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**Naval Air Station Alameda
Alameda, California**

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**Revised Final
Work Plan for an
Ecological Assessment**

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FINAL
WORK PLAN FOR AN ECOLOGICAL ASSESSMENT

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**WORK PLAN
ECOLOGICAL ASSESSMENT
NAS ALAMEDA**

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Ecological Assessment Work Plan is designed to identify ecological impacts on biota possibly caused by hazardous materials use and disposal within the project area at the Naval Air Station (NAS) Alameda. The project area includes the Seaplane Lagoon, the Western Bayside, the Oakland Inner Harbor, the Runway Wetland, and the West Beach Landfill Wetland. These ecological subareas have been identified, based on information from site reconnaissance and previous studies, as the principal areas in which significant ecological impacts could occur.

The work plan has been designed to identify potential impacts on biota by focusing on locations where impacts from the site are most likely to be observed, based on a knowledge of past disposal practices at the site. Adjacent to the project area there exist several known contaminant source areas that could also create impacts within the project area. Some portions of the project area may be more isolated than others from sources of impacts external to NAS Alameda. However, none of the project area is entirely isolated from these potential interferences. Therefore, a careful evaluation of the results of the sampling program will be required in order to assess causal relationships if impacts are observed.

The ecological assessment will include identification of priority pollutants in samples of surface sediments, sediment cores, surface water, and biological tissues collected from each sampling area and the reference area. Ecological impacts will be assessed through bioassay, bioaccumulation, and benthic community analysis. Priority pollutants analyses and toxicity testing will be conducted on stormwater samples taken from the storm sewer which discharges into the Seaplane Lagoon. Surface sediments, within the upper 10 cm typically associated with the bioactive zone of the sediments will be sampled. Additional subsurface sediment samples will be collected from selected surface sediment sampling locations to provide information on the extent of contamination and to evaluate the potential impacts remedial alternatives, such as removal of contaminated sediments, may have on the ecosystem.

1.2 THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT NAS ALAMEDA

The U.S. Navy began evaluation of potential contamination at Naval Air Station (NAS) Alameda under the Naval Assessment and Control of Installation Pollutants (NACIP) program. An initial assessment study (IAS) was completed in 1983, followed by a confirmation study (CS) that was completed in 1985. U.S. Environmental Protection Agency (EPA) and California Department of Health Services (DHS) comments on the IAS and CS were reviewed and incorporated in work plans to conduct a remedial investigation (RI) and feasibility study (FS) at the facility. The RI/FS is being conducted as part of the Defense Environmental Restoration Program (DERP) using Installation Restoration Program (IRP) funding. The ecological evaluation (EE) work plan prepared as part of the sitewide RI/FS work plans was submitted for agency review in 1990. Comments on the EE work plan were incorporated in the November 1990 submittal. The ecological evaluation is Phase IV of the sitewide RI for NAS Alameda. Phases I through III have been completed or are nearing completion.

The ecological concerns that have developed as the primary issues related to NAS Alameda are the possible effects of hazardous waste contaminants on the ecological resources in San Francisco Bay and the Oakland estuary in the vicinity of the facility, the ecological effects of the facility on the Seaplane Lagoon, and wetlands in the West Beach Landfill. Additional considerations include use of the facility by special status species, migratory birds, mammals, and spawning fish. The current intent is to provide descriptions of this usage from existing information on the San Francisco Bay ecosystem in general and the NAS Alameda vicinity in particular. Additional field surveys are not anticipated beyond those described in this work plan.

The results of the ecological sampling program and literature review will be evaluated to identify the risks posed by NAS Alameda on the surrounding ecological systems. Those risks will be characterized on the basis of guidance existing at the time. The resulting analyses will be combined into an ecological risk assessment report that will be a component of the overall NAS Alameda RI.

1.3 OBJECTIVES OF THE ECOLOGICAL ASSESSMENT WORK PLAN

The primary objectives of the work plan are:

- To identify contaminant concentrations in sediment and surface water samples collected from NAS Alameda
- To identify potential impacts on biota resulting from exposure to site sediments, and surface water, in the vicinity of NAS Alameda
- To evaluate potential impacts from stormwater discharges to the Seaplane Lagoon
- To delineate and characterize two potential wetlands on NAS Alameda

1.4 WORK PLAN APPROACH

The approach taken in this work plan is as follows:

- The project area has been divided into subareas where generally similar environmental processes and contaminant disposal and transport processes are thought to occur. These subareas include the Seaplane Lagoon, the Western Bayside, the Oakland Inner Harbor, the Runway Wetland, and the West Beach Landfill Wetland.
- Sample locations were chosen within each subarea, where ecological impacts are expected to be observable.
- A "tiered" approach to media analysis was designed to make the analysis of bioaccumulation and benthos samples dependent upon detection of contamination in sediments and/or upon sediment toxicity to selected indicator organisms. The "triggers" which activate the dependent tiered analyses are quite sensitive, but the tiered approach would prevent unnecessary analyses of "clean" sediments.

Tier I analysis addresses the following questions:

- Does water in the bayside, lagoon and wetlands subareas meet accepted water quality standards? This will be evaluated by direct sampling and analyses of water samples, comparison with reference area samples, and comparison with state water quality objectives.
- Are elevated levels of priority pollutants present in the sediment to which biota may be exposed? This will be evaluated by direct sediment sampling and analysis and subsequent statistical comparison of onsite data with reference area data.
- If bioavailable contaminants are present in sediments, are they present at levels that are toxic to the organisms living in the area? This will also be evaluated by conducting acute and chronic bioassay tests on collected sediment and statistical comparison of onsite data with data from reference area samples.

If the answer to the first three questions is negative, then a statistical evaluation of the power of the sampling and analytical program to distinguish significant differences between site and reference area samples will be undertaken. If this evaluation indicates that the sampling program was adequately sensitive, then Tier II analysis will not be required.

If Tier I evaluation indicates that levels of contamination in one of the subareas is significantly higher than in the reference area, then Tier II analysis will be undertaken for the subarea in question. Tier II analysis will address the following questions:

- Given that contaminants are present in sediments, do they accumulate in the tissues of organisms, potentially impacting other organisms in the food web? This will be evaluated by conducting laboratory bioaccumulation studies on archived sediment from areas showing significant toxicity or contamination in Tier I analyses.

- Have the compositions of the benthic communities in the impacted subareas been altered? This will be evaluated by conducting benthic infaunal analyses on archived sediment from areas showing significant toxicity or contamination in Tier I analyses.

A flow chart, which graphically illustrates the approach is shown in Figure 1-1, and the protocols are described in detail in the work plan. The data being collected in this phase of the ecological assessment should be used in tandem with other available information on Bay sediments, in particular with information concerning sediments near NAS Alameda and the Oakland Inner Harbor. The work plan purposefully skews the sampling locations toward those areas with the greatest expected contaminant concentrations. The work plan will not definitively quantify all ecological risk. A full characterization of the nature and extent of contamination is being developed as part of the RI. The potential risks to public health will also be addressed in the NAS Alameda RI report.

1.5 WORK PLAN IMPLEMENTATION

The scope of work delineated in this work plan should be implemented in accordance with the tasks outlined below:

- Task 1: Review existing information - Prior to implementing the work plan existing data will be examined to ensure that the number and location of samples are adequate to meet the work plan objectives. This would include information which was not available at the time this document was prepared, including RI/FS sampling results, delineation of wetlands and results from recent sampling in the Oakland Inner Harbor.
- Task 2: Implement sampling and analysis plan - This task is described in greater detail in this report and covers sampling activities at the site.
- Task 3: Data evaluation - The data gathered during this investigation will be compiled and evaluated to determine whether further study is needed. Data on chemical contamination and acute and chronic toxicity collected in Tier I, and

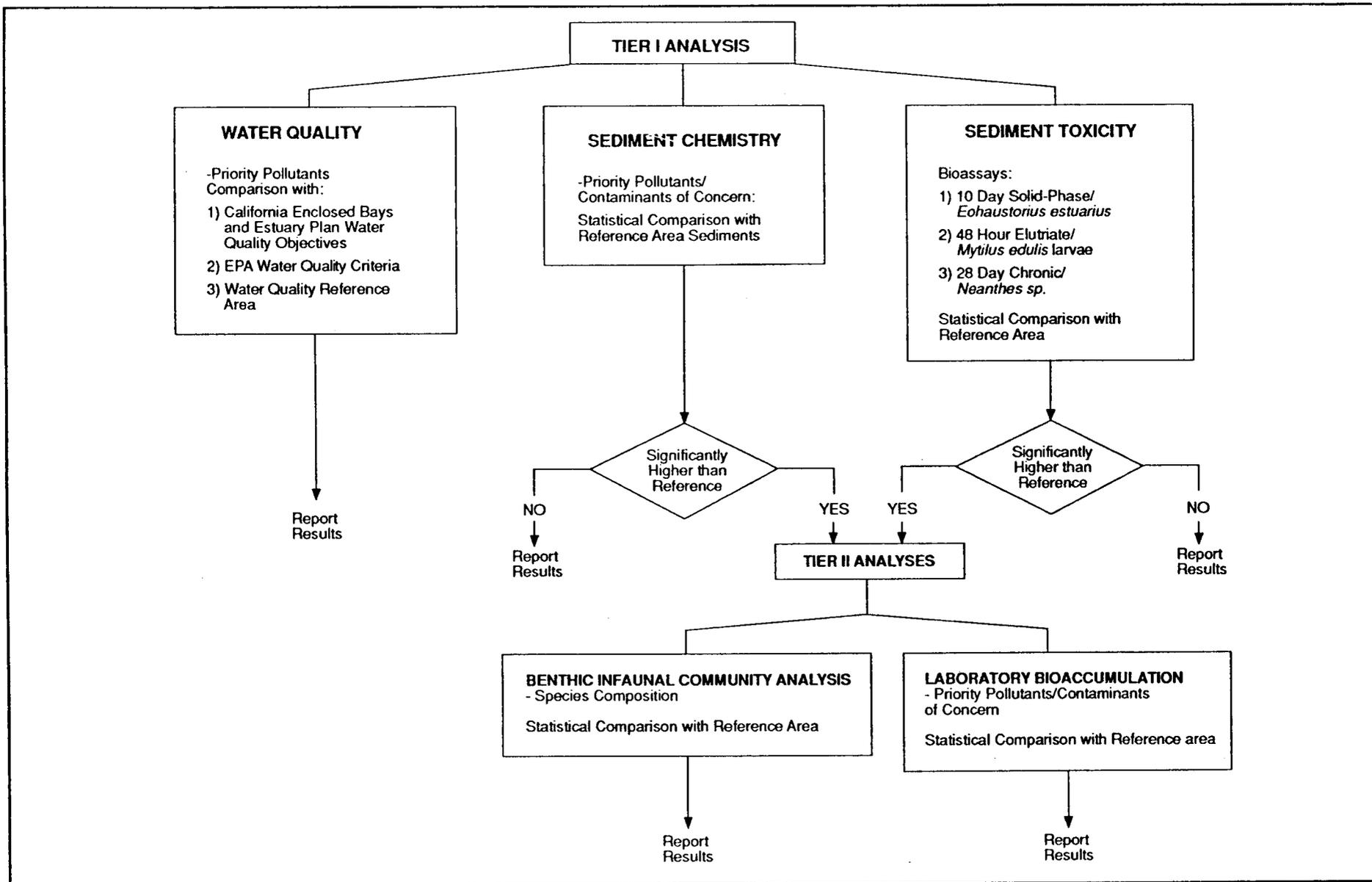


Figure 1-1

Flowchart of the Tiered Analytical Approach



data on bioaccumulation in infaunal species and benthic community analyses collected in Tier II of this study will be used to assess the stress levels to biota resulting from exposure to chemical contaminants. The intensity, scale, and value of impacts to biological communities will be evaluated on the distribution of measured contamination and toxicity, the level of biological responses measured in selected test organisms, and the ecological importance of test groups of organisms. Species selected for this study are of ecological importance in the study area, thus allowing ecological inferences to be made from these results.

1.6 REPORT ORGANIZATION

The work plan includes a Field Sampling Plan (Section 3.0), a Quality Assurance Project Plan (Appendix A), an addendum (Appendix B) to the existing Health and Safety Plan for the Remedial Investigation/Feasibility Study and a glossary of terms (Appendix C). The Field Sampling Plan (FSP) describes activities related to collection of samples from subtidal areas, wetlands areas, and storm sewer outfalls for chemical toxicity and biodiversity analysis. The Quality Assurance Project Plan (QAPP) describes the methods and procedures that will be used to maintain the level of precision and accuracy required to meet the data quality objectives of the project. The Health and Safety Plan Addendum activities describe additional health and safety procedures specific to activities described in this work plan.

The following section (Section 2.0), presents a brief summary of past and present waste-related activities, and results of previous investigations that have been evaluated in the design and preparation of this work plan.

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

NAS Alameda is located at the geographic center of the San Francisco Bay Area and occupies the western quarter of the island of Alameda as shown in Figure 2-1. The station contains 2,842 acres of land, water, and airspace easement, including 1,734 acres of dry land. It is one of the largest and most diversified naval activities on the west coast. Its permanent-party population consists of almost

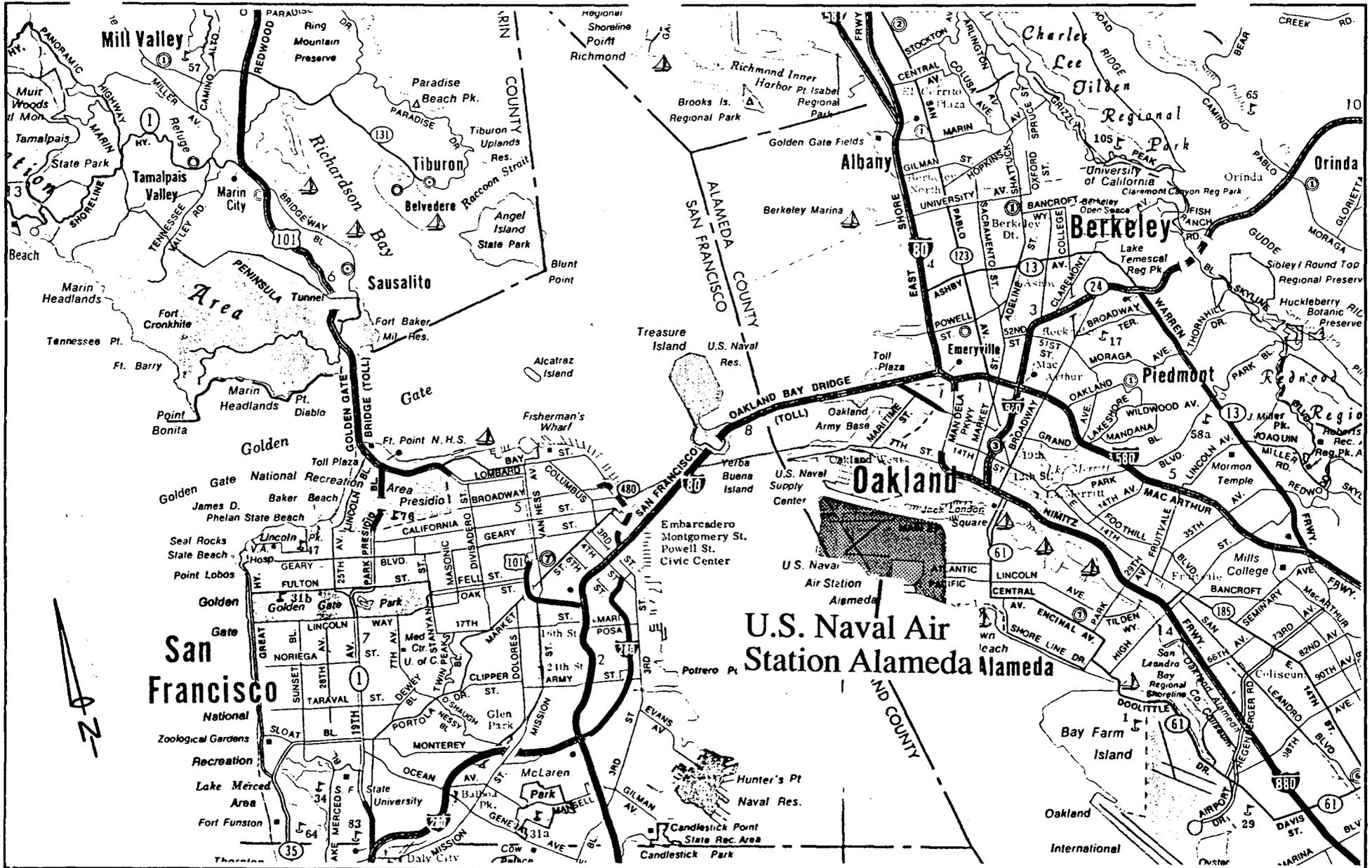


Figure 2-1 Location of Naval Air Station Alameda

6,000 civilian employees and nearly 2,500 active-duty military personnel. NAS Alameda's facilities include a fully instrumental naval airfield with seven aircraft maintenance hangars, the largest deepwater naval port in northern California, and one of the two largest complexes of aircraft maintenance and rework buildings on the west coast.

In September 1980, the Navy initiated the IRP, which was formerly the NACIP program, to assess and control its installation pollutants due to past operations. An IAS was performed at NAS Alameda in August 1981 to identify the areas of potential contamination. The IAS was completed in 1983 and recommended further studies of 7 of the 12 sites to confirm the existence of contamination.

In May 1985, the verification study of the IRP concluded that, of the seven sites studied, only four sites warranted a RI. The RI is to develop detailed information on the nature and extent of potential contamination at the West Beach Landfill, 1943 to 1956 Disposal Area, Area 97 and Building 360 Plating Shop.

The RI at NAS Alameda started in January 1986 with the development of RI work plans by the Navy's architect/engineering (A/E) contractor. In June and August 1987, the U.S. Environmental Protection Agency (EPA) and the California Department of Toxic Substances Control (DTSC) (formerly known as the California Department of Health Services) provided comments on the IAS and verification study at NAS Alameda. In response to these comments, which were based on regulatory agency guidelines not available at the time the IAS and verification study were performed, 16 more sites were added to the original four sites (a total of 20 sites) for the RI. Due to limitations of the initial contract, a second A/E was selected in May 1987 to finalize the work plans and conduct the RI on the 20 sites.

Many of these IRP sites are associated with one or more of the 122 underground storage tanks or 8 aboveground storage tanks that have been documented at NAS Alameda. These IRP sites are also located near many of the facility's 60 tenants which are either hazardous material generators or users.

Because known soil, surface water, and ground water contaminants are in close proximity to wetlands and bay estuarine environments, an ecological assessment is being conducted in the following areas illustrated in Figure 2-2:

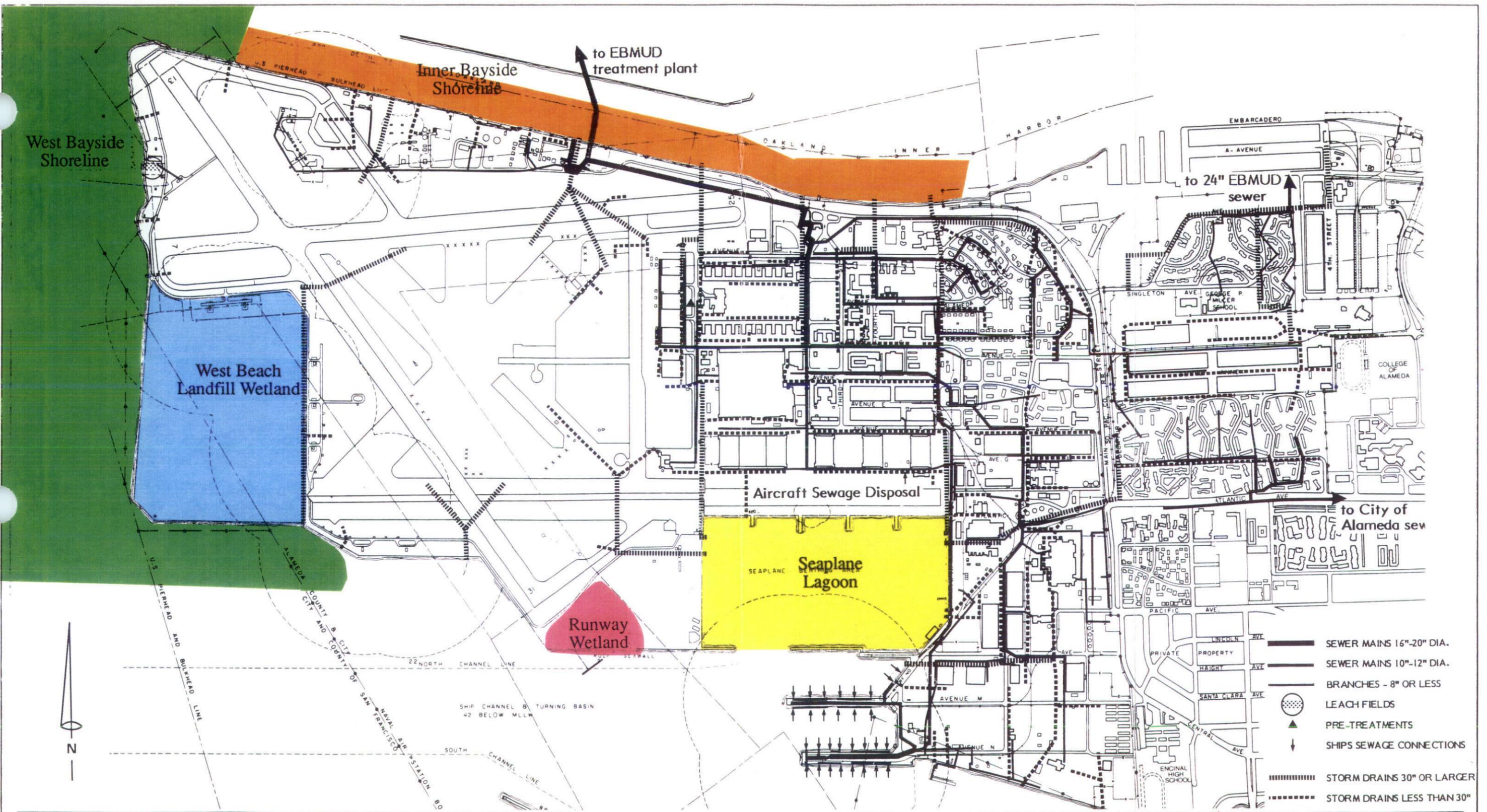


Figure 2-2 Ecological Assessment Study Areas at NAS Alameda

- Seaplane Lagoon
- Western Bay Side
- Inner Harbor Shoreline
- NAS Alameda Wetlands (Runway Wetland, West Beach Landfill Wetland)

To characterize the observed ecological effects of chemical concentrations at NAS Alameda, a reference area in San Pablo Bay is also included. The following section discusses the environmental setting of each specific area with special emphasis on nearby IRP sites and on the location of storm sewer outfalls. Currently industrial wastewater is processed separately; prior to 1975 the industrial wastewater was discharged directly into storm sewers.

2.2 ENVIRONMENTAL SETTING

In order to identify sampling areas within the wetland or marine regions, a description of each region and its associated hazardous materials issues is included. Much of the information summarized in Section 2.2 is described in detail in a report prepared by Tetra Tech (1990).

2.2.1 *Seaplane Lagoon*

The Seaplane Lagoon has been defined as IRP site 17 and is discussed relative to findings of the CSVS (Wahler 1985). It is the discharge point for much of NAS Alameda's storm sewer system (IRP site 18). Several other IRP sites surrounding it are discussed due to known or suspected operations that may have resulted in discharges into the lagoon.

IRP Site 17: Seaplane Lagoon The Seaplane Lagoon has an area of 110 acres and is located at the southeastern corner of NAS Alameda. The lagoon is 12 to 15 feet deep and opens at its southwestern corner to San Francisco Bay. No regular dredging program has ever existed and, as a result, shoaling can be seen in many areas of the lagoon. However, limited dredging has occurred, and in 1981, 21,000 cubic yards of dredge spoil was reportedly removed from the Southland side of the lagoon and disposed of at the West Beach Landfill (Ecology & Environment 1983). Sea walls surround most of the lagoon inhibiting the natural flushing processes of bay tides. The south wall of the

lagoon is formed by a breakwater extending from Pier No. 1. The entrance to the lagoon is through an opening in the breakwater approximately 800 feet long, which allows tidal circulation to occur. Outside the Seaplane Lagoon are berths for deep draft ships (Piers 1, 2 and 3), which are protected by an outer breakwater. From 1940 to 1975, the lagoon received approximately 300 million gallons of wastewater from industrial and storm sewer outfalls. Since 1975 when industrial wastewater was first segregated, the lagoon received only storm sewer outfall and surface runoff.

The wastewater disposed of into the lagoon from 1940 through 1975 was reported to be contaminated with heavy metals, solvents, paints, detergents, acids, caustics, mercury, oil, grease, and polychlorinated biphenyls (PCBs) (Ecology and Environment 1983). Ship wastewater contaminated with solvents, chromium, waste oil, and fuel was swept into the lagoon by tidal action. The cumulative effect of these wastes on aquatic life is unknown; however, employees have reported that fish caught from the lagoon in the 1970s smelled of solvents and were inedible. In addition, the bottom paint from boats anchored in the lagoon would occasionally dissolve.

In 1985, as part of the characterization study verification step (CSVs) (Wahler 1985), eight samples from the sediment at the bottom of the lagoon and two from the channel outside of the lagoon were collected and analyzed for metals, PCBs and pesticides. No PCBs or pesticides were detected. Metals were detected in both the lagoon and the channel samples. The report concluded that metal concentrations were not sufficiently high to pose an environmental threat.

In the outer breakwater area of Piers 1, 2, and 3 adjacent to the Seaplane Lagoon, extensive sediment sampling has been used to characterize maintenance dredging materials (Tetra Tech 1991). The concentrations of chemical constituents in these sediments are similar to those in sediments present in the dredged material disposal area at Alcatraz. Among the compounds detected were PCB Aroclor 1016, heptachlor, phthalate esters, total sulfides, zinc, and lead. Anthracene and organotins were also detected at concentrations greater than those in the sediments from Alcatraz. Bioassays were performed using bay mussel (*Mytilus edulis*) larvae as the test organism. All

samples showed LC_{50} values at 100 percent of test concentration. Four of the test samples showed greater than 50 percent abnormal development at the highest test concentration (100 percent elutriate).

IRP Site 6: Building 41 Building 41 is one of several hangars located along the northern boundary of the Seaplane Lagoon. This building was formerly used as a hangar for seaplanes, but is now occupied by the Aircraft Intermediate Maintenance Department (AIMD). Activities at this building involve the intermediate repair of aircraft components for transient and tenant aircraft. No obvious signs of contamination have been reported (Canonie 1990); however, there is a storm drain located near the paint stripping tank and hazardous waste drum storage area which discharges into the Seaplane Lagoon. Chemicals stored and used in the building include a petroleum hydrocarbon solvent (without chlorinated or Freon solvents - PD680) dry cleaner, trichlorofluoroethane, hydraulic oil (organic without chlorinated or Freon solvents - 6083), trichloroethane, paint wastes, and used hydraulic fluids. AIMD personnel report that as many as 100 55-gallon drums of wastes have been stored west of the building at any given time. Although no spills have been documented, rinse waters from the paint stripping tank have been discharged into the East Bay Municipal Utilities District (EBMUD) system. This system is separate from the storm sewer system.

