overall low total emission of chemicals by the MBCSD WWTP. As described in Chapter 2, not only are the chemical concentrations within the effluent itself low, but the plant discharges a comparatively small volume of wastewater overall. Offshore sediment data collected during the October 2008 survey augment more than 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 span only 10 years of the available 23 years. Lastly, the black lines and symbols track sediment concentrations at the three most-distant stations, midfield Stations 2 and 7, which are 150 m from the diffuser, and the upcoast reference Station 1.

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 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 reflected in 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 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. Additionally, they are often 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, dominate sediment 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. As discussed above, Station 8 is located in a more quiescent depositional environment due to its deeper depth, and consequently, it tends to have a slightly higher fraction of fine sediments, and an associated increase in trace-metal concentrations. Similarly, Station 1 is located more than 1 km from the other monitoring stations, and appears not to be subject to exactly the same oceanographic processes as the rest of the monitoring stations. As a result, slight differences in unnormalized trace-metal concentrations can occasionally be discerned at both of these stations.

For example, in the last decade, 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 as a separation in the solid black line with black squares (■) in the Figure. The relatively increased chromium concentrations reflect a similar scenario, albeit offset in the opposite direction (Figure 4.7c). In addition, while past Station-1 offsets in nickel concentrations appear to have re-converged with mean conditions, elevated chromium concentrations have yet to do likewise. Moreover, elevated chromium concentrations at Station 1 are incongruous with the comparatively depressed arsenic and nickel concentrations at Station 1. This suggests that the trace-metal composition of particulates deposited at Station 1 are slightly different from that of the other monitoring stations, at least over the past decade of sampling under the current NPDES permit.

Some recent concentrations at Station 8 have also appeared to depart from mean conditions. 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 particular, the records of nickel, copper, and TKN exhibit slight but consistently higher concentrations compared to most other stations. As described above, some of these differences were also observed during the October 2008 survey and were ascribed to the higher fraction of naturally occurring fine particulates present there. This hypothesis is supported by the long-term record shown in time series. Additionally, other benthic monitoring programs have documented seaward increases in background metal concentrations (Schiff and Gossett 1998, Steinhauer et al. 1994, Coats 1995). As such, it is highly unlikely that the Station-8 concentrations were related to effluent discharge. 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). As with Station 1, benthic monitoring requirements at cross-shore Stations 8 and 9

Table 4.9 Temporal Trends in Sediment Chemical Concentration

Parameter	<i>p</i> -value ^a	Rate ^b (mg/Kg/yr)	Concentration (mg/Kg-dry)		Years to Effect ^d	Emission (Kg/yr) ^e	
			2008	Effects ^c		Actual	Required
Arsenic	<0.001	0.08	3.6	8.2	47	<1.6	7
Chromium	<0.001	0.95	46	81	23	<2.6	85
Copper	<0.001	0.09	3.3	34	350	22.9	8
Nickel	<0.001	0.62	44	51.6 ^f	6	≈7.4	55
Lead	0.512	-0.01	2.2	46.7	—	—	—
Zinc	0.007	0.14	15	150	977	90	12
TKN	0.002	2.46	130	—	—	—	—
BOD	0.850	-0.12	38	—	—	—	—
TVS	<0.001	0.05	1.67	—	—	—	—

^a Trend significant if *p*-value less than 0.05

^b Rate of concentration increase per year

^c Concentration where biological effects become evident (ERL)

^d Predicted number of years (after 2008) to the time when concentrations reach biological effects levels

^e Actual mass-emission in 2008 compared to that needed to account for annual concentration increase

^f Effects-range median (ERM) for nickel because its concentration currently exceeds the ERL

have been eliminated in the new discharge permit's requirements because the inherent difference in the benthic environments at these stations can confound the interpretation of trends at the remaining stations, irrespective of normalization.

Chemical Accumulation Rates

This section quantifies long-term increases in chemical concentrations that are apparent in some of the time histories. Because the accumulation occurs at all stations, including stations distant from the outfall, the increase is unrelated to effluent discharge. Nevertheless, the increase in chemical concentrations is of environmental interest, irrespective of an evaluation of discharge impacts. Table 4.9 presents the results of a series of linear regressions applied to the time history of average chemical concentrations.¹⁷ The pair of columns labeled "*p*-value" reflects the statistical confidence in the accumulation rates listed in the next pair of columns. As with the hypothesis tests conducted on spatial trends, *p*-values less than 0.05 are considered statistically significant, so their corresponding accumulation rates are highlighted in bold font.

Two separate straight-line regressions were performed on the data for each parameter. The one labeled "All" spanned the entire 23-year time series, and included means from each of the 36 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 had improved. This is particularly evident in the time series of TKN, BOD, and TVS (Figure 4.9) where large outliers have become 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 chemicals 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

¹⁷ 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.

long-term trend over the entire record, its concentrations revealed a comparatively brief increase between October 1996 and October 2001. After that, lead concentrations declined, and in 2007, reached the low historical concentrations that were measured in 1996. Despite these large interannual fluctuations, there was no significant trend in lead concentrations over the entirety of the available record ($p=0.512$). 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 22-year time history was statistically significant ($p=0.007$), in recent years it was not ($p=0.427$). There were no long-term trends observed in BOD. Even if there were, however, they would be difficult to resolve because of the wide interannual fluctuations that occurred prior to 1998 from interferences in the chemical analyses (Figure 4.9b). Regardless, regression of the data after 1998 did not exhibit a trend either ($p=0.667$).

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 much higher rates of increase, with magnitudes at or exceeding 0.95 mg/Kg per annum. However, their overall concentrations in sediments are also proportionally higher, so their percentage increase over time was similar to that of arsenic, copper, and TVS. In actuality, visual comparison of the time series reveal that the relative increase in TKN concentrations was small, whereas volatile-solid concentrations have nearly tripled since 1986 (Figure 4.9c). In comparison, average arsenic, chromium, and copper concentrations have doubled over the last two decades (Figure 4.7ac; Figure 4.8a).

Biological Implications

The environmental relevance of metal 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 chemicals 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 possible.

The biological implications of the observed chemical accumulations are assessed in the “*Years to Effect*” column of Table 4.9. This column lists the projected number of years that it will take for each of the key chemical 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 ($p\leq 0.001$) 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 the least concern. Currently, sediment copper concentrations (near 3.3 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 two decades, they will remain benign for another three-and-a-half centuries. Similarly, current arsenic concentrations (near 3.6 mg/Kg) are only less than half of the lowest marine toxicological benchmark (ERL=8.2 mg/Kg). With annual increases of only 0.08 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 of more immediate concern. Because their concentrations are already naturally high in the marine sediments of northern Estero Bay, even small annual increases will result in a rapid approach toward marine toxicological benchmarks. If chromium concentrations continue to increase at approximately 0.95 mg/Kg each year,

contaminant levels could begin to affect marine organisms in as little as 23 years, or by the year 2031. However, after 1995, chromium concentrations appear to have stabilized and, as a result, the post-1990 trend is no longer discernable ($p=0.158$).

Over the last 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 toxic levels within Estero Bay sediments by 2014.

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 less influence on marine organisms. In contrast, the dissolved phases of these metals are far more bioavailable and indicative of potential biological impacts.

Low dissolved-phase concentrations within Estero Bay sediments were 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 (36 µg/L, 50 µg/L, 3.1 µg/L, and 8.2 µg/L, respectively). 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 are slightly elevated within the pore water, it is likely that indigenous infaunal populations have adapted to the higher ambient concentrations over the millennia of exposure.

Low MBCSD Metal Emission

The foregoing discussion identified two trace metals, chromium and nickel, whose projected concentration increases could cause them to approach harmful-effects thresholds within a few decades. However, the observed historical increases in these metal concentrations are 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, there are no heavy industrial inputs to the MBCSD collection system, and trace-metal concentrations within effluent are uniformly low; so low, in fact, that MBCSD metal emissions could not

appreciably contribute to the accretion of these metals in marine sediments. This can be demonstrated with an elementary mass-balance computation.

The two right-hand columns of Table 4.9 compare the actual year-2008 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 both metals of concern, actual mass emissions from the MBCSD outfall during 2008 were well below the emissions that would be required to achieve the observed annual increase in sediment concentrations. Specifically, an upper bound mass emission of less than 2.6 Kg of chromium cannot account for the observed 0.95-mg/Kg/yr increase in sediment chromium concentrations. In fact, the emission would have to be nearly 30-times higher. Similarly, the annual increase observed in nickel concentrations could be explained only by a discharge of well more than 55 Kg per annum, while the actual discharge in 2008 was probably closer to 7.4 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 and nickel concentrations within effluent were too low to be quantified in either of the effluent samples (Table 2.8). Consequently, the actual year-2008 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 (MDL) 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. 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 chemical analysis. However, metal concentrations are probably increasing within a much larger volume of seafloor sediments than was assumed in the mass-balance computation. The area of increase was assumed to cover only the region sampled, namely a radius of approximately 1 km. 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 chemicals 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. Infauna serve as the best indicators of marine pollution because they have limited mobility and cannot easily escape exposure to contaminants in their immediate environment. Other organisms, such as marine mammals and finfish, range more widely, making it impossible to determine where the organisms were exposed to contaminants.

The diffuser structure lies on the seafloor, where particulate contaminants discharged into marine waters ultimately settle and accumulate. Because infauna reside within seafloor sediments, they are close to the potential source of pollution. Additionally, infaunal species vary in their sensitivity to pollutant stressors. As such, changes in relative abundance among species can signal alterations in their environment. 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.

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. The benthic monitoring has now amassed 23 years of infaunal data. During that time, 157,000 specimens representing more than 360 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 uniformly high diversity that does not decrease with proximity to the diffuser.

These observations hold true despite widespread variations in the abundance of individual organisms. Over the years, the dominance of individual taxa have waxed and waned in response to natural changes in the environment. Additionally, for many taxa, distinct differences in abundance are evident between the winter and summer sampling seasons. Other species come and go in response to powerful long-term variations in the oceanographic environment. One such 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 the last 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.

More than 5,000 individual organisms were enumerated in the 45 sediment samples that were collected at nine stations during the benthic survey conducted in October 2008. A compendium of the taxonomic identifications and enumerations conducted on year-2008 sediment samples is provided in Tables C.1 through C.10 at the back of this report. Table C.11 and Table C.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 22 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 2008 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 Healthy Indigenous Infaunal Community Surrounding the Outfall

The type and abundance of benthic organisms directly reflect the quality of the marine sediments where they live. Infaunal communities residing in degraded sediments tend to exhibit low species richness and diversity because they are primarily populated by only a few opportunistic taxa that feed on detritus and thrive in sediments that are high in subsurface organics. In contrast, clean sediments are populated by diverse assemblages of organisms that include filter feeders, which extract nutrients from suspended particulates. These suspension feeders are sensitive to excessive particulate loads such as those that can be discharged from low-performance 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 excentricus*, 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.

Since 2000, the parchment tubes of the Ornate Tubeworm (*Diopatra ornata*) have routinely been separated in the field prior to sieving of the infauna. Ornate tubeworms are so called for the elaborate layering of pieces of shells, algae, sticks, and other debris onto the outside of their large parchment tubes (Figure 4.10). The inclusion of large numbers of nestling epifauna that reside on the microhabitats created by these tube casings, particularly small crabs and other crustaceans, can dramatically skew the enumeration of marine infaunal organisms in samples where they are present. Because epifauna live on the surface of marine substrates, they tend to be more mobile and less susceptible to sediment pollutants than infauna, which live in the interstices between sand grains. Removal of the parchment tubes in the field, prior to sieving, avoids the inclusion of large populations of epiphytes. The tubeworms themselves, however, are 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). During the October 2008 survey, a series juvenile *D. ornata* tube casings were separated from samples collected at Station 4.

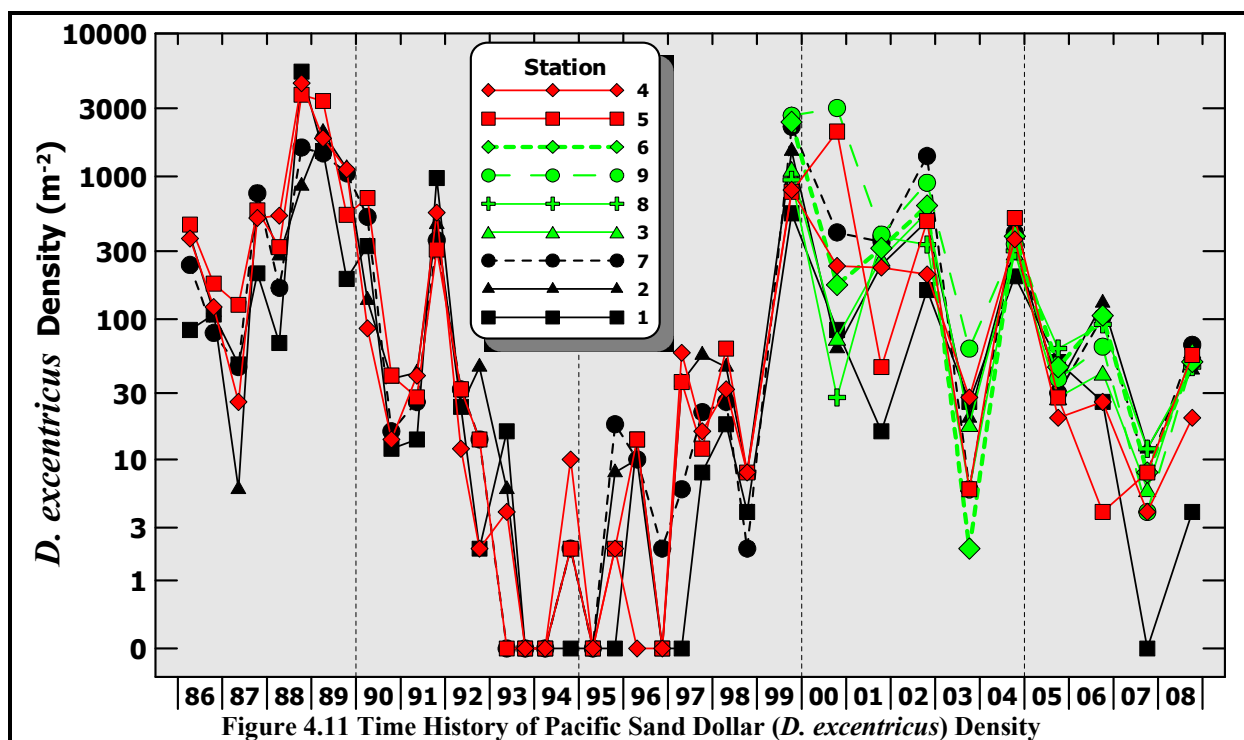


Figure 4.10 Photograph of a Tubeworm (*Diopatra* sp.)

Statistical analyses performed on the 2008 benthic samples also excluded Pacific sand dollar (*Dendraster excentricus*) populations. Although sand dollars are filter feeders and can be sensitive to pollution, they are removed from the database prior to statistical analysis because they exhibit extreme population fluctuations from year to year (Figure 4.11) which can potentially mask discharge-related impacts on less-dominant taxa.

Sand dollars form dense beds just seaward of the wave break, which acts as a barrier for predacious sea stars. As a result, predation is limited because 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 predation, permitting enhanced recruitment of juvenile sand dollars. 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.

Similarly, the population drop documented in 2003 may have been linked to a predation event in late 2002. On numerous occasions during the October 2002 survey, short-spined sea stars (*Pisaster*



brevispinus) became jammed in the jaws of the grab sampler, resulting in an unusually high number of repeated grab sampling attempts at several stations. Accordingly, sand dollar populations in 2003 were markedly diminished, suggesting that predation may have played a significant role in the reduction observed between 2002 and 2003.

Because their large numbers overwhelmingly dominate the population statistics during high-recruitment years, sand dollars have the potential to mask any influence from the discharge on less-dominant taxa whose populations are more consistent and sensitive to potential discharge impacts. For example, average sand dollar densities have ranged from a high of 2600 m⁻² in October of 1988 to less than 50 m⁻² between May 1992 and October 1998. During 1999, recruitment peaked again before engaging in a general decline through 2007 when a total of only 31 sand dollars were collected. The October 2008 survey numbers indicate a slight rebound from 2007, however, removal of the 198 specimens of *D. excentricus* from the database had little impact on the statistical analyses. Regardless, community indices were computed both with (Table C.11) and without (Table C.12) their population in 2008.

Exclusion of the highly transient sand dollar population does not detract from the impact evaluation because their distribution is 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). Additionally, although no sand dollars were found at reference Station 1 (black) in 2007 and only a few were found there in 2008, during most years, this station has historically produced fewer sand dollars than the other stations. Regardless, the apparent difference in the population at this station that has occurred over the past two years is still too preliminary to suggest any consistent trend.

In general, 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; no permanent sand dollar beds exist 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). Not surprisingly, sand dollars collected during the MBCSD benthic surveys are predominately composed of small juveniles of the same cohort.

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.

Population density, shown in Figure 4.12a, measures the total abundance, or number of organisms, within a 1-m² 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 are generally small compared to the wide temporal fluctuations between surveys.

The largest population changes occur on a seasonal basis. Post-summer populations (those sampled during the October survey) 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 when storms generate intense wave-induced currents that scour the bottom near the 15-m water depth of the outfall. Post-summer populations reflect recruitment of the more delicate annelid worms that can only survive during quiescent benthic-flow regimes. The absence of winter surveys after 1998 accounts for the uniform increase in density that is apparent in the last decade of the monitoring record (Figure 4.12a)

Any spatial gradients in density 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 chemicals from the effluent discharge over the last two decades has had no discernable impact on infaunal abundance, particularly when compared to large seasonal and interannual population fluctuations.

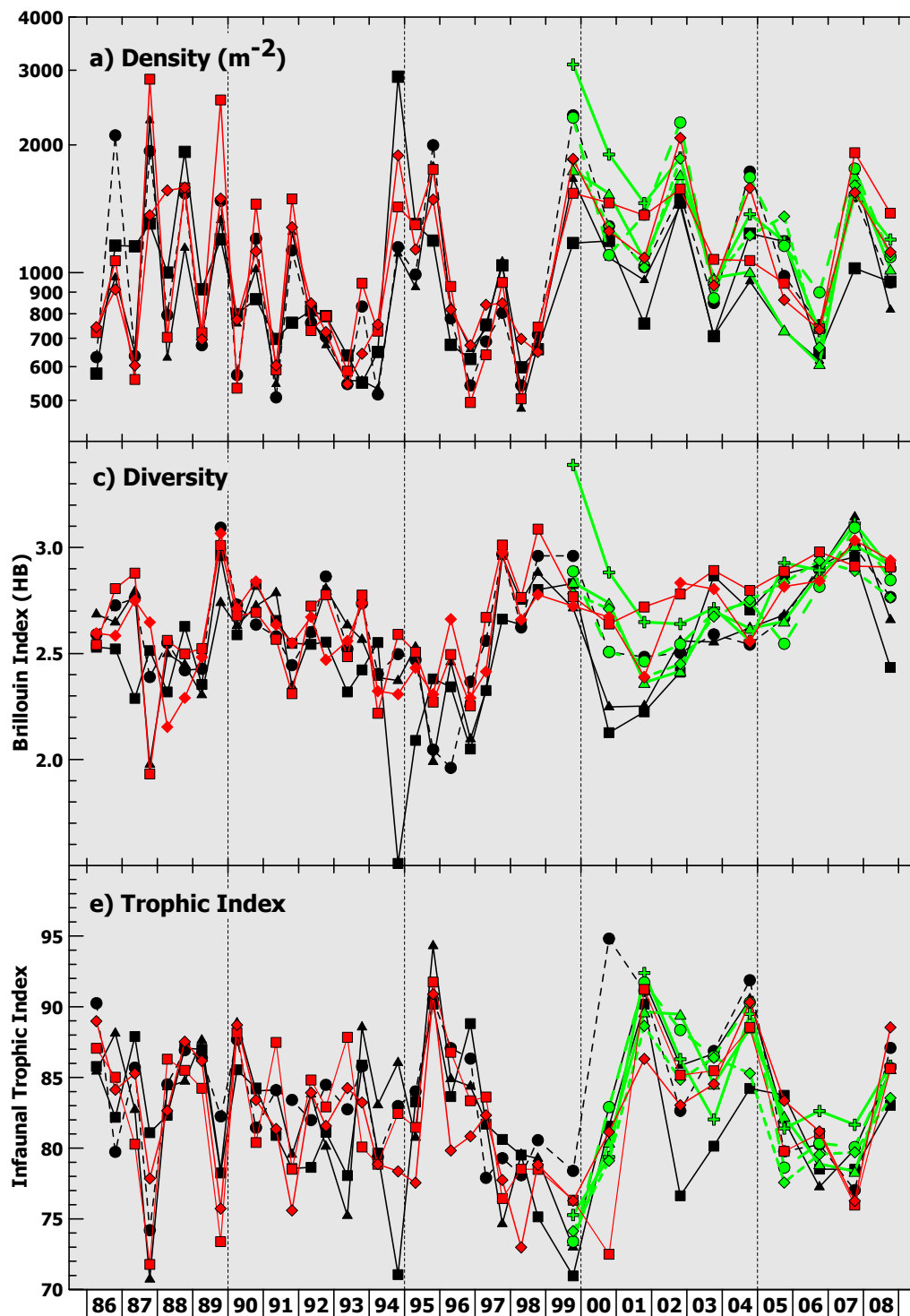
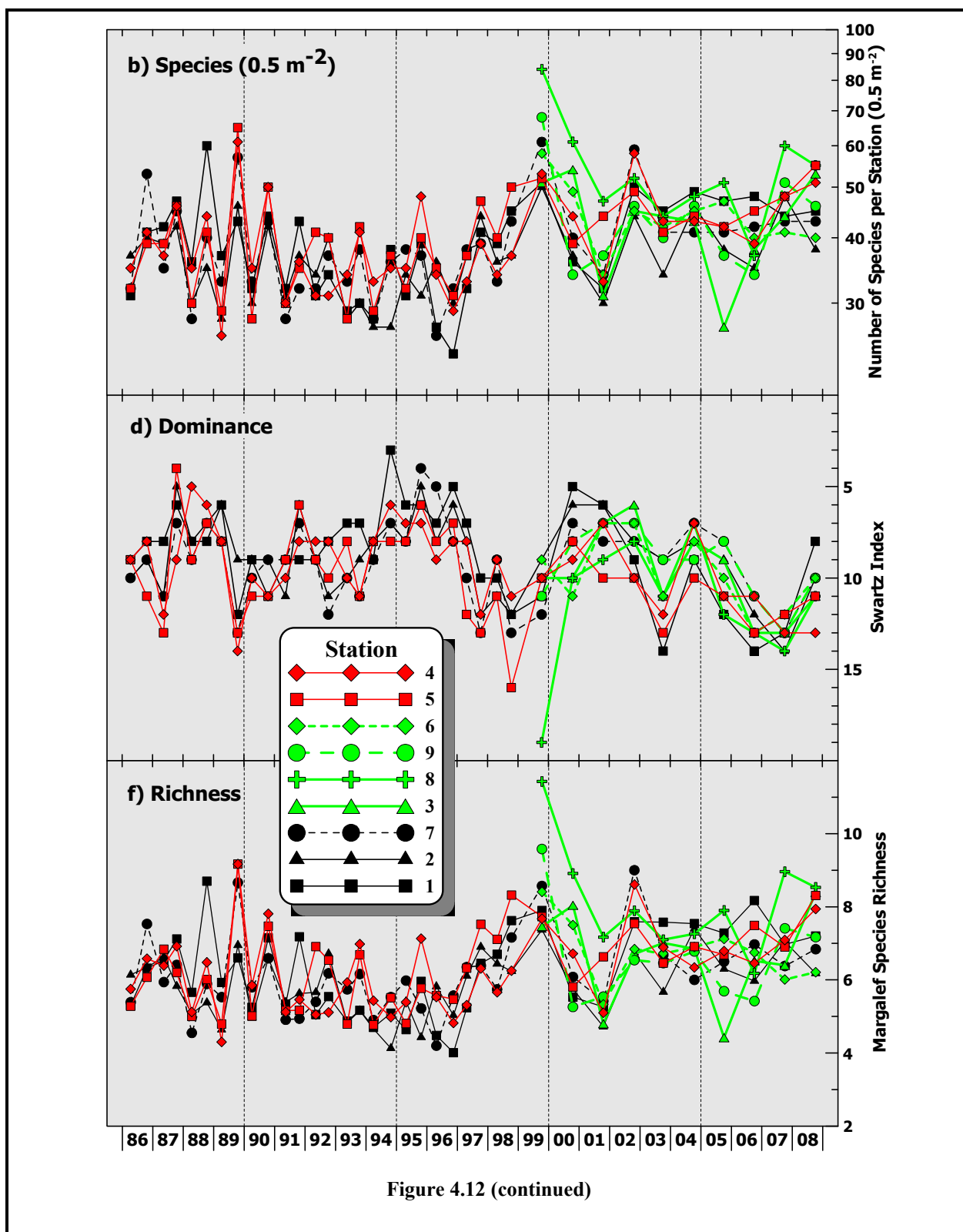


Figure 4.12 Time History of Infaunal Community Parameters



Number of Species

The total number of species is another measure of the overall health of benthic communities (Figure 4.12b). Everything else being equal, infaunal communities 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 automatically 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 steadily increased relative to stations near the outfall. As with abundance, any spatial differences in the 2008 data 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. Between 1990 and 1996, only one, and usually no *D. ornata* specimens were collected during any given survey. However, in the post-winter surveys of both 1997 and 1998, two ornate tubeworms were encountered. In 1999, four of these tubeworms were found at Station 8 alone. These tubes were not removed prior to sieving, and as discussed previously, the inclusion of numerous epiphytic taxa associated with their tube casings 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 can be an artifact of the sample size (abundance) rather than purely an increase in species richness or diversity. In 2008, the number of species enumerated at each station generally ranged between 40 and 55, which is comparable to the past several years. In contrast, the total abundance of organisms decreased slightly in 2008 relative to 2007 levels (Figure 4.12a). Thus, the decrease in the number of organisms collected between 2007 and 2008 does not appear to have materially affected the number of species.

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 C.2). Both exhibit nearly identical time histories in the MBCSD database, so only the Brillouin index is shown in Figure 4.12c.

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.

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 an artifact of the enumeration of additional epiphytes residing on the casings of ornate tubeworms. As discussed previously, the presence of a large

number of epiphytic species (Figure 4.12ab) heavily influenced both the overall abundance, and number of species counted at this station during the 1999 survey.

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 Station 1 during the October 1994 survey. As a result of the numeric dominance of this one taxon, the computed diversity at this station was low.

M.sacculata is often one of the numerically dominant taxa found in northern Estero Bay, but on average, only approximately 50 specimens are typically collected at each station. During the 2008 survey, only 230 specimens were collected at all nine stations combined. High populations of this species were recorded in 1994 because 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, so a few replicate samples typically contain most of the specimens, while other grab samples from the same station contain none. 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 an *a priori* assumption concerning how individuals are distributed 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, 10.4 species accounted for 75% of the specimens in the benthic samples collected during the October-2008 survey. This indicated that infaunal abundance was evenly distributed among the species. Moreover, low dominance was found at all the stations in the 2008 survey.

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, indicating that sediments are relatively clean. Lower infaunal indices occur when populations of species in Group III (surface deposit feeders) and Group IV (sub-surface detritus feeders), which generally dominate when sediments are high in organic contaminants.

The *ITI* has been consistently high throughout the monitoring program, and the 2008 survey was comparable to trophic indices recorded historically (Figure 4.12e). The *ITI* has always been well above the critical *ITI* of 58 that normally indicates a transition to degraded conditions. In fact, trophic indices have always exceeded 70, confirming 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 *ITIs* measured in samples collected during 2008 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*, *Rhepoxynius abronius*, and *Rhepoxynius menziesi* (see Table C.1). Together, these three amphipod species alone accounted for almost 22% of the total specimens collected during the survey. In fact, *M. major* and *R. abronius* were the second and third-most abundant taxa collected during the 2008 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 C-2 in the Appendix). The prevalence of these species at all stations during the October-2008 survey lends confidence in the general lack of potential discharge-related impacts.

Additionally, *R. abronius* is known to be particularly sensitive to pollution (Pearson and Rosenberg 1978) and is often utilized for bioassay testing of marine sediments (ASTM 1992; USEPA-USACOE 1991, 1993). This taxon is also especially 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, *R. abronius* were observed to have their highest abundance at Station 8 (80 specimens, Table C.1), which generally has a slightly elevated mud fraction (Figure 4.6 on Page 4-24).

In contrast, opportunistic pollution-tolerant species, such as *Polydora ligni*, *Capitella capitata*, *Paraprionospio pinnata*, and oligochaete worms, were almost entirely absent in the samples collected during 2008. Out of the 45 benthic grab samples collected, only 3 juvenile specimens of an unidentified species of *Polydora* were and one *P. pinnata* were enumerated (Table C.3). Instead, the prevalence of sensitive filter-feeding taxa and the general absence of pollution-tolerant opportunistic taxa led to overall high levels of the infaunal trophic index in 2008, signifying the presence of a uniformly healthy benthic population consistent with that documented over the last two decades.

4.3.2 Infaunal Distribution in 2008 Unrelated to Outfall Proximity

The previous section documented the overall health of the infaunal community surrounding the outfall using a 23-year record of infaunal community indices. This section investigates whether spatial trends related to outfall proximity exist in the infaunal data collected in 2008. As described in Appendix C.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.

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 144 m or more from the outfall.

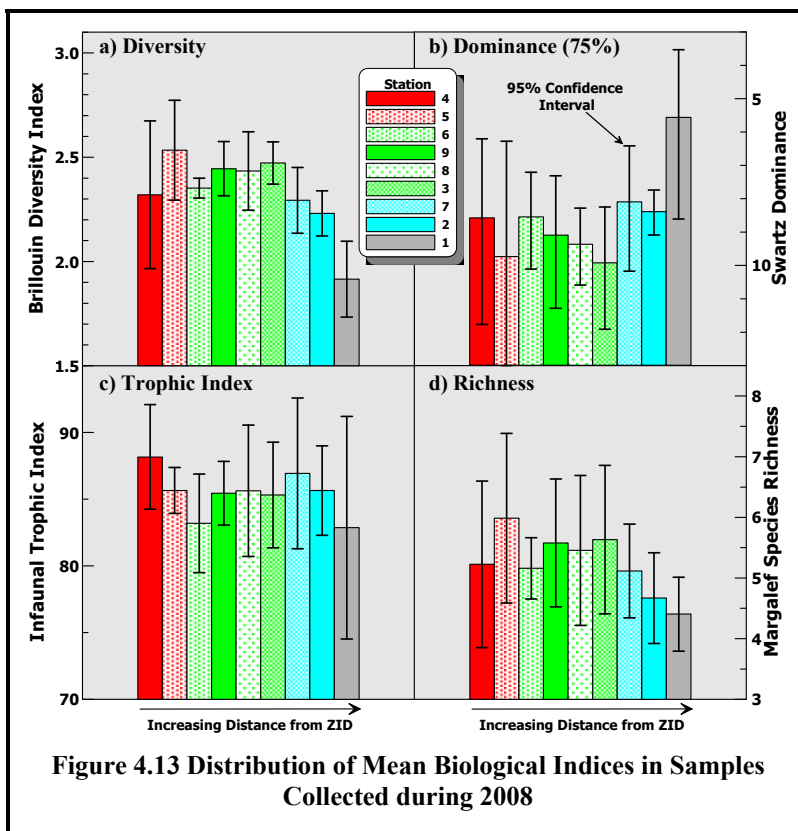
Impacts to infaunal communities from the discharge would be reflected in the bar chart as a spatial trend of steadily increasing diversity, ITI, or richness from left to right (Figure 4.13acd).

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. If anything, the opposite appears to be the case.

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, except perhaps occasionally at Station 1.

4.3.3 Spatiotemporal Infaunal Trends Unrelated to Outfall Proximity

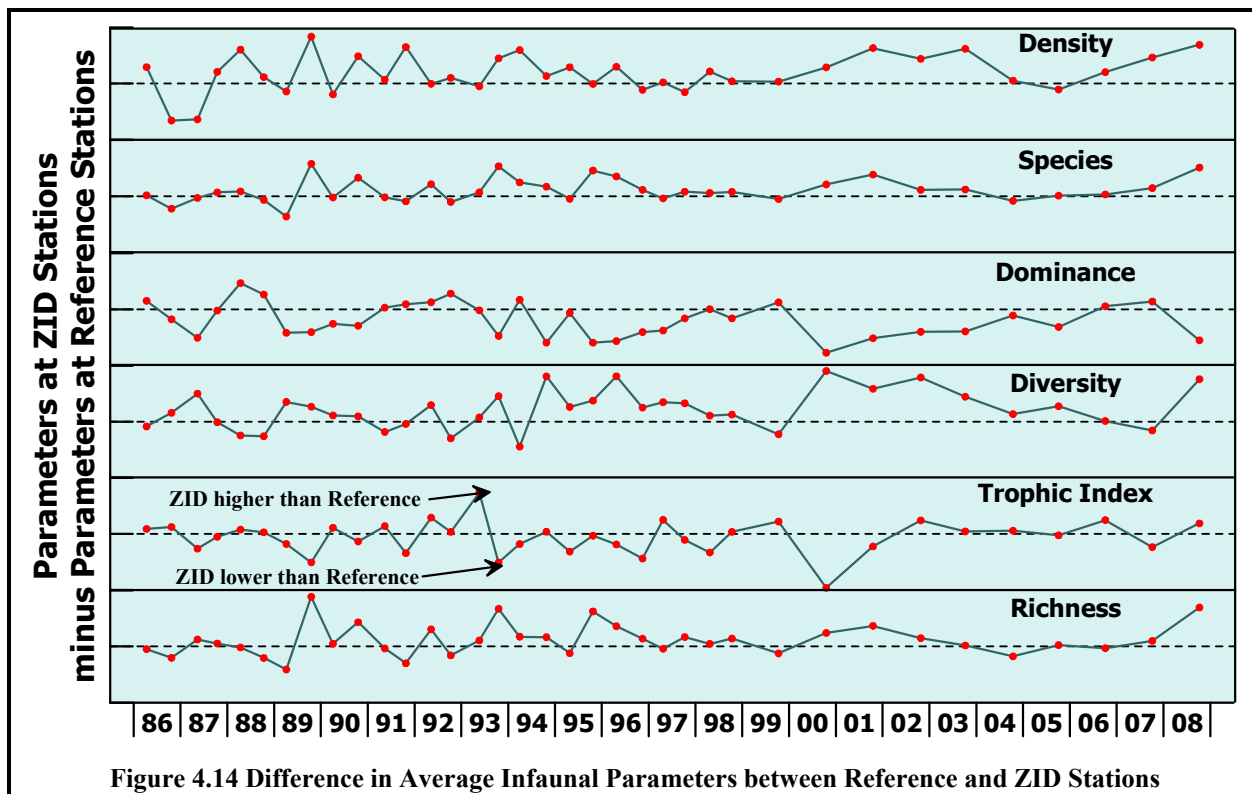
As with the chemical constituents within northern Estero Bay sediments, subtle spatiotemporal trends in the infaunal community can be difficult to discern in the time series shown in Figure 4.12. The parameters exhibit wide fluctuations between seasons and years. Compared to these large temporal oscillations, 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 from regional influences throughout



Estero Bay are far larger than those induced by any localized effects. Therefore, within a given survey, spatial differences in infaunal parameters can be difficult to discern when they are confounded by larger natural differences in the sedimentary environment and other zoogeographic influences.

The limitations associated with purely spatial or purely temporal approaches to impact evaluation are largely eliminated through the use of an analysis technique based on 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 occur in unison at all stations and represent a simultaneous response to regional influences. Time series of differences in parameters at ZID and distant stations are presented in Figure 4.14.

If the MBCSD discharge were negatively affecting the benthic community over time, the infaunal properties of populations at stations near the outfall (4 and 5) would slowly diverge from those of the distant stations (1, 2, and 7). This would 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 23-year MBCSD time series did not discern a statistically significant linear trend in any of the infaunal indices. Parallelism was strongly indicated ($p > 0.16$) for all indices. This includes the diversity index, which in prior years had shown a trend that was marginally significant ($p < 0.055$). Figure 4.14 shows that the diversity time series is unusual because all but three of the 21 surveys conducted since 1992 exhibited a positive offset, namely, the average diversity at stations near the outfall has been consistently higher than the diversity at the distant reference stations. However, the positive offset is unrelated to the effluent discharge because it is opposite of that expected from deleterious exposure to contaminant loads. Higher diversity at stations close to the outfall reflects a healthier infaunal community compared to the distant reference stations.

4.3.4 Influential Taxa

Table C.1 shows that six species accounted for more than half of the specimens collected in 2008. These influential taxa consisted of three filter-feeding amphipods, a marine isopod, and two predatory worms. The nemertean *Carinoma mutabilis* was by far the most abundant taxon found in 2008, representing over 16 percent of all organisms collected. Nemerteans are soft-bodied, unsegmented worms (Figure 4.15). *C. mutabilis* 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. However, in 2008, this taxon was more prevalent than usual. Whereas in 2007, a total of 395 *C. mutabilis* were collected and comprised approximately five percent of the total infauna, the number of *C. mutabilis* collected during 2008 was more than double that (834) (Table C.1). Additionally, *C. mutabilis* evinced one of the more pronounced differences in taxonomic distribution observed during 2008. The average abundance of *C. mutabilis* at most of the benthic sampling stations was around 95; however, samples from Station 1 contained 157 *C. mutabilis* (Table C.2). This represented nearly one-third of all specimens collected at Station 1. Conversely, a total of only 14 *C. mutabilis* were enumerated at Station 4, comprising less than 3 % of all the specimens collected at that station.



