FEBRUARY 1989

SAMPLING PLAN

SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSAL ADDENDUM

REMEDIAL INVESTIGATION / FEASIBILITY STUDY
NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

VOLUME IA

DEPARTMENT OF THE NAVY
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA 94066-0727

SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSAL
ADDENDUM A TO SAMPLING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

CanonieEnvironmental

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February 16, 1989

86-018-04

Ms. Bella G. Dizon (Code 1813BD)
Western Division Naval Facilities
Engineering Command
PO Box 727
San Bruno, CA 94066-0727

Transmittal
Final Sampling Plan, SWAT Proposal Addendum
Remedial Investigation/Feasibility Study
Naval Air Station Alameda
Alameda, California

Dear Ms. Dizon:

Enclosed are three copies of the final SWAT Proposal Addendum for the Remedial Investigation\Feasibility Study Sampling Plan at the 1943-1956 Disposal Area and the West Beach Landfill within the Naval Air Station Alameda. This addendum incorporates our responses to the comments made by the California Regional Water Quality Control Board and adopted by the California Department of Health Services. Seventeen more copies will be delivered on February 17, 1989.

This report completes a portion of the work authorized under contract N62474-85-D-5620 Delivery Order 004.

If you have any questions, please call us.

Respectfully submitted,

C. Carlos White, P.E.
Assistant Project Engineer

James W. Babcock, Ph.D.
Project Supervisor

CCW/JWB/as

Enclosures

N00236.000311
ALAMEDA POINT
SSIC NO. 5090.3

FINAL SAMPLING PLAN, SOLID WASTE ASSESSMENT TEST PROPOSAL ADDENDUM REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) VOLUME 1A OF 8

DATED 01 FEBRUARY 1989

THIS RECORD CONTAINS MULTIPLE VOLUMES WHICH HAVE BEEN ENTERED SEPARATELY

VOLUME 1 OF 8 – FINAL SAMPLING PLAN, RI/FS DATED 2/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000785**

VOLUME 1A OF 8 – FINAL SAMPLING PLAN, SOLID WASTE ASSESSMENT TEST PROPOSAL ADDENDUM, RI/FS DATED 12/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000789**

VOLUME 1A OF 8 – FINAL SAMPLING PLAN, SOLID WASTE ASSESSMENT TEST PROPOSAL ADDENDUM, RI/FS DATED 2/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000786**

N00236.000311
ALAMEDA POINT
SSIC NO. 5090.3

VOLUME 1B OF 8 – FINAL AIR SAMPLING PLAN, RI/FS DATED 12/1/88 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000275**

VOLUME 2 OF 8 – FINAL HEALTH AND SAFETY PLAN, RI/FS DATED 12/1/88 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000274**

VOLUME 2 OF 8 – REVISED FINAL HEALTH AND SAFETY PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000351**

VOLUME 2 OF 8 – REVISED FINAL HEALTH AND SAFETY PLAN, RI/FS DATED 11/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000780**

VOLUME 3 OF 8 – FINAL QUALITY ASSURANCE PROJECT PLAN – QUALITY ASSURANCE / QUALITY CONTROL PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000341**

N00236.000311
ALAMEDA POINT
SSIC NO. 5090.3

VOLUME 3 OF 8 – FINAL QUALITY ASSURANCE PROJECT PLAN – QUALITY ASSURANCE / QUALITY CONTROL PLAN, RI/FS DATED 1/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000782**

VOLUME 4 OF 8 – COMMUNITY RELATIONS PLAN, RI/FS DATED 2/15/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000301**

VOLUME 5 OF 8 – FINAL PROJECT MANAGEMENT PLAN/SCHEDULE, RI/FS DATED 2/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000322**

VOLUME 6 OF 8 – DATA MANAGEMENT PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000361**

VOLUME 7 OF 8 – FINAL PRELIMINARY PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION PLAN, RI/FS DATED 6/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000371**

VOLUME 8 OF 8 – FINAL FEASIBILITY STUDY PLAN, RI/FS DATED 1/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000783**

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY

NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

1.0 INTRODUCTION

The Work Plan for a Remedial Investigation/Feasibility Study (RI/FS) at NAS Alameda is currently under preparation. This Remedial Investigation Work Plan, while initiated under the Naval Assessment and Control of Installation Pollutants (NACIP) program purview, has been written to satisfy the Comprehensive Environmental Response, Compensation and Liability Act as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) remedial investigation program developed by the U.S. Environmental Protection Agency (EPA). It is consistent with EPA guidance on CERCLA/SARA Remedial Investigation (RI) Work Plan development.

The Work Plan for the RI/FS at NAS Alameda consists of the following planning documents:

Volume 1 Sampling Plan
Volume 1A Sampling Plan, SWAT Proposal Addendum
Volume 1B Air Sampling Plan
Volume 2 Health and Safety Plan
Volume 3 Quality Assurance Project Plan (QAPP), Quality Assurance/Quality Control Plan (QA/QC)
Volume 4 Community Relations Plan
Volume 5 Project Management Plan/Schedule
Volume 6 Data Management Plan
Volume 7 Public Health and Environmental Evaluation Plan
Volume 8 Feasibility Study Plan

The purpose of Volume 1A is two-fold. First, it satisfies the requirements of the sampling plan of the RI/FS Work Plan for the two landfills. Second, it satisfies the requirements of the SWAT Proposal for the California Regional Water Quality Control Board (RWQCB).

The objectives of the NAS Alameda site investigation work plan are to determine if contamination of soil and ground water has occurred in areas which have been identified as potential waste release sites, define the nature and extent of contamination at confirmed waste release sites, and to collect the data necessary to complete a Feasibility Study (FS) and evaluate general response actions.

This document presents the Solid Waste Assessment Test (SWAT) proposal for two landfill sites located at the Naval Air Station (NAS) Alameda in Alameda, California (Figure 1-1). These two sites are designated as Site 1: the 1943-1956 Disposal Area and Site 2: the West Beach Landfill (Figure 1-2).

Implementation of a SWAT program by all landfill owners is required under the provisions of the Calderon Bill (AB 3525), which has been incorporated into the California Water Code (Section 13272). The program requires investigation of the site to determine if there is any migration of hazardous wastes.

The following SWAT proposal closely follows the format suggested in the draft SWAT Guidance document prepared by the California State Water Resources Control Board (SWRCB) in October 1986. This draft SWAT Guidance document is included as Appendix G so the reader can more easily follow the organization of this SWAT proposal.

The RI/FS Work Plan includes Volume 2, the Health and Safety Plan [Canonie Environmental Services Corp. (Canonie), 1988b], and Volume 3, the Quality Assurance Project Plan and Quality Assurance/Quality Control Plan (QAPP) (Canonie, 1988c). The principles and procedures set forth in those two volumes will be followed during the investigation outlined in this SWAT proposal, and this SWAT proposal will make reference to those two Work Plan documents concerning certain key procedures.

1.1 Site Name

Site 1: 1943-1956 Disposal Area

Site 2: West Beach Landfill

Previous Name: None

1.2 Operator and Owner

Owner: Naval Air Station Alameda
Alameda, California

Contact: Mr. Randolf Cate (Code OLE)
Department of the Navy
Naval Air Station Alameda
Alameda, California

Phone No: 415-869-4731

Operator (Inactive): Naval Air Station
Alameda, California

Phone No: 415-869-4731

Previous Owners: The property where the landfills are located was previously owned by the U.S. Army (1930-1936), but the property was covered by San Francisco Bay at that time, and the landfills had not been created.

1.3 Site Locations

The two landfill sites are adjacent to each other and are located at the extreme western end of NAS Alameda. A general location map is provided on Figure 1-1, and the location of the two landfill sites on the air station property is shown on Figure 1-2.

Site 1, the 1943-1956 Disposal Area, is located in the extreme northwestern corner of the station and occupies an area of about 120 acres. The Oakland Inner Harbor estuary lies along its northern perimeter and San Francisco Bay along its western perimeter.

Site 2, the West Beach Landfill, is located adjacent to and south of the 1943-1956 Disposal Area, on the southwestern corner of the station. It occupies an area of about 110 acres. San Francisco Bay is located along its western and southern perimeters.

Other location parameters include the following:

Township, range and section numbers (Mt. Diablo Base Line and Meridian):

Site 1: The northern half is within T1S, R4W, Section 32.

The southern half is within T2S, R4W, Section 5.

Site 2: T2S, R4W, Section 5.

Assessors parcel numbers:

Site 1: The site is entirely within the City and County of Alameda, Assessor's Parcel Number (APN) Book 74, Pages 890 and 891, Parcel No. 1.

Site 2: The northeast half of Site 2 is within the City and County of Alameda, APN Book 74, Pages 890 and 891, Parcel No. 1.

The southwest half of Site 2 is within the City and County of San Francisco, but the Assessor's office has not assigned a parcel number.

1.4 Site Use

The two landfill sites were not open to the public, but were for the use of NAS Alameda and other Naval facilities in the Oakland vicinity.

During the periods that the landfills were in use, records of the waste materials deposited at the landfills were not maintained. In 1980 the U.S. Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations. An Initial Assessment Study (IAS) was performed at NAS Alameda by Ecology and Environment, Inc. (E&E, 1983). This report assembled information concerning disposal practices and waste materials disposed at the two landfill sites. A summary of this information follows.

1.4.1 Site 1: 1943-1956 Disposal Area

Waste disposal operations at the 1943-1956 Disposal Area began during the early 1940s and continued through 1956. The exact quantities of wastes disposed of at this site are unknown, but have been estimated at 15,000 to 200,000 tons. Long-term employees have reported that the area received all of the wastes generated on the base other than those drained to storm sewers. Materials known to have been disposed of at the site include old aircraft engines, cooked garbage, cables, scrap metal, waste oil, paint waste, solvents, cleaning compounds, construction debris, and radioactive material.

The disposal method reportedly used consisted of digging trenches to the water table, filling them with waste, and compacting the material with a bulldozer. Cover material was applied on an irregular basis.

Based on aerial photographs dated March 24, 1947 (Figure C-2, Appendix C) and September 6, 1949, most of the waste disposal activity appears to have been concentrated in the northern half of the site. An aerial photograph dated August 14, 1953 shows that by that date the area had been covered by the present runways.

1.4.2 Site 2: West Beach Landfill

The West Beach Landfill served as the NAS Alameda disposal area from approximately 1952 through March 1978. Waste disposal operations began at the site in the early 1950s with the disposal of waste chemical drums in the northeast corner of the site. Disposal operations increased after 1956 when waste disposal at the 1943-1956 Disposal Area ceased. By the late 1960s and early 1970s, most of the disposal of hazardous wastes at the site had been discontinued. Disposal operations at this landfill ceased in March 1978.

In addition to wastes from NAS Alameda, this landfill was used for disposal of wastes from Oak Knoll Naval Hospital (now Oakland Naval Hospital); Naval Supply Center, Oakland; and Treasure Island. Materials reportedly disposed of at the landfill included municipal garbage; solvents; oily waste and sludges; paint waste, strippers, thinners, and sludges; plating wastes; industrial strippers and cleaners; acids; mercury; polychlorinated biphenyl (PCB)-contaminated fluids and TAC rags; batteries; low-level radiological wastes; scrap metal; inert ordnance; spoiled food; asbestos; pesticides; tear gas agents (CS and CSC); infectious waste; creosote; and waste medicines and reagents.

Estimates of the amounts of waste in the landfill vary. It has been estimated that a maximum of 1.6 million tons of municipal garbage and 30,000 tons to 500,000 tons of hazardous waste are present in the landfill.

Details of these estimates are available in the Initial Assessment Study (E&E, 1983), but some of this detail will be presented in the following paragraphs.

Table 6-15 in Appendix F lists the wastes from overhauled aircraft which were disposed of at this site. Table 6-16 lists estimated volumes of materials disposed of by plant maintenance and Public Works personnel.

PCB-contaminated oil from base transformers was disposed of, as well as approximately three tons of PCB-contaminated oils contained in oil-soaked TAC rags.

Approximately 30 cubic yards of infectious waste was received from Oak Knoll Naval Hospital each day.

Several hundred pounds of tear gas agents (CS and CSC) as a loose powder in containers were disposed of after the Berkeley student riots in 1968 or 1969.

Inert ordnance was also disposed of at the site. Approximately four truckloads of these explosives, ranging in size from 4 feet long and 12 inches wide to smaller ammunition, were buried in 1976.

In the late 1970s a quantity of pesticides covered by the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) were disposed of in an area covering 900 to 2,500 square feet. The pesticides included both solids and liquids but were primarily solids, and were contained in cardboard containers, glass bottles, and plastic containers.

Two unlined oil sumps into which tanker trucks drained waste oils were located on the site.

In 1981, 24,000 cubic yards of dredge spoils from the seaplane lagoon were deposited in the southwest corner of the site.

Disposal methods used at the site reportedly consisted of excavating a trench to the water table, filling the trench in with disposal materials, spreading and compacting the material with a bulldozer, and then covering the area with the excavated soil on an intermittent basis (E&E, 1983).

A map of the West Beach Landfill which originally appeared in the IAS (E&E, 1983) and which shows the estimated locations of some of the hazardous wastes disposed of at the site is provided as Figure 6-7 in Appendix F. The information used by E&E to develop this map was incomplete. The map shown as Figure 6-7 of Appendix F is not considered to be accurate but can be used for general guidance. Additional discussion of disposal methods is provided in Section 2.1.2.

1.5 Administrative Orders

On September 9, 1983 the California Regional Water Quality Control Board (RWQCB) gave notice to the Navy of a Tentative Order of Closure Requirements for the Class II Solid Waste Disposal Site (West Beach Landfill). The Tentative Order was followed by Order No. 83-35 on September 28, 1983. The Closure Requirements contained specifications for the final cover, the leachate cutoff barrier, methane gas control, earthquake damage control, drainage, and erosion control; and prohibited disposal of dredge spoils pending further review by the RWQCB. The order also set due dates for task completions and compliance report submittals.

On June 30, 1988 the California Department of Health Services (DHS) sent the Navy a Notice of Remedial Action Order. This order found that the landfill sites constituted a nuisance that is injurious to health or offensive to the senses. The Navy was ordered to conduct remedial activities including a remedial investigation and feasibility study (RI/FS), and the order outlined the requirements of the RI/FS.

1.6 Site Closure Information

1.6.1 Site 1: 1943-1956 Disposal Area

The 1943-1956 Disposal Area was used for waste disposal until 1956, but closure of the site began in 1952 when plans for the extension of Runway 12 (now Runway 13-31) and Runway 7-25 required covering of much of the site. An aerial photograph dated August 14, 1953 shows that the present runway configuration in this former landfill area was complete by that date. Spoils stockpiled in this area during dredging operations of the late 1940s were used as fill during the 1952 runway construction.

Disposal operations apparently continued in the landfill in the areas which had not been covered by runways from 1952 until 1956. In 1956 disposal operations were moved to the West Beach Landfill which had opened immediately to the south. The entire 1943-1956 Disposal Area was eventually covered with soil of an unknown depth.

During the mid-1950s, the western edge of the 1943-1956 Disposal Area was developed as the West Beach Fleet Recreation Area. At the present time, facilities in this area include a baseball diamond, picnic area, and a recreation building. The site also includes two ammunition storage facilities and a pistol range. A jogging course runs the length of the site.

The area is today covered by an unknown depth of soil, but no exposed waste is apparent. The perimeter of the landfill is assumed to extend to the rock seawall at the edge of San Francisco Bay, and the recreational facilities in the area are located directly on top of the former waste disposal areas.

1.6.2 Site 2: West Beach Landfill

Disposal operations at the West Beach Landfill ended in March 1978. The Navy developed plans to close the site as a Class II landfill in accordance with state and local regulations. Various investigations and designs for closure of the site were completed by contractors working for the Navy during the late 1970s and early 1980s and discussed with regulatory agencies; but due to a series of difficulties encountered at the site, an approved plan for closure was not completed.

A brief history of these closure efforts since 1978 is provided in the following paragraphs.

In March 1978, Harding-Lawson Associates (HLA) submitted the Sanitary Landfill Site Study (HLA, 1978) for the West Beach Landfill. Results of chemical analyses from this study are discussed in Section 2.2.2. Water quality tests indicated that polluting materials were present in the water and that leachate was seeping into San Francisco Bay from the landfill, but the concentrations at the seawall were not significantly greater than those found in the bay waters adjacent to the site. The report also concluded that the site cover material at that time was not adequate to prevent surface water infiltration. This study was submitted in August 1978 to the DHS for review.

In June 1980, the Navy submitted the Draft Sanitary Landfill Closure Plan (HLA, 1980) to the RWQCB for review. This plan included construction plans and specifications by HLA dated May 30, 1980. The closure concept was that the existing landfill surface would be stripped and resurfaced with one foot of compacted low-permeability borrow material obtained from the existing dredge material pond, a dike would be constructed to enclose the entire 110-acre area to accommodate disposal of future dredged material, surface runoff would be collected and disposed of through storm drains, and a continuous gas venting system would be installed along the north and east sides of the landfill to prevent lateral migration of methane. In the

June 13, 1980 meeting between the RWQCB and the Navy, the RWQCB expressed concern about the leachate seeping from the landfill to the San Francisco Bay waters in the vicinity of Wells 4 or 5 (see Figure 2-2). The Navy agreed to include measures to seal this area.

On September 9, 1983, the RWQCB issued a Tentative Order of Closure Requirements for the West Beach Landfill. The Tentative Order was followed by Order No. 83-35 on September 28, 1983. The order contained requirements for the final cover, the leachate cutoff barrier, methane gas control, earthquake damage, drainage, erosion control, and compliance reports. Commencement of the placement of dredge spoils onto the landfill was prohibited until the RWQCB could determine that measures necessary to protect the ground water quality had been taken. These measures were to be addressed in the NPDES permit application. The completion date for the cover and grading work was specified as October 15, 1987.

On October 19, 1983, HLA submitted the Confirmation Study (HLA, 1983). Additional ground water sampling had been performed. The report concluded that there did not appear to be significant amounts of hazardous materials in the ground water, and that the landfill should be closed as a Class II site.

In June 1985, the Navy notified the RWQCB that the slurry wall and the seawall repairs had been completed on October 1, 1984. It was also reported that the cover thickness had been checked and found to be less than the thickness specified.

On November 26, 1985, the Navy informed the RWQCB that the borrow area from which the cover soil had been taken had been declared a wetlands, and the additional cover material required to meet the cover-thickness requirements could no longer be taken from this borrow site. It would be necessary to find an alternate source of suitable cover material. On April 25, 1986, the Navy informed the RWQCB that the most recent survey of the cover at the site had indicated that 75,000 cubic yards of additional cover material would be required. The contractor was at that time spreading the 20,000 cubic yards of imported material that had been located.

On March 28, 1986, the Navy submitted as-built drawings of the Solid Waste Disposal System plans prepared by HLA to the RWQCB (Appendix D, Drawing C-2). The as-built drawings show the approximate boundary between refuse area and dredge spoils area, the plans and construction details of the perimeter dikes surrounding the landfill, the two-foot thick slurry wall along the western side of the landfill, the gas venting system along the northern and eastern part of the landfill, drainage swales and ditches, and the decant weir.

On June 11, 1986, the RWQCB requested a proposal from the Navy to address the problem of ponding at the site. In November 1986, the Navy submitted to the RWQCB interim grading plans (revision dated November 10, 1986) for prevention of ponding. HLA and the Navy would oversee the work. In January 1987, the Navy informed the RWQCB that the remedial work to prevent ponding had been completed on December 15, 1986. As-built drawings were submitted dated December 1986.

During 1987 and 1988, the Navy communicated with the RWQCB concerning the possibility of depositing dredge spoils from nearby projects as cover for the West Beach Landfill. Testing programs for permeability and chemical analyses have been performed, but no dredge spoils have been deposited at the landfill due to execution schedule and funding problems of the dredging projects.

On June 11, 1987, the RWQCB notified the Navy of the SWAT requirements at the landfill.

Historical aerial photographs of the site since 1978 have been provided in Appendix C. These include photographs dated September 14, 1979; June 21, 1983; May 15, 1985; and March 30, 1988. As-built drawings of the closure work which has been completed are presented in Appendix D.

At the present time the West Beach Landfill is surrounded by an earthen berm approximately 15 feet wide and 5 feet above the surface of the landfill. San Francisco Bay lies approximately 30 feet beyond the berm. During recent site visits no exposed areas of organic fill were apparent. A number of piles of construction debris were apparent, and dredge spoils were exposed in the constructed wetlands in the landfill area.

The area is moderately to well vegetated, primarily by grasses. The area supports a diverse wildlife and is known to provide nesting areas for birds.

1.7 Certification

I, Richard J. Greenwood, certify that the information contained in this SWAT proposal is complete and accurate, and that the proposals herein are in accordance with accepted practice.

Richard J. Greenwood
California Registered Civil Engineer
License Number C041338

Mr. Greenwood's resume is presented in Appendix E.

2.0 SITE INFORMATION

2.1 Site Construction Details

No detailed as-built plans, specifications, or descriptions of the original construction of the landfills are available for submittal with the SWAT proposal. However, a summary of known construction procedures at the sites will be presented in two sections which follow.

2.1.1 Construction of the 1943-1956 Disposal Area

Information concerning construction of the 1943-1956 Disposal Area is limited. It is apparent from historical aerial photographs and early maps and nautical charts that the area occupied by both of the landfill sites was covered by the waters of San Francisco Bay prior to 1940 (Figures 2-3 through 2-6 and Figure C-1 in Appendix C). The rock seawall, which today lies along the southern edge of the Oakland Inner Harbor estuary at the northern perimeter of the landfill, has been in place since some time prior to 1915 (Figure 2-3). The seawall was originally a jetty which protected the harbor entrance and included railroad tracks along its length and piers at the western end, approximately at the northwest corner of the present 1943-1956 Disposal Area site.

The area of NAS Alameda just east of the landfill areas, where the main runways are located today, was also originally under water. This area was filled in with dredge spoils during the late 1930s. A historical aerial photograph dated February 18, 1939 (Figure C-1, Appendix C) shows this fill operation nearing completion. The end of the jetty is also visible in this photograph, extending out into the area at the northern perimeter of what would become the landfill.

Nautical charts from 1937 and 1942 show that the water depth in the vicinity of the future 1943-1956 Disposal Area varied from 4 to 18 feet relative to mean lower low water shortly before construction of the landfill began. The 1943-1956 Disposal Area was originally filled in with dredge spoils during the early 1940s, beginning with the northern part of the landfill area next to the jetty. An aerial photograph taken some time during World War II shows disposal operations in the northern half of the site, but filling of the southern half with dredge spoils was still under way. Aerial photographs dated March 24, 1947 (Figure C-2, Appendix C) and September 6, 1949 show disposal operations in the northern half, but no evidence of disposal in the southern half of the site.

The disposal method at the site reportedly consisted of digging trenches in the fill soil to the water table, filling them with waste, and compacting the material with a bulldozer. Cover material was applied on an irregular basis (E&E, 1983).

The landfill was partly covered in 1952 when the runways were extended to their present configuration. An aerial photograph dated August 14, 1953 shows the completed runways, but disposal operations were apparently continuing in the western and northern portion of the site in the areas which had not been covered by the runways. There is no sign in the 1953 photograph that filling work had begun in the West Beach Landfill.

Disposal operations at the site ended in the mid-1950s. Closure activities are described in Section 1.6.1.

2.1.2 Construction of the West Beach Landfill

According to a report produced by the Navy staff, filling of the West Beach Landfill began in 1956 with construction of the seawall on the south and west sides and hydraulic placement of 15 to 20 feet of sand fill (Cristi, 1973). According to nautical charts dated 1937 and 1942, the water depth in the area in 1937 and 1938 ranged from 8 feet to 20 feet below the mean lower low water datum (Figures 2-5 and 2-6). The fill operations in the area can be seen in progress in the historical aerial photograph dated May 3, 1957 (Figure C-3, Appendix C).

According to the 1978 Harding-Lawson study of the site (HLA, 1978), the landfill has been divided into three areas, designated as Areas A, B, and C on Plate 1 of Appendix F. After the initial filling of the landfill area with sand, clayey and sandy dredge spoil was added in Areas B and C.

The HLA study concluded that the disposal of the wastes described in Section 1.4.2 was limited to Areas A and B. Area B was originally limited to disposal of dredge spoil material, but during the late 1970s some refuse was disposed of in this area. Areas B and C were diked and used for the disposal of dredge spoil material in 1970 and 1973. Most of this material came from the Navy pier areas, turning basin, and entrance channel, and it is possible that some chemical contamination was present in the dredged material.

According to the Harding-Lawson study, disposal operations consisted of excavating about 20 feet of the hydraulic sand fill, filling the excavation with waste materials and excavated sand, and covering the fill with the remaining sand (HLA, 1978). Operations during the late 1970s were described by HLA as consisting of excavation of trenches to just above the ground water surface, depositing the waste at the working face of the excavation, spreading and compacting the waste with a bulldozer, collecting the cover material (on-site dredge slurry sands and bay mud) by dragline and front-end loader, spreading the cover with a scraper, and track-rolling the cover with bulldozers (HLA, 1978). This latter description of disposal operations corresponds to the description provided in the IAS (E&E, 1983). The IAS also provided a diagram of where wastes had been disposed at the site (Figure 6-7 in Appendix F), but this diagram was based on incomplete information and should only be used for general guidance.

A study of historical photographs reveals some additional information. Several photographs from the late 1960s show a large area of water extending eastward into the landfill area from the rock seawall about mid-way up the site area from the southern perimeter. This can be clearly seen in the aerial photograph dated May 19, 1969 (Figure C-4, Appendix C). Disposal operations were proceeding around the edges of this water area. During this period there was a culvert through the seawall and this area of surface water was open to tidal action. After 1968 a flap-gate was installed on the culvert to stop the tidal action. The area had apparently been filled by the time of the aerial photographs dated May 19, 1971 and April 30, 1973 (Figure C-5, Appendix C).

Disposal operations at the site were discontinued in March 1978. Closure activities at the site are described in Section 1.6.2. The aerial photograph dated September 14, 1979 (Figure C-6, Appendix C) shows the site about one year after disposal operations were halted.

Several studies of the site have been performed since disposal operations were discontinued. These included soil borings which provide an indication of the depth of the fill material at the site. Discussions of these studies are presented in Section 2.2.2, and copies of boring logs are provided in Appendix B.

2.2 Existing Chemical Data

The two landfills under study had no leachate collection and removal systems, and there are therefore no recent analyses of leachate available for submittal with the SWAT proposal. There have been, however, several investigations of the landfill areas since the late 1970s which have collected samples for analysis. A summary of these data on physical and chemical parameters is presented in the two sections which follow.

2.2.1 Previous Investigations at the 1943-1956 Disposal Area

The 1943-1956 Disposal Area (Figure 1-2) was investigated by Wahler Associates (Wahler) during the Verification Step Confirmation Study (Wahler, 1985), prepared under the NACIP program. Five permanent ground water monitoring wells were installed along the western perimeter of the disposal area as shown on Figure 2-1. The following analyses were performed on both the soil and ground water samples:

- Purgeable hydrocarbons;
- Base-neutral extractable organics;
- Seventeen metals;
- Radiation (gross alpha and gross beta).

Results of chemical analyses for inorganic and organic constituents in soil and ground water from the 1943-1956 Disposal Area are presented in Table 1 of Appendix A.

The soil samples test data for inorganic analyses show that in most of the samples, 11 of the 17 metals tested for were detected, with copper, zinc, and lead levels at high concentrations. The organic analysis results of the soil samples from Well WA-3 show that it contained a number of polynuclear aromatic hydrocarbons (PAHs) which were not detected in the other samples.

The most significant findings of the ground water analyses were the trichloroethylene (TCE) and trans-1,2-dichloroethylene (trans-1,2-DCE) levels that were detected in samples from Wells WA-1 and WA-2. Metals were detected in only two of the water samples: zinc was found in Well WA-1 and molybdenum was found in Well WA-3.

Low levels of radiation were detected in most of the soil and water samples.

2.2.2 Previous Investigations at the West Beach Landfill

A Sanitary Landfill Site Study was conducted by Harding-Lawson Associates (HLA, 1978) for the West Beach Landfill.

Test borings were drilled and subsurface conditions were investigated (Figure 2-2). It was concluded that the subsurface water generally flows across the site from the north and east boundaries to the south and west. Data regarding the influence of tidal action on the fluctuation of water levels in the observation wells was collected and is contained in Table 2, Appendix A. Water quality was tested from water samples taken from selected points, and results of the sample analyses are contained in Table 3, Appendix A. The water quality tests indicated that chemicals were present in the water and that leachate was seeping into San Francisco Bay from the landfill, but the concentrations were not significantly greater than those found in the bay waters adjacent to the site.

The report stated that the adequacy of the site cover material to prevent surface water infiltration was questionable.

During the study, soil gas was monitored at several observation wells. It was found that the landfill was generating methane and that in some of the borings the gas concentration was at combustible levels. Data from the soil gas study is contained in Tables 4, 5, and 6 of Appendix A.

As part of their Confirmation Study, HLA (1983) recommended and performed water sampling on 6 of the original 15 observation wells. Samples were taken for laboratory testing using chain-of-custody procedures. The testing included gas chromatograph scans for the EPA's list of 129 priority pollutants. A copy of these test data is presented in Appendix A. Comparison of this data with their data from the 1978 monitoring well tests indicated that the heavy metals concentrations were about the same as they were in 1977 (less than one part per million). No volatile or base neutral fractions were detected; the acid fraction contained only a trace of phenol; and the total identifiable chlorinated hydrocarbon (TICH) fraction indicated a slight trace of PCB. Based on this analysis, HLA concluded that it did not appear that significant amounts of materials were present in the landfill at hazardous levels. In response to the recommendations of the IAS (E&E, 1983), HLA included in their Confirmation Study the installation of six additional monitoring wells (Figure 2-2). Samples were taken in these new wells and also from the several existing monitoring wells constructed in 1976. Additional test data and results are presented in Appendix A. From analysis of these samples, HLA concluded that there did not appear to be significant amounts of hazardous materials in the ground water, and that the landfill should be closed as a Class II site.

3.0 SOLID WASTE ASSESSMENT MONITORING PROPOSAL: SAMPLING PLAN

3.1 Objectives and Procedures

3.1.1 Objectives

The sampling and monitoring plan described in this proposal is designed to meet the objectives of both the SWAT report which must be prepared and the RI/FS program which is under preparation for NAS Alameda, as described in Section 1.0.

The specific objectives of the plan are the following:

1. Determine whether there is a radiation exposure hazard to base personnel from buried radioactive material in the landfill areas.

2. Determine whether there is an exposure hazard to station personnel from improperly covered contaminants, especially in the fleet recreation area within Site 1, the 1943-1956 Disposal Area.

3. Determine the hydrogeologic and physical characteristics of the soils at the two sites so that monitoring facilities and remedial alternatives can be developed.

4. Determine the nature and concentrations of contaminants in the ground water which is leaving the two landfill areas, and estimate the rate of flow of ground water from the sites into San Francisco Bay.

5. Determine the tidal influence on ground water flow and direction.

3.1.2 Procedures

As discussed in Section 1.0, all of the procedures outlined in the Health and Safety Plan (Canonie, 1988b) and the QAPP (Canonie, 1988c) volumes of the RI/FS Work Plan for NAS Alameda will be followed during the work described in this SWAT proposal. These volumes include detailed descriptions of drilling, monitoring well construction, sampling, sample custody, and laboratory procedures.

Some of the important procedures which will be followed at the landfill sites are summarized in the following sections.

3.1.2.1 Decontamination Station

A decontamination area will be established on the western side of the base during the work at the landfill sites. This will include a facility of the type shown on Figure 3-9 for collecting wash water used for decontamination.

The decontamination of equipment is necessary to safeguard worker health, minimize the possibility of spreading of contamination, and protect the accuracy of analytical results of samples collected with the equipment. All personnel and hand-held monitoring and sampling equipment will be decontaminated at each site. (Refer to the Health and Safety Plan for decontamination procedures.)

The wash waters used for decontamination will be collected and stored in Department of Transportation (DOT) approved 55-gallon drums for later disposal. These drums will be stored either in the controlled equipment storage area or at a hazardous waste storage generator accumulation point designated by the Navy Project Coordinator. The choice of the appropriate storage area is subject to approval by the Navy Project Coordinator. Samples of wash water will be analyzed to determine whether the liquids can be disposed of on-site or whether they will require off-site disposal.

3.1.2.2 Drilling Procedures

All on-site drilling will be conducted using a mobile drilling truck capable of augering, mud rotary drilling, air rotary drilling, angle boring, and advancing and retrieving split spoons and core barrels. A continuous flight, hollow-stem auger will be used to advance all borings on-site. If this method does not prove feasible, then either the mud rotary or air rotary method shall be used.

The drilling truck, augers, drilling rods, bits, pumps, tubs, circulation hoses, and any other equipment which will be used during subsurface investigations will be steam cleaned prior to its use at the site. All equipment used during the drilling of a borehole will be steam cleaned prior to its reuse at any other boring location.

3.1.2.3 Sampling Procedures

Soil samples from unpaved sites which require only shallow sampling (less than 3-foot depth) will be collected using a hand-held auger and an 18-inch or 12-inch split spoon sampler. Samples will be collected using the procedures described in Section 5.3.2 of the Quality Assurance Project Plan (QAPP).

Soil samples from exploratory borings and monitoring well locations will be continuously obtained using a combination of a split spoon sampler (2-inch inside diameter, 24-inches long) and an NX-sized or 94-millimeter diameter core sampler. If the geologic conditions appear to be similar throughout the site, soil samples will be continuously collected to a depth of at least 50 feet, but below 50 feet may be collected at five-foot intervals and/or at each distinct change in lithology. Split spoon samples will be obtained by advancing the sampler ahead of the hollow-stem augers and driving the sampler into undisturbed soil below the mouth of the augers. The sampler is driven into the ground with a 140 pound hammer which is repeatedly raised 30 inches and dropped onto the top of the sampler. The sampler is advanced to a predetermined depth, and then withdrawn and opened to retrieve the soil sample. The depth intervals where split spoon samples are collected will be determined on a site-by-site basis. Soil samples can be obtained from the desired depth interval using this method.

The core sampler can be used with either hollow stem auger or rotary drilling methods. Where the hollow stem auger is used, this sampler rests inside the hollow section of the auger and is advanced simultaneously into undisturbed soils with the penetration of the auger during drilling. This device will be used for lithologic purposes and between areas where split spoon samples are obtained.

After the split spoon or core sampler is retrieved and opened, the sample recovery will be measured and recorded. The physical characteristics of the soils will be described on the field boring log using the Unified Soils Classification System.

The soil samples will be retained in labeled core boxes except for those samples which are sent to the laboratory for analysis. The samples will be retained in the core boxes until the RWQCB accepts and approves the SWAT Report. Soil samples from borings which are determined by the analytical laboratory to be contaminated will be disposed of in 90 days.

At the depth intervals where soil samples for chemical analysis are required, the split spoon will be loaded with brass tubes. During drilling activities, the Organic Vapor Analyzer (OVA) and observations of the other soil characteristics such as discoloration will be used to determine which samples will be sent to the laboratory.

Upon sample recovery, the brass tubes containing the soil sample will be removed from the split spoon, the ends sealed with aluminum foil and plastic end caps, and then securely taped closed. Once collected, the samples will be marked with a unique sample number, logged onto a chain-of-custody form, placed on ice in a cooler, and sent to a State of California approved laboratory for analysis. Chain-of-custody procedures are identified in Section 6.1.2 of the QAPP.

After the collection of each sample, the samplers will be decontaminated prior to reuse. The primary decontamination process will be steam cleaning. An alternative decontamination process consists of placing the samplers into a washtub containing Alconox detergent and tap water, and cleaning the them with a brush. Next, the samplers will be rinsed with tap water to remove all soap, and rinsed with hexane to remove any residual contaminants. The waste hexane will be collected and containerized for proper disposal. The samplers will be thoroughly rinsed with deionized water and allowed to air dry.

Thin-walled tube samplers, if feasible, will be used to collect undisturbed soil samples for engineering parameter analysis. An undisturbed soil sample will be collected by hydraulically advancing a 24-inch long, 3-inch outside diameter, thin-walled sampler ahead of the augers. After the sample has been retrieved, the ends of the sampler will be sealed with aluminum foil and taped to retain the soil sample and to preserve the water content in the soil. The outside of the tube will be indelibly marked with the site name, boring number, and depth at which collected. The samples will be recorded using chain-of-custody procedures and sent to the appropriate soils laboratory for analyses.

Surface water samples will be collected using either Method III-1: Sampling Surface Waters Using a Dipper or Other Transfer Device or Method III-2: Use of Pond Sampler For the Collection of Surface Water Samples. Method III-1 employs the use of a stainless steel or Teflon container which can be used to transfer liquid samples from their source to a sample bottle. Using this method prevents unnecessary contamination of the outer surface of the sample bottle that occurs when the bottle is placed directly into the liquid medium. This method also allows a sample to be taken by a technician without the technician physically contacting the sampling medium.

Method III-2 is a modification of Method III-1. This method utilizes the same type of container as Method III-1 and adds an extension handle which allows retrieval of samples from areas beyond the normal reach of a technician. This method can be useful when water samples are collected from piers or the deck of a floating sampling platform.

Ground water samples will be collected from wells using method III-9: Sampling Monitoring Wells With a Bucket-Type Bailer, after they have been purged using the methods described in Section 5.3.3.2 of the QAPP. Method III-9 employs a bucket-type bailer equipped with a check valve on the bottom to collect liquid samples. A stainless steel or Teflon bailer will be used to collect samples.

All sampling equipment will be decontaminated before use and prior to reuse. The decontamination procedure to be used employs the steps described in the decontamination of split spoons.

3.1.2.4 Monitoring Well Construction

The construction of monitoring wells is described in detail in Section 4.0 of the QAPP. Figures 3-4 through 3-7 shows the generalized well construction features.

All monitoring wells will be surveyed and tied into existing benchmarks to provide proper elevation control. This will allow an evaluation of ground water flow patterns and tidal influences.

3.2 Site 1: 1943-1956 Disposal Area Monitoring Proposal

3.2.1 Site Reconnaissance

A site reconnaissance will be performed at the 1943-1956 Disposal Area to familiarize field personnel with the work area, identify all potential work hazards and obstructions, locate and designate specific sampling locations, and define site-specific health and safety procedures.

A radiation survey will be conducted at the 1943-1956 Disposal Area to determine whether any exposure hazard to personnel working at the landfill exists. A sampling grid with a 200-foot spacing will be established (Figure 3-1) and a Geiger-Muller detector will be used to record measurements taken at each of the nodes. The field crew will carry a Geiger-Muller detector and flame ionization detector (FID) device during the establishment of the grid, and measurements will be taken and recorded as the grid is established. Any reading above acceptable levels with either device will cause immediate cessation of activity in that area. (Refer to the RI/FS Health and Safety Plan for acceptable working levels.) If no dangerous anomalies are detected, then the area will be cleared for work.

Soil boring and monitoring well locations will be identified and marked with numbered wooden stakes. Personnel and equipment decontamination areas will be selected during this phase. The equipment decontamination pit (Figure 3-9), or an equivalent design, will be constructed before drilling activities begin.

3.2.2 Soil Sampling

3.2.2.1 Sampling of Surface Soils

As stated in Section 1.6.1, the western edge of the 1943-1956 Disposal Area was developed in the mid-1950s as the West Beach Fleet Recreation Area. Activities that occur in the area include baseball, picnicking, and jogging. If surface contaminants are present, significant direct contact exposure to surface soils could occur while engaging in these activities. The disposal area was reportedly covered with soil after landfilling operations had ceased; however, the depth of cover and the source of the soil are not documented. From the past disposal practices and the nature of wastes deposited at the site, the potential for residual contamination exists. Sampling and analysis of surface soils are necessary to determine whether contaminants such as metals, PAHs, and PCBs, all of which adsorb strongly to soil particulates, are present in the surface soils.