IRP Site 8: Building 114 Pest Control Area Building 114 now serves as an administrative center and as a location of Public Works Center (PWC) activities. The activities include a maintenance shop and paint shop. The building formerly housed a PWC woodworking shop, paint shop, and steam cleaning shop as well as a storage facility for pesticides and herbicides. Steam cleaning, paint stripping, and spray painting activities generated approximately 250 gallons of wastewater per day, which were discharged directly into storm drains. The storm drains emptied into San Francisco Bay through the Seaplane Lagoon. Separator pits functioned inadequately, and their contents were routinely dumped into the West Beach Landfill.

Prior to 1974 the facility stored pesticides and herbicides. All equipment used in weed and pest control was rinsed. The pesticides and herbicides stored at the site included

chlordane, lindane, DDT, malathion, diazinon, Telvar, Chlorvar, 2,4-D, Roundup, Princep, and Krovar I.

IRP Site 10: Building 400 Missile Rework Facility Building 400 is located on Avenue F at the northwest corner the Seaplane Lagoon. Currently, it houses a small paint shop and cleaning shop. Prior to 1972, the building housed the missile rework operations. Wastes generated from those activities included sludge, metal shavings, paint strippers, cleaning solvents, oils, and grease. These wastes were usually deposited in the West Beach Landfill. Wastewater from the above procedures contained elevated levels of solvents, heavy metals, and phenols. This wastewater was discharged, untreated, into the industrial wastewater collection system. It is unknown whether any wastes were discharged to storm sewers which emptied into the Seaplane Lagoon.

IRP Site 11: Building 14 Engine Test Cell Building 14 is located on Fifth Street adjacent to the eastern side of the Seaplane Lagoon. At present, two engine test shops and several laboratories are housed in this building. The laboratories have had small mercury spills in the past. Waste generated during cleanup of these spills was disposed of in the West Beach Landfill. The primary environmental concern at this building is the existence of old underground fuel storage tanks.

IRP Site 18: Station Sewer System The storm sewer discharges directly into the Seaplane Lagoon at seven outfall locations, four of which are at least 30-in in diameter. The pipes are reported to be constructed mainly of corrugated steel and may be in very poor condition. The system received untreated wastewater from plating bath dumps, paints and paint strippers, pesticides and herbicides, oil and grease, cleaning solvents, and possibly PCB contaminated oils prior to 1975. After that time all wastewater was transferred to the industrial wastewater treatment plant. If cracks or leaks exist within the sewer, contaminants from untreated wastewater could enter soil or ground water media.

2.2.2 *Western Bayside*

The Western Bayside area is a region of open bay water adjacent to the northern and western edge of NAS Alameda. The sampling site, as defined, is illustrated in Figure 2-2. The site is approximately 2,000 yards long with depths ranging from 2 feet immediately offshore of NAS Alameda to 22 feet at the outer edge of the site. The site is located adjacent to IRP sites 1 and 2.

IRP Site 1: 1943-1956 Disposal Area - This area at the northwest corner of the NAS was part of the open bay until fill materials were deposited from the early 1940s to 1956. The depth of San Francisco Bay in this area was initially 4 to 18 feet. The region was filled from the north to south with dredged spoils. Trenches were then dug within the dredged fill to the ground water level and filled with waste materials from the base. The area received all wastes generated by the base except those drained to storm sewers. Wastes included medical wastes, waste oil, paint, solvents, garbage, scrap metal, cleaning solvents, and construction debris. Records of the types and quantities of materials used for fill were not kept. An estimate of the quantity of wastes disposed of at this site is approximately 200,000 tons.

The landfill was constructed without a liner or a leachate collection system and was covered by clean topsoil irregularly. Landfill material is assumed to be in direct contact with San Francisco Bay waters, and all ground water discharge through the artificial fill is assumed to flow into bay waters. Ground water is encountered at 3 to 5 feet below the ground surface.

IRP Site 2: West Beach Landfill - The West Beach Landfill occupies 110 acres at the southwest corner of NAS Alameda. The landfill is bordered on the south and west by San Francisco Bay and on the north and east by the former 1943 to 1956 landfill. The West Beach Landfill was opened in 1956 immediately after the northern landfill had reached capacity. After initial construction of seawalls to the south and west, approximately 8 to 20 feet of dredged spoils were emplaced to raise the elevation above sea level. Trenches were dug into the fill to the depth of the water table and filled with waste materials from NAS Alameda, Navy Hospital Oakland, Naval Supply Center

Oakland, and Naval Station Treasure Island. Wastes included municipal garbage, solvents, waste oil, paints, cleaning agents, plating wastes, acids, mercury, PCB-contaminated fluids, scrap metal, inert ordnance, asbestos, pesticides, tear gas agents, infectious wastes, and waste medicines. Figure 2-3 illustrates the locations where some of these waste were disposed. The use of waste as fill material ceased in 1978 although dredge spoil from Seaplane Lagoon dredging was reportedly disposed there in 1981. Few records exist for early disposal practices. It is estimated that the landfill contains a maximum of 1.6 million tons of municipal waste and 30,000 to 500,000 tons of hazardous wastes. The area was generally filled from north to south as shown in Figure 2-3.

The landfill was constructed without a liner or leachate control system and the containing seawalls were not effective in preventing contaminated ground water from leaching into San Francisco Bay. Ground water is encountered at approximately 3 feet below the ground surface and flows west. Soil and ground water investigations (Ecology and Environment 1983) have documented compromised water quality with leachate seeping into San Francisco Bay. Tidal influences in the artificial fill aquifer may flush the aquifer of some hazardous materials.

2.2.3 Inner Harbor Shoreline

The Inner Harbor Shoreline area is the 3,000-yard long portion of the Oakland Inner Harbor located adjacent to the northern boundary of NAS Alameda. The Inner Harbor Channel, which is annually dredged to a channel depth of 38 feet below mean sea level (msl), extends to within about 150 feet of the shore. It is expected, although not assumed, that most of the contaminated sediments that are deposited on the subtidal slope of the channel would ultimately slough into the channel and would, therefore, be removed during dredging.

Sediments within the Inner Harbor Channel have been extensively studied to evaluate their suitability for ocean disposal. Results of the most recent sampling within the Inner Harbor adjacent to the NAS Alameda are not yet available. However, the sediments typically contain polynuclear aromatic hydrocarbons (PAHs), oil and grease, organotins, lead, chromium, arsenic, nickel, copper, and phthalate

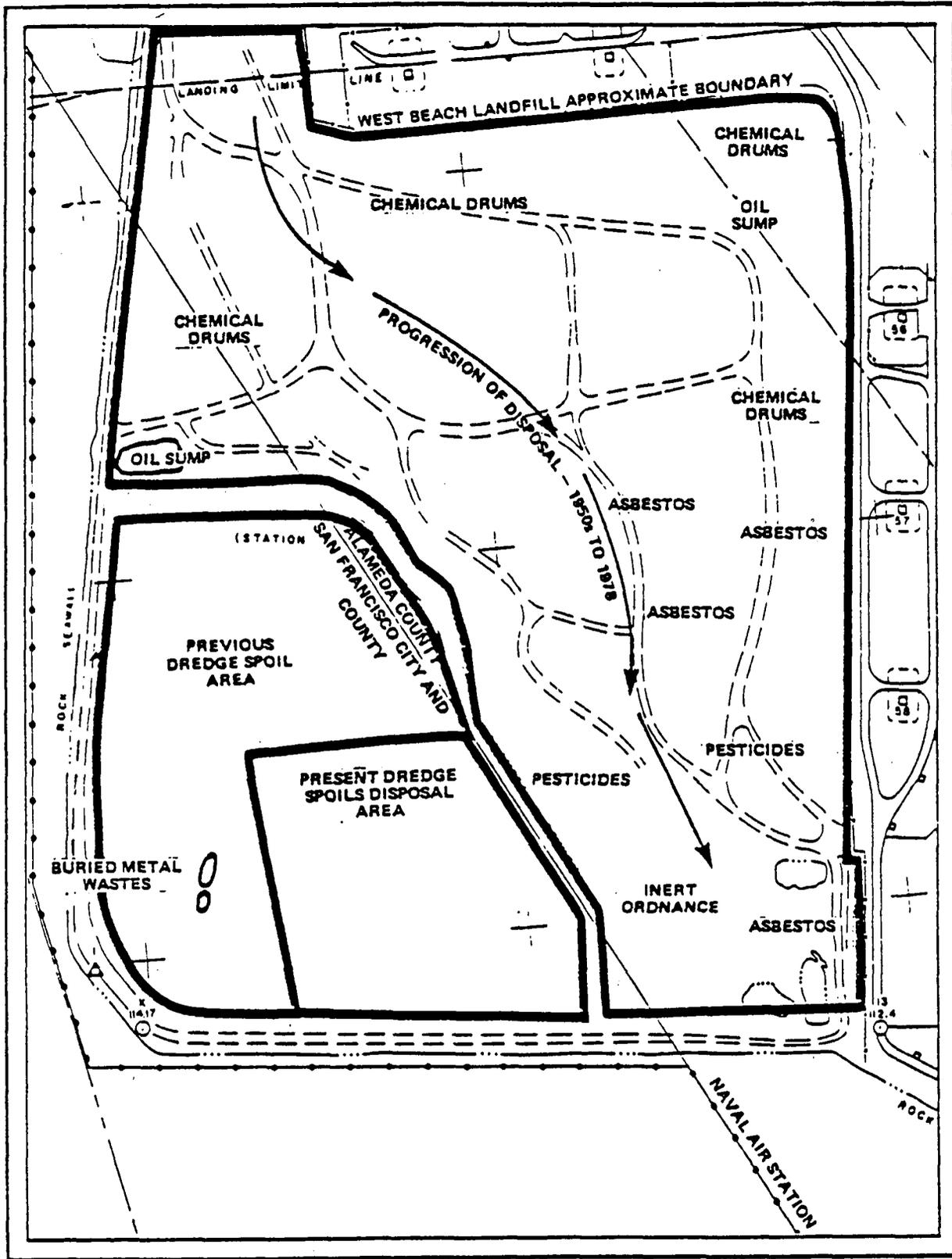
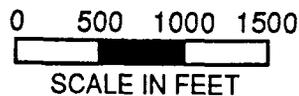


Figure 2-3

Area of Suspected Hazardous Waste Disposal, West Beach Landfill (NAS Alameda)



SOURCE: INITIAL ASSESSMENT STUDY NAS ALAMEDA

esters. These compounds may be indicative of widely dispersed sources. PCBs, pesticides, and chlorinated organic compounds appear sporadically in sediments, and may be indicators of point sources.

This sampling area is adjacent to IRP Site 1, the 1943-1956 Disposal Area (discussed in Section 2.2.2); Site 14, Fire Training Area; and Site 15, Buildings 301 and 389. In addition, the sampling area itself has been defined as IRP site 20 and the storm sewer system emptying into the harbor as IRP site 18.

IRP Site 20: Oakland Inner Harbor Estuary - Several stormwater discharge points exist along the northern perimeter of NAS Alameda. No untreated wastes are currently discharged to the estuary but surface spills could be discharged through the storm sewers. Historically, the estuary may have received up to 150 million gallons of untreated industrial and nonindustrial wastes containing organic compounds, metals, oils, detergents, and pesticides.

No sediment or aquatic biota samples have been collected from the south shore of the estuary adjacent to NAS Alameda. However, the U.S. Army Corps of Engineers conducted a water quality study along the north bank in 1987 and found an increase in test organism mortality according to toxicity bioassay results.

IRP Site 18: Station Sewer System - The storm sewer effluent flowing toward the north discharges directly into the Oakland Inner Harbor. The integrity of the system is unknown. However, it is suspected that the system could have received untreated wastewater from plating bath dumps, paints and paint strippers, pesticides and herbicides, oil and grease, cleaning solvents, and possibly PCB contaminated oils. If cracks or leaks exist within the sewer, contaminants from untreated wastewater could enter soil or ground water media.

IRP Site 14: Fire Training Area - A steel tank has been used to store waste fuels to start the training fires. Wastes generated from fire fighting activities include aqueous foam, carbon dioxide, potassium chloride, "purple K" and Bowser fuels containing heavy

metals (Ecology and Environment 1983). Runoff from the fire training activities could have discharged either directly into the estuary or to storm sewers which in turn discharge into the estuary.

Site 15: Buildings 301 and 389 - Both buildings are located north of runway 7-25, approximately 500 feet inland from Oakland Inner Harbor. The area is presently used to store unused machinery, but in the past was used to store out-of-service transformers. An estimated 200 to 400 gallons of PCB contaminated oil may have been present at the site inside of transformers. In addition to occasional leaks occurring, in order to control weeds, oil was drained from the contaminated transformers and sprayed on the weeds. PCB contaminated soils could have washed into the estuary after storm events.

2.2.4 Wetlands

West Beach Landfill Wetland - The West Beach Landfill has been defined as IRP site 2. Even though historical documents indicate that the landfill was raised above sea level, most of the southern portion of this area may be a brackish pickleweed wetland. At present the site is reported to be covered with a layer of topsoil. San Francisco Bay waters adjacent to the landfill serve as spawning grounds for fish. A wetland determination, described in Section 3.10, will delineate the boundaries of the wetland study area.

The landfill was constructed without a liner or leachate control system and the containing seawalls were not effective in preventing contaminated ground water from leaching into the bay. Ground water is encountered at approximately 3 feet below the ground surface and flows west. Soil and ground water investigations (Ecology and Environment 1983) have documented compromised water quality with leachate seeping into San Francisco Bay. Tidal influences in the artificial fill aquifer potentially flush the aquifer of most hazardous materials.

The Navy is currently under Order 83-35 from the San Francisco Bay RWQCB for closure of the West Beach Landfill as a Class II landfill. The order also establishes that the current property owner and any subsequent property owner will be responsible for cleanup activity and that any new property owner must be supplied a copy of the order. An addendum to Order 83-35 was

issued after the Navy revealed the likelihood of significant hazardous waste disposal at the landfill. This order mandated the completion of a solid waste assessment test (SWAT) in order to document any occurrence of hazardous material. The SWAT task of the RI/FS for this site is currently underway.

Runway Wetland - The area referred to as the Runway Wetland is located on the southern edge of NAS Alameda immediately west of the Seaplane Lagoon. This area is not part of an existing IRP site and has not been documented as a former landfill or an area that received refuse or hazardous materials. A wetland determination will be performed as described in Section 3.10, to determine the boundaries of this suspected wetland. Because of its low-lying topography and potential for receiving runoff from surrounding areas, and for harboring wetland biota, this area has been included in the sampling plan for the ecological assessment.

3.0 FIELD SAMPLING PLAN

The field sampling plan describes the sample locations and rationale, the sampling methods and procedures for applicable media, and the measurement parameters designated to quantify the ecological impacts from the site. Prior to implementing the field sampling plan, existing information will be evaluated to ensure that the number and location of proposed samples are adequate to meet the work plan objectives. Puget Sound Estuary Program (PSEP) protocols (Tetra Tech and EVS Consultants 1986) and American Society for Testing of Materials (ASTM) methods have been adopted in this field sampling plan.

3.1 SAMPLE LOCATIONS AND RATIONALES

Sampling will occur in five subareas of the NAS Alameda and the surrounding estuary where potential contact between biological receptors and toxic substances may occur. The subareas are conceptual units, within which similar environmental processes occur. The field sampling plan uses a tiered approach to evaluate potential ecological impacts on biota within each of these subareas which may have been caused by hazardous materials use and disposal at NAS Alameda.

Sampling within each of these subareas will include the following Tier I analyses:

- Sediment chemistry. Contaminants of concern will be measured in three replicate composite sediment samples at each sampling site. Chemical analyses will also be conducted on three additional samples collected from 120 cm cores at 12 of the subtidal surface sediment sample locations. Measured levels will be compared statistically with replicate analyses for sediments collected at the reference area. Reference sediment selection criteria are described in Section 3.1.6 below.
- Sediment toxicity. The toxicity of surface sediment samples collected at each sampling site will be evaluated by conducting both acute and chronic bioassay tests on 5 replicate composite samples from each sampling site. Acute tests include 10-day solid phase bioassay tests using the amphipod *Eohaustorius estuarus* and 48-hour elutriate bioassay tests using the bivalve larvae *Mytilus edulis*. Chronic tests includes 28-day bioassay tests using the marine polychaete *Neanthes sp.* Results for each site will be compared statistically with similar tests conducted with sediments collected at a reference area.
- Water Chemistry. Priority pollutant concentrations will be measured in water samples collected at selected sampling locations. Measured concentrations will be compared with California water quality standards; primarily with the water quality objectives contained in the California Enclosed Bays and Estuarine Plans (Water Resources Control Board 1991).

The Tier I sediment chemistry and sediment toxicity data for all five test areas will be statistically compared with the results from a reference area. Statistical analysis will be conducted using the one-way analysis of variance (ANOVA) or nonparametric analysis, depending on the homogeneity of sample variances. In those areas where sediment contaminant concentrations and bioassay mortality are significantly higher than in the reference area, the following Tier II analyses will be performed:

- Benthic community analysis. Benthic infaunal community analysis will be conducted for samples collected from sites where the concentration of contaminants-of-concern in sediment or sediment toxicity are found to be significantly higher than those measured at the reference site or sediment concentrations exceed National Oceanic and Space Administration (NOAA) effects range low (ER-L) values.
- Bioaccumulation of contaminants-of-concern. Concentrations of contaminants-of-concern will be measured in the tissue of the polychaete *Neanthes sp.* exposed for 28 days to sediment from those study areas where the concentrations of these chemicals in sediment and sediment toxicity are found to be significantly higher than those measured at a reference area.

The tiered approach will maximize the information obtained while avoiding unnecessary analyses. Benthic community structure is unlikely to have been altered at Alameda unless significant changes have occurred in the physical and chemical characteristics of the sediment and overlying water. Thus it is not necessary to evaluate benthic communities unless the preliminary analysis indicates that alterations in these environmental variables have occurred. Similarly, while tissue analysis for contaminants-of-concern may be necessary at NAS Alameda, identification of sampling locations, the biota at risk, and the level of study of bioaccumulation in biota can be best identified once problem areas (i.e., high sediment contaminant levels and bioassay mortality) have been defined.

The five subareas, which are listed below, are shown on Figure 2-2:

- Seaplane Lagoon
- Western Bayside
- Inner Harbor Shoreline
- West Beach Landfill Wetland
- Runway Wetland

The study areas at NAS Alameda represent both estuarine areas and wetland environments. Reference areas, representing estuarine and wetland areas that are not affected by the site, will be located in San Pablo Bay. Samples of stormwater discharges will also be collected from selected stormwater

sewer outfall locations within Seaplane Lagoon for chemical analysis and National Pollutant Discharge Elimination System (NPDES) bioassay testing. Each of these areas is described in greater detail below.

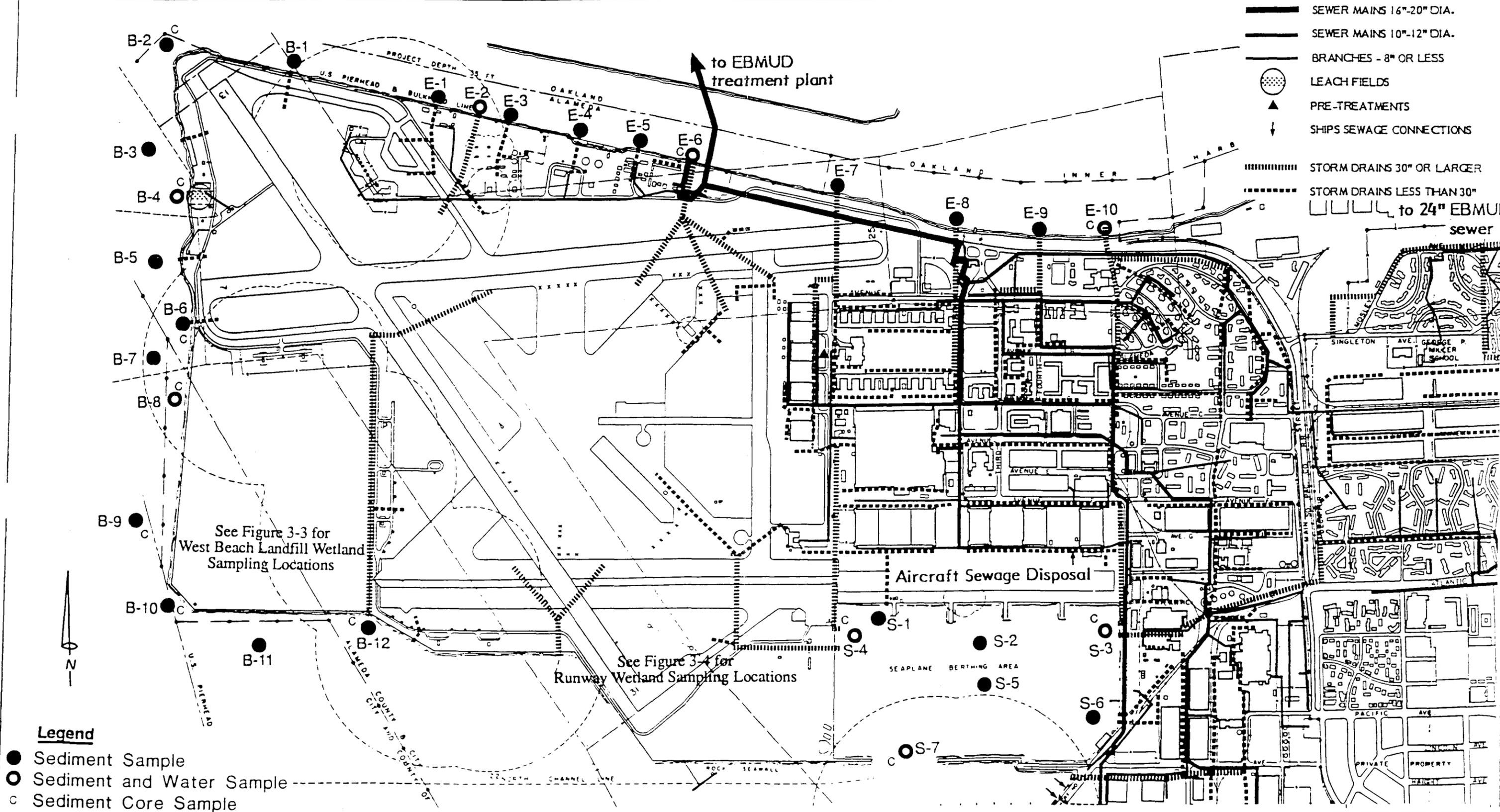
3.1.1 Seaplane Lagoon

Figure 3-1 shows the locations of sediment and water sampling stations. Seven sediment sampling stations are proposed (S-1 through S-7). Five replicate composite sediment samples will be collected at each sediment station. Sediment core samples will be collected from three locations (S-3, S-4, and S-7). Water samples will be collected at three locations (S-3, S-4 and S-7). Four of the sample locations (S-1, S-3, S-4, and S-6) were chosen to be opposite existing storm sewer outfalls. Locations S-2 and S-5 are centrally located to represent the bulk mixing zone in the lagoon. Location S-7 is at the mouth of the lagoon.

Locations S-1 and S-4 are located in the northwestern corner of the lagoon. S-1 is located near the outfall of a storm drain that enters the lagoon just east of the first of four small piers on the north wall of the lagoon. The storm drain appears to collect drainage from the vicinity of several diesel and gasoline storage tanks, as well as IRP site 13 where transformers that may have contained PCBs were reportedly stored. Sediment samples will be collected from within 50 feet of the discharge point of this storm drain if it can be located. Otherwise, the samples will be collected from a point just west of the end of the small pier.

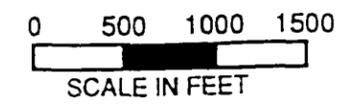
Sample location S-4 is located opposite the outfalls of two 30-in or larger storm drains, that collect runoff from the southeast runway area, from IRP Site 13, and from IRP Site 5. IRP Site 5 housed a plating shop, and includes tanks and sumps associated with plating wastes. Surface sediments would be sampled from a point approximately equidistant from the two outfalls, near the base of the sediment slope. If these characteristics cannot be identified, the sediment will be collected from approximately 300 feet south and 100 feet east of the northwest corner of the lagoon.

Sample location S-2 is located approximately on the north-south midline of the lagoon, approximately one-third of the distance from the north wall to the south breakwater (about 500 feet south and about 500 feet east of the northwest corner).



- Legend**
- Sediment Sample
 - Sediment and Water Sample
 - c Sediment Core Sample

Figure 3-1 Marine Sampling Locations: Seaplane Lagoon, West Bayside and Inner Harbor Shoreline



Sample location S-3 is located opposite two storm sewer outfalls in the northeast corner of the lagoon. Several IRP Sites are located within the collection area of these storm drains. Location S-3 should be located about 100 feet west of and approximately equidistant from the outfalls of these drains.

Location S-5 is directly south of location S-2, about two-thirds of the distance from the north wall to the south breakwater (about 1,000 feet).

Location S-6 is approximately opposite two small storm drain outfalls in the southeast corner of the lagoon, and directly opposite the boathouse structure built on the bevelled corner of the lagoon.

Location S-7 is in the deepest portion of the channel at the entrance to the Seaplane Lagoon. An attempt will be made to collect water samples at location S-7 during an outgoing tide, if possible, so that the sample is representative of the interior of the lagoon.

3.1.2 Western Bayside

Sediment and water sample station locations are shown on Figures 3-1 and 3-2. Five replicate composite samples will be collected from 14 sediment collection stations numbered B-1 through B-14. Sediment core samples will be collected from seven of these locations (B-2, B-4, B-6, B-8, B-9, B-10, and B-12). Water samples will be collected at three of the stations (B-4, B-8, and B-12). The water samples are not expected to differ significantly, since any toxic materials entering the bayside area from the land would be subject to rapid mixing and dilution with ambient San Francisco Bay water. However, three water samples will be collected to increase confidence in the values obtained in the event that differences in water quality are observed between study areas.