Figure 4.15 The nemertean worm *C. mutabilis*

The second and third-most abundant taxa encountered during 2008, *Majoxiphalus major* and *Rhepoxynius abronius* were discussed previously with respect to their role as indicators of clean sediments. In the 2008 benthic samples, as well as those collected in past surveys, the phoxocephalid amphipod assemblage has been influential in distinguishing the infaunal communities at the various stations (MRS, 2007a). 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 4.16, are small shrimp-like scavengers that eat organic debris. These organisms 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.

Analyses conducted over the past several years, support the notion that physical characteristics, such as grain size distribution, are largely responsible for the observed differences in phoxocephalid amphipod community structure among the nine benthic stations. For example, Table C.1 shows that samples collected at Station 8 during the October 2008 survey had the highest number of *R. abronius* specimens (80). As in past surveys, the increased fine-sediment mud fractions found at Station 8 reflect the presence of a more quiescent wave environment that is apparently well suited to *R. abronius*.

Competition for the same ecological niche among closely related phoxocephalid amphipods, may also play a part in their relative distributions, particularly at stations where *R. abronius* is naturally less abundant due to physical sediment characteristics.



Figure 4.16 A Gammarid Amphipod

The fourth-most abundant organism encountered during the October 2008 benthic survey was the sphaeromatid isopod, *Tecticeps convexus* (Figure 4.17). One of the most distinguishing features of this group of isopods is their ability to roll their compact, convex bodies into a ball. In this ability they resemble certain terrestrial isopods, called pillbugs, a striking example of parallel evolution. *T. convexus* are surface deposit feeders that possess a broad, grinding structure used to chew algae or other plant material, and to scrape diatoms and detritus off sand grains. Like other sphaeromatid isopods, they exhibit marked sexual dimorphism wherein males are substantially larger than females.

Another pollution sensitive gammarid amphipod, *Eohaustorius sencillus*, was the fifth-most abundant taxon enumerated during the October 2008 survey. Similar to *C. mutabilis*, this species is normally among the top five most populous organisms in the sediment samples collected as part of the MBCSD monitoring program. This amphipod was prevalent at all stations, and accounted for nearly six percent of the specimens collected overall.

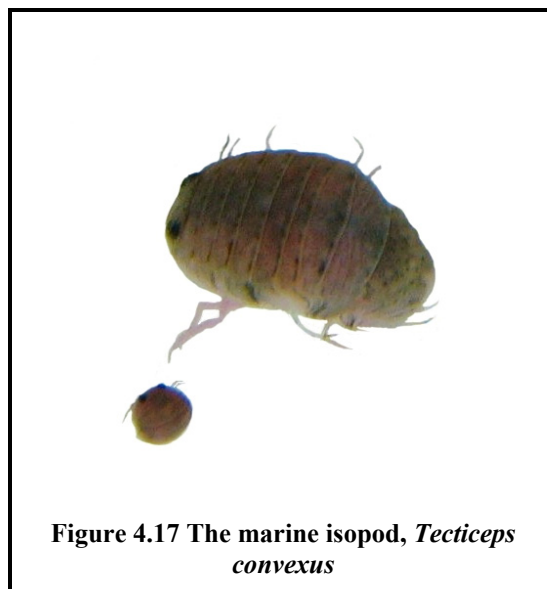


Figure 4.17 The marine isopod, *Tecticeps convexus*

Finally, another pronounced difference in taxonomic distribution among stations during 2008 was the relative paucity of the polychaete *Scoloplos armiger* at Station 1. *S. armiger* is a common bristleworm found throughout the marine environment worldwide. It can attain lengths of up to 120 mm, and actively burrows through sediments, feeding with an eversible proboscis. Like *E. sencillus*, *S. armiger* comprised slightly over five percent of the total organisms collected during the October 2008 survey (Table C.1). However, Station 1 samples contained a total of only 12 of these worms, which was less than half the abundance found at any other station (Table C.2).

As with benthic samples from previous surveys, the infaunal community surrounding the MBCSD outfall in 2008 reflected slight differences in the benthic environment at the various monitoring stations.

Generally, the same few species were found to be influential in differentiating the community structure at specific stations, primarily Stations 1 and 8. 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 station 8, along with the concomitant differences in orbital wave motion and fine sediment fractions at both stations.

Although this was not the case during 2008, in previous years, Station 9 has also displayed differences that appear to be related to station depth and physical location properties. 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, from 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.

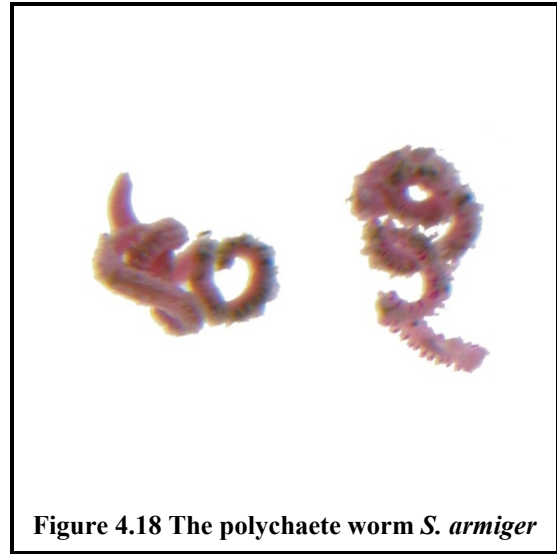


Figure 4.18 The polychaete worm *S. armiger*

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CHAPTER 5

Conclusions and Recommendations

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5.0 CONCLUSIONS AND RECOMMENDATIONS

The City of Morro Bay and Cayucos Sanitary District (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 local ecology and beneficial uses of the receiving waters. This report is a part of the reporting program that 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 of effluent constituents, receiving water quality, benthic sediment chemistry, and marine biota. Of the thousands of measurements collected as part of the monitoring program during 2008, none exceeded the discharge limitations.

5.1 TREATMENT PLANT

The MBCSD Wastewater Treatment Plant (WWTP) has been operating under the provisions of a 301(h)-modified NPDES permit since 1986, with 2008 marking 23 years of consistently high performance by this treatment facility. There is no evidence of a decline in treatment performance in the more the 23 years of annual averages shown in Table 5.1. In fact, many of the best measures of treatment performance have been achieved during the past five years of operation, with the 2008 performance exceeding all other years. For example, the average effluent Total Suspended Solids (TSS) concentration in 2008 (20.0 mg/L) was the lowest on record, even lower than the 1987 average (21.8 mg/L) when El Niño-related storms caused an unusually low influent TSS (274 mg/L). In contrast to 1987, the low effluent TSS concentration in 2008 was the direct result of the exceptional efficiency of the treatment process, which reduced high influent TSS concentrations by an average of 94.1%. This removal rate matched the 2007 rate as the highest average rate ever recorded. Moreover, these increases in plant efficiency were not a coincidence because they followed two successive years when removal rates exceeded 93%, setting records for annual removal rates at those times. Combined with the low total flow in 2008, the high efficiency of the plant's solids-removal process generated the lowest mass emission of suspended solids (30 MT) recorded since monitoring began in 1986, easily besting records set in the previous four years. The 2008 solids emission was half of the long-term annual average emission and only 15% of the solids discharge permitted under the NPDES permit. The record low emissions and high effluent quality measurements achieved over the past five years attest to the consistent and exemplary level of recent plant performance.

Reductions in the discharge of oil and grease (O&G) and biochemical oxygen demand (BOD) echo the appraisal of recent plant performance based on TSS. As with TSS, the discharge of O&G and BOD over the past four years has been exceptionally low, while their corresponding removal rates were high compared to the average rates achieved over the 23 years of monitoring. Averages computed over the 23 years of monitoring are shown in bold font at the bottom of Table 5.1. Across the board, effluent TSS, O&G, and BOD concentrations and emissions were markedly lower in the past five years than the overall monitoring-program averages, despite the higher-than-average influent concentrations for these constituents over the same time period. Accordingly, removal rates for these constituents were among the highest measured since monitoring began, far exceeding the average removal rate for the monitoring program overall. As with TSS, BOD removal in 2008 was the highest on record, and its emission was the lowest on record. Reduced emissions in the last five years benefited from more-accurate flow measurements and substantial reductions in inflow and infiltration (I&I) into the collection system due to an aggressive source-identification program.

5.1.1 Overall Performance

Irrespective of comparisons with historical performance, the average wastewater characteristics measured over the last five years demonstrated that the treatment process was routinely and substantially exceeding expectations based on the original plant design, the NPDES discharge permit, and federal regulatory standards. For example, in 2008 the average suspended-solids removal rate was 19% above the permitted minimum, and the average BOD removal rate was nearly three times the minimum permitted rate of 30%. The treatment process was so efficient that average effluent TSS and BOD concentrations during every month in 2008 remained well under the 60-mg/L threshold below which removal rate requirements are not even imposed on the discharge. Moreover, the plant routinely achieved treatment levels that exceeded the requirements for full secondary treatment. For example, monthly solids-removal rates substantially surpassed the 85% full secondary criterion throughout 2008, while BOD removal rates achieved full secondary levels in all but one month, when it was 0.7% below the standard. However, BOD loading from wastewater discharges to the open ocean is of negligible concern, so the MBCSD discharge effectively met secondary treatment requirements for all of 2008. Other effluent constituents were also correspondingly low during 2008. 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

Year	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		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
2007	1.09	381	20.9	94.1	31	330	44.4	86.0	68
2008	1.10	337	20.0	94.1	30	331	38.4	88.3	58
Average	1.42	334	33.5	89.1	66	272	51.8	80.3	100
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
2007	52	4.0	92.4	6	27	7.6	1.4 ¹	4.36	28
2008	84	4.4	94.8	7	30	7.5	1.4 ¹	5.56	27
Average	50	5.8	87.4	11	37	7.5	1.0	6.44	24
Limitation		25.0			75	6-9	1.5³	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. Flow through the plant during 2008 (1.10 MGD) was comparable with the four lowest annual flows on record, which all occurred in the previous five years. Although some of this flow reduction was an artifact of improvements in the accuracy of flow measurements instituted in 2002, during 2008 approximately 120 million gallons less flowed through the plant than the average annual throughput measured over the entire course of the monitoring program.

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 decreased the amount of relatively clean rain and groundwater that is unnecessarily treated at the WWTP. These I&I reductions decreased the total volume of flow processed by the plant, thereby increasing the proportion sewage that is treated by the plant.

5.1.2 Influential Events

Along with the high overall performance of the treatment process during 2008, there were only ten isolated instances of noticeable short-term changes in wastewater parameters. As in past years, these anomalous measurements were all related to specific events during the year. These slightly atypical wastewater measurements were few in number and did not occur randomly; this demonstrates the overall effectiveness of the treatment process and the high degree of control exercised by plant personnel. Three events were related to equipment; the others were related to short-term flow increases from rainwater inflow and population increases in the service area during holiday periods. One of the events occurred when plant personnel identified an anomalous pH increase within the influent stream and located the source as a malfunctioning pH-neutralization system at Mission Linen that pretreats the discharge to the collection system, which was quickly repaired. A second event was related to the unexpected failure of pumps within the influent channel. Quick response by plant personnel limited impacts to the treatment process. The third equipment-related event arose from necessary repairs to the trickling filters that caused a minor decline in the efficacy of the secondary process over several weeks. The absence of major impacts to the treatment process in 2008 was the direct result of a vigilant and proactive program of preventative maintenance, wherein plant personnel actively seek out and correct potential mechanical impairment of treatment-plant components and respond quickly to the inevitable failures that occasionally occur.

Since monitoring began in 1986, three major influences have identifiably affected reported plant flow, overttotalization, I&I, and short-term population increases in the service area. Historically, the most influential factor was the artificially increased flow from overttotalization. Overttotalization was particularly significant prior to 2002, when only the effluent flow meter reported flow rates. This meter consistently overestimated flow by as much as 25%. Without overttotalization, average flow over the 23 year record would be closer to 1.2 MGD rather than the reported 1.42 MGD. Because of overestimated flow 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 66 MT was actually closer to 54 MT. Similarly, the average annual BOD emission reported at 100 MT was, in reality, closer to 84 MT, and the reported 11 MT of O&G discharged on average was closer to 10 MT.

In 2002, overttotalization was largely eliminated after the more accurate influent flow meter was commissioned, and reported flow began to be based on its measurements. However, flow is still occasionally overttotalized due to aberrant influent flow readings 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 overttotalization. Reasonably accurate flow estimates from the effluent flow meter were determined based on an adjustment determined in the flow-meter intercomparison study conducted in 2002. During 2008, the corrected effluent flow totals were only used in place of influent readings once.

The second type of event that identifiably increases flow rates is I&I. I&I comprised at least 14.8% of the flow measured during 2008. Brief but noticeable increases in the plant flow directly correlated with rainstorms. Approximately 510,000 gallons of rainwater flowed into the collection system for every inch of rain that fell during 2008. This inflow rate was somewhat less than those determined in prior years when total rainfall amounts were substantially higher. Over longer periods, infiltration of groundwater into the collection system observably increased plant throughput. Compared to the brief inflow events from rainstorms, groundwater infiltration contributes a much greater cumulative volume of water to the collection system.

Significant I&I contributions during the dry season (April through September) give the mistaken impression that the treatment plant was operating at approximately 54% of its dry-weather design capacity in 2008. 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 a minimal amount of I&I contributions, the contribution of pure sewage constituted less than 50% of the plant's design capacity during the 2008 dry season.

The third type of event noticeably affecting plant flow arises from large population fluctuations within the service area. 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. Short-term population increases on weekends and holidays also accounted for approximately 8.3% of the total flow through the treatment plant during 2008. In comparison, longer-term population increases over the summer tourist season accounted for 2.2% of the annual flow. Baseline flow through the treatment plant, without the additional flow contributed by tourisms and identifiable I&I fluctuations, represented 74.7% of the total flow measured during 2008.

5.1.3 Effluent Contaminants

The treatment process was primarily designed to remove organic particulates from the wastewater stream and disinfect effluent. It was not designed to eliminate the majority of chemical contaminants dissolved in wastewater. Instead, a vigorous pollution-prevention program limits 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. Domestic users generate more than 90% of the sewage processed at the WWTP; non-industrial users or light industry, which generate wastewater similar to that of domestic sources but on a larger scale, contribute the remaining portion of the WWTP's influent. Without 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 appear in low concentrations within effluent and biosolid samples collected during 2008. Of the 165 chemical compounds tested in semi-annual effluent samples, only nine were present in quantifiable amounts. The measured concentrations of these compounds were all well below applicable NPDES discharge limits. In most cases, the concentrations were orders of magnitude lower than their respective limits. The associated mass emissions were also well below the limits identified in the discharge permit.

Quantified compounds included three trace metals (copper, lead, and zinc), cyanide, a nonchlorinated phenolic compound, a halomethane, xylene, and a common phthalate compound. The ever-present ammonia and radionuclides were also quantified in the 2008 effluent samples. Because of its sewage origin, ammonia regularly occurs in wastewater. Additionally, some level of radioactivity in effluent samples is expected because of naturally occurring radionuclides. Nonetheless, radiation levels were still well within limits established for drinking water standards and similar to historical levels. Similarly, trace metals also 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. The other compounds have also been occasionally detected within effluent samples and do not indicate a new or elevated source within the collection system.

As with effluent samples, chemical analyses of biosolid samples quantified only very low concentrations of some commonly occurring wastewater constituents. In addition to the bulk organic compounds, the only constituents with quantifiable concentrations included 17 ubiquitous trace metals, cyanide, and the

same common phthalate found in effluent. All measured concentrations were low and well below regulatory limits that would make the biosolids hazardous or unsuitable for composting and land application. Because of the high quality of the biosolids and implementation of windrow composting allowed the plant to make the final product available to the public for beneficial reuse as a high-quality soil amendment.

Largely because of low contaminant concentrations in effluent, bioassays conducted over the past decade consistently demonstrate the MBCSD effluent's low toxicity to marine organisms. The chronic bioassays conducted in 2008 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 2008. Although all toxicity measurements in 2008 were less than 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 2008 and in other recent 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 (COP) as specified in the NPDES discharge permit. Extremely sensitive electronic probes provided a detailed picture of water quality during the four surveys conducted in 2008. Precise navigation and high-resolution data on light transmittance, density, temperature, salinity, pH, and dissolved oxygen assessed 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, generated by the upward displacement of ambient seawater and not the presence of wastewater constituents, or they were insignificant compared to the larger ambient variations from natural oceanographic processes. Several of these plume measurements captured the signature of wastewater while it was undergoing rapid initial mixing within as little as 1 m from the outfall. Dilution rates determined from these close-in measurements were compared with expected critical initial dilution ratios based on modeling during the outfall design. They demonstrated that the diffuser structure had dispersed the wastewater to a much greater extent than predicted by the modeling.

Because tests for compliance with the receiving-water limitations in the discharge permit only apply outside the ZID, these close-in measurements were not subject to the standards in the COP. Nevertheless, most of the plume observations collected within the ZID were 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 2008 surveys confirmed that the diffuser was operating efficiently and that wastewater was diluted by more than a 120-fold 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 23 years. 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, the abundance of the Pacific sand dollar (*Dendraster excentricus*) greatly increased 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 fluctuations known as El Niños. 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 more than 157,000 specimens collected over 23 years of benthic monitoring. None of these parameters exhibited statistically significant spatial distributions related to the effluent discharge or long-term spatiotemporal trends indicative of an increasingly degraded benthic habitat near the outfall. Not only were the spatial differences in 2008 small compared to inherent sampling variability, but seasonal and interannual changes in community structure from natural environmental oscillations, such as El Niño, were overwhelmingly larger. 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 collected near the outfall since benthic monitoring began in 1986. None of these properties exhibited a relationship to the discharge in 2008, although the analyses did reveal a slight, but statistically significant, increase in some of the bulk sediment chemical concentrations. These long-term 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 within 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 with 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 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 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 adversely affected by wastewater discharge, the MBCSD regularly samples the surfzone for coliform bacteria. Over the years, this surfzone monitoring detected many elevated levels of indigenous and enteric bacteria. However, these measurements of elevated bacteria are unrelated to effluent discharged from the treatment plant. The plant disinfects all wastewater before it is discharged. Consequently, elevated coliform densities in surfzone samples are 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, resulting in seawater concentrations that are less than 0.75% of the original contaminant concentrations within the effluent. These low level concentrations occur within 15 m of the discharge. There is little likelihood that effluent impinges on the adjacent shoreline 0.5 miles 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 collected close to the outfall in 2003 and 2004 have been tested for a broad suite of bacterial pathogens; none were detected.

Instead, decades of monitoring have clearly demonstrated that non-point sources of microbial contamination have been responsible for the occasionally elevated surfzone bacteria. Terrestrial, non-point-source bacterial contamination from runoff is a recognized problem along the coast of central and southern California because infrequent rain allows contaminants to build up during long dry spells. Non-point bacterial sources on the beach increase surfzone coliform levels when high surf entrains fecal material from seabirds and other animals 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 outflow. Other areas of the beach seldom show elevated coliform levels, except during rainstorms 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 23 years 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 2008. 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.

Most of the recommendations in recent reports dealt with potential improvements to the monitoring program rather than with improvements to plant performance. The efficacy of the treatment process reached all-time highs for the past five years, and this was particularly true in 2008. Consequently, only one recommendation pertaining to plant performance is provided here. Furthermore, many recommendations for improving the monitoring program in recent reports have been adopted in the new NPDES discharge permit, effective in March 2009. Analysis of 2008 monitoring data further strengthens and confirms the veracity of these previous recommendations. Monitoring changes in the new permit based on previous analyses and recommendations are as follows:

- Elimination of acute-toxicity bioassays because they no longer accurately reflect the actual toxicity of the MBCSD effluent because changes in protocols caused results confounded by ammonia toxicity;
- Reduction in the frequency of effluent chemical analyses because concentrations measured over the last two decades have been consistently well below discharge limits;

- Revisions to the benthic sampling program that eliminate sampling at Stations 1, 8, and 9, increase grab sampling at the remaining stations, and reduce chemical analyses for synthetic organic compounds that have never been detected in benthic sediments;
- Elimination of sulfide analysis within benthic porewater samples because its absence in six years of high-resolution analyses has demonstrated that the sediments do not contain measureable levels;
- Revisions to the water-column sampling program that reduce the number of vertical CTD casts in lieu of a towed-CTD survey capable of higher-resolution delineation of the discharge plume;
- Explicit clarification that water-quality limits only apply to wastewater constituents and not anomalies generated as a result of the upward displacement of ambient bottom water; and
- Elimination of surfzone monitoring except when effluent coliform exceeds permit limits.

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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	Parameter	Quantity
Waste Loading		Tank 1	2.74
Flow (MGD)		Tank 2	2.74
Average dry-weather flow	2.06	Surface loading rate PSDWF (10 ³ L/m ² /day)	29.74
PSDWF	2.36	Detention time at PWWF (hr.)	2.2
Peak dry-weather flow	6.64	Total Treatment	
PWWF	6.60	Overall treatment efficiencies (%)	
Strength		BOD ₅	57
BOD ₅ (mg/L)	280	Suspended solids	75
Suspended solids (mg/L)	280	Expected effluent quality (mg/L)	
Grit (ft ³ /mg)	10	BOD ₅	120
Waste quantities at PSDWF		Suspended solids	70
BOD ₅ (mt/day)	2.5	Solids stabilization	
Suspended Solids (mt/day)	2.5	Anaerobic digester loading (mt/day)	
Grit (ft ³ /day)	23.6	Primary solids	1.6
Preliminary Treatment		Secondary solids	0.4
Mechanically cleaned bar screen		Assumed sludge volatile content (%)	
Number	1	Primary solids	70
Capacity (MGD)	8.2	Secondary solids	82
Channel Monster		Sludge volume (m ³ /day)	50.7
Number	1	Digester 1 (existing, fixed cover)	
Capacity (MGD)	7.0	Diameter (m)	12.2
Influent pumps (variable speed)		Side water depth (m)	4.9
Number	3	Volume (m ³)	629
Capacity each (MGD)	3.3	Digester 2 (existing, fixed cover)	
Total head (m)	9.6	Diameter (m)	12.2
Aerated grit removal tanks		Side water depth (m)	5.8
Number	1	Volume (m ³)	725
Length (m)	9.1	Digester 3 (new, floating cover)	
Width (m)	4.9	Diameter (m)	10.7
Depth (m)	2.4	Side water depth (m)	6.9
Detention time at PWWF (min)	6.3	Volume (m ³)	646
Grit Pumps		Hydraulic detention time based on net volume of digesters 2 and 3 (days)	23
Number	2	Assumed volatile solids reduction (%)	55
Capacity (gpm)	250	Expected sludge gas production (m ³ /day)	804
Primary Treatment			
Sedimentation tanks			
Number	2		
Diameter (m)			
Tank 1	15.2		
Tank 2	12.2		
Average side water depth (m)			

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

Parameter	Quantity
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
Effluent and Biosolids Chemistry

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APPENDIX B

Analytical Results for Effluent and Biosolid Samples Collected during 2008

Table B.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	410.4 370.5	403.6 340.2	NA	NA
Acute Toxicity (quarterly): <i>Pimephales promelas</i>	TUa	EPA-821-R-02-012	1.5	1.41 ^e 1.41 ^e	1.41 ^e 1.46 ^e	NA	NA
Methyl tert-butyl ether (MTBE)	µg/L (ppb)	624	NA	<0.13 ^f	<0.13	<0.198	NA
Asbestos (>10 µm & Total)	MFL	100.2	NA	— ^g	<0.19	NA	NA
Acenaphthene	µg/L (ppb)	625	NA	<0.48	<0.48	<0.7	NA
Aniline	µg/L (ppb)	625	NA	<0.46	<0.46	<0.7	NA
Benzoic Acid	µg/L (ppb)	625	NA	<6.1	<6.1	<9.3	NA
Benzyl Alcohol	µg/L (ppb)	625	NA	<0.67	<0.67	<1.0	NA
Butylbenzyl Phthalate	µg/L (ppb)	625	NA	<0.59	<0.59	<0.9	NA
4-Bromophenyl phenyl ether	µg/L (ppb)	625	NA	<0.69	<0.69	<1.1	NA
4-Chloroaniline	µg/L (ppb)	625	NA	<0.87	<0.87	<1.3	NA
2-Chloronaphthalene	µg/L (ppb)	625	NA	<0.5	<0.5	<0.8	NA
4-Chlorophenyl phenyl ether	µg/L (ppb)	625	NA	<0.68	<0.68	<1.0	NA
2,6-Dinitrotoluene	µg/L (ppb)	625	NA	<0.74	<0.74	<1.1	NA
Di-n-octylphthalate	µg/L (ppb)	625	NA	<0.85	<0.85	<1.3	NA
Endrin Aldehyde	µg/L (ppb)	608	NA	<0.0022	<0.016	<0.0136	NA
2-Methylnaphthalene	µg/L (ppb)	625	NA	<0.51	<0.51	<0.8	NA
Naphthalene	µg/L (ppb)	625	NA	<0.62	<0.62	<0.9	NA
2-Naphthylamine	µg/L (ppb)	625	NA	<6.5	<6.5	<9.9	NA
2-Nitroaniline	µg/L (ppb)	625	NA	<0.8	<0.8	<1.2	NA
3-Nitroaniline	µg/L (ppb)	625	NA	<0.82	<0.82	<1.3	NA
4-Nitroaniline	µg/L (ppb)	625	NA	<1.1	<1.1	<1.7	NA
N-Nitrosodi-n-propylamine	µg/L (ppb)	625	NA	<0.59	<0.59	<0.9	NA
1,2,4-Trichlorobenzene	µg/L (ppb)	625	NA	<0.67	<0.67	<1.0	NA
4-Chloro-3-methylphenol	µg/L (ppb)	625	NA	<0.67	<0.67	<1.0	NA
2-Chlorophenol	µg/L (ppb)	625	NA	<0.65	<0.65	<1.0	NA
2,4-Dichlorophenol	µg/L (ppb)	625	NA	<0.6	<0.6	<0.9	NA
2,4-Dimethylphenol	µg/L (ppb)	625	NA	<0.52	<0.52	<0.8	NA
2-Methylphenol	µg/L (ppb)	625	NA	<0.57	<0.57	<0.9	NA

^a Sampling statistic associated with lowest permitted limit, viz. either six-month median or 30-day average

^b Chemical samples were collected on 9 January 2008, the chronic bioassay sample was collected on 8 January 2008, and four daily acute bioassay samples were collected from 7 January through 10 January 2008 and another four were collected from 7 April through 10 April 2008.

^c The chemical composite sample was collected on 2 July 2008, the grab samples was collected on 15 July 2008, the chronic bioassay sample was collected on 14 July 2008, and four daily acute bioassay samples were collected from 14 July through 17 July 2008 and another four were collected from 20 October through 23 October 2008.

^d Not applicable or not specified in NPDES discharge permit

^e Test results were artificially elevated by ammonia interference

^f The “less-than” symbol “<” indicates the substance was not detected above the Method Detection Limit (MDL) listed after the “<” symbol

^g Analysis not required

Table B.1 Effluent Monitoring Results

Constituent	Units	Method	Concentration			Mass Emission	
			Permit Limit ^a	January-June ^b	July-December ^c	Loading (kg)	Goal (kg/yr)
3&4 Methylphenol	µg/L (ppb)	625	NA	<0.83	≈1.8 ^h	<2.0	NA
2-Nitrophenol	µg/L (ppb)	625	NA	<0.42	<0.42	<0.6	NA
4-Nitrophenol	µg/L (ppb)	625	NA	<1.7	<1.7	<2.6	NA
Pentachlorophenol	µg/L (ppb)	625	NA	<0.45	<0.45	<0.7	NA
Phenol	µg/L (ppb)	625	NA	<0.37	<0.37	<0.6	NA
2,4,5-Trichlorophenol	µg/L (ppb)	625	NA	<0.93	<0.93	<1.4	NA
Chloroethane	µg/L (ppb)	624	NA	<0.12	<0.12	<0.183	NA
1,1-Dichloroethane	µg/L (ppb)	624	NA	<0.11	<0.11	<0.168	NA
trans-1,2-Dichloroethene	µg/L (ppb)	624	NA	<0.14	<0.14	<0.213	NA
1,2-Dichloropropane	µg/L (ppb)	624	NA	<0.12	<0.12	<0.183	NA
Trichlorofluoromethane	µg/L (ppb)	624	NA	<0.14	<0.14	<0.213	NA
Total Xylenes	µg/L (ppb)	624	NA	0.79	≈ 0.47	≈ 0.97	NA
Methoxychlor	µg/L (ppb)	608	NA	<0.0036	<0.0055	<0.0069	NA
Azinphos Methyl	µg/L (ppb)	8140	NA	—	<0.055	<0.084	NA
Bolstar	µg/L (ppb)	8140	NA	—	<0.055	<0.084	NA
Chlorpyrifos	µg/L (ppb)	8140	NA	—	<0.024	<0.037	NA
Coumaphos	µg/L (ppb)	8140	NA	—	<0.054	<0.082	NA
Demeton	µg/L (ppb)	8140	NA	—	<0.026	<0.040	NA
Diazinon	µg/L (ppb)	8140	NA	—	<0.044	<0.067	NA
Dichlorvos	µg/L (ppb)	8140	NA	—	<0.07	<0.107	NA
Disulfoton	µg/L (ppb)	8140	NA	—	<0.039	<0.059	NA
Ethoprop	µg/L (ppb)	8140	NA	—	<0.025	<0.038	NA
Fensulfothion	µg/L (ppb)	8140	NA	—	<0.088	<0.134	NA
Fenthion	µg/L (ppb)	8140	NA	—	<0.033	<0.050	NA
Merphos	µg/L (ppb)	8140	NA	—	<0.058	<0.088	NA
Mevinphos	µg/L (ppb)	8140	NA	—	<0.053	<0.081	NA
Naled (Dibrom)	µg/L (ppb)	8140	NA	—	<0.072	<0.110	NA
Parathion Methyl	µg/L (ppb)	8140	NA	—	<0.074	<0.113	NA
Phorate	µg/L (ppb)	8140	NA	—	<0.041	<0.063	NA
Ronnel	µg/L (ppb)	8140	NA	—	<0.067	<0.102	NA
Stirophos	µg/L (ppb)	8140	NA	—	<0.046	<0.070	NA
Tokuthion	µg/L (ppb)	8140	NA	—	<0.032	<0.049	NA
Trichloronate	µg/L (ppb)	8140	NA	—	<0.038	<0.058	NA
Objectives for the Protection of Marine Aquatic Life							
Arsenic	µg/L (ppb)	200.8	670	≈1.2	<0.82	<1.55	17
Cadmium	µg/L (ppb)	6010/200.7	130	<3.3	<1.4	<3.6	88
Chromium (Hexavalent) ⁱ	µg/L (ppb)	6010/200.7	270	≈1.1	<2.3	<2.6	93
Copper	µg/L (ppb)	6010/200.7	140	16	14	22.9	690
Lead	µg/L (ppb)	200.8	270	2.1	1.1	2.46	465
Mercury	µg/L (ppb)	7470/245.1	5	≈ 0.025	<0.016	<0.031	1.4
Nickel	µg/L (ppb)	6010/200.7	670	≈ 4.7	≈ 5.0	≈ 7.4	142
Selenium	µg/L (ppb)	200.8	2010	≈ 0.91	≈ 1.8	≈ 2.05	65
Silver	µg/L (ppb)	6010/200.7	70	<9.4	<2.5	<9.20	28
Zinc	µg/L (ppb)	6010/200.7	1620	60.	58.	90.0	244
Cyanide, Total	µg/L (ppb)	335.3	130	<3.2	5.8	<6.8	57
Total Residual Chlorine ^j	µg/L (ppb)		270				

^h The “approximately-equal-to” symbol “≈” indicates the substance was detected above the MDL but could not be accurately quantified because it was below the PQL

ⁱ Measured as total chromium

^j Daily measurements are discussed in Chapter 2 of this report

Table B.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	20 23 28 34 22 22	29 28 24 41 27 30	NA	NA
Nonchlorinated Phenolics	µg/L (ppb)	625	4020	<0.37	4.9	<3.9	NA
Chlorinated Phenolics	µg/L (ppb)	625	130	<0.43	<0.43	<0.7	NA
Endosulfan	µg/L (ppb)	608	1.21	<0.0016	<0.007	<6.46E-3	3
Endrin	µg/L (ppb)	608	0.27	<0.0022	<0.0041	<4.77E-3	1
HCH	µg/L (ppb)	608	0.54	<0.0009	<0.0047	<0.0042	228
Toxicity-Chronic: <i>M. pyrifera</i> germination	TUc	CSWRCB	134	5.56	5.56	NA	NA
Toxicity-Chronic: <i>M. pyrifera</i> growth	TUc	CSWRCB	134	5.56	5.56	NA	NA
Radioactivity Gross α	pCi/L	7110C	15 ^k	—	0.448 ± 0.562	NA	NA
Radioactivity Gross β	pCi/L	900.0	50 ^k	—	12. ± 0.52	NA	NA
Objectives for the Protection of Human Health: Noncarcinogens							
Acrolein	µg/L (ppb)	624	29500	<3.7	<3.7	<5.6	NA
Antimony	µg/L (ppb)	6010/200.7	160800	<16	<14	<22.9	285
bis(2-chloroethoxy) methane	µg/L (ppb)	625	590	<0.58	<0.58	<0.9	142
bis(2-chloro-1-methylethyl) ether	µg/L (ppb)	625	160800	<0.73	<0.73	<1.1	NA
Chlorobenzene	µg/L (ppb)	624	76400	<0.11	<0.11	<0.168	NA
Chromium III ^l	mg/L (ppm)	6010/200.7	25500	≈1.1	<2.3	<2.6	NA
Di-n-butyl phthalate	µg/L (ppb)	625	469000	<0.74	<0.74	<1.1	142
Dichlorobenzene	µg/L (ppb)	624	683000	<0.13	<0.13	<0.198	5.7
1,1-Dichloroethene	µg/L (ppb)	624	951000	<0.12	<0.12	<0.183	3
Diethyl phthalate	µg/L (ppb)	625	4420000	<0.85	<0.85	<1.3	191
Dimethyl phthalate	mg/L (ppb)	625	109900	<0.55	<0.55	<0.8	142
2-Methyl-4,6-dinitrophenol	µg/L (ppb)	625	29500	<2.2	<2.2	<3.4	142
2,4-Dinitrophenol	µg/L (ppb)	625	540	<2.4	<2.4	<3.7	342
Ethylbenzene	µg/L (ppb)	624	549000	<0.13	<0.13	<0.198	3
Fluoranthene	µg/L (ppb)	625	2000	<0.7	<0.7	<1.1	142
Hexachlorocyclopentadiene	µg/L (ppb)	625	7800	<0.26	<0.26	<0.4	NA
Isophorone	µg/L (ppb)	625	2010000	<0.51	<0.51	<0.8	142
Nitrobenzene	µg/L (ppb)	625	660	<0.55	<0.55	<0.8	142
Thallium	µg/L (ppb)	200.8	1880	<0.016	<0.054	<0.05	285
Toluene	µg/L (ppb)	624	11400000	≈0.24	≈0.27	≈0.388	4
1,1,2,2-Tetrachloroethane	µg/L (ppb)	624	160800	<0.22	<0.22	<0.335	3
Tributyltin ^l	µg/L (ppb)	—	0.19	—	—	—	NA
1,1,1-Trichloroethane	µg/L (ppb)	624	7240000	<0.27	<0.27	<0.412	3
1,1,2-Trichloroethane	µg/L (ppb)	624	5760000	<0.12	<0.12	<0.183	3
Objectives for the Protection of Human Health: Carcinogens							
Acrylonitrile	µg/L (ppb)	624	13.4	<2	<2	<3.0	NA
Aldrin	µg/L (ppb)	608	0.003	<0.0014	<0.0065	<5.93E-3	0.01 ^m
Benzene	µg/L (ppb)	624	790	<0.12	<0.12	<0.183	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 B.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	<4.7	<4.7	<7.0 ⁿ	0.03 ^m
Beryllium	µg/L (ppb)	200.7/6010	4.42	<0.72	<1.1	<1.4	28 ^m
bis-(2-chloroethyl) ether	µg/L (ppb)	625	6.03	<0.52	<0.52	<0.8	17 ^m
bis-(2-ethylhexyl) phthalate	µg/L (ppb)	625	470	12	18	22.8	320
Carbon Tetrachloride	µg/L (ppb)	624	120	<0.089	<0.089	<0.136	3
Chlordane	µg/L (ppb)	608	0.0031	<0.38	<1.9	<1.710 ⁿ	0.0088 ^m
Chloroform	µg/L (ppb)	624	17400	0.93	1.0	1.47	5
DDT	µg/L (ppb)	608	0.0228	<0.0015	<0.0038	<4.001E-3	0.06
1,4-Dichlorobenzene	µg/L (ppb)	624	2410	≈ 0.16	≈ 0.43	≈ 0.445	57
3,3-Dichlorobenzidine	µg/L (ppb)	625	1.09	<0.88	<0.88	<1.3	3.1 ^m
1,2-Dichloroethane	µg/L (ppb)	624	17400	<0.098	<0.098	<0.149	3
Methylene chloride	µg/L (ppb)	624	60300	≈ 0.19	<0.16	<0.27	NA
1,3-Dichloropropene	µg/L (ppb)	624	1190	<0.086	<0.086	<0.131	NA
Dieldrin	µg/L (ppb)	608	0.0054	<0.0021	<0.006	<6.10E-3	0.02 ^m
2,4-Dinitrotoluene	µg/L (ppb)	625	350	<0.99	<0.99	<1.5	142
1,2-Diphenylhydrazine	µg/L (ppb)	625	21	<0.7	<0.7	<1.1	60 ^m
Halomethanes	µg/L (ppb)	624	17400	≈ 0.13	<0.12	<0.2	25
Heptachlor	µg/L (ppb)	608	0.0965	<0.0044	<0.006	<7.90E-3	0.27 ^m
Hexachlorobenzene	µg/L (ppb)	625	0.0281	<0.71	<0.71	<1.1 ⁿ	0.08 ^m
Hexachlorobutadiene	µg/L (ppb)	625	1880	<0.59	<0.59	<0.9	142
Hexachloroethane	µg/L (ppb)	625	340	<0.52	<0.52	<0.8	142
N-Nitrosodimethylamine	µg/L (ppb)	625	980	<0.45	<0.45	<0.7	342
N-Nitrosodiphenylamine	µg/L (ppb)	625	340	<0.8	<0.8	<1.2	142
PAHs	µg/L (ppb)	625	1.18	<0.52	<0.52	<0.8	3.4 ^m
PCBs	µg/L (ppb)	608	0.0026	<0.1	<0.5	<0.450 ⁿ	0.0073 ^m
Dibenzofuran	µg/L (ppb)	625	NA	<0.81	<0.81	<1.2	57
Dioxin (Total TCDD)	pg/L	8280	0.52	—	<22.2	<9.15E-6 ⁿ	1.42E-06 ^m
Tetrachloroethene	µg/L (ppb)	624	13300	<0.11	<0.11	<0.168	4
Toxaphene	µg/L (ppb)	608	0.0281	<0.42	<2.1	<1.89 ⁿ	0.08 ^m
Trichloroethene (TCE)	µg/L (ppb)	624	3620	<0.13	<0.13	<0.198	3
2,4,6-Trichlorophenol	µg/L (ppb)	625	40	<0.43	<0.43	<0.7	114 ^m
Vinyl chloride	µg/L (ppb)	624	4820	<0.14	<0.14	<0.213	3

