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NFD POINT MOLATE
SSIC NO. 5090.3

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NFD POINT MOLATE
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NAVAL FUEL DEPOT
POINT MOLATE
TREATMENT PONDS AREA
CHARACTERIZATION
AND INTERIM CORRECTIVE ACTIONS
FIELD WORK PLAN

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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
CLEAN
Western Division

Contract Number N62474-88-D-5086

Contract Task Order 0143

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NAVAL FUEL DEPOT
POINT MOLATE
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FIELD WORK PLAN

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October 22, 1991

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1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC) received contract task order (CTO) 0143 from the Department of the Navy, Naval Facilities Engineering Command Western Division (WESTDIV), to perform a characterization study and provide an interim corrective action plan for the treatment ponds area at Naval Fuel Depot (NFD) Point Molate. This field work plan presents PRC's technical approach for characterization activities and implementation of interim corrective actions. This contract task order is authorized under U.S. Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) contract number N62474-88-D-5086.

The field work plan is divided into sections describing the site background, characterization activities and field procedures, and interim corrective actions and methods. A characterization and interim corrective action report will document the results of the investigation. It will recommend remedial actions to preclude the petroleum hydrocarbon contaminant migration toward San Francisco Bay, and initiate the cleanup of hydrocarbon contamination in soil and ground water.

2.0 BACKGROUND

The treatment ponds area is a component of the wastewater treatment facility used for the treatment of oily wastewater. The treatment ponds are unlined aeration basins which oxidize hydrocarbon components in the wastewater following the separation of oily wastewater in a system of oil-water separators. After cycling through these treatment ponds, the water passes through a final charcoal and chlorination stage prior to discharge into San Francisco Bay. Discharge water must meet the requirements of the National Pollutant Discharge Elimination System (NPDES) permit issued for NFD Point Molate.

The treatment ponds area was investigated by PRC in 1990 and Harding Lawson Associates, Inc. (HLA) in 1978, 1981, and 1984. The treatment ponds area, constructed on top of a former sump pond, is a known source of petroleum contamination in subsurface soils, fill material, and within the shallow water table. Data are not available to determine if contamination from the treatment ponds area is posing a threat to near-shore aquatic life; however, contamination of tidal flats sediments near the treatment ponds has occurred, and may presently be occurring. For this reason,

the Regional Water Quality Control Board San Francisco Bay Region (RWQCB) has requested a priority characterization and interim remediation of the petroleum contamination in the treatment ponds area. WESTDIV issued CTO 143 to address specific concerns within the treatment ponds area, although a site-wide ground water monitoring plan and site characterization study for NFD Point Molate has been written (PRC 1991a) and will be implemented following CTO 143 activities.

Although the treatment ponds area and the underlying former sump pond are known sources of hydrocarbon contamination, immediate source control measures are not readily feasible due to various factors. These factors include the following:

- The limited data regarding the nature of contaminants in the vicinity of the treatment ponds area
- The extent of floating petroleum hydrocarbons within the shallow water table in the proximity with the treatment ponds area and the nearby shoreline
- The unknown extent of hydrocarbon-contaminated soil and sediment in the vicinity of the treatment ponds area and near the shore area
- The existence of an operating wastewater treatment facility immediately overlying the likely source area of hydrocarbon contamination
- The existence of multiple underground fuel transfer pipelines and other utilities within the study area
- The unknown hydraulic influence of the unlined treatment ponds (aeration basins) on the movement of hydrocarbons in soil or ground water within this area
- The unknown hydraulic relationship between the tidally influenced shallow water table and the San Francisco Bay

The objectives of CTO 143 are to provide characterization data which will define the factors listed above, to implement an interim corrective action designed to mitigate or preclude the movement of hydrocarbons toward San Francisco Bay, and to recommend and provide design requirements for appropriate alternative remedial action(s).