The bayside sample stations are an average of approximately 850 feet apart but are located near stormwater outfalls, culverts, a leachfield, or other onshore features associated with drainage from the land. Most of these features are located in the northwest portion of the IRP Site 1 landfill (see Figure 2-2). Station B-1 is located along the north bank of the IRP Site 1 landfill, near a storm sewer outfall that drains the northern runway area. Station B-2 is located near the northwest corner of NAS Alameda. This area is expected to be subjected to a high degree of turbulence, from tidal currents, wave action, and the wakes of ships and boats. Sediments in this area are expected to be generally coarse and highly

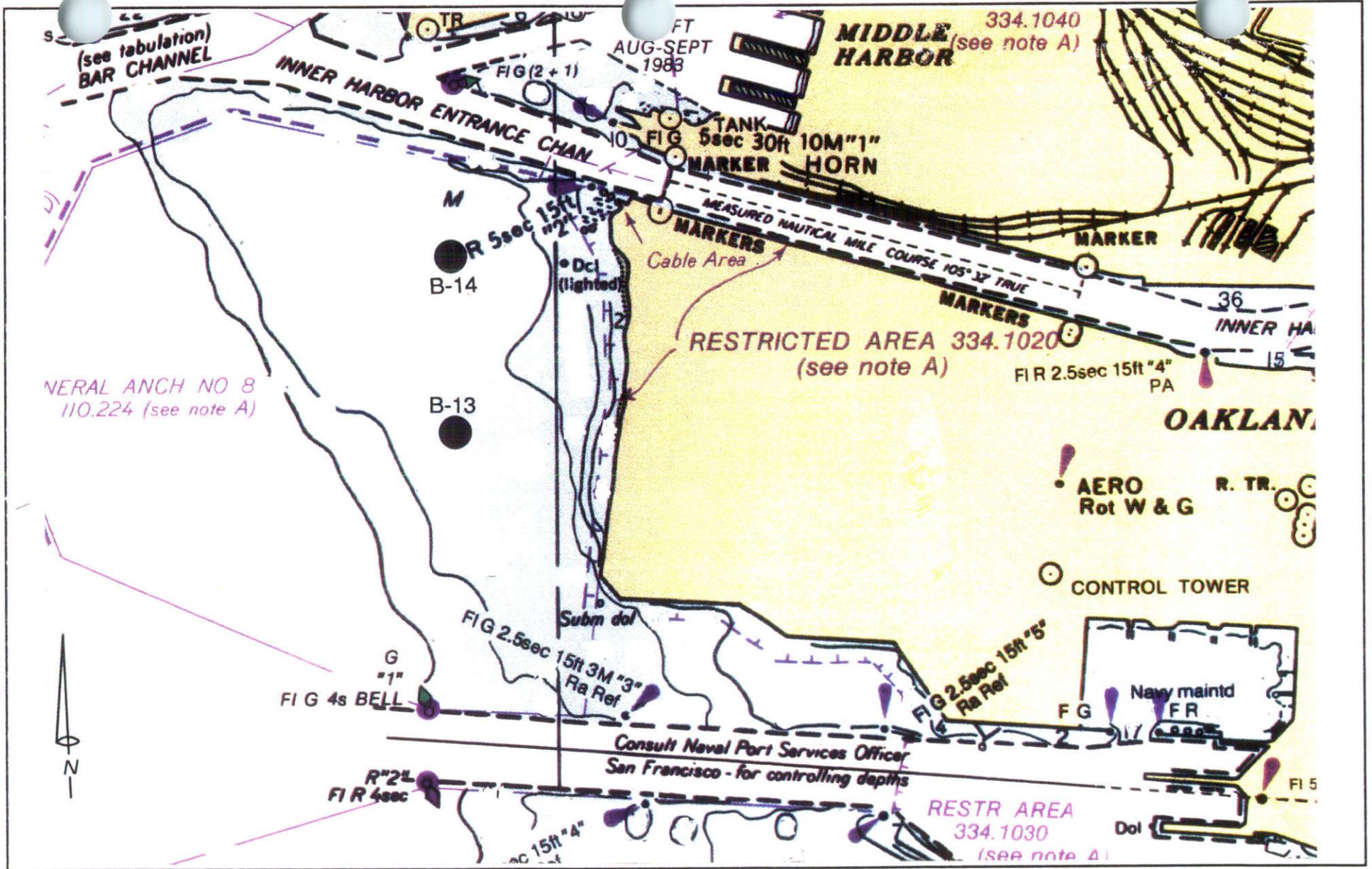
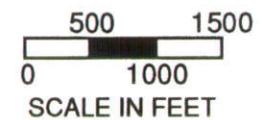


Figure 3-2 West Bayside Composite Sample Locations



disturbed. Locations B-3, B-5, and B-6 are located near stormwater drainage outfalls. Station B-4 is located near a leachfield in the vicinity of a firing range.

The distances of the stations from the shore will alternate between proximal samples (50 to 75 feet from shore) and distal samples (at the approximate first break in sediment slope, which is assumed to occur at a depth of about 17 feet mean lower low water (mllw) and at a distance of between 100 to 800 feet offshore). Thus, the even numbered samples with the inclusion of sample B-1 will be proximal stations, and the odd-numbered samples will be distal locations.

Stations B-7 through B-12 will be located along the outer perimeter of the West Beach Landfill. The stations are spaced at 1,000 foot intervals, with the following exceptions:

- Station B-8 will be located opposite a culvert located 800 to 1,000 feet south of the northwest corner of the West Beach Landfill. This culvert drains the landfill area into San Francisco Bay and is subject to tidal action
- Station B-10 is located approximately opposite a topographically low part of the West Beach Landfill (Station W-2)
- Station B-12 will be located near a storm sewer (reported to be a concrete ditch) outfall passing along and possibly draining the eastern perimeter of the West Beach Landfill which contains a wide variety of waste

Based on soundings shown on the 1:40,000 navigational chart of the San Francisco Bay entrance produced by NOAA (1986) (Figure 3-2), a break in the sediment slope occurs at a depth of about 15 to 20 feet below mllw off the west shore of NAS Alameda. The steepest sediment slope occurs along the southwest corner of the West Beach Landfill, and the most gradual slopes occur west of the IRP Site 1 landfill. These slopes are indicative of the erosional or depositional environments which occur in these areas. It appears likely that fine sediments and dissolved material will be widely dispersed in this active environment at the west edge of NAS Alameda. The general downslope path of sediments originating from the bayside shoreline will be toward the west-southwest. The most rapid downslope transport is expected to occur in the region of the West Beach Landfill, while downslope transport is expected to be

slower along the northwest bayside shoreline. The approximate locations of stations B-13 and B-14 are shown on Figure 3-2. Stations B-13 and B-14 are located approximately 1,500 ft from the West Bayside Shoreline within a relatively wide region between the 25 to 30 ft mllw contours. This region is probably dominated by deposition of sediments precipitating from the water column, with a negligible contribution from downslope transport.

3.1.3 Inner Harbor Shoreline

Along the Oakland Inner Harbor area, 10 sample stations (E-1 through E-10) have been selected so that the average distance between stations (about 850 feet) is about the same as for stations along the bayside, and so that the stations generally correspond with stormwater outfalls. Sediment core samples will be collected from two locations (E-6 and E-10). Water samples will be collected from three locations (E-2, E-6, and E-10). Locations E-1 through E-6 are located opposite an area containing a former fire training area (IRP site 14), a transformer storage area (IRP site 15), and several fuel storage tanks. Station E-4 is located opposite a pier (Pier No. 4). Some dredging outside the boundaries of the Inner Harbor channel may have been performed in the vicinity of Pier 4 in the past, based on indications from subsurface profiles of this area. Stations E-7 through E-10 are generally associated with stormwater discharge points representing the collection system that drains the northeast corner of NAS Alameda. As described in Section 2.0, some or all of these storm drains may have discharged industrial waste liquids to the Inner Harbor prior to 1975.

Since extensive sediment sampling has been completed within the boundary of the Inner Harbor channel, which is about 150 feet from the shore along the northern shore of NAS Alameda, sample stations will be located approximately midway between the channel boundary (base of the sediment slope) and the bankside mean sea level line. Thus, sediment samples E-1 through E-10 will be collected at a distance of about 75 feet from the shore in approximately 17 feet of water.

3.1.4 West Beach Landfill Wetland

The final boundaries of the wetlands areas will be determined in the course of the wetland determination study, described in this workplan. The sampling plan described here for the wetlands is subject to modification as required. Before describing the approach to sample collection in the wetlands

areas, it should be noted that the West Beach Landfill includes the breeding areas and nesting habitats of Caspian terns and western gulls. These birds need to be protected from disturbance during their nesting seasons in order to prevent disruption of this nesting colony and violation of the Migratory Bird Treaty Act. Therefore, the West Beach Landfill may not be accessible to sampling activities between the months of April and August.

Based on recent topographic survey mapping of NAS Alameda, the portion of the West Beach Landfill that lies approximately within the boundary of the City and County of San Francisco (the southwestern third of the landfill) is at an elevation between about mean sea level and 3 feet above mean sea level. This means that much of this land may be subject to periodic inundation by brackish waters of the Bay.

Sample stations W-1 through W-7, shown on Figure 3-3, fall within this region. The exact locations of these stations will be determined based on field reconnaissance of the area. Site locations will be chosen to be representative of areas in which wetlands species are present. Additional sample locations can be added if the wetland evaluation indicates a need for additional sampling coverage outside the southwestern corner.

Soil, sediment, and surface have been sampled at the West Beach Landfill Wetland on a 200 foot grid system as part of the RI/FS. The results of this sampling are not yet available. These results will be reviewed as part of the wetland evaluation as they become available.

3.1.5 Runway Wetland

Based on recent topographic mapping, the Runway Wetland area shown in Figure 3-4 contains at least two small topographic depressions that are within the tidal range. Together, these depressions cover an area that appears to be less than 4 acres. Four sample stations have been proposed for this region. The area has been assumed to be a brackish water wetland for purposes of developing this sampling plan. Since no historical hazardous waste activities have been reported in this area, the number of samples might be reduced if further evaluation indicates that the area is smaller. Sample stations R-1 through R-4 shown in Figure 3-4 are intended to be distributed as widely as possible within the established wetland area. No sampling stations have been proposed in the estuary opposite the Runway

Legend

- Sediment Sample
- Sediment and Water Sample

GENERAL LEGEND

- MAJOR BUILDING, PIER
- MINOR BUILDING
- TANK
- CURB
- EDGE OF TRAVELLED WAY
- DIRT ROAD
- CONCRETE
- RAILROAD
- CRANE TRACK
- FENCE
- RETAINING WALL
- GUARDRAIL
- STATION BOUNDARY
- INDEX CONTOUR WITH VALUE
- INTERMEDIATE CONTOUR
- SPOT ELEVATION
- WATERLINE

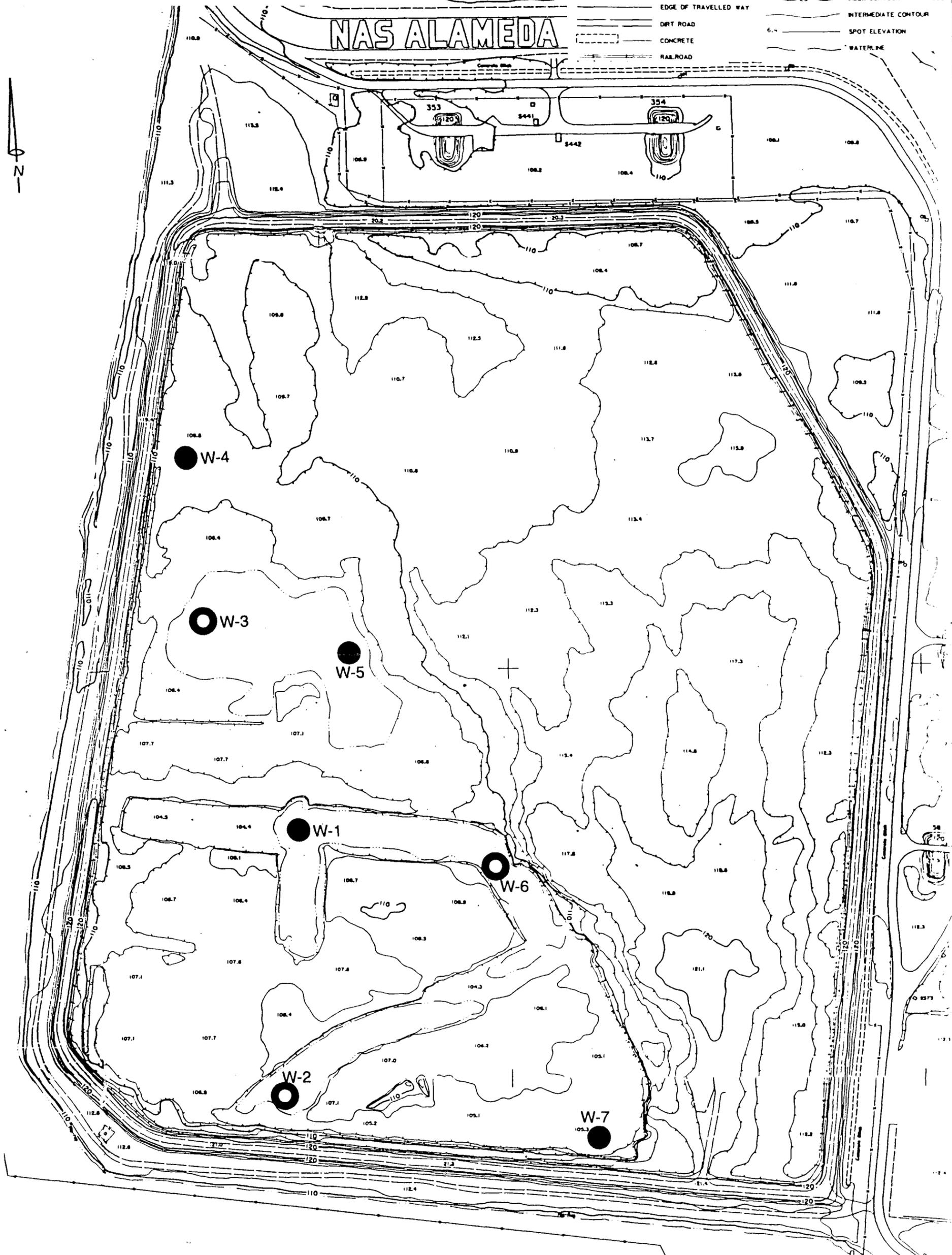
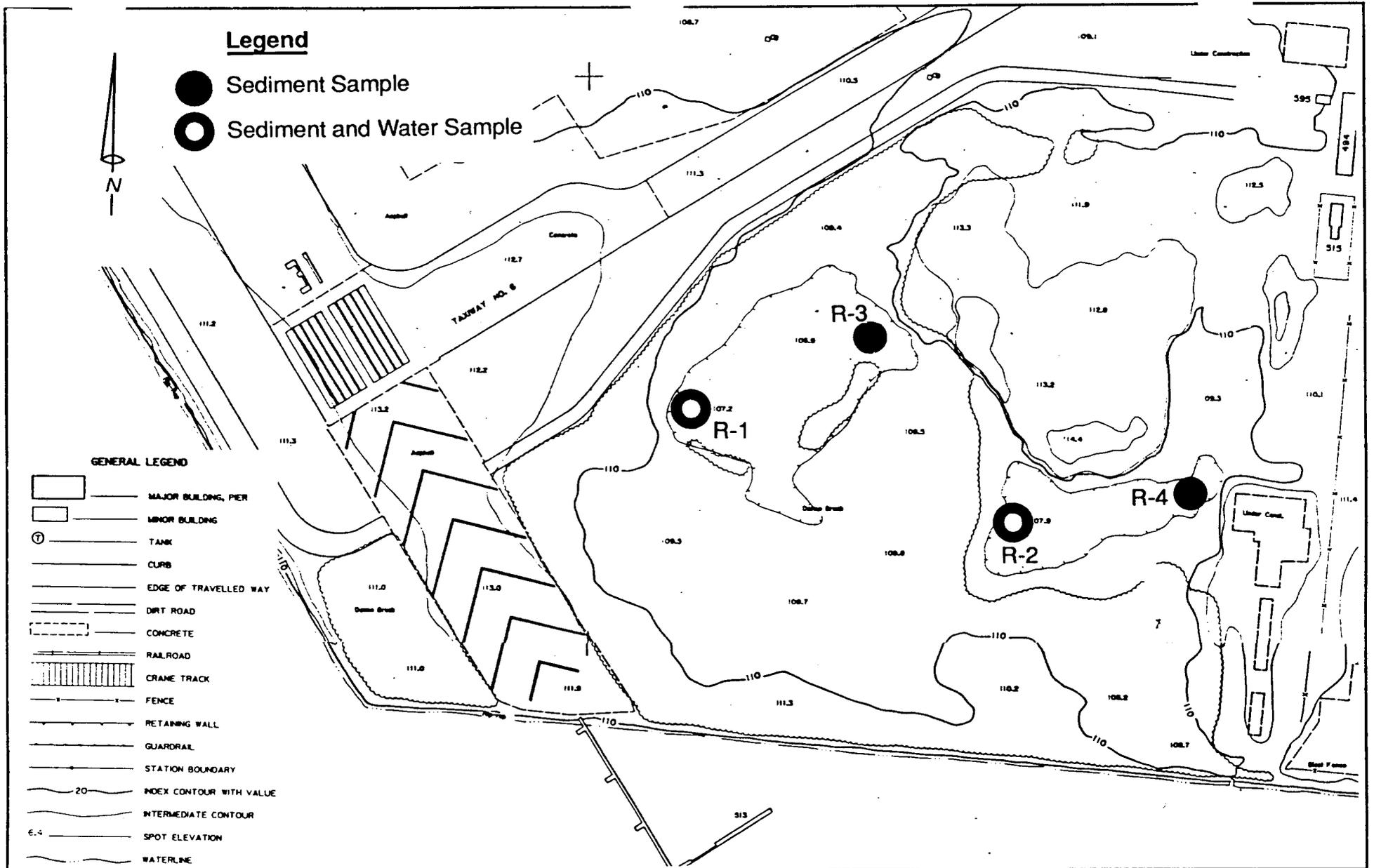


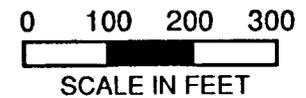
Figure 3-3

Proposed Sampling Locations at West Beach Landfill Wetland



31

Figure 3-4 Proposed Sampling Locations at Runway Wetland



Wetland, because recent predredge sediment evaluations have been conducted in this area (Tetra Tech 1991). The data from the predredge sediment evaluations will be compared with data collected during the ecological assessment to determine the nature and extent of contamination.

3.1.6 Reference and Control Sediments

A reference area provides a means of evaluating ecological effects when the ecological endpoints are not regulatory standards. The Testing Manual for Evaluation of Dredged Material Proposed for Ocean Disposal (U.S. EPA/COE 1991) defines reference sediment as:

a sediment, substantially free of contaminants, that is as similar to the grain size of the dredged material and the sediment at the disposal site as practical, and reflects conditions that would exist in the vicinity of the disposal site had no dredged-material disposal ever occurred, but had all the other influences on sediment condition taken place.

While this ecological assessment differs from a dredge disposal site evaluation in many respects, the objective of studying conditions in the reference area is to account for some impacts relative to background conditions so that regional conditions are not incorrectly attributed to the site.

Figures 3-5 and 3-6 show the locations of two proposed reference sites for bioassay studies: Island No. 1 east of the mouth of the Sonoma River at San Pablo Bay in Solano County (a wetland reference area); and the central bay north of Point Pinole and north of the shipping channel, in Marin County (an estuary reference area). The final estuary reference site would be selected to meet the following criteria:

- Avoids the dredge spoil disposal area
- Avoids the channels to Mare Island
- Avoids the area southwest of the Petaluma River
- Avoids shoreline point sources or outfalls
- Falls within the area east of Pinole Point and north of Point Wilson

The proposed estuary site is shown in Figure 3-5. This area generally yields sediments with contaminant levels among the lowest in the San Francisco Bay. It is also a good source of fine sediments. It should be noted that all locations within the San Francisco Bay are potentially subject to contamination. Therefore, acceptance of reference samples will depend upon their being substantially free of

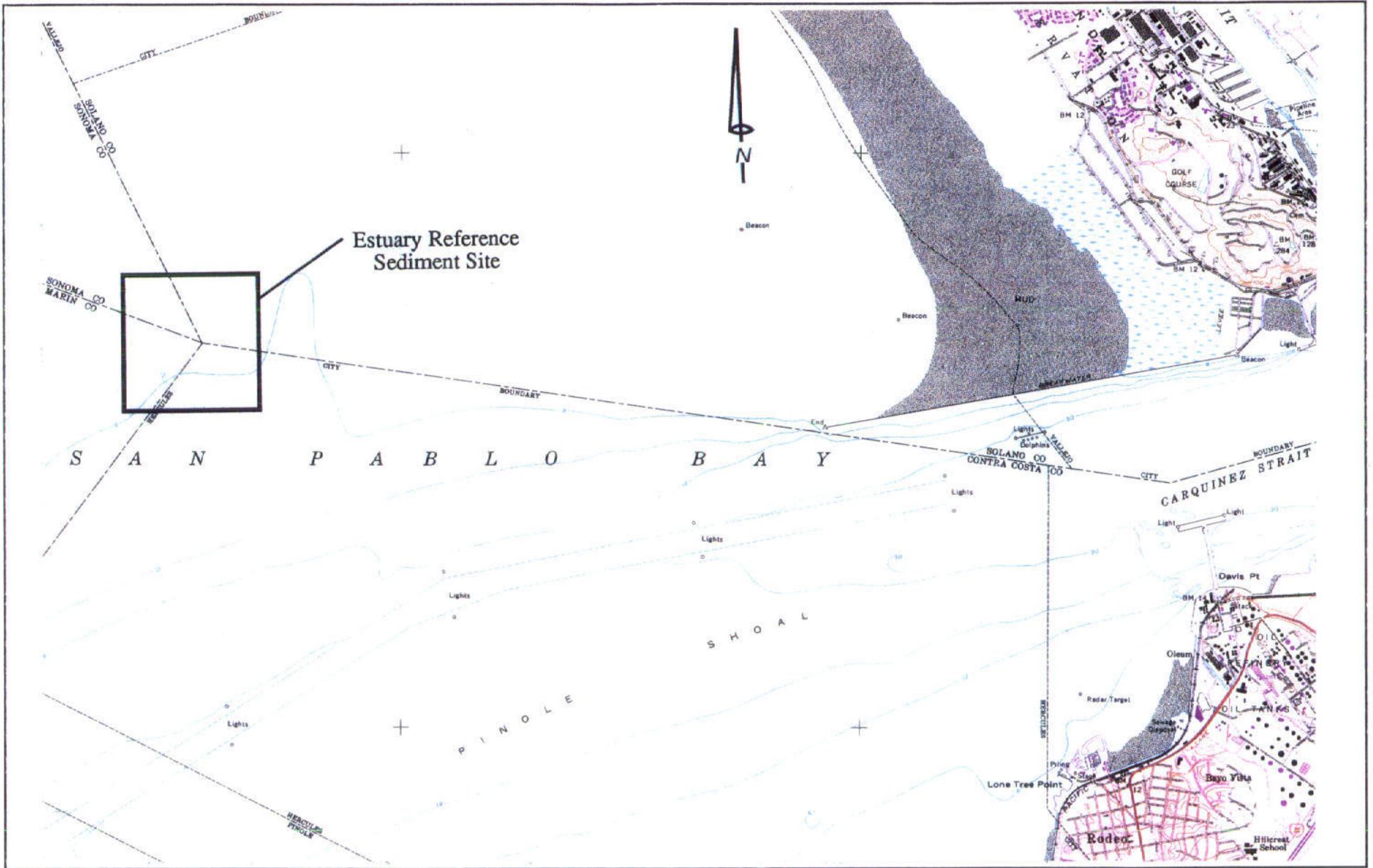


Figure 3-5 Estuary Reference Sediment Site, San Pablo Bay

0 1500
SCALE IN FEET

adopted from USGS Mare Island, California
7.5 minute quadrangle



contamination.

Specific sampling sites within the reference areas would be selected for sampling when conditions at NAS Alameda have been characterized. Comparable interstitial salinity, sediment grain size distribution, and sediment total organic carbon (TOC) are the primary variables to be used in selecting sample sites within the reference areas.

Control sediment is defined in the U.S. COE Testing Manual (U.S. EPA/COE 1991) as:
a natural sediment essentially free of contaminants. The essential characteristic of control sediment is that it be fully compatible with the needs of the test organism such that it have no discernable influence on the response being measured in the test. The results of the control-sediment tests are used to verify the health of organisms used in testing and the acceptability of test conditions.

Control sediment will be obtained from the laboratory which supplies test organisms, and will be sediment in which the organisms are cultured.

3.1.7 Stormwater Discharge Locations in Seaplane Lagoon

Stormwater discharge samples will be collected from three representative outfalls in the Seaplane Lagoon. The choice of outfalls to sample will be a field decision, with consideration to the rate of discharge, visual or olfactory observations, results of field tests (including pH, conductivity, or organic vapor associated with the discharge), and results of existing analytical data. The effluent collection and testing study will be coordinated with the ongoing sewer remediation project, if possible.

3.2 CRUISE PROCEDURES

Precautions will be taken to prevent contamination of samples during collection and initial processing on board the vessel. Cleaning of samples, working areas, and instrumentation is essential before collection of each sample for chemical or toxicity analyses. Work areas of the sample vessel will be arranged to avoid contamination of samples by engine exhaust, oil, and other interfering substances.

3.2.1 Vessel Specifications

The survey vessel must be shallow draft and stable, with a winch or hoist for lowering and retrieving the sediment sampling equipment. The vessel will be equipped with satellite navigation equipment as described below. The vessel will be equipped with flat work space and adequate space for equipment. Several vessels with these capabilities are available locally with experienced crew.

3.2.2 Station Location Methods

The navigational system that will be used for this study is the Global Positioning System (GPS). GPS is a radio navigation system that calculates and displays position information obtained from orbiting satellites. The GPS system that will be used for this survey is the Magnavox MX 200 GPS Navigator System. Position information is displayed as latitude and longitude, in either degrees and decimal minutes, or degrees, minutes, and seconds format. This system has a horizontal root mean square accuracy of 15 m. The accuracy of the GPS signal is sometimes reduced to about 100 m by Selective Availability, a Department of Defense program that denies full GPS accuracy to nonmilitary users by introducing algorithms that alter satellite radio signals. At the present time, Selective Availability is in place and is expected to be applied during this survey. Therefore, the navigation system used for this survey is expected to have an accuracy of approximately 100 m.

The precision of the system is governed by the number of satellite signals received during a given time period. The MX 200 has six channels to receive satellite signals and so can update position information every 0.25 to 0.5 second, while more basic systems update every 2 to 3 seconds. Therefore, the proposed navigation system will have excellent precision. The latitude and longitude of each station will be recorded to the nearest 0.1 second using the GPS system. Navigational information will be augmented by plotting all station locations on U.S. Geological Survey (USGS) 7.5-minute quadrangle maps, and by photographing and estimating distances to landmarks from sampling locations. Depth of all sampling stations will be measured with a digital readout fathometer.

Although other navigation systems involving shore operations may offer a higher degree of both accuracy and precision, it is impractical to employ them given the location and number of sampling

stations to be included in this study. Additional location measurements will be made by taking compass bearings from fixed landmarks on shore, when feasible.

3.3 WATER SAMPLING METHODS AND PROCEDURES

Water samples will be collected at three stations in each of the study areas, except the Runway Wetland, where two stations will be sampled. Table 3-1 lists the number of samples and minimum sample volume that will be collected in each area. Additional volume may be collected to ensure against breakage.

Water samples will be collected for direct chemical analysis. Three distinct types of water samples, requiring different collection procedures, will be collected. These include marine water samples from the offshore and lagoon areas, brackish water samples from low-lying portions of the wetlands, and stormwater effluent, from selected storm sewer outfalls into the Seaplane Lagoon.

A complete list of the analytes and test methods is provided in Section 3.9. Methods, container requirements, preservation techniques, and holding times are presented in the quality assurance project plan (Appendix A).

TABLE 3-1 WATER SAMPLE REQUIREMENTS

Area	Number of Stations	Number of Field Replicates per Station	Total Number of QA Samples	Volume per Sample (L)	Total Volume (L)
West Beach Landfill Wetland	3	3	1	5.5	32
Runway Wetland	2	2	1	5.5	24
West Bayside	3	3	1	5.5	32
Inner Harbor Shoreline	3	3	1	5.5	32
Seaplane Lagoon	3	3	1	5.5	32
Subtidal Reference Area	1	1	1	5.5	16
Wetland Reference Area	1	1	1	5.5	16
Total		16	7	5.5	184

3.3.1 General Documentation and Sample Handling Procedures

The following general procedures apply to all stages of sample handling. Proper chain-of-custody will be maintained throughout the sampling and analysis program from the time of collection to the point of data reporting. Chain-of-custody documents include:

- Field log book
- Sample labels
- Chain-of-custody records
- Custody seals

A bound field log book will be used to record all pertinent information on field sampling activities. The field team leader will be responsible for maintaining the log book with sufficient detail to allow reconstruction of the field activity without relying on memory.