ⁿ Comparison of loading and emission goal is indeterminate because the maximum loading computed from MDL exceeds the emission goal

Table B.2 Biosolids Monitoring Results

Constituent	Units ^o	Method Number	Concentration ^p
Percent Solids	%	SM-2540G	87.7
Oil and Grease	mg/Kg (ppm)	1664HEM	54,000
Inorganic Parameters			
pH	pH units	9045	6.43
Cyanide, Total	mg/Kg (ppm)	9012	3.5
Nitrogen as NO ₃	mg/Kg (ppm)	300.0	2,400
Nitrogen, Total Kjeldahl (TKN)	mg/Kg (ppm)	351.2	29,000
Ammonia as N	mg/Kg (ppm)	350.1	5,600
Organic Nitrogen ^q	mg/Kg (ppm)	—	23,400
Phosphate, Total	mg/Kg (ppm)	365.4	79,000
Total Dissolved Solids STLC ^r	mg/L (ppm)	160.1	5,600
Metals			
Antimony	mg/Kg (ppm)	6010B	<0.8
Arsenic	mg/Kg (ppm)	6010B	4
Barium	mg/Kg (ppm)	6010B	400
Beryllium	mg/Kg (ppm)	6010B	≈0.16
Boron	mg/Kg (ppm)	6010B	12
Cadmium	mg/Kg (ppm)	6010B	3.5
Chromium	mg/Kg (ppm)	6010B	46
Hexavalent Chromium	mg/L (ppm)	7199	≈0.79
Cobalt	mg/Kg (ppm)	6010B	4.7
Copper	mg/Kg (ppm)	6010B	470
Copper STLC Waste Extraction	mg/L (ppm)	6010BSTLC	10
Lead	mg/Kg (ppm)	6010B	45
Lead STLC Waste Extraction	mg/L (ppm)	6010BSTLC	0.78
Mercury	mg/Kg (ppm)	7471	1.2
Molybdenum	mg/Kg (ppm)	6010B	20
Nickel	mg/Kg (ppm)	6010B	36
Selenium	mg/Kg (ppm)	6010B	7.8
Silver	mg/Kg (ppm)	6010B	3.6
Thallium	mg/Kg (ppm)	6010B	≈2.1
Vanadium	mg/Kg (ppm)	6010B	25
Zinc	mg/Kg (ppm)	6010B	1,100
Organochlorine Pesticides and PCBs			
Aldrin	mg/Kg (ppm)	8080	<0.00075
Alpha-BHC	mg/Kg (ppm)	8080	<0.004
Beta-BHC	mg/Kg (ppm)	8080	<0.011
Gamma-Chlordane	mg/Kg (ppm)	8080	<0.43
4,4'-DDD	mg/Kg (ppm)	8080	<0.0018
4,4'-DDE	mg/Kg (ppm)	8080	<0.0013
4,4'-DDT	mg/Kg (ppm)	8080	<0.00089
Delta-BHC	mg/Kg (ppm)	8080	<0.0022
Dieldrin	mg/Kg (ppm)	8080	<0.00092

^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

Table B.2 Biosolids Monitoring Results

Constituent	Units^o	Method Number	Concentration^p
Endosulfan I	mg/Kg (ppm)	8080	<0.0025
Endosulfan II	mg/Kg (ppm)	8080	<0.0019
Endosulfan Sulfate	mg/Kg (ppm)	8080	<0.0038
Endrin	mg/Kg (ppm)	8080	<0.001
Endrin Aldehyde	mg/Kg (ppm)	8080	<0.0018
Gamma-BHC (Lindane)	mg/Kg (ppm)	8080	<0.0072
Heptachlor	mg/Kg (ppm)	8080	<0.0075
Heptachlor Epoxide	mg/Kg (ppm)	8080	<0.0043
Methoxychlor	mg/Kg (ppm)	8080	<0.0038
Toxaphene	mg/Kg (ppm)	8080	<0.21
PCB-1016	mg/Kg (ppm)	8080	<0.078
PCB-1221	mg/Kg (ppm)	8080	<0.14
PCB-1232	mg/Kg (ppm)	8080	<0.035
PCB-1242	mg/Kg (ppm)	8080	<0.047
PCB-1248	mg/Kg (ppm)	8080	<0.035
PCB-1254	mg/Kg (ppm)	8080	<0.022
PCB-1260	mg/Kg (ppm)	8080	<0.063
Organophosphorus Pesticides			
Azinphos methyl	mg/Kg (ppm)	8140	<0.0056
Bolstar	mg/Kg (ppm)	8140	≈0.015
Chlorpyrifos	mg/Kg (ppm)	8140	<0.0024
Coumaphos	mg/Kg (ppm)	8140	<0.0065
Demeton O/S	mg/Kg (ppm)	8140	≈0.019
Diazinon	mg/Kg (ppm)	8140	<0.0018
Dichlorvos	mg/Kg (ppm)	8140	<0.018
Disulfoton	mg/Kg (ppm)	8140	≈0.018
Ethoprop	mg/Kg (ppm)	8140	<0.0024
Fensulfthion	mg/Kg (ppm)	8140	<0.016
Fenthion	mg/Kg (ppm)	8140	<0.003
Merphos	mg/Kg (ppm)	8140	<0.0033
Mevinphos	mg/Kg (ppm)	8140	<0.0042
Naled	mg/Kg (ppm)	8140	<0.005
Methyl parathion	mg/Kg (ppm)	8140	<0.0062
Phorate	mg/Kg (ppm)	8140	<0.0018
Ronnel (Fenchlorphos)	mg/Kg (ppm)	8140	<0.0048
Stirophos (Tetrachlorvinphos)	mg/Kg (ppm)	8140	<0.0074
Tokuthion (Prothiofos)	mg/Kg (ppm)	8140	<0.003
Trichloronate	mg/Kg (ppm)	8140	<0.0033
Volatile Organic Compounds			
Benzene	mg/Kg (ppm)	8240	<0.013
Bromodichloromethane	mg/Kg (ppm)	8240	<0.0076
Bromoform	mg/Kg (ppm)	8240	<0.0085
Bromomethane	mg/Kg (ppm)	8240	<0.015
Carbon tetrachloride	mg/Kg (ppm)	8240	<0.013
Chlorobenzene	mg/Kg (ppm)	8240	<0.008
Chloroethane	mg/Kg (ppm)	8240	<0.014
Chloroform	mg/Kg (ppm)	8240	<0.012
Chloromethane	mg/Kg (ppm)	8240	<0.0087
Dibromochloromethane	mg/Kg (ppm)	8240	<0.0062
1,2-Dichlorobenzene	mg/Kg (ppm)	8240	<0.012

Table B.2 Biosolids Monitoring Results

Constituent	Units ^o	Method Number	Concentration ^p
1,3-Dichlorobenzene	mg/Kg (ppm)	8240	<0.0089
1,4-Dichlorobenzene	mg/Kg (ppm)	8240	<0.011
1,1-Dichloroethane	mg/Kg (ppm)	8240	<0.013
1,2-Dichloroethane	mg/Kg (ppm)	8240	<0.011
1,1-Dichloroethene	mg/Kg (ppm)	8240	<0.014
trans-1,2-Dichloroethene	mg/Kg (ppm)	8240	<0.011
1,2-Dichloropropane	mg/Kg (ppm)	8240	<0.013
cis-1,3-Dichloropropene	mg/Kg (ppm)	8240	<0.0065
trans-1,3-Dichloropropene	mg/Kg (ppm)	8240	<0.0089
Ethylbenzene	mg/Kg (ppm)	8240	<0.014
Methylene chloride	mg/Kg (ppm)	8240	<0.025
1,1,2,2-Tetrachloroethane	mg/Kg (ppm)	8240	<0.0092
Tetrachloroethene	mg/Kg (ppm)	8240	<0.013
Toluene	mg/Kg (ppm)	8240	<0.013
1,1,1-Trichloroethane	mg/Kg (ppm)	8240	<0.013
1,1,2-Trichloroethane	mg/Kg (ppm)	8240	<0.012
Trichloroethene	mg/Kg (ppm)	8240	<0.013
Trichlorofluoromethane	mg/Kg (ppm)	8240	<0.0081
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/Kg (ppm)	8240	<0.014
Vinyl chloride	mg/Kg (ppm)	8240	<0.011
Total Xylenes	mg/Kg (ppm)	8240	<0.034
Methyl t-butyl ether	mg/Kg (ppm)	8240	<0.0064
Base Neutral and Acid Organic Compounds			
Acenaphthene	mg/Kg (ppm)	8270C	<4.9
Acenaphthylene	mg/Kg (ppm)	8270C	<4.4
Aniline	mg/Kg (ppm)	8270C	<1.7
Anthracene	mg/Kg (ppm)	8270C	<5
Benzidine	mg/Kg (ppm)	8270C	<110
Benzo[a]anthracene	mg/Kg (ppm)	8270C	<4.3
Benzo[b]fluoranthene	mg/Kg (ppm)	8270C	<4.6
Benzo[k]fluoranthene	mg/Kg (ppm)	8270C	<4.8
Benzo[a]pyrene	mg/Kg (ppm)	8270C	<4
Benzo[g,h,i]perylene	mg/Kg (ppm)	8270C	<3.4
Benzoic acid	mg/Kg (ppm)	8270C	<2.6
Benzyl alcohol	mg/Kg (ppm)	8270C	<4
Benzyl butyl phthalate	mg/Kg (ppm)	8270C	<4.5
bis(2-Chloroethyl) ether	mg/Kg (ppm)	8270C	<3.7
bis(2-Chloroethoxy)methane	mg/Kg (ppm)	8270C	<3.7
bis(2-Chloroisopropyl)ether	mg/Kg (ppm)	8270C	<3.7
bis(2-Ethylhexyl)phthalate	mg/Kg (ppm)	8270C	82
4-Bromophenyl phenyl ether	mg/Kg (ppm)	8270C	<5
4-Chloroaniline	mg/Kg (ppm)	8270C	<2.8
2-Chloronaphthalene	mg/Kg (ppm)	8270C	<4.4
4-Chlorophenyl phenyl ether	mg/Kg (ppm)	8270C	<4.6
Chrysene	mg/Kg (ppm)	8270C	<4.7
Dibenzo[a,h]anthracene	mg/Kg (ppm)	8270C	<4.4
Dibenzofuran	mg/Kg (ppm)	8270C	<4.6
Di-n-butyl phthalate	mg/Kg (ppm)	8270C	<0.66
3,3-Dichlorobenzidine	mg/Kg (ppm)	8270C	<3.3
Diethyl phthalate	mg/Kg (ppm)	8270C	<6

Table B.2 Biosolids Monitoring Results

Constituent	Units ^o	Method Number	Concentration ^p
Dimethyl phthalate	mg/Kg (ppm)	8270C	<4.6
2,4-Dinitrotoluene	mg/Kg (ppm)	8270C	<3.4
2,6-Dinitrotoluene	mg/Kg (ppm)	8270C	<3.9
Di-n-octyl phthalate	mg/Kg (ppm)	8270C	<6.1
1,2-Diphenylhydrazine	mg/Kg (ppm)	8270C	<0.68
Fluoranthene	mg/Kg (ppm)	8270C	<5
Fluorene	mg/Kg (ppm)	8270C	<3.3
Hexachlorobenzene	mg/Kg (ppm)	8270C	<4.8
Hexachlorobutadiene	mg/Kg (ppm)	8270C	<3.8
Hexachlorocyclopentadiene	mg/Kg (ppm)	8270C	<2.6
Hexachloroethane	mg/Kg (ppm)	8270C	<3.4
Indeno[1,2,3-cd]pyrene	mg/Kg (ppm)	8270C	<5.6
Isophorone	mg/Kg (ppm)	8270C	<3.5
2-Methylnaphthalene	mg/Kg (ppm)	8270C	<4.2
Naphthalene	mg/Kg (ppm)	8270C	<3.5
2-Naphthylamine	mg/Kg (ppm)	8270C	<3.5
2-Nitroaniline	mg/Kg (ppm)	8270C	<4
3-Nitroaniline	mg/Kg (ppm)	8270C	<3.8
4-Nitroaniline	mg/Kg (ppm)	8270C	<3.9
Nitrobenzene	mg/Kg (ppm)	8270C	<3.4
N-Nitrosodimethylamine	mg/Kg (ppm)	8270C	<2.8
N-Nitrosodiphenylamine	mg/Kg (ppm)	8270C	<4.6
N-Nitrosodi-N-propylamine	mg/Kg (ppm)	8270C	<3.9
Phenanthrene	mg/Kg (ppm)	8270C	<5.2
Pyrene	mg/Kg (ppm)	8270C	<4.5
1,2,4-Trichlorobenzene	mg/Kg (ppm)	8270C	<3.8
4-Chloro-3-methylphenol	mg/Kg (ppm)	8270C	<4
2-Chlorophenol	mg/Kg (ppm)	8270C	<3.9
2,4-Dichlorophenol	mg/Kg (ppm)	8270C	<4
2,4-Dimethylphenol	mg/Kg (ppm)	8270C	<3.5
2,4-Dinitrophenol	mg/Kg (ppm)	8270C	<16
4,6-Dinitro-2-methylphenol	mg/Kg (ppm)	8270C	<2.1
2-Methylphenol	mg/Kg (ppm)	8270C	<3.9
3&4 Methylphenol	mg/Kg (ppm)	8270C	<9
2-Nitrophenol	mg/Kg (ppm)	8270C	<3.5
4-Nitrophenol	mg/Kg (ppm)	8270C	<4
Pentachlorophenol	mg/Kg (ppm)	8270C	<4.6
Phenol	mg/Kg (ppm)	8270C	<4.3
2,4,5-Trichlorophenol	mg/Kg (ppm)	8270C	<4.7
2,4,6-Trichlorophenol	mg/Kg (ppm)	8270C	<5.3
Other Parameters			
Asbestos	%	600/R-93/116	ND ^s

^s None detected

APPENDIX C
Infaunal Biology

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INFAUNAL INDICES

C.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 j^{th} 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: $h = \frac{\ln(N!) - \sum_{j=1}^S [\ln(n_j!)]}{N}$. 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.

C.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.

C.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:

$$C' = \sum_{j=1}^S \left(\frac{n_j(n_j-1)}{N(N-1)} \right) \text{ (Magurran 1988).}$$

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.

C.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.

C.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 C.1 Species Abundance Totaled among Replicate Samples Collected at
Benthic Stations in October 2008

Taxonomic Group	Taxon	Station									Station Total	Percent of Total	Cumulative %
		1	2	3	4	5	6	7	8	9			
Nemertea	<i>Carinoma mutabilis</i>	157	101	78	14	98	119	97	96	74	834	16.66	16.66
Crustacea	<i>Majoxiphalus major</i>	5	32	49	123	89	46	45	37	81	507	10.13	26.78
Crustacea	<i>Rhepoxynius abronius</i>	54	42	58	31	58	27	53	80	48	451	9.01	35.79
Crustacea	<i>Tecticeps convexus</i>	44	25	34	36	84	37	29	43	25	357	7.13	42.92
Crustacea	<i>Eohaustorius sencillus</i>	18	20	29	49	31	50	29	48	16	290	5.79	48.71
Annelida	<i>Scoloplos armiger</i>	12	25	28	33	37	39	27	32	36	269	5.37	54.08
Annelida	<i>Magelona sacculata</i>	33	14	26	7	34	31	10	23	52	230	4.59	58.68
Echinodermata	<i>Dendraster excentricus</i>	2	22	30	10	28	25	33	23	25	198	3.95	62.63
Bivalvia	<i>Tellina bodegensis</i>	4	12	22	29	24	11	13	16	39	170	3.40	66.03
Crustacea	<i>Rhepoxynius menziesi</i>	8	22	19	9	13	27	17	6	19	140	2.80	68.82
Annelida	<i>Chaetozone setosa</i>	10	17	11	6	20	12	7	19	8	110	2.20	71.02
Annelida	<i>Onuphis iridescens</i>	6	7	13	13	15	15	9	16	11	105	2.10	73.12
Crustacea	<i>Pacifoculodes spinipes</i>	3	7	13	8	8	14	17	7	6	83	1.66	74.78
Annelida	<i>Sigalion spinosa</i>	5	8	17	1	17	12	8	11	2	81	1.62	76.39
Annelida	<i>Nephtys caecoides</i>	4	9	10	4	11	7	13	7	7	72	1.44	77.83
Annelida	<i>Glycera convoluta</i>	9	6	5	15	6	9	4	8	7	69	1.38	79.21
Annelida	<i>Lumbrineris californiensis</i>	1	6	8	8	9	12	10	7	8	69	1.38	80.59
Bivalvia	<i>Tellina modesta</i>	9	6	6	5	2	5	5	15	14	67	1.34	81.93
Annelida	<i>Ampharete labrops</i>	15	4	3	5	9	3	4	5	4	52	1.04	82.96
Crustacea	<i>Photis macinerneyi</i>	10	2	4	4	6	9	6	6	2	49	0.98	83.94
Bivalvia	<i>Chione</i>	—	3	3	—	10	8	1	17	1	43	0.86	84.80
Nemertea	<i>Carinomella lactea</i>	—	—	—	18	—	—	24	—	—	42	0.84	85.64
Bivalvia	<i>Pandora bilirata</i>	—	5	7	2	5	8	3	4	6	40	0.80	86.44
Crustacea	<i>Anchicolurus occidentalis</i>	5	2	5	4	9	3	—	6	2	36	0.72	87.16
Crustacea	<i>Aoroides intermedius</i>	—	—	—	28	—	—	—	8	—	36	0.72	87.88
Crustacea	<i>Americhilidium shoemakeri</i>	1	6	2	2	7	2	5	3	5	33	0.66	88.54
Crustacea	<i>Foxiphalus xiximeus</i>	—	—	1	17	3	—	—	10	2	33	0.66	89.20
Nemertea	<i>Cerebratulus californiensis</i>	—	3	3	7	7	5	2	1	4	32	0.64	89.83
Annelida	<i>Spiophanes bombyx</i>	1	1	1	2	3	4	2	4	7	25	0.50	90.33
Bivalvia	<i>Siliqua lucida</i>	—	—	4	1	6	3	1	3	4	22	0.44	90.77
Annelida	<i>Glycinde armigera</i>	1	1	2	—	8	2	1	2	4	21	0.42	91.19
Annelida	<i>Axiiothella rubrocincta</i>	4	—	3	1	2	3	2	1	3	19	0.38	91.57
Echinodermata	<i>Amphiodia</i>	3	2	1	1	1	2	2	4	1	17	0.34	91.91
Annelida	<i>Lumbrineris</i>	—	—	1	—	2	3	1	9	1	17	0.34	92.25
Crustacea	<i>Diastylopsis tenuis</i>	1	—	1	—	5	2	2	2	2	15	0.30	92.55
Annelida	<i>Chone mollis</i>	—	—	—	3	3	2	1	1	4	14	0.28	92.83
Phoronida	<i>Phoronis</i>	7	1	1	—	1	—	—	1	2	13	0.26	93.09
Crustacea	<i>Synidotea bicuspidata</i>	—	—	—	8	1	1	—	3	—	13	0.26	93.35
Crustacea	<i>Mesolamprops dillonensis</i>	1	3	—	—	—	—	2	3	3	12	0.24	93.59
Annelida	<i>Notomastus lineatus</i>	—	—	2	2	3	—	1	3	1	12	0.24	93.83
Annelida	<i>Typosyllis farallonensis</i>	4	2	2	—	—	2	—	1	—	11	0.22	94.05
Bivalvia	<i>Nuculana</i>	2	—	—	1	2	1	3	1	1	11	0.22	94.27
Annelida	<i>Pectinaria californiensis</i>	1	1	—	—	2	1	—	2	4	11	0.22	94.49
Crustacea	<i>Gibberosus myersi</i>	—	—	2	1	2	1	1	—	4	11	0.22	94.71
Bivalvia	<i>Rocheportia tumida</i>	4	1	1	1	2	—	—	—	1	10	0.20	94.91

Table C.1 Species Abundance Totaled among Replicate Samples Collected at Benthic Stations in October 2008

Taxonomic Group	Taxon	Station									Station Total	Percent of Total	Cumulative %
		1	2	3	4	5	6	7	8	9			
Mollusca	<i>Odostomia</i>	–	–	1	4	1	2	–	1	1	10	0.20	95.11
Crustacea	<i>Photis brevipes</i>	–	–	1	3	3	2	–	–	–	9	0.18	95.29
Annelida	<i>Spiophanes duplex</i>	1	1	1	1	1	–	1	2	–	8	0.16	95.45
Nemertea	<i>Amphiporus bimaculatus</i>	1	1	–	4	–	1	–	1	–	8	0.16	95.61
Mollusca	Gastropoda	1	–	2	1	1	–	1	1	1	8	0.16	95.77
Annelida	<i>Eupolymnia heterobranchia</i>	–	1	1	6	–	–	–	–	–	8	0.16	95.93
Bivalvia	<i>Cooperella subdiaphana</i>	–	–	2	–	1	1	1	1	2	8	0.16	96.09
Annelida	<i>Platynereis bicanaliculata</i>	–	–	–	6	1	–	–	1	–	8	0.16	96.25
Mollusca	<i>Olivella pedroana</i>	–	–	–	3	2	–	–	–	3	8	0.16	96.41
Crustacea	<i>Leuroleberis sharpei</i>	–	1	1	–	1	2	–	1	–	6	0.12	96.52
Crustacea	<i>Bathycopea daltonae</i>	–	–	–	–	1	1	2	1	1	6	0.12	96.64
Crustacea	<i>Tiron biocellata</i>	1	–	2	–	1	–	–	–	1	5	0.10	96.74
Annelida	<i>Syllides</i>	1	–	1	1	1	–	1	–	–	5	0.10	96.84
Mollusca	<i>Nassarius fossatus</i>	–	1	3	–	1	–	–	–	–	5	0.10	96.94
Annelida	<i>Nereis latescens</i>	–	–	–	5	–	–	–	–	–	5	0.10	97.04
Annelida	<i>Tenonia priops</i>	–	–	–	1	–	–	–	2	2	5	0.10	97.14
Cnidaria	Actiniaria	3	1	–	–	–	–	–	–	–	4	0.08	97.22
Annelida	<i>Magelona hartmanae</i>	3	–	–	1	–	–	–	–	–	4	0.08	97.30
Echinodermata	<i>Leptosynapta</i>	2	–	–	–	–	–	–	–	2	4	0.08	97.38
Crustacea	<i>Lepidopa californica</i>	1	–	1	–	1	–	–	–	1	4	0.08	97.46
Annelida	<i>Podarkeopsis glabra</i>	1	–	–	–	2	–	–	1	–	4	0.08	97.54
Crustacea	<i>Exacanthomysis davisii</i>	1	–	–	–	–	–	2	1	–	4	0.08	97.62
Nemertea	Lineidae	–	3	–	–	–	1	–	–	–	4	0.08	97.70
Annelida	<i>Diopatra ornata</i>	–	–	1	1	1	–	1	–	–	4	0.08	97.78
Crustacea	<i>Edotia sublittoralis</i>	1	1	–	–	–	–	–	–	1	3	0.06	97.84
Annelida	<i>Goniada maculata</i>	–	1	1	–	–	–	1	–	–	3	0.06	97.90
Annelida	<i>Aphelochaeta</i>	–	–	3	–	–	–	–	–	–	3	0.06	97.96
Annelida	<i>Apoprionospio pygmaea</i>	–	–	1	1	1	–	–	–	–	3	0.06	98.02
Mollusca	<i>Alvania</i>	–	–	1	–	–	–	–	–	2	3	0.06	98.08
Annelida	<i>Armandia bioculata</i>	–	–	–	3	–	–	–	–	–	3	0.06	98.14
Crustacea	<i>Cancer gracilis</i>	–	–	–	3	–	–	–	–	–	3	0.06	98.20
Annelida	<i>Polydora</i>	–	–	–	2	–	–	–	1	–	3	0.06	98.26
Annelida	<i>Eteone</i>	–	–	–	1	2	–	–	–	–	3	0.06	98.32
Annelida	<i>Harmothoe</i>	–	–	–	1	2	–	–	–	–	3	0.06	98.38
Crustacea	<i>Mandibulophoxus gilesi</i>	–	–	–	–	–	–	1	1	1	3	0.06	98.44
Vertebrata	<i>Porichthys notatus</i>	–	–	–	–	–	–	–	1	2	3	0.06	98.50
Crustacea	<i>Callinassa</i>	2	–	–	–	–	–	–	–	–	2	0.04	98.54
Annelida	<i>Amaeana occidentalis</i>	2	–	–	–	–	–	–	–	–	2	0.04	98.58
Annelida	<i>Aedicira pacifica</i>	2	–	–	–	–	–	–	–	–	2	0.04	98.62
Annelida	<i>Sthenelais verruculosa</i>	1	–	1	–	–	–	–	–	–	2	0.04	98.66
Annelida	<i>Travisia gigas</i>	1	–	1	–	–	–	–	–	–	2	0.04	98.70
Bivalvia	Mytilidae	1	–	–	–	1	–	–	–	–	2	0.04	98.74
Mollusca	<i>Turbonilla</i>	1	–	–	–	–	–	–	1	–	2	0.04	98.78
Annelida	<i>Scolecipis foliosa</i>	1	–	–	–	–	–	–	1	–	2	0.04	98.82
Nemertea	Anopla	–	–	1	1	–	–	–	–	–	2	0.04	98.86

Table C.1 Species Abundance Totaled among Replicate Samples Collected at
Benthic Stations in October 2008

Taxonomic Group	Taxon	Station									Station Total	Percent of Total	Cumulative %
		1	2	3	4	5	6	7	8	9			
Annelida	<i>Phyllochaetopterus</i>	—	—	1	—	1	—	—	—	—	2	0.04	98.90
Mollusca	<i>Polinices lewisii</i>	—	—	1	—	—	1	—	—	—	2	0.04	98.94
Mollusca	<i>Nassarius perpinguis</i>	—	—	1	—	—	—	1	—	—	2	0.04	98.98
Crustacea	<i>Blepharipoda occidentalis</i>	—	—	—	2	—	—	—	—	—	2	0.04	99.02
Annelida	<i>Eumida</i>	—	—	—	1	1	—	—	—	—	2	0.04	99.06
Crustacea	<i>Caprella californica</i>	—	—	—	1	1	—	—	—	—	2	0.04	99.10
Crustacea	<i>Crangon</i>	—	—	—	1	—	1	—	—	—	2	0.04	99.14
Annelida	Terebellidae	—	—	—	1	—	—	—	1	—	2	0.04	99.18
Crustacea	<i>Cyclaspis nubila</i>	—	—	—	—	2	—	—	—	—	2	0.04	99.22
Nemertea	<i>Paranemertes sp. A</i>	—	—	—	—	—	—	2	—	—	2	0.04	99.26
Annelida	<i>Eteone fauchaldi</i>	—	—	—	—	—	—	1	1	—	2	0.04	99.30
Bivalvia	<i>Rochefortia grippi</i>	—	—	—	—	—	—	—	2	—	2	0.04	99.34
Crustacea	Lysianassidae	1	—	—	—	—	—	—	—	—	1	0.02	99.36
Annelida	<i>Mediomastus</i>	1	—	—	—	—	—	—	—	—	1	0.02	99.38
Annelida	<i>Phylo felix</i>	1	—	—	—	—	—	—	—	—	1	0.02	99.40
Annelida	<i>Acmira catherinae</i>	1	—	—	—	—	—	—	—	—	1	0.02	99.42
Annelida	<i>Mediomastus acutus</i>	1	—	—	—	—	—	—	—	—	1	0.02	99.44
Echinodermata	Molpadiidae	1	—	—	—	—	—	—	—	—	1	0.02	99.46
Bivalvia	<i>Solen sicarius</i>	—	1	—	—	—	—	—	—	—	1	0.02	99.48
Annelida	<i>Asychis disparidentata</i>	—	1	—	—	—	—	—	—	—	1	0.02	99.50
Annelida	<i>Hesionura</i>	—	—	1	—	—	—	—	—	—	1	0.02	99.52
Annelida	<i>Leitoscoloplos pugettensis</i>	—	—	1	—	—	—	—	—	—	1	0.02	99.54
Annelida	<i>Owenia collaris</i>	—	—	1	—	—	—	—	—	—	1	0.02	99.56
Annelida	<i>Paraprionospio pinnata</i>	—	—	1	—	—	—	—	—	—	1	0.02	99.58
Annelida	<i>Phyllodoce multipapillata</i>	—	—	1	—	—	—	—	—	—	1	0.02	99.60
Annelida	<i>Phyllodoce</i>	—	—	—	1	—	—	—	—	—	1	0.02	99.62
Crustacea	Isaeidae	—	—	—	1	—	—	—	—	—	1	0.02	99.64
Crustacea	<i>Gnathopleustes pugettensis</i>	—	—	—	1	—	—	—	—	—	1	0.02	99.66
Echinodermata	<i>Pisaster brevispinus</i>	—	—	—	1	—	—	—	—	—	1	0.02	99.68
Annelida	<i>Exogone</i>	—	—	—	1	—	—	—	—	—	1	0.02	99.70
Bivalvia	Bivalvia	—	—	—	—	1	—	—	—	—	1	0.02	99.72
Bivalvia	<i>Clinocardium nuttallii</i>	—	—	—	—	1	—	—	—	—	1	0.02	99.74
Annelida	<i>Pista moorei</i>	—	—	—	—	1	—	—	—	—	1	0.02	99.76
Annelida	<i>Drilonereis falcata</i>	—	—	—	—	1	—	—	—	—	1	0.02	99.78
Annelida	<i>Pista brevibranchiata</i>	—	—	—	—	1	—	—	—	—	1	0.02	99.80
Mollusca	Naticidae	—	—	—	—	—	—	1	—	—	1	0.02	99.82
Annelida	<i>Spiochaetopterus costarum</i>	—	—	—	—	—	—	1	—	—	1	0.02	99.84
Nemertea	<i>Tubulanus</i>	—	—	—	—	—	—	—	1	—	1	0.02	99.86
Nemertea	<i>Tubulanus frenatus</i>	—	—	—	—	—	—	—	1	—	1	0.02	99.88
Crustacea	<i>Neomysis kadiakensis</i>	—	—	—	—	—	—	—	1	—	1	0.02	99.90
Mollusca	<i>Cylichna diegensis</i>	—	—	—	—	—	—	—	1	—	1	0.02	99.92
Crustacea	<i>Listriella melanica</i>	—	—	—	—	—	—	—	1	—	1	0.02	99.94
Annelida	<i>Polycirrus</i>	—	—	—	—	—	—	—	—	1	1	0.02	99.96
Bivalvia	Pectinidae	—	—	—	—	—	—	—	—	1	1	0.02	99.98
Bivalvia	<i>Pandora punctata</i>	—	—	—	—	—	—	—	—	1	1	0.02	100.00
Total Number of Individuals		478	431	539	569	718	575	507	621	569	5007		

**Table C.2 Species Abundance within Replicate Samples Collected at
Benthic Station 1 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	37	34	30	29	27	157	32.85	32.85
Crustacea	<i>Rhepoxynius abronius</i>	14	10	5	2	23	54	11.30	44.14
Crustacea	<i>Tecticeps convexus</i>	1	2	2	39	—	44	9.21	53.35
Annelida	<i>Magelona sacculata</i>	9	8	5	11	—	33	6.90	60.25
Crustacea	<i>Eohaustorius sencillus</i>	2	1	2	1	12	18	3.77	64.02
Annelida	<i>Ampharete labrops</i>	3	2	7	—	3	15	3.14	67.15
Annelida	<i>Scoloplos armiger</i>	1	3	3	1	4	12	2.51	69.67
Annelida	<i>Chaetozone setosa</i>	4	2	2	2	—	10	2.09	71.76
Crustacea	<i>Photis macinerneyi</i>	—	5	1	4	—	10	2.09	73.85
Annelida	<i>Glycera convoluta</i>	2	4	—	2	1	9	1.88	75.73
Bivalvia	<i>Tellina modesta</i>	—	3	1	1	4	9	1.88	77.62
Crustacea	<i>Rhepoxynius menziesi</i>	1	3	—	—	4	8	1.67	79.29
Phoronida	<i>Phoronis</i>	—	3	—	4	—	7	1.46	80.75
Annelida	<i>Onuphis iridescens</i>	2	—	1	2	1	6	1.26	82.01
Crustacea	<i>Majoxiphalus major</i>	1	1	2	1	—	5	1.05	83.05
Crustacea	<i>Anchicolurus occidentalis</i>	—	2	—	—	3	5	1.05	84.10
Annelida	<i>Sigalion spinosa</i>	—	—	2	1	2	5	1.05	85.15
Bivalvia	<i>Tellina bodegensis</i>	1	1	—	1	1	4	0.84	85.98
Annelida	<i>Nephtys caecoides</i>	1	—	—	1	2	4	0.84	86.82
Annelida	<i>Axiothella rubrocincta</i>	3	—	1	—	—	4	0.84	87.66
Bivalvia	<i>Rocheffortia tumida</i>	4	—	—	—	—	4	0.84	88.49
Annelida	<i>Typosyllis farallonensis</i>	—	1	1	1	1	4	0.84	89.33
Crustacea	<i>Pacifoculodes spinipes</i>	1	—	1	1	—	3	0.63	89.96
Cnidaria	Actiniaria	2	—	—	—	1	3	0.63	90.59
Annelida	<i>Magelona hartmanae</i>	3	—	—	—	—	3	0.63	91.21
Echinodermata	<i>Amphiodia</i>	—	1	2	—	—	3	0.63	91.84
Annelida	<i>Aedicira pacifica</i>	1	1	—	—	—	2	0.42	92.26
Echinodermata	<i>Dendraster excentricus</i>	1	—	—	—	1	2	0.42	92.68
Echinodermata	<i>Leptosynapta</i>	2	—	—	—	—	2	0.42	93.10
Crustacea	<i>Callinassa</i>	—	1	1	—	—	2	0.42	93.51
Bivalvia	<i>Nuculana</i>	—	1	—	1	—	2	0.42	93.93
Annelida	<i>Amaeana occidentalis</i>	—	—	—	—	2	2	0.42	94.35
Annelida	<i>Lumbrineris californiensis</i>	1	—	—	—	—	1	0.21	94.56
Annelida	<i>Podarkeopsis glabra</i>	1	—	—	—	—	1	0.21	94.77
Annelida	<i>Sthenelais verruculosa</i>	1	—	—	—	—	1	0.21	94.98
Crustacea	<i>Edotia sublittoralis</i>	—	1	—	—	—	1	0.21	95.19
Annelida	<i>Syllides</i>	—	1	—	—	—	1	0.21	95.40
Annelida	<i>Spiophanes bombyx</i>	—	1	—	—	—	1	0.21	95.61
Nemertea	<i>Amphiporus bimaculatus</i>	—	1	—	—	—	1	0.21	95.82
Annelida	<i>Pectinaria californiensis</i>	—	1	—	—	—	1	0.21	96.03

**Table C.2 Species Abundance within Replicate Samples Collected at
Benthic Station 1 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Acmira catherinae</i>	—	1	—	—	—	1	0.21	96.23
Annelida	<i>Mediomastus acutus</i>	—	1	—	—	—	1	0.21	96.44
Echinodermata	Molpadiidae	—	1	—	—	—	1	0.21	96.65
Annelida	<i>Scolecopsis foliosa</i>	—	1	—	—	—	1	0.21	96.86
Bivalvia	Mytilidae	—	—	1	—	—	1	0.21	97.07
Mollusca	Gastropoda	—	—	1	—	—	1	0.21	97.28
Annelida	<i>Spiophanes duplex</i>	—	—	1	—	—	1	0.21	97.49
Crustacea	<i>Americhilidium shoemakeri</i>	—	—	—	1	—	1	0.21	97.70
Mollusca	<i>Turbonilla</i>	—	—	—	1	—	1	0.21	97.91
Crustacea	<i>Mesolamprops dillonensis</i>	—	—	—	1	—	1	0.21	98.12
Annelida	<i>Mediomastus</i>	—	—	—	1	—	1	0.21	98.33
Crustacea	<i>Lepidopa californica</i>	—	—	—	1	—	1	0.21	98.54
Annelida	<i>Travisia gigas</i>	—	—	—	1	—	1	0.21	98.74
Crustacea	<i>Tiron biocellata</i>	—	—	—	—	1	1	0.21	98.95
Crustacea	<i>Diastylopsis tenuis</i>	—	—	—	—	1	1	0.21	99.16
Annelida	<i>Glycinde armigera</i>	—	—	—	—	1	1	0.21	99.37
Crustacea	Lysianassidae	—	—	—	—	1	1	0.21	99.58
Crustacea	<i>Exacanthomysis davis</i>	—	—	—	—	1	1	0.21	99.79
Annelida	<i>Phylo felix</i>	—	—	—	—	1	1	0.21	100.00
Total Number of Individuals		99	98	72	111	98	478		