Characterization activities will include the following components:

- Surface geophysical surveys
- Soil boring installation
- Chemical analyses of soil samples
- Physical analyses of soil samples
- Chemical analyses of sediment samples
- Monitoring well/piezometer installation
- Chemical analyses of ground water samples
- Aquifer testing
- Tidal monitoring survey
- Land surveying

Interim corrective actions will include the following:

- Installation of extraction well(s)
- Installation of extraction system(s) within extraction well(s)
- Establishment of design requirements for hydraulic containment and extraction trench(s)
- Assessment of treatment technologies (alternative remedial actions) for oil-contaminated soils and ground water

2.1 SITE HISTORY

NFD Point Molate covers over 300 acres in the Potrero Hills near Richmond, California along the eastern shore of San Francisco Bay. NFD Point Molate is located approximately 1.5 miles north of the Richmond-San Raphael Bridge and approximately 2 miles northwest of the city of Richmond. NFD Point Molate is bordered to the north, south, and east by Standard Oil Corporation (Chevron) and to the west by San Francisco Bay. The majority of land around NFD Point Molate is occupied by Chevron and is used for oil refining or oil storage. Topography at NFD Point Molate ranges from flat, reclaimed tidal marsh at sea level to steep, dissected slopes nearly 500 feet above mean sea level.

NFD Point Molate has been in operation since the early 1940s. It currently stores over 40 million gallons of fuel and oil in 29 underground and aboveground bulk storage tanks. NFD Point Molate also has three smaller capacity secondary storage tanks (one of which is abandoned), one inactive waste disposal site (landfill), an oil treatment storage facility, and the treatment ponds area including an operating oily water treatment plant (NEESA, 1988). The location of the treatment ponds area is shown in Figure 1. Tank locations are also shown in both Figure 1 and Plate 1.

Current tank usage is limited to marine diesel fuel Naval distillate (also referred to as marine diesel fuel or F-76), JP-5, reclaimed fuels (fuel oil recovery), defuel mixtures (fuel, fresh water, and sediment mixtures with no heavy metals or waste oils) from off-loading of Naval vessels, and off-load fuel (fuel from Naval vessels). Tank usage is summarized as follows:

F-76:	Tanks 1, 2, 5 through 13, and 21 through 24
JP-5:	Tanks 3, 4, and 14 through 19
Defuel tanks:	Tanks 20, B, C
Off-load tanks:	Tanks F and G
Fuel oil recovery:	Tank E

Several different fuels have been stored in Tanks 1 through 24. Navy Special Fuel Oil (NSFO), a black, viscous bunker fuel, was stored first in Tanks 1 through 20. Tanks 1 through 9 have contained diesel fuel and jet turbine fuel subsequent to containing NSFO. Aviation gasoline has been stored in five tanks (Tanks 11, 21, 22, 23, and 24), motor gasoline in four (Tanks 21, 22, 23, and 24), and ballast in one (Tank 20).

In 1981, a large diesel fuel leak was discovered at NFD Point Molate. In response to this and previous uncontrolled releases, WESTDIV initiated a series of characterization and prevention activities. The Naval Energy and Environmental Support Activity (NEESA) performed a preliminary assessment (PA) at NFD Point Molate on September 22, 1987. The PA report (NEESA, 1988) recommended a site inspection (SI) under the Department of the Navy's Installation Restoration Program (IRP) for three sites within NFD Point Molate. PRC was contracted by WESTDIV to perform the SI under CTO 10. The sites investigated under the SI are the treatment ponds area