The radiation survey grid established during the site reconnaissance phase (Figure 3-1) will be utilized to conduct a surface soil sampling program. A hand auger sampling device will be used to collect soil samples from zero to six inches in depth at the node points of the grid. These samples will be analyzed for the parameters listed in Table 3-1 to determine whether the surface soils in this area present a hazard to the people using this area for recreational purposes.

3.2.2.2 Soil Borings and Soil Sampling

Monitoring wells, which are discussed in Section 3.2.3, will be located in sets of two or three adjacent wells at a series of locations which form a ring around both the 1943-1956 Disposal Area and the West Beach Landfill immediately outside the perimeter of the landfills (Figure 3-3).

Prior to well installation, two exploratory borings will be drilled at the northern corners of the 1943-1956 Disposal Area to evaluate the Merritt Sand Formation and provide data for designing the deep monitoring wells. Additional exploratory borings will be considered, if additional geologic information is needed. The locations of the exploratory borings, including two additional locations, are shown on Figure 3-3.

At least one soil boring for the purpose of soil sampling will be completed at each of the locations of a set of monitoring wells before the monitoring wells are installed. Wherever practical, upon completion of drilling, the soil sample boring will be converted immediately into one of the monitoring wells planned for that location.

Actual monitoring well and boring locations will be determined in the field during the site reconnaissance phase. All preparation work (see Section 3.2.1) must be completed before field sampling can begin.

Soil sample borings and monitoring wells will be placed to facilitate the detection of contaminants leaching from the disposal area. At each location where a set of three monitoring wells is planned, the soil sample boring will be advanced to the bottom of the Merritt Sand Formation, which lies beneath the bay mud. At locations where a set of two monitoring wells is planned, the deeper well will be screened in the upper portion of the Merritt Sand Formation. The soil sample borings at these locations will penetrate the Merritt Sand Formation, but may not extend to the bottom of that formation. At two of the monitoring well locations proposed in the upgradient well area (Figure 3-3), only one well is planned, and this well will be screened in the uppermost water bearing zone. At these two locations the soil sample boring will be advanced only until the bay mud is encountered. Since detailed lithologic logs will be required, continuous soil samples for physical characterization will be collected during each soil sample boring. At the depth intervals where samples for chemical analysis are required, brass tubes will be loaded into the sampler.

Particle size analyses, including the sieve analysis and hydrometer methods using the ASTM Method 422-63 protocol, will be performed on each distinct lithologic unit at each boring location for soil classification and well design purposes. The design of well filter packs and screen slot widths will consider the results of the particle size analyses of soil samples from previous soil borings.

Split spoon samplers loaded with brass tubes will be used to collect soil samples for contaminant analyses. Sample preparation is described in Section 3.1.2.3. Thin-walled tube samplers, if feasible, will be used to collect undisturbed soil samples for physical property analyses. The types of chemical analyses to be performed on soil samples are presented in Table 3-1. The samples will be analyzed according to the methods listed in Table 3-3.

All drilling activities at the 1943-1956 Disposal Area will be monitored with an OVA meter, a combination oxygen and lower explosive limit detector, and a Geiger-Muller detector. (Refer to the Health and Safety Plan for more detailed information.)

3.2.3 Monitoring Well Installation

Monitoring wells will be installed at locations approximately 500 feet apart forming a ring around both the 1943-1956 Disposal Area and the West Beach Landfill (Figure 3-3). This ring will be located just outside the estimated perimeter of the landfill areas. At each of these locations, at least two monitoring wells will be installed: one extending down to the bay mud and screened within the uppermost water bearing zone (Figure 3-4) and one extending through the bay mud into the second water bearing zone (the Merritt Sand Formation) and screened only within the upper portion of that second zone (Figure 3-5). At a minimum of four of the well locations, a third monitoring well will be installed and screened within the lower portion of the Merritt Sand (Figure 3-6). A cross section showing these various well types is provided on Figure 3-8, and well locations are shown on Figure 3-3.

For the purposes of aquifer testing, at least four 4-inch diameter monitoring wells will also be installed along the landfill perimeters and upgradient of the landfills. These wells will be screened throughout the Merritt Sand (Figure 3-7). The locations of these wells are shown on Figure 3-3.

Before installing each deep monitoring well, the upper water-bearing zone in each well will be sealed off by the placement of a conductor casing. After the conductor casing is positioned into the borehole, the annulus between the casing and borehole will be sealed with a cement-bentonite grout using tremie methods. Illustrations of the casing are shown on Figures 3-5 through 3-7.

The wells will be installed to allow continuing monitoring of ground water levels and collection of ground water samples. Specific well construction materials and procedures are described in the QAPP. Generalized well construction diagrams are presented on Figures 3-4 through 3-7. The actual depth of screen placement will be determined in the field based on the hydrogeologic characteristics revealed by the soil sample borings at each location. (See Section 3.2.2.2.)

The rationale for monitoring well locations and depths is presented in Section 3.5.

3.2.4 Ground Water Sampling

Ground water samples will be collected from each of the wells installed at the locations shown on Figure 3-3. Samples from the wells around the 1943-1956 Disposal Area will be analyzed for the parameters listed in Table 3-1 according to the methods listed in Table 3-3. The analytical results of these samples will be evaluated to determine whether any contamination is present in the ground water in that area.

Ground water samples will be collected from monitoring wells after the well has been installed, developed, and allowed a sufficient recovery time. Water level measurements will be taken and recorded at each well prior to purging and sampling. A sufficient number of water samples will be collected to allow for the analysis of the ground water parameters listed on Table 3-1. Refer to the QAPP for information regarding well purging and sample collection procedures. The types of samples to be collected and the preservation method for these samples are also listed in the QAPP.

A series of pressure transducers placed in certain monitoring wells will be employed to measure the tidal influences in the landfill. These transducers will be connected to a data logger to record systematic water level measurements. Measurements will be recorded for two 48-hour periods, once during a period of the monthly high tides and a second time during a period of the monthly low tides.

3.3 Site 2: West Beach Landfill Monitoring Proposal

3.3.1 Site Reconnaissance

A site reconnaissance will be performed at the West Beach Landfill to familiarize field personnel with the work area, identify all potential work hazards and obstructions, locate and designate specific sampling locations, and define site-specific health and safety procedures.

A radiation survey will be conducted at the West Beach Landfill to determine whether any exposure hazard to personnel working at the landfill exists. A sampling grid with a 200-foot spacing (Figure 3-2) will be established and a Geiger-Muller detector will be used to record measurements taken at each of the nodes. The field crew will carry a Geiger-Muller detector and FID device during the establishment of the grid, and measurements will be taken and recorded as the grid is established. Any reading above the acceptable levels identified in the Health and Safety Plan with either device will cause immediate cessation of activity in that area. Refer to the Health and Safety Plan for the specific action levels. If no dangerous anomalies are detected, then the area will be cleared for work.

Soil boring and monitoring well installation locations will be identified and marked with numbered wooden stakes. Personnel and equipment decontamination areas will be selected during this phase. The equipment decontamination pit (Figure 3-9) will be constructed before drilling activities begin.

3.3.2 Soil Borings and Soil Sampling

Monitoring wells at the West Beach Landfill will be installed in sets of two adjacent wells at a series of locations which form a ring around both landfills. This is described in Sections 3.2.3 and 3.3.3 and locations are shown on Figure 3-3.

Prior to well installation, two exploratory borings will be drilled at the southern corners of the West Beach landfill to evaluate the Merritt Sand Formation and provide data for designing the deep monitoring wells. Additional exploratory borings will be considered, if additional geologic information is needed. The locations of the exploratory borings, including two additional locations, are shown on Figure 3-3.

At least one soil boring for the purpose of soil sampling will be completed at each of the locations of a set of monitoring wells before the monitoring wells are installed. Wherever practical, upon completion of drilling, the soil sample boring will be converted immediately into one of the monitoring wells planned for that location.

Actual monitoring well and boring locations will be determined in the field during the site reconnaissance phase. All preparation work (see Section 3.3.1) must be completed before field sampling can begin.

Soil sample borings and monitoring well pairs will be placed immediately outside the landfill berm to facilitate the detection of contaminants leaching from the landfill. Sampling will follow the procedures described in Section 3.2.2.2.

The types of chemical analyses to be performed on soil samples is presented in Table 3-2. The samples will be analyzed according to the methods listed in Table 3-3.

All boring activities at the West Beach Landfill will be monitored with an OVA meter, a combination oxygen and lower explosive limit detector, and a Geiger-Muller detector. Refer to the Health and Safety Plan for more detailed information.

3.3.3 Monitoring Well Installation

Installation of monitoring wells at the West Beach landfill will follow the same procedures described for the 1943-1956 Disposal Area in Section 3.2.3.

Monitoring wells will be installed at locations which form a ring around both landfills (Figure 3-3). This ring will be located just outside the perimeter of the landfill. On the west and south perimeters the monitoring wells will be located between the dike and the rock seawall.

At each of these locations, the monitoring wells will be installed as described in Section 3.2.3 and shown on Figures 3-3 through 3-8. The actual depth of screen placement will be determined in the field from the hydrogeologic characteristics revealed by the soil sample borings at each location.

The rationale for monitoring well locations and depths is presented in Section 3.5.

3.3.4 Ground Water Sampling

Ground water samples will be collected from each of the wells installed at the locations shown on Figure 3-3. Samples from wells around the West Beach landfill will be analyzed for the parameters listed in Table 3-2 according to the methods listed in Table 3-3. The analytical results of these samples will be evaluated to determine if any contamination is present in the ground water in that area.

Ground water samples will be collected from monitoring wells after each well has been installed, developed, and allowed a sufficient recovery time. Water level measurements will be taken and recorded at each well prior to purging and sampling. A sufficient number of water samples will be collected to allow for the analysis of the ground water parameters listed on Table 3-2. Refer to the QAPP for information regarding well purging and sample collection procedures. The types of samples to be collected and the preservation method for these samples are also listed in the QAPP.

A series of pressure transducers placed in certain monitoring wells will be employed to measure the tidal influences in the landfill. These transducers will be connected to a data logger to record systematic water level measurements. Measurements will be recorded for two 48-hour periods, once during a period of the monthly high tides and a second time during a period of the monthly low tides.

3.3.5 Surface Water Sampling

Water samples will be collected for chemical analysis from all wetlands ponds in the West Beach Landfill area.

No surface water samples for chemical analysis will be collected from San Francisco Bay or the Oakland Inner Harbor estuary. The flat hydraulic gradient at the landfill sites indicates that ground water seepage is probably at a slow rate of flow. Further, observations of tidal action in monitoring wells over 100 feet inside the seawalls indicate that the mixing of ground water and tidal flows is taking place well inside the seawall. Finally, conditions next to the seawalls, including strong wave action and tidal currents, will produce rapid mixing at the seawall face.

Previous sampling of surface water next to the rock seawalls has indicated that no significant difference was evident between water samples taken next to the seawalls and samples of San Francisco Bay water collected farther offshore in the vicinity (HLA, 1978).

3.4 Upgradient Monitoring Wells

The one-mile radius from the two landfill sites is shown on Figure 1-3. Monitoring wells are proposed at five locations upgradient from the sites within this radius, at the locations shown on Figure 3-3. At three of these locations, a set of two monitoring wells will be installed as described in Section 3.2.3 and shown on Figure 3-8. One soil sample boring will be completed to the bottom of the Merritt Sand Formation at each of these locations prior to monitoring well construction. At the remaining two locations only one monitoring well will be constructed at each location, and these will be screened within the uppermost water bearing zone only. The soil sample borings at these locations will be advanced only until the bay mud is encountered.

Soil and water sampling at these locations will be conducted as described in Sections 3.2.2 and 3.2.4, and as summarized in Tables 3-1 and 3-3.

No pressure transducers for measuring tidal influences are proposed for these locations.

In addition to providing wells for determining background water quality, these locations will also aid in determining the ground water flow directions in the vicinity of the landfills.

3.5 Monitoring Program Rationale

3.5.1 Monitoring Well Locations

There is no dispute that hazardous materials have been deposited in the 1943-1956 Disposal Area (Site 1) and the West Beach Landfill (Site 2). While additional information about the nature and quantities of these wastes would be of value, this proposal does not include drilling within the landfill areas. The hazardous wastes deposited in these landfills include explosives and present a great danger to worker health and safety.

These considerations override the need for additional data within and immediately under the landfills. Summaries of previous sampling within the landfills have been provided in Sections 2.2.1 and 2.2.2, on Figures 2-1 and 2-2, and in Appendix A.

The monitoring program presented in this SWAT proposal has concentrated, therefore, on determining the types and amounts of any contaminants leaching from the landfill. The sites will be ringed with monitoring wells located just outside the landfill areas to detect emanating plumes. Tidal influence will also be evaluated.

At most of the monitoring well locations a set of two adjacent wells will be installed. The first of these two wells will be screened within the uppermost water bearing zone, and the bottom of this well will be positioned at the top of the bay mud (Figure 3-4).

The second monitoring well will be screened within the upper portion of Merritt Sand Formation or second water-bearing zone underlying the bay mud (Figure 3-5). The bay mud should act as an aquitard between the uppermost water bearing zone and the second water bearing zone. This second deeper well will provide a means of sampling the second water bearing zone separately, because of the sealing of the upper water bearing zone.

As described in Section 3.2.3, a third monitoring well will be installed at a minimum of four of the monitoring well pair locations. This third well will be screened within the lower portion of the second water bearing zone (Figure 3-6).

A minimum of four 4-inch diameter monitoring wells that will be specifically designed for aquifer testing will be installed at locations along and upgradient of the landfill boundaries. The wells will be screened throughout the second water bearing zone (Figure 3-7).

3.5.2 Hydrogeology at NAS Alameda

3.5.2.1 Regional Geology

The San Francisco Bay region is tectonically dominated by many thrusts, reverse faults, and folds of Pliocene-Quaternary age which exist within what is now a dominant strike-slip environment (Hart, Hirschfeld, and Schulz, 1982).

Subsidence of the structural trough containing San Francisco Bay occurred in the Pleistocene and Holocene epochs, and probably continues today. Uplift and erosion of the Coastal Range during the late Cenozoic time contributed to much of the nonmarine deposits underlying bay mud.

The Franciscan melange, the bedrock underlying the site area, consists of a matrix of sheared rock material containing blocks of various rock types: sandstone, greenstone, chert, and serpentinite. This melange is, in some areas, overlain by metamorphosed volcanic rocks and deposits of chert or sandstone (Rice, Smith, and Strand, 1976).

Covering the Franciscan Assemblage is a veneer of younger, relatively undeformed sedimentary soil formations. These younger sediments range in age from late Cretaceous to Quaternary. These sediments are partially derived from the Franciscan Assemblage and frequently include Franciscan metamorphosed chert as part of their clastic component. Other major components of these sediments originated inland and were carried into the Bay by the Sacramento and San Joaquin Rivers.

The sedimentary formations in the Bay region can be divided into five distinct units. The oldest and deepest of these are the Alameda, San Antonio, and Posey Formations which are dominated by stiff clays but which also contain layers of silts and sands. These three formations are collectively referred to as Old Bay Clays. Sea level fluctuations of as much as 300 feet, due to as many as three glacial cycles of advance and retreat during the deposition of these Old Bay Clays, resulted in dense consolidation.

Sea level lowering subsequent to the deposition of the Old Bay Clays resulted in erosion of these exposed deposits. The eroded valleys were then largely infilled by the Windblown Merritt Sand, which also blanketed many areas between the eroded valleys.

Subsequent to the deposition of the aeolian Merritt Sand Formation, the sea level gradually rose to its present elevation, flooding the Bay and resulting in the deposition of a marine deposit. This marine deposit, also known as Young Bay Mud, covers much of the bay basin to depths of as much as 120 feet, and its deposition continues today.

3.5.2.2 Site Geology

The site lies adjacent to the San Francisco Bay and is underlain by at least part of all five formations, as outlined in Section 3.5.2.1. However the major formations of interest are the artificial fill, the Bay Mud, and the Merritt Sand. A regional geologic map is shown on Figure 3-11. A geologic cross section is shown in Figure 3-12.

3.5.2.2.1 Artificial Fill

The site was claimed from Bay waters by placing fill consisting of refuse, bay mud, and sand. The composition varies from location to location. Because of the source of fill material, it is often difficult to distinguish the fill from the Bay Mud or the Merritt Sand. In most locations the fill is underlain by bay mud.

3.5.2.2.2 Bay Mud

The uppermost natural soil at the site is bay mud, which extends to depths of approximately 25 feet. The Bay Mud Formation is composed of dark gray to olive gray low to moderate organic clay that is frequently water saturated, highly plastic, highly sensitive due to the saline depositional environment, and often has a strong odor. The deposit is generally interlayered with silt and sand lenses.

3.5.2.2.3 Old Alluvial Deposits

Before deposition of the Bay Mud, the sea level was at a much lower elevation. During this period the region received a substantial amount of alluvial and even more aeolian deposition in nonuniform layers. As they exist under this site, these deposits consist of silty clay to clayey sand and are probably part of the Merritt Sand Formation.

3.5.2.2.4 Old Bay Clays

This unit was deposited during several interglacial periods. This unit as it exists under the site probably consists of three commonly known formations: the Posey; the San Antonio; and the Alameda. These deposits range from clayey sand to sandy clay. Because of large fluctuations in sea level, the clay was exposed, resulting in desiccation overconsolidation (Goldman, 1967).

The uppermost layer of Old Bay Clay is the Posey Formation. This layer is generally considered to have the highest degree of overconsolidation and consists of a sandy silty clay with moderately low permeability (Radbruch, 1957).

The San Antonio Formation, which is the middle layer of the Old Bay Clays, is a moderately stiff silty clay. This layer is generally considered to be a competent aquitard between the Merritt Sand Formation and the underlying Alameda Formation (HLA, 1988).

The Alameda Formation, which is the bottom layer of the Old Bay Clays, is generally considered an aquifer. It consists of green to gray sand, sandy clay, and clay with some fine gravel. The sand and sandy clay alternate in distinct continuous members. The lowest part of this formation is possibly continuous with the Santa Clara Formation in the South Bay (HLA, 1988).

3.5.2.2.5 Franciscan Bedrock

Bedrock under the site is comprised of an assemblage of altered volcanics, meta-sandstones and a melange of sandstone, shale, chert, and sepentinite of the Franciscan Assemblage as outlined in Section 3.5.2.1. These rocks have a low moisture content and have been highly sheared.

The Franciscan Assemblage outcrops at Yerba Buena Island and exists at a depth of approximately 500 feet below the site as indicated in the log of the Pan Am Well (Figure 3-10).

3.5.2.3 Hydrogeology

Three water bearing units are located beneath NAS Alameda: The shallow artificial fill, the Merritt Sand, and the Alameda Formation. The artificial fill and the Merritt Sand are separated by a layer of the Bay Mud approximately 25 feet thick, but perhaps as thick as 70 feet on the western edge of the site. The Merritt Sand and Alameda Formations are separated by the San Antonio and Posey Formations with a total thickness beneath the site of as much as approximately 250 feet.

Due to the large thickness of aquitard underlying the Merritt Sand, the Old Bay Clays will not be investigated at this time. All monitoring wells to be installed will investigate the water quality and aquifer properties in the Merritt Sand or the artificial fill.

Monitoring wells to be installed in the artificial fill are expected to be screened from 1 foot above the highest tide to an elevation between -5 feet and -10 feet relative to mean sea level. In addition, those wells to be installed in the Merritt Sand are expected to be screened between an elevation of -40 feet and -100 feet.

Based upon the information gathered from these monitoring wells to be installed, the final SWAT report will include aquifer properties, piezometric heads, water quality data, and a more accurately defined cross section of the various geologic contact layers.

4.0 SOLID WASTE ASSESSMENT MONITORING PROPOSAL: CHEMICAL ANALYSES

The monitoring plan proposed for the SWAT program is based upon information that has been obtained from previous site investigations. These investigations have included chemical analyses of soil and water samples from the sites, surveys of the limited written records available, and interviews with long-term site personnel.

These previous studies enable the SWAT program to be targeted to site-specific parameters. This information indicates that the parameters required in the draft SWAT Guidance document (SWRCB, 1986, pages 7 and 8) should be broadened to include additional analyses.

As discussed in Section 1.0, this SWAT proposal is also designed to serve as the sampling plan for the two landfill sites under the RI/FS program for NAS Alameda which is under preparation. Therefore, the program of sampling analysis which is proposed must also be planned to generate data useful during the formulation of remedial measures for confirmed sites. Accordingly, this proposal specifies the soil and ground water tests necessary to support formulation of remedies within the general response actions described in Volume 1 of the RI/FS Work Plan (Canonie, 1988a). The data generated are directly related to engineered solutions. Data needs have been identified consistent with the EPA guidance document, "Data Needs for Selecting Remedial Action Technologies" (EPA, 1987d).

The sample types and analyses proposed for the sites are listed in Tables 3-1 and 3-2. The methods of analysis are listed in Table 3-3. These methods meet the requirements of the draft SWAT Guidance document.

5.0 BACKGROUND WATER QUALITY

5.1 Well Location

Background water quality data based upon quarterly upgradient well sampling data is unavailable. Several wells exist (Figure 5-1) from which it may be possible to develop background data from a future monitoring program. It will be necessary to obtain ground water samples from the water-bearing zones overlying and underlying the bay mud layer.

Sampling of the deeper water bearing zone may be possible at the Pan American Well (Well BG-1, Figure 5-1). This is a 500-foot deep well located approximately 1,500 feet east of the 1943-1956 Disposal Area. This well is out of service, but it may be feasible to reactivate the well for sampling. Assuming that the deeper water bearing zone gradient is coincident with the general gradient of the uppermost water bearing zone (ie, ground water flow is in a westerly direction), this well is suitably located for background analysis of water migrating into the landfill sites.

Another well, shown on the Alameda County well inventory as Well 2S/4W,3E1, also known as the Army Well, is located approximately 8,000 feet east of the West Beach Landfill (Well BG-2, Figure 5-1). This well is 353 feet deep and its water is presently used for landscape irrigation.

The well shown on the Alameda County inventory as 2S/4W,3F1 is located east of the Army Well and approximately 9,500 feet east of the West Beach Landfill (Well BG-3, Figure 5-1). This well is 376 feet deep and is abandoned; therefore its use as a background sample source is uncertain.

Background water sampling of the uppermost water bearing zone may be performed from two existing monitoring wells located approximately 1,200 and 6,200 feet east of the West Beach Landfill (Wells BG-4 and BG-5, Figure 5-1). These two wells are 9 and 13 feet deep, respectively. It is uncertain whether the closer of these two wells is still in existence. The more distant of these two wells is located within 100 feet of the Oakland Inner Harbor waterfront, and the samples may not be representative of the quality of water entering the landfill.

In addition to these existing wells, new monitoring wells have been proposed in Section 3.4 at five locations within the one-mile radius. Descriptions of these wells are provided in Section 3.2.3. These new wells will also provide data on background water quality.

5.2 Sampling and Testing

Background water samples will be taken quarterly from each well where sampling is possible and judged suitable to represent background conditions. During each quarterly sampling event, at least one sample will be taken from each well and a minimum of four samples will be taken from the system. A separate analysis will be conducted on each sample.

Background samples will be tested for the same chemical constituents as the samples taken from well locations at the landfill perimeters (Tables 3-1 and 3-2).

6.0 UNSATURATED ZONE MONITORING

The draft SWAT Guidance document requires that the monitoring program be designed to detect waste constituents which may escape from waste sites before such constituents reach ground water, and therefore requires that the monitoring program include an unsaturated zone monitoring system (SWRCB, 1986, p. 9). Elsewhere, however, the guidance document notes that where justified by a qualified opinion and the concurrence of the local RWQCB, some of the monitoring requirements may be waived, and specific mention is made of the example of no vadose zone at the site (SWRCB, 1986, pages 6 and 7).

There is no unsaturated zone below the two landfills at NAS Alameda. The ground water surface is located only a few feet below the ground surface and is above the bottoms of the landfills. This estimate is based on water level data and estimates of the base of fill beneath the 1943-1956 Disposal Area (Wahler, 1985, Table 1) and the West Beach Landfill (HLA, 1978, Table 3). The elevation of the ground water surface is maintained by the immediate proximity of the open water surface of San Francisco Bay.

Based on these considerations, no unsaturated zone monitoring program is being proposed.

REFERENCES

REFERENCES

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TABLES

TABLE 3-1

SAMPLE TYPES AND ANALYSES/RATIONALE FOR 1943-1956 DISPOSAL AREA

Sample matrix	Analysis	Rationale
Soils		
Split Spoon Samples and Surface Samples	VOA	Solvents/cleaning compounds
	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Metals	Scrap metals
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
Thin-Walled Tube Samples	Gradation	Disposal Treatment Isolation
	Atterberg limits	Disposal Treatment Isolation
	Modified Proctor compaction	Evaluate disposal options
	Water content	Affects treatment method
	Specific gravity	Indicates density
	One-dimensional consolidation	Evaluate disposal options
	Permeability	Describe fate and transport
Ground Water	VOA	Solvents/cleaning compounds
	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Oil and Grease	Waste oils
	Metals	Scrap metals
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
	Chemical oxygen demand (COD)	Likely that significant chemical concentrations exist
	Chloride	Indicator parameter
	Nitrate	Indicator parameter
	Fluoride	Indicator parameter
	Cyanide	Indicator parameter
	Hardness	Affects treatment method
	Alkalinity	General treatment information
	Total dissolved soilds (TDS)	General treatment information
	Total organic carbon (TOC)	Evaluate treatment options
	Acidity	General treatment information
	Specific conductance	Describe fate and transport
	Temperature	Indicator parameter
	pH	Indicator parameter

TABLE 3-2

SAMPLE TYPES AND ANALYSES/RATIONALE FOR WEST BEACH LANDFILL

Sample matrix	Analyses	Rationale
Soils		
Split Spoon Samples	VOA	Paint strippers
	BNA extractables	Paint strippers
	Pesticides/PCBs	Pesticides/PCB waste oil
	Metals	Industrial waste
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
Thin-Walled Tube Samples	Gradation	Disposal treatment isolation
	Atterberg Limits	Disposal treatment isolation
	Modified Proctor compaction	Evaluate disposal options
	Water content	Affects treatment method
	Specific gravity	Indicates density
	One-dimensional consolidation	Evaluate disposal options
	Permeability	Describe fate and transport
Ground Water	VOA	Paint strippers
	BNA extractables	Paint strippers
	Pesticides/PCBs	Pesticides/PCB waste oil
	Oil and Grease	Waste oils
	Metals	Industrial Waste
	Chemical oxygen demand (COD)	Indicator parameter
	Chloride	Indicator parameter
	Nitrate	Indicator parameter
	Hardness	Affects treatment method
	Alkalinity	General treatment information
	Total dissolved solids (TDS)	General treatment information
	Total organic carbon (TOC)	Evaluate treatment options
	Acidity	General treatment information
	Specific conductance	Describe fate and transport
	Temperature	Indicator parameter
	pH	Indicator parameter

TABLE 3-3

ANALYTICAL METHODS

Chemical Class	Matrix	Method	Reference
Volatile Organics	Water	624	(1)
	Soil	8240	(2)
Base/Neutrals and Acid Extractables	Water	625	(1)
	Soil	8270	(2)
Pesticides/PCBs	Water	608	(1)
	Soil	8080	(2)
Oil and Grease	Water	413.1	(4)
Metals (except Mercury and Selenium)	Water	200.7	(4)
	Soil	6010	(2)
Mercury	Water	245.1	(4)
	Soil	7471	(2)
Selenium	Water	270.2	(4)
	Soil	7740	(2)
Gross Alpha & Beta Radioactivity	Water	900.0	(5)
	Soil	9310	(2)
Uranium 226 and 228	Water	706/7	(5)
	Soil	706/7	(5)
Cyanide	Water	335.3	(4)
COD	Water	410.1	(4)
Chloride	Water	300	(6)

TABLE 3-3

ANALYTICAL METHODS
(Continued)

Chemical Class	Matrix	Method	Reference
Fluoride	Water	340.2	(4)
Nitrate	Water	300	(6)

---

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FIGURES

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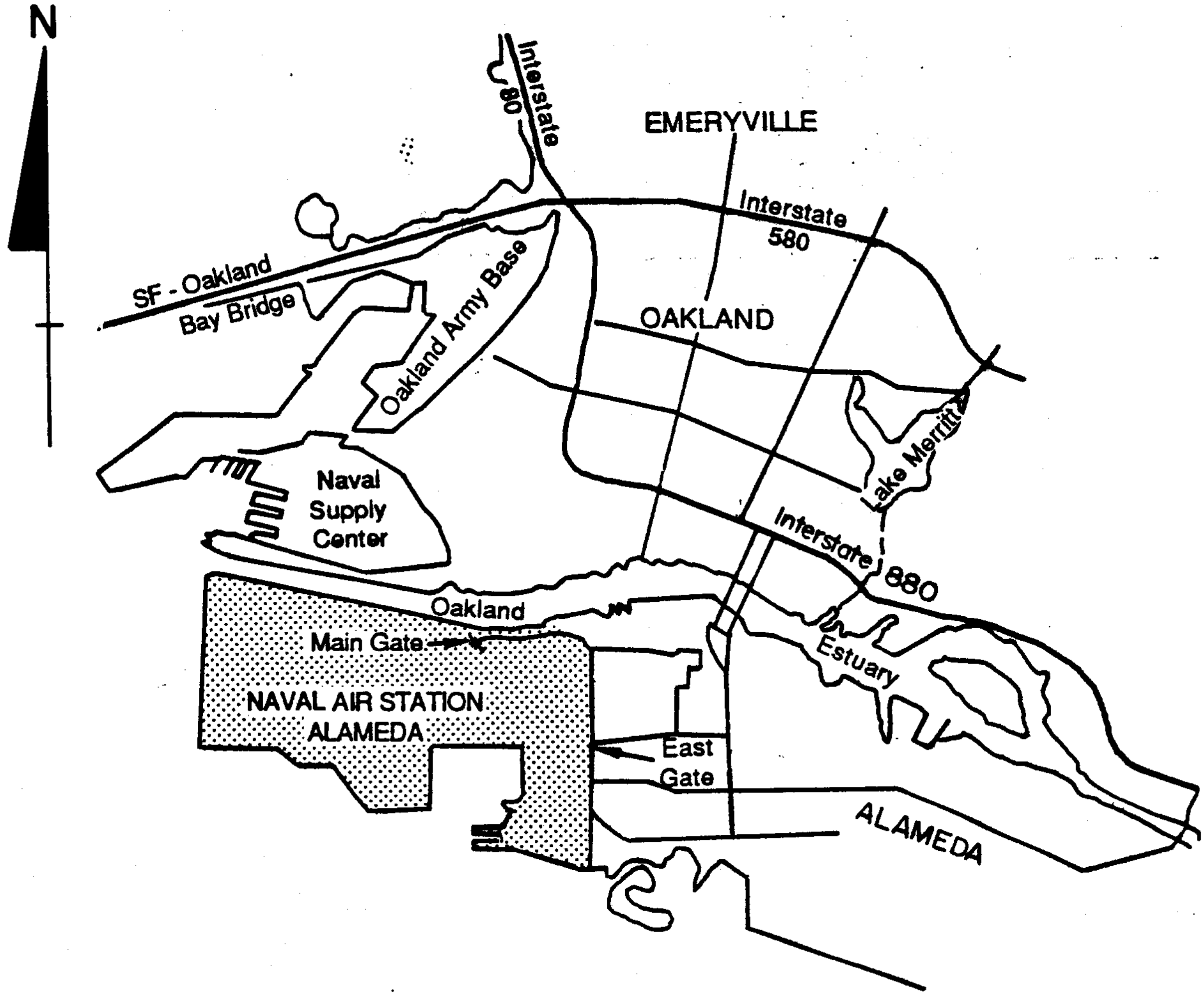
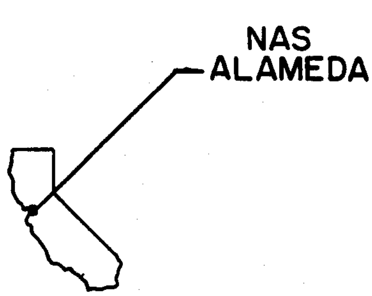


SITE LOCATION



SCALE

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SITE LOCATION PLAN
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

Canonie Environmental

DATE: 5-4-88	FIGURE I-1	DRAWING NUMBER
SCALE: AS SHOWN		86-018-A1

DRAWING NUMBER	86-018-A1
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CHECKED BY	CCW
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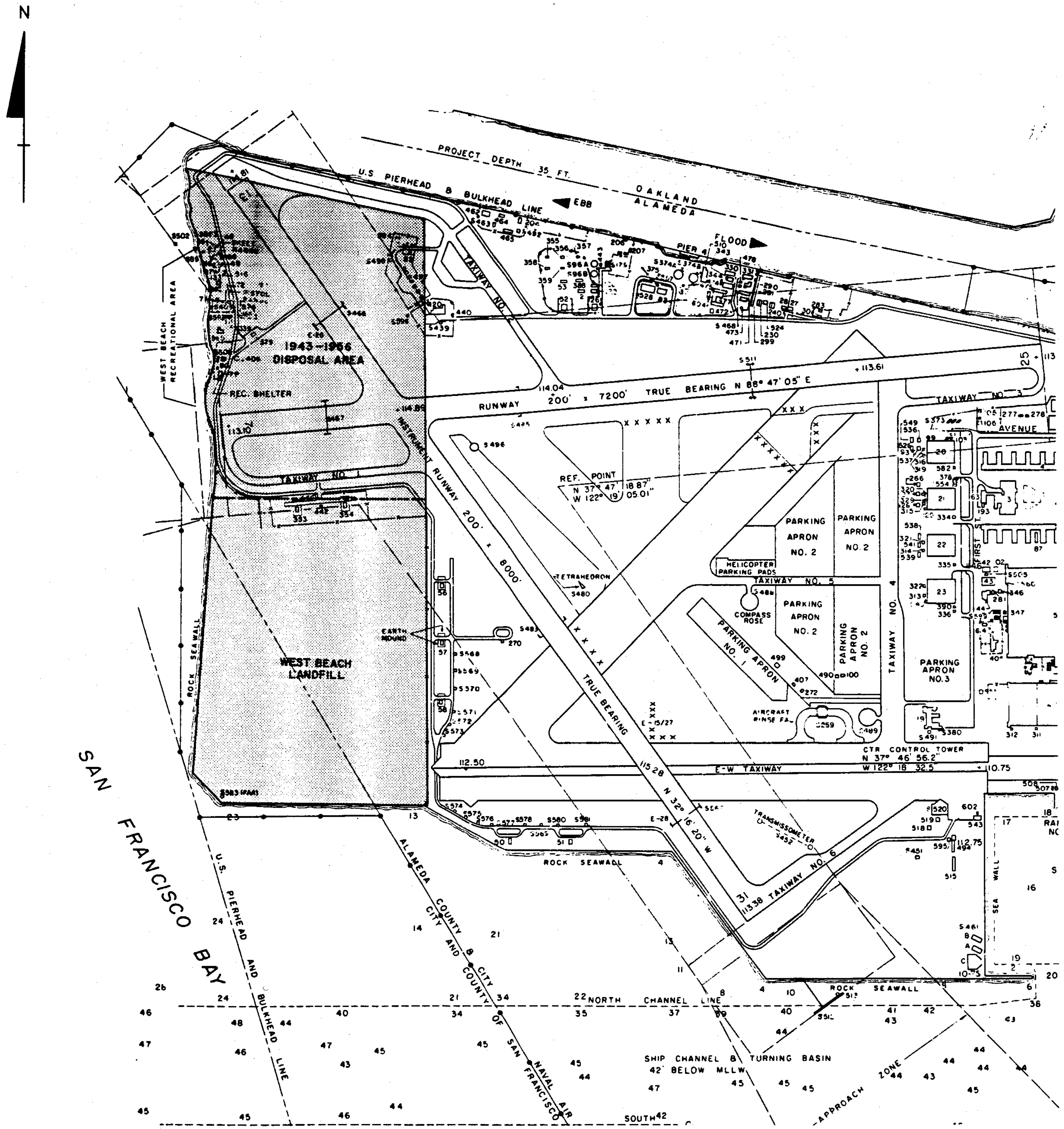
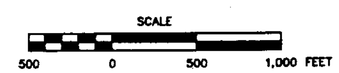
LEH	5-4-88
DRAWN BY	
REVISIONS	NO. DATE





REFERENCE:
U.S. NAVY MAP

SITE PLAN
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

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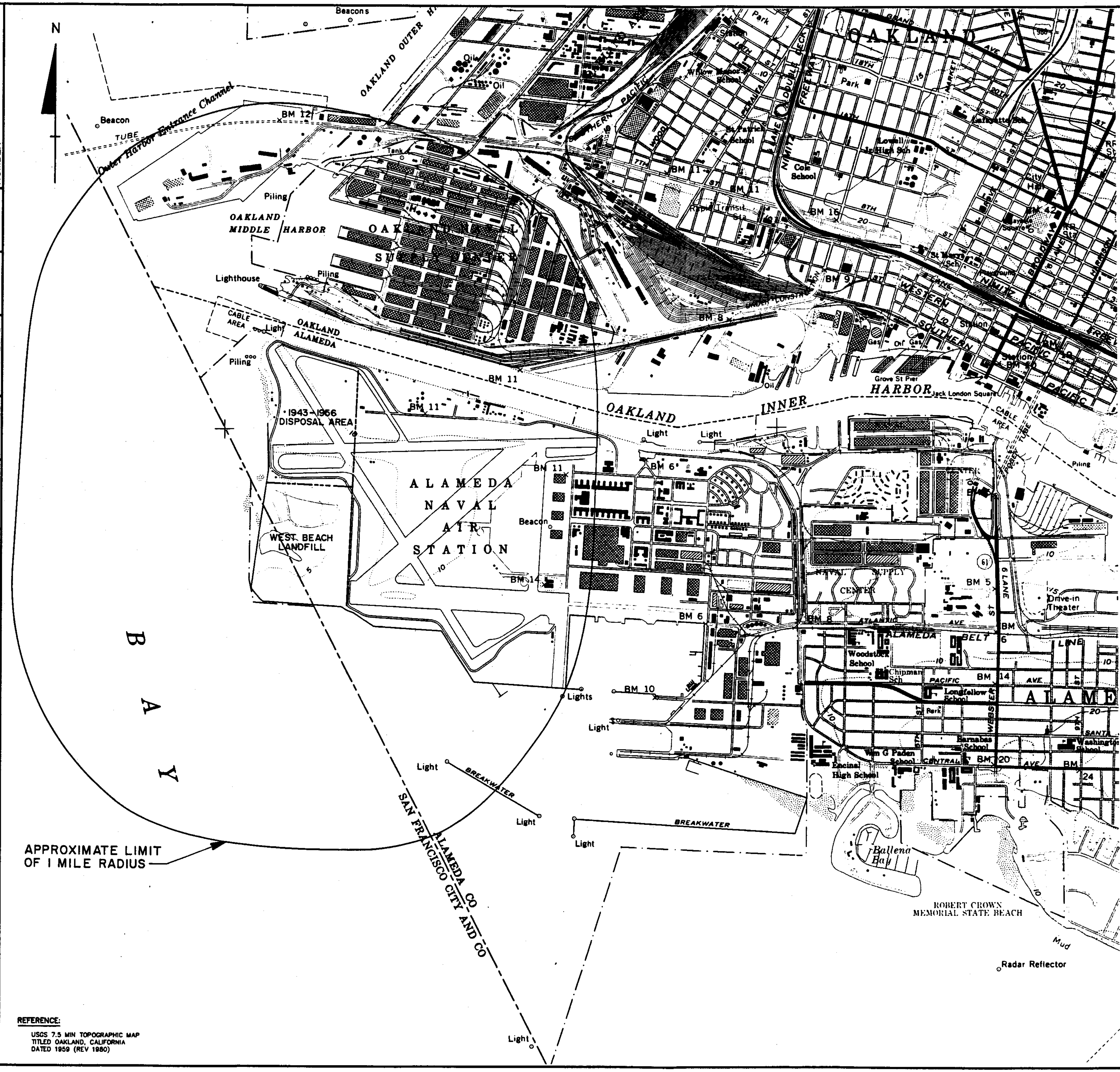
DATE: 9-14-88	FIGURE 1-2	DRAWING NUMBER 86-018-E19
SCALE: AS SHOWN		