All entries will be made in indelible ink. The log book will include:

- Date and time of start and finish of work
- Names of field personnel
- Purpose of sampling
- Description of sampling site
- Description of photographs
- Location of sampling site
- Details of actual sampling methods and procedures, including deviations from standard procedures
- Field observations
- Field measurements (such as pH, depth, temperature conductivity and dissolved oxygen)
- Sample identification
- Types and numbers of samples collected
- Shipping information

Sample labels will be waterproof and indicate the sample number, date and time of collection, location, preservation technique, and sample collector's name. All samples will be accompanied by a chain-of-custody record. Samples must not be left unattended unless properly secured. Custody seals should be attached to all containers to verify that the containers have not been tampered with.

3.3.2 Sample Collection Equipment

Depth, temperature, conductivity, and dissolved oxygen will be measured in situ in the water column at marine water sampling locations using portable field instruments. Depth will be measured from the length of cable payed out as the probes are lowered to make these measurements taking into account the wire angle observed during measurements. Salinity will be calculated from conductivity measurements. The pH and water turbidity samples will be measured on board the vessel using a portable pH meter and a portable turbidometer at the time samples are collected. Depth to the bottom will be measured with a fathometer.

Water samples for chemical analysis will be collected from a depth of 1 m below the surface using a Niskin grab sampler, fitted with a multiple sampler frame so that adequate volumes for all analyses and replicates can be collected at each station simultaneously.

In the wetlands, water samples will be collected from low-lying, submerged areas during ebb tides. Water samples will be collected using a subsurface grab bottle sampling device loaded with precleaned sample bottles. In the event that water depth is insufficient for sampling by this method, a specially designed hand held sampling device will be used to collect water samples. If a device cannot be designed to meet sampling needs, a decontaminated stainless steel bucket will be used to collect sample volumes in low-lying wetland areas.

Effluent samples will be collected from stormwater outfall locations, if accessible, using precleaned sample collection jars of a size sufficient to collect all of the sample needed for chemical analysis in one grab. If outfalls are not accessible, samples will be collected by lowering a subsurface grab sampler into the storm sewer through the nearest upstream manhole.

The stormwater effluent equipment and procedures are described in detail in Section 3.5.

Water sample container and preservation requirements are presented in Section 4.0 of Appendix A, the Quality Assurance Project Plan.

3.3.3 *Water Sample Collection Methods*

Sampling instruments will be calibrated and operated according to the manufacturer's instructions. In addition, the following standard procedures will be employed.

Prior to deployment, it is critical that the interiors of the bottles used for sampling remain free of contamination. Therefore, after cocking the sampler, all members of the sampling team will avoid touching the insides of the samplers and stoppers.

Water samples will be collected by lowering the Niskin sampler 1 m below the water surface. The sampler will be closed at a depth and brought on board. The stoppers at both ends of the sampler will be checked immediately for complete seals. If leaking is observed, the sample will be rejected. Depending on the volume of the Niskin sampler, multiple bottle casts may be required to obtain sufficient water for chemical analyses and toxicity testing.

Once the samples have been collected and placed in the appropriate containers, they will be stored on ice at 4°C. The samples will not be filtered prior to analysis.

3.4 SEDIMENT SAMPLING METHODS AND PROCEDURES

Sediment samples will be collected in each of the five study areas, for determination of both sediment chemistry and sediment toxicity. PSEP protocols for collection of sediment samples described in Tetra Tech (1986a, 1986b, 1986c) will be used. The protocols are summarized below and in Appendix A.

3.4.1 Sediment Sample Collection Equipment

Subtidal surface sediments will be collected using a stainless steel single or dual 0.1 m² van Veen bottom grab sampler. The grab sampler will be attached to a hydraulic winch cable with a ball-bearing swivel to prevent twisting of the cable.

Wetland sediments will be collected using a 4-in diameter clear polyvinyl chloride (PVC) tube sampler or stainless steel trowel, depending on the consistency and water content of the sediment.

3.4.2 Sediment Sample Collection Methods

Subtidal Sediments - Most of the toxic chemicals of concern in the ecological assessment, which originate from onshore sources, will be concentrated in the fine grained materials, such as silts and flocculated clays. It is desirable to collect samples with a high proportion of fine grained materials in order to assess the worst case conditions throughout the project area. The suitability of a sediment sampling location will depend on the ability to obtain an acceptable sample with the van Veen grab. Conditions which may affect suitability of a location include the slope of the bottom surface, subsurface obstacles, hazardous conditions in the sampling area, and relative abundance of fine grained sediments which affects sampler penetration. At least one test grab sample will be collected at each station, to enable the field team leader to evaluate the suitability of the sample station for sampling. The final sampling locations may be modified by the field team leader if an acceptable sample cannot be obtained at the station initially selected.

The grab sampler will be lowered and raised at a rate not to exceed 5 m per minute. Once the sampler is brought on board, it will be placed on a flat surface. Access doors on the top of the grab will allow visual characterization of the sediment surface to assess sample acceptability. Prior to characterization, the overlying water will be removed by siphoning.

A sample will be considered acceptable if the following criteria are met:

- The sampler is not over-filled with sediment so that the sediment surface is pressed against the top of the sampler

- Overlying water is present
- The overlying water is not excessively turbid
- The sediment surface is relatively flat
- The desired penetration depth is achieved (for this project, the desired penetration depth is at least 12 cm)

A sample will be rejected if it does not meet these criteria.

After a sample is deemed acceptable, a decontaminated stainless steel ruler will be used to measure the sampler penetration depth. The sample quality and its texture will be described in the sample log prior to removing sediment from the grab.

Unrepresentative material will be removed from the samples under the supervision of the chief scientist, and noted in the field log. Unrepresentative material may include large sticks, shells, and rocks. If the amount of unrepresentative material exceeds 20 percent of the sample, the sample will be rejected and another sample collected.

For each sample site, five replicate composite sediment samples will be collected for chemical analysis and sediment bioassays. The sediment sample requirements for a typical site are given in Figure 3-7. Approximately 2 L of sediment from the fourth and fifth composited sample will be archived for possible future sediment chemistry analysis. Each replicate composite sample will consist of the upper 10 cm of sediment from five separate grab samples. Sediment in contact with the sampler walls will not be collected because of possible disturbance or contamination. After all five grabs have been collected, the sediment will be mixed with a stainless steel spoon until it attains uniform color and texture. Approximately 1.5 L of sediment will be removed from each composite sample for use in sediment bioassay testing, while approximately 1 L will be removed and archived for possible Tier II bioaccumulation testing. The remaining sediment will be transferred to precleaned sample jars for chemical analysis. In addition to the sediment composite samples collected for chemical analysis and bioassays, five 0.1 m² van Veen grab samples will be collected at each site and archived separately for benthic analysis (see Section 3.7). These sediment samples will not be composited.

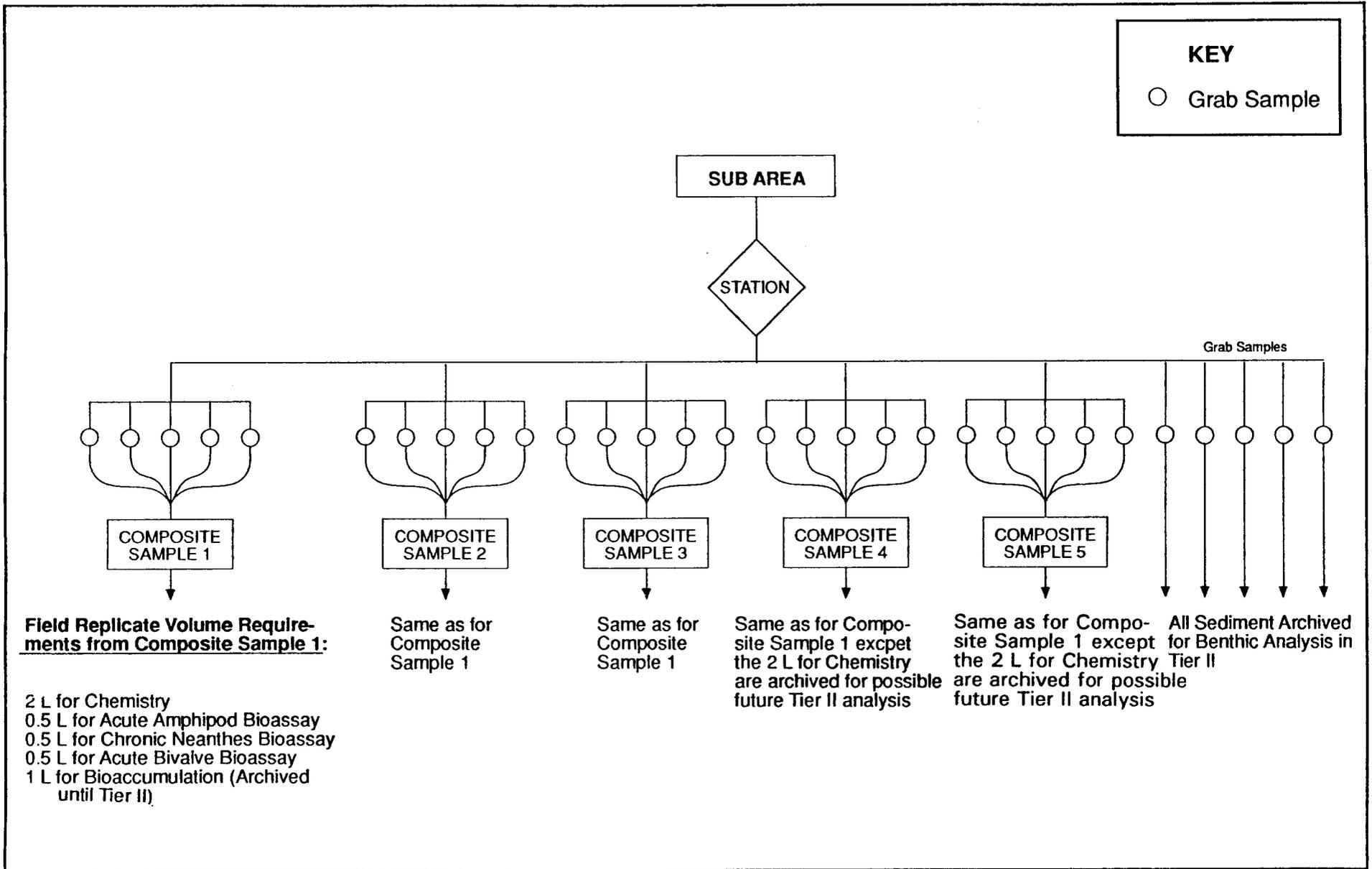


Figure 3-7 Sediment Sample Requirements



Sediment core samples will also be collected at 12 of the subtidal sample locations shown on Figure 3-1 (E-6, E-10, B-2, B-4, B-6, B-8, B-9, B-10, B-12, S-3, S-4, and S-7). Each core will be a minimum of 120 cm. Polycarbonate liners will be used for the sample coring device. Each undisturbed core will be photographed on its side in color next to a ruler. The top 10 cm will be analyzed as part of the surface sediment sampling program. The next two 30-cm segments will be individually composited and analyzed for all of the standard sediment chemistry constituents except volatile organic compounds. A final discrete sample will be taken 25 cm from the bottom of the core.

Wetland Sediments - Wetland sediments will be preferentially collected from locations that are subject to periodic saturation or inundation due to tidal fluctuations. These are the lowest points in the wetlands, and represent the areas into which ground water drains at low tidal stands. Access to these areas may be improved at low tidal stands. The field team leader will be responsible for scheduling sampling at appropriate times to collect samples from these areas, and to minimize impacts to wildlife which use the area. Scheduling of sampling activities and techniques to reduce impacts on wildlife, such as nesting birds, will be coordinated with base personnel and wildlife biologists from the Environmental Division and Planning Branch of the Western Division, Naval Facilities Engineering Command.

A wetlands assessment, described in Section 3.10, will be conducted prior to commencement of field sampling activities. The extent of the wetlands will be delineated in the wetland assessment, and sediment, water, and biota samples will be collected only from within the areas determined to be wetlands. Surficial (upper 10 cm) sediments will be collected. Sample collection locations will be located in the field from compass bearings and ranges taken on existing land marks in the vicinity. The location of each sample will be plotted in the field on a scale map of the area, and the location data will be recorded in the field log book. In addition, to facilitate future identification of the sampling points, the sites will be staked.

For each sample site, five field replicate composite sediment samples will be collected for chemical analysis, sediment bioassays and bioaccumulation analysis. Each replicate composite sample will consist of the upper 10 cm of sediment from approximately 10 sediment grab samples. To collect sediment samples, a previously cleaned 4-in clear PVC tube will be pushed vertically into the sediment to a depth of about 10 cm. The top of the tube will be capped and the tube, containing the sample, will be withdrawn. The upper 10 cm of sediment retained in the sampler will be extruded into a stainless steel

bowl and composited by stirring with a stainless steel stirrer until a homogenous color and consistency is achieved. Approximately 1.5 L of sediment will be removed from each composite sample for use in sediment bioassay testing (Section 3.6), while approximately 1 L of sediment will be removed and archived for bioaccumulation testing in Tier II. The remaining sediment (2L) will be directly transferred to precleaned sample jars for chemical analysis. In addition to sediment collection for chemical analysis, bioassays and bioaccumulation testing, five 4-in diameter cores of sediment to a depth of 10 cm will be collected and archived separately for benthic analysis in Tier II.

3.4.3 Sample Handling

All sampling equipment will be made of noncontaminating materials and will be decontaminated between each station. Personnel will wear polyethylene gloves while handling the samples. These will be worn as liners for nitrile gloves while collecting samples. In addition field personnel will wear protective clothing as described in the health and safety plan (see Appendix B).

Bowls, utensils, and other sampling equipment that may come into contact with samples will be washed with laboratory grade detergent (Alconox), rinsed with potable water, rinsed with metal-free water, rinsed with laboratory grade methanol and allowed to air-dry. Residual methanol will be collected and stored for proper disposal at the conclusion of the field activities.

The field log will include general information for each station (station number, date, crew, weather) and specific information for each cast of the grab (grab number, position, water depth, time). The physical characteristics of the sediment that will be recorded for each grab sample in a sample log include sediment texture, color, presence of oil sheen, and odor; grab penetration depth (nearest 0.5 cm); degree of leakage or sediment surface disturbance; any obvious abnormalities such as wood/shell fragments or large animals; and gross characteristics of the vertical profile, including changes in sediment characteristics.

Sediment samples will be labeled and stored on ice in insulated coolers in the field following PSEP protocols. Ice will be held in watertight bags to prevent potential contamination of the samples. Samples will be shipped or transported directly to the analytical laboratory so that they arrive at the

laboratory within the specified holding times. In general, samples will be shipped on the day of collection. Individual sample containers will be wrapped to prevent breakage.

3.5 MONITORING OF STORMWATER DISCHARGES

Seven outfalls reportedly discharge stormwater runoff to the Seaplane Lagoon and the San Francisco Bay. This runoff may contain pollutants, which if discharged in sufficient quantities may adversely affect water quality and biota in the lagoon. The U.S. Environmental Protection Agency (EPA) has not finalized regulations for the implementation of stormwater NPDES permits. However, the final stormwater rule went into effect in December 1990 codified as 40 CFR 122. It is anticipated that all facilities, whether covered by an individual, group, or general permit, will be required to submit quantitative stormwater data yearly under permit compliance conditions. This section presents a sampling plan for stormwater discharge to the Seaplane Lagoon and San Francisco Bay waters.

The objectives of the stormwater sampling are to:

- Characterize the hydrochemistry of stormwater discharge relative to priority pollutants
- Estimate the mass loading of pollutants-of-concern to the lagoon and Bay waters
- Analyze the toxicity of stormwater discharge

3.5.1 Selection of Sampling Sites

Stormwater discharge will be measured for three stormwater outfalls that discharge to the Seaplane Lagoon. The stormdrain outfalls will be selected based on the following criteria:

- The selected outfalls were historically used to discharge industrial wastewater to the seaplane lagoon
- The collection area served by the sewer system represented by the selected outfalls represent the largest of those systems that discharge to the lagoon
- The total collection area served by the sewer systems represented by the selected outfalls contains as many recognized IRP sites as possible and,

- The sewer outfall or an upstream manhole is accessible to sampling equipment

3.5.2 Selection of Storm Events

Stormwater sampling should be conducted during a "typical" storm event for the San Francisco Bay area, in terms of intensity, volume, and duration. Criteria for selection of an appropriate storm event will include the following:

- The storm must have been preceded by at least 72 hours of dry weather
- Precipitation produced by the storm event must exceed 0.1 in
- The storm event must not vary by more than 50 percent from the 5-year average rainfall volume and storm duration at the nearest representative rainfall gauging station

Local professional weather forecasters will be consulted to determine the likelihood of impending storms to meet these criteria. Sampling teams will be mobilized to selected outfall sites at the onset of a storm likely to meet the criteria.

Upon arrival at the NAS Alameda site, the sampling team will install a precipitation gauge in the area of the outfalls to determine the precipitation during the course of sampling. Rainfall intensity and volume will be evaluated by recording the precipitation gauge volume every 30 minutes during the period of sampling. The duration of the storm event and the total amount of precipitation will also be recorded.

3.5.3 Flow Measurements

Flow measurements are necessary to allow a calculation of the mass loading of pollutants entering the lagoon and San Francisco Bay from stormwater discharge. Several techniques can be used to estimate stormwater flow rates. The selection of an appropriate measurement technique will depend upon regulatory requirements and the NPDES monitoring objectives. Flow measuring devices, that are triggered automatically by water flow and provide a continuous measure of flow rates, are available and could be installed in the outfalls if fine scale resolution of stormwater flow is deemed necessary. Alternatively, cost-effective manual devices can be utilized during the sampling of stormwater outfalls.

During the designated stormwater sampling schedule, measurements will be taken of the geometric dimensions of the outfall, and the depth of water within the storm sewer outfall. These measurements will be used to calculate the cross-sectional flow area of each outfall pipe during the storm event. At each outfall pipe sampling location measurements of water depth at the sampling point and flow rate past the sampling point will be made immediately preceding the collection of each water sample. These measurements will allow calculation of stormwater discharge during discrete intervals throughout the storm event.

3.5.4 Collection of Water for Chemical Analysis

A composite sample of stormwater will be collected manually over a 5-hour period for each outfall. The salinity of the composite sample will be determined in the field using a conductivity meter. Field measurements of temperature, pH, dissolved oxygen, and turbidity will also be made using portable field equipment. The standard operating procedures for these methods are given in Appendix A-2 of the Quality Assurance Project Plan. A maximum of 10 L of water will be collected during each hour interval. Water samples will be collected during each hour interval from the stormwater outfalls and placed in precleaned polycarbonate carboys. Approximately 2.5 L will be collected during each 15-minute interval. A final 20 L composite sample for each outfall will consist of a mixture of volumes of water collected during each hourly interval. The volume of water contributed to the composite for each interval will be determined by weighting each sample by the mean discharge calculated over the hourly sampling period (see Section 3.5.3).

The composite samples from each outfall and the reference station will be maintained at 4 °C and stored at this temperature until used for chemical analysis. The samples will not be filtered prior to analysis. Effluent sample requirements are shown in Table 3-2.

3.5.5 Toxicity Testing of Stormwater

Dilution water for toxicity tests will be prepared first, prior to initiation of the bioassays according to EPA-approved methods. Tests will be conducted under conditions known to be non-stressful to the test organisms. Dissolved oxygen concentrations in the test water will be measured. Sample water will be filtered with a plankton net to remove native organisms. Dissolved oxygen of the dilution water

will be adjusted to near saturation. Sample and dilution water will be added to test tanks in the appropriate dilution ratios to achieve a dilution factor of 0.3 between 1 and 100 percent stormwater using five concentrations (100 percent, 30 percent, 10 percent, 3 percent, 1 percent). The pH of test tanks will be measured and recorded.

The fathead minnow *Pimephales promelas* was selected for use in a chronic bioassay test of stormwater runoff. This species was considered appropriate since it is tolerant of low salinities expected in stormwater runoff and it has been selected for a number of other NPDES effluent toxicity studies in the region. EPA Method 1000 will be used to conduct this bioassay. This method uses fathead minnows less than 36 hours old in a 7-day static renewal test of five stormwater dilutions (in geometric series). Test results will report survival and growth (in terms of weight increase) of the larvae held in stormwater test solutions compared with freshwater control sample larvae. Results of the chronic bioassays will be considered acceptable if survival of the control group is greater than 90 percent. Sample volume requirements are shown in Table 3-2.

In the event that the storm drain system contains saline water intruded from San Francisco Bay during collection of the storm drain samples, the inland silverside, *Menidia beryllina*, will be used for chronic bioassay testing of stormwater. This species was considered appropriate due to its wide range of salinity tolerance (5 to 32 ppt). Other marine species commonly used for bioassay testing of saline waters require salinities of greater than 20 ppt. EPA (1988) methods will be used to conduct this bioassay. This procedure will require 7 to 11 day-old silverside larvae in a 7-day, static-renewal test of five stormwater dilutions (in geometric series). Test results will be based on the survival and growth (increase in weight) of the larvae as compared to the control larvae. Results of chronic bioassays will be considered acceptable if survival of the control group is greater than 90 percent. Sample volume requirements are the same as those shown for the fathead minnow (Table 3-2).

TABLE 3-2 STORMWATER EFFLUENT SAMPLE REQUIREMENTS

	Number of Stations	Number of Field Replicates per Station	Total Number of QA Samples	Volume per Location (L)	Total Volume (L)
Number of Samples for Water Chemistry	3	3	3	5.5	66
Number of Samples for Toxicity Testing	3	3	N/A	5	45

3.6 SEDIMENT BIOASSAY SAMPLING METHODS AND PROCEDURES

Solid and liquid (elutriate) phase sediment bioassays will be conducted to determine the toxicity to biota of sediment from the NAS Alameda study areas. Both bioassays will be conducted using sediment collected from each sediment sampling station. The locations of sediment sampling stations are shown in Figures 3-1 through 3-4.

3.6.1 Test Organisms

Bioassays are designed to determine whether a particular material or medium (such as sediment or water) is likely to produce unacceptable adverse effects on marine organisms. Several types of organisms are commonly used to conduct sediment and water bioassays. However, the inferences drawn from the test results have the greatest validity when the assay species occur naturally in the vicinity of the area being evaluated. The toxicity of sediments will be evaluated by conducting a 10-day solid phase bioassay test using the amphipod *Eohaustorius estuarus*. *E. estuarus* is present in San Francisco Bay,

and is therefore preferred over the amphipod, *Rhepoxynius abronius*, which is more commonly used for this bioassay test.

Elutriate toxicity will be evaluated by conducting a 48-hour embryo-larval bioassay test using the bivalve *Mytilus edulis*. This bivalve also occurs naturally within San Francisco Bay and has been used as part of the California Mussel Watch Program to assess the bioaccumulation of pollutants within the Bay. These mussels can spawn under controlled laboratory conditions. The procedure for bivalve conditioning and induced spawning is described in the PSEP protocols. Embryos will undergo 48-hour exposures to test and control sediment elutriates during which time normal embryos develop into prodissoconch I larvae. Toxicity will be measured based on abnormal shell developments and larval death.

Neanthes, a marine nereid polychaete, is widely distributed, and has been collected in California. *Neanthes* has been successfully maintained in culture since 1964, and since 1966, various life states of *Neanthes* have been used as bioassay organisms. The level of contamination affecting juvenile survival and growth in *Neanthes* is similar to the level that affects reproductive success. The 28-day bioassay using juvenile *Neanthes* will be used to assess chronic toxicity of the sediments in the study area.

3.6.2 Sample Collection Methods

The equipment and methods that will be used to collect sediment for the bioassay test are described in Section 3.4.

A summary of the sediment sample requirements for bioassays is shown in Table 3-3.

3.6.3 Sample Preparation and Handling

The solid phase bioassay tests will be conducted using the protocols specified in the PSEP (1986) and in the Tetra Tech and EVS Consultants Final Report (1986). Sediment from each of the sediment sampling sites will be composited in a solvent-rinsed stainless steel bowl. Composite samples can be held in containers for several hours (at bottom temperature) prior to sieving (Tetra Tech and EVS Consultants

TABLE 3-3 SEDIMENT REQUIREMENTS FOR BIOASSAYS

Area	Number of Locations	Replicates per Location	Sediment per Test (L)	Total Sediment per Area
West Beach Landfill Wetland	7	5	1.5	52.5
Runway Wetland	4	5	1.5	30
West Bayside	14	5	1.5	105
Inner Harbor Shoreline	10	5	1.5	75
Seaplane Lagoon	7	5	1.5	52.5
Subtidal Reference Area	1	5	1.5	7.5
Wetland Reference Area	1	5	1.5	7.5
Total	44	35	10.5	330

1986). Sediments will be brought to shore and homogenized and sieved. Following homogenization of the sediment, the composited material will be sieved through a 1.0 mm mesh screen into a settling container. Press sieving will be tried initially on all bioassay sediment samples prior to any other method of sieving. After the sediments have settled for a minimum of 6 hours, overlying seawater will be removed and the sediments will be thoroughly mixed using solvent-rinsed stainless steel implements. The resulting test sediment will be stored in the dark at 4 °C during transport to the bioassay laboratory.

3.6.4 Bioassay Testing Procedure

Solid-phase bioassays will be conducted and analyzed using the protocols specified in ASTM (1989) and in Tetra Tech and EVS Consultants (1986). Holding times for sediment samples used in bioassays will not exceed 14 days. Data obtained from the 10 day bioassay test with *Eohaustorius estuarus* will include the number of initial burials, the daily number of emerged specimens, and the percent reburials.

Exposure chambers will be prepared using designated sediment composite samples collected from each sample area. Five replicate composite sediment samples will be analyzed from each sample station

to assess field variability. A set of five laboratory replicates will be performed for one sample composite from each sample subarea. Sufficient sample volume will be collected in each replicate composite sample to allow for laboratory replication. If reproducibility of laboratory results is within 10 percent then no additional laboratory replicates will be analyzed for the sample subarea. Homogenized sediment from each composite sample will be placed in a 1-L glass container to a depth of 2 cm and 900 ml of filtered seawater will be added. Constant temperature and constant illumination are maintained throughout the test period (static test). A daily record will be kept of water quality parameters in the test chambers (dissolved oxygen, salinity, temperature, pH, and in some chambers, ammonia).

In addition to testing reference sediments from San Pablo Bay and the sediments in the study areas, a control sample will be tested using sediment in which the test organisms have been cultured. Test organisms and control sediment will be obtained from a laboratory, and the source of the sediment and organisms will be documented. At least 20 test animals will be introduced to each exposure chamber to initiate the bioassay. Standard toxicant tests will be included as part of the testing process. The initial number of amphipods that burrow into the sediment within an hour after being placed in the treatment tanks will be recorded. The number of emerging amphipods will be recorded daily. After 10 days of exposure, live amphipods will be carefully removed by sieving the sediment and collecting the amphipods in clean seawater. The number that rebury themselves in the control sediment after 1 hour will be recorded. Statistical analysis of survival data will be carried out using methods described in the U.S. EPA/COE Testing Manual (U.S. EPA/COE 1991). These methods are summarized below in Section 3.6.5.

Elutriate bioassays with *Mytilus edulis* larvae will be conducted and analyzed using the protocols specified in ASTM (1989) and Tetra Tech and EVS Consultants (1986). Data obtained from the 48 hour test will include larval percent survival and incidences of larval abnormalities in:

- Reference sediment collected from San Pablo Bay and
- Five replicate sediment composite samples from each sample station in the study area.