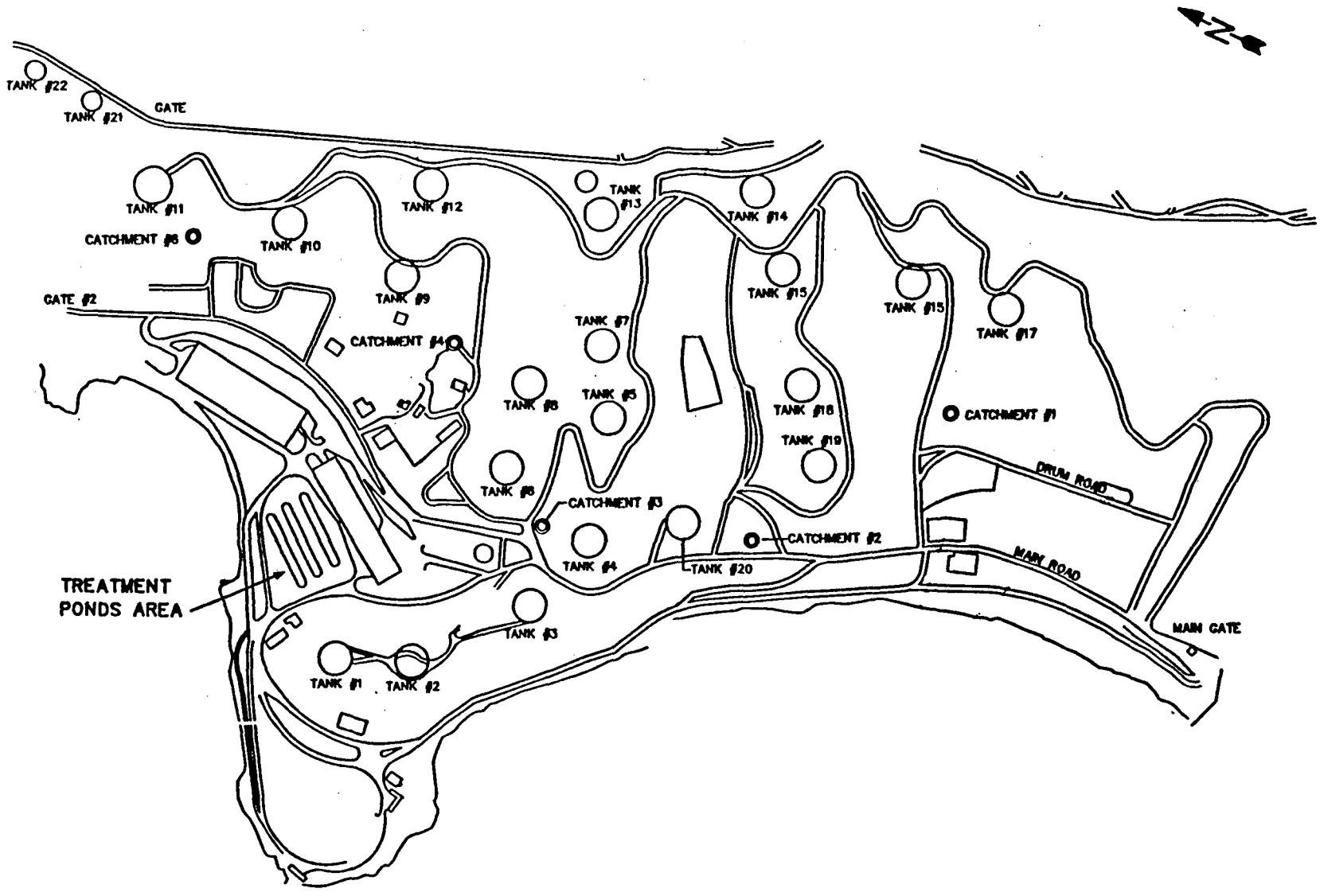

FIGURE 1
NAVAL FUEL DEPOT POINT MOLATE
SITE MAP

(described below), an inactive landfill, and several sandblast grit disposal areas. SI results pertinent to the treatment ponds area appear in the Draft SI Summary Report prepared by PRC (1991b) as well as in Section 2.2.2 below.

The treatment ponds area consists of the existing wastewater treatment plant, an oil treatment storage facility, and a nearby sewage treatment facility. Included in the wastewater treatment plant are three aeration basins (treatment ponds), two oil-water separators, weir separators, a filtration system, pump houses, and off-loading and fuel oil recovery tanks. The three aeration basins and Tank G, an off-loading tank are currently located over a former sump pond. The sump pond was used for the containment of contaminated fuels, leaking drums, and other liquid wastes. Other materials, including up to six railroad cars full of used batteries were disposed in the sump pond (PRC, 1990a). Liquids in the sump pond were pumped out and sent to the neighboring refineries for reprocessing. Some of the sludge and waste, including most of the batteries, was removed prior to filling the pond with fill material; however, an undetermined quantity of sludge remained in the former sump area. The present wastewater treatment facility and aeration basins were constructed over the fill. The aeration basins are unlined and are approximately 6 feet deep. A sheet piling cutoff wall associated with the sump pond was installed in the late 1940s, and reportedly remains intact (HLA, 1984). The cutoff wall reportedly extended to depths of 4.5 to 24 feet below ground surface. According to HLA, it provides a partial barrier to subsurface flow toward the Bay. However, the effectiveness of this cutoff well requires further investigation, and is included in characterization activities for CTO 143.