**Table C.3 Species Abundance within Replicate Samples Collected at
Benthic Station 2 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	12	15	35	18	21	101	23.43	23.43
Crustacea	<i>Rhepoxynius abronius</i>	11	7	1	20	3	42	9.74	33.18
Crustacea	<i>Majoxiphalus major</i>	5	8	5	9	5	32	7.42	40.60
Crustacea	<i>Tecticeps convexus</i>	3	3	9	4	6	25	5.80	46.40
Annelida	<i>Scoloplos armiger</i>	4	6	5	6	4	25	5.80	52.20
Crustacea	<i>Rhepoxynius menziesi</i>	2	—	10	4	6	22	5.10	57.31
Echinodermata	<i>Dendraster excentricus</i>	3	9	2	7	1	22	5.10	62.41
Crustacea	<i>Eohaustorius sencillus</i>	6	4	3	4	3	20	4.64	67.05
Annelida	<i>Chaetozone setosa</i>	6	2	5	3	1	17	3.94	71.00
Annelida	<i>Magelona sacculata</i>	—	2	7	4	1	14	3.25	74.25

**Table C.3 Species Abundance within Replicate Samples Collected at
Benthic Station 2 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Bivalvia	<i>Tellina bodegensis</i>	3	3	2	3	1	12	2.78	77.03
Annelida	<i>Nephtys caecoides</i>	—	2	2	5	—	9	2.09	79.12
Annelida	<i>Sigalion spinosa</i>	—	1	2	2	3	8	1.86	80.97
Annelida	<i>Onuphis iridescens</i>	1	—	3	2	1	7	1.62	82.60
Crustacea	<i>Pacifoculodes spinipes</i>	2	—	1	2	2	7	1.62	84.22
Annelida	<i>Lumbrineris californiensis</i>	1	1	2	1	1	6	1.39	85.61
Crustacea	<i>Americhilidium shoemakeri</i>	2	1	1	—	2	6	1.39	87.01
Annelida	<i>Glycera convoluta</i>	2	1	1	—	2	6	1.39	88.40
Bivalvia	<i>Tellina modesta</i>	3	1	2	—	—	6	1.39	89.79
Bivalvia	<i>Pandora bilirata</i>	—	2	—	3	—	5	1.16	90.95
Annelida	<i>Ampharete labrops</i>	—	2	—	1	1	4	0.93	91.88
Bivalvia	<i>Chione</i>	2	—	—	1	—	3	0.70	92.58
Nemertea	<i>Cerebratulus californiensis</i>	—	1	1	—	1	3	0.70	93.27
Crustacea	<i>Mesolamprops dillonensis</i>	—	—	3	—	—	3	0.70	93.97
Nemertea	Lineidae	—	—	—	—	3	3	0.70	94.66
Crustacea	<i>Anchicolurus occidentalis</i>	1	1	—	—	—	2	0.46	95.13
Echinodermata	<i>Amphiodia</i>	1	—	—	1	—	2	0.46	95.59
Crustacea	<i>Photis macinerneyi</i>	—	—	1	—	1	2	0.46	96.06
Annelida	<i>Typosyllis farallonensis</i>	—	—	1	—	1	2	0.46	96.52
Annelida	<i>Glycinde armigera</i>	—	1	—	—	—	1	0.23	96.75
Nemertea	<i>Amphiporus bimaculatus</i>	—	1	—	—	—	1	0.23	96.98
Annelida	<i>Goniada maculata</i>	—	1	—	—	—	1	0.23	97.22
Phoronida	<i>Phoronis</i>	—	—	1	—	—	1	0.23	97.45
Bivalvia	<i>Solen sicarius</i>	—	—	1	—	—	1	0.23	97.68
Annelida	<i>Spiophanes bombyx</i>	—	—	1	—	—	1	0.23	97.91
Crustacea	<i>Leuroleberis sharpei</i>	—	—	—	1	—	1	0.23	98.14
Bivalvia	<i>Rocheffortia tumida</i>	—	—	—	1	—	1	0.23	98.38
Mollusca	<i>Nassarius fossatus</i>	—	—	—	1	—	1	0.23	98.61
Annelida	<i>Eupolymnia heterobranchia</i>	—	—	—	1	—	1	0.23	98.84
Annelida	<i>Pectinaria californiensis</i>	—	—	—	1	—	1	0.23	99.07
Annelida	<i>Spiophanes duplex</i>	—	—	—	1	—	1	0.23	99.30
Annelida	<i>Asychis disparidentata</i>	—	—	—	1	—	1	0.23	99.54
Cnidaria	Actiniaria	—	—	—	—	1	1	0.23	99.77
Crustacea	<i>Edotia sublittoralis</i>	—	—	—	—	1	1	0.23	100.00
Total Number of Individuals		70	75	107	107	72	431		

Table C.4 Species Abundance within Replicate Samples Collected at
Benthic Station 3 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	18	18	22	14	6	78	14.47	14.47
Crustacea	<i>Rhepoxynius abronius</i>	9	15	6	12	16	58	10.76	25.23
Crustacea	<i>Majoxiphalus major</i>	6	13	10	10	10	49	9.09	34.32
Crustacea	<i>Tecticeps convexus</i>	8	10	4	3	9	34	6.31	40.63
Echinodermata	<i>Dendraster excentricus</i>	12	2	5	7	4	30	5.57	46.20
Crustacea	<i>Eohaustorius sencillus</i>	11	10	1	4	3	29	5.38	51.58
Annelida	<i>Scoloplos armiger</i>	8	5	7	4	4	28	5.19	56.77
Annelida	<i>Magelona sacculata</i>	7	7	1	6	5	26	4.82	61.60
Bivalvia	<i>Tellina bodegensis</i>	5	9	2	3	3	22	4.08	65.68
Crustacea	<i>Rhepoxynius menziesi</i>	3	5	1	7	3	19	3.53	69.20
Annelida	<i>Sigalion spinosa</i>	1	4	9	3	—	17	3.15	72.36
Crustacea	<i>Pacifoculodes spinipes</i>	4	—	2	1	6	13	2.41	74.77
Annelida	<i>Onuphis iridescens</i>	—	2	6	1	4	13	2.41	77.18
Annelida	<i>Chaetozone setosa</i>	4	—	3	4	—	11	2.04	79.22
Annelida	<i>Nephtys caecoides</i>	—	3	1	5	1	10	1.86	81.08
Annelida	<i>Lumbrineris californiensis</i>	—	3	1	1	3	8	1.48	82.56
Bivalvia	<i>Pandora bilirata</i>	2	1	3	1	—	7	1.30	83.86
Bivalvia	<i>Tellina modesta</i>	1	1	3	—	1	6	1.11	84.97
Annelida	<i>Glycera convoluta</i>	—	2	1	2	—	5	0.93	85.90
Crustacea	<i>Anchicolurus occidentalis</i>	—	3	—	—	2	5	0.93	86.83
Crustacea	<i>Photis macinerneyi</i>	1	1	1	1	—	4	0.74	87.57
Bivalvia	<i>Siliqua lucida</i>	—	—	2	1	1	4	0.74	88.31
Mollusca	<i>Nassarius fossatus</i>	1	1	—	—	1	3	0.56	88.87
Bivalvia	<i>Chione</i>	1	—	2	—	—	3	0.56	89.42
Nemertea	<i>Cerebratulus californiensis</i>	1	—	—	1	1	3	0.56	89.98
Annelida	<i>Ampharete labrops</i>	—	1	—	—	2	3	0.56	90.54
Annelida	<i>Axiothella rubrocincta</i>	—	—	1	1	1	3	0.56	91.09
Annelida	<i>Aphelochaeta</i>	—	—	—	1	2	3	0.56	91.65
Crustacea	<i>Americhilidium shoemakeri</i>	1	—	1	—	—	2	0.37	92.02
Annelida	<i>Typosyllis farallonensis</i>	1	—	—	1	—	2	0.37	92.39
Annelida	<i>Glycinde armigera</i>	—	1	1	—	—	2	0.37	92.76
Mollusca	Gastropoda	—	1	1	—	—	2	0.37	93.14
Crustacea	<i>Tiron biocellata</i>	—	1	—	1	—	2	0.37	93.51
Crustacea	<i>Gibberosus myersi</i>	—	1	—	1	—	2	0.37	93.88
Bivalvia	<i>Cooperella subdiaphana</i>	—	—	1	1	—	2	0.37	94.25
Annelida	<i>Notomastus lineatus</i>	—	—	1	—	1	2	0.37	94.62
Echinodermata	<i>Amphiodia</i>	1	—	—	—	—	1	0.19	94.81
Crustacea	<i>Lepidopa californica</i>	1	—	—	—	—	1	0.19	94.99
Mollusca	<i>Nassarius perpinguis</i>	1	—	—	—	—	1	0.19	95.18
Nemertea	Anopla	1	—	—	—	—	1	0.19	95.36

**Table C.4 Species Abundance within Replicate Samples Collected at
Benthic Station 3 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Diopatra ornata</i>	—	1	—	—	—	1	0.19	95.55
Annelida	<i>Phyllochaetopterus</i>	—	1	—	—	—	1	0.19	95.73
Phoronida	<i>Phoronis</i>	—	—	1	—	—	1	0.19	95.92
Annelida	<i>Apoprionospio pygmaea</i>	—	—	1	—	—	1	0.19	96.10
Crustacea	<i>Diastylopsis tenuis</i>	—	—	1	—	—	1	0.19	96.29
Crustacea	<i>Leuroleberis sharpei</i>	—	—	1	—	—	1	0.19	96.47
Bivalvia	<i>Rocheportia tumida</i>	—	—	1	—	—	1	0.19	96.66
Annelida	<i>Spiophanes bombyx</i>	—	—	1	—	—	1	0.19	96.85
Mollusca	<i>Polinices lewisii</i>	—	—	1	—	—	1	0.19	97.03
Annelida	<i>Travisia gigas</i>	—	—	1	—	—	1	0.19	97.22
Crustacea	<i>Photis brevipes</i>	—	—	—	1	—	1	0.19	97.40
Crustacea	<i>Foxiphalus xiximeus</i>	—	—	—	1	—	1	0.19	97.59
Mollusca	<i>Alvania</i>	—	—	—	1	—	1	0.19	97.77
Annelida	<i>Goniada maculata</i>	—	—	—	1	—	1	0.19	97.96
Annelida	<i>Hesionura</i>	—	—	—	1	—	1	0.19	98.14
Annelida	<i>Paraprionospio pinnata</i>	—	—	—	1	—	1	0.19	98.33
Annelida	<i>Syllides</i>	—	—	—	—	1	1	0.19	98.52
Mollusca	<i>Odostomia</i>	—	—	—	—	1	1	0.19	98.70
Annelida	<i>Lumbrineris</i>	—	—	—	—	1	1	0.19	98.89
Annelida	<i>Eupolymnia heterobranchia</i>	—	—	—	—	1	1	0.19	99.07
Annelida	<i>Spiophanes duplex</i>	—	—	—	—	1	1	0.19	99.26
Annelida	<i>Leitoscoloplos pugettensis</i>	—	—	—	—	1	1	0.19	99.44
Annelida	<i>Owenia collaris</i>	—	—	—	—	1	1	0.19	99.63
Annelida	<i>Phyllodoce multipapillata</i>	—	—	—	—	1	1	0.19	99.81
Annelida	<i>Sthenelais verruculosa</i>	—	—	—	—	1	1	0.19	100.00
Total Number of Individuals		109	122	107	103	98	539		

**Table C.5 Species Abundance within Replicate Samples Collected at
Benthic Station 4 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Crustacea	<i>Majoxiphalus major</i>	22	27	23	17	34	123	21.62	21.62
Crustacea	<i>Eohaustorius sencillus</i>	8	15	2	7	17	49	8.61	30.23
Crustacea	<i>Tecticeps convexus</i>	1	5	6	16	8	36	6.33	36.56
Annelida	<i>Scoloplos armiger</i>	5	8	4	5	11	33	5.80	42.36
Crustacea	<i>Rhepoxynius abronius</i>	5	14	1	2	9	31	5.45	47.80
Bivalvia	<i>Tellina bodegensis</i>	8	5	6	4	6	29	5.10	52.90
Crustacea	<i>Aoroides intermedius</i>	—	1	—	—	27	28	4.92	57.82
Nemertea	<i>Carinomella lactea</i>	—	—	10	8	—	18	3.16	60.98
Crustacea	<i>Foxiphalus xiximeus</i>	1	—	—	—	16	17	2.99	63.97
Annelida	<i>Glycera convoluta</i>	3	1	4	4	3	15	2.64	66.61

Table C.5 Species Abundance within Replicate Samples Collected at
Benthic Station 4 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	6	3	—	1	4	14	2.46	69.07
Annelida	<i>Onuphis iridescens</i>	—	5	2	—	6	13	2.28	71.35
Echinodermata	<i>Dendraster excentricus</i>	3	1	2	4	—	10	1.76	73.11
Crustacea	<i>Rhepoxynius menziesi</i>	1	1	—	4	3	9	1.58	74.69
Crustacea	<i>Synidotea bicuspidata</i>	1	2	—	—	5	8	1.41	76.10
Annelida	<i>Lumbrineris californiensis</i>	2	2	—	—	4	8	1.41	77.50
Crustacea	<i>Pacifoculodes spinipes</i>	—	—	2	2	4	8	1.41	78.91
Nemertea	<i>Cerebratulus californiensis</i>	1	2	—	2	2	7	1.23	80.14
Annelida	<i>Magelona sacculata</i>	1	2	—	3	1	7	1.23	81.37
Annelida	<i>Chaetozone setosa</i>	1	—	1	2	2	6	1.05	82.43
Annelida	<i>Platynereis bicanaliculata</i>	—	—	—	—	6	6	1.05	83.48
Annelida	<i>Eupolymnia heterobranchia</i>	—	—	—	—	6	6	1.05	84.53
Annelida	<i>Ampharete labrops</i>	1	1	—	—	3	5	0.88	85.41
Bivalvia	<i>Tellina modesta</i>	2	2	—	1	—	5	0.88	86.29
Annelida	<i>Nereis latescens</i>	—	—	—	—	5	5	0.88	87.17
Mollusca	<i>Odostomia</i>	1	1	—	1	1	4	0.70	87.87
Annelida	<i>Nephtys caecoides</i>	1	—	1	1	1	4	0.70	88.58
Crustacea	<i>Photis macinerneyi</i>	—	1	1	1	1	4	0.70	89.28
Crustacea	<i>Anchicolurus occidentalis</i>	—	—	1	3	—	4	0.70	89.98
Nemertea	<i>Amphiporus bimaculatus</i>	—	—	—	—	4	4	0.70	90.69
Annelida	<i>Chone mollis</i>	1	—	—	1	1	3	0.53	91.21
Annelida	<i>Armandia bioculata</i>	1	—	—	—	2	3	0.53	91.74
Crustacea	<i>Photis brevipes</i>	3	—	—	—	—	3	0.53	92.27
Mollusca	<i>Olivella pedroana</i>	—	1	2	—	—	3	0.53	92.79
Crustacea	<i>Cancer gracilis</i>	—	—	—	—	3	3	0.53	93.32
Annelida	<i>Spiophanes bombyx</i>	—	—	1	1	—	2	0.35	93.67
Annelida	<i>Polydora</i>	—	—	1	—	1	2	0.35	94.02
Crustacea	<i>Americhilidium shoemakeri</i>	—	—	1	—	1	2	0.35	94.38
Annelida	<i>Notomastus lineatus</i>	—	—	1	—	1	2	0.35	94.73
Bivalvia	<i>Pandora bilirata</i>	—	—	2	—	—	2	0.35	95.08
Crustacea	<i>Blepharipoda occidentalis</i>	—	—	—	1	1	2	0.35	95.43
Annelida	<i>Phyllodoce</i>	1	—	—	—	—	1	0.18	95.61
Bivalvia	<i>Nuculana</i>	1	—	—	—	—	1	0.18	95.78
Bivalvia	<i>Rochefortia tumida</i>	1	—	—	—	—	1	0.18	95.96
Annelida	<i>Magelona hartmanae</i>	1	—	—	—	—	1	0.18	96.13
Annelida	<i>Spiophanes duplex</i>	1	—	—	—	—	1	0.18	96.31
Annelida	<i>Apoprionospio pygmaea</i>	—	1	—	—	—	1	0.18	96.49
Annelida	<i>Eteone</i>	—	1	—	—	—	1	0.18	96.66
Nemertea	<i>Anopla</i>	—	1	—	—	—	1	0.18	96.84
Annelida	<i>Syllides</i>	—	—	1	—	—	1	0.18	97.01

**Table C.5 Species Abundance within Replicate Samples Collected at
Benthic Station 4 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Bivalvia	<i>Siliqua lucida</i>	—	—	—	1	—	1	0.18	97.19
Crustacea	<i>Gibberosus myersi</i>	—	—	—	1	—	1	0.18	97.36
Annelida	Terebellidae	—	—	—	1	—	1	0.18	97.54
Annelida	<i>Sigalion spinosa</i>	—	—	—	—	1	1	0.18	97.72
Echinodermata	<i>Amphiodia</i>	—	—	—	—	1	1	0.18	97.89
Annelida	<i>Eumida</i>	—	—	—	—	1	1	0.18	98.07
Annelida	<i>Tenonia priops</i>	—	—	—	—	1	1	0.18	98.24
Crustacea	Isaeidae	—	—	—	—	1	1	0.18	98.42
Crustacea	<i>Caprella californica</i>	—	—	—	—	1	1	0.18	98.59
Crustacea	<i>Crangon</i>	—	—	—	—	1	1	0.18	98.77
Crustacea	<i>Gnathopleustes pugettensis</i>	—	—	—	—	1	1	0.18	98.95
Annelida	<i>Axiothella rubrocincta</i>	—	—	—	—	1	1	0.18	99.12
Mollusca	Gastropoda	—	—	—	—	1	1	0.18	99.30
Echinodermata	<i>Pisaster brevispinus</i>	—	—	—	—	1	1	0.18	99.47
Annelida	<i>Diopatra ornata</i>	—	—	—	—	1	1	0.18	99.65
Annelida	<i>Exogone</i>	—	—	—	—	1	1	0.18	99.82
Annelida	<i>Harmothoe</i>	—	—	—	—	1	1	0.18	100.00
Total Number of Individuals		84	103	75	94	213	569		

**Table C.6 Species Abundance within Replicate Samples Collected at
Benthic Station 5 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	25	32	13	11	17	98	13.65	13.65
Crustacea	<i>Majoxiphalus major</i>	19	11	17	17	25	89	12.40	26.04
Crustacea	<i>Tecticeps convexus</i>	31	12	3	16	22	84	11.70	37.74
Crustacea	<i>Rhepoxynius abronius</i>	10	12	12	9	15	58	8.08	45.82
Annelida	<i>Scoloplos armiger</i>	11	7	5	6	8	37	5.15	50.97
Annelida	<i>Magelona sacculata</i>	11	4	3	3	13	34	4.74	55.71
Crustacea	<i>Eohaustorius sencillus</i>	1	10	5	10	5	31	4.32	60.03
Echinodermata	<i>Dendraster excentricus</i>	2	6	9	5	6	28	3.90	63.93
Bivalvia	<i>Tellina bodegensis</i>	5	3	5	7	4	24	3.34	67.27
Annelida	<i>Chaetozone setosa</i>	2	5	6	6	1	20	2.79	70.06
Annelida	<i>Sigalion spinosa</i>	1	5	4	5	2	17	2.37	72.42
Annelida	<i>Onuphis iridescens</i>	3	6	2	1	3	15	2.09	74.51
Crustacea	<i>Rhepoxynius menziesi</i>	3	7	1	1	1	13	1.81	76.32
Annelida	<i>Nephtys caecoides</i>	2	2	2	1	4	11	1.53	77.86
Bivalvia	<i>Chione</i>	2	4	1	—	3	10	1.39	79.25

Table C.6 Species Abundance within Replicate Samples Collected at
Benthic Station 5 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Lumbrineris californiensis</i>	—	2	2	4	1	9	1.25	80.50
Crustacea	<i>Anchicolurus occidentalis</i>	—	2	3	3	1	9	1.25	81.75
Annelida	<i>Ampharete labrops</i>	—	—	6	2	1	9	1.25	83.01
Crustacea	<i>Pacifoculodes spinipes</i>	1	1	2	2	2	8	1.11	84.12
Annelida	<i>Glycinde armigera</i>	—	3	2	1	2	8	1.11	85.24
Nemertea	<i>Cerebratulus californiensis</i>	1	2	2	—	2	7	0.97	86.21
Crustacea	<i>Americhilidium shoemakeri</i>	1	3	1	—	2	7	0.97	87.19
Annelida	<i>Glycera convoluta</i>	2	1	2	1	—	6	0.84	88.02
Bivalvia	<i>Siliqua lucida</i>	2	—	1	2	1	6	0.84	88.86
Crustacea	<i>Photis macinerneyi</i>	—	1	1	2	2	6	0.84	89.69
Bivalvia	<i>Pandora bilirata</i>	3	—	1	1	—	5	0.70	90.39
Crustacea	<i>Diastylopsis tenuis</i>	—	—	2	1	2	5	0.70	91.09
Annelida	<i>Spiophanes bombyx</i>	1	1	1	—	—	3	0.42	91.50
Annelida	<i>Notomastus lineatus</i>	1	1	1	—	—	3	0.42	91.92
Annelida	<i>Chone mollis</i>	—	2	1	—	—	3	0.42	92.34
Crustacea	<i>Photis brevipes</i>	—	—	2	1	—	3	0.42	92.76
Crustacea	<i>Foxiphalus xiximeus</i>	—	—	3	—	—	3	0.42	93.18
Annelida	<i>Pectinaria californiensis</i>	1	1	—	—	—	2	0.28	93.45
Annelida	<i>Harmothoe</i>	1	—	—	—	1	2	0.28	93.73
Bivalvia	<i>Tellina modesta</i>	2	—	—	—	—	2	0.28	94.01
Bivalvia	<i>Nuculana</i>	2	—	—	—	—	2	0.28	94.29
Annelida	<i>Podarkeopsis glabra</i>	—	1	—	—	1	2	0.28	94.57
Annelida	<i>Axiothella rubrocincta</i>	—	—	1	1	—	2	0.28	94.85
Mollusca	<i>Olivella pedroana</i>	—	—	1	1	—	2	0.28	95.13
Crustacea	<i>Cyclaspis nubila</i>	—	—	2	—	—	2	0.28	95.40
Bivalvia	<i>Rocheortia tumida</i>	—	—	2	—	—	2	0.28	95.68
Annelida	<i>Lumbrineris</i>	—	—	—	1	1	2	0.28	95.96
Annelida	<i>Eteone</i>	—	—	—	2	—	2	0.28	96.24
Crustacea	<i>Gibberosus myersi</i>	—	—	—	—	2	2	0.28	96.52
Crustacea	<i>Synidotea bicuspidata</i>	1	—	—	—	—	1	0.14	96.66
Crustacea	<i>Caprella californica</i>	1	—	—	—	—	1	0.14	96.80
Crustacea	<i>Tiron biocellata</i>	—	1	—	—	—	1	0.14	96.94
Annelida	<i>Syllides</i>	—	1	—	—	—	1	0.14	97.08
Annelida	<i>Phyllochaetopterus</i>	—	1	—	—	—	1	0.14	97.21
Annelida	<i>Platynereis bicanaliculata</i>	—	—	1	—	—	1	0.14	97.35
Bivalvia	<i>Cooperella subdiaphana</i>	—	—	1	—	—	1	0.14	97.49
Annelida	<i>Spiophanes duplex</i>	—	—	1	—	—	1	0.14	97.63
Annelida	<i>Pista moorei</i>	—	—	1	—	—	1	0.14	97.77
Phoronida	<i>Phoronis</i>	—	—	—	1	—	1	0.14	97.91
Echinodermata	<i>Amphiodia</i>	—	—	—	1	—	1	0.14	98.05

Table C.6 Species Abundance within Replicate Samples Collected at Benthic Station 5 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Eumida</i>	—	—	—	1	—	1	0.14	98.19
Bivalvia	<i>Clinocardium nuttallii</i>	—	—	—	1	—	1	0.14	98.33
Bivalvia	Mytilidae	—	—	—	1	—	1	0.14	98.47
Crustacea	<i>Lepidopa californica</i>	—	—	—	1	—	1	0.14	98.61
Annelida	<i>Apoprionospio pygmaea</i>	—	—	—	—	1	1	0.14	98.75
Crustacea	<i>Bathycopea daltonae</i>	—	—	—	—	1	1	0.14	98.89
Bivalvia	Bivalvia	—	—	—	—	1	1	0.14	99.03
Mollusca	<i>Odostomia</i>	—	—	—	—	1	1	0.14	99.16
Crustacea	<i>Leuroleberis sharpei</i>	—	—	—	—	1	1	0.14	99.30
Mollusca	<i>Nassarius fossatus</i>	—	—	—	—	1	1	0.14	99.44
Mollusca	Gastropoda	—	—	—	—	1	1	0.14	99.58
Annelida	<i>Diopatra ornata</i>	—	—	—	—	1	1	0.14	99.72
Annelida	<i>Drilonereis falcata</i>	—	—	—	—	1	1	0.14	99.86
Annelida	<i>Pista brevibranchiata</i>	—	—	—	—	1	1	0.14	100.00
Total Number of Individuals		148	150	131	129	160	718		

Table C.7 Species Abundance within Replicate Samples Collected at Benthic Station 6 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	27	24	20	25	23	119	20.70	20.70
Crustacea	<i>Eohaustorius sencillus</i>	26	10	8	1	5	50	8.70	29.39
Crustacea	<i>Majoxiphalus major</i>	9	12	10	7	8	46	8.00	37.39
Annelida	<i>Scoloplos armiger</i>	8	6	9	7	9	39	6.78	44.17
Crustacea	<i>Tecticeps convexus</i>	1	25	4	5	2	37	6.43	50.61
Annelida	<i>Magelona sacculata</i>	5	7	4	7	8	31	5.39	56.00
Crustacea	<i>Rhepoxynius abronius</i>	9	10	4	1	3	27	4.70	60.70
Crustacea	<i>Rhepoxynius menziesi</i>	16	3	5	1	2	27	4.70	65.39
Echinodermata	<i>Dendraster excentricus</i>	6	5	2	2	10	25	4.35	69.74
Annelida	<i>Onuphis iridescent</i>	1	2	1	7	4	15	2.61	72.35
Crustacea	<i>Pacifoculodes spinipes</i>	—	4	5	1	4	14	2.43	74.78
Annelida	<i>Lumbrineris californiensis</i>	1	1	2	5	3	12	2.09	76.87
Annelida	<i>Sigalion spinosa</i>	4	1	1	3	3	12	2.09	78.96
Annelida	<i>Chaetozone setosa</i>	—	4	2	2	4	12	2.09	81.04
Bivalvia	<i>Tellina bodegensis</i>	6	3	1	1	—	11	1.91	82.96

Table C.7 Species Abundance within Replicate Samples Collected at
Benthic Station 6 in October 2008

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Glycera convoluta</i>	2	2	1	2	2	9	1.57	84.52
Crustacea	<i>Photis macinerneyi</i>	—	2	6	—	1	9	1.57	86.09
Bivalvia	<i>Pandora bilirata</i>	1	1	1	3	2	8	1.39	87.48
Bivalvia	<i>Chione</i>	—	2	5	1	—	8	1.39	88.87
Annelida	<i>Nephtys caecoides</i>	4	2	—	—	1	7	1.22	90.09
Bivalvia	<i>Tellina modesta</i>	2	—	2	1	—	5	0.87	90.96
Nemertea	<i>Cerebratulus californiensis</i>	—	2	2	—	1	5	0.87	91.83
Annelida	<i>Spiophanes bombyx</i>	1	1	—	—	2	4	0.70	92.52
Annelida	<i>Ampharete labrops</i>	1	1	1	—	—	3	0.52	93.04
Annelida	<i>Lumbrineris</i>	1	1	1	—	—	3	0.52	93.57
Bivalvia	<i>Siliqua lucida</i>	1	—	1	1	—	3	0.52	94.09
Crustacea	<i>Anchicolurus occidentalis</i>	1	—	1	1	—	3	0.52	94.61
Annelida	<i>Axiothella rubrocincta</i>	2	—	—	1	—	3	0.52	95.13
Mollusca	<i>Odostomia</i>	1	1	—	—	—	2	0.35	95.48
Annelida	<i>Chone mollis</i>	1	—	—	1	—	2	0.35	95.83
Annelida	<i>Glycinde armigera</i>	1	—	—	1	—	2	0.35	96.17
Annelida	<i>Typosyllis farallonensis</i>	1	—	—	—	1	2	0.35	96.52
Crustacea	<i>Photis brevipes</i>	2	—	—	—	—	2	0.35	96.87
Echinodermata	<i>Amphiodia</i>	—	1	—	—	1	2	0.35	97.22
Crustacea	<i>Americhilidium shoemakeri</i>	—	—	—	1	1	2	0.35	97.57
Crustacea	<i>Diastylopsis tenuis</i>	—	—	—	1	1	2	0.35	97.91
Crustacea	<i>Leuroleberis sharpei</i>	—	—	—	1	1	2	0.35	98.26
Nemertea	Lineidae	1	—	—	—	—	1	0.17	98.43
Annelida	<i>Pectinaria californiensis</i>	1	—	—	—	—	1	0.17	98.61
Mollusca	<i>Polinices lewisii</i>	1	—	—	—	—	1	0.17	98.78
Crustacea	<i>Bathycopea daltonae</i>	—	1	—	—	—	1	0.17	98.96
Crustacea	<i>Crangon</i>	—	1	—	—	—	1	0.17	99.13
Bivalvia	<i>Nuculana</i>	—	—	1	—	—	1	0.17	99.30
Bivalvia	<i>Cooperella subdiaphana</i>	—	—	1	—	—	1	0.17	99.48
Nemertea	<i>Amphiporus bimaculatus</i>	—	—	1	—	—	1	0.17	99.65
Crustacea	<i>Gibberosus myersi</i>	—	—	—	1	—	1	0.17	99.83
Crustacea	<i>Synidotea bicuspidata</i>	—	—	—	—	1	1	0.17	100.00
Total Number of Individuals		144	135	102	91	103	575		

**Table C.8 Species Abundance within Replicate Samples Collected at
Benthic Station 7 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	21	14	23	15	24	97	19.13	19.13
Crustacea	<i>Rhepoxynius abronius</i>	20	3	9	14	7	53	10.45	29.59
Crustacea	<i>Majoxiphalus major</i>	8	6	10	13	8	45	8.88	38.46
Echinodermata	<i>Dendraster excentricus</i>	5	6	10	7	5	33	6.51	44.97
Crustacea	<i>Tecticeps convexus</i>	1	2	5	19	2	29	5.72	50.69
Crustacea	<i>Eohaustorius sencillus</i>	10	8	3	2	6	29	5.72	56.41
Crustacea	<i>Rhepoxynius menziesi</i>	2	2	7	—	6	17	3.35	59.76
Nemertea	<i>Carinomella lactea</i>	—	20	4	—	—	24	4.73	64.50
Annelida	<i>Scoloplos armiger</i>	6	6	9	2	4	27	5.33	69.82
Crustacea	<i>Pacifoculodes spinipes</i>	3	4	1	3	6	17	3.35	73.18
Annelida	<i>Nephtys caecoides</i>	1	3	3	5	1	13	2.56	75.74
Annelida	<i>Lumbrineris californiensis</i>	2	2	3	1	2	10	1.97	77.71
Bivalvia	<i>Tellina bodegensis</i>	1	6	2	2	2	13	2.56	80.28
Annelida	<i>Onuphis iridescens</i>	1	2	3	2	1	9	1.78	82.05
Annelida	<i>Magelona sacculata</i>	3	1	—	2	4	10	1.97	84.02
Annelida	<i>Sigalion spinosa</i>	3	2	1	1	1	8	1.58	85.60
Annelida	<i>Chaetozone setosa</i>	2	3	1	1	—	7	1.38	86.98
Crustacea	<i>Photis macinerneyi</i>	1	2	2	1	—	6	1.18	88.17
Annelida	<i>Glycera convoluta</i>	1	2	—	1	—	4	0.79	88.95
Bivalvia	<i>Tellina modesta</i>	1	1	—	2	1	5	0.99	89.94
Crustacea	<i>Americhilidium shoemakeri</i>	1	—	—	3	1	5	0.99	90.93
Annelida	<i>Ampharete labrops</i>	3	—	1	—	—	4	0.79	91.72
Bivalvia	<i>Pandora bilirata</i>	1	—	—	1	1	3	0.59	92.31
Bivalvia	<i>Nuculana</i>	—	1	1	1	—	3	0.59	92.90
Annelida	<i>Axiiothella rubrocincta</i>	1	1	—	—	—	2	0.39	93.29
Nemertea	<i>Paranemertes sp. A</i>	1	1	—	—	—	2	0.39	93.69
Annelida	<i>Spiophanes bombyx</i>	—	—	1	1	—	2	0.39	94.08
Nemertea	<i>Cerebratulus californiensis</i>	1	—	—	1	—	2	0.39	94.48
Echinodermata	<i>Amphiodia</i>	1	—	—	—	1	2	0.39	94.87
Crustacea	<i>Exacanthomysis davisii</i>	1	—	—	—	1	2	0.39	95.27
Crustacea	<i>Diastylopsis tenuis</i>	—	1	—	1	—	2	0.39	95.66
Crustacea	<i>Mesolamprops dillonensis</i>	—	1	1	—	—	2	0.39	96.06
Crustacea	<i>Bathycopea daltonae</i>	—	2	—	—	—	2	0.39	96.45
Mollusca	Naticidae	1	—	—	—	—	1	0.20	96.65
Annelida	<i>Goniada maculata</i>	1	—	—	—	—	1	0.20	96.84
Crustacea	<i>Gibberosus myersi</i>	—	1	—	—	—	1	0.20	97.04
Annelida	<i>Glycinde armigera</i>	—	1	—	—	—	1	0.20	97.24
Crustacea	<i>Mandibulophoxus gilesi</i>	—	1	—	—	—	1	0.20	97.44
Mollusca	Gastropoda	—	1	—	—	—	1	0.20	97.63
Annelida	<i>Spiophanes duplex</i>	—	1	—	—	—	1	0.20	97.83

**Table C.8 Species Abundance within Replicate Samples Collected at
Benthic Station 7 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Bivalvia	<i>Chione</i>	—	—	—	1	—	1	0.20	98.03
Mollusca	<i>Nassarius perpinguis</i>	—	—	1	—	—	1	0.20	98.22
Annelida	<i>Eteone fauchaldi</i>	—	—	1	—	—	1	0.20	98.42
Annelida	<i>Spiochaetopterus costarum</i>	—	—	1	—	—	1	0.20	98.62
Bivalvia	<i>Cooperella subdiaphana</i>	—	—	—	1	—	1	0.20	98.82
Annelida	<i>Lumbrineris</i>	—	—	—	1	—	1	0.20	99.01
Bivalvia	<i>Siliqua lucida</i>	—	—	—	—	1	1	0.20	99.21
Annelida	<i>Chone mollis</i>	—	—	—	—	1	1	0.20	99.41
Annelida	<i>Syllides</i>	—	—	1	—	—	1	0.20	99.61
Annelida	<i>Notomastus lineatus</i>	—	—	—	1	—	1	0.20	99.80
Annelida	<i>Diopatra ornata</i>	—	—	—	1	—	1	0.20	100.00
Total Number of Individuals		104	107	104	106	86	507		

**Table C.9 Species Abundance within Replicate Samples Collected at
Benthic Station 8 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Nemertea	<i>Carinoma mutabilis</i>	26	16	21	16	17	96	15.46	15.46
Crustacea	<i>Rhepoxynius abronius</i>	18	16	11	20	15	80	12.88	28.34
Crustacea	<i>Eohaustorius sencillus</i>	16	6	4	9	13	48	7.73	36.07
Crustacea	<i>Tecticeps convexus</i>	3	5	17	17	1	43	6.92	43.00
Crustacea	<i>Majoxiphalus major</i>	5	3	5	13	11	37	5.96	48.95
Annelida	<i>Scoloplos armiger</i>	5	10	9	5	3	32	5.15	54.11
Annelida	<i>Magelona sacculata</i>	5	5	3	2	8	23	3.70	57.81
Echinodermata	<i>Dendraster excentricus</i>	6	2	9	5	1	23	3.70	61.51
Annelida	<i>Chaetozone setosa</i>	1	4	7	5	2	19	3.06	64.57
Bivalvia	<i>Chione</i>	4	1	6	4	2	17	2.74	67.31
Bivalvia	<i>Tellina bodegensis</i>	4	4	1	3	4	16	2.58	69.89
Annelida	<i>Onuphis iridescens</i>	6	4	4	—	2	16	2.58	72.46
Bivalvia	<i>Tellina modesta</i>	1	3	1	5	5	15	2.42	74.88
Annelida	<i>Sigalion spinosa</i>	5	—	1	2	3	11	1.77	76.65
Crustacea	<i>Foxiphalus xiximeus</i>	—	—	—	10	—	10	1.61	78.26
Annelida	<i>Lumbrineris</i>	1	2	3	1	2	9	1.45	79.71
Annelida	<i>Glycera convoluta</i>	1	1	2	3	1	8	1.29	81.00
Crustacea	<i>Aoroides intermedius</i>	—	—	—	8	—	8	1.29	82.29
Crustacea	<i>Pacifoculodes spinipes</i>	2	—	1	1	3	7	1.13	83.41
Annelida	<i>Lumbrineris californiensis</i>	3	2	—	—	2	7	1.13	84.54