Five elutriate concentrations will be tested for each sample area, as well as, for reference and control sediment. Both a positive (toxic) and a negative (laboratory water) control will be run concurrently with each set of test sediment elutriates.

Elutriate chambers will be prepared using composite samples collected from test areas, from a reference area, and control sediment. Twenty grams of sediment will be suspended in 1 L of artificial seawater prepared no more than 2 days in advance and adjusted to a salinity of 28 parts per thousand (ppt). Sediment resuspension in the bioassay chambers will be accomplished by shaking for 10 seconds.

Adult *Mytilus edulis* will be obtained from a commercial rearing facility and conditioned as described in the Tetra Tech and EVS Consultants final report (1986). At the appropriate time adult mussels will be induced to spawn and fertilization will be accomplished within one hour of spawning as described in the same document.

Exposure chambers will be prepared as described above. Within two hours of fertilization, each exposure chamber will be inoculated with 20,000 to 40,000 developing embryos (1 ml of inoculum concentrated at 20-40 eggs per ml).

After a 48-hour exposure period, the bioassay will be terminated and the larvae will be microscopically examined. The normal and abnormal larvae will be enumerated to determine percent survival (relative to the seawater control) and the percent abnormality.

Survival in both clean and toxic controls will be evaluated. Survival values for bivalve larvae in toxic controls will be determined by measuring percent survival in a serial dilution of the reference toxicant cadmium chloride. Water quality conditions for maintenance of the reproductive organisms will be recorded. Water quality parameters will be measured at the beginning and end of the test in each test container (temperature, salinity, pH, and dissolved oxygen). Statistical analysis of survival data will follow the methods described in the U.S. EPA/COE testing manual (U.S. EPA/COE 1991). Statistical tests are described in Section 3.6.5.

Twenty-eight day chronic, solid-phase, flow-through seawater toxicity tests will be conducted using juvenile *Neanthes sp.* according to protocols specified in Pesch and Hoffman (1983). Data obtained from these 28-day chronic tests will include percent survival and growth for *Neanthes* exposed to reference sediment and sediment from sample areas.

Five replicate composite samples will be tested from each sample station. Laboratory cultures of *Neanthes* from a California population will be obtained for this bioassay. The worms will be between 0.5 - 1.0 mg (dry weight), 2-3 weeks post-emergence to ensure that they are in rapid growth phase during the exposure period. The juvenile *Neanthes* bioassay will be conducted as a static renewal exposure and food will be provided to the test organisms during the exposure period to promote growth. Exposure chambers will be prepared using control sediment, reference sediment, and sediment from sample stations. Sand should be used as the control sediment for *Neanthes*.

A minimum of 20 animals will be introduced to each exposure chamber to initiate the bioassay. Following the 28-day exposure period, the percent survival, average individual biomass (dry weight), and total average biomass (dry weight) will be recorded. Interstitial salinity values of the control, reference and test sediments will be recorded. A daily record will be kept of water quality parameters in the test chamber (dissolved oxygen, salinity, temperature, pH, and ammonia). Results will be compared statistically as described below in section 3.6.5.

3.6.5 Bioassay Sample Analysis

Results from all bioassay tests will be statistically compared with reference and control sediments. Laboratory replicates on one composite sample per sample area will be assessed to determine laboratory precision. Field variability will be assessed by calculating the mean and standard deviation for the five samples analyzed from each station. These data will be compared with reference and control data using parametric or non-parametric statistical tests.

A Levine's test will be performed all data to determine homogeneity of variance. An analysis of variance (ANOVA) or Kruskal-Wallis test will be performed, whichever is appropriate, followed by a t-test to determine whether results from sample areas are significantly different from results from

reference and control areas. Statistically significant increases are considered unreasonable when they are greater than or equal to two times the level measured in samples from the reference area.

3.7 BENTHIC COMMUNITY ANALYSIS

Assessment of benthic community structure is an analysis of *in situ* benthic biota that can be used alone or in conjunction with other sediment assessment techniques (e.g., sediment toxicity bioassays). It is commonly used to assess impacts to benthic communities and sediment quality through comparisons with test and reference stations for the purposes of determining the spatial extent, magnitude and variability of impacts. The objectives of benthic community analyses are:

- Characterization of the existing macrobenthic conditions; and,
- Evaluation of any observed effects on the benthic communities.

The benthic community analysis will not distinguish between impacts resulting from past versus present discharges. Residual contamination from past discharges could result in currently observable impacts. The purpose of the benthic analysis is to identify the existence of impacts, not to attribute them to specific causes. Evaluation of the entire body of data gathered in this study, and in the rest of the RI/FS may lead to identification of causal relationships.

3.7.1 Description of Tiered Approach

As part of this sampling effort, samples for benthic infaunal community analysis will be collected at the same time and location as the samples collected for analysis of sediment pollutants and sediment toxicity. However, the benthic samples will be archived and not analyzed unless the results of any sediment bioassay is significantly less than that measured for reference stations or the results of sediment chemistry analysis indicate contamination greater than NOAA ER-L values. Collecting the benthic samples at the same time and in the same locations as the other sediment samples assures that the results of the benthic community analyses will reflect the conditions at the test locations, regardless of when or if they are analyzed. This tiered approach to the analysis of the benthic infauna samples is designed to be a cost effective use of the sampling and analysis efforts.

3.7.2 Sample Collection Equipment

Collection of benthic samples will occur in both subtidal and wetland habitats. Different sampling equipment will be required for these different habitats. For the subtidal areas, a modified 0.1 m² van Veen grab sampler will be used; while hand-held coring devices will be utilized in the wetland areas to collect benthic samples. Both types of equipment are commonly used to sample benthic infauna (Tetra Tech 1987b; Eleftheriou and Holme 1984).

Other equipment required for the collection of benthic samples includes a boat rigged with a hydraulic winch (for subtidal sampling), a sieving stand, 1.0 mm mesh screens for sieving sediments, 10 percent borax-buffered formalin for preserving benthic fauna specimens, storage containers, and interior and exterior labels for each sample.

3.7.3 Sample Collection Methods

Five replicate benthic infauna samples will be collected at each station in both subtidal and wetland habitats. In subtidal areas, benthic samples will be collected using a modified 0.1 m² van Veen grab sampler. The grab will be attached to a hydraulic winch cable with a swivel to prevent twisting movements during sampler deployment and to ensure proper contact with the bottom. The grab will be slowly lowered through the water column to prevent the sampler from flipping during descent and from creating a pressure wave sufficient to disturb bottom sediments. After contact with the bottom, the grab will be raised at a constant rate, carefully retrieved once it is at the surface, and placed in a level position on a sieving stand. Each sample will be inspected before acceptance based upon the degree of disturbance, penetration depth, and amount of leakage from the grab. The following criteria will be satisfied prior to sample acceptance:

- Sediment is not extruded from the upper face of the sampler such that organisms may have been lost
- Overlying water is present (indicates minimal leakage)
- The sediment surface is relatively flat (indicates minimal disturbance or winnowing)
- The following minimum penetration depths are achieved:

- 4 cm for medium to coarse sand
- 6 cm for fine sand
- 10 cm for silt and clay

If a sample fails to meet any one of these criteria, it will be rejected. Sampling will continue until five acceptable samples are collected.

For the wetland habitats, a 4-in diameter hand-held clear PVC core will be placed into the sediments to a depth of at least 10 cm, capped, and removed from the sediments. The sediment in the core will be extruded so that the 10 cm are collected (about 0.8 L). The sediment will be placed into a storage container for processing.

Upon acceptance of a grab or core sample, the entire sample (no subsamples, split samples, or composites) will be washed on a 1.0 mm mesh screen. The material remaining on the screen will be fixed in a 10 percent borax-buffered formalin solution. Each replicate sample container will be labelled with interior and exterior labels identifying station information and sampling date. Samples will be inventoried, chain-of-custody forms will be completed, and samples will be sealed for shipment to the taxonomic laboratory. In general, the collection and analysis of the benthic samples will follow the protocols specified by Eleftheriou and Holme (1984), Swartz (1978), and Tetra Tech (1987a,b).

3.7.4 Sample Handling

Upon arrival at the laboratory, all samples will be reinventoried and checked against the chain-of-custody forms. If a sample consists of multiple containers, all containers will be located and processed as a group. Samples will be rescreened after being held in formalin for a minimum of 24 hours to ensure adequate preservation of the organisms. Individual samples will be rinsed with fresh water into a 0.5 mm mesh screen to remove the formalin from the sediments. Use of a screen with half the mesh size of the screen used in the field will ensure retention of all organisms and fragments. All material retained on the sieve will be transferred to glass or plastic jars, stained with rose bengal, and preserved with 70 percent ethanol. All internal and external labels will also be transferred to the jars. A rescreening log will be filled out as each sample is completed and will include sample number, date and time rescreened, and number of sample jars used. Standard techniques will be used for sorting organisms from the

sediment. Each sample will be sorted in its entirety by one individual to facilitate quality assurance and control checks. All organisms will be removed from the sediment residue and will be sorted into major taxa groups.

The wet-weight biomass of major taxonomic groups (polychaetes, mollusks, crustaceans, echinoderms, and miscellaneous taxa) will be determined to the nearest 0.1 g for each replicate sample using methods specified by Tetra Tech (1987a,b). All organisms will be identified to the lowest practical taxonomic level (usually genus or species) and enumerated. A voucher collection will be prepared and the names and qualifications of the taxonomists will be included. The quality assurance and control (QA/QC) procedures for both sorting and taxonomy are discussed in the QA/QC plan.

3.7.5 Benthic Community Sample Analysis

Characterization and assessment of impacts to benthic infaunal communities in each study area will be assessed by measuring the following variables and indices (Tetra Tech 1985):

- Species composition;
- Species richness (number of taxa per 0.1-m² grab or number of taxa per core);
- Density, by species (number of individuals per grab, core, or m²);
- Shannon-Wiener diversity (H') (per replicate and per station);
- Evenness (J) (per replicate and per station);
- Dominance index (number of taxa accounting for 75 percent of the total abundance);
- Cluster analyses (Bray-Curtis);
- Enumeration, including densities, of pollution-tolerant, opportunistic and pollution-sensitive taxa; and,
- Total biomass and major taxa biomass (per replicate and per station).

These variables and indices will be compared statistically among the test stations and the appropriate reference stations (for example, wetland samples will only be compared with similar samples from the reference area wetlands). Enumeration of pollution tolerant, opportunistic, and pollution-sensitive taxa will be based on available literature, and is intended as a qualitative indicator. Detection of significant

differences may indicate impacted conditions. Before comparisons are made, differences in sediment type (for example, grain size) will be taken into account.

3.8 BIOACCUMULATION TESTING

Bioaccumulation testing will be conducted using archived sediment from sample stations where high levels of chemical contamination has been confirmed and/or high levels of toxicity has been found. Two-liter portions of each of five replicate composite samples designated for possible Tier II bioaccumulation testing will be analyzed for each sample station, where Tier I analyses showed chemistry or toxicity "hits".

A 28-day laboratory bioaccumulation test will be conducted using sediment from the study area and reference areas. The test organism will be *Macoma sp.* This clam is a filter- and deposit-feeding species with a low potential for metabolizing polyaromatic hydrocarbons (PAHs) and therefore, is a good indicator for bioaccumulation of PAHs and other contaminants. Another organism, *Neanthes sp.*, was considered for the bioaccumulation tests but was rejected due to concerns that some worm species are able to metabolize PAHs. Also, the small biomass of *Neanthes* individuals make *Macoma* a more attractive choice for analytical purposes.

The test will be initiated using reference, control and test sediments in the same manner as the 28-day toxicity tests using *Neanthes*. At least 20 individual *Macoma* will be placed in each of five replicate test chambers. The test chambers will be maintained under flow-through conditions, and daily water quality measurements will be taken on each chamber, including pH, salinity, temperature, and dissolved oxygen. Ammonia will be measured in two randomly selected chambers in each replicate set daily. All measurements will be taken by instruments calibrated and logged daily. On day 28, the muds will be sieved to remove the clams. The surviving animals will be counted and placed in clean aquaria under-flow-through conditions to depurate for 24 hours. They will be taken to the chemistry laboratory for compositing and analysis of tissue-borne priority pollutants. If greater than 25 percent toxicity (mortality) is encountered in reference or test conditions, then all project managers, including responsible regulatory project managers, will be notified.

The analysis of bioaccumulation will be made by statistical comparison of tissue levels from the reference group to those of the test group. The analysis will be conducted using the one-way analysis of variance (ANOVA) or non-parametric analysis, depending on the homogeneity of variances, and will be carried out using methods in the Testing Manual (EPA/COE 1991).

3.9 SAMPLE CHEMICAL ANALYSIS

All samples for chemical analysis will be analyzed for the same core group of trace metals, semivolatile organic compounds, organochlorine pesticides, and miscellaneous analytes. In addition, some analytical parameters are unique to either sediments or water. The list of analytes, analytical methods, and method quantitation limits for water, sediments, and tissue is provided in Table 3-4. Further discussion of the analytical program is provided below. QA/QC procedures are discussed in Appendix A.

Not all of the chemical species that have been used at NAS Alameda are expected to be present in water or sediments. Previous sampling of estuary waters and sediments indicates that elevated metals, PAHs, PCBs, and oil and grease are frequently detected while pesticides are rarely detected. Volatile organic compounds are not expected due to the turbulence of the receiving waters and the hydrophobicity of the compounds, which causes them to partition to air. Large organic molecules tend to bind strongly to organic matter, which is generally abundant in estuary and wetland waters.

The analytical program described in this sampling plan is intended to assess the effects on biota of chemicals from the major contaminant groups that may be present in media at NAS Alameda, that are the most persistent in the environment, and that are most toxic to biota. If these chemicals are present in environmental media at NAS Alameda, if they are found to be concentrated in aquatic organisms, and if they are also found to have a negative impact on diversity and abundance of species, then clearly a threat to the environment is present at the site. This ecological assessment is also designed to identify the variability of ecological effects between specific areas of NAS Alameda.

TABLE 3-4 HAZARDOUS SUBSTANCE LIST ANALYTES AND DETECTION LIMITS

	Sediment	Water
METALS		
EPA Method 6010/7000	mg/kg	µg/L
Antimony	1	3
Arsenic	0.5	10
Beryllium	0.25	5
Cadmium	0.25	5
Chromium	0.5	10
Copper	0.5	25
Lead	0.15	3
Mercury	0.01	0.5
Nickel	2	40
Selenium	0.25	5
Silver	0.5	10
Thallium	0.5	10
Zinc	1	20

	Sediment	Water
ORGANIC COMPOUNDS		
<i>Base/Neutral Compounds</i>		
EPA Method 8270	µg/kg	µg/L
Acenaphthene	67	1
Acenaphthylene	67	1
Benzidine	670	10
Benzo(a)anthracene	67	1
Benzo(a)pyrene	67	1
Benzo(b)fluoranthene	67	1
Benzo(g,h,i)perylene	67	1
Benzo(k)fluoranthene	67	1
Benzyl alcohol	330	5
Bis (2-chloroethoxy)methane	67	1
Bis (2-chloroethyl)ether	67	1
Bis (2-chloroisopropyl)ether	67	1
Bis (2-ethylhexyl)phthalate	67	1
4-Bromophenyl phenyl ether	67	1
Butyl benzyl phthalate	67	1
4-Chloroaniline	200	3
2-Chloronaphthalene	67	1
4-Chlorophenyl phenyl ether	67	1
Chrysene	67	1
Dibenzo(a,h)anthracene	67	1
Dibenzofuran	67	1
1,2,-Dichlorobenzene	67	1
1,3,-Dichlorobenzene	67	1

	Sediment	Water
<i>Base/Neutral Compounds (Cont.)</i>	$\mu\text{g}/\text{kg}$	$\mu\text{g}/\text{L}$
1,4-Dichlorobenzene	67	1
3,3'-Dichlorobenzidine	330	5
Diethyl phthalate	67	1
Dimethyl phthalate	67	1
Di-N-Butyl phthalate	67	1
2,4-Dinitrotoluene	330	5
2,6-Dinitrotoluene	330	5
Di-N-Octyl phthalate	67	1
Fluoranthene	67	1
Fluorene	35	1
Hexachlorobenzene	67	1
Hexachlorobutadiene	130	2
Hexachlorocyclopentadiene	330	5
Hexachloroethane	130	2
Indeno (1,2,3-c,d)pyrene	67	1
Isophorone	67	1
2-Methylnaphthalene	67	1
Naphthalene	67	1
2-Nitroaniline	330	5
3-Nitroaniline	330	5
4-Nitroaniline	330	5
Nitrobenzene	67	1
N-Nitrosodipropylamine	67	1
N-Nitrosodiphenylamine	67	1
Phenanthrene	67	1
Pyrene	67	1
1,2,4-Trichlorobenzene	67	1
Methyl mercury	150	5

	Sediment	Water
Acid Compounds		
EPA Method 8270	µg/kg	µg/L
Benzoic Acid	670	10
2-Chlorophenol	67	1
2,4-Dichlorophenol	200	3
2,4-Dimethylphenol	130	2
4,6-Dinitro 2-methylphenol	670	10
2,4-Dinitrophenol	330	5
2 Methylphenol	67	1
4-Methylphenol	67	1
2-Nitrophenol	330	5
4-Nitrophenol	330	5
4-Chloro-3-methylphenol	130	2
Pentachlorophenol	330	5
Phenol	130	2
2,4,5-Trichlorophenol	330	5
2,4,6-Trichlorophenol	330	5

	Sediment	Water
Pesticides		
EPA Method 8080	$\mu\text{g}/\text{kg}$	$\mu\text{g}/\text{L}$
Aldrin	0.5	0.05
α -BHC	0.5	0.05
β -BHC	0.5	0.05
Δ -BHC	0.5	0.05
γ -BHC (Lindane)	0.5	0.05
Chlordane	0.5	0.5
4,4'-DDD	0.5	0.1
4,4'-DDE	0.5	0.1
4,4'-DDT	0.5	0.1
Dieldrin	0.02	0.1
Endosulfan I	0.5	0.1
Endosulfan II	0.5	0.1
Endosulfan sulfate	0.5	0.1
Endrin	0.02	0.1
Endrin aldehyde	0.5	0.1
Endrin ketone	2.5	0.1
Heptachlor	0.5	0.05
Heptachlor-epoxide	0.5	0.05
Methoxychlor	1	0.5
PCB-1016	2	0.5
PCB-1221	2	0.5
PCB-1232	2	0.5
PCB-1242	2	0.5
PCB-1248	2	0.5
PCB-1254	2	1
PCB-1260	2	1
Toxaphene	10	1
MISCELLANEOUS METHODS		
Tributyltin (GCFPD)	5 $\mu\text{g}/\text{kg}$	5 ng/L ^a
Gross alpha	$\alpha = 2 \text{ pCi}/\text{gm}$	
Gross beta	$\beta = 4 \text{ pCi}/\text{gm}$	

^a A detection limit of 5 ng/L or less may be achieved using gas chromatography/mass spectrometry selected ion monitoring. Sample volume will be increased to 500 ml for this parameter. This increase should not affect the total sample volume collected at a station.

3.9.1 Water Samples

General water quality parameters include salinity, pH, temperature, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total suspended solids (TSS), total organic carbon (TOC), and dissolved organic carbon (DOC).

The general water quality parameters are major indicators of the comparability of waters. Many aquatic organisms are confined to a narrow range of conditions, and become stressed outside this range. Therefore, it is important to define the conditions that occur in the study areas and reference sites so that appropriate correlations can be made.

Analyses will be performed on unfiltered samples. Most of the toxic organic compounds proposed in this work plan will be present in the water column because they are bound to suspended particulates and organic matter. Total suspended solids and organic carbon are measures of this material. Dissolved organic carbon is included in response to previous agency concerns.

Conductivity, pH, temperature, turbidity, and dissolved oxygen will be measured in the field with portable instruments. Salinity is proportional to conductivity, and will be calculated from direct measurement of conductivity.

COD, BOD, TSS, TOC, and DOC cannot be adequately preserved and thus must be analyzed as soon as possible after sample collection. Samples will be cooled to 4° C and stored in dark until analyzed. Sulfide concentration is a key factor in the uptake and removal of metals from the water column to sediments, much as organic matter plays a key role in partitioning of hydrophobic organic compounds. The recommended analytical method for the priority pollutant metals in all media is atomic absorption spectrophotometry (AA), which can achieve a lower detection limit than inductively coupled plasma (ICP). Where ambient metal concentrations are expected to be relatively high, ICP can be used. Semivolatile organic compounds can be identified and quantified by U.S. EPA Method 8270 for gas chromatography/mass spectrometer (GC/MS). For purposes of this work plan, the method quantitation limits obtainable with U.S. EPA Method 8270 are considered adequate. Method 8270 is designed as a screen analysis since existing data in the areas of study are sparse. After analysis of data from this study and current ongoing studies, lower detection limits may be warranted. Lower detection limits can be

achieved using more selective methods. U.S. EPA Method 8080 will be used to quantify organochlorine pesticides which are expected to be present only at low concentrations. U.S. EPA Method 8080 is also used to detect PCBs.

3.9.2 *Sediment Samples*

The same analytical suite will be used for sediments as for water and tissues. However, most of the compounds of concern are expected to partition to sediments. Holding times for sediment samples analyzed for organic compounds is 14 days until extraction. The primary measures of sediment comparability between the reference area and the study areas will be grain size distribution, interstitial salinity and TOC. Interstitial salinity is a measure of the salinity of the water remaining in the pore space of the sediments. Grain size may be determined separately for coarse sediments and fine sediments. The method is described by Plumb (1981).

3.10 WETLAND CHARACTERIZATION AND DELINEATION

Jurisdictional waters are regulated by the U.S. Army Corps of Engineers (COE) under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Jurisdictional waters include navigable waters (seas, lakes, bays, and rivers), tributaries of navigable waters, and wetlands (Department of Defense 1986). Wetlands must meet certain technical criteria to be considered jurisdictional (Environmental Laboratory 1987). These include positive indicators of hydrophytic vegetation, hydric soils, and wetland hydrology.

This work plan has been developed from the COE wetlands delineation manual (Environmental Laboratory 1987). The 1992 Energy and Water Development Appropriations bill requires that federal agencies discontinue use of the federal manual for identifying and delineating jurisdictional wetlands prepared by the Federal Interagency Committee for Wetland Delineation in 1989 (COE 1991). The work plan described below has been developed from the wetlands delineation manual for man-induced wetlands (areas greater than 5 acres in size). NAS Alameda, has been built primarily on imported fill. Small wetland areas have developed on portions of the imported fill in two areas, the West Beach Landfill Wetland and the Runway Wetland. The study sites are presently undeveloped by the Navy. Wetlands observed on the site include diked pickleweed marsh, tidal pickleweed marsh, and seasonal pools. Each

appears to exceed 5 acres in size, although the wetlands on them may not. The wetlands delineation manual outlines the procedure for areas greater than 5 acres in size. Wetland size will be determined as part of the delineation.

The delineation of jurisdictional wetlands proposed below will be done at a level of detail sufficient to permit verification of the work by the COE. This verification will be arranged as soon as the delineation is completed. Delineations must be verified by the COE before they can be considered valid. Delineations verified by the COE are valid for 3 years.

3.10.1. *Gather Existing Data*

The following information should be gathered for review and for future reference:

- Available contour map of study sites (this map can be used during field surveys and as a base map for wetland mapping)
- Current color aerial photograph of the study sites at a scale of 1 in = 100 ft
- Historic aerial photographs of study sites at 4 or 5 year intervals which document their history during the last 20 years
- Tidal gauge data for the NAS Alameda, in order to determine the extent of tidal marsh associated with the Runway Wetland
- U.S. Fish and Wildlife Service National Wetland Inventory maps
- Any available documents which may be relevant to the fill history of the study sites

3.10.2 *Synthesize Existing Data*

Prior to the commencement of field surveys, all available information will be synthesized such that it can be readily referenced by field investigators. This synthesis will include the following:

- Base maps of each study site showing site boundaries and significant physical features (e.g., topographic features and areas of permanent inundation)
- Acreage calculations for each study site

- Mapped locations of areas of recent disturbance on each study site as determined from historic aerial photographs
- Mapped extent of mean high tide at study site with tidal marsh

3.10.3 Field Surveys

The field surveys outlined below are according to the methodology for man-induced wetlands with areas greater than 5 acres in size in the 1987 wetlands delineation manual. Difficult areas where the transition between upland and wetland is gradual, sampling according to methods outlined under comprehensive determinations may be required. The wetlands field program will also incorporate wetland evaluation techniques (WET); experienced field biologists trained in use and interpretation of WET will determine the functions of the NAS Alameda wetlands. The WET analysis will provide a baseline of existing wetland functions for comparison with potential changes resulting from remedial action at the facility. The WET analysis will be concurrent with the wetland delineation field surveys.

Establish a Baseline and Locate the Position of Each Transect - One project boundary will be selected as a baseline. The baseline will be perpendicular to the hydrologic gradient. For both study sites, the baseline will most likely be their northern boundaries, although, for the Runway Wetland, an additional baseline along the western boundary will probably be necessary. A minimum of three transects will be selected for each for each baseline. The baseline of each study site will be divided into three increments of equal length. The midpoint of each baseline increment will serve as the starting point of each transect. Each transect will run perpendicular to the baseline.

Sample Observation Points Along Each Transect - Normal environmental conditions appear to be present in each wetland site. This should be confirmed prior to sampling. Upon confirmation that such is the case, observation points will be sampled along each transect such that data are collected from all plant community types encountered along the transect. The interval between observation points may vary along each transect according to the size of the community type, but for the study sites in question, 200 to 300 foot intervals will be appropriate. If, within that interval, there is a transition from upland to wetland, or wetland to upland, one or more intermediate observation points will be sampled in order to locate the upland/wetland boundary.

Data gathered at each observation point will be recorded on a standard data form (Figure 3-8). Data gathered will be from each of the technical criteria which together determine the present absence of a wetland.

Vegetation. Vegetation will be identified through the facultative neutral test. Plant species will be determined to be obligatory (OBL), facultative wetland (FACW), or facultative (FAC). For each observation point the dominant shrub (by height) and herbaceous (by areal cover) vascular plants within a 5 foot radius will be recorded. This assessment of dominance can be subjective unless the transition zone is very gradual and the wetland/upland boundary is difficult to determine. In such cases, quantitative sampling by measuring shrub height or estimating areal cover with a meter quadrant may be appropriate. The wetland indicator status of each will be noted and the presence of hydrophytic vegetation determined (more than 50 percent of the dominant species are OBL, FACW, FAC). The presence or absence of hydrophytic vegetation will be noted on the data form.

Soils. The soil at each observation point will not be examined if all the dominant plants are OBL or FACW with one OBL. In such cases it can be presumed that the soils are hydric. When such is not the case, a soil pit will be dug to a depth of 10 inches. When determined to be safe, the soils will be examined for hydric characteristics (such as appropriate Munsell notation, mottling, sulfidic smells). Where positive hydric soil indicators are observed, the presence or absence of hydric soils will be noted on the data form for that observation point.

Hydrology. Each observation point will be examined for positive indicators of wetland hydrology. The presence or absence of such indicators will be noted for each observation point on the data form.

When each data form has been completed for each observation point, a determination will be made whether the technical criteria of jurisdictional wetlands have been met at that point.

Sample Additional Observation Points as Needed - It may be necessary to gather data at observation points not located on any transect. Portions of each wetland appear to be a mosaic of uplands and wetlands. To document the presence or absence of islands or fingers of wetlands that are not on established transects, representative observation points will be sampled in these areas.