DRAWN BY	LEA 9-14-88
CHECKED BY	
APPROVED BY	
DRAWING NUMBER	86-018-E19

REVISIONS | NO. | DATE

DRAWN BY	LEA 9-20-88	CHECKED BY CCW APPROVED BY 10-25-88	DRAWING NUMBER. 86-018-E26

REVISIONS | NO. | DATE



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USGS 7.5 MIN TOPOGRAPHIC MAP
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DATED 1959 (REV 1980)

SCALE
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TOPOGRAPHIC MAP WITH 1 MILE RADIUS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

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DATE: 9-20-88	FIGURE 1-3	DRAWING NUMBER 86-018-E26
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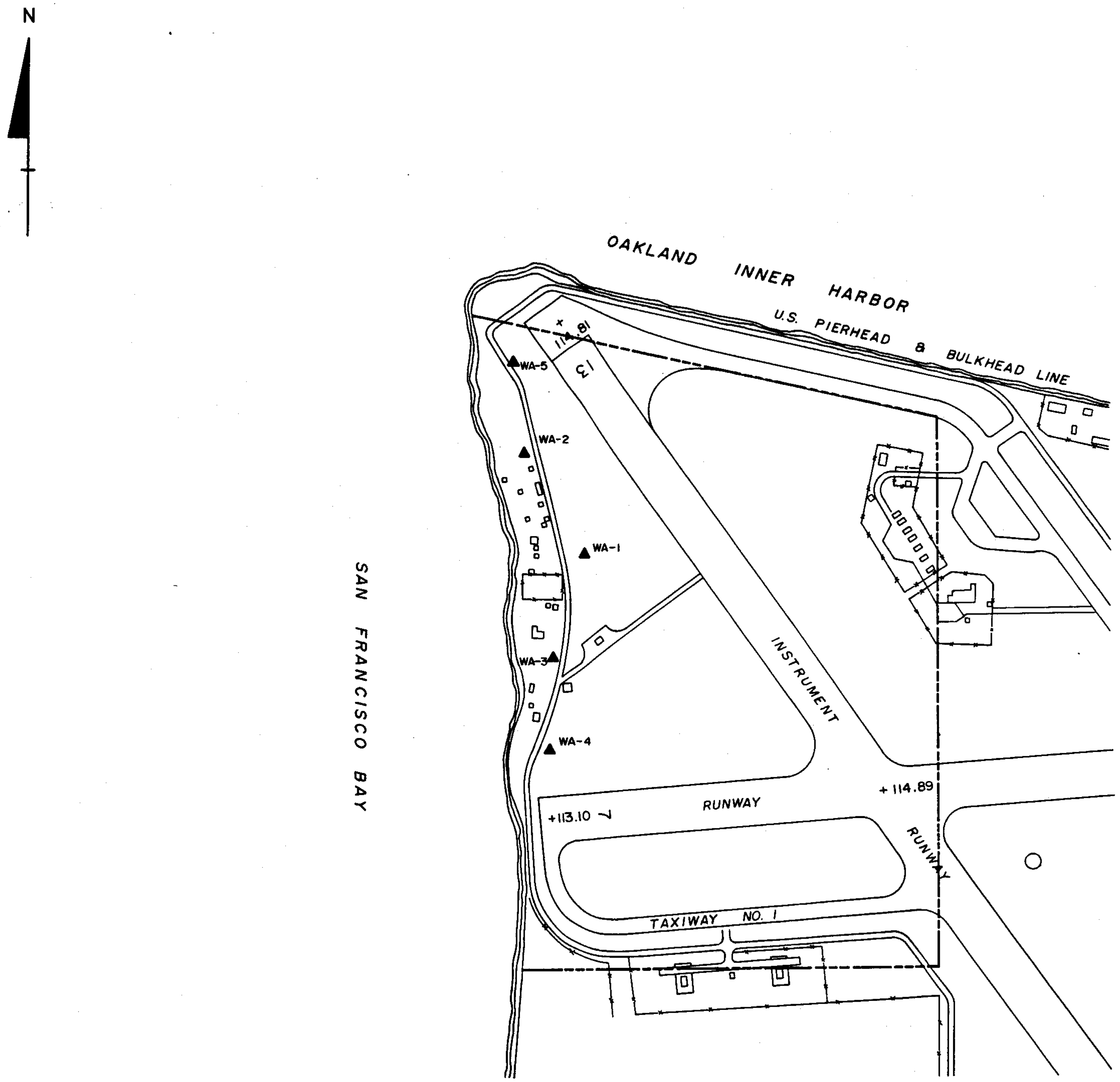

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▲ EXISTING WELL LOCATIONS (WAHLER, 1985)

------ LIMIT OF DISPOSAL AREA

SCALE

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EXISTING WELL LOCATIONS
1943-1956 DISPOSAL AREA
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

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DATE: 9-19-88	FIGURE 2-1	DRAWING NUMBER 86-018-E23
SCALE: AS SHOWN		

REVISIONS	NO.	DATE

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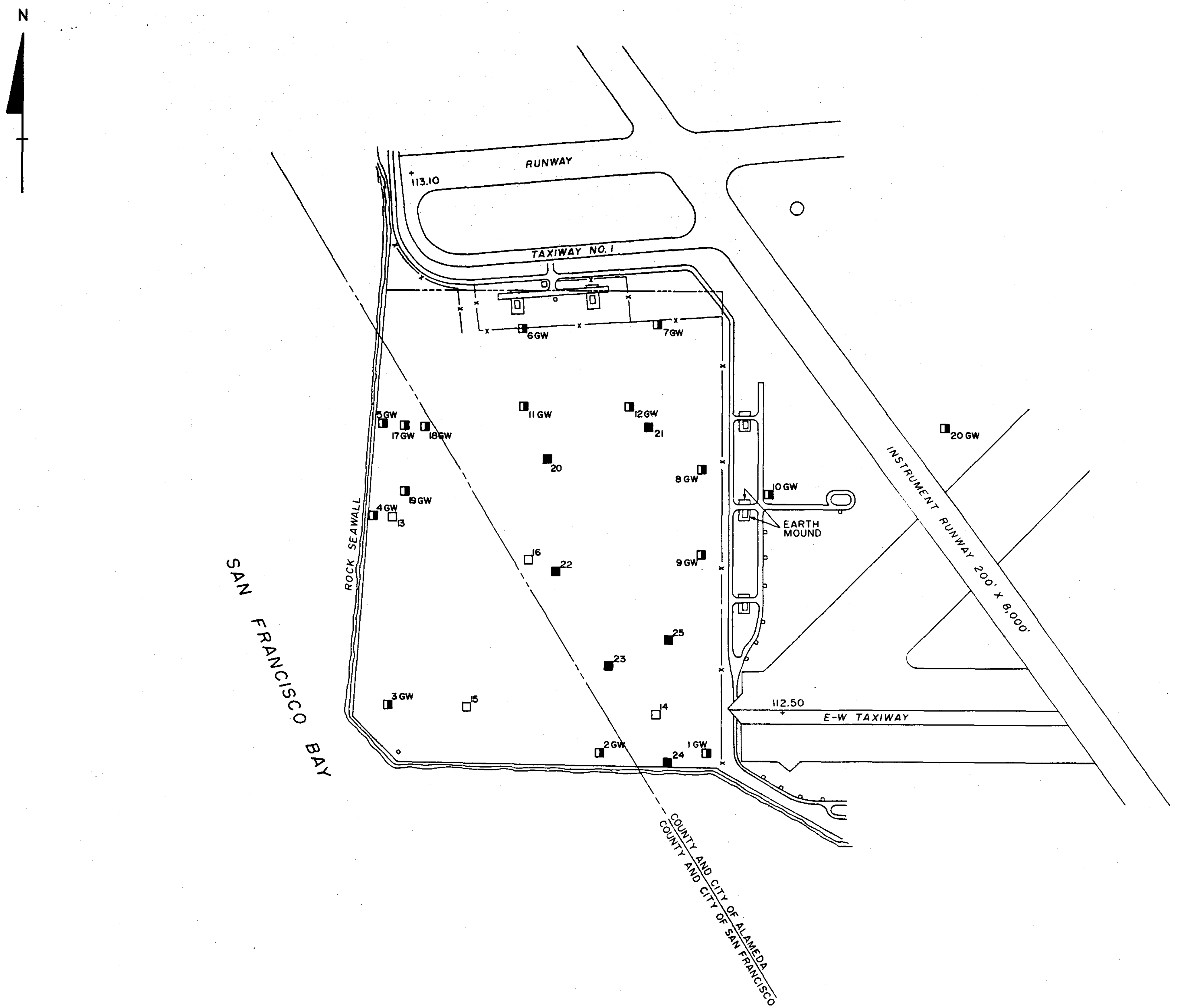

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- □ EXISTING TEST BORING DRILLED WITH HAND AUGER (HLA, 1978)
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- ■ EXISTING MONITORING WELL LOCATION (HLA, 1983)

SCALE
300 0 300 600 FEET

EXISTING BORING LOCATIONS
WEST BEACH LANDFILL
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

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DATE: 9-16-88	FIGURE 2-2	DRAWING NUMBER 86-018-E21
SCALE: AS SHOWN		

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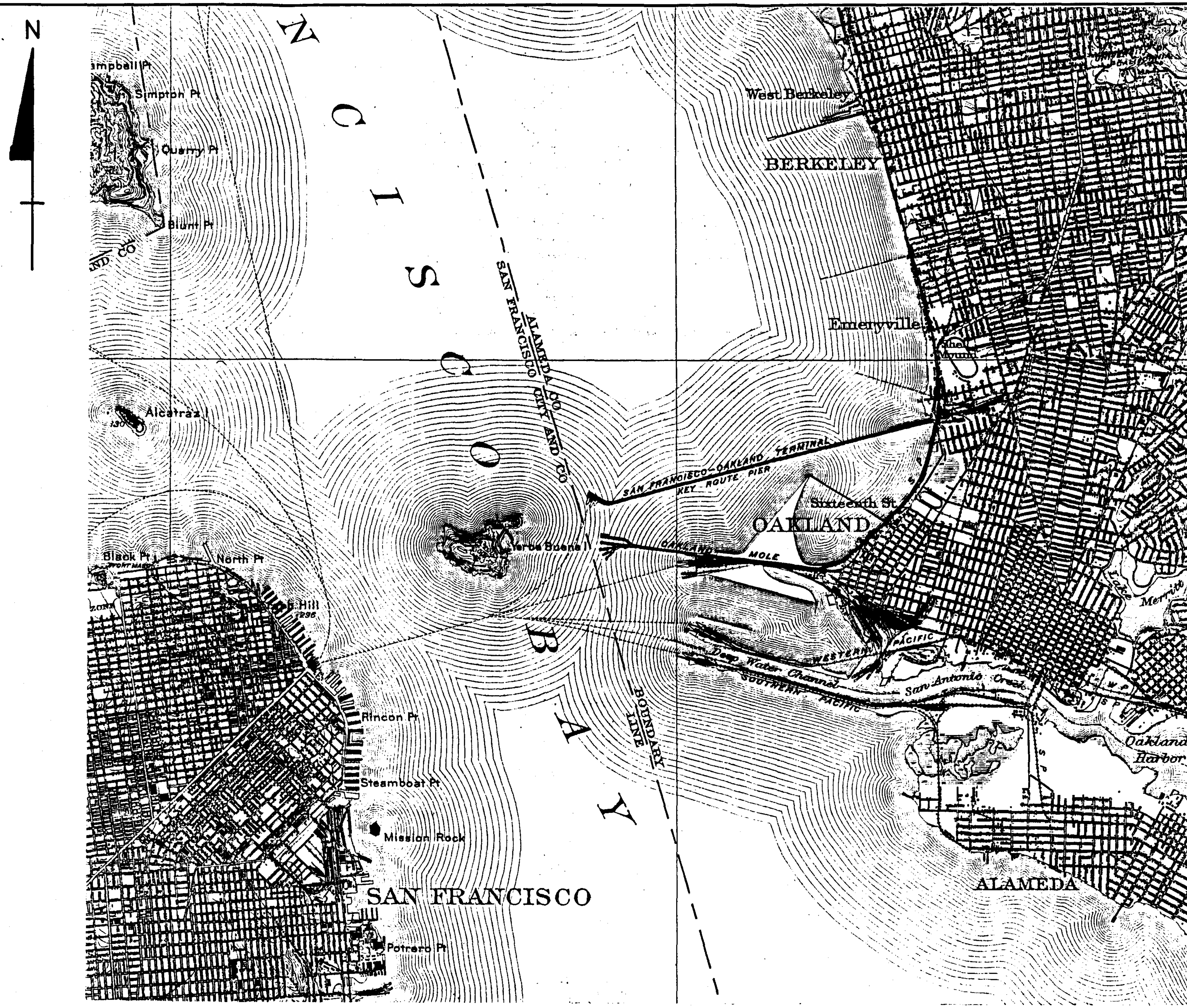
CHECKED BY CCW 10-25-88
APPROVED BY
REVISIONS NO. DATE



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PORTION OF U.S.
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NAVAL AIR STATION
ALAMEDA, CALIFORNIA

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DATE: 9-27-88	FIGURE 2-3	DRAWING NUMBER 86-018-B36
SCALE: NTS		

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PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1930
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DATE: 9-27-88 SCALE: NTS	FIGURE 2-4	DRAWING NUMBER 86-018-B34

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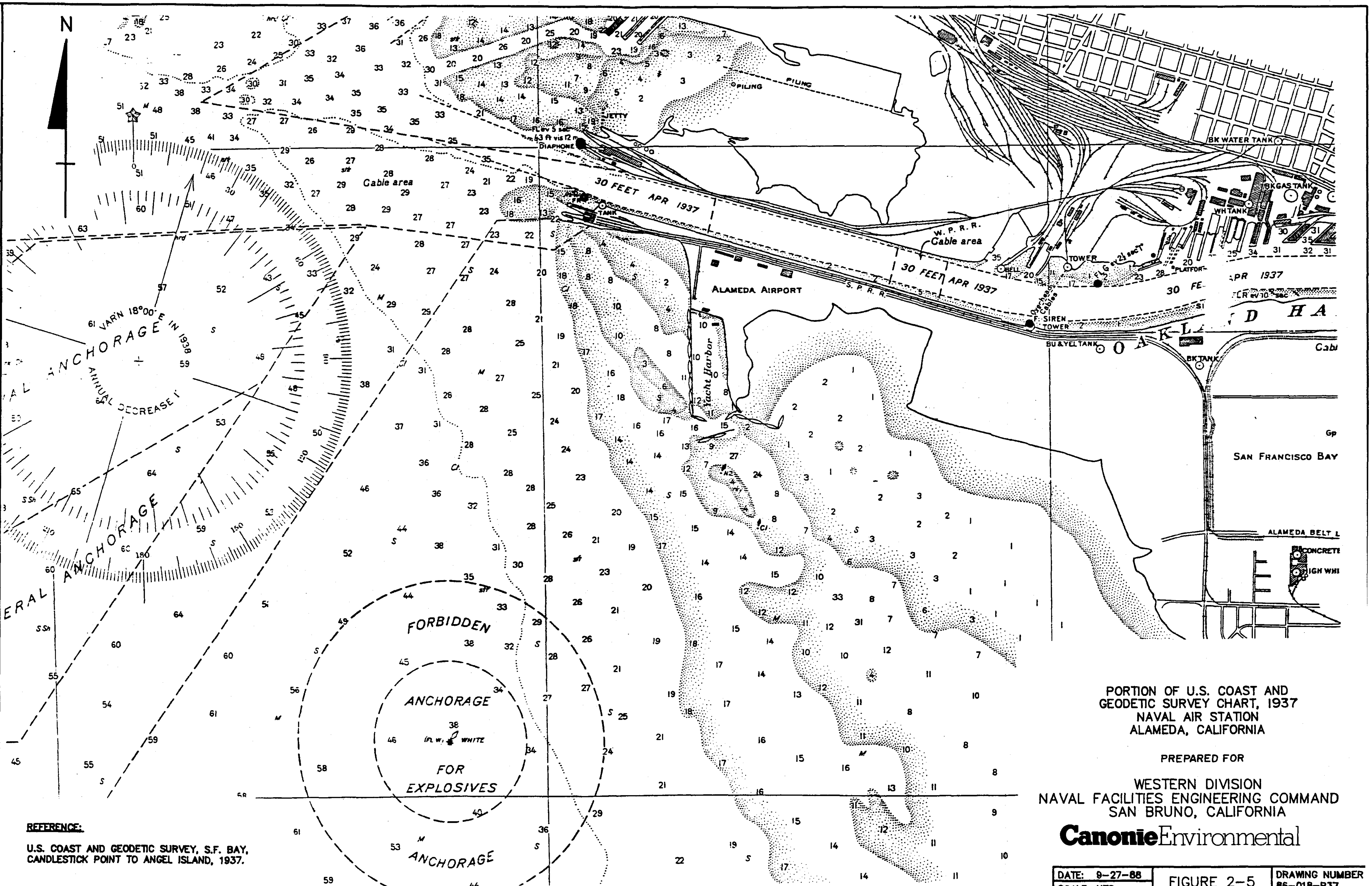

PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1937
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

REFERENCE:

U.S. COAST AND GEODETIC SURVEY, S.F. BAY, CANDLESTICK POINT TO ANGEL ISLAND, 1937.

DATE: 9-27-88	FIGURE 2-5	DRAWING NUMBER 86-018-B37
SCALE: NTS		

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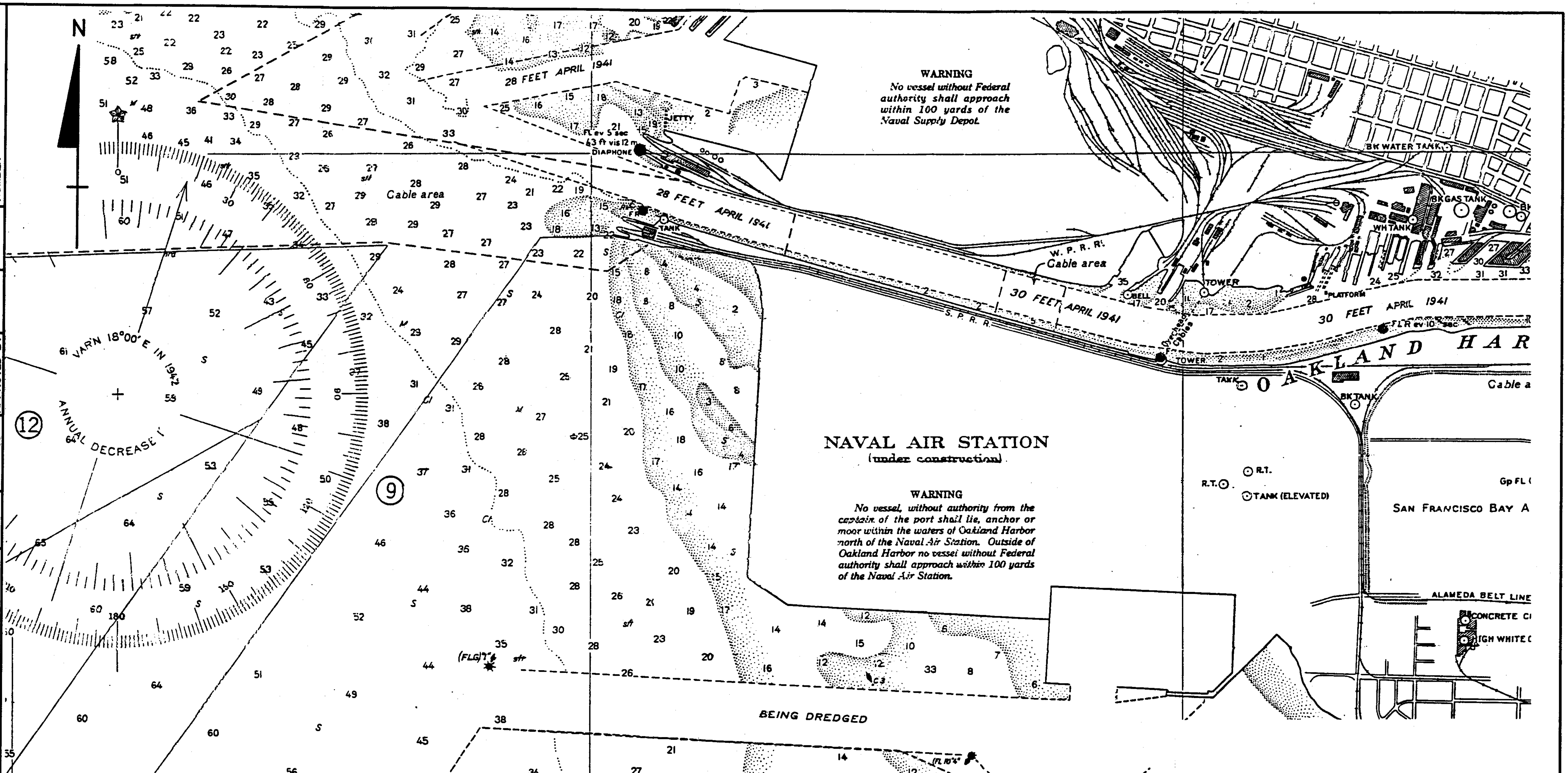

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PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1942
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

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DATE: 9-27-88	FIGURE 2-6	DRAWING NUMBER 86-018-B35
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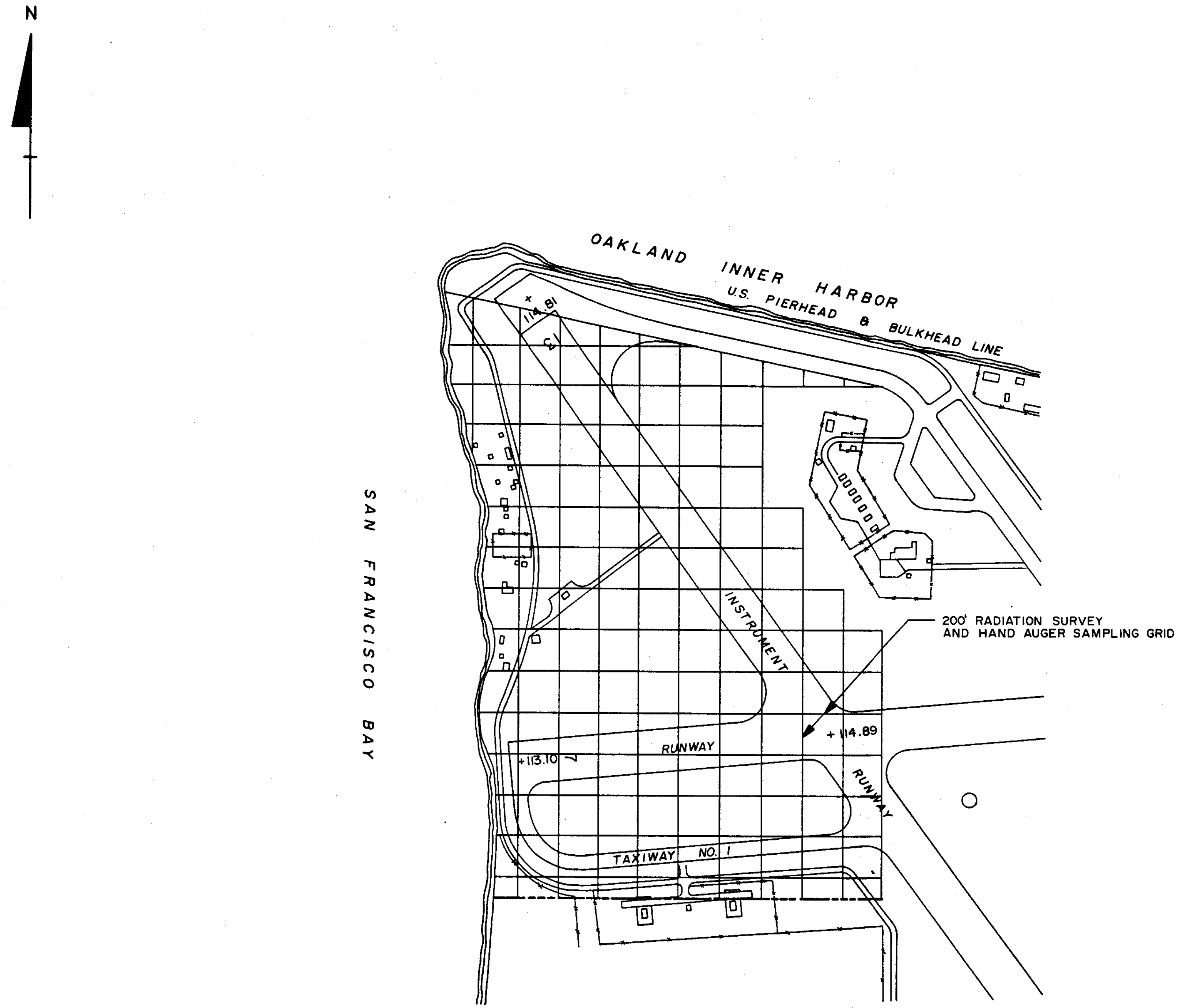
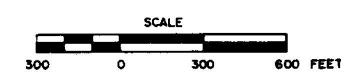
REVISIONS	NO.	DATE	DRAWN BY	BJH 9-27-88	CHECKED BY / APPROVED BY	10-25-88	DRAWING NUMBER	86-018-B35





SAMPLING GRID
1943-1956 DISPOSAL AREA
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

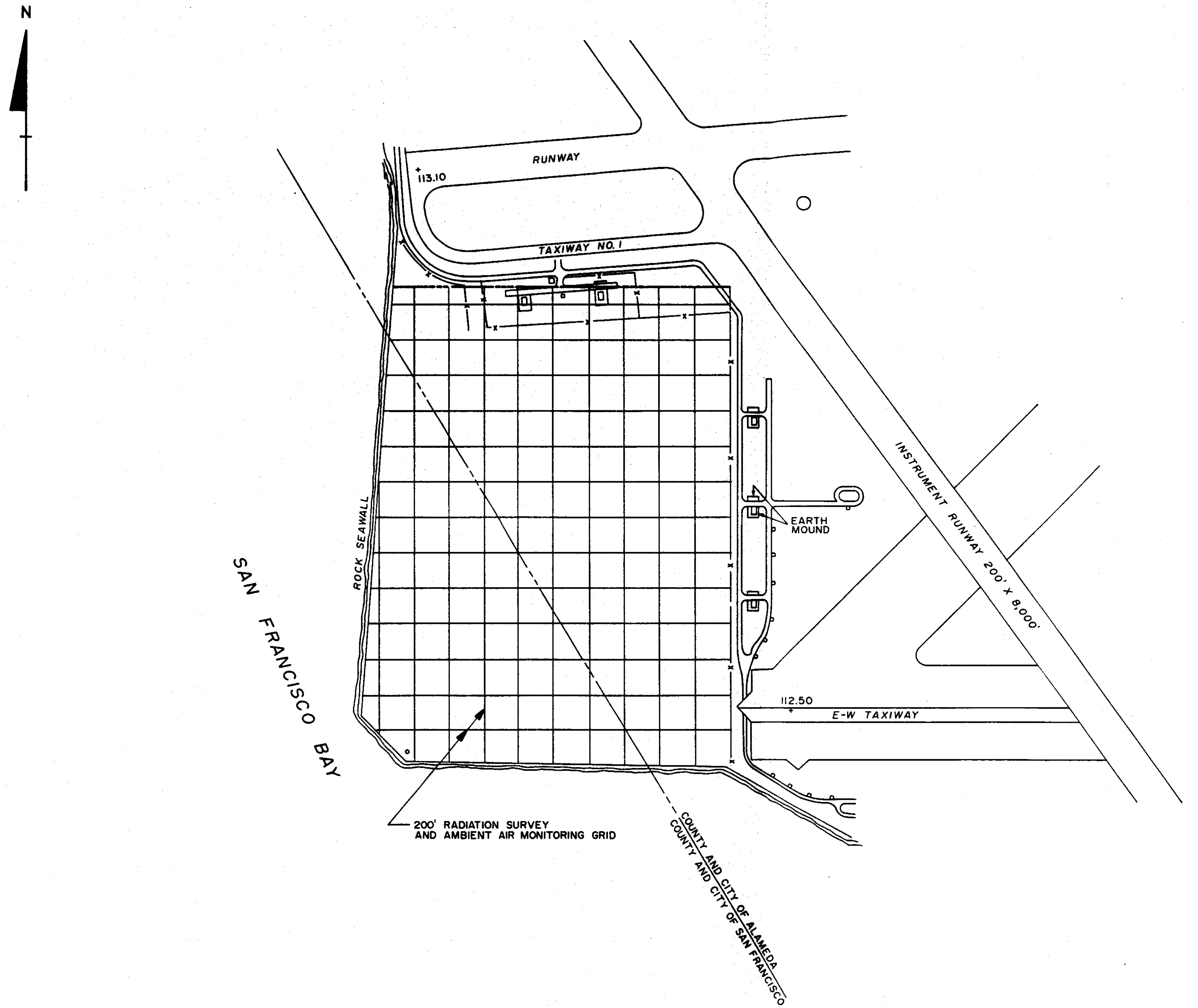
PREPARED FOR

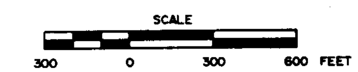
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-22-88	FIGURE 3-1	DRAWING NUMBER 86-018-E31
SCALE: AS SHOWN		

DRAWING NUMBER	86-018-E31
CHECKED BY / APPROVED BY	CCW 10-25-88
DRAWN BY	VZC 9-22-88
REVISIONS	NO. DATE





SAMPLING GRID
WEST BEACH LANDFILL
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

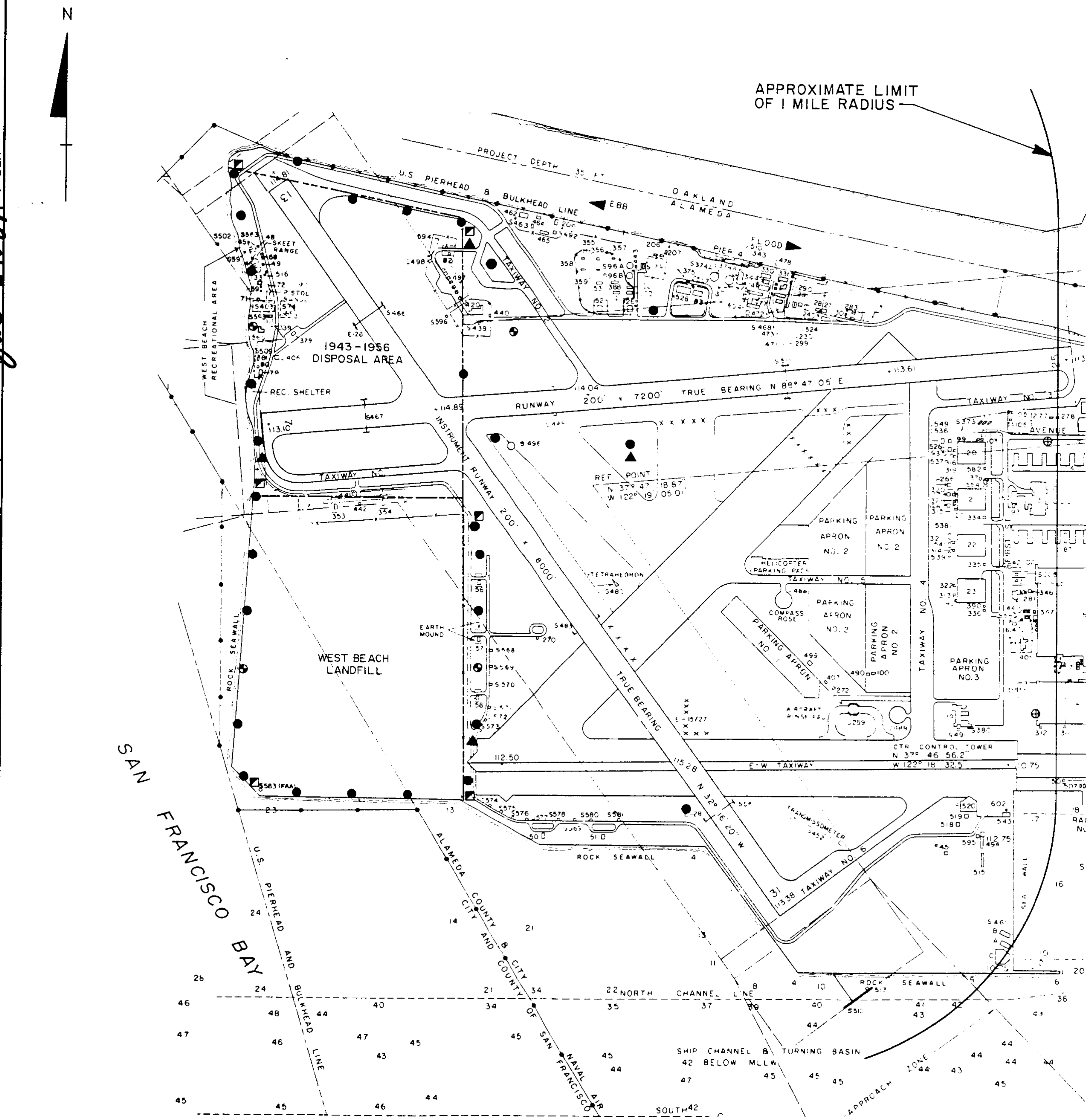
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

Canonie Environmental

DATE: 9-22-88	FIGURE 3-2	DRAWING NUMBER 86-018-E30
SCALE: AS SHOWN		

DRAWING NUMBER	86-018-E30
DRAWN BY	VZC 9-22-88
CHECKED BY	
APPROVED BY	
REVISIONS	NO. DATE



LEGEND:

- ● PROPOSED MONITORING WELL LOCATIONS, EACH LOCATION TO HAVE TWO WELLS: ONE WELL SCREENED WITHIN THE UPPERMOST WATER BEARING ZONE, ONE WELL SCREENED WITHIN THE SECOND WATER BEARING ZONE
- ⊕ PROPOSED MONITORING WELL LOCATIONS, EACH LOCATION TO HAVE ONLY ONE WELL, THAT WELL TO BE SCREENED WITHIN THE UPPERMOST WATER BEARING ZONE ONLY
- ◩ PROPOSED DEEP EXPLORATION BORING LOCATION
- ⊛ PROPOSED MONITORING WELL LOCATIONS, EACH LOCATION TO HAVE THREE WELLS: ONE WELL SCREENED WITHIN THE UPPERMOST WATER BEARING ZONE, TWO WELLS SCREENED WITHIN THE UPPER AND LOWER PORTIONS OF THE SECOND WATER BEARING ZONE.
- ▲ PROPOSED MONITORING WELL LOCATION, ONE WELL SCREENED THROUGHOUT THE SECOND WATER BEARING ZONE.