**Table C.9 Species Abundance within Replicate Samples Collected at
Benthic Station 8 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Nephtys caecoides</i>	—	1	4	1	1	7	1.13	85.67
Crustacea	<i>Rhepoxynius menziesi</i>	—	1	—	4	1	6	0.97	86.63
Crustacea	<i>Anchicolurus occidentalis</i>	—	—	2	3	1	6	0.97	87.60
Crustacea	<i>Photis macinerneyi</i>	—	—	3	1	2	6	0.97	88.57
Annelida	<i>Ampharete labrops</i>	—	—	2	2	1	5	0.81	89.37
Bivalvia	<i>Pandora bilirata</i>	1	—	1	1	1	4	0.64	90.02
Annelida	<i>Spiophanes bombyx</i>	1	—	2	1	—	4	0.64	90.66
Echinodermata	<i>Amphiodia</i>	—	—	1	3	—	4	0.64	91.30
Crustacea	<i>Americhilidium shoemakeri</i>	1	—	—	1	1	3	0.48	91.79
Annelida	<i>Notomastus lineatus</i>	1	—	—	—	2	3	0.48	92.27
Bivalvia	<i>Siliqua lucida</i>	—	1	1	1	—	3	0.48	92.75
Crustacea	<i>Synidotea bicuspidata</i>	—	—	3	—	—	3	0.48	93.24
Crustacea	<i>Mesolamprops dillonensis</i>	—	—	3	—	—	3	0.48	93.72
Annelida	<i>Glycinde armigera</i>	1	—	—	1	—	2	0.32	94.04
Annelida	<i>Spiophanes duplex</i>	1	—	—	1	—	2	0.32	94.36
Crustacea	<i>Diastylopsis tenuis</i>	1	—	—	—	1	2	0.32	94.69
Annelida	<i>Tenonia priops</i>	2	—	—	—	—	2	0.32	95.01
Bivalvia	<i>Rocheftoria grippi</i>	2	—	—	—	—	2	0.32	95.33
Annelida	<i>Pectinaria californiensis</i>	2	—	—	—	—	2	0.32	95.65
Phoronida	<i>Phoronis</i>	1	—	—	—	—	1	0.16	95.81
Annelida	<i>Polydora</i>	1	—	—	—	—	1	0.16	95.97
Nemertea	<i>Tubulanus</i>	1	—	—	—	—	1	0.16	96.14
Crustacea	<i>Bathycopea daltonae</i>	1	—	—	—	—	1	0.16	96.30
Bivalvia	<i>Cooperella subdiaphana</i>	1	—	—	—	—	1	0.16	96.46
Nemertea	<i>Tubulanus frenatus</i>	1	—	—	—	—	1	0.16	96.62
Annelida	<i>Axiiothella rubrocincta</i>	1	—	—	—	—	1	0.16	96.78
Crustacea	<i>Neomysis kadiakensis</i>	1	—	—	—	—	1	0.16	96.94
Annelida	<i>Scolecopsis foliosa</i>	1	—	—	—	—	1	0.16	97.10
Vertebrata	<i>Porichthys notatus</i>	—	1	—	—	—	1	0.16	97.26
Mollusca	Gastropoda	—	1	—	—	—	1	0.16	97.42
Annelida	<i>Typosyllis farallonensis</i>	—	1	—	—	—	1	0.16	97.58
Annelida	Terebellidae	—	1	—	—	—	1	0.16	97.75
Annelida	<i>Chone mollis</i>	—	—	1	—	—	1	0.16	97.91
Bivalvia	<i>Nuculana</i>	—	—	1	—	—	1	0.16	98.07
Mollusca	<i>Turbonilla</i>	—	—	1	—	—	1	0.16	98.23
Nemertea	<i>Cerebratulus californiensis</i>	—	—	1	—	—	1	0.16	98.39
Annelida	<i>Podarkeopsis glabra</i>	—	—	1	—	—	1	0.16	98.55
Annelida	<i>Platynereis bicanaliculata</i>	—	—	—	1	—	1	0.16	98.71
Mollusca	<i>Odostomia</i>	—	—	—	1	—	1	0.16	98.87
Crustacea	<i>Leuroleberis sharpei</i>	—	—	—	1	—	1	0.16	99.03

**Table C.9 Species Abundance within Replicate Samples Collected at
Benthic Station 8 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Crustacea	<i>Mandibulophoxus gilesi</i>	—	—	—	1	—	1	0.16	99.19
Mollusca	<i>Cylichna diegensis</i>	—	—	—	1	—	1	0.16	99.36
Crustacea	<i>Listriella melanica</i>	—	—	—	1	—	1	0.16	99.52
Crustacea	<i>Exacanthomysis davisii</i>	—	—	—	—	1	1	0.16	99.68
Nemertea	<i>Amphiporus bimaculatus</i>	—	—	—	—	1	1	0.16	99.84
Annelida	<i>Eteone fauchaldi</i>	—	—	—	—	1	1	0.16	100.00
Total Number of Individuals		134	91	132	155	109	621		

**Table C.10 Species Abundance within Replicate Samples Collected at
Benthic Station 9 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Crustacea	<i>Majoxiphalus major</i>	19	12	21	15	14	81	14.24	14.24
Nemertea	<i>Carinoma mutabilis</i>	19	19	14	13	9	74	13.01	27.24
Annelida	<i>Magelona sacculata</i>	11	8	5	10	18	52	9.14	36.38
Crustacea	<i>Rhepoxynius abronius</i>	2	15	6	6	19	48	8.44	44.82
Bivalvia	<i>Tellina bodegensis</i>	7	7	7	8	10	39	6.85	51.67
Annelida	<i>Scoloplos armiger</i>	4	4	11	9	8	36	6.33	58.00
Echinodermata	<i>Dendraster excentricus</i>	2	6	6	6	5	25	4.39	62.39
Crustacea	<i>Tecticeps convexus</i>	11	—	6	5	3	25	4.39	66.78
Crustacea	<i>Rhepoxynius menziesi</i>	1	2	8	3	5	19	3.34	70.12
Crustacea	<i>Eohaustorius sencillus</i>	5	2	3	2	4	16	2.81	72.93
Bivalvia	<i>Tellina modesta</i>	2	2	4	2	4	14	2.46	75.40
Annelida	<i>Onuphis iridescens</i>	1	1	3	1	5	11	1.93	77.33
Annelida	<i>Chaetozone setosa</i>	1	3	1	1	2	8	1.41	78.73
Annelida	<i>Lumbrineris californiensis</i>	1	4	—	—	3	8	1.41	80.14
Annelida	<i>Glycera convoluta</i>	1	2	1	1	2	7	1.23	81.37
Annelida	<i>Nephtys caecoides</i>	—	2	1	3	1	7	1.23	82.60
Annelida	<i>Spiophanes bombyx</i>	—	3	4	—	—	7	1.23	83.83
Crustacea	<i>Pacifoculodes spinipes</i>	1	2	1	—	2	6	1.05	84.89
Bivalvia	<i>Pandora bilirata</i>	2	—	2	2	—	6	1.05	85.94
Crustacea	<i>Americhilidium shoemakeri</i>	1	3	—	—	1	5	0.88	86.82
Annelida	<i>Glycinde armigera</i>	1	—	1	2	—	4	0.70	87.52
Annelida	<i>Chone mollis</i>	2	1	1	—	—	4	0.70	88.22
Nemertea	<i>Cerebratulus californiensis</i>	2	—	1	1	—	4	0.70	88.93
Crustacea	<i>Gibberosus myersi</i>	2	—	2	—	—	4	0.70	89.63
Bivalvia	<i>Siliqua lucida</i>	—	1	1	2	—	4	0.70	90.33

**Table C.10 Species Abundance within Replicate Samples Collected at
Benthic Station 9 in October 2008**

Taxonomic Group	Taxon	Replicate					Total	Percent of Total	Cumulative Percent
		1	2	3	4	5			
Annelida	<i>Ampharete labrops</i>	—	1	2	1	—	4	0.70	91.04
Annelida	<i>Pectinaria californiensis</i>	—	1	2	1	—	4	0.70	91.74
Crustacea	<i>Mesolamprops dillonensis</i>	1	1	—	—	1	3	0.53	92.27
Mollusca	<i>Olivella pedroana</i>	1	—	1	1	—	3	0.53	92.79
Annelida	<i>AxiotHELLa rubrocincta</i>	—	1	—	—	2	3	0.53	93.32
Crustacea	<i>Anchicolurus occidentalis</i>	1	1	—	—	—	2	0.35	93.67
Crustacea	<i>Diastylopsis tenuis</i>	1	1	—	—	—	2	0.35	94.02
Crustacea	<i>Photis macinerneyi</i>	1	—	—	—	1	2	0.35	94.38
Crustacea	<i>Foxiphalus xiximeus</i>	—	1	1	—	—	2	0.35	94.73
Bivalvia	<i>Cooperella subdiaphana</i>	—	1	—	—	1	2	0.35	95.08
Annelida	<i>Sigalion spinosa</i>	—	—	1	1	—	2	0.35	95.43
Annelida	<i>Tenonia priops</i>	—	—	1	1	—	2	0.35	95.78
Vertebrata	<i>Porichthys notatus</i>	—	—	2	—	—	2	0.35	96.13
Mollusca	<i>Alvania</i>	—	—	—	2	—	2	0.35	96.49
Phoronida	<i>Phoronis</i>	—	—	—	—	2	2	0.35	96.84
Echinodermata	<i>Leptosynapta</i>	—	—	—	—	2	2	0.35	97.19
Crustacea	<i>Lepidopa californica</i>	1	—	—	—	—	1	0.18	97.36
Crustacea	<i>Bathycopea daltonae</i>	—	1	—	—	—	1	0.18	97.54
Mollusca	<i>Odostomia</i>	—	1	—	—	—	1	0.18	97.72
Bivalvia	<i>RocheFortia tumida</i>	—	1	—	—	—	1	0.18	97.89
Bivalvia	Pectinidae	—	1	—	—	—	1	0.18	98.07
Crustacea	<i>Mandibulophoxus gilesi</i>	—	1	—	—	—	1	0.18	98.24
Mollusca	Gastropoda	—	1	—	—	—	1	0.18	98.42
Crustacea	<i>Edotia sublittoralis</i>	—	—	1	—	—	1	0.18	98.59
Echinodermata	<i>Amphiodia</i>	—	—	1	—	—	1	0.18	98.77
Crustacea	<i>Tiron biocellata</i>	—	—	1	—	—	1	0.18	98.95
Bivalvia	<i>Chione</i>	—	—	1	—	—	1	0.18	99.12
Annelida	<i>Lumbrineris</i>	—	—	1	—	—	1	0.18	99.30
Annelida	<i>Polycirrus</i>	—	—	1	—	—	1	0.18	99.47
Bivalvia	<i>Nuculana</i>	—	—	—	1	—	1	0.18	99.65
Bivalvia	<i>Pandora punctata</i>	—	—	—	1	—	1	0.18	99.82
Annelida	<i>Notomastus lineatus</i>	—	—	—	—	1	1	0.18	100.00
Total Number of Individuals		104	113	126	101	125	569		

Table C.11 Infaunal Indices in Sediment Samples Collected in October 2008

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	99	95	23	4.13	2.29	2.00	0.19	7	4.83	0.73	83
	Replicate 2	98	90	24	3.75	2.40	2.09	0.18	8	5.11	0.76	80
	Replicate 3	72	67	17	3.94	2.09	1.79	0.23	6	3.81	0.74	87
	Replicate 4	111	104	21	4.95	1.97	1.74	0.23	3	4.31	0.65	74
	Replicate 5	98	96	21	4.57	2.29	2.02	0.16	6	4.38	0.75	91
Station 2	Replicate 1	70	67	17	3.94	2.56	2.23	0.10	9	3.81	0.90	87
	Replicate 2	75	75	23	3.26	2.71	2.34	0.09	9	5.10	0.87	84
	Replicate 3	107	106	25	4.24	2.56	2.26	0.14	9	5.15	0.80	82
	Replicate 4	107	105	25	4.20	2.75	2.43	0.09	10	5.16	0.85	87
	Replicate 5	72	68	22	3.09	2.56	2.18	0.13	9	4.98	0.83	88
Station 3	Replicate 1	109	106	22	4.82	2.69	2.41	0.09	9	4.50	0.87	81
	Replicate 2	122	120	25	4.80	2.78	2.49	0.08	9	5.01	0.86	87
	Replicate 3	107	103	33	3.12	2.95	2.56	0.08	11	6.90	0.84	85
	Replicate 4	103	100	30	3.33	2.97	2.59	0.07	11	6.30	0.87	85
	Replicate 5	98	94	29	3.24	2.96	2.57	0.07	12	6.16	0.88	89
Station 4	Replicate 1	84	82	26	3.15	2.69	2.32	0.11	9	5.67	0.83	85
	Replicate 2	103	101	22	4.59	2.46	2.18	0.13	7	4.55	0.80	93
	Replicate 3	75	73	20	3.65	2.43	2.09	0.14	7	4.43	0.81	88
	Replicate 4	94	93	25	3.72	2.76	2.42	0.09	10	5.29	0.86	85
	Replicate 5	213	204	38	5.37	3.05	2.79	0.07	13	6.96	0.84	89
Station 5	Replicate 1	148	143	26	5.50	2.55	2.31	0.12	7	5.04	0.78	83
	Replicate 2	150	144	28	5.14	2.84	2.56	0.09	10	5.43	0.85	87
	Replicate 3	131	130	39	3.33	3.25	2.86	0.06	16	7.81	0.89	86
	Replicate 4	129	122	29	4.21	2.91	2.60	0.07	10	5.83	0.87	86
	Replicate 5	160	153	34	4.50	2.86	2.58	0.09	9	6.56	0.81	86
Station 6	Replicate 1	144	142	29	4.90	2.70	2.43	0.10	8	5.65	0.80	87
	Replicate 2	135	130	24	5.42	2.64	2.38	0.10	8	4.73	0.83	85
	Replicate 3	102	95	25	3.80	2.77	2.43	0.09	10	5.27	0.86	82
	Replicate 4	91	90	27	3.33	2.70	2.34	0.11	9	5.78	0.82	82
	Replicate 5	103	102	25	4.08	2.77	2.44	0.09	10	5.19	0.86	80
Station 7	Replicate 1	104	102	27	3.78	2.67	2.34	0.11	9	5.62	0.81	90
	Replicate 2	107	105	29	3.62	2.91	2.56	0.08	11	6.02	0.86	80
	Replicate 3	104	102	23	4.43	2.66	2.36	0.10	8	4.76	0.85	86
	Replicate 4	106	103	26	3.96	2.66	2.35	0.10	8	5.39	0.82	88
	Replicate 5	86	85	21	4.05	2.54	2.22	0.12	8	4.50	0.83	91
Station 8	Replicate 1	134	126	32	3.94	2.83	2.51	0.09	10	6.41	0.82	87
	Replicate 2	91	86	19	4.53	2.54	2.25	0.11	8	4.04	0.86	85
	Replicate 3	132	120	27	4.44	2.83	2.53	0.08	10	5.43	0.86	79
	Replicate 4	155	147	33	4.45	2.97	2.67	0.07	11	6.41	0.85	90
	Replicate 5	109	105	28	3.75	2.79	2.46	0.09	9	5.80	0.84	87
Station 9	Replicate 1	104	104	28	3.71	2.71	2.38	0.10	8	5.81	0.81	85
	Replicate 2	113	111	32	3.47	2.94	2.58	0.08	11	6.58	0.85	85
	Replicate 3	126	122	32	3.81	2.98	2.64	0.07	11	6.45	0.86	88
	Replicate 4	101	98	25	3.92	2.78	2.46	0.08	9	5.23	0.87	83
	Replicate 5	125	121	23	5.26	2.72	2.45	0.09	9	4.59	0.87	86

Table C.11 Infaunal Indices in Sediment Samples Collected in October 2008

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	96	90	21.2	4.3	2.21	1.93	0.20	6.0	4.49	0.72	83
	Station 2	86	84	22.4	3.7	2.63	2.29	0.11	9.2	4.84	0.85	86
	Station 3	108	105	27.8	3.9	2.87	2.53	0.08	10.4	5.77	0.87	85
	Station 4	114	111	26.2	4.1	2.68	2.36	0.11	9.2	5.38	0.83	88
	Station 5	144	138	31.2	4.5	2.88	2.58	0.08	10.4	6.13	0.84	86
	Station 6	115	112	26.0	4.3	2.71	2.41	0.10	9.0	5.32	0.83	83
	Station 7	101	99	25.2	4.0	2.69	2.36	0.10	8.8	5.26	0.83	87
	Station 8	124	117	27.8	4.2	2.79	2.48	0.09	9.6	5.62	0.85	86
	Station 9	114	111	28.0	4.0	2.82	2.50	0.08	9.6	5.73	0.85	85
Standard Deviation	Station 1	14	14	2.7	0.49	0.17	0.15	0.03	1.9	0.50	0.04	6.7
	Station 2	19	20	3.3	0.54	0.09	0.10	0.02	0.4	0.58	0.04	2.7
	Station 3	9	10	4.3	0.87	0.13	0.08	0.01	1.3	0.99	0.01	3.2
	Station 4	56	53	7.0	0.88	0.25	0.27	0.03	2.5	1.02	0.02	3.2
	Station 5	13	12	5.3	0.85	0.25	0.20	0.02	3.4	1.09	0.04	1.4
	Station 6	23	23	2.0	0.84	0.05	0.04	0.01	1.0	0.41	0.03	3.0
	Station 7	9	8	3.2	0.31	0.14	0.12	0.01	1.3	0.62	0.02	4.5
	Station 8	25	23	5.5	0.35	0.16	0.15	0.01	1.1	0.98	0.02	4.0
	Station 9	12	10	4.1	0.71	0.13	0.11	0.01	1.3	0.84	0.02	1.9
Station Total	Station 1	478	452	46	9.83	2.60	2.45	0.16	8	7.36	0.68	83
	Station 2	431	421	39	10.79	2.87	2.72	0.09	10	6.29	0.78	86
	Station 3	539	523	54	9.69	3.12	2.96	0.07	12	8.47	0.78	86
	Station 4	569	553	52	10.63	3.13	2.97	0.08	13	8.08	0.79	89
	Station 5	718	692	56	12.36	3.09	2.96	0.07	11	8.41	0.77	86
	Station 6	575	559	41	13.63	2.94	2.82	0.08	11	6.32	0.79	84
	Station 7	507	497	44	11.30	2.96	2.82	0.08	11	6.93	0.78	87
	Station 8	621	584	56	10.43	3.10	2.95	0.07	12	8.63	0.77	86
	Station 9	569	556	47	11.83	3.04	2.90	0.07	11	7.28	0.79	86
Survey	Total	5007	4837	99	48.86	3.18	3.14	0.07	12	11.55	0.69	86

Table C.12 Infaunal Indices without *D. excentricus* in Sediment Samples Collected in October 2008

Parameter		Marine Benthic Community Metrics										
		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	98	94	22	4.27	2.25	1.97	0.20	6	4.62	0.73	83
	Replicate 2	98	90	24	3.75	2.40	2.09	0.18	8	5.11	0.76	80
	Replicate 3	72	67	17	3.94	2.09	1.79	0.23	6	3.81	0.74	87
	Replicate 4	111	104	21	4.95	1.97	1.74	0.23	3	4.31	0.65	74
	Replicate 5	97	95	20	4.75	2.26	1.99	0.17	6	4.17	0.75	91
Station 2	Replicate 1	67	64	16	4.00	2.49	2.16	0.10	8	3.61	0.90	87
	Replicate 2	66	66	22	3.00	2.66	2.27	0.10	9	5.01	0.86	84
	Replicate 3	105	104	24	4.33	2.51	2.22	0.15	8	4.95	0.79	82
	Replicate 4	100	98	24	4.08	2.68	2.36	0.10	9	5.02	0.84	87
	Replicate 5	71	67	21	3.19	2.52	2.15	0.13	8	4.76	0.83	88
Station 3	Replicate 1	97	94	21	4.48	2.63	2.34	0.09	8	4.40	0.87	81
	Replicate 2	120	118	24	4.92	2.74	2.46	0.08	9	4.82	0.86	87
	Replicate 3	102	98	32	3.06	2.90	2.51	0.09	11	6.76	0.84	85
	Replicate 4	96	93	29	3.21	2.92	2.54	0.08	11	6.18	0.87	85
	Replicate 5	94	90	28	3.21	2.90	2.52	0.08	11	6.00	0.87	89
Station 4	Replicate 1	81	79	25	3.16	2.63	2.26	0.12	8	5.49	0.82	85
	Replicate 2	102	100	21	4.76	2.43	2.16	0.13	7	4.34	0.80	93
	Replicate 3	73	71	19	3.74	2.37	2.04	0.15	7	4.22	0.80	88
	Replicate 4	90	89	24	3.71	2.70	2.36	0.10	9	5.12	0.85	85
	Replicate 5	213	204	38	5.37	3.05	2.79	0.07	13	6.96	0.84	89
Station 5	Replicate 1	146	141	25	5.64	2.51	2.28	0.12	6	4.85	0.78	83
	Replicate 2	144	138	27	5.11	2.78	2.51	0.09	10	5.28	0.84	87
	Replicate 3	122	121	38	3.18	3.22	2.82	0.06	16	7.72	0.89	86
	Replicate 4	124	117	28	4.18	2.86	2.55	0.08	10	5.67	0.86	86
	Replicate 5	154	147	33	4.45	2.81	2.52	0.09	9	6.41	0.80	86
Station 6	Replicate 1	138	136	28	4.86	2.64	2.37	0.11	8	5.50	0.79	87
	Replicate 2	130	125	23	5.43	2.58	2.32	0.11	7	4.56	0.82	85
	Replicate 3	100	93	24	3.88	2.72	2.39	0.09	9	5.07	0.86	82
	Replicate 4	89	88	26	3.38	2.65	2.30	0.12	9	5.58	0.82	82
	Replicate 5	93	92	24	3.83	2.71	2.37	0.10	10	5.09	0.85	80
Station 7	Replicate 1	99	97	26	3.73	2.60	2.28	0.12	8	5.46	0.80	90
	Replicate 2	101	99	28	3.54	2.86	2.50	0.09	11	5.88	0.86	80
	Replicate 3	94	92	22	4.18	2.59	2.28	0.11	8	4.64	0.84	86
	Replicate 4	99	96	25	3.84	2.59	2.27	0.11	7	5.26	0.80	88
	Replicate 5	81	80	20	4.00	2.46	2.15	0.13	7	4.34	0.82	91
Station 8	Replicate 1	128	120	31	3.87	2.77	2.45	0.10	10	6.27	0.81	87
	Replicate 2	89	84	18	4.67	2.49	2.20	0.11	8	3.84	0.86	85
	Replicate 3	123	111	26	4.27	2.77	2.46	0.09	10	5.31	0.85	79
	Replicate 4	150	142	32	4.44	2.92	2.62	0.08	10	6.26	0.84	90
	Replicate 5	108	104	27	3.85	2.76	2.44	0.09	9	5.60	0.84	87
Station 9	Replicate 1	102	102	27	3.78	2.66	2.34	0.11	8	5.62	0.81	85
	Replicate 2	107	105	31	3.39	2.88	2.52	0.09	11	6.45	0.84	85
	Replicate 3	120	116	31	3.74	2.93	2.59	0.08	11	6.31	0.85	88
	Replicate 4	95	92	24	3.83	2.72	2.39	0.09	8	5.09	0.86	83
	Replicate 5	120	116	22	5.27	2.65	2.39	0.09	8	4.42	0.86	86

Table C.12 Infaunal Indices without *D. excentricus* in Sediment Samples Collected in October 2008

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	95	90	20.8	4.3	2.19	1.92	0.20	5.8	4.40	0.72	83
	Station 2	82	80	21.4	3.7	2.57	2.23	0.12	8.4	4.67	0.84	86
	Station 3	102	99	26.8	3.8	2.82	2.47	0.08	10.0	5.63	0.86	85
	Station 4	112	109	25.4	4.1	2.63	2.32	0.11	8.8	5.23	0.82	88
	Station 5	138	133	30.2	4.5	2.84	2.53	0.09	10.2	5.99	0.83	86
	Station 6	110	107	25.0	4.3	2.66	2.35	0.11	8.6	5.16	0.83	83
	Station 7	95	93	24.2	3.9	2.62	2.29	0.11	8.2	5.12	0.82	87
	Station 8	120	112	26.8	4.2	2.74	2.43	0.09	9.4	5.46	0.84	86
	Station 9	109	106	27.0	4.0	2.77	2.45	0.09	9.2	5.58	0.84	85
Standard Deviation	Station 1	14	14	2.6	0.51	0.17	0.15	0.03	1.8	0.49	0.04	6.7
	Station 2	19	19	3.3	0.59	0.09	0.09	0.02	0.5	0.60	0.04	2.7
	Station 3	11	11	4.3	0.86	0.13	0.08	0.01	1.4	0.99	0.01	3.2
	Station 4	58	54	7.4	0.89	0.27	0.29	0.03	2.5	1.11	0.02	3.2
	Station 5	14	13	5.3	0.94	0.25	0.19	0.02	3.6	1.13	0.04	1.4
	Station 6	22	22	2.0	0.84	0.06	0.04	0.01	1.1	0.41	0.03	3.0
	Station 7	8	8	3.2	0.25	0.15	0.13	0.02	1.6	0.62	0.02	4.5
	Station 8	23	21	5.5	0.36	0.16	0.15	0.01	0.9	1.00	0.02	4.0
	Station 9	11	10	4.1	0.73	0.13	0.10	0.01	1.6	0.85	0.02	1.9
Station Total	Station 1	476	450	45	10.00	2.58	2.44	0.16	8	7.20	0.68	83
	Station 2	409	399	38	10.50	2.81	2.66	0.10	10	6.18	0.77	86
	Station 3	509	493	53	9.30	3.08	2.91	0.07	11	8.39	0.78	86
	Station 4	559	543	51	10.65	3.09	2.94	0.08	13	7.94	0.79	89
	Station 5	690	664	55	12.07	3.04	2.91	0.08	11	8.31	0.76	86
	Station 6	550	534	40	13.35	2.89	2.76	0.09	10	6.21	0.78	84
	Station 7	474	464	43	10.79	2.91	2.77	0.09	10	6.84	0.77	87
	Station 8	598	561	55	10.20	3.05	2.90	0.08	11	8.53	0.76	86
	Station 9	544	531	46	11.54	2.99	2.85	0.08	10	7.17	0.78	86
Survey	Total	98	94	22	4.27	2.25	1.97	0.20	6	4.62	0.73	83

SUSAN J. WILLIAMS

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Education

B.S.	Marine Biology, California State University, Long Beach
Certificate	Environmental Studies, California State University, Long Beach
M.S.	Biology, California State University, Long Beach

Credential

Instructor, California Community Colleges
Subjects: Biological Sciences, Marine Sciences, Ecology

Qualifications

Susan Williams is an environmental scientist with over thirty years experience in ecological monitoring and assessment. She has a strong background in natural history and an excellent working knowledge of such varied communities as coastal sage scrub, coastal dunes, wetlands, and marine benthos. Ms. Williams also has training in hazardous materials management, including courses and seminars in CEQA, environmental auditing, and the fate of toxins in the environment. She has an extensive background in biological survey techniques and laboratory methodology.

The postgraduate Environmental Studies Certificate provided interdisciplinary training in economics, public health issues, environmental toxicology, and assessing human impacts on terrestrial and marine environments.

Professional Employment

- 1989-present. Consultant and Contract Employee. Projects include Shoreline Recovery Study of the Exxon Valdez spill, terrestrial ecological survey of a Superfund site, and various benthic surveys, and environmental education.
- 1990-present. Interpretive Specialist, City of Ventura (Community Services). As part of the Interpretive Outreach Program, deliver classroom and field presentations on a variety of natural and cultural history topics; program development.
- 1993 - 1994. Park Ranger (Interpretive Division), Channel Islands National Park. Staff Visitor Center, present programs to school groups and general public, develop public programs (Tidepools, Island Ethnobotany).
- 1989 - 1994. Part-time Instructor, Oxnard College. Topics taught include Microbiology, Marine Biology, Biology, and Environmental Sciences.
- 1986 - 1989. Researcher, Battelle Ocean Sciences, Ventura. Laboratory supervisor, task leader for monitoring program, taxonomist, safety officer.
- 1984 - 1986. Research Scientist, Harbors Environmental Project, University of Southern California. Assessment of the marine environment of Marina Del Rey; monitoring offshore 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, 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 stations, supervised laboratory.
- 1975 - 1978. Associate Research 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.

Miscellaneous

Charter Member, Southern California Association of Marine Invertebrate Taxonomists

Participant, Boys & Girls Club of Ventura Career Fair

Judge, Ventura County Science Fair (2004-present). Assigned categories included Zoology, Botany, and Human Biology, junior division (grades 6-8)

Publications and Technical Reports

Ms. Williams has published 13 papers, ranging from taxonomic works and ecological analyses to articles on environmental issues for the general public.

Detailed list available upon request.

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 from 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 Point Bar, CT. These tests were conducted from 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 from 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 data analysis of epifaunal communities on the reefs and infaunal communities surrounding the reefs, wrote sections

Roy K. Kropp (Continued)

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

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APPENDIX D

Sediment Properties: October 2008 Survey

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APPENDIX D

Sediment Properties of Samples Collected during October 2008 Offshore Survey

Table D.1 Sediment Grab Sample Collection Record

Station	Sample	Date	Time ^a	Penetration Depth (cm)	Latitude	Longitude	Sediment Type	Sediment Color	Comments/ Observations ^b
1	Bio 1	10/07/2008	12:04:20	8.5	35° 23.720' N	120° 52.690' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	12:06:34	10.0	35° 23.719' N	120° 52.690' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	12:08:53	10.0	35° 23.719' N	120° 52.692' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	12:11:15	10.0	35° 23.722' N	120° 52.696' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	12:15:57	9.0	35° 23.720' N	120° 52.692' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	07:13:16	N/A	35° 23.722' N	120° 52.666' W	Sand	Lt. Brown	
2	Bio 1	10/07/2008	07:31:06	8.0	35° 23.283' N	120° 52.531' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	07:39:10	8.0	35° 23.288' N	120° 52.529' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	07:43:55	8.5	35° 23.284' N	120° 52.529' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	07:46:33	7.8	35° 23.284' N	120° 52.529' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	07:49:01	7.0	35° 23.283' N	120° 52.531' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	07:32:06	N/A	35° 23.276' N	120° 52.504' W	Sand	Lt. Brown	
3	Bio 1	10/07/2008	07:59:40	10.0	35° 23.230' N	120° 52.522' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	08:02:16	8.0	35° 23.229' N	120° 52.530' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	08:04:46	9.0	35° 23.232' N	120° 52.531' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	08:07:14	7.0	35° 23.231' N	120° 52.528' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	08:09:30	8.5	35° 23.225' N	120° 52.530' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	07:44:17	N/A	35° 23.228' N	120° 52.501' W	Sand	Lt. Brown	
4	Bio 1	10/07/2008	08:27:14	8.0	35° 23.204' N	120° 52.495' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	08:31:54	8.0	35° 23.202' N	120° 52.497' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	08:34:25	9.0	35° 23.207' N	120° 52.496' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	08:36:35	7.5	35° 23.206' N	120° 52.497' W	Sand	Lt. Brown	<i>P. brevispinus</i> released
	Bio 5	10/07/2008	08:40:54	8.5	35° 23.200' N	120° 52.498' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	07:57:53	N/A	35° 23.205' N	120° 52.502' W	Sand	Lt. Brown	
5	Bio 1	10/07/2008	09:45:37	9.5	35° 23.189' N	120° 52.514' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	09:47:54	8.0	35° 23.184' N	120° 52.512' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	09:50:04	8.5	35° 23.190' N	120° 52.515' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	09:52:14	9.5	35° 23.184' N	120° 52.512' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	09:54:28	10.0	35° 23.187' N	120° 52.514' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	08:11:12	N/A	35° 23.182' N	120° 52.500' W	Sand	Lt. Brown	
6	Bio 1	10/07/2008	10:22:50	7.5	35° 23.165' N	120° 52.510' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	10:25:18	8.0	35° 23.167' N	120° 52.512' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	10:27:28	7.5	35° 23.165' N	120° 52.512' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	10:29:34	9.0	35° 23.170' N	120° 52.513' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	10:31:35	7.5	35° 23.171' N	120° 52.513' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	08:24:07	N/A	35° 23.159' N	120° 52.502' 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 Sediment Grab Sample Collection Record

Station	Sample	Date	Time ^a	Penetration Depth (cm)	Latitude	Longitude	Sediment Type	Sediment Color	Comments/ Observations ^b
7	Bio 1	10/07/2008	10:44:11	8.5	35° 23.111' N	120° 52.519' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	10:46:40	10.0	35° 23.108' N	120° 52.524' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	10:49:08	7.0	35° 23.108' N	120° 52.522' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	10:51:14	9.5	35° 23.111' N	120° 52.527' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	10:53:36	8.5	35° 23.111' N	120° 52.525' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	08:38:05	N/A	35° 23.111' N	120° 52.505' W	Sand	Lt. Brown	
8	Bio 1	10/07/2008	11:06:42	7.0	35° 23.196' N	120° 52.552' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	11:09:39	9.5	35° 23.200' N	120° 52.546' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	11:11:45	9.5	35° 23.199' N	120° 52.541' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	11:13:59	8.5	35° 23.201' N	120° 52.536' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	11:16:12	8.0	35° 23.205' N	120° 52.535' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	08:59:00	N/A	35° 23.191' N	120° 52.541' W	Sand	Lt. Brown	
9	Bio 1	10/07/2008	11:32:08	9.5	35° 23.195' N	120° 52.466' W	Sand	Lt. Brown	
	Bio 2	10/07/2008	11:37:09	7.0	35° 23.190' N	120° 52.478' W	Sand	Lt. Brown	
	Bio 3	10/07/2008	11:39:17	8.0	35° 23.189' N	120° 52.478' W	Sand	Lt. Brown	
	Bio 4	10/07/2008	11:41:28	8.5	35° 23.188' N	120° 52.479' W	Sand	Lt. Brown	
	Bio 5	10/07/2008	11:44:15	8.5	35° 23.188' N	120° 52.479' W	Sand	Lt. Brown	
	Chem 1	10/08/2008	09:10:58	N/A	35° 23.190' N	120° 52.465' W	Sand	Lt. Brown	

Table D.2 Grain-Size Class Distribution in October 2008 Sediment Samples

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	0.028%	1.192%	1.015%	2.902%	73.471%	20.908%	0.343%	0.142%
Station 2	0.000%	0.080%	0.113%	1.051%	82.546%	15.776%	0.434%	0.001%
Station 3	0.000%	0.691%	0.885%	3.167%	82.667%	12.156%	0.309%	0.125%
Station 4	0.047%	0.650%	0.973%	2.910%	84.176%	11.008%	0.115%	0.121%
Station 5	0.101%	0.522%	0.556%	2.203%	83.753%	12.466%	0.232%	0.168%
Station 6	0.000%	0.453%	0.791%	2.219%	81.542%	14.584%	0.388%	0.023%
Station 7	0.000%	0.271%	0.605%	1.773%	79.435%	17.473%	0.344%	0.098%
Station 7(d)	0.000%	0.220%	0.616%	2.072%	81.449%	15.238%	0.340%	0.064%
Station 8	0.000%	0.135%	0.407%	1.918%	80.297%	16.737%	0.345%	0.161%
Station 9	0.000%	0.600%	0.677%	2.901%	83.125%	12.339%	0.350%	0.007%

Table D.3 Grain-Size Weight Distribution in October 2008 Sediment Samples

Phi Size (µm) Class	Dry Weight (grams)			Percentage Summary		
	<-1 to 4	>4	Total	-2 to -1	-1 to 4	4 to >9
	2000 to 62.5	<62.5		2000	1000 to 62.5	<62.5
	Coarse	Fine		Gravel	Sand	Mud
Station 1	104.518	0.509	105.027	0.028%	99.488%	0.485%
Station 2	100.836	0.441	101.277	0.000%	99.565%	0.435%
Station 3	103.007	0.449	103.456	0.000%	99.566%	0.434%
Station 4	103.897	0.246	104.143	0.047%	99.717%	0.236%
Station 5	103.087	0.414	103.501	0.101%	99.499%	0.400%
Station 6	102.708	0.424	103.132	0.000%	99.589%	0.411%
Station 7	104.147	0.463	104.610	0.000%	99.557%	0.443%
Station 7(d)	105.404	0.428	105.832	0.000%	99.596%	0.404%
Station 8	103.859	0.528	104.387	0.000%	99.494%	0.506%
Station 9	102.410	0.367	102.777	0.000%	99.643%	0.357%

Table D.4 Grain-Size Statistics for October 2008 Sediment Samples

Station	Percent Coarser than Listed Diameter (µm)								
	Mean (φ)	σ (φ)	Skewness (φ)	Mean (µm)	5%	16%	50%	84%	95%
1	2.71	0.402	0.01	153	252	198	154	118	95
2	2.71	0.302	0.12	153	210	184	154	125	100
3	2.62	0.345	0.03	163	247	202	163	130	105
4	2.61	0.329	0.01	164	245	202	164	132	109
5	2.64	0.323	0.06	160	232	196	161	130	105
6	2.67	0.335	0.06	157	232	195	158	126	102
7	2.71	0.336	0.08	153	223	189	154	122	99
7(d)	2.68	0.330	0.07	156	227	192	157	125	101
8	2.70	0.334	0.09	154	222	190	155	123	99
9	2.63	0.335	0.04	162	240	199	162	130	105

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APPENDIX E

Sediment Chemistry: October 2008 Survey Methods, Results, and QA/QC

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Methods

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**Table E.1 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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Analytical Results

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843	ND	
TCMX (Surrogate)	38.9	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	95.2	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 13:46	JYT	GC-1	0.997	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	

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Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624	ND	
2-Fluorophenol (Surrogate)	64.2	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		
Phenol-d5 (Surrogate)	63.2	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-01			Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
Nitrobenzene-d5 (Surrogate)	61.3	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		
2-Fluorobiphenyl (Surrogate)	43.3	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	69.4	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		
p-Terphenyl-d14 (Surrogate)	69.0	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:04	SKC	MS-B2	1.010	BRJ1624		