**Figure 3-8
Standard Wetland Data Form**

Applicant Name: _____ Application Number: _____ Project Name: _____

State: _____ County: _____ Legal Description: _____ Township: _____
 Date: _____ Range: _____
 Plot No.: _____
 Section: _____

Vegetation: [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

<u>Species</u>	<u>Indicator Status</u>	<u>Species</u>	<u>Indicator Status</u>
<u>Trees</u>		<u>Herbs</u>	
1.		7.	
2.		8.	
3.		9.	
<u>Samplings/shrubs</u>		<u>Woody vines</u>	
4.		10.	
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: _____ Other indicators: _____

Hydrophobic vegetation: Yes _____ No _____ Basis: _____

Soil

Series and Phase: _____ On hydric soils list? _____
 Mottled: Yes: _____ No: _____ Mottle color: _____ Matrix color: _____
 Clayed: Yes: _____ No: _____ Other indicators: _____
 Hydric soils: Yes: _____ No: _____ Basis: _____

Hydrology

Inundated: Yes: _____ No: _____ Depth of standing water: _____
 Saturated soils: Yes: _____ No: _____ Depth to saturated soil: _____
 Other indicators: _____
 Wetland hydrology: Yes: _____ No: _____ Basis: _____
 Atypical situation: Yes: _____ No: _____

Normal circumstances? Yes: _____ No: _____
 Wetland Determination: Wetland: _____ Nonwetland: _____
 Comments: _____
 Determined by: _____

3.10.4 Synthesis of Field Data and Preexisting Data

All observation points will be plotted on the base map. Those points which meet the technical criteria of jurisdictional wetlands will be noted. The wetland/upland boundary established from field sampling will be compared to changes in signature on the current aerial photograph to assist in the location of this boundary in areas where field data were not gathered. The boundary will be drawn on a draft map which will then be field checked. Any anomalies encountered may require additional sampling so that the appropriate adjustments can be made.

3.10.5 Preparation of Final Delineation

A final map will be prepared after completion of the final field check. The map will differentiate between areas subject to both Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, and areas subject only to Section 404 of the Clean Water Act. Baselines, transects and numbered observation points will be located on the final map.

3.10.6 Preparation of Technical Report

A technical report will be prepared which includes an executive summary, an introduction, a methods section, a results section, and technical appendices which, at a minimum, will include a list of vascular plants observed on the site and all numbered data forms keyed to the final map. Zonation patterns will be discussed if they are evident and spacial dominance described.

3.10.7 Site Visit with Staff of the U.S. Army Corps of Engineers

The senior wetland biologist responsible for the delineation will accompany staff of the COE on a visit to both wetlands to verify the delineation.

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

1.0 INTRODUCTION

1.1 DOCUMENT PURPOSE AND SCOPE

This quality assurance/quality control (QA/QC) plan has been developed for the sampling program of the NAS Alameda ecological assessment. This section addresses QA/QC protocols and procedures for both field sampling and laboratory analytical work. The section also includes a glossary of terms (Appendix A-1), and standard operating procedures (Appendix A-2).

This document discusses field protocols for navigation and station positioning, sample collection and handling, equipment decontamination, field documentation, and chain of custody. The laboratory section discusses protocols for sample receipt, handling, tracking and storage, as well as analytical methods and QA procedures for conventional variables, organic and inorganic contaminants.

The field measurement and laboratory protocols prescribed for this project are based primarily on U.S. EPA approved methods. Sediment sampling procedures are based on the Washington Department of Ecology's marine sediment quality implementation plan and protocols established in the Puget Sound Estuary Program (PSEP 1989). Water sampling procedures will follow those outlined by Thomas (1977). Analytical testing of water samples will follow procedures outlined in Methods for Chemical Analysis of Water and Wastes (EPA 1983), Standards Methods for the Examination of Water and Wastewater (APHA 1989), and U.S. EPA Methods 624/625. Analytical testing of sediment will be done in accordance with EPA SW 846, 3rd edition (1986) except where noted in Table 2. Bioassay protocols will be as described in ASTM methods and the Puget Sound Protocols. Any differences between these protocols are identified in this document to provide clear instruction to the analytical laboratories.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

QA/QC procedures are necessary to ensure that the data collected as part of this study achieve an acceptable level of quality and that the level of quality attained is adequately documented. Detailed QA/QC procedures for the variables considered in this study are described in the specific protocols. This section describes the more general QA procedures that will be incorporated into the collection and analysis of all environmental samples.

Project organization and responsibilities are an important part of the QA protocols. Table 1 shows the duties of each person responsible for QA.

The field team leader or a designee will thoroughly review the sample plan (including QA/QC criteria) before each sampling effort. Prior to sampling, the sampling crew should be familiar with:

- Identity of project personnel and their respective responsibilities
- Statement and prioritization of study objectives
- Description of survey area, including background information and station locations
- Identification of variables to be measured and corresponding required containers and preservatives
- Identification of all sample splits or performance samples to be submitted with the survey samples
- Brief description of sampling methods, including station positioning technique, sampling devices, replication, and any special considerations

TABLE 1. PERSONNEL RESPONSIBILITIES FOR QUALITY ASSURANCE

Personnel Title	Responsibilities
Project Manager	Provide oversight of all program activities. Review work plan, health and safety plan, and QA project plan to ensure objectives for the program are met.
Contract Officers	Review final project QA objectives, needs, problems, and requests. Approve appropriate QA corrective actions as needed. Provide oversight and expertise for sampling activities.
Field Team Leaders	Implement necessary action and adjustments to accomplish field survey objectives. Oversee field survey performance and provide technical expertise to accomplish project objectives. Ensure that tasks are successfully completed within the projected time periods. Oversee chain-of-custody procedures.
Project QA Officer	Provide technical QA assistance to accomplish project objectives including suggestions for corrective action implementation. Oversee laboratory performance and adherence to QA/QC plan. Ensure that data quality objectives have been met. Conduct field sampling operations in accordance with approved site work plan. Ensure that all QA protocols (including chain-of-custody documentation, sample collection and labeling, sample storage and shipping, and instrument calibration) are followed as required. Recognize and implement necessary corrective actions. Document field operations.
Health and Safety Officer	Ensure that health and safety guidelines are followed by field team members and any contractors to avoid any compromise of sample integrity or worker health and safety. Document any health and safety issues affecting project implementation or sample collection. Provide technical assistance as required to resolve health and safety issues requiring corrective action.
Laboratory QA Coordinator (each lab)	Establish analytical program QC procedures; oversee preparation of laboratory QA/QC plan. Monitor compliance with laboratory's QA/QC plan and serve as QA/QC point of contact. Perform all required QC sample analyses including analytical duplicates, blanks, matrix spikes, performance evaluation samples, and standard reference materials. Initiate and document required corrective action. Perform preliminary review of data for completeness and transcription or analytical error. Follow good laboratory practices and U.S. EPA guidelines.

- Detailed cruise schedule, including time, date, and location of embarkation and debarkation
- Sample storage and shipping procedures
- Identity of analytical laboratories
- Survey vessel requirements (size, sample storage needs)
- Location and availability of an alternate survey vessel
- All special equipment needed for the survey (sampling equipment, navigation equipment, communication devices)

Study objectives and their prioritization will be understood by all members of the scientific party. This will ensure that if modifications of the plan become necessary in the field, their impact on the overall goals of the cruise can be evaluated adequately.

3.0 OBJECTIVES FOR MEASUREMENT

3.1 SAMPLING OBJECTIVES

The overall sampling objectives for the ecological assessment are 1) to collect and analyze water samples, sediment samples, tissue samples, and benthic samples for different parameters, including identification of inorganic and organic contaminants, and 2) perform a separate series of bioassays for both sediment and sediment elutriate from each of the study areas. The sampling objectives will be achieved through the design and implementation of the sampling program, and by collection of a sufficient number of samples from appropriate locations. The rationale for selection of sampling locations, the number of samples to be collected, and the methods for collecting samples are presented in the main portion of the document.

3.2 DATA OBJECTIVES

The overall QA objective for measurement data is to ensure that data of known and acceptable quality are provided. To achieve this goal, data must be reviewed for 1) comparability, 2) precision, 3) accuracy (or bias), and 4) completeness.

1. **Comparability:** Data will be calculated and reported in units consistent with those of other agencies and organizations (Table 2) to allow comparability of databases. Comparability is a qualitative characteristic expressing the confidence with which one data set can be compared with another. The comparability goal is achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. Only when precision and accuracy are known can data sets be compared with confidence.
2. **Precision:** Precision measures the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to their average value. The precision of laboratory duplicate analyses and matrix spike/matrix spike duplicate (MS/MSD) analyses will be calculated to provide an estimate of laboratory precision. Laboratory

precision as determined by duplicate laboratory sample analyses will be summarized in the QA/QC section of the draft report.

3. **Accuracy:** Accuracy is a measure of bias in the measurement system. For this survey, the analytical data will be determined through an assessment of the recovery of surrogate compounds, spike compounds, and check standards. Surrogate compounds will be added to each sample for organic compound analysis and the percent recovery will be reported with sample results. Re-analysis will be required for samples in which surrogate recoveries are outside established control limits. All corrective actions taken for samples requiring reanalysis will be reported with sample results. MS/MSD recoveries will also be calculated and used for determining accuracy. The results of MS/MSD analyses will be reported with sample results. If spike compound recoveries are outside control limits, then sample reanalysis will be required. Results of check standards will also be used to indicate whether recalibration is necessary during analysis. Any actions taken to bring compound recoveries within control limits will be reported by the laboratory in case narratives supplied with sample results.

4. **Completeness:** Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Completeness of the data will be calculated by dividing the number of valid measurements obtained by the number of measurements planned. Completeness of the data set obtained for this survey will be reported with sample results in the draft report.

Sample locations have been purposely chosen in areas near storm sewer outfalls which are expected to have the greatest potential contaminant concentration. Additional random sample locations have been chosen between storm sewer outfalls to test for contaminants which tend to settle out a distance from the source. This sampling strategy is likely to identify contaminated regions associated with the most likely sources.

QA objectives setting requirements for precision, accuracy, and completeness have been established for each measurement variable where possible, and are presented in Table 2.

TABLE 2 OBJECTIVES FOR MEASUREMENT DATA

Variables	Matrix	Units	Maximum Permissible Bias	Required Analytical Precision	Required Completeness	Method ^(a)
PCBs/Pesticides	Water	µg/L	±25%	±25%	95%	608
	Sediment	µg/kg ^(b)	±30%	±30%	95%	8080
Base/Neutral/Acid Extractables (includes semivolatiles)	Water	µg/L	±25%	±25%	95%	625
	Sediment	µg/kg ^(b)	±35%	±35%	95%	8270
Metals	Water	µg/L	±20%	±20%	95%	200 series, 100.7.7
	Sediment	mg/kg ^(b)	±25%	±25%	95%	6020, 7000 series ^(c)
Grain Size	Sediment	%	±10%	±10%	95%	43-2
TOC	Water	mg/L	±20%	±25%	95%	415.1
	Sediment	mg/kg ^(b)	±30%	±30%	95%	9060
TSS	Water	mg/L	^(d)	^(d)	95%	160.1
Total Solids (% moisture)	Sediment	%	^(d)	^(d)	95%	6202, 7000 (subset of metals analyses)
Radionuclides	Sediment	pCi/g	±10%	^(d)	95%	901.1

TABLE 2 (Continued)

Variables	Matrix	Units	Maximum Permissible Bias	Required Analytical Precision	Required Completeness	Method ^(a)
Field Analyses Dissolved oxygen	Water	mg/L	± 1%	± 0.1 mg/L	95%	360.1
pH	Water	pH units	± 1%	± 0.2 units	95%	150.1
Conductivity	Water	umho at 25° C	± 5%	± 8 umhos ^(e)	95%	120.1 ^(g)
Temperature	Water	°C	^(d)	^(d)	95%	170.1 ^(g)
Turbidity	Water	NTU	^(d)	± 5 units	95%	180.1

^(a) Methods specified are from the following references: water (U.S. EPA 1982, 1983; APHA 1989), sediment (U.S. EPA 1980, 1984, 1986; Di Toro et al 1989; American Society of Agronomy 1985).

^(b) Dry-weight basis.

^(c) Extraction/preparation procedures for tributyltin will be modified, as outlined in the standard operating procedures (Appendix A-2).

^(d) Bias or precision for this method has not been determined.

^(e) Given for a range of up to 100 umhos/cm. For more specific criteria, refer to method 120.1.

^(f) Given for a range of up to 444 mg/L. For more specific criteria, refer to method 130.2.

^(g) Modified for field measurements, shoreline stations only (see Appendix A-1). In situ measurements taken from vessel will use CTD.

4.0 SAMPLING PROCEDURES

The quality of data collected in an environmental study depends largely on the quality of sampling activities. Field operations must be well conceived and carefully implemented. Detailed procedures and protocols for sample collection, handling, preservation, shipping, and storage must be specified and documented.

4.1 SAMPLE COLLECTION AND ANALYSIS

Table 3 provides a summary of sample containers, preservation procedures, and holding times to be used during field sampling operations. Sample containers will be kept closed and in a cooler until use. Samples will be completely labeled as they are collected. To prevent misidentification, sample collection data, including label information, will be recorded in the field logbook as the samples are collected, and samples will be labeled before the field crew leaves the sampling location. A description of the QC samples to be collected, frequency of QC sample collection, and collection techniques is provided below.

Two field duplicate samples per sampling location will be collected and analyzed to obtain an estimate of the precision for the field sample handling procedures as well as to obtain an estimate of the variance at a particular sampling location. One duplicate will be collected for each water sample. All field duplicate samples will be submitted blind to the laboratory. Field precision and accuracy by the analysis of duplicates will be calculated and compared to laboratory precision and accuracy for the same samples to provide a determination of overall (field plus laboratory) precision and accuracy.

Sample containers will be put on ice in a cooler (4°C) after sampling, sealing, and labeling. Sample information will be recorded in a field logbook and on a sample summary log as samples are collected. Field duplicate samples will be clearly identified on the sample summary log and in the field logbook.

TABLE 3 CONTAINERS, COLLECTION VOLUMES, PRESERVATION, AND HOLDING TIMES

Parameter	Matrix	Container	Size	Number Required	Preservation	Holding Time
Metals	Water	Linear polyethylene	500 ml	55 ^(a)	HNO ₃ to pH <2	6 months (Hg-28 days)
	Sediment	Borosilicate glass, teflon lined lids	8 oz.	66 ^(a)	Cool, 4°C	6 months (Hg-28 days)
Cyanide	Water	Linear polyethylene	1 l	55 ^(a)	NaOH to pH >12	14 days
	Sediment	Borosilicate glass, teflon lined lid	^(b)	^(b)	Cool, 4°C	14 days to extraction
BNAs (includes Semivolatiles)	Water	Borosilicate glass, teflon lined lid	1 l	7 sets ^(a) of 2	Cool, 4°C	7 days to extraction, 40 days to analysis
	Sediment	Borosilicate glass, teflon lined lid	8 oz.	66 ^(a)	Cool, 4°C	14 days to extraction, 40 days to analysis
Pesticides/PCBs	Water	Borosilicate glass, teflon lined lid	1 l	7 sets ^{(a),(c)}	Cool, 4°C	7 days to extraction, 40 days to analysis
	Sediment	Borosilicate glass, teflon lined lid	8 oz.	66 ^{(a),(c)}	Cool, 4°C	14 days to extraction, 40 days to analysis
Radionuclides	Sediment	Poly wide-mouth	8 oz.	6	Cool, 4°C	6 months
Fluoride, TSS	Water	Linear polyethylene	1 l	55 ^(a)	Cool, 4°C	28 days
TOC	Water	Amber borosilicate glass	1 l	7 ^(a)	Cool, 4°C, store in dark, HCL or H ₂ SO ₄ to pH <2	28 days
	Sediment	Borosilicate glass	4 oz.	66 ^(a)	Cool, 4°C	28 days
Grain Size	Sediment	Borosilicate glass	4 oz.	66 ^(a)	Cool, 4°C	28 days

^(a) Includes required sample numbers plus additional containers (10-15% extra).

^(b) The same containers will be used for the metals and cyanide analyses - see metals category.

^(c) The same containers can be used for both the BNA and Pesticide/PCB analyses - see BNA category.

Note: Total solids will be analyzed during the metals analyses.

4.2 CHANGES IN PROCEDURE

Any changes in the sampling procedures will be documented in the field logbook. Modifications of the sampling design or procedures must be approved by the project manager prior to implementation of the change.

4.3 SEDIMENT SAMPLE COLLECTION

Sediment sampling will follow the protocols developed for EPA for the Puget Sound Estuary Program (PSEP 1989). Samples from the Western Bayside, Inner Harbor, and Seaplane Lagoon areas will be collected in a consistent, repeatable manner with a stainless steel modified 0.1 m² van Veen grab sampler, which will be operated from a boat. This sampler operates well in soft sediments, is heavy enough to operate in channels with strong flows, and collects sufficient sample volume. The sampling device will be attached to a hydraulic winch cable with a ball bearing swivel to prevent twisting movements on the sampler during deployment. The device will be raised and lowered through the water column by the vessel's hydraulic winch at a rate no greater than five meters per minute. This will ensure that the sampler does not flip over on descent and will prevent disturbance of the sediment surface on retrieval. Once the sampler is brought on board, it will be placed on the sieving stand. Access doors on the top of the sampler will allow visual characterization of the sediment surface in order to assess sample acceptability. For a sample to be acceptable, certain criteria must be met:

- The sampler is not over filled with sediment so the sediment surface is pressed against the top of the sampler
- Overlying water is present and not excessively turbid (indicates minimal leakage and sample disturbance)
- The sediment surface must be relatively flat
- The desired penetration of at least 12 cm is achieved

A sample will be rejected if it does not meet these criteria. A detailed discussion of acceptability criteria is presented in PSEP (1989).

Prior to further characterization, the overlying water in the sampler will be slowly siphoned off. Notes will be made as to the sample depth, sediment color, texture, odor, and other distinguishing characteristics such as oil sheen, wood debris of the sample.

After the sample is described and the depth at which visual evidence of the redox potential discontinuity depth, if present in the sample, is measured, surface sediments will be removed from the grab to a depth of 10 cm using a stainless steel spoon. Sediment in contact with the sampler walls will not be collected due to possible disturbance or contamination.

Sediment core samples will be collected at 12 of the subtidal sampling locations. Each core will be a minimum of 120 cm. Polycarbonate liners will be used in the sample coring device. Each undisturbed core will be photographed on its side next to a ruler. The top 10 cm will be analyzed as part of the surface sediment sampling program. The next two 30-cm segments will be individually composited and analyzed for all of the standard sediment chemistry constituents except volatile organic compounds. A final discrete sample will be taken 25 cm from the bottom of the core and analyzed as the 30-cm segments.

For the wetland habitats, a 4-in or smaller diameter hand-held clear PVC core will be pushed into the sediments to a depth of 10 cm, capped, and removed from the sediments. The sediment in the core will be extruded with a decontaminated plunger device and placed into a storage container for processing. Recovery may depend on the consistency of the sediments and the diameter of the coring device. Additional grab samples may be required to obtain adequate material if a smaller diameter core barrel is used. Alternatively, a coring device incorporating a piston in the core barrel to improve sample recovery may be used.

Sediment from five grab samples or cores will be composited and homogenized prior to being placed in containers for analysis. The sediment will be placed in a precleaned (distilled water rinse, methanol rinse) stainless-steel bowl and carefully homogenized with a stainless steel spoon until uniform color and consistency are achieved. The interstitial water salinity will be measured on the homogenized

composite using a conductivity meter. The homogenized sample will then be divided into quarters, and material from alternating quarters will be placed in the sample collection containers. Sample containers for organics and metals analysis will be prepared by the laboratories using standard U.S. EPA procedures (U.S. EPA 1980, 1982, 1983, 1984, 1986). All sediment handling devices will be rinsed with methanol and distilled water prior to use at each station.

Since an undisturbed sediment surface is necessary for chemical sampling, more detailed physical characterization of the sediment in the grab sample will be delayed until after the chemical samples have been taken. After the sediment sample has been removed, the sediment remaining in the sampler will be examined again to refine the description of the sediment characteristics, particularly through the remaining depth of the sample. Prior to, and following the collection of a set of field samples at a sampling station, sampling equipment will be decontaminated. Following decontamination, one sample will be collected, then discarded, before collecting the sample to be retained for analysis. The decontamination (DCON) column on the sample summary log will be checked to document equipment decontamination. Cross-contamination of samples will be prevented by decontaminating sampling equipment before collecting samples at each location and by keeping all sample containers closed except the one being filled. Use of polycarbonate liners will prevent cross contamination of sediment core samples.

Samples will be collected in 8-oz or 4-oz containers as per Table 3 to ensure that enough sediment is provided for analysis and reanalysis. All sample containers will be labeled on the outside with indelible ink with the laboratory ID number, date collected, and analysis to be performed. Sediment samples for grain size, organics, metals, and conventional analyses will be stored on ice until returned to the laboratory for analysis. The sample collection checklist will be completed immediately following sample collection. The chain-of-custody log will be completed just prior to offloading the samples from the boat for shipping to the laboratories.

4.4 BENTHOS SAMPLE COLLECTION

Five benthic grab samples will be collected from each sediment station. In subtidal locations, benthic samples will be collected using a modified van Veen (0.1-m²) grab sampler. The grab will be attached to a hydraulic winch cable with a swivel to prevent twisting movements during sample deployment and to ensure proper contact with the bottom. The sample will be evaluated for acceptance

based upon the degree of disturbance, penetration depth, and amount of leakage from the grab. Samples with minimal disturbance of surface sediments and adequate penetration depth will be accepted. Minimum penetration depths required for sample acceptance vary by sediment type as follows:

- 4 cm for medium to coarse sand
- 6 cm for fine sand
- 10 cm for silt and clay

Samples will also be rejected if the grab is overfilled or there is leakage (water or sediments) from the grab.

The wetland habitats will require a sediment coring device as described in Section 4.3.

Upon acceptance of a grab or core, the overlying water in the grab will be removed using a siphon and the sediments will be characterized with respect to color, odor, type, and the presence of non sediment material (such as shells, wood debris). After these observations are recorded, the entire grab sample will be washed into a 0.5-mm mesh sieve box and gently rinsed with water to remove fine materials. Once the sieving is complete, the remaining material will be rinsed into thick plastic bags for preservation. This process will be repeated for three grab samples at each station.

The samples will be preserved with a 10 percent formaldehyde solution buffered with sodium borate. Samples containing large volumes of fine grained sand or wood fragments will require a higher concentration of formaldehyde. Caution will be exercised when handling formaldehyde mixtures because it is toxic and carcinogenic. The sample bags or jars will be labeled using indelible ink on water resistant paper. Both internal and external labels will be used. The sample containers will be inventoried, sealed, and placed in labeled buckets or boxes, for return to the laboratory. The samples will be entered on a chain-of-custody form.

Standard techniques will be used for sorting organisms from the sediments. Each sample will be sorted in its entirety by a single individual to facilitate quality assurance and control checks. Small fractions of a sample will be placed in a petri dish under a 6 to 10 power magnification dissecting microscope. The petri dish will be scanned systematically and all animals and fragments will be removed using forceps. Each petri dish will be sorted twice to ensure removal of all animals.

All organisms will be counted and identified to the lowest practical taxonomic level, generally genus or species; some groups, like the Oligochaeta, will only be identified as Oligochaeta due to the complexity of the group. If animal fragments are present, only anterior portions will be counted. Identifications will be performed by regional taxonomic experts. Taxonomists will maintain a notebook with all data and information about a sample or a specimen. Taxa will be compared against specimens in a permanent reference collection for confirmation and consistency of identifications. A voucher collection representing all taxa collected during the survey will be prepared and archived by major taxonomic groups.

QA/QC procedures for both sorting and taxonomy will be rigorously followed. A minimum of twenty percent of each processed sample will be resorted to check sorting efficiency and accuracy. Sorting QA/QC will be done using 25 power magnification by someone other than the original sorter. A sample will pass if the number of organisms found during the QA/QC check does not represent more than a 5 percent difference of the total number of organisms found in the entire sample. If the number of organisms found is greater than 5 percent of the total number, the entire sample will be resorted. These exceedences of the data quality objectives will be detailed in the QA/QC report. In addition, all other sorting work performed by the sorter responsible for the error will be checked.

4.5 WATER SAMPLE COLLECTION

Water samples will be collected as grab samples using 2.5 l Niskin bottles. Grab samples will be collected at one meter below the surface. The contents of the Niskin bottle will be emptied into a linear polyethylene carboy. The sample containers will be filled from the carboy through a stopcock.

Between samples, the carboy will be rinsed thoroughly with distilled water. In addition, lowering the open bottles at each sampling location will result in additional removal of any possible residue from

previous samples. The Niskin bottles are made of PVC with silicone rubber seals. The hinges are not lubricated. These materials have a very low potential for leaching any chemicals targeted by this survey into the collected water.

No preservation is necessary for organics (with the exception of total organic carbon (TOC), which should be acidified to pH <2), besides cool temperature (4° C). Bottles containing preserved samples should be refrigerated at 4° C to minimize decomposition of the solids prior to filtration. Samples to be analyzed as base/neutral/acid extractables (BNA) and for pesticides/PCBs will be hand carried or sent overnight via express shipping to the analytical laboratories handling these procedures to ensure that all samples will arrive no later than 96 hours after sampling. The analyses for these chemicals have a 7-days-to-extraction requirement (Table 3).

Conductivity, temperature, and depth (CTD) will be measured in the field simultaneously using a CTD meter. Dissolved oxygen will be measured with a probe which can be lowered down through the water column and measurements made at 1-2 m intervals. A portable turbidimeter will be used to measure turbidity at each site, using a modified version of the EPA approved procedure specified in Table 2. The pH at each site will also be measured in the field using a YSI or similar pH meter. Procedures for these measurements are outlined in Appendix A-2.

4.6 BIOASSAY SAMPLE COLLECTION

Bioassays will be conducted on sediment and water collected from each of the four locations. Three separate bioassays will be performed. Solid-phase sediment and sediment elutriate acute bioassays and a solid phase chronic bioassay will be conducted using sediment collected from each sediment sampling station. Field collection methods for sediment and water samples are described above in Sections 4.3 and 4.5. Test organisms will be obtained from commercial culturing facilities.

4.7 SUMMARY OF ANALYSES

Table 4 contains a summary matrix of the suite of analytical parameters required for each sample type. Table 5 shows the number of samples required for each analysis for the project area.

**TABLE 4
ANALYTICAL PROCEDURES MATRIX**

Analytic Procedures	Chemistry		Sediment Toxicity			Bioaccumulation
	Sediment Chemistry	Water Chemistry	10-day Amphipod Bioassay	48-hour Larvae Bioassay	28-day Neanthes Bioassay	
<u>Organics</u>						
624/8240	X	X				X
625/8270	X	X				X
608/8080	X	X				X
Methyl Mercury	X	X				X
Tributyltin	X	X				X
<u>Inorganics</u>						
Priority Metals (AA) 6010/7000 ⁽¹⁾	X	X				X

**TABLE 4 (CONTINUED)
ANALYTICAL PROCEDURES MATRIX**

Analytic Procedures	Chemistry		Sediment Toxicity			Bioaccumulation
	Sediment Chemistry	Water Chemistry	10-day Amphipod Bioassay	48-hour Larvae Bioassay	28-day Neanthes Bioassay	
<u>General</u>						
Interstitial Salinity	X					
Salinity			X	X	X	X
DO		X	X	X	X	X
pH		X				
Conductivity		X	X	X	X	X
Temperature	X	X				X
TOC	X	X				X
DOC	X	X				X
COD	X	X				X
BOD	X	X				X
TSS	X	X				X
Gross Alpha	X	X				X
Gross Beta						

⁽¹⁾ Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc.