NFD Point Molate has implemented a spill prevention counter measure and control system (SPCCS) that consists of the following design. Valve boxes, which control or direct the flow of product stored in each tank, are distributed throughout the facility. Each valve box has been modified with a bottom drain that connects to a 2-inch main piping system. This piping system is channeled to pumping stations (located in manholes). The pumping stations are channeled to an Oil Recovery Systems (ORS) oil-water separator and then a corrugated plate separator (CPS) oil-water separator. Piping systems have also been installed which channel oil and water from the extraction well system to the ORS oil-water separator. Two weir separators collect drainage from the facility storm drain system and also send oil and water to the ORS oil-water separator. Oil collected from the oil-water separators is sent to Tank E for reclamation. Reclaimed water from the oil-water separators is sent to

the treatment ponds for long-term oxidation of remaining dissolved constituents. The effluent water is tested routinely in accordance to the NPDES permit. All pond operations are administered by Public Works Center (PWC) personnel. The treatment ponds also receive waste water from the Point Molate sewage treatment plant.

2.2 SUMMARY OF PREVIOUS INVESTIGATIONS

Several earlier studies, from 1973 to 1982, have been completed at NFD Point Molate, primarily targeted at both spill prevention control (engineering measures) and assessment of site conditions (site characterization). These earlier studies are listed below in chronological sequence to provide a historical summary of earlier investigations.

- Harding Lawson Associates, 1973, Engineering Services to Determine Extent of and Correction Measures for Possible Subsurface Intrusion of Oil at the Naval Fuel Department, Point Molate, California
- Bissell & Karn, Inc., 1979, Spill Prevention Control and Counter Measures Plan
- Navy Public Works Center, 1979, Environmental Impact Assessment for the Oil Spill Prevention Facility
- Harding Lawson Associates, 1981, Soil Investigation, Sewer Outfall, Point Molate, Richmond, California
- Associated Geotechnical Engineering, 1981, Leakage from Underground Fuel Tanks, Point Molate, U.S. Naval Fuel Depot, Richmond, California
- Bissell & Karn, Inc., 1982, Engineering Study for the Fuel Oil Valve Box Drainage Problem

Of these earlier studies, the HLA 1973 investigation included characterization within the area of the current wastewater treatment facility and is summarized as follows:

The 1973 investigation by HLA included the drilling of 16 test borings; the installation of fluid observation wells (monitoring wells) in 15 of these borings; and collection of selected chemical or physical samples from both new and existing observation wells, valve boxes, the former sump pond, and spoils from the excavation of the sewage treatment plant. Chemical analyses conducted on soil or fluid samples consisted of oil and grease analysis and selected infrared spectra (finger print)

analysis. On site samples of NSFO, distillate, and diesel were provided by the facility for comparative finger print analysis. Physical tests on soils included moisture content and dry density. Six borings, drilled in the bay fill area, penetrated highly permeable, loose to medium dense gravel, sand, and silt fill material up to 20 feet thick. Underlying the fill material was soft clayey silt or bay mud. Varying thicknesses of fill were encountered in other borings in addition to very firm soils and weathered sandstone and shale bedrock. Petroleum seepage was observed in four surfaces and at two shoreline locations. The largest amounts of petroleum were found in borings east of the sump pond and near the north end of the Administration Building. This petroleum was similar to NSFO. The extent of the petroleum seepage was estimated by HLA, however, the plates included in its 1973 report showing the extent of the petroleum intrusion were not available for review. HLA concluded in this study that it was not practical to assess the rate of seepage or to estimate the quantities of petroleum, particularly in fill material, because of complex site geometry, fluctuation of the ground water surface, and the heterogeneous nature of the bay fill material.

The following describes more recent studies (1984 to 1990) which are pertinent to the treatment ponds area or the shoreline near the treatment ponds area.

In May 1984, Graham & Kellam, in conjunction with HLA and Buonaccorsi & Associates, prepared a concept study (P-075) for oil spill prevention (HLA, 1984). The report summarizes a subsurface investigation by HLA as well as an engineering concept study by Buonaccorsi and Associates. HLA's investigation included geophysical refraction profiling, soil borings, monitoring well installation, ground water sampling, and recommendations for further work. Buonaccorsi and Associates' study addressed oil/water separation at the valve boxes and catch basins and proposed construction of systems to implement the process.

A set of detailed construction plans provided by Graham and Kellam, dated 1986, supplement the concept study (P-075). Also included in these plans are a comparison of 24 borings installed by HLA in 1985 and a set of drawings summarizing the associated soil gas survey performed by Tracer Research along Burma Road in December 1985.