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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Moisture	23.9	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	97	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:49	JSM	SC-1	0.962	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	33	mg O/kg	7.5	7.5	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.250	BRJ0934	ND	
Solids	76.1	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-01		Client Sample Name: Station 1, 10/8/2008 7:13:00AM, 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
Arsenic	2.3	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 12:34	DIW	PE1	0.962	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	
Chromium	46	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	
Copper	2.4	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	0.26	
Lead	2.1	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 16:39	DIW	PE1	0.962	BRJ0763	ND	
Mercury	0.029	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:08	MEV	CETAC1	0.919	BRJ0699	ND	J
Nickel	28	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 11:35	DIW	PE1	0.962	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	
Aluminum	4800	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	
Iron	6900	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:13	ARD	PE-OP1	0.962	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843	ND	
TCMX (Surrogate)	43.1	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	97.4	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 13:59	JYT	GC-1	0.997	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624	ND	
2-Fluorophenol (Surrogate)	80.4	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		
Phenol-d5 (Surrogate)	82.0	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-02			Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Nitrobenzene-d5 (Surrogate)	82.0	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		
2-Fluorobiphenyl (Surrogate)	53.6	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	98.4	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		
p-Terphenyl-d14 (Surrogate)	88.8	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 20:43	SKC	MS-B2	0.993	BRJ1624		

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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Moisture	27.1	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	110	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:52	JSM	SC-1	0.962	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	26	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	72.9	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-02		Client Sample Name: Station 2, 10/8/2008 7:32:00AM, 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
Arsenic	2.6	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 12:41	DIW	PE1	0.952	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	
Chromium	35	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	
Copper	2.7	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	0.26	
Lead	1.6	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 16:46	DIW	PE1	0.952	BRJ0763	ND	
Mercury	0.032	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:10	MEV	CETAC1	1.008	BRJ0699	ND	J
Nickel	38	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 11:41	DIW	PE1	0.952	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	
Aluminum	4200	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	
Iron	6800	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:15	ARD	PE-OP1	0.952	BRJ0759	ND	

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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843	ND	
TCMX (Surrogate)	38.7	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	78.5	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:13	JYT	GC-1	1.003	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624	ND	
2-Fluorophenol (Surrogate)	67.5	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		
Phenol-d5 (Surrogate)	66.5	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Nitrobenzene-d5 (Surrogate)	63.2	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		
2-Fluorobiphenyl (Surrogate)	41.5	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	75.0	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		
p-Terphenyl-d14 (Surrogate)	63.1	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:31	SKC	MS-B2	1.014	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
Moisture	25.1	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	100	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:54	JSM	SC-1	0.962	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	26	mg O/kg	7.5	7.5	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.250	BRJ0934	ND	
Solids	74.9	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Total Concentrations (TTLC)

BCL Sample ID: 0813326-03		Client Sample Name: Station 3, 10/8/2008 7:44:00AM, 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
Arsenic	2.8	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 12:47	DIW	PE1	0.952	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	
Chromium	33	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	
Copper	2.5	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	0.26	
Lead	1.6	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 16:52	DIW	PE1	0.952	BRJ0763	ND	
Mercury	0.017	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:12	MEV	CETAC1	0.977	BRJ0699	ND	J
Nickel	34	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 11:47	DIW	PE1	0.952	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	
Aluminum	4200	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	
Iron	6600	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:24	ARD	PE-OP1	0.952	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843	ND	
TCMX (Surrogate)	32.8	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	97.6	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:26	JYT	GC-1	0.984	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID:	0813326-04		Client Sample Name:	Station 4, 10/8/2008 7:58:00AM, Jerry Mason									
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624	ND	
2-Fluorophenol (Surrogate)	61.0	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		
Phenol-d5 (Surrogate)	61.9	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-04			Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
Nitrobenzene-d5 (Surrogate)	61.0	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		
2-Fluorobiphenyl (Surrogate)	38.5	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		S09
2,4,6-Tribromophenol (Surrogate)	60.9	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		
p-Terphenyl-d14 (Surrogate)	58.4	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 22:58	SKC	MS-B2	0.993	BRJ1624		

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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
Moisture	23.1	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	81	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:56	JSM	SC-1	0.962	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	28	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	76.9	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-04		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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
Arsenic	2.8	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:05	DIW	PE1	0.980	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	
Chromium	28	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	
Copper	2.2	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	0.27	
Lead	1.5	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:10	DIW	PE1	0.980	BRJ0763	ND	
Mercury	0.025	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:14	MEV	CETAC1	0.919	BRJ0699	ND	J
Nickel	29	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:05	DIW	PE1	0.980	BRJ0763	ND	
Zinc	9.7	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	
Aluminum	3900	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	
Iron	6100	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:26	ARD	PE-OP1	0.980	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843	ND	
TCMX (Surrogate)	36.6	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	94.0	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:39	JYT	GC-1	1	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624	ND	
2-Fluorophenol (Surrogate)	72.5	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		
Phenol-d5 (Surrogate)	73.7	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Nitrobenzene-d5 (Surrogate)	70.5	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		
2-Fluorobiphenyl (Surrogate)	42.9	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	75.4	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		
p-Terphenyl-d14 (Surrogate)	74.5	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:25	SKC	MS-B2	0.990	BRJ1624		

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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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
Moisture	25.0	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	100	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:57	JSM	SC-1	1	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	27	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	75.0	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-05		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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
Arsenic	2.7	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:12	DIW	PE1	0.962	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	
Chromium	35	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	
Copper	2.5	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	0.26	
Lead	1.6	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:17	DIW	PE1	0.962	BRJ0763	ND	
Mercury	0.025	mg/kg	0.13	0.012	EPA-7471A	10/10/08	10/13/08 11:16	MEV	CETAC1	0.822	BRJ0699	ND	J
Nickel	34	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:11	DIW	PE1	0.962	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	
Aluminum	4200	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	
Iron	6700	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:28	ARD	PE-OP1	0.962	BRJ0759	ND	

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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843	ND	
TCMX (Surrogate)	30.1	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	73.8	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 14:53	JYT	GC-1	1.003	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID:	0813326-06	Client Sample Name:	Station 6, 10/8/2008 8:24:00AM, 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
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	

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Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	

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Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	

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Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624	ND	
2-Fluorophenol (Surrogate)	51.8	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		
Phenol-d5 (Surrogate)	50.8	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		

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Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-06			Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
Nitrobenzene-d5 (Surrogate)	47.1	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		
2-Fluorobiphenyl (Surrogate)	39.6	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	45.2	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		S09
p-Terphenyl-d14 (Surrogate)	47.6	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/24/08 23:52	SKC	MS-B2	1.003	BRJ1624		

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EPA Method 1664

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Chemical Analysis

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
Moisture	24.9	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	92	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:58	JSM	SC-1	1	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	31	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	75.1	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-06		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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
Arsenic	2.7	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:18	DIW	PE1	0.990	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	
Chromium	34	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	
Copper	2.5	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	0.27	
Lead	1.6	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:23	DIW	PE1	0.990	BRJ0763	ND	
Mercury	0.018	mg/kg	0.14	0.012	EPA-7471A	10/10/08	10/13/08 11:18	MEV	CETAC1	0.868	BRJ0699	ND	J
Nickel	35	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:17	DIW	PE1	0.990	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	
Aluminum	4200	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	
Iron	6800	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:30	ARD	PE-OP1	0.990	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843	ND	
TCMX (Surrogate)	24.1	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	73.4	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 15:46	JYT	GC-1	1	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624	ND	
2-Fluorophenol (Surrogate)	86.7	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		
Phenol-d5 (Surrogate)	86.4	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-07			Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Nitrobenzene-d5 (Surrogate)	76.4	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		
2-Fluorobiphenyl (Surrogate)	35.7	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		S09
2,4,6-Tribromophenol (Surrogate)	94.6	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		
p-Terphenyl-d14 (Surrogate)	81.7	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:19	SKC	MS-B2	1.010	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Moisture	22.8	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	130	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:59	JSM	SC-1	1	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	24	mg O/kg	7.5	7.5	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.250	BRJ0934	ND	
Solids	77.2	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-07		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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
Arsenic	2.7	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:24	DIW	PE1	0.962	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	
Chromium	36	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	
Copper	2.5	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	0.26	
Lead	1.6	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:29	DIW	PE1	0.962	BRJ0763	ND	
Mercury	0.025	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:20	MEV	CETAC1	0.947	BRJ0699	ND	J
Nickel	33	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:24	DIW	PE1	0.962	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	
Aluminum	4400	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	
Iron	6900	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:32	ARD	PE-OP1	0.962	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08	15:59	JYT	GC-1	1	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843	ND	
TCMX (Surrogate)	30.6	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	67.0	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 15:59	JYT	GC-1	1	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624	ND	
2-Fluorophenol (Surrogate)	79.0	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		
Phenol-d5 (Surrogate)	85.5	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Nitrobenzene-d5 (Surrogate)	75.2	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		
2-Fluorobiphenyl (Surrogate)	39.6	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	89.3	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		
p-Terphenyl-d14 (Surrogate)	78.6	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 00:46	SKC	MS-B2	1.003	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Moisture	25.9	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	100	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 12:59	JSM	SC-1	1	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	30	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	74.1	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Total Concentrations (TTLIC)

BCL Sample ID: 0813326-08		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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
Arsenic	2.8	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:30	DIW	PE1	0.971	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	
Chromium	39	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	
Copper	2.9	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	0.26	
Lead	1.7	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:35	DIW	PE1	0.971	BRJ0763	ND	
Mercury	0.024	mg/kg	0.16	0.014	EPA-7471A	10/10/08	10/13/08 11:27	MEV	CETAC1	0.919	BRJ0699	ND	J
Nickel	38	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:30	DIW	PE1	0.971	BRJ0763	ND	
Zinc	12	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	
Aluminum	4700	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	
Iron	7400	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:34	ARD	PE-OP1	0.971	BRJ0759	ND	

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Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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
Aldrin	ND	mg/kg	0.00050	0.000026	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
alpha-BHC	ND	mg/kg	0.00050	0.00014	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
beta-BHC	ND	mg/kg	0.00050	0.00038	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
delta-BHC	ND	mg/kg	0.00050	0.000076	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.00050	0.00025	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Chlordane (Technical)	ND	mg/kg	0.050	0.015	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
4,4'-DDD	ND	mg/kg	0.00050	0.000063	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDE	ND	mg/kg	0.00050	0.000045	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	V11
4,4'-DDT	ND	mg/kg	0.00050	0.000031	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Dieldrin	ND	mg/kg	0.00050	0.000032	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan I	ND	mg/kg	0.00050	0.000086	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan II	ND	mg/kg	0.00050	0.000066	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Endosulfan sulfate	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Endrin	ND	mg/kg	0.00050	0.000035	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Endrin aldehyde	ND	mg/kg	0.00050	0.000061	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor	ND	mg/kg	0.00050	0.00026	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Heptachlor epoxide	ND	mg/kg	0.00050	0.00015	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Methoxychlor	ND	mg/kg	0.00050	0.00013	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	V11
Toxaphene	ND	mg/kg	0.050	0.0074	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1016	ND	mg/kg	0.010	0.0027	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1221	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1232	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Organochlorine Pesticides and PCB's (EPA Method 8080)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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
PCB-1242	ND	mg/kg	0.010	0.0016	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1248	ND	mg/kg	0.010	0.0012	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1254	ND	mg/kg	0.010	0.00078	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
PCB-1260	ND	mg/kg	0.010	0.0022	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
Total PCB's (Summation)	ND	mg/kg	0.010	0.0050	EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843	ND	
TCMX (Surrogate)	27.8	%	65 - 129 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843		S09
Dibutyl chlorendate (Surrogate)	81.2	%	65 - 173 (LCL - UCL)		EPA-8080	10/21/08	10/27/08 16:19	JYT	GC-1	1.003	BRJ1843		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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
Acenaphthene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Acenaphthylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Aldrin	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Aniline	ND	mg/kg	0.20	0.12	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Anthracene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzidine	ND	mg/kg	3.0	0.22	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]anthracene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[b]fluoranthene	ND	mg/kg	0.10	0.0098	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[k]fluoranthene	ND	mg/kg	0.10	0.018	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[a]pyrene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzo[g,h,i]perylene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzoic acid	ND	mg/kg	0.50	0.031	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl alcohol	ND	mg/kg	0.10	0.016	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Benzyl butyl phthalate	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
alpha-BHC	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
beta-BHC	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
delta-BHC	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
gamma-BHC (Lindane)	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethoxy)methane	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroethyl) ether	ND	mg/kg	0.10	0.0087	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Chloroisopropyl)ether	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
bis(2-Ethylhexyl)phthalate	ND	mg/kg	0.20	0.038	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
4-Bromophenyl phenyl ether	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloroaniline	ND	mg/kg	0.10	0.086	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chloronaphthalene	ND	mg/kg	0.10	0.0080	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chlorophenyl phenyl ether	ND	mg/kg	0.10	0.0092	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Chrysene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDD	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDE	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4,4'-DDT	ND	mg/kg	0.10	0.021	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzo[a,h]anthracene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Dibenzofuran	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Dichlorobenzene	ND	mg/kg	0.10	0.010	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
1,3-Dichlorobenzene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
1,4-Dichlorobenzene	ND	mg/kg	0.10	0.0089	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
3,3-Dichlorobenzidine	ND	mg/kg	0.20	0.064	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Dieldrin	ND	mg/kg	0.10	0.024	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Diethyl phthalate	ND	mg/kg	0.10	0.020	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Dimethyl phthalate	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-butyl phthalate	ND	mg/kg	0.10	0.0094	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrotoluene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,6-Dinitrotoluene	ND	mg/kg	0.10	0.017	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Di-n-octyl phthalate	ND	mg/kg	0.10	0.0081	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
1,2-Diphenylhydrazine	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Endosulfan I	ND	mg/kg	0.20	0.021	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan II	ND	mg/kg	0.20	0.029	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Endosulfan sulfate	ND	mg/kg	0.10	0.038	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin	ND	mg/kg	0.20	0.088	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Endrin aldehyde	ND	mg/kg	0.50	0.12	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Fluoranthene	ND	mg/kg	0.10	0.0096	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Fluorene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Heptachlor epoxide	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorobutadiene	ND	mg/kg	0.10	0.0099	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachlorocyclopentadiene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Hexachloroethane	ND	mg/kg	0.10	0.0077	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Indeno[1,2,3-cd]pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Isophorone	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylnaphthalene	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Naphthalene	ND	mg/kg	0.10	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Naphthylamine	ND	mg/kg	3.0	0.031	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitroaniline	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
3-Nitroaniline	ND	mg/kg	0.20	0.11	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitroaniline	ND	mg/kg	0.20	0.051	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Nitrobenzene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
N-Nitrosodimethylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodi-N-propylamine	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
N-Nitrosodiphenylamine	ND	mg/kg	0.10	0.0097	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Phenanthrene	ND	mg/kg	0.10	0.013	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Pyrene	ND	mg/kg	0.10	0.015	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
1,2,4-Trichlorobenzene	ND	mg/kg	0.10	0.014	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4-Chloro-3-methylphenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Chlorophenol	ND	mg/kg	0.10	0.0091	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dichlorophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dimethylphenol	ND	mg/kg	0.10	0.030	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4,6-Dinitro-2-methylphenol	ND	mg/kg	0.50	0.0075	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4-Dinitrophenol	ND	mg/kg	0.50	0.055	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Methylphenol	ND	mg/kg	0.10	0.023	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
3- & 4-Methylphenol	ND	mg/kg	0.20	0.019	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Nitrophenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
4-Nitrophenol	ND	mg/kg	0.20	0.0094	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Pentachlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
Phenol	ND	mg/kg	0.10	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,5-Trichlorophenol	ND	mg/kg	0.20	0.012	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2,4,6-Trichlorophenol	ND	mg/kg	0.20	0.011	EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624	ND	
2-Fluorophenol (Surrogate)	93.6	%	42 - 123 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		
Phenol-d5 (Surrogate)	95.2	%	38 - 121 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Base Neutral and Acid Extractables Organic Analysis (EPA Method 8270C)

BCL Sample ID: 0813326-09			Client Sample Name: Station 9, 10/8/2008 9:11:00AM, Jerry Mason										
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Nitrobenzene-d5 (Surrogate)	90.1	%	41 - 125 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		
2-Fluorobiphenyl (Surrogate)	61.1	%	39 - 128 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		
2,4,6-Tribromophenol (Surrogate)	114	%	49 - 135 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		
p-Terphenyl-d14 (Surrogate)	101	%	36 - 156 (LCL - UCL)		EPA-8270C	10/17/08	10/25/08 01:13	SKC	MS-B2	1.003	BRJ1624		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

EPA Method 1664

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, Jerry Mason											
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date/Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Qualls
Oil and Grease	ND	mg/kg	50	21	EPA-1664HE	10/17/08	10/17/08 09:00	JAK	MAN-SV	1	BRJ1279	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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
Moisture	23.8	%	0.05	0.05	Calc	10/14/08	10/22/08 21:51	TMS	Calc	1	BRJ0905	ND	
Total Kjeldahl Nitrogen	81	mg/kg	40	20	EPA-351.2	10/10/08	10/14/08 13:01	JSM	SC-1	0.962	BRJ0692	ND	
Volatile Solids	ND	%	0.200	0.200	SM-2540G	10/13/08	10/13/08 11:30	MSA	Inst	1	BRJ2113		
Biochemical Oxygen Demand	32	mg O/kg	10	10	SM17-5210B	10/09/08	10/09/08 12:00	HPR	YSI-57	0.333	BRJ0934	ND	
Solids	76.2	%	0.05	0.05	SM-2540G	10/13/08	10/13/08 09:55	VBA	MANUAL	1	BRJ0839		

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Total Concentrations (TTLC)

BCL Sample ID: 0813326-09		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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
Arsenic	2.8	mg/kg	0.50	0.17	EPA-7060A	10/13/08	10/15/08 13:37	DIW	PE1	0.952	BRJ0763	ND	
Cadmium	ND	mg/kg	0.50	0.035	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	
Chromium	31	mg/kg	0.50	0.13	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	
Copper	2.4	mg/kg	1.0	0.15	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	0.26	
Lead	1.5	mg/kg	0.50	0.082	EPA-7421	10/13/08	10/15/08 17:42	DIW	PE1	0.952	BRJ0763	ND	
Mercury	0.031	mg/kg	0.14	0.012	EPA-7471A	10/10/08	10/13/08 11:29	MEV	CETAC1	0.845	BRJ0699	ND	J
Nickel	32	mg/kg	0.50	0.12	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	
Silver	ND	mg/kg	0.25	0.052	EPA-272.2	10/13/08	10/16/08 12:36	DIW	PE1	0.952	BRJ0763	ND	
Zinc	11	mg/kg	2.5	0.35	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	
Aluminum	4000	mg/kg	5.0	2.7	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	
Iron	6400	mg/kg	5.0	1.2	EPA-6010B	10/13/08	10/14/08 10:36	ARD	PE-OP1	0.952	BRJ0759	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-10		Client Sample Name: Sample 1, 10/8/2008 7:13:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
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Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-11		Client Sample Name: Sample 2, 10/8/2008 7:32:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-12		Client Sample Name: Station 3, 10/8/2008 7:32:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-13		Client Sample Name: Station 4, 10/8/2008 7:58:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-14		Client Sample Name: Station 5, 10/8/2008 8:11:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-15		Client Sample Name: Station 6, 10/8/2008 8:24:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-16		Client Sample Name: Station 7, 10/8/2008 8:38:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-17		Client Sample Name: Station 8, 10/8/2008 8:59:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Water Analysis (General Chemistry)

BCL Sample ID: 0813326-18		Client Sample Name: Station 9, 10/8/2008 9:11:00AM, 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	10/09/08	10/09/08 02:00	MRM	SPEC05	1	BRJ0561	ND	

QA/QC and Chains of Custody

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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		Lab Quals
										RPD	Percent Recovery	
Acenaphthene	BRJ1624	Matrix Spike	0813326-02	ND	1.3273	1.6779	mg/kg		79.1		45 - 132	
		Matrix Spike Duplicate	0813326-02	ND	1.0738	1.6502	mg/kg	19.4	65.1	29	45 - 132	
1,4-Dichlorobenzene	BRJ1624	Matrix Spike	0813326-02	ND	1.0654	1.6779	mg/kg		63.5		35 - 113	
		Matrix Spike Duplicate	0813326-02	ND	0.85475	1.6502	mg/kg	20.3	51.8	28	35 - 113	
2,4-Dinitrotoluene	BRJ1624	Matrix Spike	0813326-02	ND	1.2394	1.6779	mg/kg		73.9		22 - 123	
		Matrix Spike Duplicate	0813326-02	ND	1.1745	1.6502	mg/kg	3.7	71.2	30	22 - 123	
Hexachlorobenzene	BRJ1624	Matrix Spike	0813326-02	ND	1.2309	1.6779	mg/kg		73.4		40 - 125	
		Matrix Spike Duplicate	0813326-02	ND	1.0799	1.6502	mg/kg	11.5	65.4	27	40 - 125	
Hexachlorobutadiene	BRJ1624	Matrix Spike	0813326-02	ND	0.87953	1.6779	mg/kg		52.4		34 - 100	
		Matrix Spike Duplicate	0813326-02	ND	0.60967	1.6502	mg/kg	34.7	36.9	30	34 - 100	Q02
Hexachloroethane	BRJ1624	Matrix Spike	0813326-02	ND	1.1516	1.6779	mg/kg		68.6		22 - 116	
		Matrix Spike Duplicate	0813326-02	ND	0.89999	1.6502	mg/kg	22.9	54.5	30	22 - 116	
Nitrobenzene	BRJ1624	Matrix Spike	0813326-02	ND	1.2526	1.6779	mg/kg		74.7		34 - 110	
		Matrix Spike Duplicate	0813326-02	ND	1.0460	1.6502	mg/kg	16.4	63.4	29	34 - 110	
N-Nitrosodi-N-propylamine	BRJ1624	Matrix Spike	0813326-02	ND	1.2376	1.6779	mg/kg		73.8		38 - 94	
		Matrix Spike Duplicate	0813326-02	ND	1.0972	1.6502	mg/kg	10.4	66.5	29	38 - 94	
Pyrene	BRJ1624	Matrix Spike	0813326-02	ND	1.0812	1.6779	mg/kg		64.4		38 - 152	
		Matrix Spike Duplicate	0813326-02	ND	0.99396	1.6502	mg/kg	6.7	60.2	30	38 - 152	
1,2,4-Trichlorobenzene	BRJ1624	Matrix Spike	0813326-02	ND	1.0182	1.6779	mg/kg		60.7		33 - 111	
		Matrix Spike Duplicate	0813326-02	ND	0.81226	1.6502	mg/kg	20.9	49.2	29	33 - 111	
4-Chloro-3-methylphenol	BRJ1624	Matrix Spike	0813326-02	ND	1.6603	1.6779	mg/kg		99.0		50 - 126	
		Matrix Spike Duplicate	0813326-02	ND	1.3721	1.6502	mg/kg	17.5	83.1	27	50 - 126	
2-Chlorophenol	BRJ1624	Matrix Spike	0813326-02	ND	1.3050	1.6779	mg/kg		77.8		42 - 116	
		Matrix Spike Duplicate	0813326-02	ND	1.1067	1.6502	mg/kg	14.8	67.1	27	42 - 116	
2-Methylphenol	BRJ1624	Matrix Spike	0813326-02	ND	1.4072	1.6779	mg/kg		83.9		27 - 124	
		Matrix Spike Duplicate	0813326-02	ND	1.2411	1.6502	mg/kg	10.9	75.2	26	27 - 124	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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	Percent Recovery Lab Quals
3- & 4-Methylphenol	BRJ1624	Matrix Spike	0813326-02	ND	2.5252	1.6779	mg/kg		150		89 - 197
		Matrix Spike Duplicate	0813326-02	ND	2.2461	1.6502	mg/kg	9.8	136	28	89 - 197
4-Nitrophenol	BRJ1624	Matrix Spike	0813326-02	ND	1.3140	1.6779	mg/kg		78.3		37 - 128
		Matrix Spike Duplicate	0813326-02	ND	1.3151	1.6502	mg/kg	1.8	79.7	30	37 - 128
Pentachlorophenol	BRJ1624	Matrix Spike	0813326-02	ND	1.1368	1.6779	mg/kg		67.8		29 - 142
		Matrix Spike Duplicate	0813326-02	ND	1.0937	1.6502	mg/kg	2.2	66.3	27	29 - 142
Phenol	BRJ1624	Matrix Spike	0813326-02	ND	1.2393	1.6779	mg/kg		73.9		40 - 112
		Matrix Spike Duplicate	0813326-02	ND	1.0822	1.6502	mg/kg	11.9	65.6	28	40 - 112
2,4,6-Trichlorophenol	BRJ1624	Matrix Spike	0813326-02	ND	1.5054	1.6779	mg/kg		89.7		55 - 120
		Matrix Spike Duplicate	0813326-02	ND	1.3323	1.6502	mg/kg	10.6	80.7	28	55 - 120
2-Fluorophenol (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	2.2305	2.6846	mg/kg		83.1		42 - 123
		Matrix Spike Duplicate	0813326-02	ND	1.9083	2.6403	mg/kg		72.3		42 - 123
Phenol-d5 (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	2.1836	2.6846	mg/kg		81.3		38 - 121
		Matrix Spike Duplicate	0813326-02	ND	1.8614	2.6403	mg/kg		70.5		38 - 121
Nitrobenzene-d5 (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	2.1282	2.6846	mg/kg		79.3		41 - 125
		Matrix Spike Duplicate	0813326-02	ND	1.8581	2.6403	mg/kg		70.4		41 - 125
2-Fluorobiphenyl (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	1.8745	2.6846	mg/kg		69.8		39 - 128
		Matrix Spike Duplicate	0813326-02	ND	1.5224	2.6403	mg/kg		57.7		39 - 128
2,4,6-Tribromophenol (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	2.4013	2.6846	mg/kg		89.4		49 - 135
		Matrix Spike Duplicate	0813326-02	ND	2.2162	2.6403	mg/kg		83.9		49 - 135
p-Terphenyl-d14 (Surrogate)	BRJ1624	Matrix Spike	0813326-02	ND	1.0104	1.3423	mg/kg		75.3		36 - 156
		Matrix Spike Duplicate	0813326-02	ND	0.89241	1.3201	mg/kg		67.6		36 - 156

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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	<u>Control Limits</u>		Lab Quals
										RPD	Percent Recovery	
Oil and Grease	BRJ1279	Duplicate	0813326-09	ND	ND		mg/kg			30		
		Matrix Spike	0813326-09	ND	694.00	788.00	mg/kg		88.1		56 - 111	
		Matrix Spike Duplicate	0813326-09	ND	613.00	788.00	mg/kg	12.4	77.8	30	56 - 111	

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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	<u>Control Limits</u>		Lab Quals
										RPD	Percent Recovery	
Total Kjeldahl Nitrogen	BRJ0692	Duplicate	0813326-01	96.923	107.23		mg/kg	10.1		20		
		Matrix Spike	0813326-01	96.923	472.21	384.62	mg/kg		97.6		80 - 120	
		Matrix Spike Duplicate	0813326-01	96.923	500.58	384.62	mg/kg	7.3	105	20	80 - 120	
Solids	BRJ0839	Duplicate	0813326-01	76.100	75.500		%	0.8		20		
Biochemical Oxygen Demand	BRJ0934	Duplicate	0813326-01	33.245	28.121		mg O/kg	16.7		20		
Volatile Solids	BRJ2113	Duplicate	0813326-01	ND	ND		%			20		

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Reported: 10/31/2008 7:53

Total Concentrations (TTLIC)

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		Lab Quals
										RPD	Percent Recovery	
Mercury	BRJ0699	Duplicate	0813074-01	0.038235	0.028611		mg/kg	28.8		20		J,A02
		Matrix Spike	0813074-01	0.038235	0.77500	0.80645	mg/kg		91.4		85 - 115	
		Matrix Spike Duplicate	0813074-01	0.038235	0.75113	0.80645	mg/kg	3.3	88.4	20	85 - 115	
Cadmium	BRJ0759	Duplicate	0813451-02	0.22724	0.21647		mg/kg	4.9		20		J
		Matrix Spike	0813451-02	0.22724	9.1217	9.6154	mg/kg		92.5		75 - 125	
		Matrix Spike Duplicate	0813451-02	0.22724	8.7930	9.6154	mg/kg	3.7	89.1	20	75 - 125	
Chromium	BRJ0759	Duplicate	0813451-02	16.217	15.922		mg/kg	1.8		20		
		Matrix Spike	0813451-02	16.217	103.19	96.154	mg/kg		90.5		75 - 125	
		Matrix Spike Duplicate	0813451-02	16.217	99.169	96.154	mg/kg	4.8	86.3	20	75 - 125	
Copper	BRJ0759	Duplicate	0813451-02	10.278	10.196		mg/kg	0.8		20		
		Matrix Spike	0813451-02	10.278	100.61	96.154	mg/kg		93.9		75 - 125	
		Matrix Spike Duplicate	0813451-02	10.278	94.709	96.154	mg/kg	6.7	87.8	20	75 - 125	
Nickel	BRJ0759	Duplicate	0813451-02	21.533	21.523		mg/kg	0.0		20		
		Matrix Spike	0813451-02	21.533	113.10	96.154	mg/kg		95.2		75 - 125	
		Matrix Spike Duplicate	0813451-02	21.533	108.84	96.154	mg/kg	4.7	90.8	20	75 - 125	
Zinc	BRJ0759	Duplicate	0813451-02	27.534	28.096		mg/kg	2.0		20		
		Matrix Spike	0813451-02	27.534	114.70	96.154	mg/kg		90.7		75 - 125	
		Matrix Spike Duplicate	0813451-02	27.534	111.13	96.154	mg/kg	4.3	86.9	20	75 - 125	
Aluminum	BRJ0759	Duplicate	0813451-02	7038.0	7285.3		mg/kg	3.5		20		
		Matrix Spike	0813451-02	7038.0	7785.9	480.77	mg/kg		156		75 - 125	A03
		Matrix Spike Duplicate	0813451-02	7038.0	7473.5	480.77	mg/kg	53.0	90.6	20	75 - 125	A03,Q02
Iron	BRJ0759	Duplicate	0813451-02	12715	12998		mg/kg	2.2		20		
		Matrix Spike	0813451-02	12715	12442	480.77	mg/kg		-56.8		75 - 125	A03
		Matrix Spike Duplicate	0813451-02	12715	11787	480.77	mg/kg	109	-193	20	75 - 125	A03,Q02
Arsenic	BRJ0763	Duplicate	0813451-02	2.8441	2.7417		mg/kg	3.7		20		
		Matrix Spike	0813451-02	2.8441	12.238	9.6154	mg/kg		97.7		75 - 125	
		Matrix Spike Duplicate	0813451-02	2.8441	12.096	9.6154	mg/kg	1.5	96.2	20	75 - 125	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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	<u>Control Limits</u>		Lab Quals
										RPD	Percent Recovery	
Lead	BRJ0763	Duplicate	0813451-02	4.5445	4.5213		mg/kg	0.5		20		
		Matrix Spike	0813451-02	4.5445	105.94	96.154	mg/kg		105		75 - 125	
		Matrix Spike Duplicate	0813451-02	4.5445	105.39	96.154	mg/kg	0	105	20	75 - 125	
Silver	BRJ0763	Duplicate	0813451-02	ND	ND		mg/kg			20		
		Matrix Spike	0813451-02	ND	10.015	9.6154	mg/kg		104		75 - 125	
		Matrix Spike Duplicate	0813451-02	ND	9.9851	9.6154	mg/kg	0	104	20	75 - 125	

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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	<u>Control Limits</u>		Lab Quals
										RPD	Percent Recovery	
Dissolved Sulfide	BRJ0561	Duplicate	0813326-10	ND	ND		mg/L			10		
		Matrix Spike	0813326-10	ND	0.47674	0.50000	mg/L		95.3		80 - 120	
		Matrix Spike Duplicate	0813326-10	ND	0.47674	0.50000	mg/L	0	95.3	10	80 - 120	

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Reported: 10/31/2008 7:53

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		Lab Quals
										Percent Recovery	RPD	
Aldrin	BRJ1843	BRJ1843-BS1	LCS	0.0074944	0.0083056	0.00050	mg/kg	90.2		76 - 127		
gamma-BHC (Lindane)	BRJ1843	BRJ1843-BS1	LCS	0.0062163	0.0083056	0.00050	mg/kg	74.8		62 - 119		
4,4'-DDT	BRJ1843	BRJ1843-BS1	LCS	0.0078749	0.0083056	0.00050	mg/kg	94.8		46 - 118		
Dieldrin	BRJ1843	BRJ1843-BS1	LCS	0.0078517	0.0083056	0.00050	mg/kg	94.5		71 - 122		
Endrin	BRJ1843	BRJ1843-BS1	LCS	0.0076412	0.0083056	0.00050	mg/kg	92.0		67 - 126		
Heptachlor	BRJ1843	BRJ1843-BS1	LCS	0.0077690	0.0083056	0.00050	mg/kg	93.5		75 - 133		
TCMX (Surrogate)	BRJ1843	BRJ1843-BS1	LCS	0.010244	0.0099668		mg/kg	103		65 - 129		
Dibutyl chlorendate (Surrogate)	BRJ1843	BRJ1843-BS1	LCS	0.023991	0.024917		mg/kg	96.3		65 - 173		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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		Lab Quals
										Percent Recovery	RPD	
Acenaphthene	BRJ1624	BRJ1624-BS1	LCS	1.3674	1.6779	0.10	mg/kg	81.5		51 - 128		
1,4-Dichlorobenzene	BRJ1624	BRJ1624-BS1	LCS	1.0813	1.6779	0.10	mg/kg	64.4		38 - 110		
2,4-Dinitrotoluene	BRJ1624	BRJ1624-BS1	LCS	1.2249	1.6779	0.10	mg/kg	73.0		30 - 117		
Hexachlorobenzene	BRJ1624	BRJ1624-BS1	LCS	1.2486	1.6779	0.10	mg/kg	74.4		51 - 117		
Hexachlorobutadiene	BRJ1624	BRJ1624-BS1	LCS	1.0235	1.6779	0.10	mg/kg	61.0		38 - 98		
Hexachloroethane	BRJ1624	BRJ1624-BS1	LCS	1.1665	1.6779	0.10	mg/kg	69.5		27 - 114		
Nitrobenzene	BRJ1624	BRJ1624-BS1	LCS	1.1924	1.6779	0.10	mg/kg	71.1		33 - 108		
N-Nitrosodi-N-propylamine	BRJ1624	BRJ1624-BS1	LCS	1.0782	1.6779	0.10	mg/kg	64.3		37 - 93		
Pyrene	BRJ1624	BRJ1624-BS1	LCS	1.2605	1.6779	0.10	mg/kg	75.1		36 - 154		
1,2,4-Trichlorobenzene	BRJ1624	BRJ1624-BS1	LCS	1.1288	1.6779	0.10	mg/kg	67.3		37 - 107		
4-Chloro-3-methylphenol	BRJ1624	BRJ1624-BS1	LCS	1.4967	1.6779	0.20	mg/kg	89.2		47 - 124		
2-Chlorophenol	BRJ1624	BRJ1624-BS1	LCS	1.1066	1.6779	0.10	mg/kg	66.0		40 - 111		
2-Methylphenol	BRJ1624	BRJ1624-BS1	LCS	1.1636	1.6779	0.10	mg/kg	69.3		24 - 121		
3- & 4-Methylphenol	BRJ1624	BRJ1624-BS1	LCS	2.0398	1.6779	0.20	mg/kg	122		94 - 186		
4-Nitrophenol	BRJ1624	BRJ1624-BS1	LCS	1.0939	1.6779	0.20	mg/kg	65.2		40 - 116		
Pentachlorophenol	BRJ1624	BRJ1624-BS1	LCS	0.90517	1.6779	0.20	mg/kg	53.9		30 - 131		
Phenol	BRJ1624	BRJ1624-BS1	LCS	1.0484	1.6779	0.10	mg/kg	62.5		39 - 107		
2,4,6-Trichlorophenol	BRJ1624	BRJ1624-BS1	LCS	1.2912	1.6779	0.20	mg/kg	77.0		51 - 119		
2-Fluorophenol (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	1.8802	2.6846		mg/kg	70.0		42 - 123		
Phenol-d5 (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	1.8728	2.6846		mg/kg	69.8		38 - 121		
Nitrobenzene-d5 (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	1.8893	2.6846		mg/kg	70.4		41 - 125		
2-Fluorobiphenyl (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	1.9376	2.6846		mg/kg	72.2		39 - 128		
2,4,6-Tribromophenol (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	2.0114	2.6846		mg/kg	74.9		49 - 135		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

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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		Lab Quals
										Percent Recovery	RPD	
p-Terphenyl-d14 (Surrogate)	BRJ1624	BRJ1624-BS1	LCS	1.0674	1.3423		mg/kg	79.5		36 - 156		

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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	<u>Control Limits</u>		Lab Quals
										Percent Recovery	RPD	
Oil and Grease	BRJ1279	BRJ1279-BS1	LCS	576.00	788.00	50	mg/kg	73.1		59 - 117		

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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		Lab Quals
										Percent Recovery	RPD	
Total Kjeldahl Nitrogen	BRJ0692	BRJ0692-BS1	LCS	404.38	400.00	40	mg/kg	101		85 - 115		
Biochemical Oxygen Demand	BRJ0934	BRJ0934-BS1	LCS	189.48	198.00	38	mg O/kg	95.7		85 - 115		