**TABLE 5
SAMPLE REQUIREMENTS**

Media	Seaplane Lagoon	West Bayside	Inner Harbor Estuary	West Landfill Wetland	Runway Wetland	Stormwater	Reference	Control	Total
Station Designation	S1-S7	B1-B14	E1-E10	W1-W7	R1-R4	D1-D3	R1-R2	N/A	N/A
Sediment Chemistry (3 replicate composites plus 3 core samples at some locations/location)	30	63	36	21	12	N/A	6	17	185
Water Chemistry (3 replicates/location)	9	9	9	9	6	9	6	13	70
Fish Bioassay (NPDES) (3 replicates)	N/A	N/A	N/A	N/A	N/A	9	N/A	3	12
10-day Amphipod (solid) (5 replicates)	35	70	50	35	20	N/A	10	69	289
48-hr <i>Mytilus</i> Larvae (elutriate) (5 replicates)	35	70	50	N/A	N/A	N/A	10	N/A	165
28-day <i>Neanthes</i> (5 replicates)	35	70	50	35	20	N/A	10	69	289
Bioaccumulation ⁽¹⁾ (5 replicates)	35	70	50	35	20	N/A	10	69	289
Benthic Community ⁽¹⁾ (5 grabs)	35	70	50	35	20	N/A	10	N/A	220

⁽¹⁾ Tier II is dependent on results of Tier I. Maximum number of samples is shown in table.

5.0 SAMPLE CUSTODY

Sample custody is a vital aspect of field investigation programs to document the proper handling and integrity of the sample. All samples must be traceable from the time of sample collection until such time as the data are used for comparative purposes or for policy decisions.

The labeling scheme for the survey will be composed of two parts, the station numbers and the sample numbers. Station numbers will consist of the following designations:

- The first character will designate the type of station:
 - S for sediment
 - C for sediment cores
 - W for water column
 - D for stormwater discharge

- The second character will designate the area in which the station is located:
 - S for Seaplane Lagoon
 - B for Western Bayside
 - E for Estuary (Oakland Inner Harbor)
 - W for West Beach Landfill Wetland
 - R for Runway Wetland
 - P for San Pablo Bay reference area

- The final set of characters will be numerals designating the number of the stations as described in the sampling plan

Sample numbers will consist of the following designations:

- The first set of characters will designate the media sampled:

- S for sediment
- W for water
- B for benthos

- The final set of characters will be numerals designating the replicate number, in order of sample collection at a sample station, with the number indicating sediment core depth for core samples

Duplicate samples will be collected as a check on sampling and analysis procedures. Therefore, they will be submitted "blind" to the laboratory. Duplicate sample labels will be filled out using dummy field sample numbers and locations. The dummy locations and sample numbers for the duplicate sample will be cross-referenced and duly noted in the field logbook and sample summary form. The dummy sample numbers will not give any hint that the samples are duplicates, and the sample label will appear as it would on a normal environmental sample.

5.1 CHAIN-OF-CUSTODY PROCEDURES

Samples obtained during the course of this sampling effort will be strictly controlled by chain-of-custody procedures from point of origin to the analytical laboratory. Regardless of sampling method, the samples must conform to the chain-of-custody procedures established in this section. The history of each sample and its handling will be documented from its collection through all transfers of custody until it is transferred to the analytical laboratory. Internal laboratory records will document custody of the sample from the time it is received through its final disposition.

A sample is considered to be in someone's custody if any of the following rules are met:

- It is in actual physical possession of the custodian
- It is in the custodian's view, after being in the custodian's physical possession
- It is in the physical possession of the custodian's, and then locked or otherwise sealed so that tampering will be evident

- It is kept in a secure area, restricted to authorized personnel only

5.2 FIELD CUSTODY PROCEDURES

The key aspect of documenting sample custody is thorough record keeping. A field logbook will be maintained to document the collection of every sample. A summary sampling log (Figure 1) will be completed as samples are collected.

Sample containers will be labeled with waterproof ink prior to the time of sampling with the following information:

- Project name/number
- Station number
- Sampling date
- Sample number
- Preservative used
- Initials of person sampling

At the time of sampling, the appropriate containers will be selected, and the sample number for each sample will be recorded on the sample summary log and field log book. Sample labels (Figure 2) will be filled in with the information listed above (using waterproof ink), attached to the sample container, and wrapped with clear tamper-proof tape before the sample container is filled.

The following field custody procedures will be followed:

- a) Samples will be collected as described in the sampling portion of this plan.
- b) Sample labels will be completed for each sample using waterproof ink, unless prohibited by weather conditions (for example, a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather).

SAMPLE NO.	
PRESERVATIVE	
SAMPLER	DATE
SITE NAME	
TAG NO.	

	SAMPLE NO.	DATE	SEAL BROKEN BY	DATE
	SIGNATURE			
	PRINT NAME AND TITLE			

Figure 2 Typical Sample Label and Custody Seal

- c) Information on the labels will be checked against summary sampling log entries, and samples recounted before leaving the vessel to verify no samples are misplaced.
- d) The field team leader will be personally responsible for the care and custody of the samples until they are properly transferred or dispatched to the laboratory.
- e) The field team leader will determine whether custody procedures are followed properly during the field work and will decide if additional samples are required.
- f) If a sample tag is lost during shipment or a tag is never created, the field team leader will write a statement detailing how the sample was collected, stored, and transferred to the laboratory. The statement will include all pertinent information, such as entries in field logbooks regarding the sample, whether the sample was in the sample collector's physical possession or in a locked compartment until hand transported to the laboratory.

5.3 TRANSFER OF CUSTODY AND SHIPMENT PROCEDURES

All samples will be accompanied by a chain-of-custody record (Figure 3) and by a sample analysis request/packing list (Figure 4) indicating sample numbers and the requested analysis. Copies of all forms will be retained by the contractor.

- a) Prior to shipping, sample containers will be securely packed inside the cooler with sufficient ice or blue ice to maintain them at 4°C during the shipping process to the analytical laboratories. The original chain-of-custody and sample analysis request forms will be enclosed in plastic and taped to the inside lid of the cooler. The cooler will be closed, fiber tape will be wrapped completely around it, and a custody seal will be attached so that it must be broken when the cooler is opened. All samples collected will be packaged and shipped to the designated laboratory via express shipping with refrigerated holding areas, except for those samples where hand carrying is preferred, due to holding times of 7

SAMPLE ANALYSIS REQUEST
PACKING LIST

PROJECT <hr/> SAMPLING CONTACT: (NAME) (PHONE)	SAMPLING DATE(S): <hr/> DATE SHIPPED: <hr/> TASK NAME/CODE: <hr/>	SHIPPED TO: ATTN.:	FOR LAB USE ONLY DATE SAMPLES REC'D: <hr/> RECEIVED BY: <hr/>
---	--	-----------------------------------	--

SAMPLE NUMBERS	SAMPLE DESCRIPTION (ANALYSIS / MATRIX / CONCENTRATION / PRESERVATIVE)
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____
13. _____	_____
14. _____	_____
15. _____	_____
16. _____	_____
17. _____	_____
18. _____	_____
19. _____	_____
20. _____	_____

Figure 4. Typical Sample Analysis Request

of 7 days or less (see Table 3).

- b) When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the chain-of-custody form. This form documents sample custody transfer from the sampler, often through courier to the analyst at the laboratory. Copies of the original chain-of-custody forms and sample analysis request forms will be retained by the field team leader for inclusion in the project files.
- c) If sent by mail, the package will be registered with return receipt requested. If sent by common carrier or air freight, proper documentation will be maintained (such as a bill of lading).

5.4 LABORATORY CUSTODY PROCEDURES

- a) A designated sample custodian will accept custody of the shipped samples and verify that the information on the sample labels matches that on the chain-of-custody form. Pertinent information as to shipment, pickup, courier, damage will be entered in the "remarks" section. The custodian will then enter the sample label data into the sample tracking system of the laboratory. This system will use the sample label number or assign a unique laboratory number to each sample label and will assure that all samples are transferred to the proper analyst or stored in the appropriate secure area.
- b) Samples will be distributed to the appropriate analysts as described in laboratory procedures. Laboratory personnel will be responsible for the care and custody of samples from the time they are received until the samples are depleted, or disposed of. The laboratory sample custodian will also maintain a lab tracking report to follow each sample through all stages of laboratory processing (Figure 5). The sample tracking records must include the dates of sample extraction or preparation, and the date of sample analysis.

- c) When sample analyses and necessary quality assurance checks have been completed in the laboratory, the unused portion of the sample and the sample container will be disposed of properly. All identifying tags, data sheets, chain-of-custody, and laboratory records will be retained as part of the permanent documentation. Samples received by the laboratory will be retained until analyses and quality assurance checks are completed.

6.0 CALIBRATION PROCEDURES

Calibration procedures, calibration frequency, and standards for laboratory measurement variables and equipment will be in accordance with the requirements set forth in the U.S. EPA Contract Laboratory Program (CLP) or the specified analytical protocols. Field equipment calibration results and the methods used for preparing standards (e.g., pH buffer solutions) will be recorded in the field logbook and equipment logbooks accompanying each instrument.

7.0 ANALYTICAL PROCEDURES

Analytical methods and method detection limits (MDLs) for chemical analyses are summarized in Table 3-4 in Section 3.9 of the work plan.

Analysis of sediment and water samples will be performed using procedures based on the U.S. EPA approved methods, with the following exceptions:

- Tributyltin (TBT) - Modified SW-846 Methods (U.S. EPA 1986) (see Appendix A-2)
- Particle size distribution - The procedure for measuring particle size distribution is outlined in Methods of Soils Analysis (American Society of Agronomy 1985)

Conductivity, temperature, pH, dissolved oxygen, and turbidity will be measured in the field according to modified U.S. EPA methods (U.S. EPA 1983) and instrument manufacturer instructions (see Appendix A-2).

To determine precision and accuracy, a combination of surrogate spikes, method blanks, matrix spikes, check standards, analytical replicates, and field duplicates will be run with each batch of parameters analyzed by a specified method as discussed in Section 9.0.

Specific bioassay protocols are described in detail in the PSEP. The general QA/QC procedures to be followed are discussed briefly below. Every test series with a particular organism should include one test chamber containing clean, inert material to serve as a negative control. The complete bioassay series must be repeated if more than 10 percent of the control animals die or show evidence of sublethal effects. For sediment bioassays, sediment samples from an area known to be free of chemical contamination should be tested so that toxicant effects can be partitioned from unrelated effects such as those of sediment grain size. Reference toxicants, to serve as positive controls, shall be included in all bioassays.

For all bioassays, information regarding test organism source, condition and mortality of test organisms upon arrival at the laboratory, maintenance of organisms in the laboratory prior to test initiation, light regime, and dates of test initiation and completion will be reported in addition to test results.

All treatment and bioassay containers should be randomized and testing should be conducted without laboratory personnel knowing sample identities. Water quality variables such as salinity, dissolved oxygen, pH, temperature, and ammonia should be measured at the beginning and termination of testing to ensure that proper bioassay conditions have been maintained.

8.0 DATA VALIDATION, REDUCTION, AND REPORTING

Sample data will be subjected to a QA review upon receipt from the laboratory. The laboratory will provide CLP Level 3 data reports. All CLP data packages will be validated. U.S. EPA guidelines for data validation will be used (U.S. EPA 1988a,b). Items reviewed during data validation will include sample holding times, results for laboratory methods blanks, matrix spike/matrix spike duplicates (MS/MSDs), check standards, field and laboratory duplicates, and laboratory performance (i.e., ability to achieve method detection limits and adherence to QA/QC criteria established for this project). An estimation of data quality (precision and accuracy) based on sample results will also be provided. For

the bioassay data, QA review will include examination of sample holding times and the results of both positive and negative bioassay controls.

The primary QA information evaluated during the data validation of the benthic infauna analysis is the number of organisms missed during the original sort. Approximately 20% of every sample will be resorted by supervisory personnel. If the number of organisms detected in the resort is greater than 5% of the organisms found in the original sort, then the entire sample will be resorted by a different sorter.

Data qualifiers will be assigned to sample results based on QA/QC criteria. Data qualifiers serve to modify the usefulness of the individual compound concentrations by evaluating the reliability of the data. The following are definitions for data qualifiers:

- U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.
- UJ - The material was analyzed for, but was not detected. The sample detection limit is an estimated quantity.
- J - The associated numerical value is an estimated quantity.
- R - The data are unusable, compound may or may not be present. Re-sampling and reanalysis are necessary for verification.

The project QA officer will also summarize the field sampling procedures and data, and note significant QA problems that have occurred during the field investigation.

The final field survey report will contain copies of the following information, where appropriate:

- Laboratory data packages (see Section 14)
- Summary sampling log
- Sampling alteration checklist

- Chain-of-custody forms
- Sample analysis request/packing lists
- Tracking form
- Corrective actions taken

A QA report will also be included, which will: 1) summarize the results of the data quality review, including the results of system audits; 2) assess data accuracy, precision, and completeness; and 3) discuss any significant problems and recommendations.

9.0 INTERNAL QUALITY CONTROL CHECKS

A rigorous laboratory QA/QC program traces the historical record of laboratory data and allows one to track reproducibility, accuracy, and precision of the analytical results. The objective of the laboratory quality assurance program for analytical measurements is to reduce measurement errors to agreed-upon limits and to assure that the results have a high probability of being of acceptable quality. Quality control is the mechanism established to control errors.

A quality control program in a laboratory includes the following:

1. Development of and strict adherence to principles of good laboratory practice
2. Consistent use of standard operating procedures
3. Establishment of and adherence to carefully designed protocols for specific measurements programs
4. Reliable and well maintained equipment
5. Appropriate calibrations and standards
6. Close supervision of all operations by management and senior personnel, including review of data calculations for errors or omissions

When properly conceived and executed, a quality control program will result in a measurement system operating in a state of statistical control, which means errors have been reduced to acceptable levels and characterized statistically.

The QA/QC manuals submitted by each laboratory will be evaluated to ensure that an ongoing rigorous QA/QC program is part of standard laboratory practice. Each plan describes the QA and QC programs, equipment, training, analytical procedures, sample tracking, sample storage and disposal, and health and safety programs in each lab.

9.1 LABORATORY QUALITY CONTROL CHECKS

Each analytical laboratory will demonstrate its ability to produce acceptable results using the recommended methods. This is consistent with EPA QA/QC guidelines and contract laboratory guidelines. Data will be evaluated based on the following criteria (as appropriate for inorganic or organic chemical analyses):

- Performance on method tests (U.S. EPA 1980, 1982, 1983, 1984, 1986, 1989)
- Percent recovery of surrogate standards
- Adequacy of detection limits obtained
- Precision of replicate analyses
- Comparison of the percentage of missing or undetected substances among replicate samples
- Percent recovery of spike compounds
- Results of check standards

Table 6 summarizes the quality control samples and their recommended frequency of analysis.

TABLE 6 SUMMARY OF QUALITY CONTROL SAMPLES

Analysis Type	Recommended Frequency of Analysis
Surrogate spikes	Required in batch - minimum three neutral, two acid spikes, plus one spike for pesticide/PCB analyses, and three spikes for volatiles. Isotope dilution technique (i.e., with all available labeled surrogates) is recommended for full scan analyses and to enable recovery corrections to be applied to data.
Method blank	Two per set of samples.
Matrix spikes ^b	<u>Not</u> required if complete isotope dilution technique used < 20 samples: one per set of samples submitted to lab for conventional analyses, 2 per set of samples for organic and metals analyses. ≥ 20 samples: 5 percent of total number of samples.
Check standards	One check standard at 0.9 times the concentration of the highest calibration standard per batch of samples, and one at 0.2 times the highest calibration standard per batch of samples.
Analytical replicates	< 20 samples: one per set of samples submitted to lab ≥ 20 samples: one triplicate and additional duplicates for a minimum of 5 percent total replication.
Field duplicates	10 percent of samples.

^a Does not apply to radionuclide analyses.

^b Does not apply to the following criteria: conductivity, pH, temperature, D.O., TOC, TSS, total solids, and turbidity.

10.0 PERFORMANCE AND SYSTEM AUDITS

For those field measurements which yield themselves to quantitative comparison, such as temperature and pH measurements of water, the QA officer will be responsible for periodic performance audits. In these audits, an independent measurement of a parameter normally measured by other personnel will be made by the QA officer and the result compared to a simultaneous measurement made by personnel typically responsible for these measurements.

If the procedure is not subject to quantitative verification, such as the collection of sediment samples, a system review may be undertaken by the QA officer. In this type of audit, adherence to protocol is monitored and any deviations noted and reported to the regulatory oversight staff. If the results of either the performance or system audit warrant a change in techniques, the QA officer is also responsible for this correction (see Section 13).

Each analytical laboratory should have its own QA officer whose responsibility it is to monitor the performance of the analytical methodology. Laboratory splits and duplicates are two methods of measuring accuracy.

11.0 PREVENTIVE MAINTENANCE

Preventive maintenance of equipment is also essential if project resources are to be used cost-effectively. Preventive maintenance will take two forms: 1) implementing a schedule of preventive maintenance activities to minimize downtime and ensure accuracy of measurement systems, and 2) ensuring stock of critical spare parts and backup systems and equipment. The preventive maintenance approach for specific pieces of equipment used in sampling, monitoring, and documentation will follow manufacturers specifications. Performance of these maintenance procedures will be documented in field logbooks.

12.0 DATA ASSESSMENT PROCEDURES

The equations presented below will be used to determine if data meet the data quality objectives.

The mean, \bar{C} , of a series of replicate measurements of concentration, C_i , for a given surrogate compound or analyte will be calculated as follows:

$$\bar{C} = \frac{1}{n} \sum_{i=1}^n C_i$$

where:

n = Number of replicate measurements.

The estimate of precision of a series of replicate measurements will usually be expressed as the relative standard deviation, RSD:

$$RSD = \frac{SD}{\bar{C}} \times 100$$

where:

SD = Standard deviation:

$$SD = \sqrt{\frac{\sum_{i=1}^n (C_i - \bar{C})^2}{(n - 1)}}$$

Alternatively, for data sets with a small number of points (e.g., duplicate measurements), the estimate of precision may be expressed as:

$$SD = \sqrt{\frac{C_1 - C_2}{2}}$$

where:

- C_1 = First concentration value measured for a variable.
 C_2 = Second concentration value measured for a variable.

The analytical precision can then be compared with overall precision for all duplicate results by the following equation:

$$SDP = \sqrt{\frac{(C_1 - C_2)^2}{2m}}$$

where:

- SDP = Pooled standard deviation.
 m = Pairs of duplicate results.

Accuracy as measured by matrix spike results will be calculated as:

$$Recovery = \frac{DC}{C_s} \times 100$$

where:

- DC = The measured concentration increase due to spiking (relative to the unspiked portion)
 C_s = The known concentration in the spike.

Completeness will be measured for each set of data received by dividing the number of valid measurements actually obtained by the number of measurements planned.

13.0 CORRECTIVE ACTION

Corrective action taken during a sampling program fall into two categories: 1) analytical or equipment malfunctions, and 2) nonconformance or noncompliance with QA requirements set forth for the project.

The QA officer is responsible for auditing performance of the field team and analytical laboratories for adherence to predetermined methods, limits of acceptability, and required sample handling described in this report. The QA officer will outline the corrective action required to conform to project specifications in the corrective action checklist (Figure 6) and a copy of the checklist will also be communicated, as soon as practicable, to all project managers, including regulatory project managers. Corrective action taken in the field will be documented in the field logbook.

In terms of internal laboratory corrective action, all labs will be required to adhere to U.S. EPA and standard operating procedure guidelines and specifications. When instrument response, quality control sample (MS/MSD, check standard, or duplicate) precision or accuracy, or blank analyses indicate exceedance of control limits, the laboratory will investigate the problem before continuing with sample analysis. The bioassay and benthic analysis laboratories each have specific procedures they will follow with respect to corrective action. In many cases, the correction action to be taken is detailed in the method protocol. In all cases, the corrective action taken will be documented by the laboratory manager and communicated to the QA officer.

13.1 CORRECTIVE ACTION CHECKLIST

The QA officer or his designee will issue a corrective action checklist for each nonconforming condition identified (i.e., when objectives for precision, accuracy, completeness, representativeness, or comparability are not satisfied or when unacceptable procedural practices or conditions are identified). The laboratory quality assurance manager will issue a corrective action checklist concerning laboratory performance and will submit the report to the project manager and quality assurance officer.

Section No. _____

Revision No. _____

Date _____

Page _____ of _____

CORRECTIVE ACTIONS CHECKLIST

SAMPLE PROGRAM IDENTIFICATION: _____

SAMPLING DATES: _____

MATERIAL TO BE SAMPLED: _____

MEASUREMENT PARAMETER: _____

ACCEPTABLE DATA RANGE: _____

CORRECTIVE ACTIONS INITIATED BY: _____

TITLE: _____ DATE: _____

PROBLEM AREAS REQUIRING CORRECTIVE ACTION: _____

MEASURES TO CORRECT PROBLEMS: _____

MEANS OF DETECTING PROBLEMS (FIELD OBSERVATIONS, SYSTEMS AUDIT, ETC.): _____

APPROVAL FOR CORRECTIVE ACTIONS: _____

TITLE: _____

SIGNATURE OF QA OFFICER: _____ DATE: _____

Figure 6. Typical Corrective Actions Checklist

The corrective action checklist will fully describe the conditions requiring corrective action, will indicate the nature of the corrections required, and will specify a schedule for compliance. The final authority for issuance of a corrective action checklist rests with the quality assurance officers who will notify all project managers.

13.2 CORRECTIVE ACTION IMPLEMENTATION

Upon the issuance of a corrective action checklist, it will be delivered to the laboratory manager and all project managers. The corrective action checklist will provide space for the responsible individual to indicate the nature of the corrective action taken and will include measures to preclude a repetition of the original deficiency. After the issue has been reviewed and the corrective action is acceptable, the QA officer and the laboratory QA manager (if applicable) will sign the corrective actions checklist to this effect and inform the involved parties that the nonconforming condition has been satisfactorily resolved.

13.3 CAUSE AND ACTION TO PREVENT RECURRENCE

The QA officer will track the corrective action checklist, analyze the corrective actions required, and take the necessary steps to resolve the causes of the nonconforming conditions in order to prevent recurrence.

14.0 QUALITY ASSURANCE REPORTS

The analytical laboratory will be required to submit data supported by sufficient backup and QA information to permit independent determination of data quality. Deliverables submitted by the laboratory will include the information described below.

14.1 ORGANIC COMPOUND ANALYSIS DELIVERABLES FOR QA

1. The laboratory will deliver a case narrative that includes a summary of any quality control, sample, shipment, or analytical problems, and documentation of all internal decisions. Included in this document will be an outline of problems

encountered and a description of solutions implemented. A copy of the signed chain-of-custody form for each group of samples will also be included in the narrative packet.

2. The sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures (one significant figure for concentrations less than 10 and two significant figures for concentrations greater than 10). For undetected values, the lower limit of detection of each compound will be reported separately for each sample. The date of sample analysis must be included.
3. The surrogate percent recovery will be summarized for all organic analyses.
4. The matrix spike/matrix spike duplicate results will be reported.
5. A summary of the method blank analysis will be reported.
6. All check standard data will be reported.
7. The results of all replicate samples will be reported.

When conducting organic analyses on the GC/MS or High Resolution GC/MS (HRGC/HRMS), the laboratories will also be asked to report and tentatively identify the ten major peaks beyond those specified by the method.

14.2 INORGANIC COMPOUND ANALYSES DELIVERABLES FOR QA

1. The laboratory will deliver a case narrative that includes a summary of any quality control, sample, shipment, or analytical problems, and documentation of all internal decisions. Included in this document will be an outline of problems encountered and a description of solutions implemented. A copy of the signed

chain-of-custody form for each group of samples will also be included in the narrative packet.

2. The sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures (one for concentrations less than 10 and two significant figures for concentrations greater than 10). For undetected values, the lower limit of detection of each compound will be reported separately for each sample. The date of sample analysis must be included.
3. The matrix spike/matrix spike duplicate results will be reported.
4. A summary of the method blank analyses will be reported.
5. All check standard data will be reported.
6. The results of all replicate samples will be reported.

The data will be compared to the project data quality objectives to determine if the data are sufficient for project tasks.

Sample holding times will be calculated by comparing the date of sample collection, shown on the summary sampling logs, with the date of sample analysis (and extraction when appropriate), presented with sample results. Laboratory certificates of analysis with complete sample results will be due from the laboratories within 30 days after the laboratory receives each sample group.

14.3 AMPHIPOD BIOASSAY DELIVERABLES FOR QA

The following data should be reported by all laboratories performing this bioassay:

1. Water quality measurements during testing (i.e., DO, temperature, salinity, pH ammonia concentration, light regime, and other protocol requirements)

2. Daily emergence for each beaker and the 10-day mean and standard deviation for each treatment
3. Ten-day survival in each beaker and the mean and standard deviation for each treatment
4. Interstitial salinity values of test sediments
5. Ninety-six hour LC50 values with reference toxicants
6. Significant differences in survival among test, reference and control sediments will be determined using parametric or non-parametric analysis of variance statistical tests, as appropriate. Specific differences in mean survival will be determined by the appropriate parametric or non-parametric statistical tests
7. A table presenting the following:
 - Name of the supplier
 - Date and location of organisms collected
 - Date of initiation and completion of the bioassay
 - Laboratory light regime
 - Feeding schedule and water quality conditions under which the organisms were held
 - Narrative description of the condition of the organisms upon arrival in the bioassay laboratory, including for example the estimated mortality of organisms upon arrival from the supplier
8. Any problems that may have influenced data quality

14.4 BIVALVE BIOASSAY DELIVERABLES FOR QA

The following data should be reported by all laboratories performing this bioassay:

1. Water quality measurements during testing (i.e., DO, temperature, salinity, pH)
2. Individual replicate, mean, and standard deviation data for larval survival after 48 hours
3. Test, reference, and control sediment replicate means and standard deviation data for larval survival and abnormalities after 48 hours
4. Individual replicate mean, and standard deviation data for larval abnormalities after 48 hours
5. Forty-eight hour EC50 values of reference toxicants
6. A table presenting the following:
 - Name of the supplier
 - Date and location of organisms collected
 - Date of initiation and completion of the bioassay
 - Laboratory light regime
 - Feeding schedule and water quality conditions under which the organisms were held
 - Narrative description of the condition of the organisms upon arrival in the bioassay laboratory, including for example the estimated mortality of organisms upon arrival from the supplier
7. Any problems that may have influenced data quality

14.5 POLYCHAETE BIOASSAY DELIVERABLES FOR QA

The following data should be reported by all laboratories performing this bioassay:

1. Water quality measurements during testing (i.e., DO, temperature, salinity, pH, ammonia)
2. Individual replicate mean and standard deviation for *Neanthes* survival (after 28 days)
3. Initial total biomass (dry weight) for three groups of five worms
4. Individual replicate mean, and standard deviation for individual and total biomass (dry weight) for *Neanthes* after 28 days
5. 96-hour LC50 values with reference toxicants
6. Information specified in Section 14.4, item 6.
7. Any problems that may influence data quality

14.6 FISH TOXICITY DELIVERABLES FOR QA

The following data should be reported by all laboratories performing this bioassay:

1. Water quality measurements before and after testing (i.e., salinity, DO, temperature, pH)
2. Individual replicate mean and standard deviation data for survival after 7 days for each dilution
3. Initial total biomass (dry weight) for three groups of five fish

4. Individual replicate mean and standard deviation data for total fish (biomass) after 7 days for each dilution
5. Individual mean and standard deviation data for total fish biomass for each dilution
6. Information specified in section 14.4, item 6.
7. Any problems that may influence data quality.