These 24 borings installed by HLA were limited to a 200-foot long area along Burma Road, and were used to define the extent of hydrocarbons in the subsurface for this particular area. The general locations of these borings are shown on Plate 1. Three cross-sections were included, showing generalized lithologies encountered in each boring. Boring data were also included indicating the depth, thickness, and type (based on visual identification) of hydrocarbons encountered.

Construction details for the pre-existing wells mentioned in the P-075 report, water level measurements, records of oil recovery from extraction wells, and a report of the soil gas survey, documented in the construction plans (P-075), were not located.

In April 1988, NEESA, Port Hueneme prepared a preliminary assessment report that assigned a medium inspection priority to three potential hazardous waste disposal sites. Included in these sites is the treatment ponds area as described earlier.

During April 1989 through September 1990, ERM-West, Inc. (ERM-West, 1990) conducted a shallow soil investigation at NFD Point Molate to determine if petroleum hydrocarbons were present in shallow soils near valve box locations and within areas of historic leaks and spills. Although not directly applicable to the treatment ponds characterization, this study included the installation of two monitoring wells along the shoreline at NFD Point Molate. Only JP-5, F-76, and volatile aromatic hydrocarbons including benzene, toluene, ethylbenzene, and xylene (BTEX) were targeted analytes in ground water samples collected from these wells. Samples from well MW-1, located along Garden Road near the shoreline (see Plate 1), contained JP-5 at a concentration of 0.23 milligrams per liter (mg/L). Samples from well MW-3, located north of the treatment ponds along the shoreline, contained BTEX; the concentration of benzene, 0.62 micrograms per liter (μg/L), exceeded the California Department of Health Services (DOHS) action level of 1 μg/L for this compound.

As the HLA 1984 concept study and PRC 1990 SI investigations are the basis from which additional characterization activities within the treatment ponds area have been developed, they are discussed in more detail below.

2.2.1 HLA 1984 Subsurface Contamination Concept Study

Field activities during the 1984 HLA study consisted of geophysical surveys, soil borings, soil sampling for physical parameters, monitoring well installation, ground water sampling, and sampling of a product seep adjacent to San Francisco Bay. Included in the report of this study were recommendations on mitigation of petroleum contamination at NFD Point Molate, most of which have since been implemented.

Geophysical surveys included ground penetrating radar (GPR) and seismic refraction profiling. GPR surveys were used to clear proposed borehole locations, and prevent damage to underground utilities, pipelines, or conduits. Seismic refraction surveys were performed to determine the depth to bedrock and to evaluate lithologic variability. Seven surveys were conducted, primarily across various ravines within the hillside areas. Three monitoring wells, installed in the vicinity of two of these seismic profiles, encountered bedrock at depths comparable to those in the refraction data.

Sixteen soil borings were installed during this study, 11 of which were converted to 2-inch monitoring wells. Areas investigated are broadly outlined as (1) an active product seep within the ravine along F Road near Tank 6; (2) the continuation of this seep toward the southeast corner of the Administration Building, and including the north end of the Administration Building; and (3) the wastewater treatment ponds area, including the possible continuation of hydrocarbon contamination from the south end of the Administration Building toward the treatment ponds area. At the time of this study, three Navy extraction wells had been installed within these areas, and a fourth was under construction. Four Navy monitoring wells, apparently installed in 1983, were also incorporated in this study. The areas investigated and associated HLA borings or monitoring wells, and Navy extraction or monitoring wells are outlined as follows. Locations of wells and borings are shown on Plate 1. This plate was used in the site-wide ground water monitoring plan/site characterization study, and shows previous boring or well locations for reference to previous investigations completed at NFD Point Molate.

Area	1984 HLA Borings/Wells	1983 Navy Monitoring Wells	Navy Extraction Well Number
Tank 6/F Road	Wells 2, 3	------	1
Administration Building	Borings 8, 12, 13, and 14/Wells 4, 9, 10, and 11	------	2
Treatment Ponds	Boring 16/Wells 5, 6, 7, and 15	USN 2, 5, 6, and 8	3, 4 (under construction)

One of the 16 HLA borings/wells installed during 1984, well number 1, not listed above, was installed between C Road and B Road, near Tank 18, presumably to confirm depth to bedrock in a nearby seismic refraction profile.