SCALE

500 0 500 1,000 FEET

REFERENCE

U.S. NAVY MAP

GROUND WATER SAMPLING LOCATIONS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

DATE: 9-20-88	FIGURE 3-3	DRAWING NUMBER 86-018-E25
SCALE: AS SHOWN		

DRAWN BY	LEA 9-20-88	CHECKED BY / APPROVED BY	CCW 10-25-88 / JWB 2-16-89	DRAWING NUMBER	86-018-E25

REVISIONS	NO.	DATE	
	△	2-14-89	ADDED MONITORING WELLS

113525

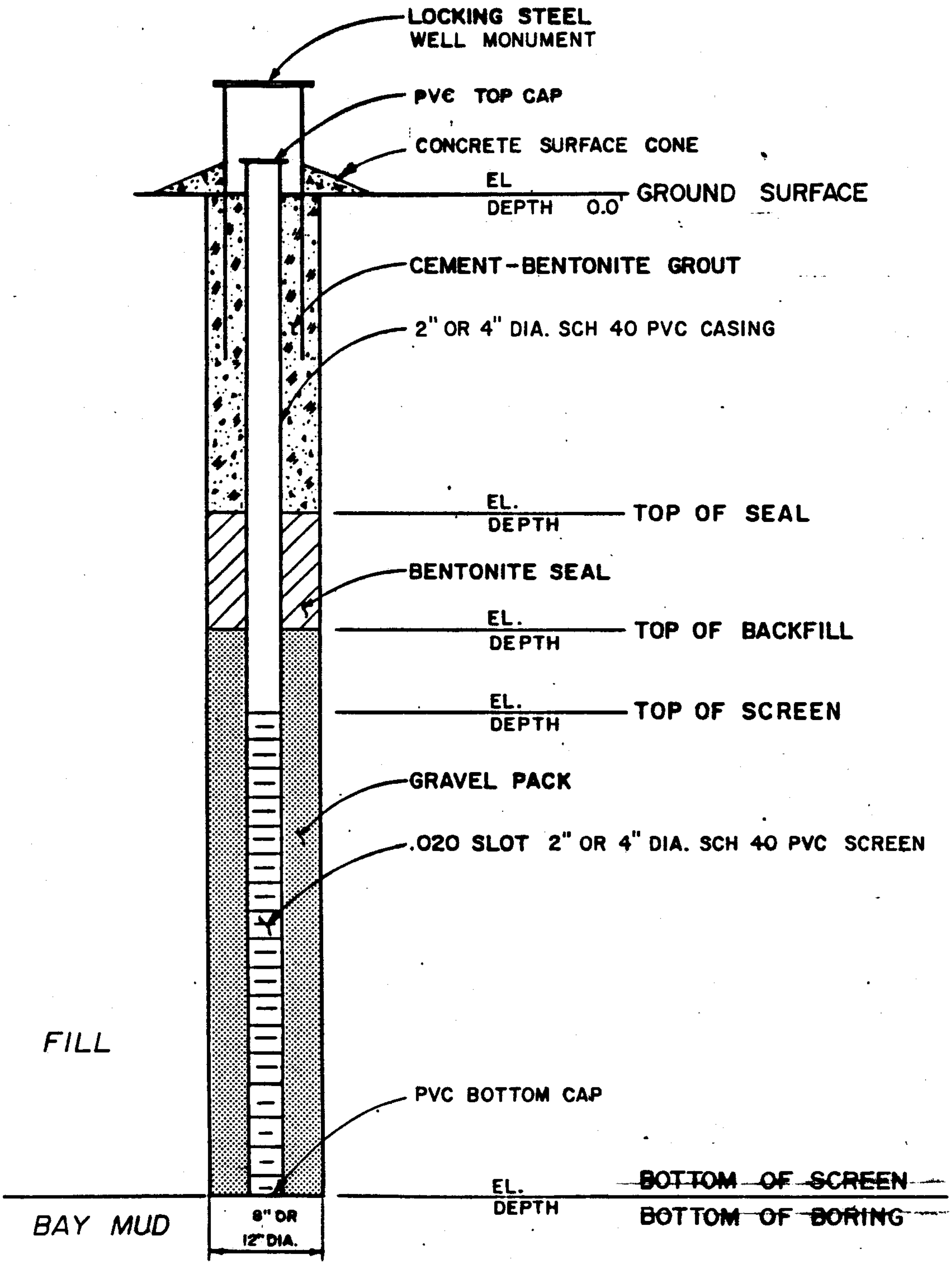
DRAWING NUMBER 86-018-A29

DRAWN BY LEA 9-23-88

CHECKED BY CCW 10-25-88

APPROVED BY JWB 2-16-89

REVISIONS | NO. | DATE



NOTES:

1. NOT DRAWN TO SCALE.
2. WELL SCREEN WITHIN FILL DEPOSITS

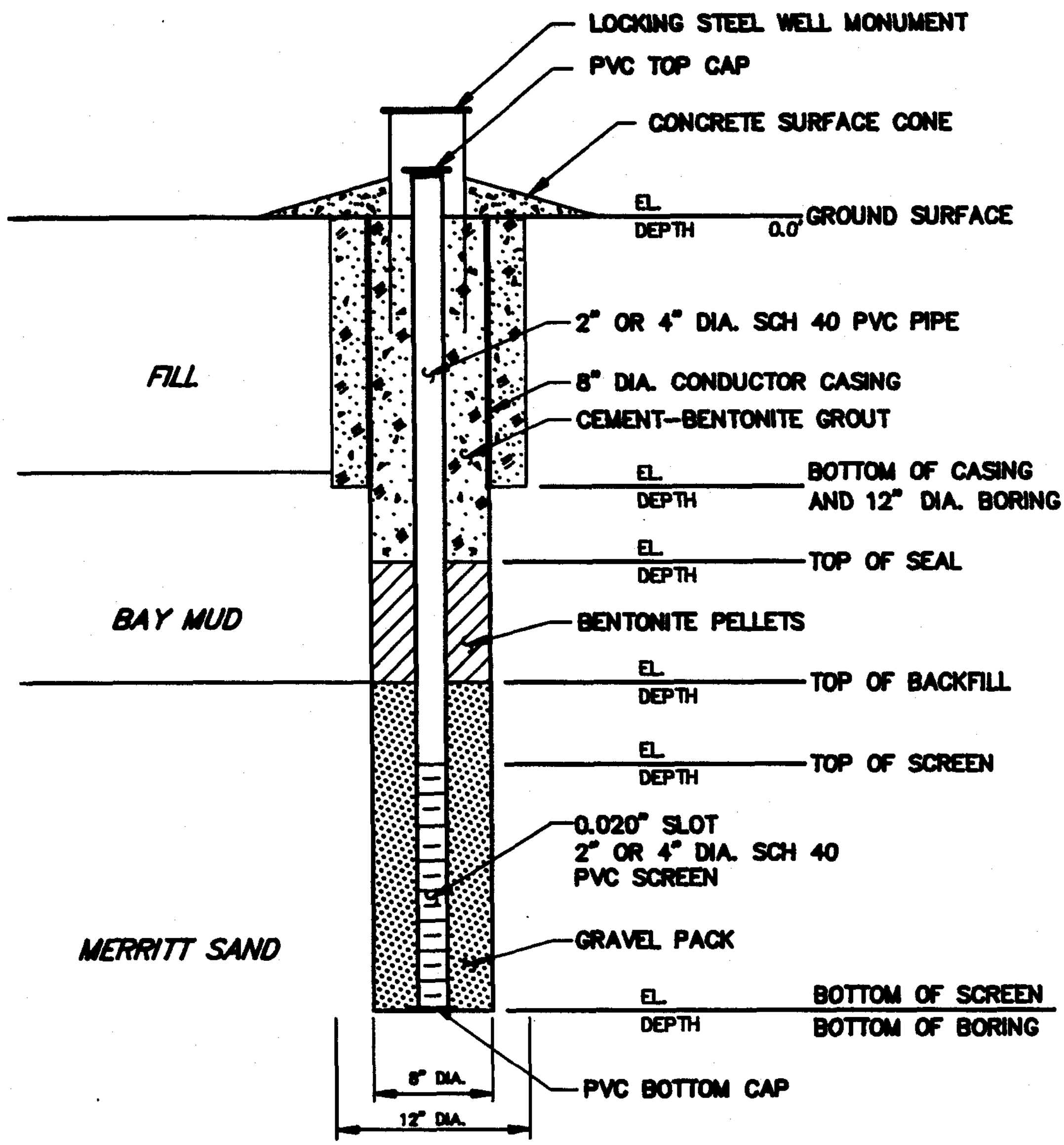
GENERALIZED MONITORING WELL CONSTRUCTION DIAGRAM

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Canonie Environmental

DATE: 9-23-88 SCALE: AS SHOWN	FIGURE 3-4	DRAWING NUMBER 86-018-A29



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN WITHIN UPPER PORTION OF MERRITT SAND

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NAVAL FACILITIES ENGINEERING
COMMAND

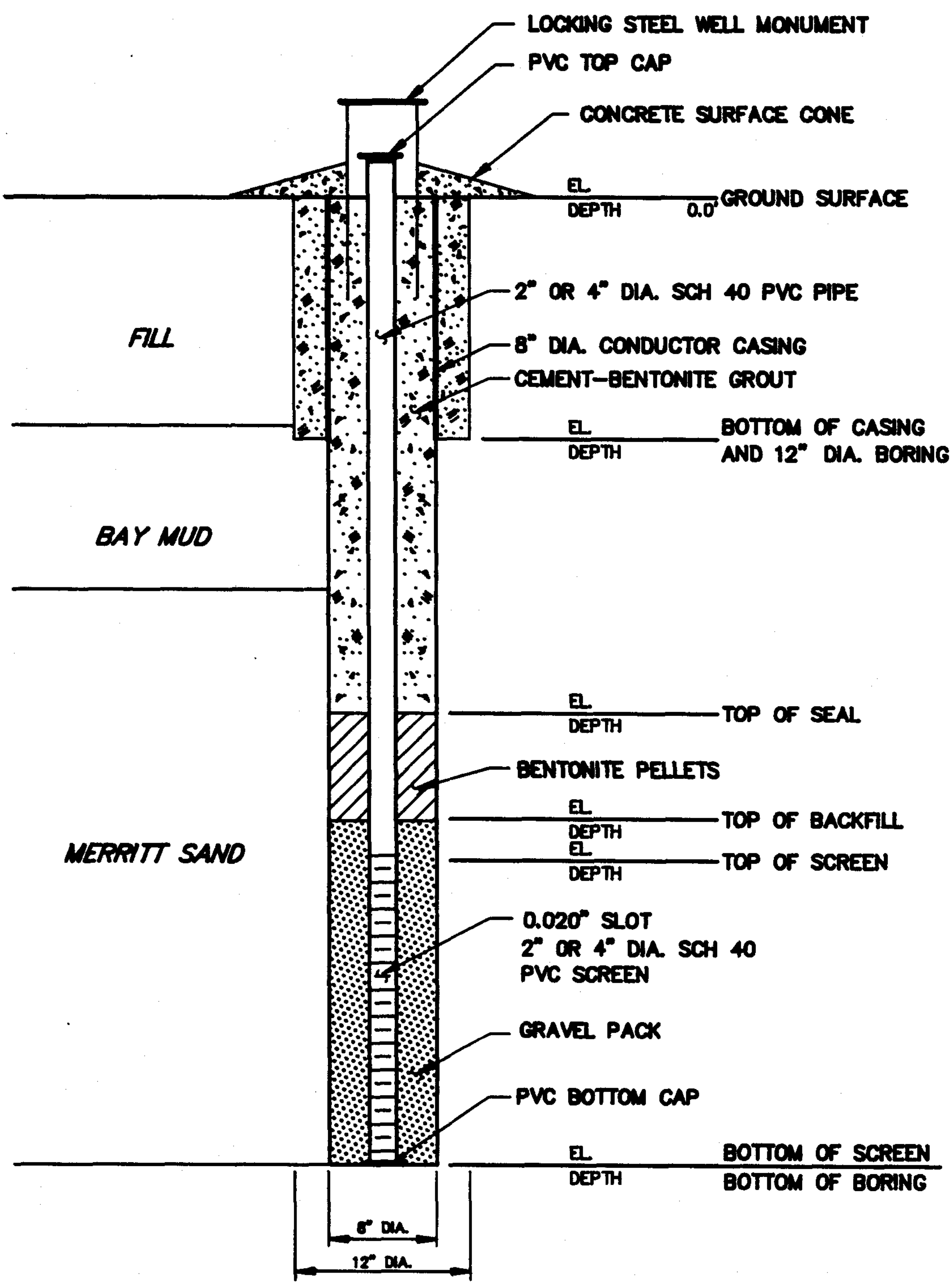
CanonieEnvironmental

DATE: 2-14-89	FIGURE 3-5	DRAWING NUMBER 86-018-A54
SCALE: NTS		

DRAWN BY	JWV	2-14-89
CHECKED BY	TGB	2-16-89
APPROVED BY	[signature]	2-16-89
DRAWING NUMBER	86-018-A54	

REVISIONS

NO.	DATE



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN WITHIN BOTTOM PORTION OF MERRITT SAND

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

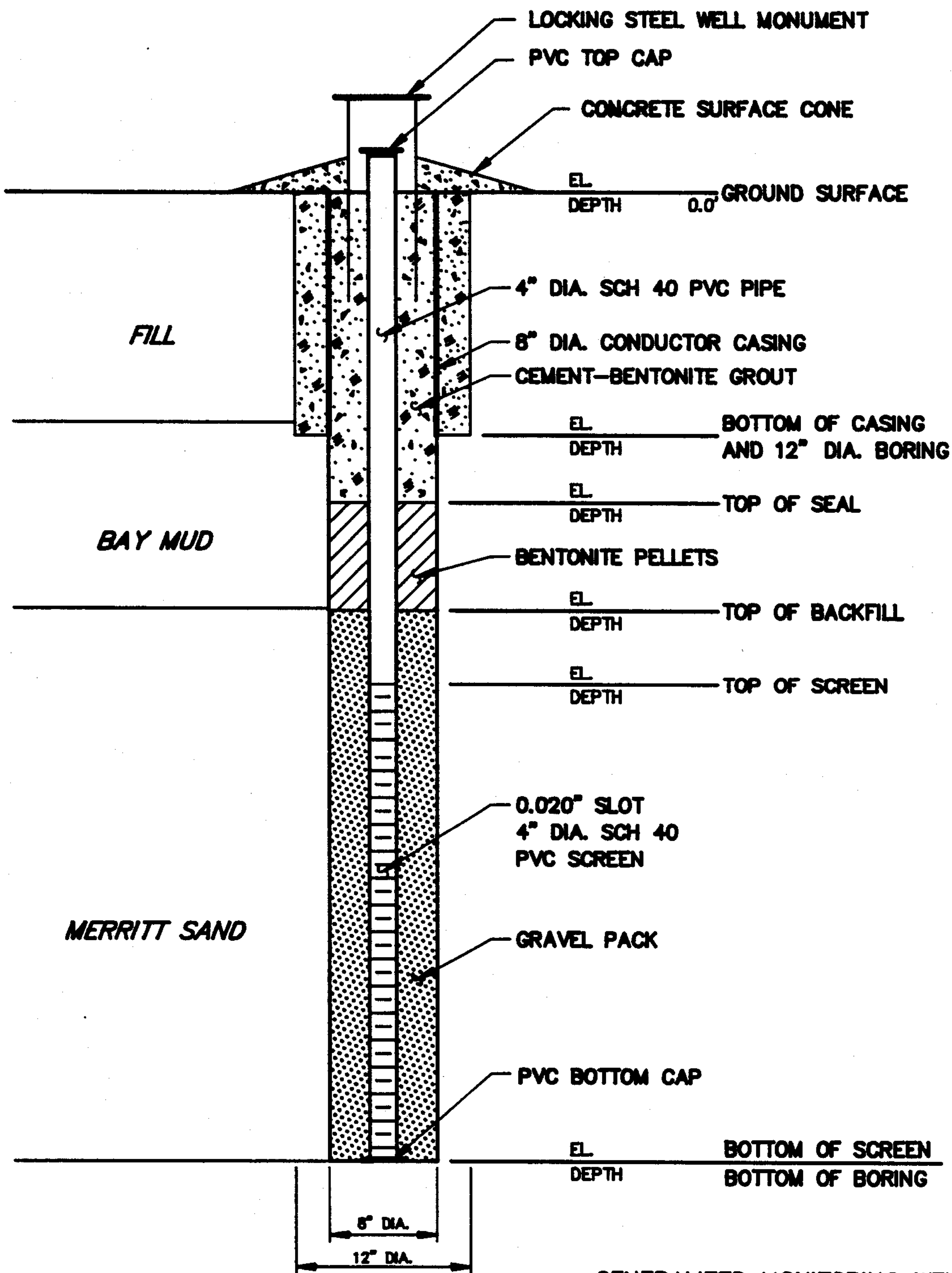
Canonie Environmental

DATE: 2-14-89 SCALE: NTS	FIGURE 3-6	DRAWING NUMBER 86-018-A53

DRAWN BY	JWV	2-14-89
CHECKED BY	TAB	2-16-89
APPROVED BY	[signature]	2-16-89
DRAWING NUMBER	86-018-A53	

REVISIONS

NO.	DATE



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN THROUGHOUT MERRITT SAND

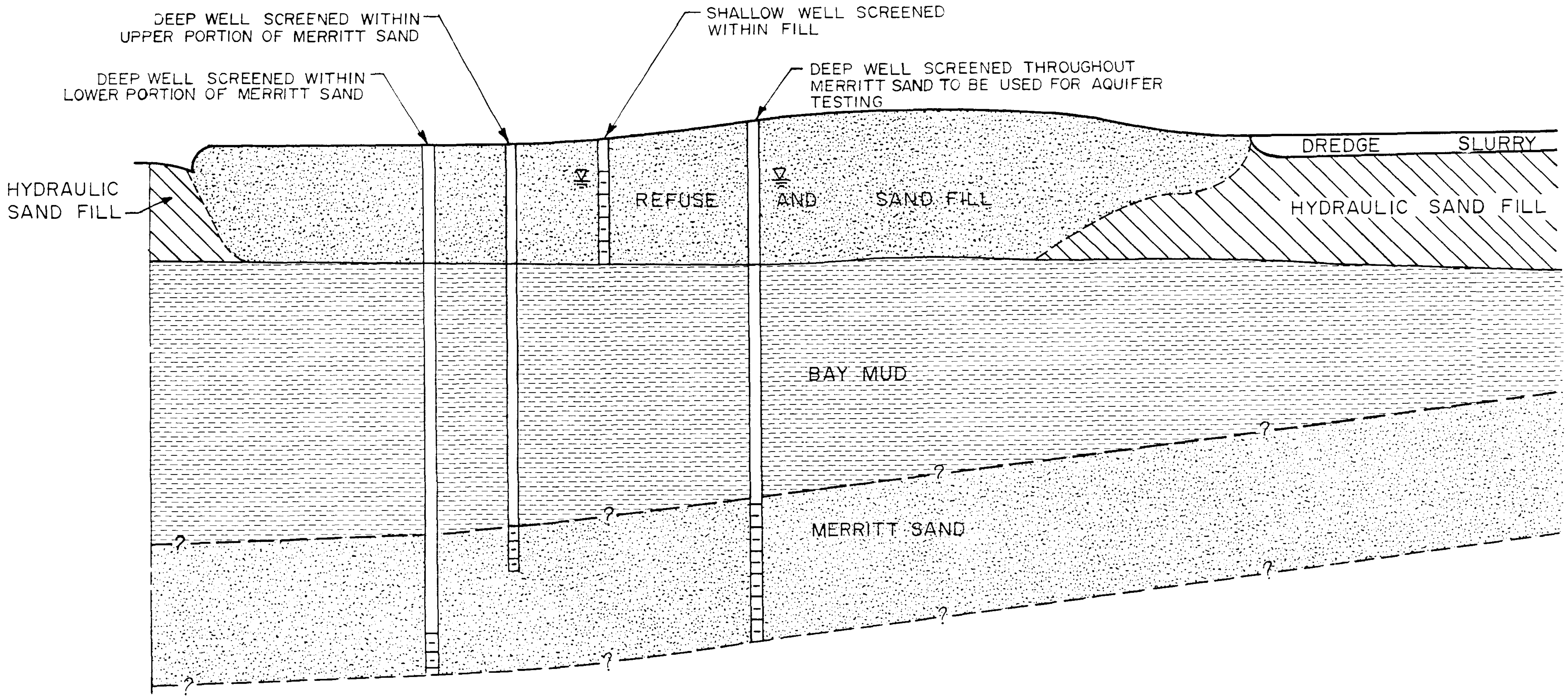
PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

CanonieEnvironmental

DATE: 2-14-89	FIGURE 3-7	DRAWING NUMBER
SCALE: NTS		86-018-A52

DRAWING NUMBER	86-018-A52
CHECKED BY	TGB 2-16-89
APPROVED BY	[signature] 2-16-89
DRAWN BY	J.W.V. 2-14-89
NO.	DATE
REVISIONS	

113525



GENERALIZED
MONITORING WELL CLUSTER
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

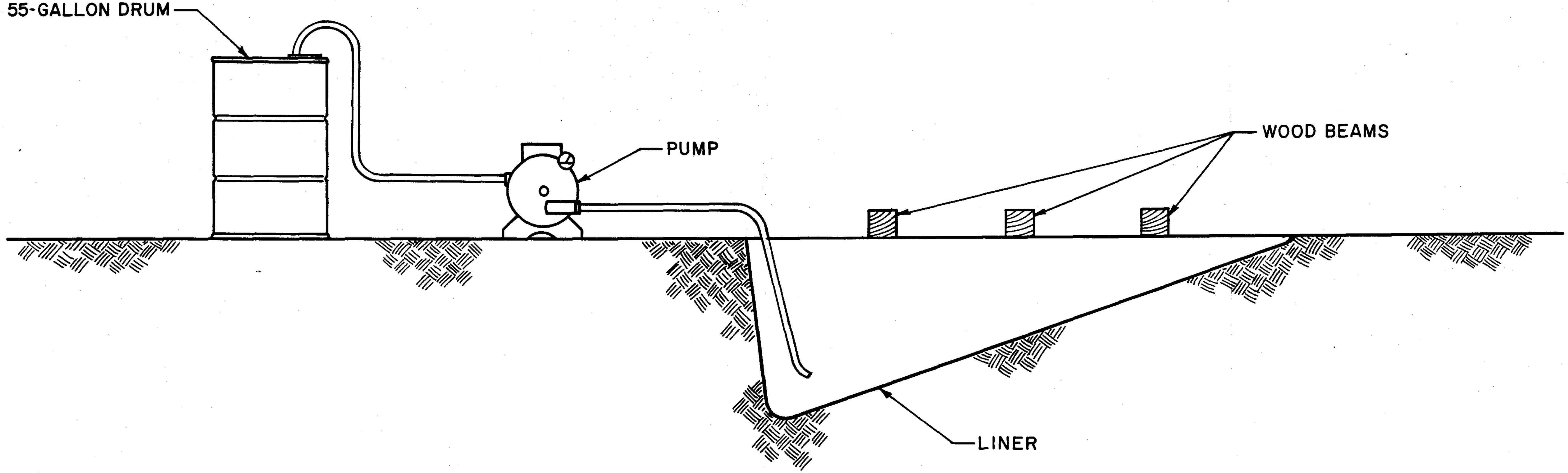
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

DATE: 9-23-88	FIGURE 3-8	DRAWING NUMBER 86-018-B32
SCALE: NTS		

DRAWING NUMBER	86-018-B32
CHECKED BY	CCW 10-25-88
APPROVED BY	2-16-87
DRAWN BY	VZC 9-23-88
REVISIONS	NO. DATE

113525



DECONTAMINATION PIT
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

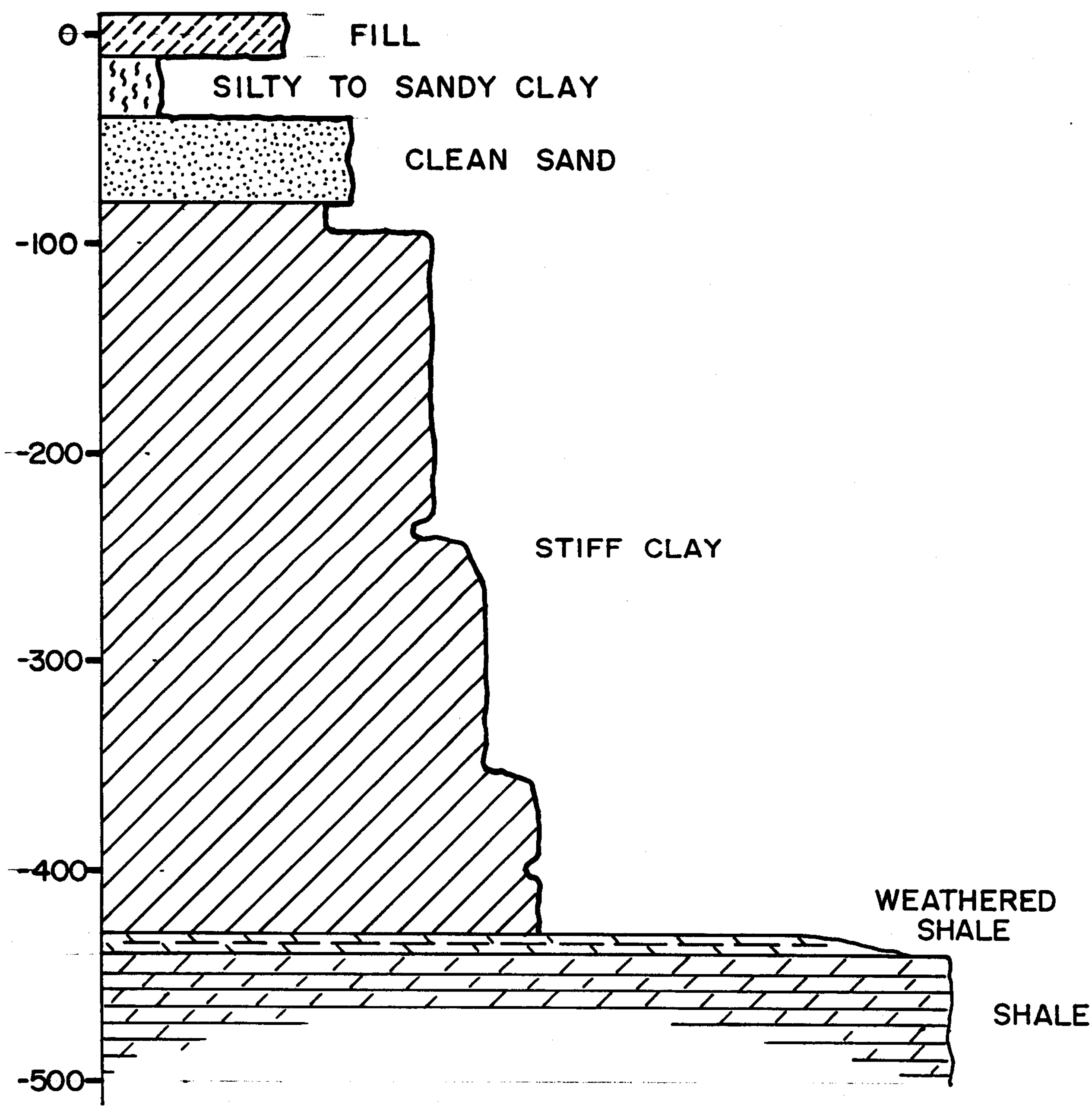
Canonie Environmental

DATE: 9-24-88 SCALE: N.T.S.	FIGURE 3-9	DRAWING NUMBER 86-018-B33

DRAWN BY	LEA 9-24-88	CHECKED BY / APPROVED BY	CCW / [signature]	10-25-88 / 2-16-89	DRAWING NUMBER 86-018-B33

REVISIONS NO. DATE

113525



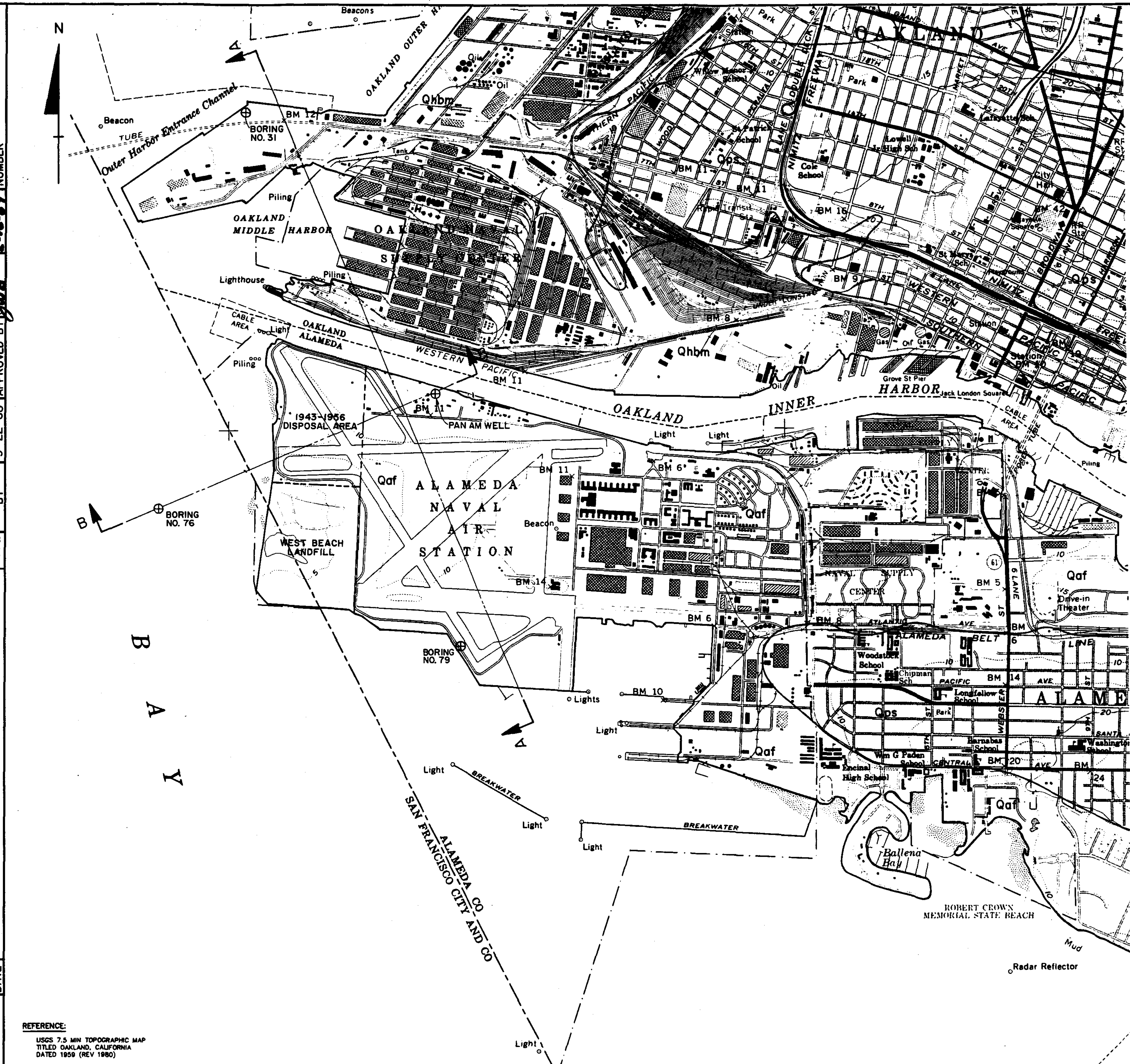
PAN AM WELL
STRATIGRAPHIC COLUMN

PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

DATE: 10-26-88 SCALE: AS SHOWN	FIGURE 3-10	DRAWING NUMBER 86-018-A45

REVISIONS	DRAWN BY	J. WADE 10-26-88	CHECKED BY	DLC	10/27/88	DRAWING NUMBER 86-018-A45
NO. DATE			APPROVED BY	JWB	2/16/89	



REFERENCE:

USGS 7.5 MIN TOPOGRAPHIC MAP TITLED OAKLAND, CALIFORNIA DATED 1959 (REV 1980)

LEGEND:

SEDIMENTARY DEPOSITS

QUATERNARY

HOLOCENE

ARTIFICIAL DEPOSITS

Qaf	ARTIFICIAL FILL – CONSISTS OF MISCELLANEOUS REFUSE, BAY MUD, OR SAND DREDGED FROM BAY; COMPOSITION VARIES FROM PLACE TO PLACE; MAY BE DIFFICULT TO DISTINGUISH FROM NATURAL BAY MUD OR MERRITT SAND. IN MOST PLACES OVERLIES BAY MUD

ALLUVIAL DEPOSITS

Qhac	COARSE-GRAINED ALLUVIUM – UNCONSOLIDATED, MODERATELY SORTED PERMEABLE SAND AND SILT WITH COARSE SAND AND GRAVEL; MORE ABUNDANT TOWARD FAN HEADS
Qham	MEDIUM-GRAINED ALLUVIUM – UNCONSOLIDATED, MODERATELY SORTED PERMEABLE FINE SAND, SILT, AND CLAYED SILT WITH A FEW THIN BEDS OF COARSE SAND
Qhaf	FINE-GRAINED ALLUVIUM – UNCONSOLIDATED PLASTIC MODERATELY TO POORLY SORTED CARBONACEOUS SILT AND CLAY

ESTUARINE DEPOSITS

Qhbm	BAY MUD – UNCONSOLIDATED WATER-SATURATED DARK PLASTIC CARBONACEOUS CLAY AND SILTY CLAY

10,000 YEARS B.P.

PLEISTOCENE

Qps	PLEISTOCENE BEACH AND DUNE SAND DEPOSITS (MERRITT SAND) – LOOSE WELL – SORTED FINE TO MEDIUM SAND
Qpa	LATE PLEISTOCENE ALLUVIUM – WEAKLY CONSOLIDATED SLIGHTLY WEATHERED POORLY SORTED IRREGULARLY INTERBEDDED CLAY, SILT, SAND AND GRAVEL

1.8 MILLION YEARS B.P.

⊕ SOIL BORING FROM DOROTHY H. RADBRUCK, 1957

SCALE

1,000 0 1,000 2,000 FEET

REGIONAL GEOLOGIC MAP NAVAL AIR STATION ALAMEDA, CALIFORNIA

PREPARED FOR

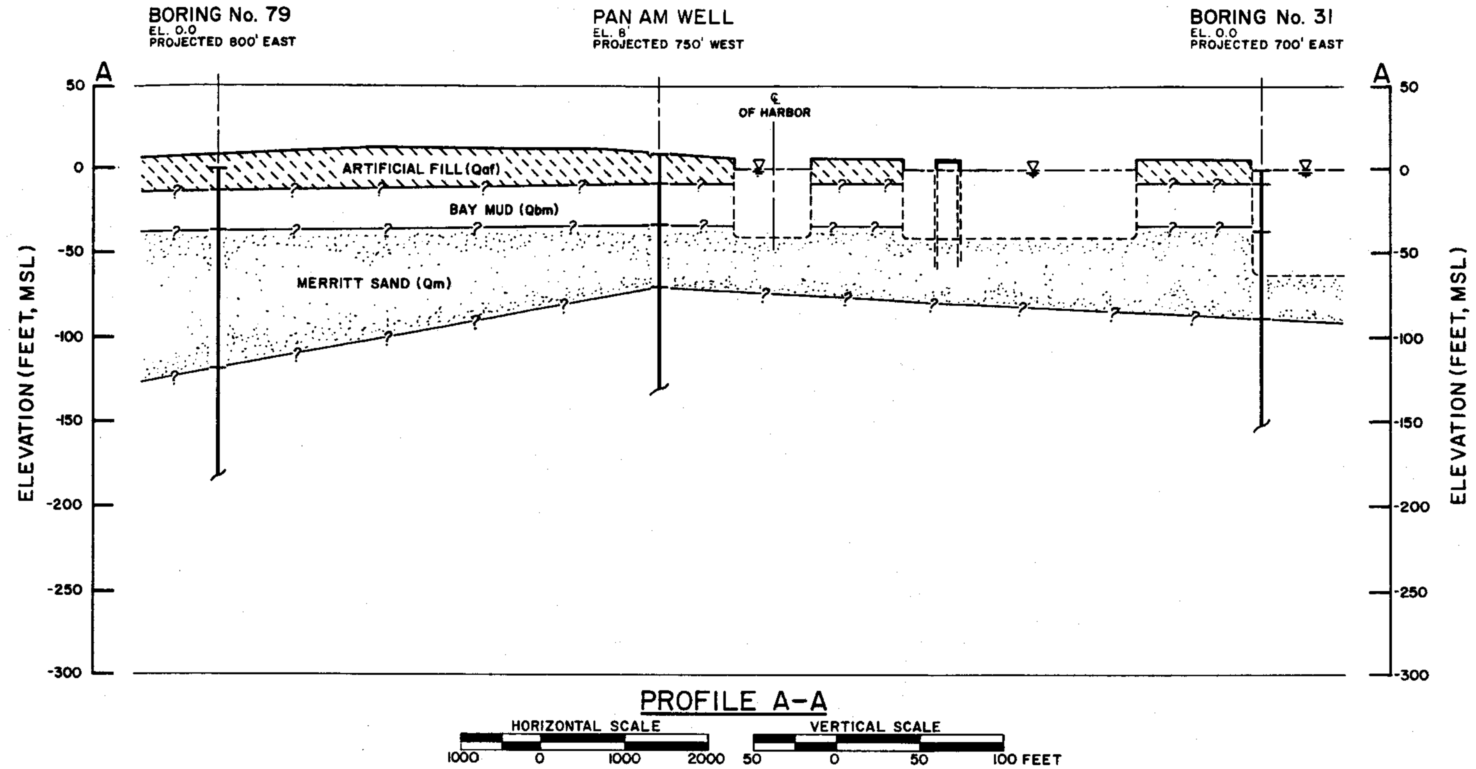
WESTERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND SAN BRUNO, CALIFORNIA

Canonie Environmental

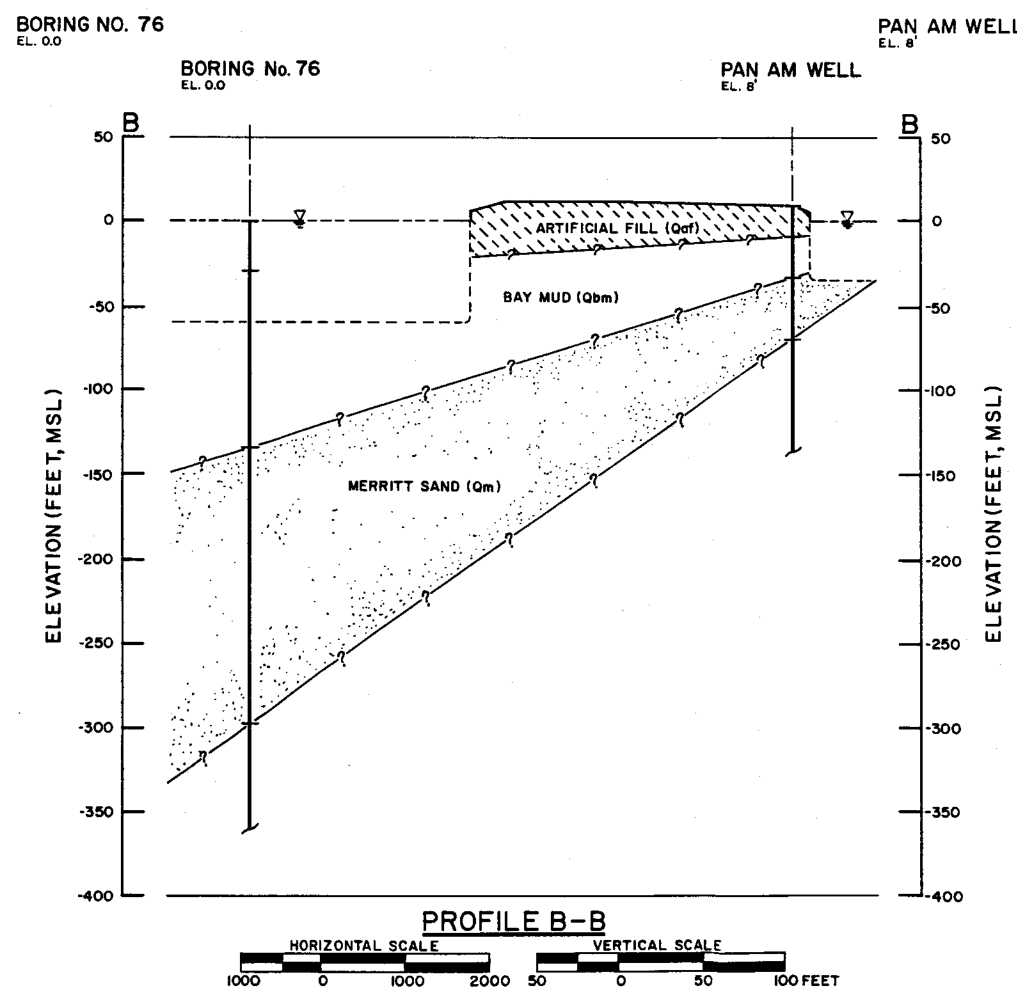
DATE: 9-22-88	FIGURE 3-11	DRAWING NUMBER 86-018-E28
SCALE: AS SHOWN		

DRAWN BY	LEA 9-22-88	CHECKED BY / APPROVED BY	CCW 10-25-88 / 2-16-89	DRAWING NUMBER	86-018-E28

REVISIONS NO. DATE



PROFILE A-A



PROFILE B-B

GEOLOGIC CROSS SECTIONS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-27-88	FIGURE 3-12	DRAWING NUMBER 86-018-E38
SCALE: AS SHOWN		

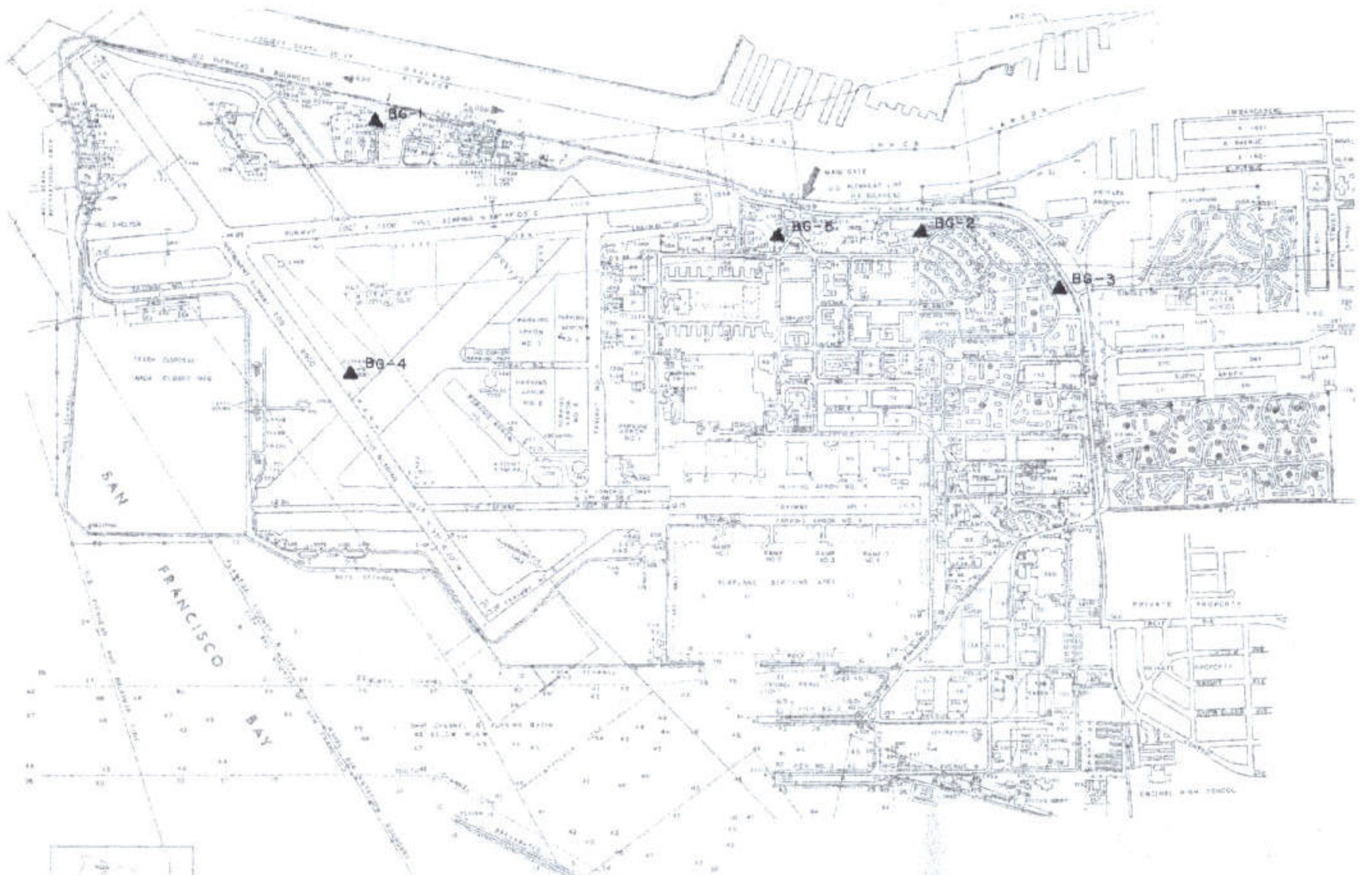
REVISIONS	NO.	DATE

DRAWN BY	LEA	9-27-88
CHECKED BY	CCW	10-25-88
APPROVED BY	[illegible]	2-16-89
DRAWING NUMBER	86-018-E38	

DRAWN BY | LEA 9-21-88 | CHECKED BY CCW | APPROVED BY 10-25-88 | DRAWING NUMBER 86-018-E27

REVISIONS | NO. | DATE

N



LEGEND:

▲ EXISTING WELL

SCALE
1000 0 1000 2000 FEET

REFERENCE:
U.S. NAVY MAP

BACKGROUND WELL LOCATION SITES
NAVAL AIR STATION
ALAMEDA, CALIFORNIA
PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-21-88	FIGURE 5-1	DRAWING NUMBER 86-018-E27
SCALE: AS SHOWN		

APPENDIX A

SAMPLING DATA FROM PREVIOUS STUDIES

TABLE 1

1943-1956 DISPOSAL AREA SOIL AND GROUND WATER TEST RESULTS

Constituent Concentrations, mg/kg = mg/l = ppm, Except as Noted

	Soil Samples - Well Number					Ground Water Samples - Well Number				
	WA-1	WA-2	WA-3	WA-4	WA-5	WA-1	WA-2	WA-3	WA-4	WA-5
Date sampled	10/12/84	10/12/84	10/15/84	10/17/84	10/19/84	1/21/85	1/21/85	1/21/85	1/21/85	1/22/85
Sample depth, feet	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	16	17	16	16	15
Screened depth, feet						5-25	6-20	6-16	5-25	4-24
Static water, feet										
depth						3.16	5.73	4.13	3.69	4.47
elevation						107.45	107.06	106.73	106.72	106.99
Combustible gas in casing, as hexane, max. obs.*										
before pumping,						95%	240 ppm	140 ppm	65 ppm	130 ppm
after pumping						100%	5%	12%	125 ppm	185 ppm
pH (no units)	8.8	8.0	7.9	8.4	8.0	7.6	7.6	7.4	7.4	6.7
Electrical conductivity umhos/cm	240	580	330	210	60	1080	3200	11800	7000	750
Gross alpha, pCi/g or l	4.4±3.3	8.0±5.4	0.1±4.8	9.6±7.2	45.7±10.8	7.2±6.6	5.5±10.8	NR	NR	0.4±2.8
Gross beta, pCi/g or l	31.7±4.4	16.1±4.4	10.5±3.3	17.6±4.2	11.2±3.5	69.3±31.6	33.8±57.4	NR	NR	50.4±16.8
Antimony ,Sb	-5.	-5.	-5.	-5.	-5.	-1.	-1.	-1.	-1.	-1.
Arsenic ,As	-5.	-5.	5.3	-5.	9.1	-1.	-1.	-1.	-1.	-1.
Barium ,Ba	80.	49.	250.	13.	57.	-0.5	-0.5	-0.5	-0.5	-0.5
Beryllium ,Be	-0.5	-0.5	-0.5	-0.5	-0.5	-0.05	-0.05	-0.05	-0.05	-0.05
Cadmium ,Cd	24.	1.6	19.	0.65	1.0	-0.1	-0.1	-0.1	-0.1	-0.1
Chromium ,Cr	90.	29.	56.	21.	49.	-0.1	-0.1	-0.1	-0.1	-0.1
Cobalt ,Co	3.8	6.4	8.2	3.7	9.4	-0.1	-0.1	-0.1	-0.1	-0.1
Copper ,Cu	160.	31.	330.	7.8	57.	-0.1	-0.1	-0.1	-0.1	-0.1
Lead ,Pb	1100.	38.	700.	-5.	6.5	-0.1	-0.1	-0.1	-0.1	-0.1
Mercury ,Hg	0.1	0.14	2.3	-0.1	-0.1	-1.	-1.	-1.	-1.	-1.
Molybdenum ,Mo	-10.	-10.	-10.	-10.	-10.	-0.01	-0.01	0.77	-0.01	-0.01
Nickel ,Ni	70.	28.	53.	18.	68.	-0.1	-0.1	-0.1	-0.1	-0.1
Selenium ,Se	-1.	-1.	-1.	-1.	-1.	-0.5	-0.5	-0.5	-0.5	-0.5
Silver ,Ag	-2.	-2.	-2.	-2.	-2.	-0.5	-0.5	-0.5	-0.5	-0.5
Thallium ,Tl	-5.	-5.	-5.	-5.	-5.	-1.	-1.	-1.	-1.	-1.
Vanadium ,V	7.5	22.	17.	14.	21.	-0.5	-0.5	-0.5	-0.5	-0.5
Zinc ,Zn	420.	64.	1800.	16.	49.	0.13	-0.1	-0.1	-0.1	-0.1

CONTINUED ON NEXT PAGE

NOTES:
*) Maximum observed reading within the casing - may represent multiple readings at different times or days.
1) "NR" = not reportable because of excessive noise due to high salt content.
2) Metals by inductively-coupled plasma emission spectroscopy, after strong acid digestion ("total metals" basis) of soils.
3) Data reported on a moist-sample-weight (as-received) basis.
4) "-" = "less than"

SOURCE: WAHLER ASSOCIATES, 1985

TABLE 1 (CONTINUED)

1943-1956 DISPOSAL AREA SOIL AND GROUND WATER TEST RESULTS

Constituent Concentrations, mg/kg = mg/l = ppm, Except as Noted

	Soil Samples - Well Number					Ground Water Samples - Well Number				
	WA-1	WA-2	WA-3	WA-4	WA-5	WA-1	WA-2	WA-3	WA-4	WA-5
Date sampled	10/12/84	10/12/84	10/15/84	10/17/84	10/19/84	1/21/85	1/21/85	1/21/85	1/21/85	1/22/85
Sample depth, feet	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	16	17	16	16	15
Screened depth, feet						5-25	6-20	6-16	5-25	4-24
Static water, feet										
depth						3.16	5.73	4.13	3.69	4.47
elevation						107.45	107.06	106.73	106.72	106.99
trichloroethylene	-0.001	-0.001	-0.001	-0.001	-0.001	0.291	0.005	-0.001	-0.001	-0.001
trans-1,2-dichloroethylene	-0.001	-0.001	-0.001	-0.001	-0.001	0.957	0.246	0.008	-0.001	-0.001
benzene	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	0.009
acetone	0.058	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010
other purgeable organics	None detected at detection limits generally below 0.001 ppm									
bis(2-ethylhexyl) phthalate	-0.040	0.625	-0.040	-0.100	-0.001	0.060	-0.001	-0.001	-0.001	-0.001
di-n-butyl phthalate	2.700	0.665	-0.040	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
acenaphthene	-0.040	-0.040	2.030	-0.100	-0.001	-0.001	0.064	-0.001	-0.001	-0.001
acenaphthylene	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	0.005	-0.001	-0.001	-0.001
napthalene	-0.040	-0.040	5.200	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(a)anthracene	-0.040	-0.040	0.370	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(b)fluoranthene	-0.040	-0.040	0.580	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(ghi)perylene	-0.040	-0.040	0.440	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(a)pyrene	-0.040	-0.040	1.330	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
ideno(1,2,3-cd)pyrene	-0.040	-0.040	1.000	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
pyrene	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	0.043	-0.001	-0.001	-0.001
chrysene	-0.040	-0.040	0.470	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
fluorene	-0.040	-0.040	1.840	-0.100	-0.001	-0.001	0.016	-0.001	-0.001	-0.001
phenanthrene	-0.040	-0.040	0.200	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
dibenzofuran	-0.040	-0.040	1.360	-0.100	-0.001	-0.001	0.014	-0.001	-0.001	-0.001
2-methylnapthalene	-0.040	-0.040	0.800	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
2-cyclohexen-1-one*	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	-0.001	0.010	-0.001	-0.001
2,5-diethyltetrahydrofuran*	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	-0.001	0.043	-0.001	-0.001
unidentified, non-priority pollutants	one	two	several	four	none	none	none	none	none	none
other acid and base/neutral extractable organics	None detected at detection limits generally below 0.040 ppm (soils) or 0.001 ppm (water)									

NOTES: *) Estimated concentrations, tentative identification.
1) Analyses by EPA Method 624 and 625 - all statistically significant peaks reported, even if unidentified.
2) Data reported on a moist-sample-weight (as-received) basis.
3) "-" = "less than".

SOURCE: WAHLER ASSOCIATES, 1985

TABLE 2. WATER LEVEL READINGS

Observation Well (Boring)	Elevation*		11/9/76		11/15/76		12/3/76		12/17/76			3/10/77	3/16/77		3/21/77	3/22/77
Number	Top of Pipe	Ground Surface	1200 to 1330	1600 to 1650	1045 to 1130	1430 to 1505	1415 to 1515	1530 to 1630	0845 to 1600	1325 to 1345	1517 to 1545	1400 to 1530	0900 to 0945	1330 to 1350	1330 to 1600	0945 to 1330
1	116.5	115.5	105.2	105.5	105.3	105.3	105.7	105.3	105.9	105.6	105.2	---	105.8	---	105.9	105.7
2	114.4	113.4	105.4	105.4	105.4	105.4	105.4	---	105.4	105.4	105.4	104.8	105.2	---	105.1	105.0
3	112.2	111.4	105.3	105.2	105.2	105.2	105.3	105.2	105.5	105.1	105.1	104.9	105.0	---	104.6	104.6
4	110.4	110.7	108.2	105.5	105.9	105.9	103.8	103.5	108.4	103.7	103.1	---	---	---	105.7	105.7
5	109.8	110.1	106.6	105.9	105.6	105.6	105.1	104.9	106.8	104.9	104.5	106.7	106.8	105.8	---	105.2
6	108.1	108.2	106.2	106.2	106.2	106.2	106.2	---	106.2	---	106.2	106.8	---	107.1	107.1	107.1
7	109.2	109.9	106.2	106.2	106.2	106.2	106.2	---	106.2	---	106.2	106.7	---	107.7	106.7	106.7
8	114.8	114.0	106.6	106.6	106.6	106.6	106.7	---	106.7	---	106.6	107.8	107.2	---	---	---
9	114.3	113.8	107.3	107.3	107.3	107.3	107.3	---	107.3	---	107.3	108.1	107.9	---	---	108.1
10	111.9	112.0	108.0	108.0	108.0	108.0	---	---	108.0	---	108.0	---	---	---	109.5	109.6
11	112.6	112.5	---	---	---	---	106.3	---	106.3	---	106.3	106.5	---	106.7	106.6	106.6
12	113.1	113.0	---	---	---	---	106.2	---	106.2	---	106.2	106.4	---	106.5	106.9	106.7
13	109.0	109.5	---	---	106.0	106.0	---	---	105.7	---	105.7	108.7	---	---	---	109.3
17	111.7	110.3	Borings installed 3/16/77										No initial readings taken		105.2	106.4
18	111.8	110.0													104.9	106.4
19	110.4	109.8													105.3	106.3
20	115.3	114.5	Boring installed 10/6/77													
Bay Tide	---	---	107.9	104.9	103.9	104.4	104.1	103.1	108.2	102.4	101.4	104.9	107.2	103.4	105.8	varies
High Tide	---	---	107.9 at 1230		106.1 at 1800		107.7 at 0930		108.3 at 0815			106.1 at 1645	107.5 at 0945		106.7 at 1330	106.4 at 1415
Low Tide	---	---	100.9 at 1930		103.5 at 1230		101.2 at 1615		100.7 at 1530			101.2 at 0945	101.0 at 1615		102.5 at 1900	101.7 at 0745
Rainfall since last reading (in.)			0		1.07		0		0			3.93	1.42		0	0
Cumulative rainfall (in.)			0		1.07		1.07		1.07			5.00	6.42		6.42	6.42

*All elevations are in feet, based on the Alameda Naval Air Station Datum

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

TABLE 2. (CONTINUED)

Observation Well (Boring) Number	Elevation* Top of Pipe	Elevation* Ground Surface	4/4/77 0745 to 1000	4/4/77 1000 to 1315	4/4/77 1320 to 1430	4/4/77 1430 to 1440	4/7/77 0800 to 0950	4/7/77 0950 to 1040	4/7/77 1050 to 1110	4/7/77 1150 to 1240	4/7/77 1250 to 1310	4/7/77 1350 to 1410	4/7/77 1450 to 1550
1	116.5	115.5	103.2	103.7	104.2	---	104.4	104.4	---	104.9	104.6	104.7	104.8
2	114.4	113.4	103.9	103.9	---	---	105.0	105.0	---	105.0	---	---	105.0
3	112.2	111.4	103.3	103.6	103.7	---	104.1	104.1	---	104.1	---	---	104.1
4	110.4	110.7	103.9	106.8	105.7	---	103.2	103.2	103.4	104.1	105.1	106.2	106.4
5	109.8	110.1	104.0	106.0	106.7	106.3	105.4	104.2	104.7	105.3	105.8	106.2	106.3
6	108.1	108.2	106.9	106.9	---	---	106.8	---	---	106.8	---	---	106.8
7	109.2	109.9	106.5	106.5	---	---	106.6	---	---	106.6	---	---	106.6
8	114.8	114.0	106.4	106.4	---	---	107.3	---	---	107.3	---	---	107.3
9	114.3	113.8	---	---	---	---	108.0	---	---	108.0	---	---	108.0
10	111.9	112.0	---	---	---	---	109.1	---	---	---	---	109.1	---
11	112.6	112.5	106.5	106.5	---	---	106.7	---	---	106.7	---	---	106.7
12	113.1	113.0	106.5	106.2	106.3	---	106.6	---	---	106.6	---	---	106.6
13	109.0	109.5	---	---	---	---	109.0	---	---	109.0	---	---	109.0
17	111.7	110.3	104.6	105.3	105.2	105.3	106.4	106.4	106.4	106.4	106.4	106.4	106.4
18	111.8	110.0	105.4	---	105.3	105.3	106.4	106.4	106.4	106.4	106.4	106.4	106.4
19	110.4	109.8	105.2	105.3	105.4	105.4	106.3	106.3	106.3	106.3	106.3	106.3	106.3
20	115.3	114.5											
Bay Tide	---	---	103.7	105.9	106.2	105.7	100.8	102.2	102.7	104.0	104.5	105.4	105.8
High Tide	---	---	107.1 at 1245				106.7 at 1530						
Low Tide	---	---	101.0 at 0600; 102.1 at 1800				100.4 at 0830						
Rainfall since last reading (in.)			0.49				0						
Cumulative rainfall (in.)			6.91				6.91						

*All elevations are in feet, based on the Alameda Naval Air Station Datum

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

TABLE 2. (CONTINUED)

Observation Well (Boring) Number	Elevation* Top of Pipe	Elevation* Ground Surface	4/13/77 1230 to 1400	4/18/77 1000 to 1045	4/18/77 1100 to 1115	4/18/77 1130 to 1145	4/18/77 1200 to 1250	4/18/77 1300 to 1315	4/18/77 1330 to 1345	4/18/77 1400 to 1415	4/18/77 1430 to 1445	7/15/77 0930 to 1100	10/14/77 1000 to 1115
1	116.5	115.5	---	104.2	104.7	104.7	104.8	105.0	105.0	105.1	105.0	104.2	104.5
2	114.4	113.4	---	---	---	---	---	---	---	---	---	104.7	105.0
3	112.2	111.4	---	104.0	---	---	104.4	---	---	---	104.3	104.4	104.7
4	110.4	110.7	---	104.8	105.7	106.1	106.4	106.5	106.4	106.1	105.1	103.6	106.6
5	109.8	110.1	105.2	---	106.1	106.2	106.3	106.3	106.3	106.2	106.2	104.8	105.8
6	108.1	108.2	106.8	---	---	---	---	---	---	---	---	106.1	106.0
7	109.2	109.9	---	---	---	---	---	---	---	---	---	106.0	106.0
8	114.8	114.0	---	---	---	---	---	---	---	---	---	106.4	106.0
9	114.3	113.8	---	---	---	---	---	---	---	---	---	107.3	107.0
10	111.9	112.0	---	---	---	---	---	---	---	---	---	107.9	107.5
11	112.6	112.5	---	---	---	---	---	---	---	---	---	105.9	105.9
12	113.1	113.0	---	---	---	---	---	---	---	---	---	105.8	105.7
13	109.0	109.5	-	---	---	---	---	---	---	---	---	---	---
17	111.7	110.3	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
18	111.8	110.0	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
19	110.4	109.8	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
20	115.3	114.5											108.5
Bay Tide	---	---	102.7	104.6	105.0	105.4	106.1	106.5	106.1	105.8	105.4	104.0	105.6
High Tide	---	---	06.7 at 0845	106.5 at 1300								105.8 at 1345	107.4 at 1345
Low Tide	---	---	01.4 at 1445	101.2 at 0600; 102.9 at 1745								100.7 at 0630	102.8 at 0715
Rainfall since last reading (in.)			0	0								66	.89
Cumulative rainfall (in.)			6.91	6.91								7.57	8.46

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

*All elevations are in feet, based on the Alameda Naval Air Station Datum

TABLE 3 WATER QUALITY TEST RESULTS

	Column 1 - Bay Waters						Column 2 - Perimeter Wells							
	Low Tide		High Tide		Bay Averages		Well #1				Well #2			Well #3
Parameters Analyzed (Units)	3/77	7/77	3/77	7/77	3/77	7/77	11/76	3/77	7/77	10/77	11/76	3/77	7/77	11/76
Oil and grease (mg/l)*	5.5	0.73	7.40	0.73	6.45	0.73	2.2	8.5	3.27	3.8	11	6.3	1.47	11
Sulfide (mg/l)	< 0.02	0.01	< 0.02	0.01	< 0.02	0.01	3.0	12	6.6	0.01	0.10	0.026	0.02	0.27
Total Hardness (mg $CaCO_3$/l)	5,800	6,100	5,600	6,100	5,700	6,100	3,700	2,000	3,300	2,200	5,500	5,300	5,600	5,200
Total Dissolved Solids (mg/l)	3,500	39,000	34,000	30,000	18,750	34,500	--	11,000	15,000	13,000	--	2,800	26,000	--
Calcium (mg/l)	300	300	310	300	305	300	380	110	240	200	620	370	560	560
Chloride (mg/l)	18,000	19,000	13,000	19,000	15,500	19,000	5,100	5,200	7,400	6,300	13,000	14,000	14,000	12,000
COD (mg/l)(1)	1,500	2,200	270	1,900	885	2,050	240	140	460	400	140	1,000	1,400	200
pH	8.4	8.3	8.4	8.2	8.4	8.2	6.7	7.3	6.1	7.5	6.7	7.6	8.1	6.6
Iron (mg/l)	1.6	0.15	0.34	0.07	0.97	0.11	51	32	10	51	70	20	0.34	200
Magnesium (mg/l)	1,100	1,200	1,100	1,200	1,100	1,200	820	330	550	440	560	950	890	600
Nitrate Nitrogen (mg N/l)	0.55	0.21	0.25	0.40	0.4	0.34	0.22	0.25	1.7	2.8	0.42	3.9	2.9	0.54
Potassium (mg/l)	420	270	410	270	415	270	340	260	140	98	300	340	170	220
Sodium (mg/l)	10,000	6,200	9,200	780	9,600	3,490	4,000	5,700	2,000	3,300	15,000	8,000	4,200	8,000
Sulfate (mg/l)	2,500	3,200	2,100	2,700	2,300	2,950	1,600	380	1,600	460	2,000	13,000	1,400	1,100
Mercury (µg/l)	< 1	< 1.0	< 1	< 1.0	< 1	< 1.0	< 1.0	< 1.0	1.3	1	2	< 1.0	3.4	< 1.0
Lead (mg/l)	0.36	< 0.02	0.34	< 0.04	0.35	< 0.03	0.22	0.16	0.16	0.37	0.25	0.36	< 0.04	0.37
Total Phosphate (mg P/l)	0.22	0.18	0.18	0.16	0.20	0.17	1.6	1.8	5.7	1.8	0.20	0.45	2.0	0.10
Total Kjeldahl Nitrogen (mg N/l)	1.40	1.7	2.80	6.9	2.1	4.3	5.8	9.6	18	15	10	0.80	2.4	5.2
Total Chromium (mg/l)	0.02	0.03	0.06	0.03	0.04	0.03	0.12	0.02	0.26	0.32	0.25	< 0.01	0.05	0.42
Cadmium (mg/l)	0.038	< 0.01	0.028	< 0.01	0.033	< 0.01	0.02	0.014	0.04	0.01	0.28	0.052	< 0.01	0.12
Turbidity (JTU)(2)	14	28	1.30	2.6	7.65	2.7	15	74	500	6.7	42	150	150	15
Ca Hardness (mg $CaCO_3$/l)	750	750	770	750	760	750	--	270	600	500	--	920	750	--
Mg Hardness (mg $CaCO_3$/l)	4,500	4,900	4,500	4,900	4,500	4,900	--	1,400	580	800	--	3,900	3,700	--

SOURCE: HARDING-LAWSON, 1978

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

(1) Chemical oxygen demand
(2) Jackson turbidity units

*Located east of landfill

TABLE 3 WATER QUALITY TEST RESULTS (CONTINUED)

											Column 3 - Interior Wells			
	Well #4			Well #5				Well #6			Well #7			
Parameters Analyzed (Units)	11/76	3/77	7/77	11/76	3/77	7/77	10/77	11/76	3/77	10/77	11/76	3/77	7/77	10/77
Oil and grease (mg/l)*	1.6	8.2	3.27	2.0	6.8	7.34	4.6	2.8	7.2	4.9	9.7	7.9	2.80	6.2
Sulfide (mg/l)	3.3	1.1	1.0	< 0.08	0.061	0.01	< 0.01	2.5	< 0.02	< 0.01	4.9	2.1	0.40	< 0.01
Total Hardness (mg $CaCO_3$/l)	3,500	6,200	3,700	4,300	1,600	1,800	1,700	2,500	1,300	4,500	3,400	2,800	3,400	5,300
Total Dissolved Solids (mg/l)	--	16,000	17,000	--	9,700	10,000	11,000	--	7,200	6,700	--	16,000	13,000	18,000
Calcium (mg/l)	260	140	150	180	86	110	160	500	110	110	380	160	160	220
Chloride (mg/l)	16,000	8,000	9,000	6,200	5,000	5,300	5,300	7,100	3,700	3,200	12,000	8,400	14,000	7,700
COD (mg/l)(1)	290	230	600	400	3,100	690	540	220	240	150	220	72	280	410
pH	7.[illegible]	7.7	8.[illegible]	6.6	7.2	7.9	7.3	7.2	7.7	7.7	6.9	7.6	8.6	7.6
Iron (mg/l)	14	3.6	0.4[illegible]	3.6	2.6	1.7	190	13	6.6	7.5	22	8.0	0.90	9.7
Magnesium (mg/l)	350	460	470	460	180	290	300	240	180	180	350	480	410	520
Nitrate Nitrogen (mg N/l)	0.0[illegible]	0.25	0.59	0.25	0.38	0.99	1.4	0.01	1.4	0.75	0.40	1.6	1.3	1.7
Potassium (mg/l)	290	310	160	310	220	130	100	130	134	43	220	200	110	86
Sodium (mg/l)	4,000	5,500	2,400	5,500	1,000	1,000	3,000	2,000	1,800	1,800	4,000	5,200	1,600	4,300
Sulfate (mg/l)	660	68	228	68	60	< 2.0	< 10	340	160	160	960	700	500	520
Mercury (µg/l)	6	< 1.0	1.3	< 1.0	< 1.0	< 1.0	< 0.5	< 1.0	< 1.0	< 0.5	2	< 1.0	< 1.0	< 0.5
Lead (mg/l)	0.65	0.16	< 0.04	0.35	0.16	0.4	0.32	0.20	0.12	0.28	0.62	0.19	0.52	0.39
Total Phosphate (mg P/l)	0.95	1.3	1.3	0.18	0.75	1.6	0.9	2.8	1.2	1.0	0.34	0.51	1.6	0.75
Total Kjeldahl Nitrogen (mg N/l)	0.43	29	18	46	28	69	100	10	1.6	8.2	18	1.8	3.2	12
Total Chromium (mg/l)	1.0	< 0.01	0.03	0.10	< 0.01	0.20	0.11	0.08	< 0.01	0.11	0.45	< 0.02	0.04	0.11
Cadmium (mg/l)	0.08	0.016	0.01	0.18	0.019	0.46	0.024	0.13	0.014	0.009	0.03	0.025	0.01	0.011
Turbidity (JTU)(2)	12	24	27	15	42	60	290	8	37	0.83	18	32	67	3.3
Ca Hardness (mg $CaCO_3$/l)	--	350	370	--	210	270	400	--	270	270	--	400	400	550
Mg Hardness (mg $CaCO_3$/l)	--	1,900	1,900	--	1,200	1,200	1,200	--	740	740	--	2,000	1,700	2,100

(1) Chemical oxygen demand
(2) Jackson turbidity units
*Located east of landfill

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

SOURCE: HARDING-LAWSON, 1978

TABLE 3 WATER QUALITY TEST RESULTS (CONTINUED)

	Well #8	Well #9	Well #11		Well #17		Well #18			Column 4 - Outside Wells*	Well #10			Well #20
Parameters Analyzed (Units)	11/76	11/76	3/77	7/77	3/77	10/77	3/77	7/77	10/77	11/76	3/77	7/77	10/77	10/77
Oil and grease (mg/l)	16	11	11	5.80	8.4	11	8.9	4.67	6.3	12	6.9	0.67	12	8.8
Sulfide (mg/l)	0.08	0.08	0.49	0.28	0.061	< 0.01	0.045	< 0.01	0.04	< 0.08	0.02	0.03	< 0.01	0.01
Total Hardness (mg $CaCO_3$/l)	1,200	1,500	1,500	1,700	1,600	982	3,500	2,300	2,300	540	28	160	300	130
Total Dissolved Solids (mg/l)	--	--	8,300	8,800	9,800	10,000	21,000	13,000	16,000	--	840	500	3,500	320
Calcium (mg/l)	600	410	250	110	85	130	180	60	150	390	1	11	45	33
Chloride (mg/l)	4,200	5,600	4,000	4,400	5,100	5,000	12,000	7,400	8,200	400	210	120	47	22
COD (mg/l)(1)	130	42	220	540	270	315	870	450	455	43	110	170	136	52
pH	6.9	6.6	7.4	8.3	7.2	7.4	7.5	8.0	7.6	8.0	7.7	8.0	7.6	7.7
Iron (mg/l)	30	41	32	32	34	16	30	1.2	21	370	290	400	470	330
Magnesium (mg/l)	100	130	860	250	260	270	650	160	380	16	67	130	32	30
Nitrate Nitrogen (mg N/l)	0.42	0.42	0.40	1.4	0.50	1.4	0.40	1.1	1.6	0.20	6.4	1.2	28	21
Potassium (mg/l)	140	190	270	120	340	87	400	160	12	17	84	11	1.4	1.6
Sodium (mg/l)	1,300	1,000	3,800	1,000	3,700	2,800	7,000	1,300	4,400	240	84	55	65	50
Sulfate (mg/l)	78	10	24	64	2.8	< 10	32	5.6	< 10	50	0.05	34	26	98
Mercury (μg/l)	< 1.0	< 1.0	< 1	1.0	< 1.0	< 0.5	< 1.0	1.0	3.3	< 1.0	< 1.0	2.6	8.2	1
Lead (mg/l)	0.10	0.12	0.25	< 0.04	0.16	0.30	0.22	0.05	0.38	0.20	0.28	0.18	0.51	0.32
Total Phosphate (mg P/l)	0.26	0.40	0.43	0.44	0.51	1.0	1.3	0.40	0.7	0.40	0.10	9.7	2.9	1.9
Total Kjeldahl Nitrogen (mg N/l)	19	51	33	61	11	110	104	110	240	3.0	2.0	8.8	9.8	5.0
Total Chromium (mg/l)	0.12	< 0.01	0.04	0.03	< 0.01	0.11	0.02	0.02	0.12	0.90	0.66	1.5	1.56	0.90
Cadmium (mg/l)	0.14	0.32	0.015	< 0.01	0.019	0.08	0.018	< 0.01	0.08	0.73	0.028	0.02	0.34	< 0.005
Turbidity (JTU)(2)	10	50	74	100	77	21	55	86	7.2	35	1,650	3,800	1.2	1.8
Ca Hardness (mg $CaCO_3$/l)	--	--	250	270	210	320	450	150	370	--	2.5	27	110	82
Mg Hardness (mg $CaCO_3$/l)	--	--	860	1,000	1,100	1,100	2,700	660	1,600	--	280	540	130	120

(1) Chemical oxygen demand
(2) Jackson turbidity units
*Located east of landfill

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

SOURCE: HARDING-LAWSON, 1978

Table 4

Gas Chromatographic Analysis Results for Observation Wells 5 and 9

	Concentration by Volume							
	Oxygen (O_2) %	Nitrogen (N_2) %	Carbon Dioxide (CO_2) %	Methane (CH_4) %	Ethane (C_2H_6) ppm	Propane (C_3H_8) ppm	Butane (C_4H_{10}) ppm	Pentane (C_5H_{12}) ppm
Well 5	3.2	70.0	19.0	8.3	2.4	39	1	1
Well 9	15.0	67.0	8.2	8.3	2.0	40	1	1

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

Table 5

Reduced Gas Chromatographic Analysis Results

Location	Concentration (% by Volume)			
	Oxygen (O_2)	Nitrogen (N_2)	Carbon Dioxide (CO_2)	Methane (CH_4)
Well 1	20	75	3.2	0.54
Well 4	18	73	1.2	1.3
Well 6	21	76	0.07	1.6
Well 10	21	77	0.05	0.01
Well 11	8.4	80	12.5	0.5
Well 12	10	45	19.0	27.3
Well 17	15	77	6.0	0.10
Well 18	21	76	.21	.24
Magazine 57	20	74	.05	.01
Magazine 353	22	77	.05	.01

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

Table 6

Combustible Gas Meter Results

	Percentage of Methane By Volume
Well 1	>3.40
Well 2	negative*
Well 3	negative
Well 4	1.30
Well 5	1.10
Well 6	0.40
Well 7	negative
Well 8	negative
Well 9	>3.40
Well 10	negative
Well 11	0.70
Well 12	>3.40
Well 17	0.02
Well 18	0.20
Well 19	negative
Magazine 56	negative
Magazine 57	negative
Magazine 58	negative
Magazine 353	negative

3.4% is the maximum the meter can measure when, converted to methane concentrations.

* Means no gas measured.

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

ANALYTICAL SCIENCE ASSOCIATES, Inc.

4560 HORTON ST. • EMERYVILLE, CA 94608 • (415) 547-6390

HLA Project No. 2176,059.01
April 1, 1983

ABSTRACT

Samples were received from the Alameda Naval Air Station on March 16 and 17 for the screening of Priority Pollutants. No contaminants were detected in the volatile or Base-Neutral fraction. The acid and pesticide fractions contained traces of phenol and polychlorinated biphenyls. No metals were detected above 1 ppm.

METHODS

I Volatile Fraction

Samples were analyzed by gas-chromatography[1,2] for the volatile priority pollutants using GCFID and GCHSD under the following analytical conditions:

Instrument	:	Perkin Elmer 3B
Column	:	SP 1000/Carbopack B
Program	:	50^0-200^0 @ 8^0/minute

II Base Neutral/Acid Fraction

Samples were analyzed by GCFID under the following analytical conditions:

Instrument	:	Perkin Elmer 3920
Column	:	1% SP2150 DB; Tenax 60/80
Program	:	50^0-270^0 @ 8^0/minute; 180^0-300^0

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

III Pesticide Fraction

The 6, 15 and 50 percent Florisil fractions were analyzed[3] by GCHSD under the following conditions:

Instrument	:	Perkin Elmer 3B
Column	:	3% OV1
Temperature	:	180°C

IV Metals

Samples were filtered (0.45 um) and analyzed by Atomic Absorption spectroscopy.

RESULTS

Data are presented in Table I. Only the actual organic components found have been reported.

1. 40 CFR, part 141 app. C
2. Sampling and Analysis Procedures for the Screening of Industrial Effluents. EPA 1979
3. Methods for the Organic Analysis of Water and Wastes. EPA 1980.

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

TABLE I

LANDFILL WELL NO.	17	18	3	19	9	8	near 6	near 12
Sample ID	9001	9002	9003	9004	9005	9006	9007	9008
Cadmium	0.053	0.03	0.024	0.024	0.018	0.011	0.012	0.009
Copper	0.72	0.06	0.06	0.04	0.04	0.03	0.06	0.08
Lead	0.17	0.09	0.07	0.05	0.06	0.06	0.07	0.06
Selenium	0.08	0.04	0.03	0.04	0.04	0.04	0.03	0.04
Silver	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05
Zinc	0.48	0.13	0.038	0.032	0.16	0.013	0.044	0.076
Oil & Grease	30	20	15	50	80	40	20	15
Phenol (ppb)	26	11	k10	k10	11	10	11	10
TICH (ppb, as arochlor 1248)	0.52	0.08	0.05	0.60	0.40	k0.05	0.20	0.10
Arsenic	0.09	0.06	0.05	0.06	0.04	0.04	0.05	0.05
Beryllium	0.012	k0.01	k0.01	k0.01	k0.01	k0.01	k0.01	k0.01
pH	7.4	7.0	7.3	7.1	7.2	7.2	7.5	7.7
Conductivity	6400	19,000	13,000	16,000	2700	3500	1500	1300
Nickel	0.11	0.11	0.10	0.13	0.12	0.07	0.06	0.07

All values in ppm unless otherwise noted.

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

ADDENDUM

LANDFILL WELL NO.	17	18	3	19	9	8	near 6	near 12
Sample ID	9001	9002	9003	9004	9005	9006	9007	9008
Chromium	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05
Mercury	0.0008	k0.0001	k0.0001	k0.0001	0.0002	k0.0001	k0.0001	k0.0001
Magnesium	120	420	420	420	57	68	33	35

All values in ppm unless otherwise noted.

k = less than value

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

EAL Corporation

Thermo Electron CORPORATION

2030 Wright Avenue
Richmond, California 94804
(415) 235-2633
(TWX) 910-382-8132

ANALYSIS REPORT

HARDING LAWSON ASSOCIATES
P O BOX 578
NOVATO CA 94947
Attention: Lyle Lewis

DATE: 9-7-83
Samples Received: 8-8-83
EAL W.O. No. 45-5300
Harding Lawson Job #: 2176.059.01
Samples Collected: 8-2-83

Well No.		23	21
Analysis	Units	ANLW-16 255-84-7	ANLW-31 255-84-8
Antimony	MG/L	0.70	<0.01
Arsenic	MG/L	0.044	0.006
Beryllium	MG/L	<0.01	<0.01
Cadmium	MG/L	0.057	0.005
Chromium	MG/L	0.057	<0.01
Copper	MG/L	0.09	0.020
Lead	MG/L	0.33	0.04
Mercury	MG/L	<0.0005	<0.0005
Nickel	MG/L	0.40	0.08
Selenium	MG/L	0.06	<0.006
Silver	MG/L	0.053	<0.01
Thallium	MG/L	0.2	<0.01
Zinc	MG/L	0.087	0.043

EAL Corporation

Thermo Electron CORPORATION

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Richmond, California 94804
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Report to HARDING LAWSON ASSOCIATES

Well No.		22	23	21	22
		ANLW-35	ANLW-16	ANLW-31	ANLW-35
Analysis	Units	255-84-9	255-84-10	255-84-11	255-84-12
Antimony	MG/L	0.62	---	---	---
Arsenic	MG/L	0.056	---	---	---
Beryllium	MG/L	<0.01	---	---	---
Cadmium	MG/L	0.055	---	---	---
Chromium	MG/L	0.057	---	---	---
Copper	MG/L	0.06	---	---	---
Lead	MG/L	0.28	---	---	---
Mercury	MG/L	<0.001	---	---	---
Nickel	MG/L	0.41	---	---	---
Selenium	MG/L	0.04	---	---	---
Silver	MG/L	0.052	---	---	---
Thallium	MG/L	0.2	---	---	---
Zinc	MG/L	0.036	---	---	---
Cyanide	MG/L	---	<0.02	<0.02	<0.02

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Richmond, California 94804
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Report to HARDING LAWSON ASSOCIATES

Well No.		23	21	22
		ANLW-16	ANLW-31	ANLW-35
Analysis	Units	255-84-13	255-84-14	255-84-15
Phenol, Total	MG/L	<0.1	<0.1	<0.1

Results for pesticides, volatile organics, and acid & base/neutrals attached.

Laurence E. Penfold
Laurence E. Penfold
Program Manager
Environmental Science Dept.