14.7 BENTHIC COMMUNITY STRUCTURE ANALYSIS DELIVERABLES FOR QA

1. The laboratory will provide abundance data for each taxon identified for each sample
2. The samples examined by each sorter
3. The qualifications of the taxonomists
4. The results of the resorts

14.8 BIOACCUMULATION STUDY DELIVERABLES FOR QA

1. The laboratory will deliver a case narrative that includes a summary of any quality control, sample, shipment, or analytical problems, and documentation of all internal decisions. Included in this document will be an outline of problems encountered and a description of solutions implemented. A copy of the signed chain-of-custody form for each group of samples will also be included in the narrative packet. The laboratory will also report and tentatively identify the ten major peaks beyond those specified by the method.

2. The sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures (one significant figure for concentrations less than 10 and two significant figures for concentrations greater than 10). For undetected values, the lower limit of detection of each compound will be reported separately for each sample. The date of sample analysis must be included.
3. The surrogate percent recovery will be summarized for all organic analyses.
4. The matrix spike/matrix spike duplicate results will be reported.
5. A summary of the method blank analysis will be reported.
6. All check standard data will be reported.
7. The results of all replicate samples will be reported.
8. Water quality measurements during testing (i.e., DO, temperature, salinity, pH ammonia concentration, light regime, and other protocol requirements)
9. Interstitial salinity values of test sediments
10. Ninety-six hour LC50 values with reference toxicants
11. A table presenting the following:
 - Name of the supplier
 - Date and location of organisms collected
 - Date of initiation and completion of the bioassay
 - Laboratory light regime
 - Feeding schedule and water quality conditions under which the organisms were held

- Narrative description of the condition of the organisms upon arrival in the bioassay laboratory, including for example the estimated mortality of organisms upon arrival from the supplier

12. Any problems that may have influenced data quality

14.9 FIELD SAMPLING PLAN DELIVERABLES

A final report will be prepared describing the results of the study. The report will include a description of the sample collection activities, a summary of the results and conclusions of the study, and recommendations. The report will contain copies of field logs, maps, photographs and other documentation of field activities. The report will also include laboratory QA reports, and results of data validation.

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APPENDIX A-1

GLOSSARY OF TERMS

AUDIT

A systematic check to determine the quality of operation of some function or activity. Audits may be of two basic types: 1) performance repeated audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system, or 2) system audits of a qualitative nature that consist of an onsite review of the field or laboratory QA system and physical facilities for sampling, calibration, and measurement.

DATA QUALITY

The totality of features and characteristics of data that influence their ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

Accuracy

The degree of agreement of a measurement (or an average of measurements of the same thing), X, with accepted reference or true value, T. This is usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, $100(X-T)/T$. It may also be expressed as the ratio, X/T. Accuracy is a measure of bias in a system.

Precision

A measure of the amount of variability among individual measures of the same property, under prescribed similar conditions. Precision is expressed in terms of standard deviation, relative percent difference, or coefficient of variation. Various measures of precision exist depending upon the prescribed similar conditions.

Completeness

A measure of the amount of valid data obtained from a measurement system compared to the amount that was intended in the sampling design. A certain percentage of the intended amount of data must be successfully collected for conclusions based on the data to be valid. Missing or incomplete data may reduce the precision of estimates, introduce bias, and thus lower the level of confidence in the conclusions.

Representativeness

Expresses the degree to which data accurately and precisely represent a characteristic of a population, variations within a sampling point, a process condition, or an environmental condition.

Comparability

Expresses the confidence with which one data set can be compared to another.

DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements regarding the minimum quality of data needed to support a specific objective or decision. For cost effective experimental design, it is necessary to anticipate the quality of data needed from the research project and to document this in terms of DQOs. DQOs are established prior to collecting data, which is necessary for a clear understanding of what is expected of the data.

DATA VALIDATION

A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, and certification.

ENVIRONMENTALLY RELATED MEASUREMENTS

A term to describe essentially all field and laboratory investigations that generate data for 1) measuring chemical, physical, or biological variables in the environment; 2) determining violations of water quality criteria in waste streams; 3) assessing health and ecological effects; 4) conducting clinical and epidemiological investigations; 5) performing engineering and process evaluations; 6) studying laboratory simulation of environmental events; and 7) studying or measuring pollutant transport and fate, including diffusion models.

PERFORMANCE AUDITS

Procedures to quantitatively determine the accuracy and precision of the total measurement system or its component parts. Generally, samples of known concentration in a stable medium are analyzed to evaluate performance.

QUALITY ASSURANCE

The total program for assuring the reliability of monitoring and measurement data. QA is a system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

QUALITY ASSURANCE PROGRAM PLAN

An orderly assembly of detailed and specific procedures that delineate how data of known and accepted quality are generated to accomplish project objectives. (A given agency or laboratory would have only one quality assurance program plan, but would have a quality assurance project plan for each project.)

QUALITY CONTROL

The routine application of statistical procedures to control and document the accuracy of the measurement process.

STANDARD OPERATING PROCEDURES

Standard operating procedures (SOPs) include details of an operation, analysis, or action whose mechanisms are thoroughly prescribed and commonly accepted as the method for performing certain routine or repetitive tasks. SOPs are prepared for all routine activities that have known or suspected direct impact on the quality of environmental data.

APPENDIX A-2

STANDARD OPERATING PROCEDURES

DISSOLVED OXYGEN

The YSI Model 51B dissolved oxygen meter will be used to measure *in situ* dissolved oxygen concentration in the field.

- Calibrate dissolved oxygen probe using manufacturer's instructions for air calibration at the beginning of each day of use. Record calibration information in instrument logbook.
- Set instrument in position which measurements will be taken and zero the instrument.
- Insert probe into water column and allow probe to equilibrate. Select temperature scale and record temperature to the nearest 1° C.
- Set oxygen solubility factor dial to the sample temperature.
- Select (read oxygen) setting. (For shipboard monitoring, lower weighted probe into water column and record oxygen reading every 2 meters). Record dissolved oxygen concentration in mg/L in the field notebook.

CONDUCTIVITY AND TEMPERATURE

Ysi Model 33 Conductivity Meter

- Zero the instrument using distilled water as a blank.
- Calibrate the instrument using the prepared KCl solution.
- Record calibration information in the field logbook.
- Pour water samples into a precleaned 500 mL plastic beaker. The 500 mL beaker and conductivity probe should be rinsed a minimum of 3 times with sample water.
- Insert instrument probe and measure temperature to the nearest 0.5° C.
- Adjust temperature setting on the instrument to the determined value.
- Gently swirl conductivity probe in the sample container to displace any air bubbles.

- Select the highest conductivity multiplier setting (range) that produces a conductivity reading. Record conductivity reading in the field logbook. If reading is off-scale, dilute the sample with distilled water, mix thoroughly, and taken another reading. Record the dilution information in the field logbook.
- Repeat measurement on an additional sample to compare results, and record the information in the field logbook.

pH

Orion Model SA 250

The Orion is equipped with an automatic temperature compensator, therefore no conversions will be required for the pH readings obtained during the field survey.

- Calibrate the instrument with standard solutions of pH 4, 7, and 10. Record calibration information in the instrument logbook.
- Pre-clean a 500-mL plastic beaker and pH and temperature probes by rinsing with sample water a minimum of 3 times.
- Pour the water sample into a 500-mL beaker and insert the pH and temperature probes. Measure temperature to the nearest 0.1° C.
- Gently swirl the pH probe in the sample container and select the pH setting 0.01. Read the pH to the nearest 0.1 unit once the reading has stabilized.
- Repeat the pH measurement procedure on an additional sample to compare results, and record the information in the field logbook.

TURBIDITY

Hach Portable Turbidimeter

- Select the middle scale (1-10 NTU).
- Zero the instrument using the blanks provided.
- Insert the 10 NTU standard and adjust the scale to read 10 NTU.
- Rinse the sample tube a minimum of three times with sample water.
- Shake the sample well and pour into the sample tube. Immediately take reading and record in field logbook. Do a duplicate reading.

- If sample reading is too low, switch scale to 0-1 NTU and calibrate for 1 NTU standard.
- If sample reading is too high, switch the scale to 10-100 NTU and calibrate using 100 NTU standard. Dilution is recommended for samples falling within this range or higher.
- Dilute sample to fall within 1-10 NTU range, and record dilution information in field notebook.

APPENDIX B

NAS ALAMEDA ECOLOGICAL ASSESSMENT HEALTH AND SAFETY PLAN

An Addendum to the NAS Alameda RI/FS Health and Safety Plan

This addendum to the NAS Alameda RI/FS Health and Safety Plan (HSP) (JMM, 1991) addresses safety issues specific to the NAS Alameda Ecological Assessment of the Seaplane Lagoon, Western Bayside and Inner Oakland Harbor, and the Runway and West Beach Landfill Wetlands. Individuals performing the Ecological Assessment are expected to keep a copy of both the HSP and this addendum at the site and are expected to implement the program as written unless otherwise directed by this addendum. This addendum includes pertinent information concerning sampling activity conducted over water.

1.0 OVERVIEW OF SAMPLING OPERATIONS

The ecological assessment will consist of sampling surface sediments and surface water from multiple sample locations in the areas listed above. None of the sampling techniques will involve invasive procedures beyond a depth of approximately one meter below the surface. This depth is expected to fall within the soil cover of the landfills or within the Bay mud depositional sequence of the remaining areas. All of these activities will be conducted either in shallow, near-shore waters in the case of the two wetlands; in open Bay water in the case of the Western Bayside area; or in restricted waters such as the Oakland Inner Harbor and the Seaplane Lagoon.

1.1 *Expected Contaminants*

1.1.1 Seaplane Lagoon

The contaminants identified in the Seaplane Lagoon and Turning Basin immediately west of the Lagoon include PCBs, heptachlor, organotin, phthalate esters, polynuclear aromatic hydrocarbons (PAHs), lead, and zinc. Bioassays from the Turning Basin revealed greater than 50% abnormal development of Bay Mussel larvae at the highest test concentration (100% elutriate). Since the Seaplane Lagoon received untreated industrial wastewater prior to 1975, the following classes of contaminants may be present in site sediments: solvents, paints, detergents, acids, caustics, mercury, oil, grease, and chromium.

1.1.2 Inner Harbor Channel

No analytical results exist for sediments or water quality along the southern edge of the Inner Harbor Channel. However sampling and analysis of channel sediments have been performed as part of the ongoing maintenance dredging effort. These results indicate the presence of PAHs, oils, grease, organotin, lead, chromium, arsenic, nickel, copper, and phthalate esters in channel bottom sediments. It is reasonable to assume that similar contaminants may be detected in sediments and/or water of the portion of the Inner Harbor Channel adjacent to NAS Alameda.

1.1.3 Runway Wetland

No information exists concerning disposal of hazardous material in this region. However since the wetland is located in an area of Bay fill, the presence of hazardous materials cannot be discounted.

1.2 *Physical Hazards*

The physical hazards at the site include all those documented within the HSP with the following exceptions:

- No hazards associated with underground utilities since no invasive sampling will occur; and,
- No hazards associated with drill rigs.

Additional hazards not documented in the HSP include hazards associated with boating; hazards associated with operation of the van Veen sampler and winch; and, hazards associated with storm sewer sampling. These hazards are described in more detail below.

1.3 HAZARD ACTIVITY ANALYSIS

The sampling activities associated with the Ecological Assessment will be conducted in and around water in areas with known or suspected contamination. The potential hazards associated with these activities and the control measures designed to mitigate these hazards are defined below:

- *Exposure to hazardous chemicals:* Since most activities will occur over waters flushed regularly by tidal action, chemical exposure is not expected to be significant. However all site personnel will be required to wear appropriate chemical protective gloves and safety boots when collecting samples. Air monitoring will be conducted as described in the HSP. Radiation badge monitoring may occur during sampling of the West Beach Landfill Wetland if the preliminary radiation survey of the landfill indicates the presence of elevated levels of radioactivity. The Project Health and Safety Officer will be responsible for verifying the results of the preliminary radiation survey of the site, and ensuring compliance with the RI/FS Health and Safety Plan.
- *Drowning:* Since sampling will take place from a boat in the open Bay, drowning hazards are present. These hazards can be mitigated by following procedures outlined in 29 CFR 1926.106:
 - Either at least one U.S. Coast Guard approved 30-inch life ring with not less than 90 feet of 600-pound capacity line attached shall be kept in an

accessible place, or all employees must wear a U.S. Coast Guard approved life jacket or work vest;

- The life vests must be inspected after each use and those with defects which alter their strength or buoyancy must be replaced;
 - At least one life-saving skiff shall be immediately available; and,
 - At least one person onboard shall be trained in cardiopulmonary resuscitation (CPR) techniques. All field personnel will be trained and drill exercises conducted in procedures to be followed in the event that a person falls overboard during water-oriented field activities. If a person falls overboard, an alarm shall be sounded. Someone shall keep the person in sight and point toward the person until they are recovered. A life preserver will be thrown overboard. The boat will approach the person from a downwind direction and move alongside into the wind for the pickup. If necessary, a strong swimmer with a life jacket and safety line attached, may go over the side to help retrieve a weakened person.
-
- *Hypothermia:* Hypothermia is the abnormal lowering of the body's internal temperature due to loss of heat from exposure to cold air, wind, or water. The greatest danger of hypothermia would be for a person exposed to bay waters for a period of time. The site safety officer and field personnel will be trained to recognize hypothermia symptoms which include shivering, mental disorientation, bluish skin and lips, incoherent speech, or unconsciousness. The site safety officer will familiarize field personnel with first aid techniques for hypothermia. All field personnel will be required to wear life jackets at all times while on a boat.
 - *Sampling using the van Veen and sediment core samplers:* Gear deployment and retrieval presents hazards because of the heavy weight of the sampling gear, its suspension above the deck, and the risk of accidental and premature closure. Safety pins will be in place on the van Veen grab whenever it is inboard of the

vessel rail. The triggering mechanism will always be set when the grab is resting on a stable surface. Special care will be exercised when removing the safety pin to ensure personnel safety in the unlikely event of a gear or winch failure.

During retrieval of sampling equipment, at least one crew member will watch for the appearance of the equipment and will alert the winch operator when the equipment is visible below the water surface and when it breaks the water surface. Failure to monitor equipment retrieval and slow the winch upon surfacing may lead to breakage of the cable, loss or damage of the gear, and possible injury from either the falling grab or the snapped cable end. In addition, monitoring the grab retrieval will alert other personnel to be positioned to safely bring the grab aboard.

After prolonged use, individual strands of the winch cable may break. Sampling personnel will be instructed to avoid contact with the moving cable unless protected by work gloves. On a periodic basis over the length of the sampling cruise, the chief scientist will inspect the cable for wear, especially where the wire is attached to the sampling gear. The chief scientist will also periodically inspect all shackles, pins, housing, swivels and thimbles to ensure the integrity of all points along the cable. Likewise, all on-deck crew members will be encouraged to periodically inspect these linkages.

The winch drum, the blocks, and the area between the sampling equipment and the rail, deck or other large equipment all represent significant pinching and crushing hazards. Personnel will be instructed to keep their hands, feet, and clothing clear of these points.

Lines, hoses, hatch covers, coolers, and mud on the deck all present tripping, slipping, and falling hazards. Every crew member will make an effort to keep the working surfaces of the deck clear and clean by coiling hoses and lines, and rinsing accumulations of mud from the deck. Awareness of the locations and status of hatch covers and other gear in use will be maintained at all times.

- *Sampling Open Storm Sewers:* The mechanical hazards anticipated during on-land storm water sampling activities include sampling open storm sewers. In order to mitigate these hazards, the following safety procedures will be followed: barricades will be placed over open storm sewers; traffic control measures will be used when necessary; and all sampling activities will be conducted from the ground surface (field personnel will not enter the storm sewer system).

- *Wetland Investigations:* Physical risks are the primary concern to field investigators conducting wetland determinations in tidal marshes and some man-induced wetlands as the result of dense vegetation obscuring various hazards. These hazards could include holes or tidal sloughs into which field investigators have been known to fall, sharp objects which could puncture rubber soled boots, or refuse (such as, metal scraps, wire) which could cause tripping. Although these hazards are not generally significant, field investigators will work in pairs within sight of each other, so that one field investigator will be available to assist the other.

2.0 ASSIGNMENT OF RESPONSIBILITIES

The responsibilities of health and safety personnel and field personnel are as described in the HSP.

3.0 PERSONNEL TRAINING

The training program described in the HSP will apply to the ecological assessment.

4.0 MEDICAL SURVEILLANCE PROGRAM

All medical surveillance protocol defined in the HSP will apply to the ecological assessment.

5.0 PERSONNEL PROTECTIVE EQUIPMENT

Table B-1 will replace Table 5-1 in the HSP. All sampling activity will be conducted initially in Level D with the exception of the West Beach Landfill Wetland sampling which will be conducted in Level C as defined in the HSP. If results from the radioactive badges worn during RI/FS sampling at the West Beach Landfill Wetland indicate non-detected levels of radioactivity, ecological assessment sampling will occur in Level D protection. All upgrade decisions will be based on criteria defined in the HSP.

6.0 HEALTH HAZARD ASSESSMENT

The criteria for health hazard assessment remains the same as that in the HSP.

7.0 STANDARD OPERATING PROCEDURES

These procedures remain the same as those in the HSP.

**TABLE B-1
INITIAL LEVEL OF PERSONAL PROTECTION FOR SAMPLE COLLECTION PROGRAM
AT ALAMEDA NAS DURING ECOLOGICAL ASSESSMENT**

Site	Known/Suspected Contaminants*	Initial Level of Personal Protection
Seaplane Lagoon	PCBs, heptachlor, organotin, phthalate esters, polynuclear aromatic hydrocarbons (PAHs), lead, zinc, solvents, mercury, chromium, oil, grease, paints, caustics	EPA Level D
Western Bayside	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc, Trichloroethylene, Trans-1,2-Dichloroethylene, Benzene, Acetone, Bis(2-Ethylhexyl)phthalate, Di-n-butylphthalate, Acenaphthylene, Naphthalene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Ideno(1,2,3-cd)pyrene, Pyrene, Chrysene, Fluorene, Phenanthrene, Dibenzofuran, 2-methylnaphthalene, 2-cyclohexen-1-one, 2,5-diethyltetrahydrofuran, Gross alpha particles, Gross beta particles	EPA Level D
Inner Harbor Channel	PAHs, oil, grease, organotin, lead, chromium, arsenic, nickel, copper, phthalate esters	EPA Level D
West Beach Landfill Wetland	Solvents, Oily Waste, Paint Waste, Strippers, Thinners, Plating Wastes, Acids, Mercury, PCBs, Batteries, Low Level Radiological Waste, Asbestos, Pesticides, Creosote, Waste Medicines, Infectious Waste, Tear Gas Canisters, inert ordnance	EPA Level C
Runway Wetland	No known contamination	EPA Level D

* Contaminants are not expected to affect offshore sampling activities conducted from a boat.

8.0 DECONTAMINATION PROCEDURES

All personnel protective equipment will be decontaminated in the same manner as described in the HSP.

9.0 SITE HEALTH AND SAFETY PROGRAM DOCUMENTATION

All site personnel are expected to sign documentation asserting that the provisions of both the HSP and this Addendum have been met. Therefore two Personal Acknowledgement forms will be required. The Personal Acknowledgement form for this Addendum is included as an attachment.

10.0 EMERGENCY RESPONSE PLAN

The emergency response will be the same for the Ecological Assessment as for the RI/FS. Battery operated portable communication equipment will be on the boat at all times. The Coast Guard and Navy will be informed of all contractor sampling activities on the water and will establish airlift protocols as necessary.

11.0 GENERAL SAFETY REQUIREMENTS

All general requirements are set forth in the HSP.

PERSONAL ACKNOWLEDGEMENT

**ECOLOGICAL ASSESSMENT
HEALTH AND SAFETY PLAN ADDENDUM**

As a component of the Health and Safety Plan (HSP) designed to provide personal safety during the field activities at the Alameda Naval Air Station, Alameda, California, you are required to read and understand the HSP Addendum. When you have fulfilled this requirement, please sign and date this personal acknowledgement.

Signature

Name (Printed)

Date

APPENDIX C GLOSSARY OF TERMS AND ACRONYMS

TERMS

Alluvium. A general term applied to sediments deposited by a stream or running water.

Aquifer. The water-bearing portion of subsurface earth material that yields or is capable of yielding useful quantities of water to wells.

Bedrock. Geologic formation or unit which underlies soil and other unconsolidated surficial deposits.

Benthic. Organisms associated with an ocean or lake bottom.

Climate. The prevalent or characteristic meteorological conditions (and their extremes) of any given location or region.

Confined Aquifer. An aquifer that is overlain by an impermeable stratum and within which water pressure may build up so that penetration by a well will result in a static water level that is considerably higher than the top of the aquifer.

Decibel. The unit of measurement of sound level calculated by taking ten times the common logarithm of the ratio of the magnitude of the particular sound pressure to the standard reference sound pressure of 20 micropascals and its derivatives.

Developed. Said of land, a lot, a parcel, or an area that has been built upon, or where public services have been installed prior to residential or commercial construction.

Direct Effects. Effects that are immediate consequences of program activities. In economics, the initial increase in employment and income resulting for program employment and material purchases before the indirect effects of these changes are measured.

Disturbed Area. Land that has had its surface altered by grading, digging, or other construction-related activities.

Effect. A change in an attribute. Effects can be caused by a variety of events, including those that result from program attributes acting on the resource attribute (direct effect); those that do not result directly from the action or from the attributes of other resources acting on the attribute being studied (indirect effect); those that result from attributes of other programs or other attributes that change because of other programs (cumulative effects); and those that result from natural causes (e.g., seasonal change).

Effluent. Wastewater discharge from a wastewater treatment facility.

Endangered Species. A species that is threatened with extinction throughout all or a significant portion of its range.

Expenditure. A disbursement of funds by a government entity; includes operation and maintenance costs, as well as capital costs.

Geologic Unit. A geologic formation, group, or member.

Hazardous Materials. Both nonradioactive (e.g., missile propellants and diesel fuel) and radioactive materials.

Hazardous Waste. A waste, or combination of wastes, which, because of its quantity, concentrations, or physical, chemical, or infectious characteristics, may either cause, or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Hydrology. The science dealing with the properties, distribution, and circulation of water on the surface of the land and in the soil and underlying rocks.

Impact. An assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and nominally subjective technique.

Microgram. One-millionth of a gram.

Mitigation. A method or action to reduce or eliminate program impacts.

Native Vegetation. Plant life that occurs naturally in an area without agricultural or cultivational efforts.

Principal Aquifer. The particular aquifer that supplies the majority of ground water used in a given region.

Recharge. The process of which water is absorbed and added to the zone of saturation, either directly into a formation or indirectly by way of another formation.

Riparian. Of or relating to land lying immediately adjacent to a water body, and having specific characteristics of that transitional area (e.g., riparian vegetation).

Runoff. The noninfiltrating water entering a stream or other conveyance channel shortly after a rainfall event.

Soil. A natural body consisting of layers or horizons of mineral and/or organic constituents of variable thickness and differing from the parent material in their morphological, physical, chemical, and mineralogical properties, and biological characteristics.

Soil Association. A collection of soils found to geographically occur together.

Soil Series. The lowest category used for differentiating groups of soils based on similar properties and characteristics. Soils are homogenous with respect to profile characteristics except for the A or surface horizon, which may vary in texture.

Soil Types. A category or detailed mapping unit used for soil surveys based on phases or changes within a series (e.g., slope, salinity).

State-Sensitive/State-Recognized Species. Plant and wildlife species in each state that are monitored and listed for purposes of protection.

Terrestrial. Living on or in, or growing from, the land.

Threatened Species. Plant and wildlife species likely to become endangered in the foreseeable future.

Ton. A unit of weight equal to 2,000 pounds.

Topsoil. The upper or productive layer(s) of a soil.

Total Dissolved Solids. The concentration of solid materials that are dissolved in a sample of water; determined as the weight of the residue of a water sample upon filtration and evaporation divided by the volume of the sample.

Unconfined Aquifer. An aquifer where the water table is exposed to the atmosphere through openings (pores) in the overlying materials.

Unique and Sensitive Habitats. Areas that are especially important to regional wildlife populations or protected species that have other important biological characteristics (e.g., severe wintering habitats, nesting areas, and wetlands).

Upland. Ground elevated above bottomlands (e.g., rolling hill terrain and terraces).

Water Table. The sustainable volume of water discharged from a well per units of time, often expressed in gallons per minute.

Wetlands. Areas that are inundated or saturated with surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil, including swamps, marshes, bogs, and similar areas.

ACRONYMS

AA	atomic absorption
ABAG	Association of Bay Area Governments
A/E	architect/engineer contractor
AGL	above ground level
AIMD	Aircraft Intermediate Maintenance Department
ASTM	American Society for Testing and Materials
BCDC	San Francisco Bay Conservation and Development Commission
BOD	biological oxygen demand
BTU	British thermal unit
CCR	California Code of Regulations
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
CS	characterization study
CSVS	characterization study/verification step
CVP	Central Valley Project
CZMA	Costal Zone Management Act
DERP	Defense Environmental Restoration Program
DFG	(California) Department of Fish and Game
DHS	(California) Department of Health Services
DLA	Defense Logistics Agency
DOC	dissolved organic carbon
DOD	(U.S.) Department of Defense
DOT	(U.S.) Department of Transportation
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utilities District
EC ₅₀	effective concentration to 50 percent
EPA	(U.S.) Environmental Protection Agency
FAA	Federal Aviation Administration
FAC	facultative plant
FACW	facultative wetland plant
FSP	field sampling plan
FWS	(U.S.) Fish and Wildlife Service
FY	fiscal year
GC/MS	gas chromatography/mass spectrometry
GPS	Global Positioning System
GSA	General Services Administration

IAS	Initial Assessment Study
ICP	inductively coupled plasma
IRP	Installation Restoration Program
LC ₅₀	lethal concentration to 50 percent
LD ₅₀	lethal dose to 50 percent
MCL	maximum contaminant level
MGD	million gallons per day
MLLW	mean lower/low water
msl	mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants Program
NAS	naval air station
NAS Alameda	Naval Air Station Alameda
NASA	(U.S.) National Aeronautics and Space Administration
NAVFACENGCOM	Naval Facilities Engineering Command
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWI	National Wetlands Inventory
OBL	obligatory plant
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PSED	Puget Sound Estuary Program
PVC	polyvinyl chloride
PWC	(Navy) public works center
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
Region	San Francisco Bay Area Region
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	(California) Regional Water Quality Control Board
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SI	site inspection
SWAT	solid waste assessment test
THC	total hydrocarbons

TOC	total organic carbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNPS	United States National Park Service

WESTDIV	Western Division
WESTDIVNAVFACENGCOM	Western Division Naval Facilities Engineering Command

UNITS OF MEASUREMENT

°C	degrees Celsius
cm	centimeter
cm/sec	centimeters/second
cy	cubic yard
°F	degrees Fahrenheit
ft	feet
in	inch
g	gram
L	liter
m	meter
m ²	square meters
mg/L	milligrams per liter
mi	mile
mg/kg	milligrams/kilogram
mm	millimeter
ppb	parts per billion
pph	parts per hundred
ppm	parts per million
ppt	parts per thousand
PM ₁₀	particular matter (less than 10 micrometers in diameter)
tpd	tons per day
μg/kg	micrograms per kilogram
μg/L	micrograms per liter