Ground water samples were obtained from all monitoring wells listed above during the 1984 study, including HLA well number 1, as well as from Navy extraction wells 1 and 2, and from two Navy monitoring wells apparently installed in 1983. Results from these samples are discussed below. These 1983 Navy monitoring wells were located in the treatment ponds area; however, no information was available on well construction details. Some of these 1983 wells were located during SI field activities and had been partially destroyed or impacted by local traffic. None of the 1983 wells had surface seals.

In addition, some HLA monitoring wells were not located during the 1990 PRC SI investigation, presumably due to destruction from vehicular traffic or overgrowth of brush around the 2-inch PVC risers.

These 1984 HLA borings or monitoring wells are shown on Plate 1, and are designated with "HLA (84)" next to the boring or well number. Plate 1 also depicts earlier soil borings installed by HLA in 1973 and 1981 studies. These borings are designated with "HLA (73)" or "HLA (81)" next to the boring number. Subsequent borings installed by HLA in 1985, in conjunction with the tracer soil gas survey along Burma Road, are not individually shown on Plate 1. However, the general

location of these 24 soil borings is outlined on Plate 1. Navy extraction wells are designated with "EW" prior to the well number on Plate 1. Four Navy monitoring wells installed in 1983 are designated with "USN (83)" prior to the well number as shown on Plate 1.

Ground water sampling results were presented in Graham and Kellam (1984) only for those analyses available at the time of their report. Concentrations were reported for F-76, JP-5, toluene, and xylene in all HLA wells, USN wells 6 and 8, and Navy extraction wells 1 and 2. Concentrations for volatile organic compounds (VOCs) were also reported for HLA well 10, and USN wells 6 and 8.

F-76 was detected in samples from HLA wells 1, 3, 5, 6, 7, 10, 11, and 15; Navy (1983) wells 2 and 6; and Navy extraction wells 1 and 2. JP-5 was detected in samples from Navy (1983) wells 2 and 6, and in samples from Navy extraction wells 1 and 2. Several VOCs, primarily solvents, were detected in HLA well 10. These solvents include Freon 113, 1,1,1-trichloroethane, 1,1-dichloroethane, perchloroethylene, and methylene chloride. Toluene and xylene were detected in HLA well 11 and in Navy wells 2, 6, and 8. HLA observed floating product in several wells, with the maximum thickness in Navy extraction well 2 and Navy (1983) well 6. Generally, HLA reported the presence of more viscous product (NSFO) along shoreline locations, however, the specific locations (wells or seeps) were not reported.

HLA's 1984 study reported general ground water flow directions from hillside canyons toward areas of flat-lying fill near the shore. With the exception of preferential flow paths along buried conduit or pipelines, HLA suggested that there are no preferred flow paths within heterogeneous fill material. HLA reported that structures such as building foundations and the treatment ponds cutoff wall which extend below the water table may also divert ground water flow directions. For example, the HLA report suggested that product may be pooling on the upgradient side of the Administration Building. Discharge from the treatment ponds was also reported as impacting local flow directions.

In general, HLA referred to both bedrock and bay muds as low permeability materials and considered the bay mud to restrict or preclude downward ground water flow. HLA suggested the presence of perched water within specific localities based on the existence of low permeability clayey silt. HLA calculated that the amount of water flowing in the vicinity of the Administration Building

was about 1 to 1.5 gallons per minute (gpm). This calculation assumed steady state ground water flow patterns and a representative conductivity value for alluvium was chosen. No in-situ or laboratory characterization of conductivity values were employed in the HLA study. HLA also suggested that leakage from the treatment ponds contributes to ground water flow toward the bay. This potentially induced gradient from the treatment ponds area may be associated with the movement of petroleum from the ponds toward the bay, and is included in characterization activities under CTO 143.

Two cross sections within the treatment ponds area were provided in the HLA report. These sections, one transverse to the ponds and one parallel to the ponds, were compiled from 1973, 1981, and 1984 HLA soil boring data. Tidal variations in the water table were also projected on these sections. The cross sections broadly defined lithologies as fill material, bay mud, or bedrock.

The extent of petroleum product contamination was roughly outlined in the HLA report. Product seepage in the Tank 6/F Road area was shown to extend to the south end of the Administration Building. The entire treatment ponds area, including the near shore area between 1983 Navy well 2 and 1984 HLA boring 16 (see Plate 1), was shown as an area of petroleum contamination.