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-2

Client I.D.: ANLW-30 8-2-83
Well No. 21

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10
p-chloro-m-cresol	< 10
2-chlorophenol	< 10
2,4-dichlorophenol	< 10
2,4-dimethylphenol	< 10
2-nitrophenol	< 10
4-nitrophenol	< 10
2,4-dinitrophenol	< 10
4,6-dinitro-2-methylphenol	< 10
pentachlorophenol	< 10
phenol	< 10

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
acenaphthene	< 2
benzidine	<10
1,2,4-trichlorobenzene	< 2
hexachlorobenzene	< 2
hexachloroethane	< 2
bis(2-chloroethyl)ether	< 2
2-chloronaphthalene	< 2
1,2-dichlorobenzene	< 2
1,3-dichlorobenzene	< 2
1,4-dichlorobenzene	< 2
3,3'-dichlorobenzidine	<10
2,4-dinitrotoluene	< 2
2,6-dinitrotoluene	< 2
2,2-diphenylhydrazine	< 2
(as azobenzene)	< 2
fluoroanthene	< 2
4-chlorophenyl phenyl ether	< 2
2-methylnaphthalene	16

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
4-bromophenyl phenyl ether	< 2
bis(2-chloroisopropyl) ether	< 2
bis(2-chlorethoxy)methane	< 2
hexachlorobutadiene	< 2
hexachlorocyclopentadiene	< 2
isophorone	< 2
napthalene	104
nitrobenzene	< 2
N-nitrosodimethylamine	< 2
N-nitrosodiphenylamine	< 2
N-nitrosodi-n-propylamine	< 2
bis(2-ethylhexyl)phthalate	10
butyl benzyl phthalate	< 2
di-n-butyl phthalate	< 2
di-n-octyl phthalate	< 2
diethyl phthalate	< 2
dimethyl phthalate	< 2
benzo(a)anthracene	< 2
benzo(a)pyrene	< 2
benzo(b)fluoranthene	< 2
benzo(k)fluoranthene	< 2
chrysene	< 2
acenaphthylene	< 2
anthracene	< 2
benzo(ghi)perylene	< 2
fluorene	< 2
phenanthrene	< 2
dibenzo(a,h)anthracene	< 2
indeno(1,2,3-cd)pyrene	< 2
pyrene	< 2

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-3

Client I.D.: ANLW-34 8-2-83
Well No. 22

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10
p-chloro-m-cresol	< 10
2-chlorophenol	< 10
2,4-dichlorophenol	< 10
2,4-dimethylphenol	< 10
2-nitrophenol	< 10
4-nitrophenol	< 10
2,4-dinitrophenol	< 10
4,6-dinitro-2-methylphenol	< 10
pentachlorophenol	< 10
phenol	< 10

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
acenaphthene	< 2
benzidine	< 10
1,2,4-trichlorobenzene	< 2
hexachlorobenzene	< 2
hexachloroethane	< 2
bis(2-chloroethyl)ether	< 2
2-chloronaphthalene	< 2
1,2-dichlorobenzene	< 2
1,3-dichlorobenzene	< 2
1,4-dichlorobenzene	< 2
3,3'-dichlorobenzidine	< 10
2,4-dinitrotoluene	< 2
2,6-dinitrotoluene	< 2
2,2-diphenylhydrazine	< 2
(as azobenzene)	< 2
fluoroanthene	< 2
4-chlorophenyl phenyl ether	< 2

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
4-bromophenyl phenyl ether	< 2
bis(2-chloroisopropyl) ether	< 2
bis(2-chlorethoxy)methane	< 2
hexachlorobutadiene	< 2
hexachlorocyclopentadiene	< 2
isophorone	< 2
napthalene	< 2
nitrobenzene	< 2
N-nitrosodimethylamine	< 2
N-nitrosodiphenylamine	< 2
N-nitrosodi-n-propylamine	< 2
bis(2-ethylhexyl)phthalate	< 2
butyl benzyl phthalate	< 2
di-n-butyl phthalate	< 2
di-n-octyl phthalate	< 2
diethyl phthalate	< 2
dimethyl phthalate	< 2
benzo(a)anthracene	< 2
benzo(a)pyrene	< 2
benzo(b)fluoranthene	< 2
benzo(k)fluoranthene	< 2
chrysene	< 2
acenaphthylene	< 2
anthracene	< 2
benzo(ghi)perylene	< 2
fluorene	< 2
phenanthrene	< 2
dibenzo(a,h)anthracene	< 2
indeno(1,2,3-cd)pyrene	< 2
pyrene	< 2

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-1
Client I.D.: ANLW-15 8-2-83
Well No. 23

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)	BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10	4-bromophenyl phenyl ether	< 2
p-chloro-m-cresol	< 10	bis(2-chloroisopropyl) ether	< 2
2-chlorophenol	< 10	bis(2-chlorethoxy)methane	< 2
2,4-dichlorophenol	< 10	hexachlorobutadiene	< 2
2,4-dimethylphenol	38	hexachlorocyclopentadiene	< 2
2-nitrophenol	< 10	isophorone	< 2
4-nitrophenol	< 10	napthalene	80
2,4-dinitrophenol	< 10	nitrobenzene	< 2
4,6-dinitro-2-methylphenol	< 10	N-nitrosodimethylamine	< 2
pentachlorophenol	< 10	N-nitrosodiphenylamine	< 2
phenol	< 10	N-nitrosodi-n-propylamine	< 2
BASE/NEUTRAL COMPOUNDS	**ug/L(ppb)**	bis(2-ethylhexyl)phthalate	6
acenaphthene	< 2	butyl benzyl phthalate	< 2
benzidine	<10	di-n-butyl phthalate	< 2
1,2,4-trichlorobenzene	< 2	di-n-octyl phthalate	< 2
hexachlorobenzene	< 2	diethyl phthalate	< 2
hexachloroethane	< 2	dimethyl phthalate	< 2
bis(2-chloroethyl)ether	< 2	benzo(a)anthracene	< 2
2-chloronaphthalene	< 2	benzo(a)pyrene	< 2
1,2-dichlorobenzene	< 2	benzo(b)fluoranthene	< 2
1,3-dichlorobenzene	< 2	benzo(k)fluoranthene	< 2
1,4-dichlorobenzene	< 2	chrysene	< 2
3,3'-dichlorobenzidine	<10	acenaphthylene	< 2
2,4-dinitrotoluene	< 2	anthracene	< 2
2,6-dinitrotoluene	< 2	benzo(ghi)perylene	< 2
2,2-diphenylhydrazine	< 2	fluorene	< 2
(as azobenzene)	< 2	phenanthrene	< 2
fluoroanthene	< 2	dibenzo(a,h)anthracene	< 2
4-chlorophenyl phenyl ether	< 2	indeno(1,2,3-cd)pyrene	< 2
		pyrene	< 2

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-5

Client I.D.: ANLW 28 & 29
Well No. 21

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	< 5	trans-1,3-dichloropropene	< 1
acrylonitrile	< 5	cis-1,3-dichloropropene	< 1
benzene	6	ethylbenzene	5
carbon tetrachloride	< 1	methylene chloride	<10
chlorobenzene	31	chloromethane	< 1
1,2-dichloroethane	< 1	bromomethane	< 1
1,1,1-trichloroethane	< 1	bromoform	< 1
1,1-dichloroethane	< 1	bromodichloromethane	< 1
1,1,2-trichloroethane	< 1	fluorotrichloromethane	< 1
1,1,2,2-tetrachloroethane	< 1	dichlorodifluoromethane	< 1
chloroethane	< 1	chlorodibromomethane	< 1
2-chloroethylvinyl ether	< 1	tetrachloroethene	< 1
chloroform	< 1	toluene	7
1,1-dichloroethene	< 1	trichloroethene	< 1
trans-1,2-dichloroethene	< 1	vinyl chloride	< 1
1,2-dichloropropane	< 1	acetone	620
		o-xylene	11

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-6

Client I.D.: ANLW 32 & 33 8-2-83
Well No. 22

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	< 5	trans-1,3-dichloropropene	< 1
acrylonitrile	< 5	cis-1,3-dichloropropene	< 1
benzene	< 1	ethylbenzene	< 1
carbon tetrachloride	< 1	methylene chloride	<10
chlorobenzene	< 1	chloromethane	< 1
1,2-dichloroethane	< 1	bromomethane	< 1
1,1,1-trichloroethane	< 1	bromoform	< 1
1,1-dichloroethane	< 1	bromodichloromethane	< 1
1,1,2-trichloroethane	< 1	fluorotrichloromethane	< 1
1,1,2,2-tetrachloroethane	< 1	dichlorodifluoromethane	< 1
chloroethane	< 1	chlorodibromomethane	< 1
2-chloroethylvinyl ether	< 1	tetrachloroethene	< 1
chloroform	< 1	toluene	< 1
1,1-dichloroethene	< 1	trichloroethene	< 1
trans-1,2-dichloroethene	< 1	vinyl chloride	< 1
1,2-dichloropropane	< 1		

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-4
Client I.D.: ANLW 13 & 14 8-2-83
Well No. 23

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	<25	trans-1,3-dichloropropene	< 5
acrylonitrile	<25	cis-1,3-dichloropropene	< 5
benzene	< 5	ethylbenzene	< 5
carbon tetrachloride	< 5	methylene chloride	<50
chlorobenzene	< 5	chloromethane	< 5
1,2-dichloroethane	< 5	bromomethane	< 5
1,1,1-trichloroethane	< 5	bromoform	< 5
1,1-dichloroethane	< 5	bromodichloromethane	< 5
1,1,2-trichloroethane	< 5	fluorotrichloromethane	< 5
1,1,2,2-tetrachloroethane	< 5	dichlorodifluoromethane	< 5
chloroethane	< 5	chlorodibromomethane	< 5
2-chloroethylvinyl ether	< 5	tetrachloroethene	< 5
chloroform	< 5	toluene	235
1,1-dichloroethene	< 5	trichloroethene	< 5
trans-1,2-dichloroethene	< 5	vinyl chloride	< 5
1,2-dichloropropane	< 5		

NON-PRIORITY POLLUTANTS

tetrahydrofuran	25	diethylether	25
diethylacetate	25	1-ethyl-4-methylbenzene	22
ozulene	22		

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-2

Client I.D.: ANLW-31
Well No. 21

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	0.2	pp-DDT (4,4')	<0.1
g-BHC (lindane)	<0.1	Endrin Aldehyde	<0.1
B-BHC	<0.1	Endosulfan Sulfate	0.1
Heptachlor	0.4	Chlordane	<0.1
D-BHC	<0.1	Toxaphene	<3
Aldrin	<0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.2
a-Endosulfan	<0.1	PCB-1221	<0.2
p,p-DDE (4,4')	<0.1	PCB-1232	<0.2
Dieldrin	<0.1	PCB-1242	<0.2
Endrin	<0.1	PCB-1254	<0.2
p,p-DDD (4,4')	<0.1	PCB-1260	<0.2
B-Endosulfan	<0.1	PCB-1262	<0.2
1,2,3,4-TCDD	<0.1		

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-3

Client I.D.: ANLW-34
Well No. 22

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	<0.1	pp-DDT (4,4')	<0.1
g-BHC (lindane)	0.3	Endrin Aldehyde	<0.1
B-BHC	<0.1	Endosulfan Sulfate	<0.1
Heptachlor	0.2	Chlordane	<0.1
D-BHC	<0.1	Toxaphene	<0.6
Aldrin	0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.1
a-Endosulfan	<0.1	PCB-1221	<0.1
p,p-DDE (4,4')	<0.1	PCB-1232	<0.1
Dieldrin	<0.1	PCB-1242	<0.1
Endrin	<0.1	PCB-1254	<0.1
p,p-DDD (4,4')	<0.1	PCB-1260	<0.1
B-Endosulfan	<0.1	PCB-1262	<0.1
1,2,3,4-TCDD	<0.1		

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-1
Client I.D.: ANLW-15
Well No. 23

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	<0.1	pp-DDT (4,4')	0.7
g-BHC (lindane)	<0.1	Endrin Aldehyde	0.1
B-BHC	<0.1	Endosulfan Sulfate	0.5
Heptachlor	<0.1	Chlordane	<0.1
D-BHC	0.2	Toxaphene	<3
Aldrin	<0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.2
a-Endosulfan	<0.1	PCB-1221	<0.2
p,p-DDE (4,4')	<0.1	PCB-1232	<0.2
Dieldrin	<0.1	PCB-1242	<0.2
Endrin	<0.1	PCB-1254	<0.2
p,p-DDD (4,4')	<0.1	PCB-1260	<0.2
B-Endosulfan	<0.1	PCB-1262	<0.2
1,2,3,4-TCDD	<0.1		

ANALYTICAL SCIENCE ASSOCIATES, Inc.

4560 HORTON ST. • EMERYVILLE, CA 94608 • (415) 547-6390

7 September 1983

Lyle Lewis
HARDING LAWSON ASSOCIATES
P. O. Box 578
Novato, CA 94948

Dear Lyle:

Enclosed is the Alameda Naval Air Station Analytical Report. If you have any questions please call.

Sincerely,

Bill

William Prater

WP:la

Enclosure

ABSTRACT

Samples from Alameda Naval Air Station were screened for Priority Pollutants and pesticides using EPA 608/624/625 GCFID/EC methodology. The only parameters found were low-level (<10 ppb) PCB ontamination in two wells.

METHODS

(A) Volatile Fraction

Samples were analyzed for volatile components by GCEC/FID[1] using the following analytical conditions:

Instrument	:	Perkin-Elmer Sigma 3
Detector	:	EC/FID
Column	:	SP1000/Graphitized Carbon Black
Temperature	:	50° - 210° C.

(B) Base-Neutral/Acid Fraction

Samples were analyzed[2] under the following analytical conditions:

Instrument	:	Perkin-Elmer Sigma 3B
Detector	:	FID
Column	:	SP2100 DB; SP1240 DA
Temperature	:	50° - 270°; 50° - 200°
Internal Standard	:	D_{10}Anthracene; 2 Nitrophenol

(C) Pesticides/PCB's

Samples were analyzed[2] under the following analytical conditions:

Instrument	:	Perkin-Elmer 3B
Detector	:	EC
Column	:	3% OV1
Temperature	:	180°C
Internal Standard	:	Aldrin

1. 40 CFR Part III, App. C.
2. 40 CFR Vol 44, #233.

TABLE I

All values in ppb

SAMPLE ID	Well No.	VOLATILE	ACID, B-N	PESTICIDES/PCB's[3]
W01	19	<1	<20	-
W04	3	<1	<20	-
W07	24	<1	<20	-
W10	Blank	<1	<20	-
W17	25	<1	<20	-
W20	9	<1	<20	-
W23	20	<1	<20	-
W36	8	<1	<20	-
W201	19	<1	<20	ND
W203	20	<1	<20	8
W205	9	<1	<20	ND
W207	Blank	<1	<20	ND
W209	3	<1	<20	ND
W211	24	<1	<20	ND
W213	23	<1	<20	ND
W215	8	<1	<20	ND
W217	18	<1	<20	ND
W219	25	<1	<20	ND
W221	21	<1	<20	4
W223	22	<1	<20	ND

(3) Detection Limit 1 ppb.

TABLE II

PERCENT RECOVERY
OF INTERNAL STANDARDS

SAMPLE ID.	VOLATILE(1)	ACID(2)	B-N(3)	PESTICIDES(4) & PCBs
W01	95	79	98	
W04	97	85	100	
W07	93	85	100	
W10	95	90	96	
W17	95	88	95	
W20	96	89	100	
W23	98	79	95	
W36	99	75	92	
W201	93	80	100	85
W203	95	82	100	85
W205	99	80	100	90
W207	95	85	95	100
W209	96	80	96	85
W211	94	90	97	88
W213	95	85	95	89
W215	95	85	100	90
W217	100	90	95	89
W219	100	88	95	90
W221	95	90	96	88
W223	96	85	99	90

1. Bromodichloromethane
2. 2 Nitrophenol
3. D_{10}Anthracene
4. Aldrin

APPENDIX B

BORING LOGS FROM PREVIOUS STUDIES

BORING LOCATION Opposite to Ground Electronics Maintenance Division			GROUND EL.
DEPTH/ELEV. WATER 4.5 ft	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 25 ft
DRILL RIG Mobile B-34	BORING DIA. 8" ϕ HA	DATE DRILLED 10/12/84	LOGGED BY JMc / CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / ROD	REC.	MODE	REMARKS
GP	0.0'- 3.0' Sandy GRAVEL, angular to rounded gravel to ~ 2" max. with some minor rubble within top 2", tan/ light brown (0-2') to dark brown (2'-3'), moist	0				HA	
SP	3.0'- 20.0' Fine to Medium SAND with gravel, brown changing to gray at 4 ft, moist to saturated at 5 ft, mild organic odor at 3 ft.		S-1A S-1B	2/4/6	18"	DR	Minor gas odor ▽ at 4 ft
		5					4% LEL at 5 ft Minor gas odor
			S-2A S-2B	5/3/3	14"	DR	
						HA	
				2/6/16		DR	Auger at 10 ft, stem filled to ~ 7.5 ft with running sand, PR taken in the stem
		10				HA	Poor cuttings return throughout interval
				4/2/3		DR	Auger at 15 ft, stem filled to ~ 13 ft with running sand. PR taken in the stem.
		15				HA	
MH-ML	20.0'-25.0' Clayey SILT, some sand, gray, soft, saturated	20					Installed 2" ϕ sch. 40 PVC pipes, (0-5 ft: blank, 5-25 ft: slotted, 0.01")
	hole terminated at 25'	25					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG PROJECT NO. NAV112A — SHEET NO. 1 OF 1	BORING NO. WA-1

BORING LOCATION North End of Skeet Range			GROUND EL.
DEPTH/ELEV. WATER 3 ft ±	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 21.5 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/12/84	LOGGED BY JMc/CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP	0.0'–5.0' Sandy GRAVEL, gravel particles are 3/4" to 1½" in size, light brown, some concrete rubble up to 12"x 12"x3".	0				HA	DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES. THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION. THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS. THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL. SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.
SP-GP	5.0'–8.0' Gravelly fine to medium SAND, brown to gray, damp to wet	5	S-1A S-1B	2/4/4	12"	DR	
						HA	
SP	8.0'–19.0' Fine to Medium SAND, blue gray, saturated						Moderate petroleum fuel odor
		10					Definite oily band on sampler @ 10', oil sheen on spilled water
	Gray-brown, appeared oxidized						Much milder odor at about 12 ft
	Numerous shell fragments to 1/4" at about 15 ft	15		2/5/3		DR	Auger at 15 ft, stem filled to ~10 ft with running sand
						HA	
MH-CH	19.0'–21.5' Clayey SILT, blue gray, saturated, soft, plastic, sometimes dilatant	20		1/1/0		DR	Trace gray clay on bit and plug. No fuel smell
	Hole terminated at 20.5' after drilling out the sampled interval						Installed 2" Φ sch. 40 PVC Threaded; (0-5.5': blank, 5.5'-19.5' slotted, 0.01")

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG — PROJECT NO. [illegible] — SHEET NO. [illegible] OF [illegible]	BORING NO. WA-2

BORING LOCATION By the fence of Party Hut Picnic Ground			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 20.0 ft
DRILL RIG Mobile B-34	BORING DIA. 8"φ HA	DATE DRILLED 10/15/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
SM-SP	0.0'-5.0' Fine SAND with wood chips and rubble, Moist, dark gray and black	0				HA	
SP	5.0'-8.0' Fine to medium SAND with wood chips, rubble, wires, etc., black.	5	S-1	2/2/3	6"	DR	Strong diesel and oil odor
						HA	
SP	8.0'-16.5' Fine to medium SAND, gray, saturated, loose, saturated						
		10		1/4" and 1/6"		DR	Diesel odor (not as strong as S-1). 8% LEL at 10 ft
						HA	
		15		2/1/0		DR	400 ppm at 15 ft. At the last 6" drive, the sampler dropped to about 18 ft
CH-MH	16.5'-20.0' Silty CLAY, gray, very soft					HA	Side wall pressure: drive rotation pressure (on 3rd gear) increased from 600 to 715 psi
	Hole terminated at 20 ft	20					Installed 2"φ sch. 40 PVC pipes, (0-6': blank, 6'-16' slotted, 16'-20' blank)

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

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SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG		BORING NO.
		PROJECT NO. NAV1123	SHEET NO. 1 OF 1	WA-3

BORING LOCATION West End of Runway 7, Northwestern Corner		GROUND EL.
DEPTH/ELEV. WATER 4 ft	DRILL CONTRACTOR EXCELTECH-RPM	TOTAL DEPTH 31.5 ft
DRILL RIG Mobile B-34 / BORING DIA. 8" Φ HA	DATE DRILLED 10/17/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP-GC	0.0'-4.0' Gravelly fine SAND, some silt and clay, dark brown, moist, gravel to ~2" max., some rubble and roots	0				HA	
SP	4.0'-14.0' Fine to medium SAND, some gravel, brown, moist. Became saturated at ~5 feet.	5	S-1	7/8/10	18"	DR	▽ No noticeable odor
						HA	
		10		3/5/6		DR	
						HA	
SM-SP	14.0'-28.0' Fine to medium SAND, some silt, trace gravel, dark gray, saturated. No noticeable odor. (Gas meter did not register any reading)	15				DR	Much water came out with cutting during drilling. Could not get sample at this depth. Drillers could not get the plug out because of running sand. Water was poured into the stem and driven through.
						HA	
		20				DR	Same condition occurred at 20'. No sampling
	More silt and less gravel					HA	
		25					

Wahler Associates

CONFIRMATION STUDY
NAS-ALAMEDA

EXPLORATION BORING LOG

PROJECT NO. NAV 112A

SHEET NO. 1 OF 2

BORING NO. WA-4

BORING LOCATION West End of Runway 7, Northwestern Corner			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR		TOTAL DEPTH
DRILL RIG	BORING DIA.	DATE DRILLED	LOGGED BY

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / ROD	REC.	MODE	REMARKS
		25				DR	Same condition occurred at 25 ft. No sampling
						HA	
CH	28.0'-31.5' Silty CLAY, trace sand and shells, gray, soft.						
		30		1/1/1		DR	
	Terminated at 31.5 ft						Installed 2" ϕ sch.40 PVC pipes (0-5': blank 5'-25' slotted, 25'-30': blank). Material kept coming up in the stem. Hole was cleaned one more time before being able to set the tip of the pipe at 30 ft

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

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Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG		BORING NO.
		PROJECT NO. NAV112A	SHEET NO. 2 OF 2	WA-4

BORING LOCATION North End of Runway 13, West side			GROUND EL.
DEPTH/ELEV. WATER 5 ft	DRILL CONTRACTOR		TOTAL DEPTH 26.5 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/19/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP-GM	0.0'–5.0' Silty GRAVEL and SAND, some cobble, rubble, groves, etc., damp, dark brown	0				HA	
GP-GM	5.0'–10.0' Silty GRAVEL and SAND, some cobble, moist to wet, dark brown	5	S-1A S-1B	12/14/5	18"	DR	▽ Gas meter reading negligible Radiation survey meter reading negligible
						HA	
GP-GM	10.0'–24.0' Fine to medium SAND, some silt, trace shells and gravel, gray, saturated, loose	10		2/3/4		DR	Gas meter reading negligible Radiation survey meter reading negligible
						HA	
		15		1/2/4		DR	
						HA	
		20		3/3/5		DR	
						HA	
	(See next sheet)	25					

Wahler Associates

CONFIRMATION STUDY
NAS-ALAMEDA

EXPLORATION BORING LOG

PROJECT NO. NAV 112 A

SHEET NO. 1 OF 2

BORING NO. WA-5

BORING LOCATION North End of Runway 13, West side			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR		TOTAL DEPTH
DRILL RIG	BORING DIA.	DATE DRILLED	LOGGED BY

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
CH-MH	24.0'-26.5' Silty CLAY, trace sand, gravel and shells, dark gray, soft	25		1/0/1		DR	
	Hole terminated at 26.5'						Installed 2"φ sch. 40 PVC pipes (0-4' blank; 4'-24' slotted) The stem was filled with soft material. The hole was cleaned and the tip of the pipe was set at 24 ft.
		30					

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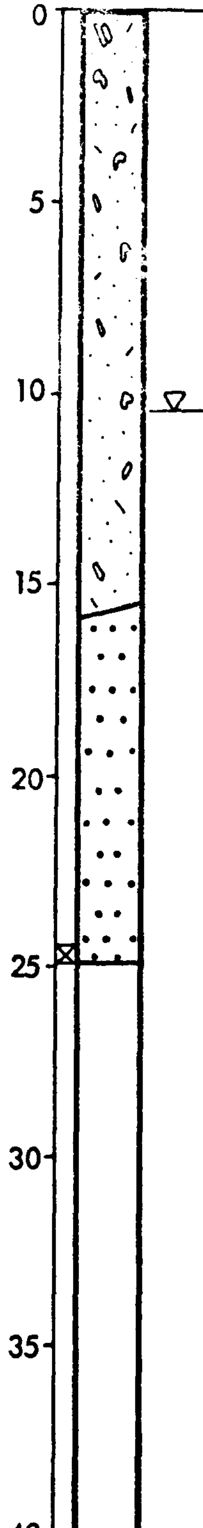
Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG	BORING NO.
		PROJECT NO. NAV112A / SHEET NO. 2 OF 2	NA-5

LOG OF BORING 1

Equipment: 6" Flight Auger

Elevation: 115.5* feet Date: 10/29/76

Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample



BROWN SILTY SAND (SM)
loose to medium dense, moist, with debris

water level 4/18/77

BROWN SAND (SP)
loose, saturated,

Refuse Fill

Hydraulic Fill

*Reference: Topo, NAS Alameda Sanitary Dump Facility, 1975, by M. B. Cristi

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

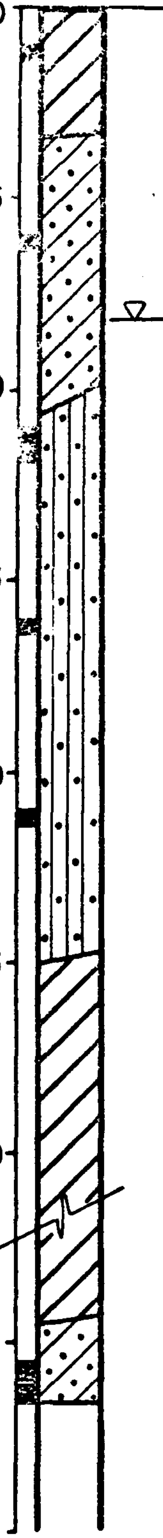
LOG OF BORING 1
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 2

LOG OF BORING 2

Equipment: 5" Rotary Wash
Elevation: 113.4 feet Date: 10/26/76

Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample



Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Description
		0	BROWN-BLACK CLAY (CH) very soft, moist
			LIGHT BROWN CLAYEY SAND (SC) loose, saturated
22.9	94	5	
			water level 4/7/77
		10	GRAY SILTY SAND (SM) loose, saturated
		15	
		20	
		25	GRAY SILTY CLAY (CH) very soft, saturated, (bay mud)
		30	
		45	LIGHT BROWN CLAYEY SAND (SC) medium dense, saturated
17.6	113		
		50	

Hydraulic Fill (0 to 25 ft)

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: KD Date 5/10/77

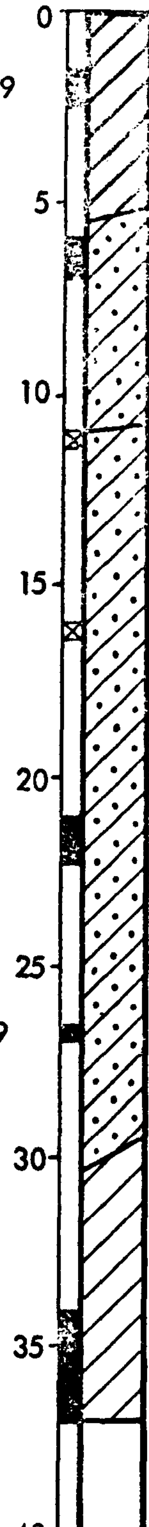
LOG OF BORING 2
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 3

LOG OF BORING 3

Equipment: 5" Rotary Wash
Elevation: 111.4 feet   Date: 10/25/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)
97% passing No. 200 sieve	64.7	59	
	23.6	99	



BROWN-GRAY CLAY (CH)
very soft, saturated

LIGHT GRAY CLAYEY SAND (SC)
medium dense, saturated
water level 4/18/77

LIGHT GRAY-BROWN CLAYEY SAND (SC) - very loose, saturated

Hydraulic Fill

GRAY SILTY CLAY (CL)
very soft, saturated, (bay mud)

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01   Appr: JCD   Date 5/20/77

LOG OF BORING 3
Sanitary Landfill Site
Alameda Naval Air Station

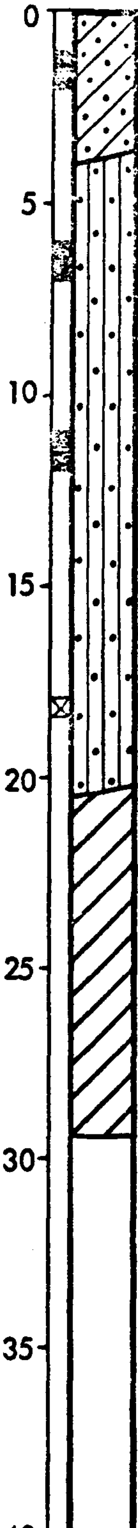
PLATE 4

LOG OF BORING 4

Equipment: 5" Rotary Wash

Elevation: 110.7 feet Date: 10/21/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample
13% passing No. 200 sieve	18.5	104		



LIGHT BROWN CLAYEY SAND (SC)
loose, dry, with debris

Refuse Fill

DARK GRAY SILTY SAND (SM)
medium dense, saturated, with concrete rubble
water level 4/18/77

Hydraulic & Sea Wall Fill

DARK GRAY CLAY (CH)
soft, saturated, (bay mud)

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Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 4

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 5

LOG OF BORING 5

Equipment 5" Rotary Wash

Elevation 110.1 Date 10/20/76

Shear Strength (lbs/sq ft)

Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Description
5.0	122	0	BROWN SILTY SANDY GRAVEL (GM) medium dense, dry
			BLACK SILTY SAND (SM) loose, moist, with debris; water level 4/18/77
		5	
		10	
			DARK GRAY SILTY SAND (SM) loose, saturated
		15	
		20	
32.7	84		
		25	BLACK CLAY (CH) very soft, saturated, (bay mud)
		30	
		35	
		40	

Refuse Fill (0 to about 12.5 ft)

Hydraulic Fill (about 12.5 to 25 ft)

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: KD Date 5/20/77

LOG OF BORING 5

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 6

LOG OF BORING 6

Equipment: 5" Rotary Wash

Elevation: 108.2 feet   Date: 10/21/76

Columns: Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

Depth (ft)	Description
0	DARK GRAY SILTY SAND (SM) loose, saturated, with rock fragments water level 4/7/77
~4	BLACK SANDY CLAY (CL) very soft, saturated
~7	DARK GRAY SILTY SAND (SM) very loose, saturated
~15	LIGHT BROWN SILTY SAND (SM) loose, saturated
~27	GRAY SILTY CLAY (CH) very soft, saturated, with shells, (bay mud)

Hydraulic Fill (0 to ~26.5 ft)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

(Continuation of Log)

Depth (ft)	Description
~63	GRAY SILTY SAND (SM) medium dense, saturated

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75, 80

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No 2176,030.01   Appr: JCD   Date 5/20/77

LOG OF BORING 6

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 7

LOG OF BORING 7

Equipment 5" Rotary Wash

Elevation 109.9 feet Date 10/25/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample
			0	
			5	
			10	
			15	
			20	
			25	
			30	
			35	
			40	

Refuse Fill

LIGHT BROWN SILTY SAND (SM)
loose, with debris
water level 4/7/77

Hydraulic Fill

GRAY SILTY SAND (SM)
loose, saturated

LIGHT BROWN SILTY SAND (SM)
loose, saturated

LIGHT GRAY CLAY (CH)
very soft, saturated, (bay mud)

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No 2176,030.01 Appr: JG Date 5/10/77

LOG OF BORING 7

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 8

LOG OF BORING 8

Equipment 8" Hollow Auger

Elevation 114.0 feet Date 10/29/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SAND (SP) medium dense, moist, with debris
			5		
					▽ water level 4/7/77
			10		
			15		
	19.2	104		■	DARK GRAY SILTY SAND (SM) loose, saturated
			20		
			25		
			30		
			35		
			40		

Refuse Fill (0–15.5 ft)

Hydraulic Fill (15.5–25 ft)

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 8

Sanitary Landfill Site
Alameda Naval Air Station

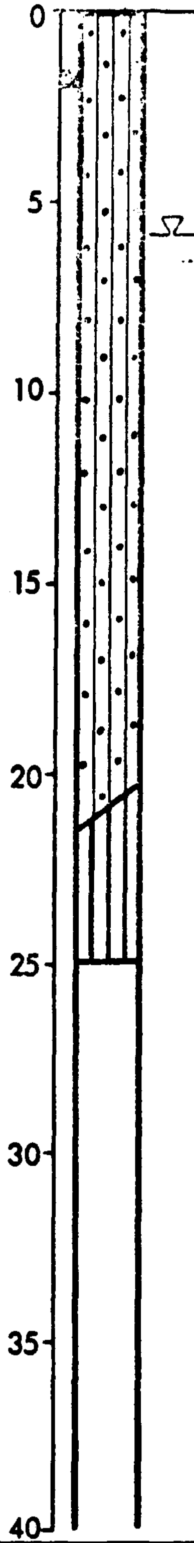
PLATE 9

LOG OF BORING 9

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample

Equipment 6" Flight Auger

Elevation 113.8 feet Date 10/29/76



BROWN SILTY SAND (SM)
loose to medium dense, moist, with debris

water level 4/7/77

Refuse Fill

DARK GRAY CLAYEY SILT (MH)
soft to medium stiff, saturated, (bay mud)

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 9

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 10

LOG OF BORING 10

Equipment 8" Hollow Auger

Elevation 112.0 feet Date 10/28/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Description
			0	LIGHT BROWN SAND (SP) medium dense, moist, with silt lenses; water level 4/7/77 (Hydraulic Fill)
	20.3	104	5	
			10	
5.7% passing No. 200 sieve	21.4	100	15	
			20	DARK GRAY SANDY SILT (ML) medium stiff, saturated
			25	
			30	
			35	
			40	

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Job No 2176,030.01 Appr: JC Date 5/20/77

LOG OF BORING 10

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 11

LOG OF BORING 11

Equipment 6" Flight Auger

Elevation 112.5 feet Date 10/29/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description	
			0		BROWN SILTY SAND (SM) loose to medium dense, with debris	Refuse Fill
			5		water level 4/7/77	
			10			
			15			
					DARK BLUE-GRAY SILTY SAND (SM) loose, saturated	Hydraulic Fill
			20			
					BLUE-GRAY CLAYEY SILT (MH) medium stiff, saturated, with lenses of silty sand	
			25			
			30			
			35			
			40			

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Job No. 2176,030.01 Appr: JCP Date 5/20/77

LOG OF BORING 11

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 12

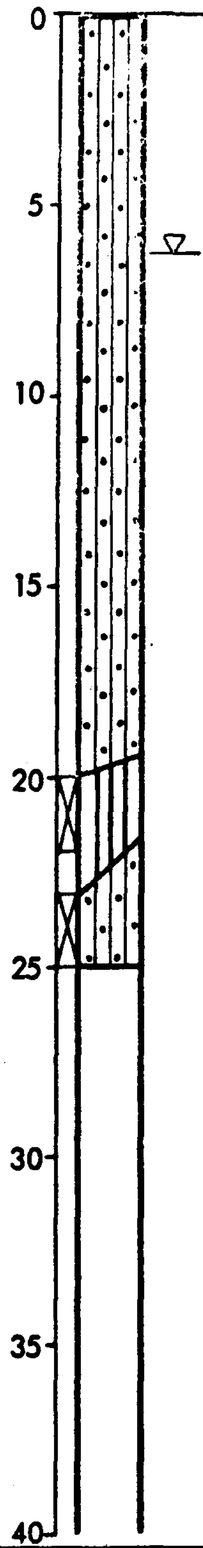
LOG OF BORING 12

Shear Strength (lbs/sq ft)

Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

Equipment 6" Flight Auger

Elevation 113.0 feet Date 10/29/76



BROWN SILTY SAND (SM)
loose, moist, with debris

water level 4/7/77

Refuse Fill

DARK GRAY CLAYEY SILT (MH)
medium stiff, saturated, (bay mud)

DARK GRAY SILTY SAND (SM)
loose, saturated

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCP Date 5/20/77

LOG OF BORING 12

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 13

LOG OF BORING 13

Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

Equipment: Hand Auger

Elevation: 109.5 feet Date: 11/9/76

82.3% passing No. 200 sieve

Depth (ft): 0, 5, 10, 15

BROWN CLAYEY SILT (MH)
stiff, dry, (desiccated bay mud)
becoming soft, moist at 3'
water level 4/7/77

DARK GRAY SILTY SAND (SM)
loose, saturated, (fill)

Hydraulic Fill

LOG OF BORING 14

Equipment: Hand Auger

Elevation: 113.3 feet Date: 11/9/76

15% passing No. 200 sieve

Depth (ft): 0, 5, 10, 15

BROWN SAND (SP)
loose, moist, with organic matter

GRAY-BLACK SILT (MH)
soft, saturated

BROWN SAND (SP)
loose, moist
becoming wetter at 6'

Hydraulic Fill

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

ob No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORINGS 13&14

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 14

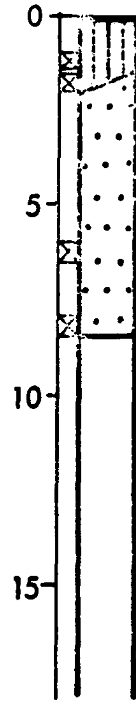
N34547

LOG OF BORING 15

Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

Equipment: Hand Auger

Elevation: 113.9 feet Date: 11/16/76



LIGHT BROWN SILT (MH)
medium stiff, dry, (desiccated bay mud)

LIGHT BROWN SAND (SP)
medium dense, dry

wet at 8'

Hydraulic Fill

LOG OF BORING 16

Equipment: Hand Auger

Elevation: 109.3 feet Date: 11/16/76

95.4% passing No. 200 sieve

BROWN SILT (MH)
soft to medium dense, moist, (desiccated bay mud)
becoming softer at 4'

Hydraulic Fill

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Job No. 2176,030.01 Appr: JO Date 5/20/77

LOG OF BORINGS 15&16

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 15

N34547

LOG OF BORING 17

Equipment 9" Hollow Auger

Elevation 110.3 feet Date 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SANDY CLAY (CL) medium stiff, wet, with organic matter
					DEBRIS FILL loose water level 4/18/77
			5		
			10		
					BLACK SAND (SP) loose, saturated
	20.2	106	15		
			20		
					BLUE-GRAY CLAYEY SILT (MH) soft, saturated, (bay mud)
			25		
					BROWN SAND (SP) loose, saturated
			30		
			35		
			40		

Refuse Fill (0 to approx. 12 ft)

Hydraulic Fill (approx. 12 to 22 ft)

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Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 17

Sanitary Landfill Site
Alameda Naval Air Station

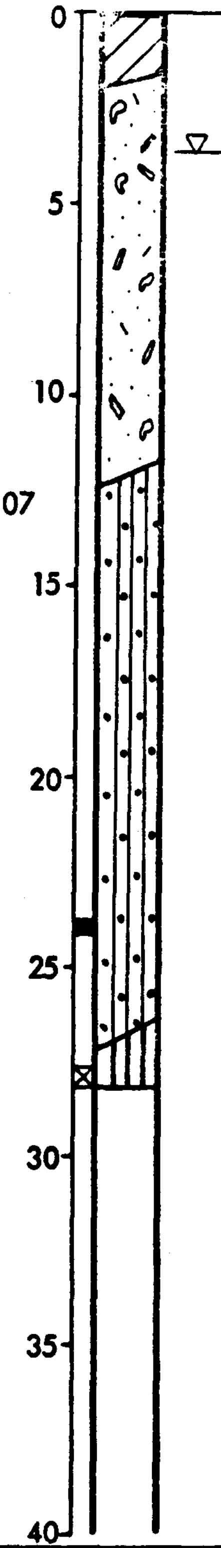
PLATE
16

LOG OF BORING 18

Equipment 9" Hollow Auger

Elevation 110 feet Date 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample
15.0% passing No. 200 sieve	20.9	107		



BROWN SANDY CLAY (CL)
medium stiff, wet, with debris

DEBRIS FILL
loose
water level 4/18/77

Refuse Fill

BLACK SILTY SAND (SM)
loose, saturated

Hydraulic Fill

DARK GRAY CLAYEY SILT (MH)
soft, saturated, (bay mud)

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Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 18
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 17

LOG OF BORING 19

Equipment: 9" Hollow Auger

Elevation: 109.8 feet Date: 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SANDY CLAY (CL) medium stiff, wet
					DEBRIS FILL loose, saturated; water level 4/18/77
			5		
			10		
					BLACK SILTY SAND (SM) loose, saturated, with layers of sandy silt
	44.6	75	15		
			20		
			25		
			30		
			35		
			40		

Refuse Fill

Hydraulic Fill

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Consulting Engineers and Geologists

Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 19
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 18

LOG OF BORING 20

Shear Strength (lbs/sq ft)

Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

Equipment Hand Auger

Elevation 114.5 feet Date 10/6/77

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40

BROWN SAND (SP)
medium dense, dry

becomes moist at 2'
becomes wet at 4'

water level 10/6/77

Hydraulic Fill

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Consulting Engineers and Geologists

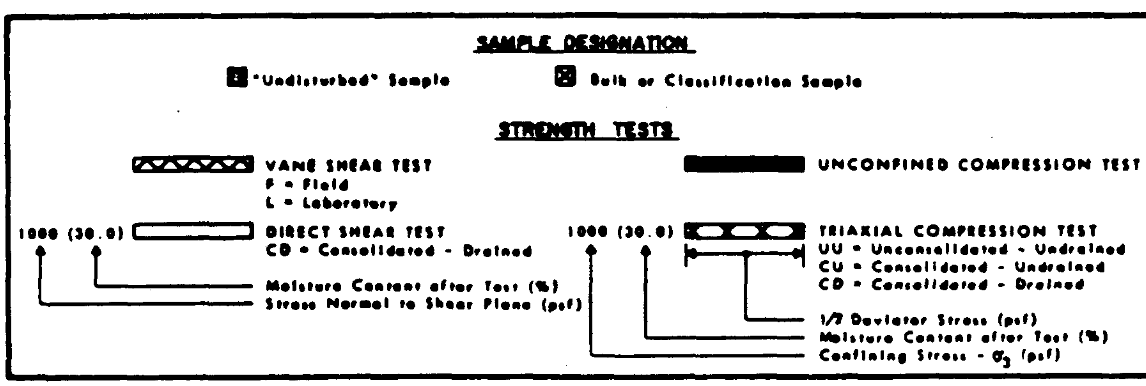
Job No. 2176,030.01 Appr: JS Date 11/21/77