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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		Lab Quals
										Percent Recovery	RPD	
Mercury	BRJ0699	BRJ0699-BS1	LCS	1.3865	1.5000	0.16	mg/kg	92.4		75 - 125		
Cadmium	BRJ0759	BRJ0759-BS1	LCS	10.079	10.000	0.50	mg/kg	101		75 - 125		
Chromium	BRJ0759	BRJ0759-BS1	LCS	103.03	100.00	0.50	mg/kg	103		75 - 125		
Copper	BRJ0759	BRJ0759-BS1	LCS	100.27	100.00	1.0	mg/kg	100		75 - 125		
Nickel	BRJ0759	BRJ0759-BS1	LCS	112.29	100.00	0.50	mg/kg	112		75 - 125		
Zinc	BRJ0759	BRJ0759-BS1	LCS	105.60	100.00	2.5	mg/kg	106		75 - 125		
Aluminum	BRJ0759	BRJ0759-BS1	LCS	537.99	500.00	5.0	mg/kg	108		75 - 125		
Iron	BRJ0759	BRJ0759-BS1	LCS	541.34	500.00	5.0	mg/kg	108		75 - 125		
Arsenic	BRJ0763	BRJ0763-BS1	LCS	10.265	10.000	1.0	mg/kg	103		75 - 125		
Lead	BRJ0763	BRJ0763-BS2	LCS	104.66	100.00	10	mg/kg	105		75 - 125		
Silver	BRJ0763	BRJ0763-BS3	LCS	10.340	10.000	5.0	mg/kg	103		75 - 125		

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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	<u>Control Limits</u>		Lab Quals
										Percent Recovery	RPD	
Dissolved Sulfide	BRJ0561	BRJ0561-BS1	LCS	0.50759	0.50000	0.10	mg/L	102		90 - 110		

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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	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000026	
alpha-BHC	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00014	
beta-BHC	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00038	
delta-BHC	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000076	
gamma-BHC (Lindane)	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00025	
Chlordane (Technical)	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.050	0.015	
4,4'-DDD	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000063	V11
4,4'-DDE	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000045	V11
4,4'-DDT	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000031	
Dieldrin	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000032	
Endosulfan I	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000086	
Endosulfan II	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000066	
Endosulfan sulfate	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00013	
Endrin	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000035	
Endrin aldehyde	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.000061	
Heptachlor	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00026	
Heptachlor epoxide	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00015	
Methoxychlor	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.00050	0.00013	V11
Toxaphene	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.050	0.0074	
PCB-1016	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0027	
PCB-1221	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0050	
PCB-1232	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0012	
PCB-1242	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0016	
PCB-1248	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0012	

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Project Number: [none]
Project Manager: Doug Coats

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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-1254	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.00078	
PCB-1260	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0022	
Total PCB's (Summation)	BRJ1843	BRJ1843-BLK1	ND	mg/kg	0.010	0.0050	
TCMX (Surrogate)	BRJ1843	BRJ1843-BLK1	60.9	%	65 - 129 (LCL - UCL)		S09
Dibutyl chlorendate (Surrogate)	BRJ1843	BRJ1843-BLK1	137	%	65 - 173 (LCL - UCL)		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
Acenaphthylene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
Aldrin	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
Aniline	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.12	
Anthracene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0098	
Benzidine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	3.0	0.22	
Benzo[a]anthracene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
Benzo[b]fluoranthene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0098	
Benzo[k]fluoranthene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.018	
Benzo[a]pyrene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	
Benzo[g,h,i]perylene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
Benzoic acid	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.50	0.031	
Benzyl alcohol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.016	
Benzyl butyl phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
alpha-BHC	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
beta-BHC	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
delta-BHC	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
gamma-BHC (Lindane)	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
bis(2-Chloroethoxy)methane	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
bis(2-Chloroethyl) ether	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0087	
bis(2-Chloroisopropyl)ether	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
bis(2-Ethylhexyl)phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.038	
4-Bromophenyl phenyl ether	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	
4-Chloroaniline	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.086	

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Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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-Chloronaphthalene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0080	
4-Chlorophenyl phenyl ether	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0092	
Chrysene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	
4,4'-DDD	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
4,4'-DDE	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.017	
4,4'-DDT	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.021	
Dibenzo[a,h]anthracene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.017	
Dibenzofuran	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
1,2-Dichlorobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.010	
1,3-Dichlorobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
1,4-Dichlorobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0089	
3,3-Dichlorobenzidine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.064	
Dieldrin	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.024	
Diethyl phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.020	
Dimethyl phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0097	
Di-n-butyl phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0094	
2,4-Dinitrotoluene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
2,6-Dinitrotoluene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.017	
Di-n-octyl phthalate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0081	
1,2-Diphenylhydrazine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	
Endosulfan I	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.021	
Endosulfan II	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.029	
Endosulfan sulfate	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.038	
Endrin	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.088	

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Project: Annual Benthic Sediment Sampling for MBTP
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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
Endrin aldehyde	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.50	0.12	
Fluoranthene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0096	
Fluorene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
Heptachlor	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
Heptachlor epoxide	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
Hexachlorobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	
Hexachlorobutadiene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0099	
Hexachlorocyclopentadiene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
Hexachloroethane	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0077	
Indeno[1,2,3-cd]pyrene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
Isophorone	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
2-Methylnaphthalene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
Naphthalene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.011	
2-Naphthylamine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	3.0	0.031	
2-Nitroaniline	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
3-Nitroaniline	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.11	
4-Nitroaniline	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.051	
Nitrobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
N-Nitrosodimethylamine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
N-Nitrosodi-N-propylamine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
N-Nitrosodiphenylamine	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0097	
Phenanthrene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.013	
Pyrene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.015	
1,2,4-Trichlorobenzene	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.014	

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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-Chloro-3-methylphenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.012	
2-Chlorophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.0091	
2,4-Dichlorophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
2,4-Dimethylphenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.030	
4,6-Dinitro-2-methylphenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.50	0.0075	
2,4-Dinitrophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.50	0.055	
2-Methylphenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.023	
3- & 4-Methylphenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.019	
2-Nitrophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
4-Nitrophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.0094	
Pentachlorophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.011	
Phenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.10	0.012	
2,4,5-Trichlorophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.012	
2,4,6-Trichlorophenol	BRJ1624	BRJ1624-BLK1	ND	mg/kg	0.20	0.011	
2-Fluorophenol (Surrogate)	BRJ1624	BRJ1624-BLK1	76.9	%	42 - 123 (LCL - UCL)		
Phenol-d5 (Surrogate)	BRJ1624	BRJ1624-BLK1	77.2	%	38 - 121 (LCL - UCL)		
Nitrobenzene-d5 (Surrogate)	BRJ1624	BRJ1624-BLK1	83.6	%	41 - 125 (LCL - UCL)		
2-Fluorobiphenyl (Surrogate)	BRJ1624	BRJ1624-BLK1	84.8	%	39 - 128 (LCL - UCL)		
2,4,6-Tribromophenol (Surrogate)	BRJ1624	BRJ1624-BLK1	87.3	%	49 - 135 (LCL - UCL)		
p-Terphenyl-d14 (Surrogate)	BRJ1624	BRJ1624-BLK1	97.5	%	36 - 156 (LCL - UCL)		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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	BRJ1279	BRJ1279-BLK1	ND	mg/kg	50	21	

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Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Chemical Analysis

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Total Kjeldahl Nitrogen	BRJ0692	BRJ0692-BLK1	ND	mg/kg	40	20	
Moisture	BRJ0905	BRJ0905-BLK1	ND	%	0.05	0.05	
Biochemical Oxygen Demand	BRJ0934	BRJ0934-BLK1	ND	mg O/kg	0.98	0.98	

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Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Total Concentrations (TTLIC)

Quality Control Report - Method Blank Analysis

Constituent	Batch ID	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Mercury	BRJ0699	BRJ0699-BLK1	ND	mg/kg	0.16	0.014	
Cadmium	BRJ0759	BRJ0759-BLK1	ND	mg/kg	0.50	0.035	
Chromium	BRJ0759	BRJ0759-BLK1	ND	mg/kg	0.50	0.13	
Copper	BRJ0759	BRJ0759-BLK1	0.27126	mg/kg	1.0	0.15	J
Nickel	BRJ0759	BRJ0759-BLK1	ND	mg/kg	0.50	0.12	
Zinc	BRJ0759	BRJ0759-BLK1	ND	mg/kg	2.5	0.35	
Aluminum	BRJ0759	BRJ0759-BLK1	ND	mg/kg	5.0	2.7	
Iron	BRJ0759	BRJ0759-BLK1	ND	mg/kg	5.0	1.2	
Arsenic	BRJ0763	BRJ0763-BLK1	ND	mg/kg	0.50	0.17	
Lead	BRJ0763	BRJ0763-BLK2	ND	mg/kg	0.50	0.082	
Silver	BRJ0763	BRJ0763-BLK3	ND	mg/kg	0.25	0.052	



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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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	BRJ0561	BRJ0561-BLK1	ND	mg/L	0.10	0.050	

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Notes And Definitions

J	Estimated Value (CLP Flag)
MDL	Method Detection Limit
ND	Analyte Not Detected at or above the reporting limit
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
A02	The difference between duplicate readings is less than the PQL.
A03	The sample concentration is more than 4 times the spike level.
Q02	Matrix spike precision is not within the control limits.
Q03	Matrix spike recovery(s) is(are) not within the control limits.
S09	The surrogate recovery on the sample for this compound was not within the control limits.
V11	The Continuing Calibration Verification (CCV) recovery is not within established control limits.



Laboratories, Inc.

Chain of Custody Form

PLEASE COMPLETE
BCL QUOTE ID: _____

Page 1 of 1

Report To: Marine research specialist
Client: Marine research specialist Project #: MO Sediment
Attn: DR. Dany Coats Project Name: annual sampling
Street Address: 3140 Telegraph Rd Global ID #:
City, State, Zip: Ventura CA 93003 Sampler(s): Jerry mason
Phone: Fax:
Email Address:
Work Order #: 0813326

Analysis Requested

Comments:

Dissolved sulfides were
Fluocuated in field +
Transferred to a sulfide bottle

Sample # Description Date Sampled Time Sampled

-1	Station 1	10/8/08	0713
-2	Station 2		0732
-3	Station 3		0744
-4	Station 4		0758
-5	Station 5		0811
-6	Station 6		0824
-7	Station 7		0838
-8	Station 8		0859
-9	Station 9		0911

moisture 160.3 or BL	total volatile solids 160.4	BOD 405.1 or 100.4	TKN 351.2	dissolved sulfide 376.2	oil & grease 41.2 or	EPA 1664 heavy	Al, Fe, AS, Cd	total chromium, Cu, Pb	Hg, Ni, Ag, Zn, 8080	8270 *
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X

Sample Matrix

Sludge	Drinking Water	Ground Water	Waste Water	Other

Are there any tests with holding times less than or equal to 48 hours?
☐ Yes ☐ No
* Standard Turnaround = 10 work days

Notes

32.9 Jm 230ml
11 p
"
"
"
"
"
"

CHK BY

DISTRIBUTION

JIMAS

SUB OUT

HOLDING TIME

Cr ⁶⁺	NO ₂	NO ₃	OP	SS
DO	Cl ₂	BOD	MBAS	COT

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

1. Relinquished By Jerry mason Date 10-8-08 Time 1540
2. Relinquished By _____ Date _____ Time _____
3. Relinquished By _____ Date _____ Time _____

Special Reporting

☐ QC ☐ EDF ☐ Raw Data

1. Received By Chris M. N... Date 10/8/08
2. Received By _____ Date _____
3. Received By _____ Date _____

Submission #: 0813326

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 ☐ Containers ☐ None ☒ Comments: _____Intact? Yes ☐ No ☐Intact? Yes ☐ No ☐All samples received? Yes ☒ No ☐All samples containers intact? Yes ☒ No ☐Description(s) match COC? Yes ☒ No ☐

COC Received

YES

NO

Emissivity: .95 Container: 80L PR Thermometer ID: TH80Temperature: A 3.3 °C / C 3.5 °CDate/Time 10-8-08Analyst Init CM

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	A	A	A	A	A	A	A	A	A	
2oz. NITRATE / NITRITE										
PT TOTAL ORGANIC CARBON										
PT 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		1								
QT EPA 549										
QT EPA 632										
QT EPA 8015M										
QT AMBER										
8 OZ. JAR										
32 OZ. JAR	B	B	B	B	B	B	B	B	B	
SOIL SLEEVE										
PCB VIAL										
PLASTIC BAG										
FERROUS IRON										
ENCORE										

Comments: _____

Sample Numbering Completed By: ALA Date/Time: 10-8-8

A = Actual / C = Corrected

1720

Marine Research Specialists
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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

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		Lab Quals
										RPD	Percent Recovery	
Aldrin	BRJ1843	Matrix Spike	0813326-01	ND	0.0047777	0.0082237	mg/kg		58.1		67 - 133	Q03
		Matrix Spike Duplicate	0813326-01	ND	0.0058592	0.0081967	mg/kg	20.7	71.5	30	67 - 133	
gamma-BHC (Lindane)	BRJ1843	Matrix Spike	0813326-01	ND	0.0046902	0.0082237	mg/kg		57.0		58 - 117	Q03
		Matrix Spike Duplicate	0813326-01	ND	0.0053595	0.0081967	mg/kg	13.7	65.4	30	58 - 117	
4,4'-DDT	BRJ1843	Matrix Spike	0813326-01	ND	0.0050756	0.0082237	mg/kg		61.7		43 - 129	
		Matrix Spike Duplicate	0813326-01	ND	0.0061344	0.0081967	mg/kg	19.2	74.8	30	43 - 129	
Dieldrin	BRJ1843	Matrix Spike	0813326-01	ND	0.0053706	0.0082237	mg/kg		65.3		74 - 121	Q03
		Matrix Spike Duplicate	0813326-01	ND	0.0063185	0.0081967	mg/kg	16.6	77.1	30	74 - 121	
Endrin	BRJ1843	Matrix Spike	0813326-01	ND	0.0053057	0.0082237	mg/kg		64.5		46 - 144	
		Matrix Spike Duplicate	0813326-01	ND	0.0063168	0.0081967	mg/kg	17.8	77.1	30	46 - 144	
Heptachlor	BRJ1843	Matrix Spike	0813326-01	ND	0.0050931	0.0082237	mg/kg		61.9		72 - 132	Q03
		Matrix Spike Duplicate	0813326-01	ND	0.0062120	0.0081967	mg/kg	20.2	75.8	30	72 - 132	
TCMX (Surrogate)	BRJ1843	Matrix Spike	0813326-01	ND	0.0047865	0.0098684	mg/kg		48.5		65 - 129	S09
		Matrix Spike Duplicate	0813326-01	ND	0.0047507	0.0098361	mg/kg		48.3		65 - 129	
Dibutyl chlorendate (Surrogate)	BRJ1843	Matrix Spike	0813326-01	ND	0.025329	0.024671	mg/kg		103		65 - 173	
		Matrix Spike Duplicate	0813326-01	ND	0.027207	0.024590	mg/kg		111		65 - 173	

Date of Report: 11/05/2008

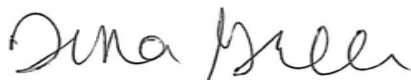
Doug Coats

Marine Research Specialists
3140 Telegraph Road, Suite A
Suite A
Ventura, CA 93003-3238

RE: Annual Benthic Sediment Sampling
BC Work Order: 0813326
Invoice ID: B052254

Enclosed are the results of analyses for samples received by the laboratory on 10/8/2008. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Contact Person: Tina Green
Client Services Manager



Authorized Signature

Marine Research Specialists
3140 Telegraph Road, Suite A
Suite A
Ventura, CA 93003-3238

Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0813326-01	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:13
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 1	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-02	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:32
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 2	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-03	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:44
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 3	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-04	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:58
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 4	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-05	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:11
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 5	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0813326-06	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:24
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 6	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-07	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:38
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 7	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-08	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:59
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 8	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-09	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 09:11
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 9	Sample Matrix:	Solids
	Sampled By:	Jerry Mason		
0813326-10	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:13
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Sample 1	Sample Matrix:	Water
	Sampled By:	Jerry Mason		

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Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0813326-11	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:32
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Sample 2	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-12	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:32
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 3	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-13	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 07:58
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 4	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-14	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:11
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 5	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-15	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:24
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 6	Sample Matrix:	Water
	Sampled By:	Jerry Mason		

Marine Research Specialists
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Ventura, CA 93003-3238

Project: Annual Benthic Sediment Sampling for MBTP
Project Number: [none]
Project Manager: Doug Coats

Reported: 10/31/2008 7:53

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
0813326-16	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:38
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 7	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-17	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 08:59
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 8	Sample Matrix:	Water
	Sampled By:	Jerry Mason		
0813326-18	COC Number:	---	Receive Date:	10/08/2008 16:08
	Project Number:	---	Sampling Date:	10/08/2008 09:11
	Sampling Location:	---	Sample Depth:	---
	Sampling Point:	Station 9	Sample Matrix:	Water
	Sampled By:	Jerry Mason		

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APPENDIX F

Laboratory Quality Assurance and Quality Control Plans

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APPENDIX F

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 according 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.

2008

**Morro Bay / Cayucos Wastewater
Treatment Plant**

**LABORATORY QUALITY
ASSURANCE MANUAL**

**Lab Director
Bruce Keogh**

Updated 3-30-06

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INTRODUCTION

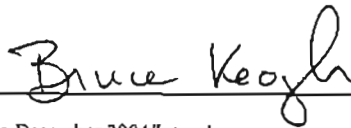
The Morro Bay – Cayucos Wastewater Treatment Plant Laboratory provides analytical services for the Morro Bay – Cayucos Wastewater Treatment Plant located at 160 Atascadero Road, the mailing address is 955 Shasta, Morro Bay, CA.

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



Date: 1-31-05

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 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:

<u>Constituent</u>	<u>Units</u>	<u>Sample Type</u>	<u>Minimum Frequency</u> <u>Sampling/Analysis</u>
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:

<u>Constituent</u>	<u>Units</u>	<u>Sample Type</u>	<u>Minimum Frequency</u> <u>Sampling/Analysis</u>
Daily Flow	MG	Metered	Daily
Maximum Daily Flow	MGD	Metered	Daily
Mean Daily Flow	MGD	Calculated	Monthly
Total Chlorine Residual	mg/l	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 ¹
Suspended Solids	mg/l	24-hr Composite	Weekly ¹
pH	pH units	Grab	Weekly ¹
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.
2. 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. DICHLOOROBENZENES 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, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-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:

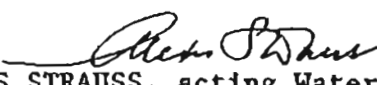
<u>Isomer Group</u>	<u>Toxicity Equivalent Factor</u>	<u>Isomer Group</u>	<u>Toxicity Equivalent Factor</u>
2,3,7,8-tetra CDD	1.0	1,2,3,7,8-penta CDF	0.05
2,3,7,8-penta CDD	0.5	2,3,4,7,8-penta CDF	0.5
2,3,7,8-hexa CDDs	0.1	2,3,7,8-hexa CDFs	0.1
2,3,7,8-hepta CDD	0.01	2,3,7,8-hepta CDFs	0.01
octa CDD	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 Board, 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

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.

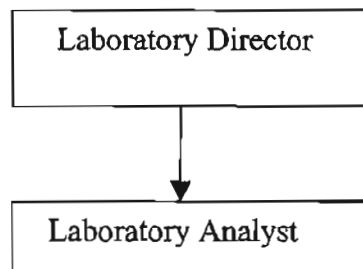
Bruce Keogh, Lab Director Bruce Keogh Date: 1-31-05

Lab/C/MyDocuments/Lab QC Docs/Lab QA Updates December 2004/qualityassuranceobjectives.doc

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:



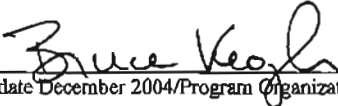
Responsibilities for each position in the Morro Bay – Cayucos Wastewater Treatment Plant Laboratory are as follows:

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  Date: 1-31-05
Lab/C/My Documents/Lab QC Docs/Lab QA Update December 2004/Program Organization and Responsibility

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 any 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
Lab/C/My Documents/Lab QC Docs/Lab QA update December 2004/Laboratory General Procedures

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

Lab/C/My Documents/Lab QC Docs/ Lab QA Updates December 2004/System Audits

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

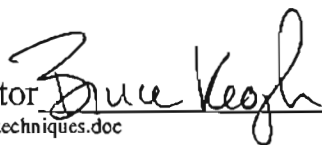
attention should be given to flushing the line by opening the valve and letting the old sludge in the line to run for at least two minutes. Then grab the sample.

Grab samples of mixed liquor suspended solids and return activated sludge are obtained at the south end of 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

Mydocuments/LabQCdocs/samplepoints&techniques.doc

 Date: 1-31-05

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 C

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 organisms.

Monitoring shall include observations of wind (direction 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:

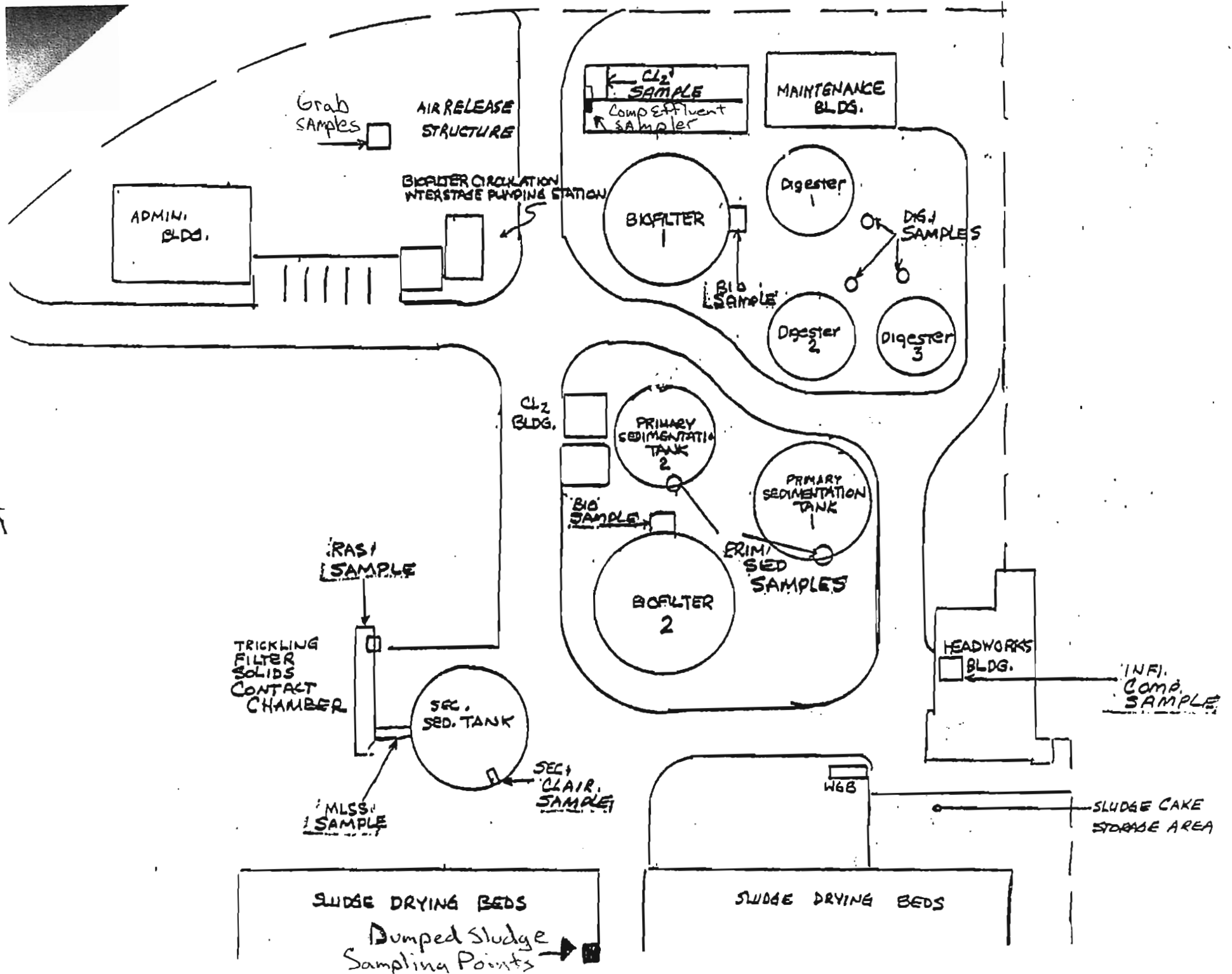
SAMPLING AND PRESERVATION
OF SAMPLES ACCORDING TO MEASUREMENT (1)

4A

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 ₂ SO 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 ₂ SO ₄ to pH 2	24 Hours (4)
Kjeldahl	P,G	Cool, 4°C H ₂ SO ₄ to pH 2	24 Hours (4)
Nitrate	P,G	Cool, 4°C H ₂ SO ₄ to pH 2	24 Hours (4)
Nitrite	P,G	Cool, 4°C H ₂ SO ₄ to pH 2	24 Hours (4)
Oil & Grease	G only	Cool, 4°C H ₂ SO ₄ to pH 2	24 Hours
Organic Carbon	P,G	Cool, 4°C H ₂ SO 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. 72-91 (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.

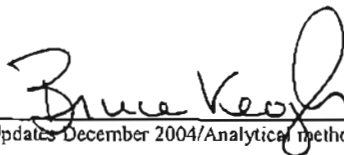


ANALYTICAL METHODS

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.

<u>Analysis</u>	<u>Method No.</u>
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



Date: 1-31-05

Lab/C/My Documents/Lab QC Docs/Lab QA Updates December 2004/Analytical methods

CALIBRATION PROCEDURES AND FREQUENCY

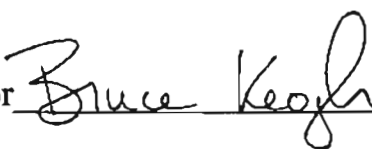
All laboratory instruments are to be calibrated prior to or during use. Instruments require calibration, standardization and informed observation to work accurately.

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



Date: 1-31-05

Lab/C/My Documents/Lab QC Docs/ Lab QA Updates December 2004/Calibration Procedures and Frequency

Data Reduction, Validation, and Reporting

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

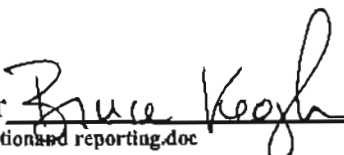
Data Validation:

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  Date: 1-31-05
Mydocuments/LabQCdocs/datareductionvalidationand reporting.doc

Maintenance of Laboratory Supplies

Standard Methods 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

Mydocuments/LabQCdocs/maintenanceoflabsupplies.doc



Date: 1-31-05



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

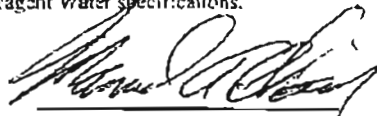
<u>TEST DESCRIPTION</u>	<u>TEST RESULT</u>
Conductivity	1.4 μ mhos/cm
pH	5.60
Total Organic Carbon	< 0.5 mg/L
Heavy Metals:	
Cadmium, Cd	< 0.001 mg/L
Chromium, Cr	< 0.002 mg/L
Copper, Cu	< 0.005 mg/L
Nickel, Ni	< 0.002 mg/L
Lead, Pb	< 0.001 mg/L
Zinc, Zn	< 0.025 mg/L
Ammonia/Organic Nitrogen	Passes USP 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 μ mhos/cm; Bacterial growth ratio: 0.8-3.0; 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) 749-3777

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

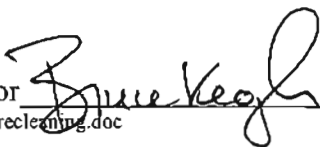
pH Spot Check:

Because some cleaning solutions are difficult to remove completely, spot check batches of clean 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
Mydocuments/LabQCdocs/glasswarecleaning.doc



Date: 1-31-05

PH Spot Check

[illegible]

Mydocuments/labQCdocs/phspotcheck.doc

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 $35^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$.
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____

Scale off in g. (s)

Date

#1

#2

#3

#4

Operator

Scale off in g. (s)

Date _____

#1

#2

#3

1 #4

Operator

EQUIPMENT TEMPERATURE RECORD
(C)

Month . Year .

Equipment_____. Certified Thermometer_____. +/-_____.

[illegible]

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 $121^{\circ} \pm 2^{\circ} \text{C}$. 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
Mydocuments/LabQCdocs/autoclave.doc

Bruce Keogh Date: 1-31-05

AUTOCLAVE RECORD SHEET

[illegible]

MYDOCUMENTS/LAB/AUTOCLAVESHEET.DOC

LAB OPEN UP

I. Procedures to open Lab:

- A. Check Temp of Bac T Incubator. ($35^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$)
- B. Check Oven Temp. ($103-105^{\circ}\text{C}$)
- C. Check BOD Incubator Temp. ($20^{\circ}\text{C} \pm 1.0^{\circ}\text{C}$)
- D. Check Refrigerator Temp. ($< 5.0^{\circ}\text{C}$)
- E. Check the Calibration of Turbidimeter. (see chart)
- F. Calibrate the PH. meter. (see Instructions)
- G. Check the H₂O Bath Temp. ($44.5^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$)

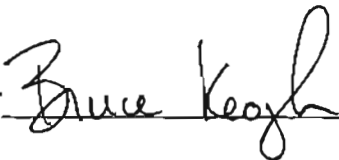
II. Other Open-up Duties:

- 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
Mydocumnets/LabQCdocs/labopenup.doc



Date: 1-31-05

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

Presumptive Test

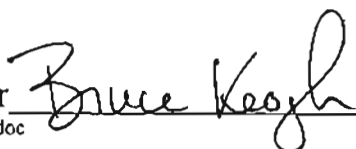
Inoculation of lactose broth

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 coliforms; thus gas formation in the BGLB medium constitutes a confirmed test: i.e. coliforms present.	Eosin-methylene agar (EMB). Coli-aerogenes organisms produce characteristic colonies; <u>Escherichia</u> : small colonies, dark, almost black centers, with greenish metallic sheen. <u>Enterobacter</u> : large, pinkish colonies, dark centers, rarely show metallic sheen. Presence of typical colonies constitutes a confirmed test: i.e. coliforms present.
Completed Test	
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).	Agar 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 Director
 Mydocuments/LabQCdocs/coliformgroupstest.doc



Date: 1-31-05

Coliform

Standard Methods 18th Edition, Page 9-45 to 9-53 Section 9221 A – E

Equipment

Pipettes – 10ml, 5ml, and 1ml
Durham tube (glass vials)
Test tubes with aluminum caps
Wire loop
35° C incubator
44.5° C incubator
Broths (LTB, BGB, EC)

Procedure

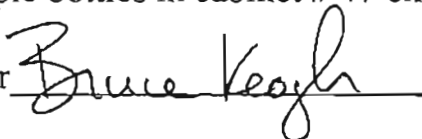
1. Make up and sterilize as on label of broth. Note: make up 1 liter of broth for approx. 80 tubes.
2. Put 10ml of broth in a test tube containing inverted durham tube using the automatic dispenser.
3. Put aluminum caps on.
4. Sterilize using autoclave.

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 pipettes 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
Mydocuments/LabQCdocs/coliformgroup1est

 Date: 1-31-05

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

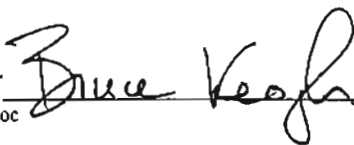
Any positive (gas production) LTB tube either at 24 hrs or 48 hrs is transferred to BGB. The BGB tubes replace the LTB tubes in the same spot.

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 18th edition page 9 – 45 sections 9221 a – e.

Bruce Keogh, Lab Director
Mydocuments/LabQCdocs/coliformgroup1cst.doc



Date: 1-31-05

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 positive/negative controls.

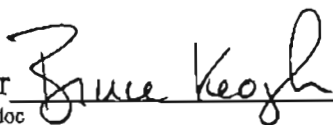
Using a steril inoculation loop transfer the appropriate bacteria to the prepared broths.

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 $\pm$ 0.5°C for 24 to 48 hours. Log results in lab book. EC broth will be incubated at 44.5° C $\pm$ 0.2° C for 24 hours only. Log results in lab book.

Bruce Keogh, Lab Director
Mydocuments/LabQCdocs/MediaQCPosNeg.doc



Date: 1-31-05

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)

[illegible]

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.

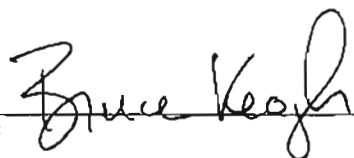
These tubes are then incubated in 35° C incubator by the east wall and checked at the end of 24 hours and 48 hours. The results are entered in the laboratory log book. At the end of 24 hours, transfer with transfer loop the positive tubes (gas production constitutes a positive result) to BLGB broth and 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 coliform 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
Mydocuments/LabQCdocs/coliformgroupstest.doc

 Date: 1-31-05

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:

R E C F I V I N G	N o n S D e e w b a r g i e s	Marine Growth							
		Storm\Shipping							
		Garbage\Refuse							
		Tars\Oils							
		TOTAL COLIFORM							
W A T E R S	S e D w e a b g r e i s	Soap\Grease balls							
		Rubber Goods							
		Fecal Material							
		FECAL COLIFORM							
B E A C H A R E A	N o n D S e b w r a i g s e	Marine Growth							
		Storm\Shipping							
		Garbage\Refuse							
		Tars\Oils							
	S e D w e a b g r e i s								
		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 first 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 hour 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:

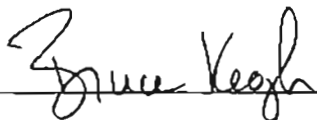
Mg. total nonfilterable residue $PPM = \frac{(a-b) \times 1000}{\text{Sample volume, ml.}}$

A= weight of filter paper + residue in mg. and

B= weight of filter paper, mg.

Note: 1.00 gr. = 1000mg

Bruce Keogh, Lab Director
Mydocuments/LabQCdocs/suspendedsolids.doc

 Date: 1-31-05

Suspended Solids Record

40

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 (trichloromethyl) 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.

Mydocuments/labQCdocs/BOD&DOMeter.doc

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
Mydocuments/labQCdocs/BOD&DOmeter.doc



Date: 1-31-05

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

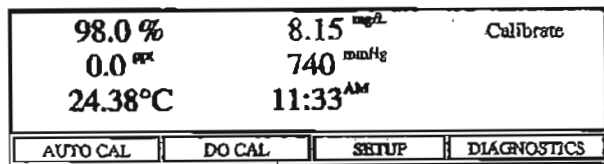
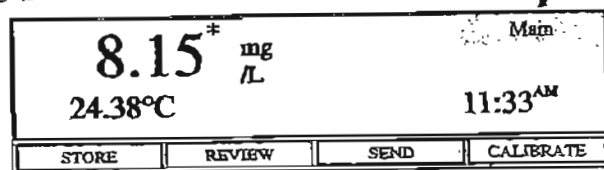
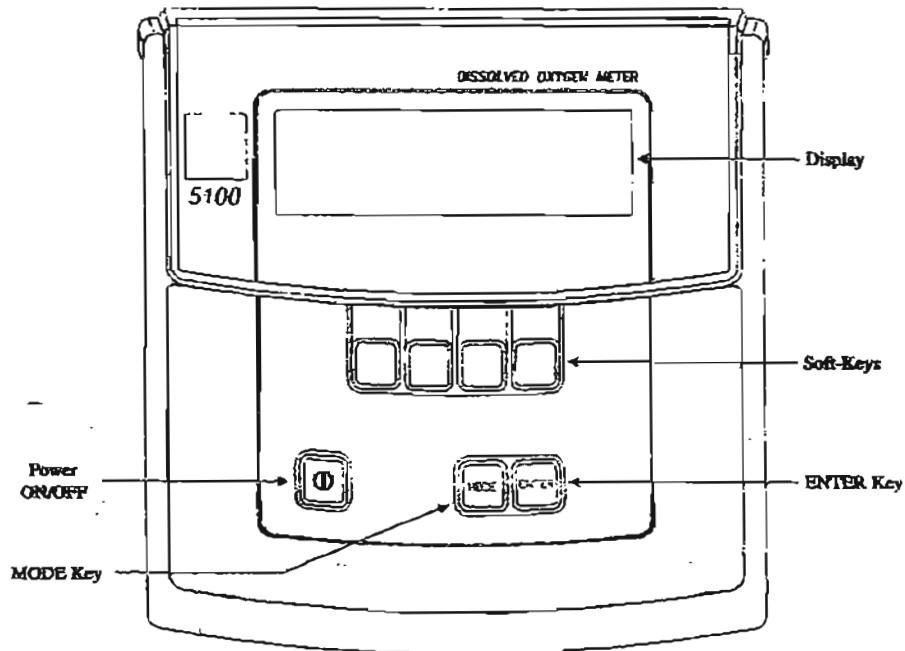
Mydocuments/LabQCdocs/BOD&Dometer.doc

Date 1-31-05

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)

[illegible]¹Time at start of incubation

²Include Time Sampler
On and period of
collection

5/5

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.

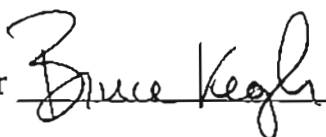
pH meter Cont.

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
Mydocuments/LabQCdocs/PH.doc

 Date: 1-31-05

PH. CALIBRATION

[illegible]

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:

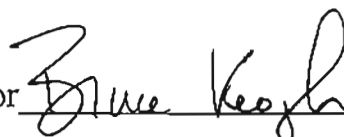
To get an accurate reading a dilution may be necessary for this test. Collect a sample of the wastewater or water to be tested in a clean sample bottle. Add 2.5 ml of sample to your 10ml grad. cylinder. Then fill the rest of the cylinder with DI water up to 10ml.