LOG OF BORING 20
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 19

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS — MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS — MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS



KEY TO TEST DATA

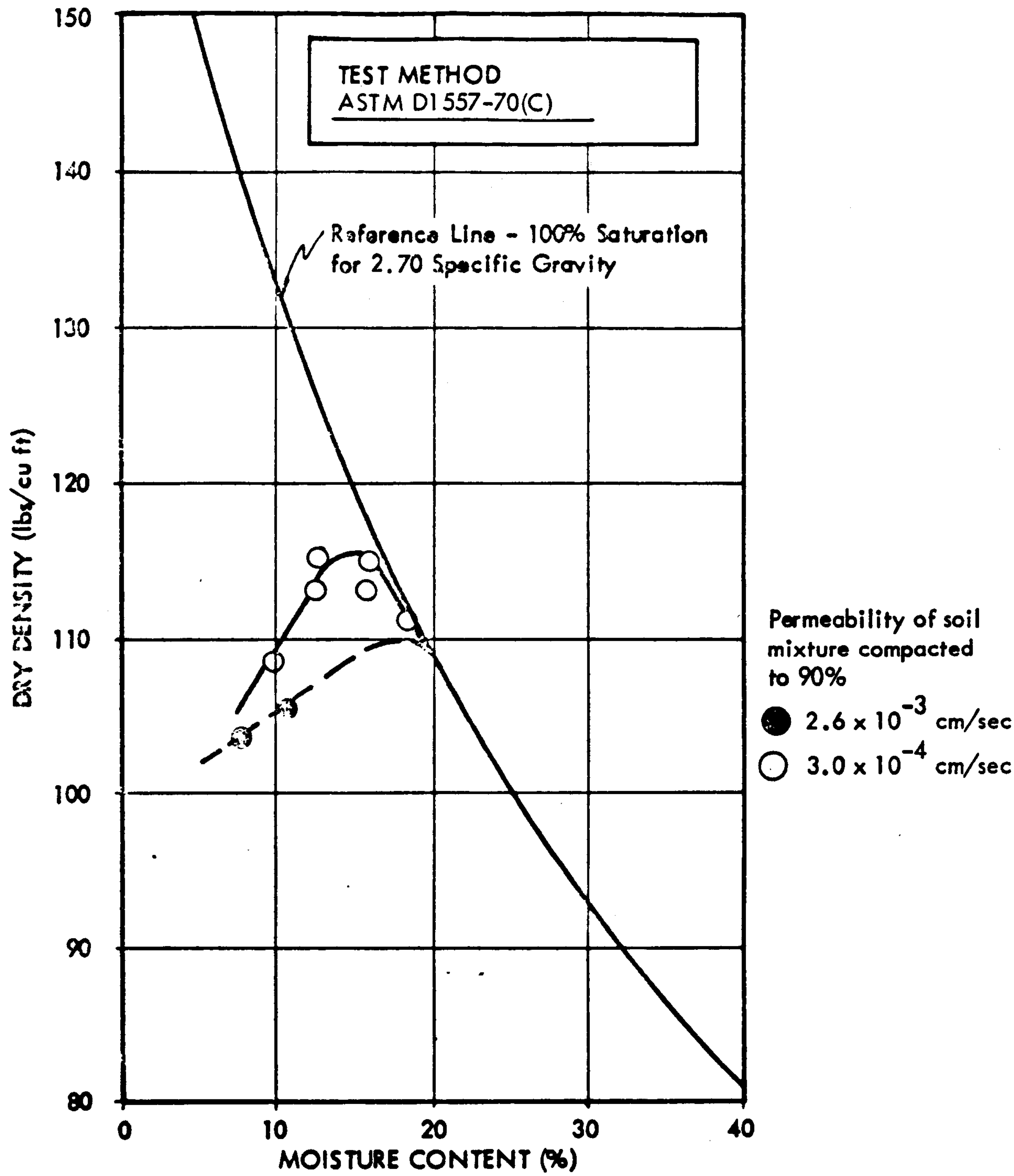
HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCS Date 6/3/77

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA
Alameda Naval Air Station

PLATE 20

N02470



Symbol	Sample Source	Classification	Optimum Moisture (%)	Maximum Dry Density (pcf)
--●--	Dredged slurry pond	50% Sand, 50% Bay Mud (CH)	18.0	110
—○—	Dredged slurry pond	70% Sand, 30% Bay Mud (CH)	15.0	116

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 11/21/77

COMPACTION TEST DATA

Sanitary Landfill Site
Alameda Naval Air Station

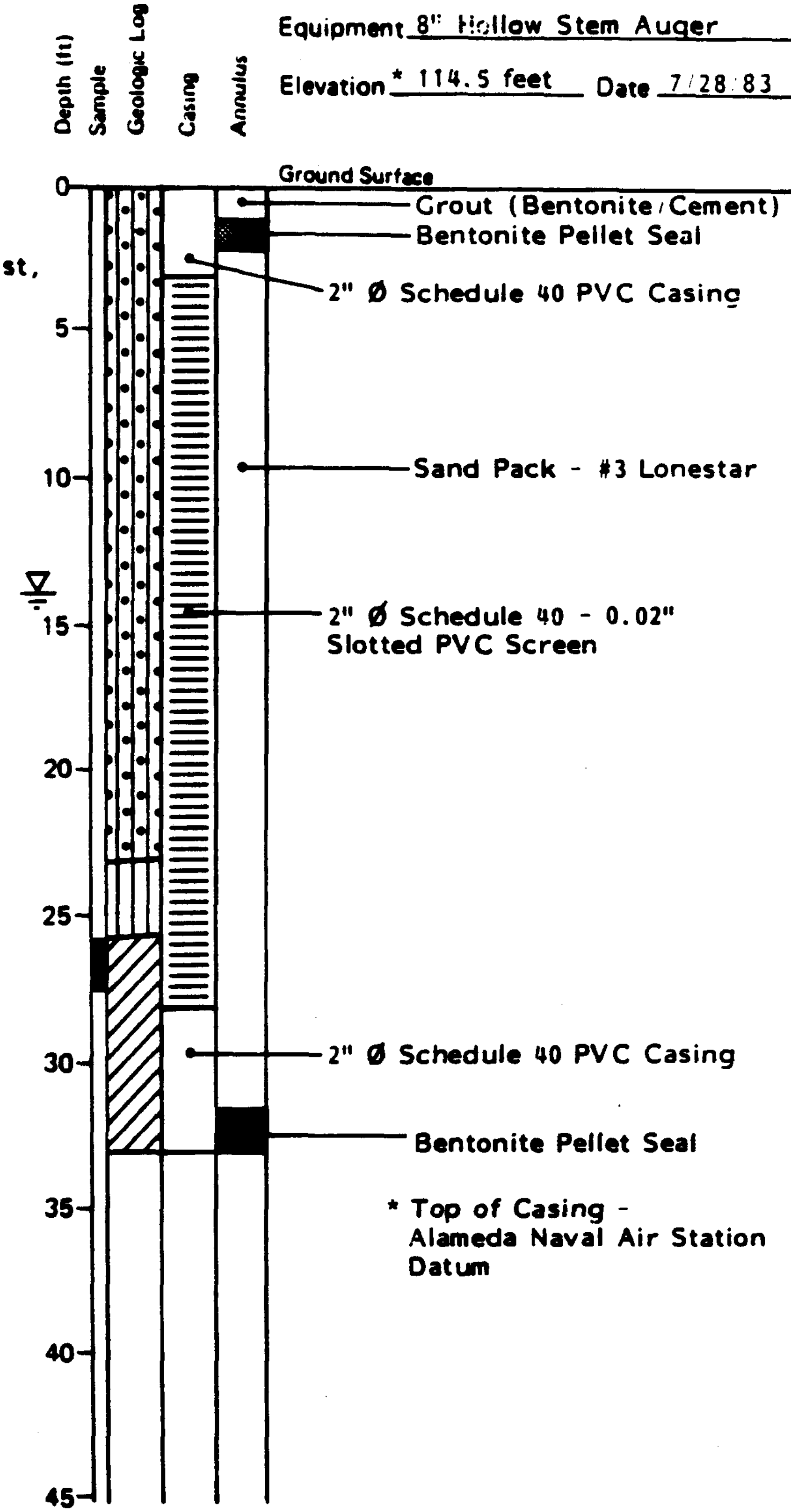
PLATE 21

N30336

BROWN SILTY SAND (SM)
loose to medium dense, moist, with debris beginning at 1.5 feet

DARK BROWN SANDY SILT (ML) - medium stiff, saturated

GRAY CLAY (CH)
soft, saturated



Harding Lawson Associates
Engineers, Geologists & Geophysicists

Log of Boring 20
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

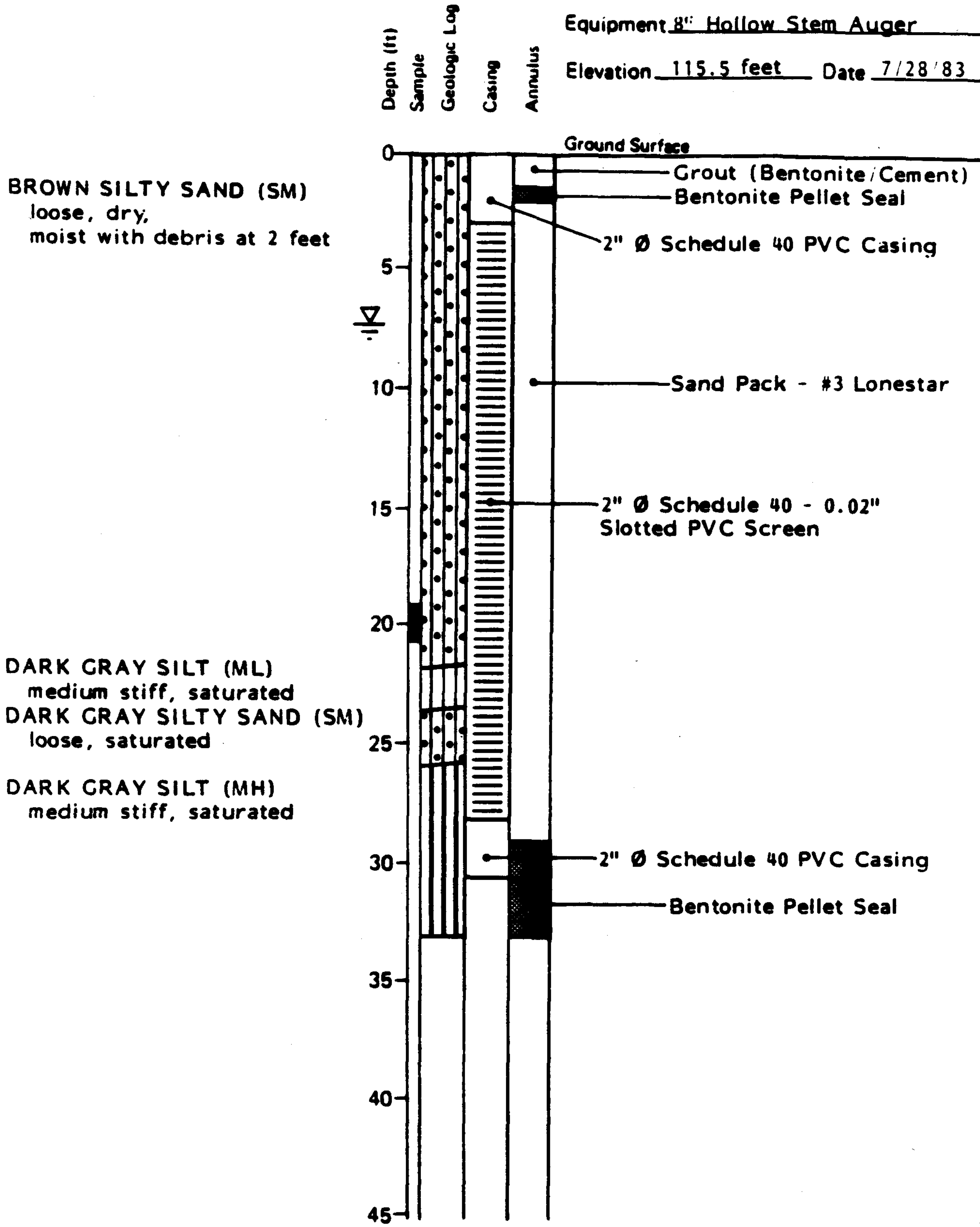
PLATE **2**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176,059 0002

Equipment 8" Hollow Stem Auger

Elevation 115.5 feet Date 7/28/83



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Log of Boring 21
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

PLATE **3**

MLQ	2176,059.01		10/83		

2176,059 0003

Equipment 6" Hollow Stem Auger

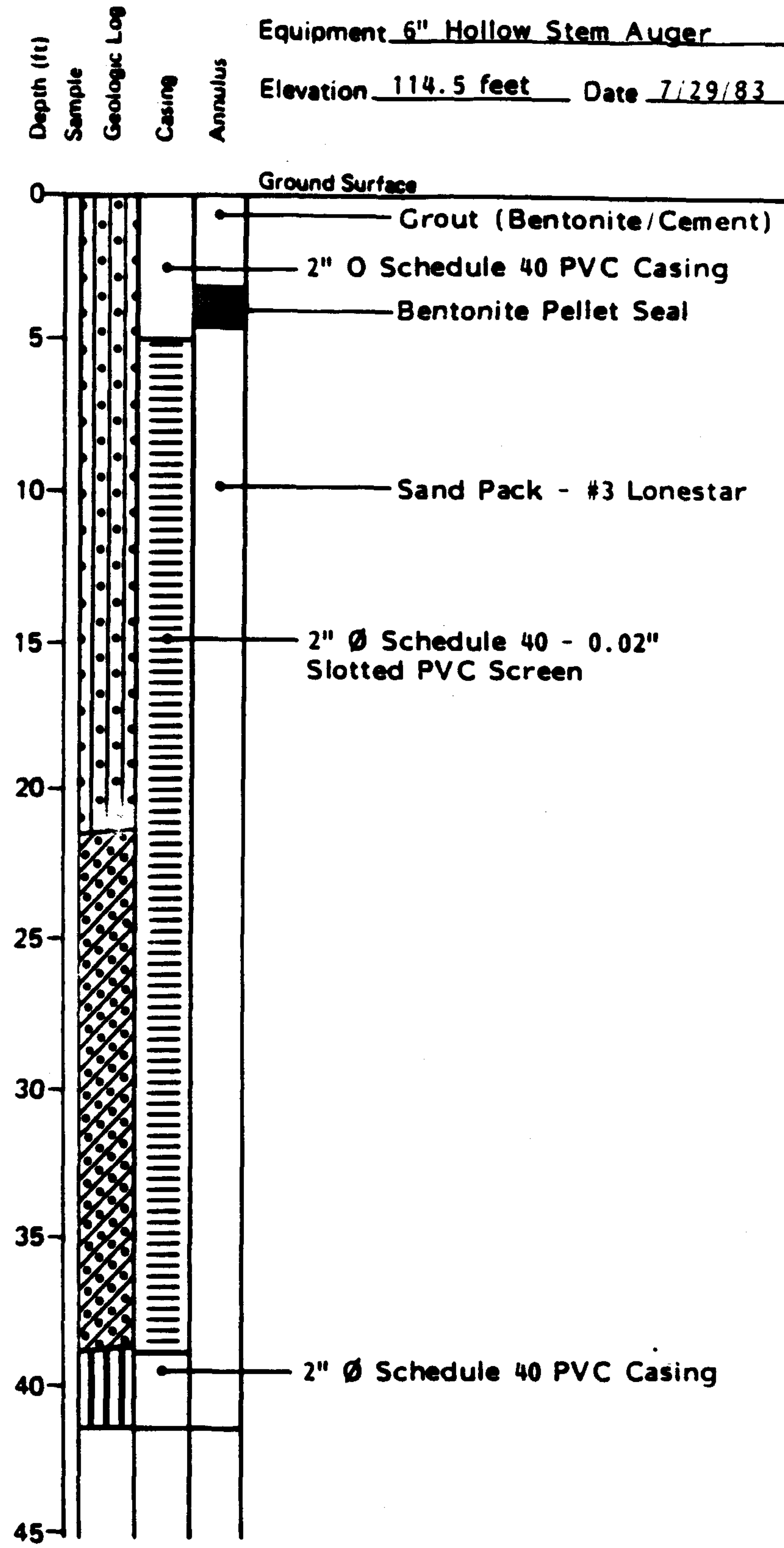
Elevation 114.5 feet Date 7/29/83

BROWN SILTY SAND (SM)
loose, dry, with debris at 1.0 feet

change to gray in color at 6 feet

DARK GRAY CLAYEY SAND (SC) - loose, saturated

DARK GRAY SILT (MH)
medium stiff, saturated



HLA **Harding Lawson Associates** Engineers, Geologists & Geophysicists	**Log of Boring 22** Sanitary Landfill Site Alameda Naval Air Station Alameda, California		PLATE **4**
DRAWN MLQ	JOB NUMBER 2176,059.01	APPROVED	DATE 10/83

2176.059 0004

BROWN GRAVELLY SILTY SAND (SM) - medium dense, moist, with debris beginning at 1.0 feet

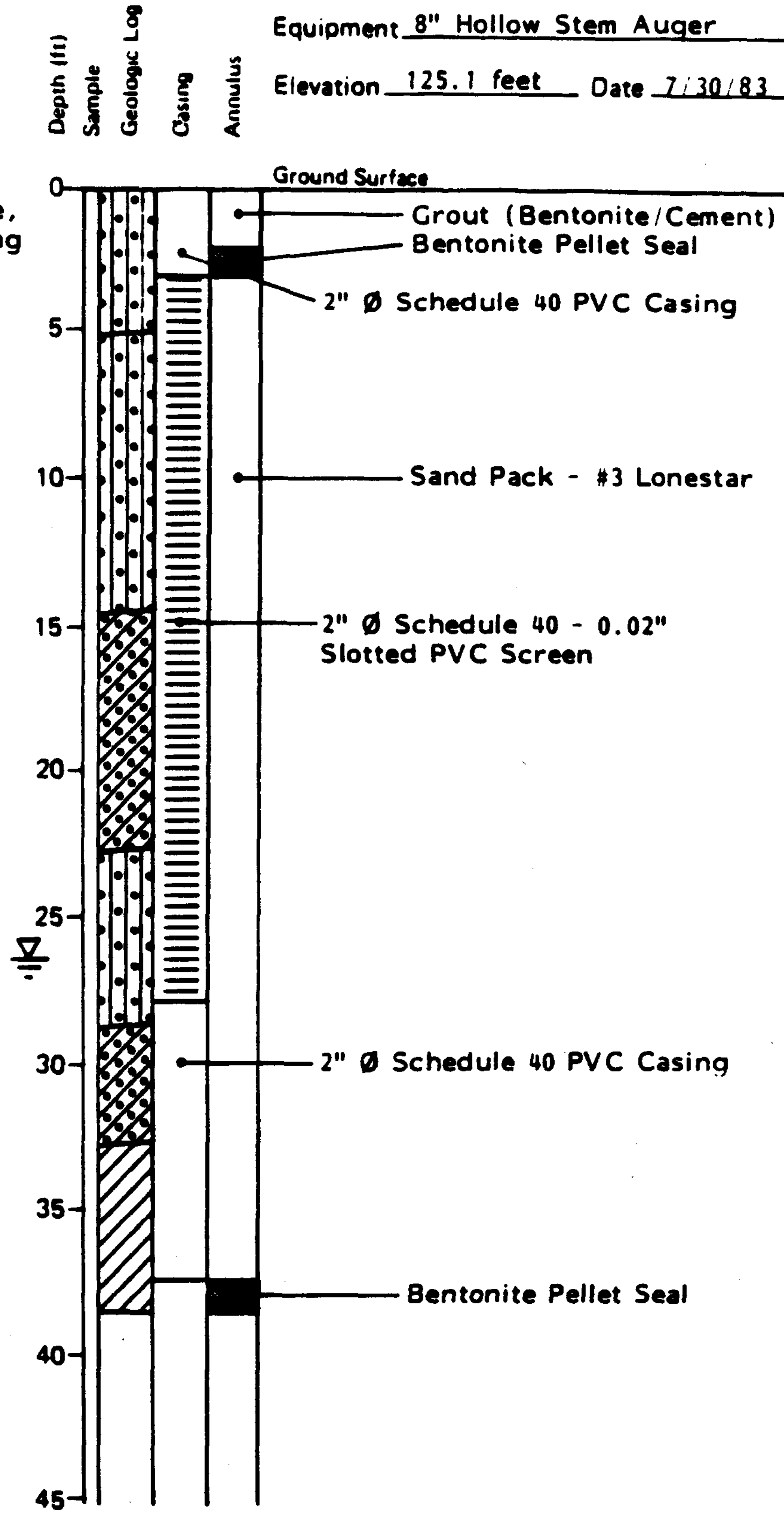
BROWN SILTY SAND (SM) loose, saturated, with debris

BROWN CLAYEY SAND (SC) medium dense, saturated, with small amount of debris

GRAY SILTY SAND (SM) medium dense, saturated

DARK GRAY CLAYEY SAND (SC) - medium dense, saturated

DARK GRAY SANDY CLAY (CH) - medium stiff, saturated



HLA **Harding Lawson Associates**
Engineers, Geologists & Geophysicists

Log of Boring 23
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

PLATE **5**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176,059.0005

Equipment 8" Hollow Stem Auger

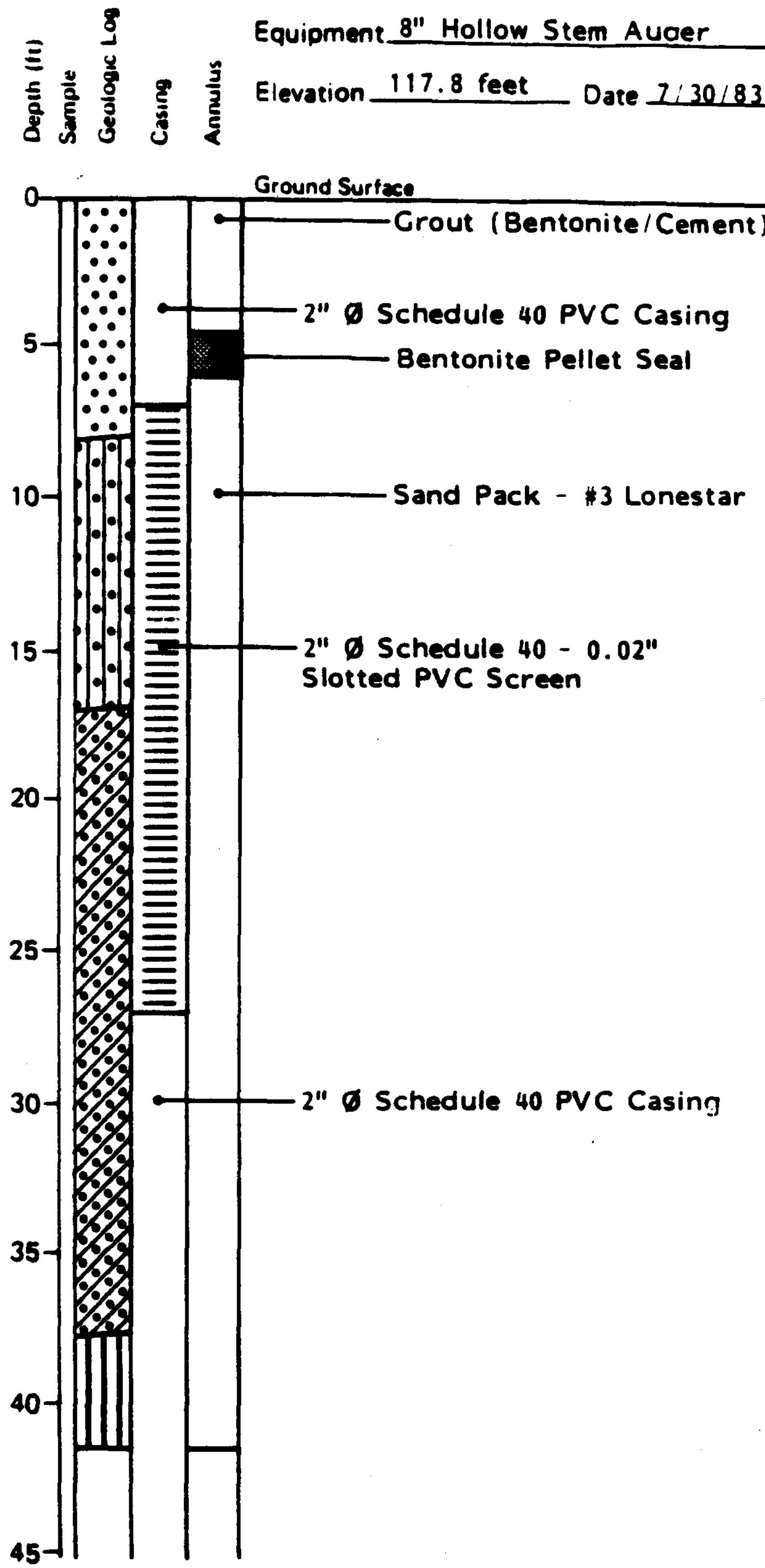
Elevation 117.8 feet   Date 7/30/83

DARK BROWN GRAVELLY SILTY SAND (SP) - loose, dry

DARK GRAY SILTY SANDY (SM) - loose, saturated, with debris

GRAY CLAYEY SAND (SC) medium dense, saturated

GRAY SILT (MH)



Harding Lawson Associates

HLA

Log of Boring 24

Sanitary Landfill Site

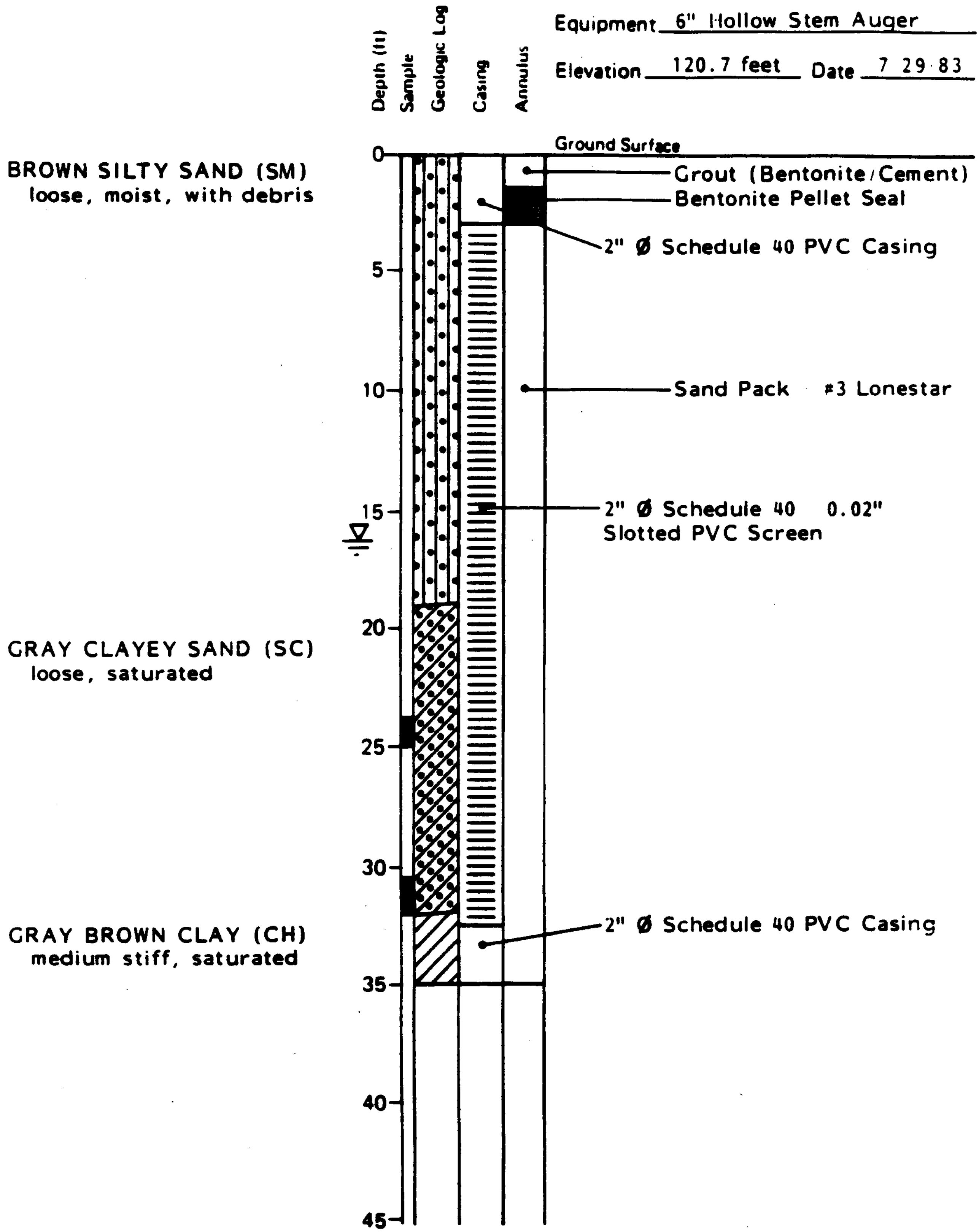
Alameda Naval Air Station

Alameda, California

PLATE 6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176,059.0006



Harding Lawson Associates

HLA

Log of Boring 25
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

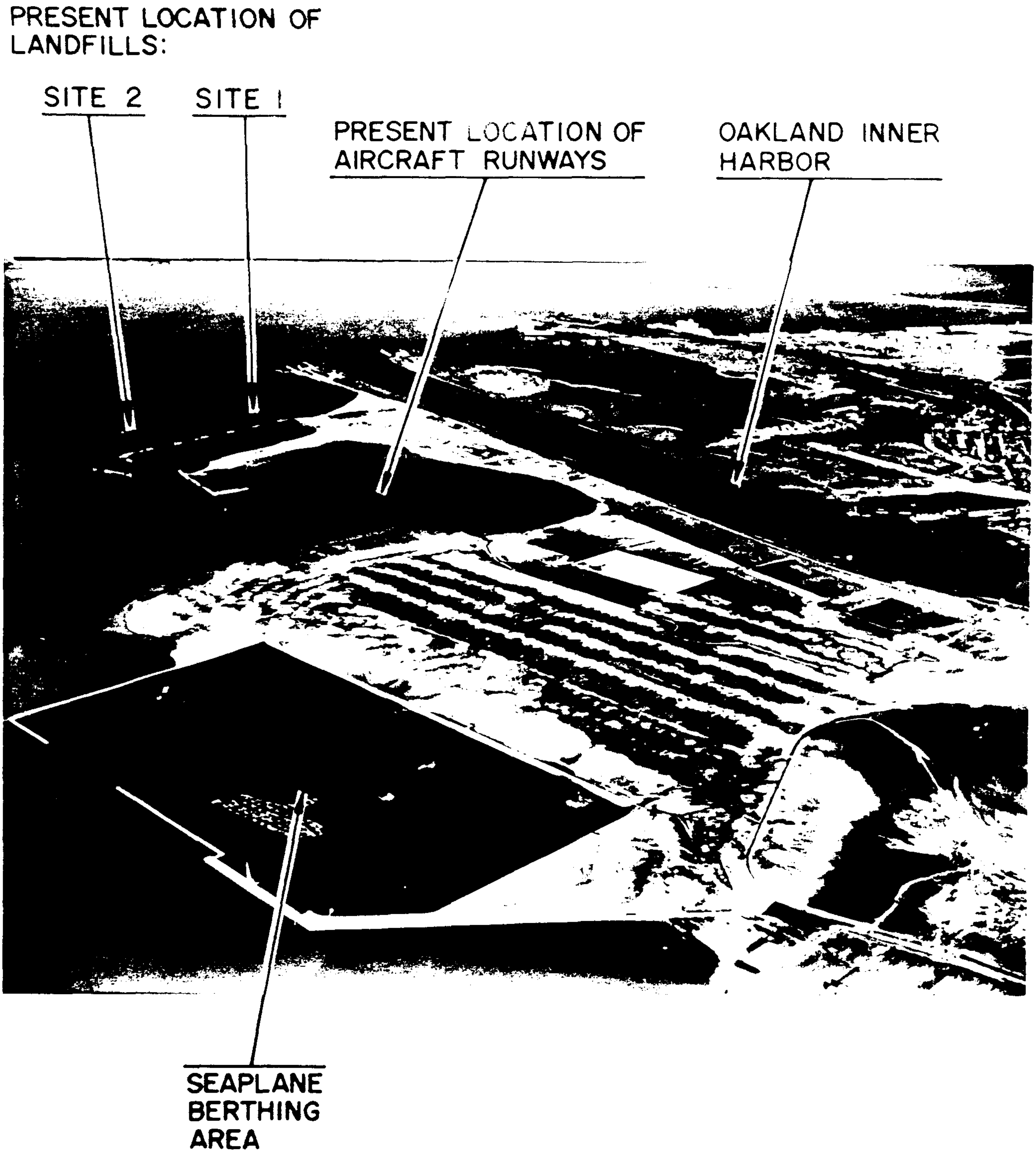
PLATE 7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176.059.0007

APPENDIX C

HISTORICAL AERIAL PHOTOGRAPHS



HISTORICAL AERIAL PHOTO
FEBRUARY 18, 1939
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH FEBRUARY 18, 1939
PHOTO NO. AAP-2-14

DATE: 9-13-88 SCALE: N.T.S.	FIGURE C-1	DRAWING NUMBER 86-018-A10

DRAWING NUMBER 86-018-A10
CHECKED BY
APPROVED BY
DRAWN BY J. WADE 9-13-88
REVISIONS
NO.
DATE

HISTORICAL AERIAL PHOTO
MARCH 24, 1947
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MARCH 24, 1947
PHOTO NO. AV-11-08-06

DATE: 9-13-88	FIGURE C-2	DRAWING NUMBER 86-018-A11
SCALE: N.T.S.		

DRAWING NUMBER 86-018-A11

DRAWN BY J. WADE 9-13-88

CHECKED BY

APPROVED BY

REVISIONS

NO. DATE

HISTORICAL AERIAL PHOTO
MAY 3, 1957
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY 3, 1957
PHOTO NO. AV-253-08-23

DATE: 9-13-88	FIGURE C-3	DRAWING NUMBER 86-018-A12
SCALE: N.T.S.		

DRAWING NUMBER 86-018-A12
CHECKED BY
APPROVED BY
DRAWN BY J. WADE 9-13-88
REVISIONS NO. DATE

DRAWING NUMBER 86-018-A13

DRAWN BY	J. WADE
	9-13-88
CHECKED BY	
APPROVED BY	

REVISIONS | NO. | DATE

HISTORICAL AERIAL PHOTO
MAY [illegible], [illegible]
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY [illegible], [illegible]
PHOTO NO. [illegible]

DATE: 9-13-88	FIGURE C-4	DRAWING NUMBER 86-018-A13
SCALE: N.T.S.		

DRAWING NUMBER 86-018-A14

HISTORICAL AERIAL PHOTO
APRIL 30, 1973
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

DATE: [illegible] SCALE: N.T.S.	FIGURE C-5	DRAWING NUMBER 86-018-A14

DRAWN BY | CHECKED BY | APPROVED BY

REVISIONS

HISTORICAL AERIAL PHOTO
SEPTEMBER 14, 1979
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH SEPTEMBER 14, 1979
PHOTO NO. AV-1750-03-3

DATE: 9-13-88	FIGURE C-6	DRAWING NUMBER 86-018-A15
SCALE: N.T.S.		

DRAWING NUMBER	86-018-A15
CHECKED BY	
APPROVED BY	
DRAWN BY	J. WADE 9-13-88
REVISIONS	NO. DATE

HISTORICAL AERIAL PHOTO
JUNE 21, 1983
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH JUNE 21, 1983
PHOTO NO. AV-2300-03-03

DATE: 9-13-88	FIGURE C-7	DRAWING NUMBER 86-018-A16
SCALE: N.T.S.		

DRAWING NUMBER 86-018-A16
CHECKED BY
APPROVED BY
DRAWN BY J. WADE 9-13-88
NO.
DATE
REVISIONS

HISTORICAL AERIAL PHOTO
MAY 15, 1985
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY 15, 1985
PHOTO NO. AV-2640-03-04

DATE: 9-13-88 SCALE: N.T.S.	FIGURE C-8	DRAWING NUMBER 86-018-A17

DRAWING NUMBER 86-018-A17

DRAWN BY J. WADE 9-13-88

CHECKED BY

APPROVED BY

NO. DATE

REVISIONS

HISTORICAL AERIAL PHOTO
MARCH 30, 1988
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

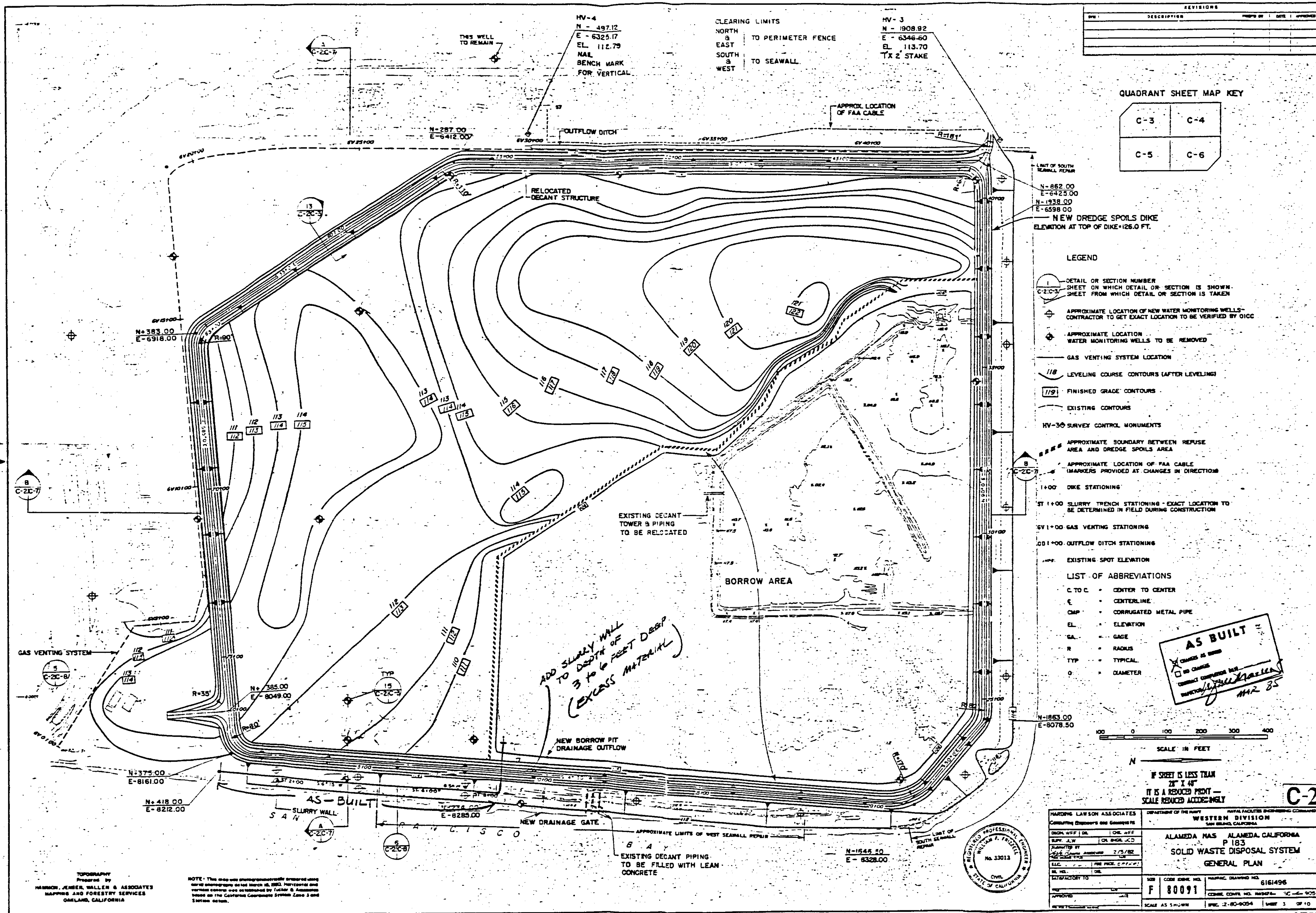
PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MARCH 30, 1988
PHOTO NO. AV-3268-03-06

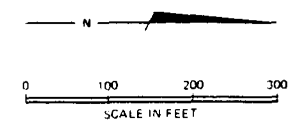
DATE: 9-13-88	FIGURE C-9	DRAWING NUMBER 86-018-A18
SCALE: N.T.S.		