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
Mydocuments/LabQCdocs/chlorineresid.doc

 Date: 1-31-05

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 CAL key. The SO annunciator lights. The NTU value of the dilution water used in the previous water used in the pervious calibration is displayed.
5. 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.
6. 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.
7. 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.
8. Fill a clean sample cell to the line with well mixed 200 NTU Formazin standard, and complete the same steps used in # 7. This time the S3 light will show.
9. 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 S0 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:

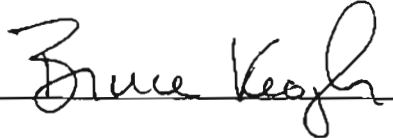
1. Collect a representative sample in a clean container. Fill the sample cell to the line. Take care to handle the sample cell by the top. Cap the sample cell. Our turbidimeter is designed to stay on 24hrs a day. If machine is ever turned off refer to Quick Reference Guide, step 1 in procedures.

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 18th edition page 2-8,9 sections 2130a-b.

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

Turbidity Meter Calibration

Standards Used #1_____, #2_____.

#3 _____, #4 _____.

[illegible]

Settleable Solids

Refer to Standard Methods 18th 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 for 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 Imhoff 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

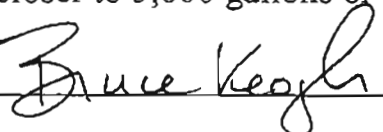
Example:

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:

$$\begin{aligned}\% \text{ Efficiency} &= \frac{(\text{ml influent}) - (\text{ml effluent})}{(\text{ml influent})} \times 100 \\ &= \frac{10.0 - 0.5}{10.0} \times 100 = 95\% \text{ removal}\end{aligned}$$

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
Mydocuments/LabQCdocs/settleablesolids.doc

 Date: 1-31-05

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 located in the lower headworks.

Method:

Partition-Gravimetric Method

Apparatus:

1. Separatory funnel, 1 Liter with teflon stoplock
2. Distilling flask
3. Water bath
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 trichlorotrifluoroethane (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:

$$\text{Mg oil and grease/L} = \frac{(A-B) \text{ in mg} \times 1000}{\text{Ml sample}}$$

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.

Grease and Oil Cont.

Refer to Standard Methods 18th Edition, page 2-51 section 2530 -c

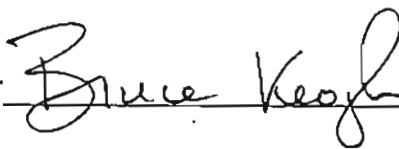
CAUTION !!!

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
Mydocuments/LabQCdocs/grease&oil.doc

 Date: 1-31-05

CAUTION:

Trichlorotrifluoroethane (freon) is extremely 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 separatory funnel properly.

— Avoid breathing the vapor of the solvent.

— Avoid getting the solvent on the skin.

— For additional information, refer to Standard Method 15th. edition, page 460.

Top open
for draining

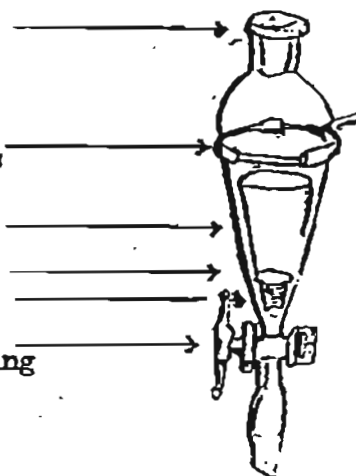
ring with
rubber cushions

top layer

interface

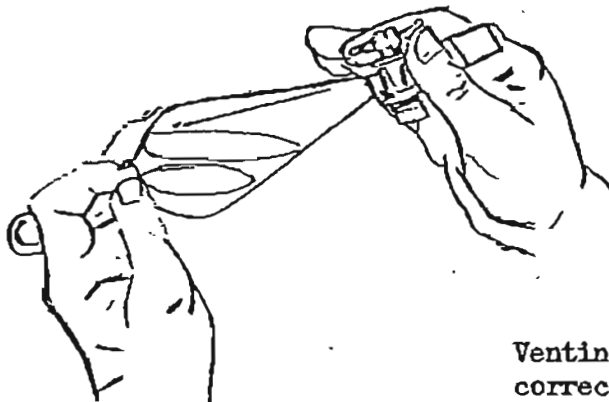
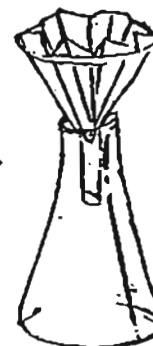
bottom layer

stopcock
open for draining



fluted filter
paper

Erlenmeyer
flask
(other kind of flask
can also be used)



Venting position, showing correct way of holding funnel for shaking and venting.

GREASE & OIL

NAME	DATE	TIME	SAMPLE DESCRIBE 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	
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				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	

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 supernatant 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:

1. Place about 200 ml of sludge into a centrifuge bottle and centrifuge for about 15 minutes, or filter sample through coarse paper.
2. Measure 100 ml of the supernatant 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.
7. 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 = _____

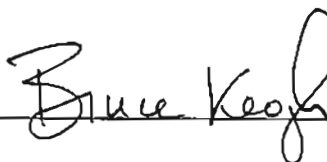
8. Calculation of the volatile acids = If 100 ml of sludge sample is taken, then Volatile acid in mg/L = (ml of standard NaOH used) x 86.5.
9. Record results of test. Volatile acids = _____ mg/L.
10. Sample calculation:
ml of Standard NaOH used = 2.0ml
Volatile acids, mg/L = (ml Std. NaOH used) x 86.5
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 for 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, reseedling 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 H₂SO₄ 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
Mydocuments/LabQCdocs/volatile acid.doc

 Date: 1-31-05

Alkalinity

Standard Methods 18th Edition, Page 2-25 Sections 2320 A-B

Equipment:

Graduated cylinder 50ml

Beaker 80ml

5ml Pipette

H₂SO₄ 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. Pour the 45ml D.I. water into 80ml beaker.
3. Take 5ml pipette and add 5ml of digester supernatant which has been separated 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 supernatant 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



Date: 1-31-08

Mydocuments/LabQCdocs/alkalinityvolatilematter,moisture.doc

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.			

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:

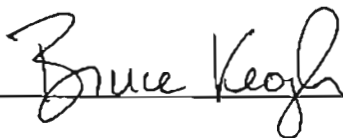
Porcelain dish
Furnace
Desiccator
Drying oven
Analytical balance

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 18th Edition Page 2-57 Section 2540 B,E

Bruce Keogh, Lab Director
Mydocument/labQCdocs/volatilematter.doc

 Date: 1-31-05

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 (100- MOISTURE)			

VOLATILE CONTENT

WT OF DISH & DRY SOLIDS			
WT OF DISH			
WT OF DRY SOLIDS			
WT OF DISH & DRY SOLIDS			
WT OF DISH & ASH			
LOSS IN WEIGHT			
VOLATILE 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, 3) 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.

1.1 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*, 3) *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, comprehensive standardization, 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 processing systems, technical review of raw data 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

The QA Officer is responsible for the maintenance of the QAPP. Review of this plan should take place by each department supervisor and 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.

QUALITY OBJECTIVES

3.0 QUALITY OBJECTIVES

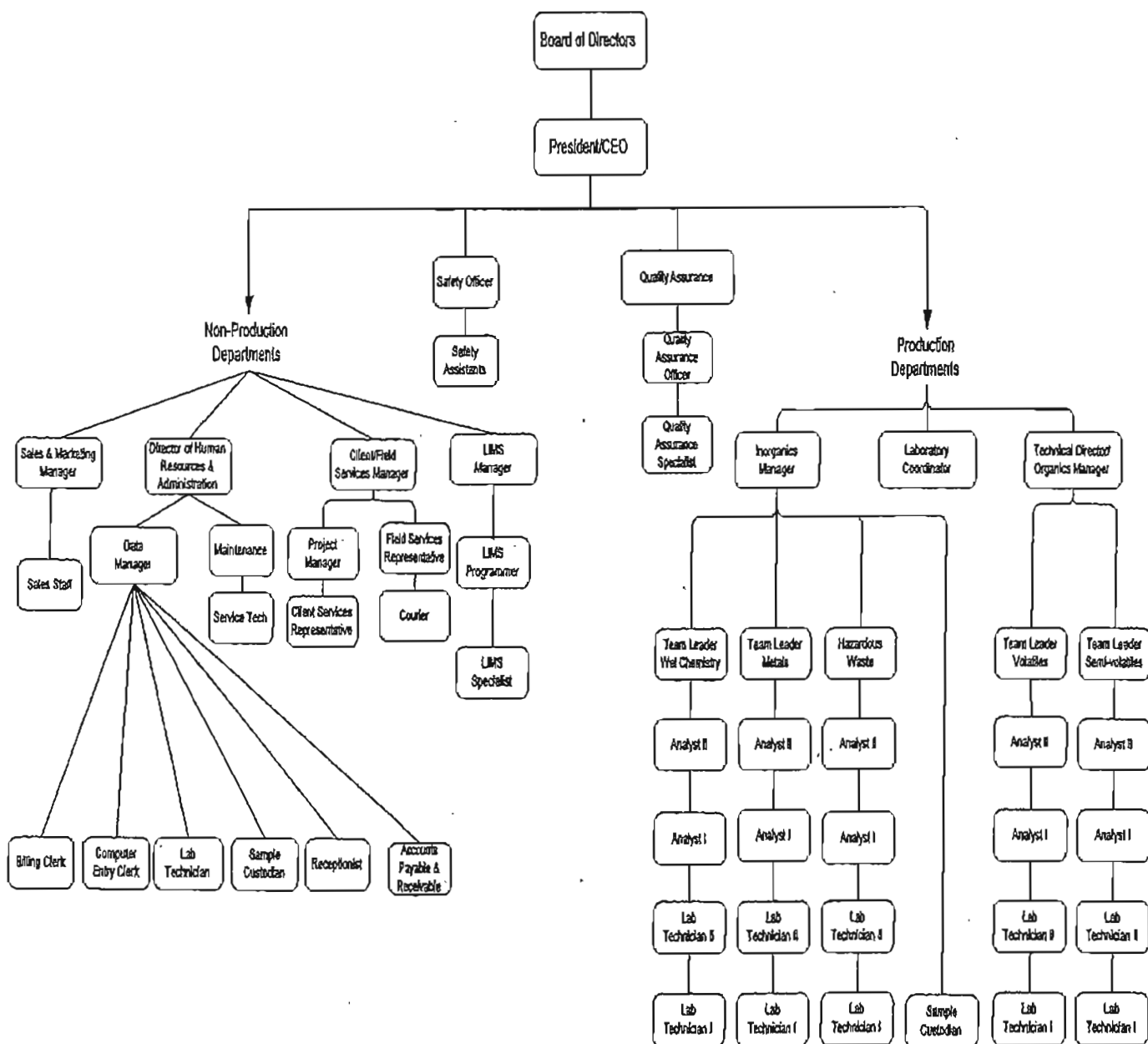
Quality assurance objectives are set to provide the metrics necessary to assess and ensure the quality of generated data. Laboratory QA objectives will be accomplished by applying EPA method acceptance criteria and laboratory internal controls for QC parameters including preparation blanks, surrogates, 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 precision 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 expressed 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 for 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. Special 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 Organizational Chart
Company Structure



SAMPLING PROCEDURES

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 Part 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 Logs 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 field 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 on a quarterly basis or whenever new containers are used.

Table 1 displays Information on proper containers, preservatives and holding times.

4.2.1 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 made 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

SAMPLING PROCEDURES

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 $\mu\text{g/L}$, 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 date 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 06/23/97.
The following weeks' sample is labeled - Batch 215A 05/30/97.

If any target analytes are quantified above 2.0 $\mu\text{g/L}$, a new trip blank batch should be processed.

4.2.3 EQUIPMENT BLANK

A sample of deionized water, which is poured over or through field sampling equipment. This water is processed 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 conducted 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 / CONTAINER ORDERING

Completing a bottle order is the responsibility of Client Service personnel. An order is completed by entering all 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.

SAMPLE CUSTODIAN

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 procedures established by the EPA for litigation-related practices. The Chain-of-Custody record 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.

5.2 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

[illegible]

SAMPLING PROCEDURES

TABLE 1

GENERAL/INORGANIC CHEMISTRY

ANALYSIS	CONTAINER	PRESERVATIVE	CONTAINER	HOLDING TIME (FROM SAMPLING DATE)	
	WATER	WATER (2-8°C)	SOIL	WATER	SOIL
ALKALINITY	PT. PE	UNPRESERVED	N/A	14 DAYS	N/A
AMMONIA (NH ₃)	PT. PE	H ₂ SO 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 ₂ SO 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 ₂ SO ₄	8 OZ. JAR	28 DAYS	28 DAYS
NITRITE/NO ₂	PT. PE	UNPRESERVED	8 OZ. JAR	48 HR.	28 DAYS
NO ₂ 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 ₂ SO ₄	8 OZ. JAR	28 DAYS	28 DAYS
PHOSPHORUS • TOTAL (P)	PT. PE	H ₂ SO 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 MARGENE	SODIUM THIOSULFATE	N/A	24 HR.	N/A
TKN (KJELDAHL NITROGEN)	PT. PE	H ₂ SO ₄	8 OZ. JAR	28 DAYS	28 DAYS
TOTAL ORGANIC CARBON (TOC)	4 OZ. AMBER GLASS (GLASS ONLY)	H ₂ SO ₄	8 OZ. JAR	28 DAYS	28 DAYS
TOTAL ORGANIC HALIDE (TOX)	PT. AMBER	H ₂ SO 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, 824.2/824/8260	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, 608, 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, 616, 616.1, 8161	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
525, 8270C	2X 1 L GLASS AMBER	UNPRESERVED	8 OZ. JAR	7 DAYS	40 DAYS	14 DAYS	40 DAYS
MODIFIED 632, 832	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	8 MO. (28 DAYS-Hg)
• NOT FILTERED	QT. PE	UNPRESERVED	6 MO. (28 DAYS-Hg)
• ORGANIC LEAD	QT. AMBER GLASS	CHILL TO 2-8° 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	8 MO. (28 DAYS-Hg)
• EP TOXICITY	8 OZ. JAR	CHILL TO 2-8° C	8 MO. (28 DAYS-Hg)
• WET	8 OZ. JAR	CHILL TO 2-8° C	8 MO. (28 DAYS-Hg)
• TCLP (SEE ALSO ORGANIC CHEMISTRY)	8 OZ. JAR	CHILL TO 2-8° C	8 MO. (28 DAYS-Hg)
• SPLP	8 OZ. JAR	CHILL TO 2-8° C	6 MO. (28 DAYS-Hg)
• HEXAVALENT CHROMIUM (Cr + 6)	8 OZ. JAR	CHILL TO 2-8° C	30 DAYS UNTIL EXTRACTION/24 HR. IN EXTRACT FORM
• ORGANIC LEAD	8 OZ. JAR	CHILL TO 2-8° 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 4) ensuring a safe working environment.

Laboratory features:

- 1) (2) Walk-in and (4) large wall reach-in refrigerators
- 2) (6) Fire proof data storage rooms
- 3) chemical storage rooms
- 4) Two-story storage area
- 5) Hazardous Waste drum storage facility
- 6) (8) safety shower/eye stations
- 7) (3) 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 accommodate 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, GC-GC/MS.

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.

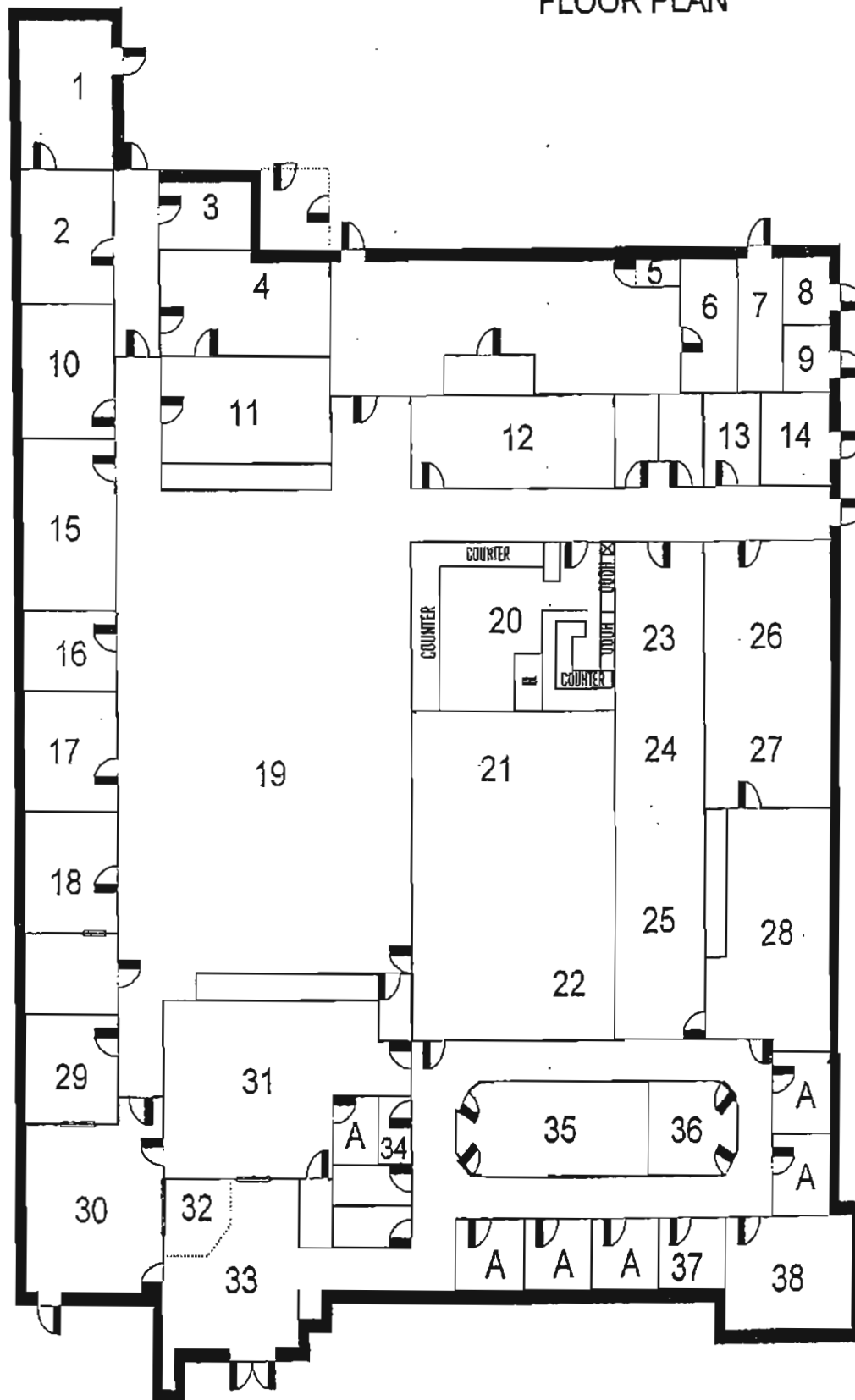
6.5 RECORD KEEPING

- 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 Lab
- 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 8

PERSONNEL / TRAINING

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	Duration	Trainers
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 for 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 one 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 for 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 the 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 sample tracking record.
- 8.1.3 Sample Receipt Form - Record of samples submitted and their disposition, condition, and number.
- 8.1.4 Sample Control Approval Form - Provides a review of the log-in process on 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 Log - 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 Log - Used to document routine maintenance and subcontract repair of instrumentation.
- 8.2.7 Standards Log - Record of standards preparation.
- 8.2.8 Reagent Log - 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 Technical Review Sheets - Formatted sheets which guide reviewers to 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 oven 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 Tracking 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.

INSTRUMENTATION

9.0 INSTRUMENTATION

9.1 Wet Chemistry

9.1.1 Ion Chromatographs

Instrument	ID	Analysis	Year in Service	Method
Dionex Model 2000i AI450 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, Fluoride	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 AAI Auto Analyzer Cyanide Automated Distillation/Colorimetric	AAII-1	Cyanide	1985- current	EPA-335.3 EPA-335.4
Technicon AAI Auto Analyzer Hexavalent Chromium Diphenylcarbazide	AAII-2	Hexavalent Chromium	1985- current	SW-7196
Technicon AAI Auto Analyzer Phenol Automated distillation/Colorimetric	AAII-3	Phenol	1985- current	EPA-420.2
Technicon AAI Auto Analyzer ortho-Phosphate Molybdenum blue	AAII-4	ortho-Phosphate	1985- current	EPA-365.1 EPA-365.2
Technicon AAI-5 Auto Analyzer NH ₃ -N Automated Colorimetric	AAII-5	NH ₃ -N	1977- current	EPA-350.1

INSTRUMENTATION

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

INSTRUMENTATION

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

INSTRUMENTATION

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	Varian 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 Chemstation with Enviroquant Tekmar Sample Heater	MS-V2	Volatiles	1991	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B
HP 5971 Takmar 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

INSTRUMENTATION

HP 5971 Tekmar 3000 Concentrator Tekmar Solatek 72 HP Chemstation with Enviroquant	MS-V7	Volatiles	2001	EPA-524.2 EPA-601 EPA-624 EPA-8240B EPA-8260B
HP 5971 Tekmar 3000 Concentrator Tekmar Precept II HP Chemstation with Enviroquant	MS-V8	Volatiles	2001	EPA-524.2 EPA-601 EPA-624 EPA-8240B 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	Analyte	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

INSTRUMENTATION

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 2016 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

BC LABORATORIES, INC.

INSTRUMENTATION

Varian 3400 with PID and FID Tekmar 2000 Concentrator Tekmar 2016 Autosampler HP Chemstation with GC-Enviroquant	GC-V5	BTEX, MTBE, TPH (gas)	1991	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-V6	BTEX, MTBE, TPH (gas)	1991	EPA-8020, 8021 8015M
HP 5890 Series II with PID and FID Tekmar 3000 Concentrator Tekmar 2016 Autosampler Tekmar 2032 Autosampler HP Chemstation with GC-Enviroquant	GC-V7	BTEX, MTBE, TPH (gas)	1998	EPA-8020, 8021 8015M
HP 5890 Series II with PID and FID Tekmar 3000 Concentrator Tekmar Precept II Autosampler HP Chemstation 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 79956A Quaternary 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	EPA-413.2 EPA-418.1

9.4 Microbiology

INSTRUMENTATION

Instrument	ID	Analysis	Year In Service
Incubator - ASP Model	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	IS-41	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	#1, #2, #3	10 (10 tubes/samples)	1990
Quebec Colony Counter Capacity/100 Potential Capacity/200			1980
Dissection Microscope	Bausch & Lomb		1986
IDEX Spectrolina	EA-160		1996

9.5 Sampling Equipment

9.5.1 Well Sampling

Instrument	ID	Year In Service
ISCO	2700	1994
Grundfos Rediflo	BMI	1992
Grundfos 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

INSTRUMENTATION

9.5.3 Instrumentation

Instrument	Model	Year in Service
Omega pH H60 and pH Conductivity Meter		1994
Myron Company pH & Conductivity Meter		1994
HNU Photolionizer	Model HW - 101	1994

9.6 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

BC LABORATORIES, INC.**INSTRUMENTATION**

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	35
Halon	
Combined Class ABC	
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 1994), 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 I, 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

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- 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
 - 10.1 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 not 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, the Word Processing Specialists records the following information:

Logbook ID

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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 must 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 of 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 aforementioned formats, or from projects initiation forms completed by laboratory interviewers. The information is translated 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 LIMS 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

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6. Identify project initiation date
7. Obtain 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 or 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 not 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 continuous 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

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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 be 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 negative, 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 found 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 on 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	EPA 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		EPA 249.2, EPA 200.9	EPA 200.8
Potassium	EPA 200.7, 6010B			EPA 200.8
Selenium	EPA 200.7, 6010B		EPA 270.2, SW7740, EPA 200.9	EPA 200.8
Silica	EPA 200.7, 6010B			EPA 200.8
Silver	EPA 200.7, 6010B		EPA 272.2, EPA 200.9	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, EPA 200.9	EPA 200.8
Vanadium	EPA 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
EOB / 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

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 150.1	SW9040
Conductivity	EPA 120.1	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 calculations (% 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's software. Sample analyses are processed via data systems enviroquant and Varian's enviropro. Results are then recorded onto worksheets. The reduced data is electronically transferred to the LIMS. The LIMS performs statistical calculations (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample 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 calculations (% 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 calculations (% 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 used 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 calculations (% 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's software. Values are recorded onto a QC bench sheet then transferred to worksheets. The reduced data is electronically transferred to the LIMS.

DATA REDUCTION, VALIDATION, AND REPORTING

The LIMS performs statistical calculations (% 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 calculations (% 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 used as the linear regression model. Results are reduced on QC log sheets then transferred onto worksheets. The reduced data is electronically transferred to the LIMS. The LIMS performs statistical calculations (% recoveries % RPD, % found, etc) and sample calculations in test solutions sample weights, extract volume and sample dilution.

BC LABORATORIES, INC.

PQL/MDL DETERMINATIONS

Analyst:
 Analyte:
 Method:
 Run Date:
 Instrument ID:
 Matrix:
 Units:
 Prep Date:
 MDL Study No:

Analyst:
 Analyte:
 Method:
 Run Date:
 Instrument ID:
 Matrix:
 Units:
 Prep Date:
 MDL Study No:

Analyst:
 Analyte:
 Method:
 Run Date:
 Instrument ID:
 Matrix:
 Units:
 Prep Date:
 MDL Study No:

____/____/____ - ____ - ____
 DATE INSTR ID SEQ MATRIX
 NO (W,S)

____/____/____ - ____ - ____
 DATE INSTR ID SEQ MATRIX
 NO (W,S)

____/____/____ - ____ - ____
 DATE INSTR ID SEQ MATRIX
 NO (W,S)

MDL Std. ID	Response	Conc.	MDL Std. ID	Response	Conc.	MDL Std. ID	Response	Conc.
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			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 $r =$ $r^2 =$ Standard Curve $r =$ $r^2 =$ Standard Curve $r =$ $r^2 =$

1st Order	2nd Order	3rd Order	1st Order	2nd Order	3rd Order	1st Order	2nd Order	3rd Order
Stand. ID	Conc.	Response	Stand. ID	Conc.	Response	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		$t_{(n-1, .99)} =$	$t_{(n-1, .99)} =$
Run No. 3		10s =	
Analyst:		Blank Response Data:	
Instrument:		$\bar{x} =$	$s =$ 3.29(s) =
Method:		3s =	
Matrix:		10s =	
Units:		STANDARD CURVE	
		Standard ID	Conc.
Instrument Parameters:			Response
Standard Calibration Setting:			
Flowcell Length:		1st Order	2nd Order
Program Method ID:			3rd Order
Date of Preparation:		Correlation Coefficient:	
		PQL:	MDL:

Run No. 1			Run No. 2		
MDL STD. ID	RESPONSE	CONC.	MDL STD. ID	RESPONSE	CONC.
1.			1.		
2.			2.		
3.			3.		
4.			4.		
5.			5.		
6.			6.		
7.			7.		
8.			8.		
Run No. 3			Blank Determination		
MDL STD. ID	RESPONSE	CONC.	BLANK ID	RESPONSE	CONC.
1.			1.		
2.			2.		
3.			3.		
4.			4.		
5.			5.		
6.			6.		
7.			7.		
8.			8.		

PERFORMANCE AND SYSTEMS AUDITS

TABLE 8
LEVEL OF QC EFFORT

TEST	MATRIX	FREQUENCY	CRITERIA	CHEMISTRY
Duplicate	Water	10% or 1 per batch, whichever is greater	<10% RPD above 5 times PQL, If <5 times PQL, $\leq$ PQL.	Inorganic
	Soil/ Wastewater	5% for solid and wastewater matrices	<20% RPD above 5 times PQL, If <5 times PQL, $\leq 2 \times$ 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%	$\pm 15\%$ 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 into 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 soil 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 for 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 525/8270, EPA 531.1, EPA 515.1/8150, EPA 8010/8020, EPA 8240/8260, 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 160.2, EPA 413.1, nitrogen forms (350.1, 353.2, 300.0, 351.1), EPA 365.4, 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, 3) 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's Meetings.

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.

ANALYTICAL QUALITY CONTROL REQUIREMENTS

13.0 QC PARAMETERS

Required QC parameters will vary according to method, specific project requirements, and/or 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 Duplicate
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

Sample/Sample Duplicate
Matrix Spike/Matrix Spike Duplicate
Laboratory Control Sample-Water 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

ANALYTICAL QUALITY CONTROL REQUIREMENTS

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 size 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 properly 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 1) QC parameters type, 2) Method code, 3) Sample number, 4) date 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 to 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 $\pm 3 s$
 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 $\pm 3 s$
 s is the standard deviation of the recoveries

Control Limit (for surrogates) = Mean Recovery $\pm 3 s$
 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 made 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:

$$RPD = \frac{|x1 - x2|}{\bar{X}} \times 100$$

ANALYTICAL QUALITY CONTROL REQUIREMENTS

- $|d|$ = 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 less 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:

$$\% \text{ RECOVERY} = \frac{X - B}{T} \times 100$$

- 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 for 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 for 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 (or 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 noncompliance. The extent and steps of corrective action procedures will vary according to project requirements or individual client protocols.

PREVENTATIVE MAINTENANCE

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 initiated. 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 GC/MS
- 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 when 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	Frequency	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.	± 0.0005 g	Daily or with each use
Thermometers	Verify accuracy against NIST-certified thermometer, or if purchased with certificate of traceability, check for mercury separation daily.	$\pm 1.0^{\circ}\text{C}$	Annually
Temporary storage refrigerators	Verify temperature within range.	$4^{\circ}\text{C} \pm 2^{\circ}\text{C}$	Daily
Long-term storage refrigerators	Verify temperature within range.	$4^{\circ}\text{C} \pm 2^{\circ}\text{C}$	Daily
Freezers	Verify temperature within range.	$< -10^{\circ}\text{C}$	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)

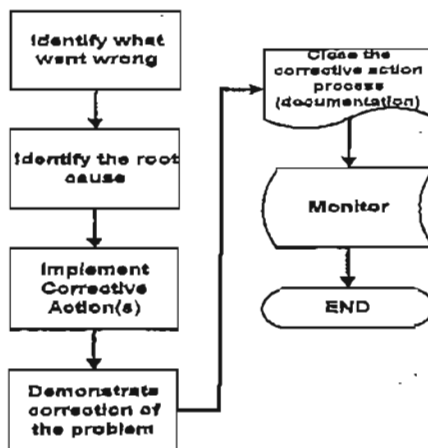
A term used to describe a preemptive positive action or process modification, which increases the level of quality and customer satisfaction.

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 action 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.

PREVENTATIVE MAINTENANCE

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

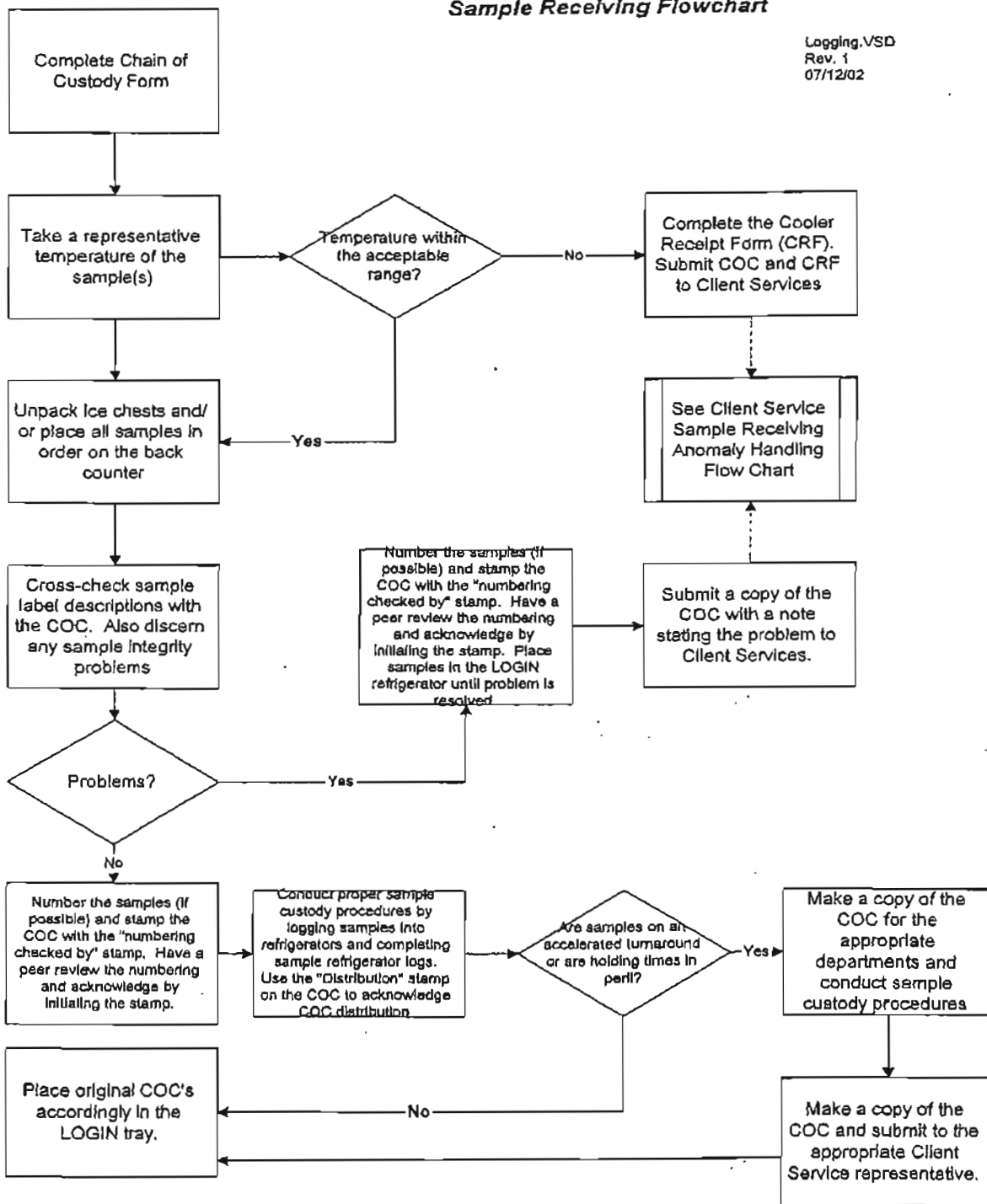
Quality Assurance reports, prepared by the Quality Assurance Officer, are issued on a quarterly basis. The purpose of these quarterly updates is to give an indication of overall laboratory performance and quality of work. These reports contain information pertaining to the overall performance of the laboratory. Annual internal audit reports are also completed to measure laboratory performance during the previous three month spans.

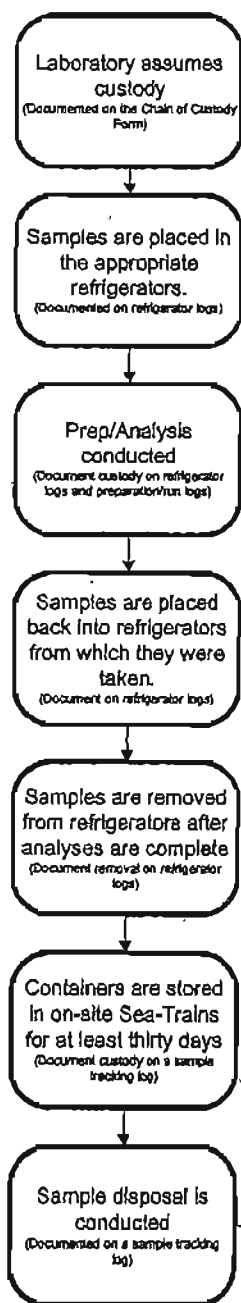
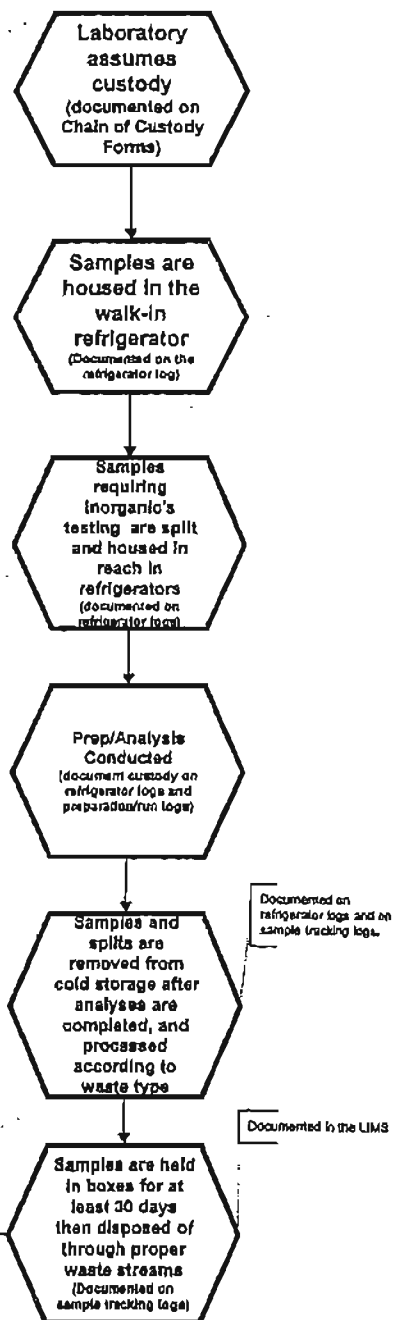
Information is gathered from internal and external audit results, control charts, monitoring programs and supervisor/analyst interviews. Situations such as equipment malfunctions, new or updated QC techniques, revised analytical procedures, corrective action activities, and any significant QC or performance 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.

Sample Receiving Flowchart

Logging.VSD
Rev. 1
07/12/02



Sample Tracking
Aqueous Matrices**Sample Tracking**
Non-Aqueous Matrices

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 of an as needed basis. When the audits samples arrive, prepare and process them immediately. If this cannot be 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 any 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.

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AQUATIC TESTING LABORATORIES

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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 Plan
LABORATORY QUALIFICATION	Facilities/Equipment/Staff	SOQ*
	Written SOP's for 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.

Quality 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 SOP'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 be 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 a 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) 650-0546 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 for 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. Miller. 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.
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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 the 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) are 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.