DRAWING NUMBER	86-018-A18
CHECKED BY	
APPROVED BY	
DRAWN BY	J. WADE 9-13-88
NO.	
DATE	
REVISIONS	

APPENDIX D

AS-BUILT DRAWINGS OF CLOSURE FEATURES


HV-4
N - 497.12
E - 6325.17
EL 112.79
NAIL
BENCH MARK
FOR VERTICAL
THIS WELL TO REMAIN
CLEARING LIMITS
NORTH & EAST TO PERIMETER FENCE
SOUTH & WEST TO SEAWALL
HV-3
N - 1908.92
E - 6346.60
EL 113.70
1"X 2" STAKE
REVISIONS
QUADRANT SHEET MAP KEY
C-3
C-4
C-5
C-6
APPROX. LOCATION OF FAA CABLE
OUTFLOW DITCH
N-287.00
E-6412.00
RELOCATED DECANT STRUCTURE
N-862.00
E-6425.00
N-1938.00
E-6598.00
NEW DREDGE SPOILS DIKE
ELEVATION AT TOP OF DIKE=126.0 FT.
LEGEND
DETAIL OR SECTION NUMBER
SHEET ON WHICH DETAIL OR SECTION IS SHOWN
SHEET FROM WHICH DETAIL OR SECTION IS TAKEN
APPROXIMATE LOCATION OF NEW WATER MONITORING WELLS-CONTRACTOR TO GET EXACT LOCATION TO BE VERIFIED BY OICC
APPROXIMATE LOCATION WATER MONITORING WELLS TO BE REMOVED
GAS VENTING SYSTEM LOCATION
LEVELING COURSE CONTOURS (AFTER LEVELING)
FINISHED GRADE CONTOURS
EXISTING CONTOURS
HV-3 SURVEY CONTROL MONUMENTS
APPROXIMATE BOUNDARY BETWEEN REFUSE AREA AND DREDGE SPOILS AREA
APPROXIMATE LOCATION OF FAA CABLE (MARKERS PROVIDED AT CHANGES IN DIRECTION)
1+00 DIKE STATIONING
ST 1+00 SLURRY TRENCH STATIONING - EXACT LOCATION TO BE DETERMINED IN FIELD DURING CONSTRUCTION
GV 1+00 GAS VENTING STATIONING
OD 1+00 OUTFLOW DITCH STATIONING
EXISTING SPOT ELEVATION
LIST OF ABBREVIATIONS
C TO C. = CENTER TO CENTER
℄ = CENTERLINE
CMP = CORRUGATED METAL PIPE
EL. = ELEVATION
GA. = GAGE
R = RADIUS
TYP = TYPICAL
Ø = DIAMETER
N+383.00
E-6918.00
EXISTING DECANT TOWER & PIPING TO BE RELOCATED
BORROW AREA
ADD SLURRY WALL TO DEPTH OF 3 to 6 FEET DEEP (EXCESS MATERIAL)
AS BUILT
MAR 85
GAS VENTING SYSTEM
N+385.00
E-8049.00
N-1863.00
E-8078.50
SCALE IN FEET
IF SHEET IS LESS THAN 28" X 40" IT IS A REDUCED PRINT — SCALE REDUCED ACCORDINGLY
NEW BORROW PIT DRAINAGE OUTFLOW
N+375.00
E-8161.00
N+418.00
E-8212.00
AS-BUILT
SLURRY WALL
E-8285.00
NEW DRAINAGE GATE
SAN FRANCISCO BAY
APPROXIMATE LIMITS OF WEST SEAWALL REPAIR
LIMIT OF SOUTH SEAWALL REPAIR
EXISTING DECANT PIPING TO BE FILLED WITH LEAN CONCRETE
N-1645.50
E-8328.00
TOPOGRAPHY Prepared by HARRISON, JENSEN, WALLEN & ASSOCIATES MAPPING AND FORESTRY SERVICES OAKLAND, CALIFORNIA
HARDING LAWSON ASSOCIATES
WESTERN DIVISION
ALAMEDA NAS ALAMEDA, CALIFORNIA
P 183
SOLID WASTE DISPOSAL SYSTEM
GENERAL PLAN
F 80091
6161496
SCALE AS SHOWN
C-2



NOTES

General

The purpose of the Interim Grading Plan is to prevent ponding in low areas which occurred on the Alameda Naval Air Station Landfill during the winter of 1985 1986. The Plan includes cuts and fills in addition to a drainage swale which will promote drainage to the existing outlet pipe located at the decant tower at approximately elevation 112.0 feet.* Contours for the north end of the landfill were provided by the contractor in a revised As Built Plan; the topography in this region has been added to the revised Interim Grading Plan.

Borrow Area

The approximate limits of an onsite borrow area are included on the Plan. About ½ to 1 foot of soil may be cut in this region and utilized for the fill. If there are areas in this region which are lower than the Plan indicates, these areas should be avoided. At least one foot of cover is to be maintained over debris. If debris is encountered during construction, it must be covered with a minimum of one foot of soil. If additional borrow is needed for fill, supplementary areas which have an excess of one foot of cover over debris will be located by the engineer and can be used.

Fill Area

Approximate contours for fill adjacent to the dikes in the east and northeast portions of the landfill are included on the Plan. Soil is to be transported from the borrow area and compacted over the existing cover to the grades shown on the Plan. The fill should be compacted sufficiently such that it can be sealed to minimize the infiltration of water. Sealing should be accomplished by rolling with rubber tired equipment. Additional low areas are to be filled as shown on the plan.

Drainage Swale

A swale is to be formed by cutting and filling at the locations shown on the Plan. The base of the swale is to be graded to promote drainage to the outlet pipe and the pipe in the north dike.

Interim Grading

Grading completed December 15, 1986 by Contri Construction Company consisted of the following items:

1. Cuts and fills to achieve the approximate contours shown. A slight adjustment was made to the contours in the northeast corner as they were shown on the original plan. Contri performed cuts and fills in this area as shown on the revised plan to promote drainage from the actual high point, 114.5, which was not shown on the original as built plan.
2. Drainage swale cut in the fill to promote drainage to the decant tower and the pipe in the north dike.
3. Installation of a drainage pipe in the north dike where a cut was originally proposed.

* All elevations are Naval Air Station Datum, MLLW+101.20 feet

Harding Lawson Associates
Engineers, Geologists & Geophysicists

As-Built Interim Grading Plan
Alameda Naval Air Station
Landfill
Alameda, California ~~DRAFT~~

PLATE 2

JAS	2176,060.01	[signature]	10/86
LM	12/86	[signature]	

APPENDIX E

RESUME OF RESPONSIBLE PROFESSIONAL

RICHARD J. GREENWOOD

Project Manager

Education

M.S., Geotechnical Engineering, Utah State University, 1978
B.S., Civil Engineering, Utah State University, 1976

Registrations

Professional Engineer: California, Colorado

Affiliations

American Society of Civil Engineers
Society of Mining Engineers of AIME

Experience and Background

Mr. Greenwood has over 11 years of engineering experience with over six years of experience in investigation, engineering design and construction of ground water control and ground water remediation. He has been directly responsible for engineering, cost control and project management of both hazardous and non-hazardous sites. Non-hazardous projects have included: water resource planning and management for both confined and unconfined aquifer systems; seepaged modeling control and water supply management for large earth dam project and piezometric and pore pressure influence in both foundation and slope stability evaluations. Hazardous projects have included: feasibility studies, remedial investigation, design, construction, containment, and clean-up work sites contaminated with volatile organics, acids, pesticides, metals, aromatics and uranium.

Prior to joining Canonie Environmental Services Corp., Mr. Greenwood was involved in numerous field and analytical programs including:

- Design and construction supervision of small, medium, and large earth dams. Dam types included water resource, flood control, mining, and hazardous waste.

- Hydrologic analysis and hydraulic design of ditches and conveyance structures for control of surface water for large surface coal mines; flood plain prediction for large river courses; mine sequence planning for surface and underground coal mines; slope stability analysis on steep slope high-walls for large surface coal mines; research and development of methods for backfilling shafts and tunnels in conjunction diction, and design of remedial work for subsided areas; design of portal access openings for underground mines; and cause evaluation and design of stabilization measures for landslide areas in mined areas.

- Traffic surveys; traffic prediction and analysis; pavement design; design of timber roads; design of detention ponds and drainage and conveyance structures for shopping centers, residential subdivisions and multi-family developments; design of sewage treatment facilities in remote forest areas; preparing and filing legal descriptions of property boundaries and performing property surveys.

- Evaluation of retaining structures for highway embankments supported with rock anchor tiebacks and drilled caissons; liquefaction analysis for tailings embankments; cause evaluation of foundation and structural damage to school buildings; subsurface investigation and design of foundations for residential developments, commercial buildings, and electrical power plants.

- Experience with computer programming and design in Basic and Fortran. Design of CADD systems for civil and geotechnical engineering and geotechnical testing. Usage and evaluation of ground water flow using seepage and ground water flow models.

Publications

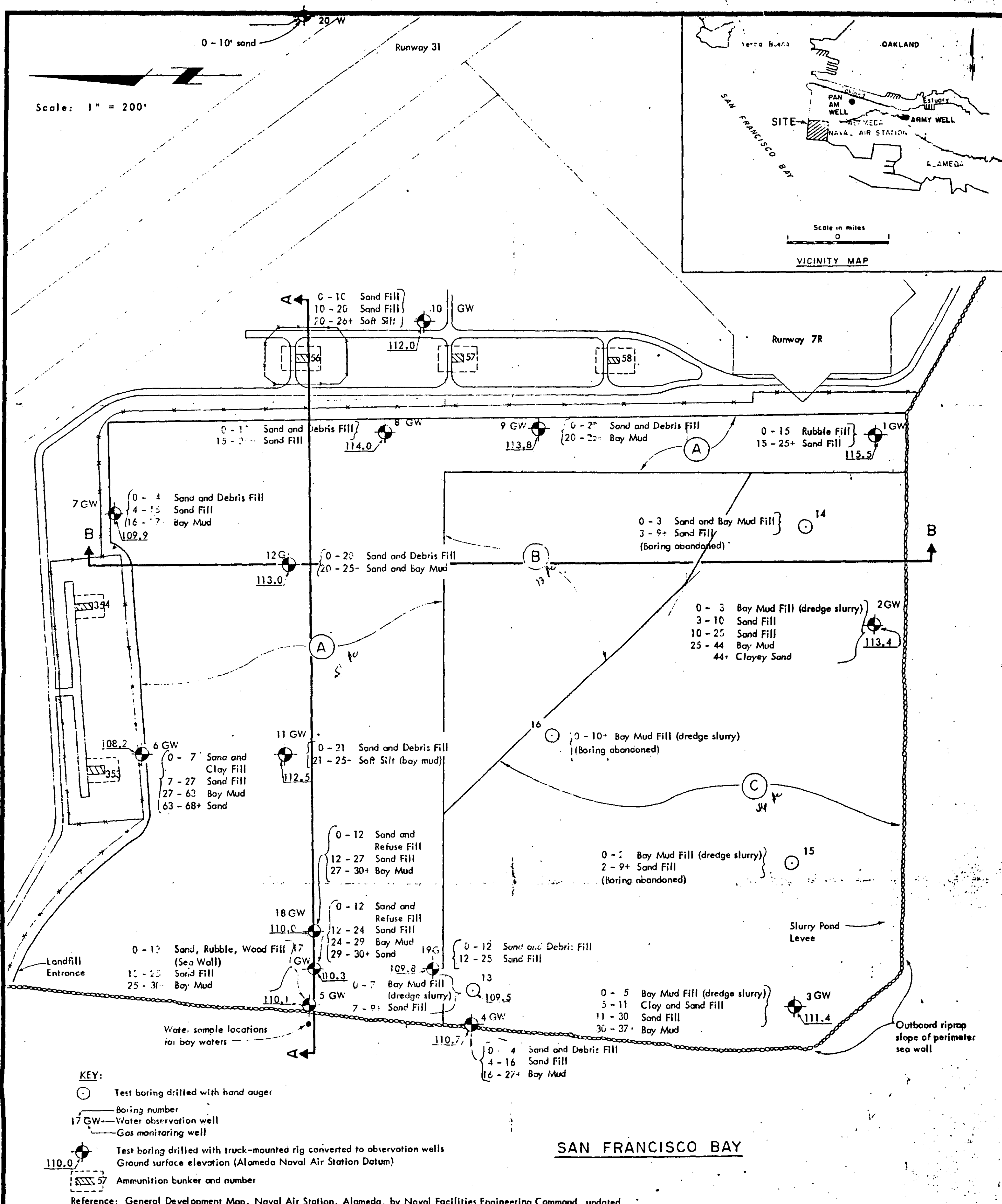
Greenwood, R. J., 1979, "Development of a Liquefaction opportunity Map for Cache Valley, Utah", Master's Thesis, Utah State University, Logan, Utah.

Taylor, M. J. and R. J. Greenwood, November 1981, "Classification and Surface Water Controls - Nonwater Impounding Mine Waste Structures", Proceedings of the Symposium on Design of Non-Impounding Mine Waste Dumps, Society of Mining Engineers of AIME, Denver, Colorado.

Greenwood, R. J., 1984, "Microcomputers in Civil Engineering - Small Business Applications", Proceedings - Second National Conference on Microcomputers in Civil Engineering, American Society of Civil Engineering.

APPENDIX F

WASTE DISPOSAL DATA



Job No. 2176,030.01 Designed ALB Drawn GER Checked LEL Approved Date 12/17/76 Scale 1" = 200'	HARDING - LAWSON ASSOCIATES *Consulting Engineers and Geologists*	PLOT PLAN SANITARY LANDFILL SITE ALAMEDA NAVAL AIR STATION Alameda California	PLATE 1

86-018-B44

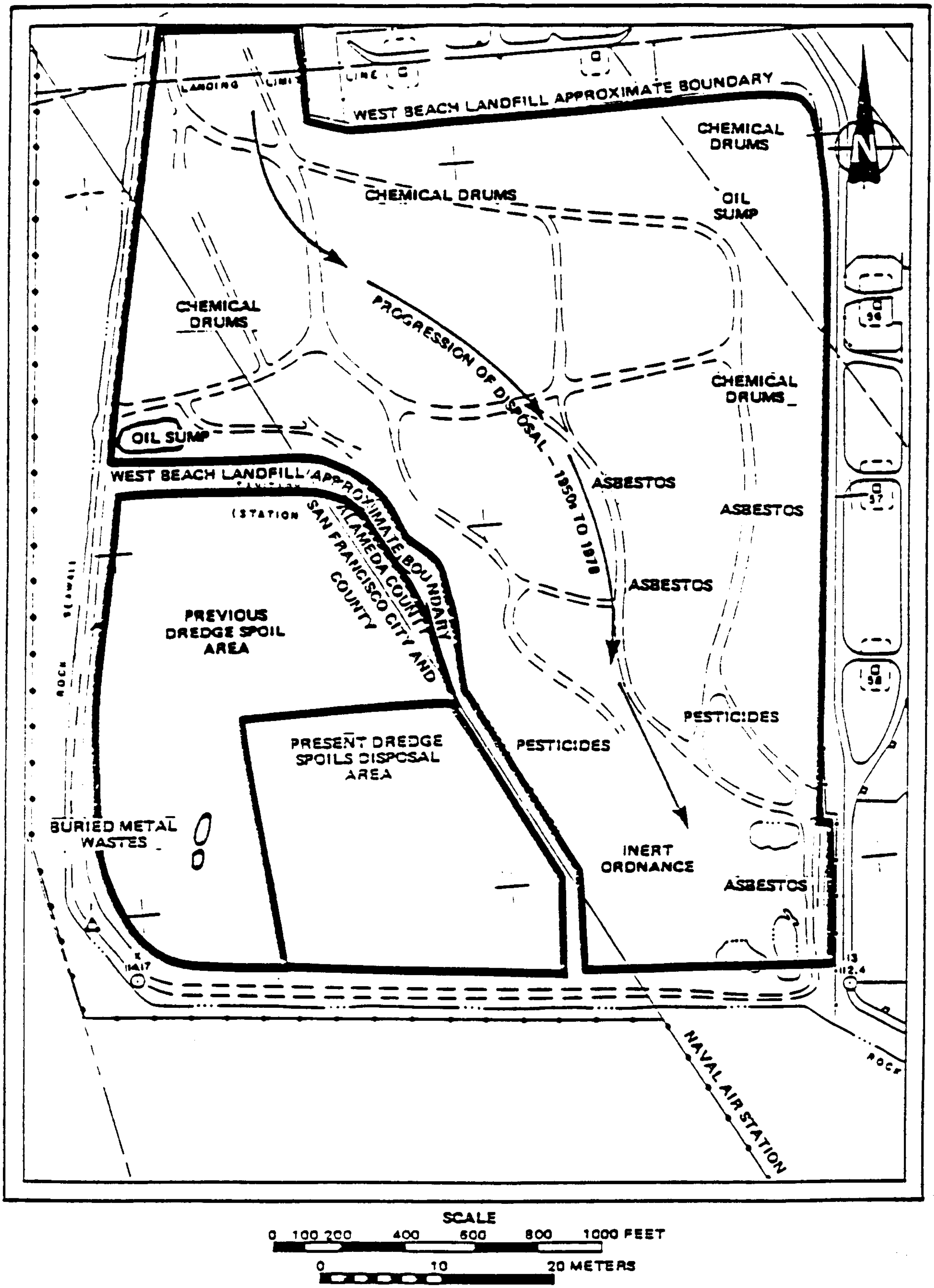


Figure 6—7 AREAS OF SUSPECTED HAZARDOUS WASTE DISPOSAL, WEST BEACH LANDFILL (SITE 1), NAS ALAMEDA

SOURCE: E & E (1983)

Table 6-15

WASTE PRODUCTS FROM AIRCRAFT OVERHAUL AND REPAIR

Nomenclature	Quantity/Year
Acid, Hydrochloric[1]	1,000 gallons
Acid, Nitric[1]	700 gallons
Acid, Sulfuric[1]	350 gallons
Methyl Ethyl Ketone[3]	18,000 gallons
Ethyl Acetate[3]	50,000 gallons
Sodium Hydroxide[1]	4,400 pounds
Stoddard Solvent[2]	160,000 gallons
Paint Remover[2]	105,000 gallons
Cleaner Brightener[1]	2,400 gallons
Ortho Dichlorobenzene[1]	1,000 gallons
Methylene Chloride[1]	11,000 gallons
Methyl Chloroform[3]	4,900 gallons
Trichlorethylene[2]	24,000 gallons
Toluene[1]	2,600 gallons
Xylene[1]	4,500 gallons
Oil, 1010[2]	16,000 gallons
Naphtha, Aliphatic[3]	4,000 gallons
Naphtha, Aromatic[3]	1,800 gallons
Emulsion Cleaner[1] (MIL-C-22543)	80,000 gallons
Carbon Remover[2] (MIL-C-19853)	12,000 gallons
Acetone	9,100 gallons
Cleaning Compound[2]	
Turco 4228	15,000 pounds
Chromic Acid[1]	19,700 pounds
Sodium Cyanide[1]	2,400 pounds
Potassium Cyanide[1]	2,400 pounds
Copper Cyanide[1]	500 pounds
#396 Perliton	
Heat Treating Cyanide	500 pounds
Paint Thinners[2] (various kinds)	35,000 gallons
Steam Cleaner	21,000 gallons

1. To drains by leakage, direct discharge, or drag-out; to seaplane lagoon or estuary.
2. Buried at the dump.
3. To drains or buried at dump.

Source: Navy, Department of, Naval Facilities Engineering Command, Western Division, 1966, Report on Study of Water Pollution Generated in Industrial Wastewater at Naval Air Station, Alameda, California.

Note: Quantities were rounded to two significant figures.

SOURCE: E & E (1983)

Table 6-16

ESTIMATED VOLUMES OF SLUDGE DISPOSED OF AT THE WEST BEACH LANDFILL - 1960s

Building	Volume
Plant Maintenance Disposals	
5	21,000 gallons per month
360	14,000 gallons per month
Public Works Disposals	
6	350 gallons per month
10	100 gallons per month
14	2,000 gallons per month
67	100 gallons per month
162	4,000 gallons per month
166	175 gallons per month
360	1,000 gallons per month
372	2,200 gallons per month
397	3,000 gallons per month
410	4,000 gallons per month
459	60 gallons per month
460	200 gallons per month
Total	53,000 gallons per month

Source: Navy, Department of, Naval Facilities Engineering Command, Western Division, 1966, Report on Study of Water Pollution Generated in Industrial Wastewater at Naval Air Station, Alameda, California.

Note: Quantities have been rounded to two significant figures.

SOURCE: E & E (1983)

APPENDIX G

DRAFT SOLID WASTE ASSESSMENT TEST (SWAT) GUIDANCE

OCT 15 1986

SOLID WASTE ASSESSMENT TEST
SWAT
GUIDANCE

OCTOBER 1986

PREPARED BY
STATE WATER RESOURCES CONTROL BOARD

TABLE OF CONTENTS

INTRODUCTION

In 1984, Section 13273 was added to the Water Code by Assembly Bill (AB) 3525. This section required the State Water Resources Control Board (State Board) to rank the approximately 2,100 active and inactive solid waste disposal sites throughout the state on the basis of the potential threat they may pose to water quality. The State Board approved a ranked list of solid waste disposal sites in December 1985 and revised it in September 1986. Annual revisions are anticipated to occur every September for the duration of this list. The list contains 13 ranks with 150 sites per rank, and an incomplete Rank 14. Revisions to the original December 19, 1985 list were necessary to meet Regional Water Quality Control Board (Regional Board) water quality objectives.

The purpose of this guidance document is to explain and summarize how to combine relevant sections of the Administrative Code, Title 23, Subchapter 15 and/or the Water Code necessary to comply with Water Code Section 13273. No new regulatory authority is necessary for the Solid Waste Assessment Test (SWAT) Program. Existing Water code and Subchapter 15 sections provide the prerequisite authority for the State Board to implement the SWAT Program. The major difference between the SWAT Program and Subchapter 15 is that once a SWAT report is completed by the disposal site operator and reviewed and accepted by the appropriate Regional Board, the requirements of Water Code Section 13273 have been met (i.e., identification of hazardous waste migration into water or soil) in contrast to Subchapter 15 which requires continuous monitoring. If a disposal site is found to be polluting surface or ground water through a SWAT investigation, enforcement action will be undertaken pursuant to existing authority within the Water Code and Subchapter 15.

The operators of the 150 disposal sites in Rank 2 are required to submit a SWAT report to the appropriate Regional Board on or before July 1, 1988. Section 13273 of the Water Code requires that the SWAT report contain:

- an analysis of the surface and ground water, on and under, within one mile of a solid waste disposal site to provide a reliable indication whether there is any leakage of hazardous waste, and
- a chemical characterization of the soil-pore liquid in those areas which are likely to be affected if the solid waste disposal site is leaking as compared to geologically similar areas near the solid waste disposal site which have not been affected by the leakage or waste discharge.

The SWAT report is required to be certified by either a registered Civil Engineer, a registered Geologist, or a certified Engineering Geologist pursuant to Sections 6762, 7842, and 7850 of the Business and Profession Code. The certifier is additionally required to have a minimum of five-years experience in ground water hydrology. The analytical laboratory performing the chemical analysis must be a Hazardous Materials Laboratory certified by the California Department of Health Services.

Disposal site operators with active sites on the State Board's ranked list may also wish at this time to comply with the State Board's regulations "Discharge of Waste to Land," found in California's Administrative Code, Title 23, Chapter 3, Subchapter 15. In such cases, they should comply with relevant sections of Subchapter 15 in addition to the material required under this guidance. Disposal site operators should contact their Regional Boards for specific information on Subchapter 15 compliance. Disposal site operators in the process of implementing Subchapter 15 requirements will find that most of their SWAT Program requirements will have been satisfied with their Subchapter 15 efforts. In these cases, the required SWAT will summarize the ongoing Subchapter 15 efforts and report on the specific hazardous waste test results required by the Regional Board.

Section 13273(d) of the Water Code reads as follows:

> "The regional board shall examine the report submitted pursuant to subdivision (b) and determine whether the number, location, and design of the wells and the soil testing could detect any leachate buildup, leachate migration, or hazardous waste migration. If the regional board determines that the monitoring program could detect the leachate and hazardous waste, the regional board shall take the action specified in subdivision (e). If the Regional Board determines that the monitoring program was inadequate, the Regional Board shall require the solid waste disposal site to correct the monitoring program and resubmit the solid waste assessment test based upon the results from the corrected monitoring program (underlined for emphasis)."

In order to minimize the necessity of repeating a SWAT test, the SWAT consists of two phases, a SWAT proposal and a SWAT report. The initial SWAT submittal should be made to the appropriate Regional Board on or before the proposal deadline corresponding to the ranking of the site as shown on Table 1. The initial submittal shall consist of the SWAT proposal outlined in this guidance. The schedule depicted in Table 1 is intended to prescribe sufficient time for completion of the entire SWAT effort. Two key elements are included in this consideration. First is adequate time for Regional Board review and concurrence with the initial SWAT proposal (about 60 days), including our allowance for any necessary revision to the initial SWAT proposal. Second is actual implementation of an accepted SWAT proposal to meet the appropriate July 1 deadline, established by Water Code Section 13273, for the SWAT report.

Table 1

SCHEDULE FOR SOLID WASTE DISPOSAL SITE
SOLID WASTE SWAT ASSESSMENT TESTS

RANK	ASSESSMENT PERIOD	PROPOSAL DEADLINE	REPORT DEADLINE
1	1986	July 1, 1986	July 1, 1987
2	1987	April 1, 1987	" 1988
3	1988	" 1988	" 1989
4	1989	" 1989	" 1990
5	1990	" 1990	" 1991
6	1991	" 1991	" 1992
7	1992	" 1992	" 1993
8	1993	" 1993	" 1994
9	1994	" 1994	" 1995
10	1995	" 1995	" 1996
11	1996	" 1996	" 1997
12	1997	" 1997	" 1998

Information required to be contained in both the SWAT proposal and the SWAT report is outlined starting on page 5 of this guidance material. All references contained in this guidance, unless otherwise noted, refer to code sections found in Title 23, Subchapter 15 of the Administrative Code.

Information contained in the SWAT proposal and SWAT report is desired in clearly written, tabular, and graphic formats as appropriate. Plans, diagrams, and other illustrations should be prepared to convenient, readable scale. Maps and sections should all be at the same scale where possible for easy cross reference. If a report submitted by an operator refers to another source, the relevant information from that source shall be referenced (Section 2595(b)).

For those sites where hazardous wastes are known to be leaking because of existing monitoring programs or other available information, the operator may apply to the appropriate Regional Board for a waiver to the SWAT requirements. The request for a waiver should include all the information in Section I of the SWAT proposal of this guidance, and Section V of the SWAT report of this guidance.

The Water Code provides for the assessment of penalties if either the SWAT proposal or SWAT report are submitted to the Regional Board after their due date. Sections 13267 and 13268 of the Water Code will be used to enforce compliance of the SWAT Program. Civil liabilities will be assessed site operators at the rate of up to $5,000 per day if hazardous waste is not leaking from the disposal site, and up to $25,000 per day if hazardous waste is leaking from the disposal site for each day the SWAT reports are late. Since the Legislature enacted the SWAT Program and specified the SWAT due date by law, the State Board is powerless to grant time extensions. Therefore, we recommend timely submittal of SWAT proposals and SWAT reports to avoid substantial penalties.

SWAT PROPOSAL

I. Introductory Data

A. Site Name (including previous names and aliases).

B. Operator and Owner (including previous operators and owners names, mailing addresses, and telephone numbers).

C. Site location. Include map showing relationship to highways and nearby communities which specifies:

1. Street address if available, or general location.

2. Township, range, section, and fractional section.

3. County Assessor's parcel number(s).

D. Describe whether the site is/was open to the public, or is/was for private use only.

E. Explain any present enforcement orders or administrative civil liability complaints.

F. The following information shall be included for closed sites:

1. Date closed.

2. Description of final treatment closure procedures which were used for the wastes in the waste site.

3. Description of final cover and other closure related improvements.

G. Provide certification by a qualified person as to accuracy and completeness of the SWAT proposal, repert, or waiver together with a statement of their qualifications, including certifier's signature and Registration(s) or Certificate Number(s) (Water Code Section 13273(b)).

II. Site Information

A. Operators who operate classified waste sites pursuant to Section 2596(a)(1) shall submit detailed construction and as-built plans, specifications, and descriptions for all liners, containment structures, leachate collection and removal system components, leak detection system components, precipitation and drainage control facilities, and interim covers which have been installed or used at each site. Operators shall submit a description of and location for ancillary facilities including roads, waste handling areas, buildings, and equipment cleaning facilities.

B. For any site having a leachate collection and removal system, recent analyses, pursuant to Section 2557, shall be submitted with the SWAT proposal. In addition to standard physical and chemical parameters (i.e., pH, Temp, E.C.), a pollutant scan using EPA methods 601 and 602 or EPA methods 624 and 625, ICP metals, and AA should be included. The Regional Board will specify which EPA methods are to be utilized. For EPA methods 601 and 602, laboratory orders should request that all peaks be reported. If unidentified peaks are present, EPA test method 624 should be run to identify the peaks. As a minimum, the following substances should be reported from ICP metals procedure: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, K, Ag, Se, Na, Tl, V, and Zn. Due to the limited detection limits of the ICP metals method for Hg and Se, it is preferred the AA method be used to analyse for Hg and Se. If deemed appropriate, analysis for acetone and methyl ethyl ketone should also be made. Any other chemical data required by the Regional Board should be included.

III. Solid Waste Assessment Monitoring Proposal

All monitoring wells shall be constructed in a manner that maintains the integrity of the drill hole and prevents cross-contamination of saturated zones. The monitoring wells shall be in full compliance with Section 2555(c & d).

A. Operators shall submit to the Regional Board detailed plans and equipment specifications for compliance with the surface water, ground water, and unsaturated zone monitoring requirements with their proposal. When leachate analyses are not available from a leachate collection and removal system, the SWAT proposal shall provide a means for leachate sampling and analysis. Site operators shall provide technical support which includes rationale for the spatial distribution and depth of ground water and unsaturated zone monitoring facilities and for the design of monitoring equipment (Section 2596(a)). Where justified by a qualified opinion and the concurrence of the local Regional Board, the possible waiver of some monitoring requirements (i.e., no vadose zone, ground water at excessive depths) and monitoring facilities will be considered. This report shall be accompanied by:

1. a map showing the locations of proposed monitoring facilities.

2. drawings and data showing construction details of proposed monitoring facilities. These data shall include:

   a. casing and test hole diameter.
   b. casing materials (PVC, stainless steel, etc.).
   c. depth of each test hole.
   d. size and position of perforations or screens.
   e. method and joining sections of casing.
   f. nature of filter material.
   g. depth and composition of seals.
   h. method and length of time of development.

3. specifications, drawings, and dates for location and installation of unsaturated zone monitoring equipment.

B. The detection monitoring program shall be designed to detect the presence of waste constituents in surface water or ground water immediately outside of or under the waste site (Section 2556(a), and Water Code Section 13273(b)).

C. The water quality monitoring program shall include consistent and appropriate sampling and analytical procedures that accurately measure the chemical characterization of background water quality and waste constituents to provide a reliable indication of the impact of the disposal site on water quality (Section 2555(e)). As a minimum, the program shall include procedures and techniques for:

1. sample collections.
2. sample preservation and shipment.
3. chain of custody control.
4. analytical procedures. The program shall include a pollutant scan including EPA methods 601 and 602 and/or 624 and 625. ICP metals, and, if deemed appropriate, analyses for acetone and methyl ethyl ketone. The Regional Board will specify which EPA methods are to be utilized. Laboratory orders should request that all peaks be reported. If

unidentified peaks are present with EPA methods 601 and 602, EPA method 624 should be run for identifying the unknown peaks. As a minimum, the following substances should be reported from the ICP metals procedures: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, K, Ag, Se, Na, Tl, V, and Zn. Due to the limited detection limits of the ICP metals method for Hg and Se, it is preferred the AA method be used to analyse for Hg and Se. Standard physical and chemical parameters (i.e., pH, Temp, E.C.) should be included as well as tests for TDS (105°C), COD, CL_2, and NO_3. Any other chemical data required by the Regional Board should be included.

D. Procedures for obtaining background water quality are outlined below:

1. Background water quality shall be based on data from quarterly sampling upgradient from the waste disposal facility for one year, if available. These analyses shall (Section 2595(g)(7)):

   a. account for measurement errors in sampling and analyses.

   b. account for seasonal fluctuations in background water quality, if such fluctuations are expected to affect the concentration of hazardous constituents.

2. Background water quality may be based on appropriate water quality data that are available in lieu of one-year analyses (Section 2595(g)(7)).

3. Background water quality of ground water may be based on sampling of wells that are not upgradient from the waste management unit where (Section 2595(g)(7)):

   a. hydrogeologic conditions do not allow for sampling in the upgradient direction.
   b. sampling at other wells will provide a representative indication of background water quality.

4. In developing the data base used to determine a background value in ground water, the site operator shall take a minimum of one sample from each well used to determine background. A minimum of four samples shall be taken from the entire system used

to determine background water quality, each time the system is sampled. Should there be only one background well, the four consecutive samples shall be obtained from the one well and separate analyses for each sample shall be conducted (Section 2595(g)(7)).

F. The unsaturated zone monitoring program shall be designed to detect waste constituents which may escape from waste sites before such constituents reach ground water (Section 2559(a)).

G. The unsaturated zone monitoring system shall include a sufficient number of monitoring points at appropriate locations and depths to represent the background soil-pore liquid quality that has not been affected by leakage from the disposal site, as well as soil-pore liquid in locations that are most likely to have been affected by seepage from waste disposal facilities (Section 2559(b)).

SWAT REPORT

I. Site Characteristics

A. Provide in the report an analysis describing how the ground and surface water have affected or may affect the waste site, and how the site has or may affect ground and surface water (Section 2595(a)).

B. Provide a topographical map of the disposal site and its surrounding region within one mile of the site showing elevation contours, natural ground slopes, drainage patterns, and other topographic features (before and after disposal site construction, if possible) (Section 2595(d)).

C. Geology

1. Provide a geologic map and geologic cross-sections of the waste disposal site showing lithology and structural features. Cross-sections shall be indexed to the geologic map and shall be located to best portray geologic features relevant to the discharged waste. Scales should be consistent with other site cross sections for purposes of comparisons (Section 2595(f)(1)).

2. Describe the natural geologic materials beneath the waste site and its surroundings, including identification of rock types, nature of alteration depth and nature of weathering, compatibility of wastes and geologic materials, continuity and lateral extent of formations, and all other pertinent lithologic data (Section 2595(f)(2)).

3. Describe the geologic structure of the waste site including the attitude (strike and dip) of bedding (if any); thickness of beds (if any); the location, attitude, and condition (tight, open, clay or gypsum-filled, etc.) of any fractures; the nature, type (anticlinal, synclinal, etc.), and orientation of any folds; the location, attitude and nature (tight, gouge-filled, etc.) of any faults; and all other pertinent structural data (Section 2595(f)(3)).

OCT 15 1986

D. Hydrology

1. Evaluate the water-bearing characteristics of the natural geologic materials identified under subsection (C)(2) of this section including delineation of all ground water zones and basic data used to determine the above (Section 2595(g)(1)).

2. Evaluate the on-site permeability of soils immediately underlying the disposal site in accordance with Section 2595(g)(2).

3. Evaluate the perennial direction(s) of ground water movement within the uppermost ground water zone(s) within one mile of the disposal site perimeter. Include a ground water table map clearly delineating the ground water flow regime (Section 2595(g)(3)).

4. Provide a map showing the location of all springs in the disposal site and within one mile of the perimeter. The map shall be accompanied by tabular data indicating the flow and the mineral quality of the water from each spring (Section 2595(g)(5)).

E. Land and Water Use

1. Provide a map showing the locations of all monitoring wells, water wells, oil/gas wells, geophysical exploration wells, and geothermal wells in the disposal site or within one mile of its perimeter (Section 2595(h)(1)).

2. List the name and address of the owner of each well located in subsection (E)(1) (Section 2595(h)(2)).

3. Provide well information where available for each well indicated in subsection (E)(1) of this section including, but not limited to (Section 2595(h)(3)):

   a. total depth of well.
   b. diameter of casing at ground surface and at total depth.
   c. type of well construction (cable-tool, rotary, etc.).
   d. depth and type of perforations.
   e. name and address of well driller.
   f. year of well construction.
   g. use of well (agricultural, domestic, stock watering, etc.).

h. depth and type of seals.
i. lithologic, geophysical, and other types of well logs, if available.
j. water levels, pump tests, water quality, and other well data, if available.
k. annular packing materials and intervals.
l. abandonment methods, if applicable.

4. Describe the current land use within one mile of the perimeter of the disposal site (e.g., residential, commercial, industrial, agricultural, recreational, etc.) (Section 2595(h)(4)).

5. Describe the current and anticipated future use of ground water within one mile of the perimeter of the waste site (Section 2595(h)(5)).

II. <u>Waste Characteristics</u>

A. For the entire history of the site and insofar as data are available:

1. List the types, quantities, physical state (e.g., solid, liquid) and concentrations of wastes discharged at the site. Wastes and known waste constituents shall be specifically identified according to the most descriptive nomenclature. A listing of hazardous waste constituents shall include reference numbers for listings established by Department of Health Services in Section 66680 of Title 22 of the Administrative Code (Section 2594(a)).

2. Provide a description of disposal methods; including waste mixing, operating procedures, and management practices (Section 2594(a)).

B. Characterize and locate, vertically and horizontally, the hazardous or potentially hazardous materials already in the site. Also, include a list of waste generators for each type of hazardous or potentially hazardous waste (Water Code Section 13273).

III. <u>Solid Waste Assessment Test Summary</u>

The SWAT report summary shall include all of the results and conclusions of the monitoring program conducted during the twelve months in which the site was assessed. The SWAT summary shall include:

A. An evaluation, supported by water quality analyses, of the quality of water known to exist under or within one mile of the disposal site perimeter including all data necessary to establish background water quality (Section 2595(g)(6)).

B. The report shall include the results of any on-site leachate monitoring required. It shall also include the results of any additional analyses required by the respective Regional Board.

C. The report shall also include the location and description (as outlined in Section III, A, of the SWAT proposal) of all monitoring wells required by the respective Regional Board.

IV. Air Quality Solid Waste Assessment Test

A. Summarize the findings of the Air Quality SWAT.

B. Discuss the implications of such findings relative to potential degradation of water quality as a result of gas migration.

V. Conclusions

A. Provide a full description of any hazardous materials in the disposal site regardless of concentration or quantity of the substances.

B. Provide a full description of any leakage of hazardous materials from the site.

C. Describe any threats to water quality as a result of migrating gases from the site.

D. Describe any remedial measures required/implemented to mitigate any threat to water quality.