Petroleum seepage was also observed along the shoreline near Burma Road between Tanks 2 and 3. HLA analyzed a sample from this seep for oil and grease; however, results of this analysis were not available at the time of its report. A subsequent soil gas study was completed along Burma Road in 1985; however, results of this study were not available. Associated with the soil gas study was the installation of 24 soil borings by HLA in 1985. Results of these borings are provided in the P-075 construction plans, dated 1986 as discussed earlier. These boreholes were placed apparently to assess the presence of petroleum contamination and provide general lithologic descriptions.

HLA provided several options for mitigation of petroleum contamination at the site, as well as recommendations for operation of Navy extraction wells, and installation of additional extraction wells. Four additional extraction wells were subsequently installed by the Navy; however, the effectiveness and performance of these wells have not been fully established.

2.2.2 PRC SI Investigation, September 1990

The SI investigation performed by PRC during September and October 1990 was tailored specifically to areas of concern identified in the preliminary assessment. The areas investigated included the landfill, three sandblast grit disposal areas, and the treatment ponds area.

Soil and ground water samples collected in the treatment ponds area were analyzed for volatile and semivolatile organic compounds (SVOCs), inorganic compounds, pesticides/PCBs, BTEX, and total petroleum hydrocarbons (TPH). Two distinct types of hydrocarbons were encountered in soils and ground water during the SI investigation. These were subsequently identified as JP-5 and a heavier oil (motor oil range) by TPH analyses in ground water samples obtained from two monitoring wells installed during the SI investigation. The source of the heavier oil encountered in monitoring well PRC 2 and indicative of NSFO, is likely attributed to the former sump pond, as reported oils of this type were disposed in the sump pond (PRC, 1990). The source of the JP-5 encountered in monitoring well PRC 3 has not been determined as a result of the SI investigation, and many potential sources exist in the vicinity of PRC 3. The most likely source is nearby pipelines which carry fuel to and from the NFD Point Molate fuel pier. These pipelines are routinely pressure tested, and have not been reported as leaking. During August of 1991, however, a heavier oil also indicative of NSFO was observed in monitoring well PRC 3. The thickness of the floating oil was monitored and measured 0.5 ft. This observation suggests that NSFO, likely attributable to the former sump pond, migrated toward monitoring well PRC 3 during the 10-month period following SI activities completed in October 1990.

TPH concentrations in soil in the diesel range (F-76) were reported as high as 3,630 milligrams per kilogram (mg/kg) with associated values in ground water of 2.4 mg/L. Numerous semivolatile compounds, indicative of heavier oils, were detected in some treatment ponds soil samples; however, these compounds were not detected in associated ground water samples. All concentrations of BTEX detected in ground water samples were less than California Department of Health Services (DHS) action levels.

As a result of the SI investigation, only the treatment ponds area was recognized as having an impact on ground water and possibly San Francisco Bay. Two sediment samples obtained in the near shore area of the treatment ponds during low tide resulted in values of TPH in the diesel (F-76) and motor oil range from 129 mg/kg to 4,710 mg/kg. Toluene, ethylbenzene, and xylene were

detected in these sediment samples at concentrations well below water quality criteria for the protection of saltwater aquatic life, or California applied action levels (AALs) in water for saltwater species with the exception of toluene in one sample. These samples indicate that the movement of contaminants from the treatment ponds area toward San Francisco Bay has occurred or may be occurring, but the extent and concentration of hydrocarbon constituents within the tidal flats area is not known and warrants further investigation.

Additional soil borings are necessary to further assess the sources of the product types encountered, although final determination of the exact sources may not be possible. These soil borings will also assess the vertical extent of hydrocarbons within the soil profile. Additional monitoring wells are necessary within the treatment ponds area to assess the horizontal extent of hydrocarbon contamination and to provide future monitoring locations for other potential leaks or spills. Additionally, monitoring wells are proposed to assess the adequacy of the existing extraction well system to produce a water table gradient.

The following recommendations for the treatment ponds area are based on the information obtained during the PRC SI investigation:

- Determination of the extent of hydrocarbon contamination in the near shore tidal flats area of the treatment ponds
- Determination of the extent of and further characterization of hydrocarbon contamination within the treatment ponds area
- Installation of additional monitoring wells along the treatment ponds shoreline area targeted at intercepting potential hydrocarbon plumes from sources within or near the treatment ponds area
- Determination of sources of hydrocarbon contamination (including heavy bunker fuel and lighter JP-5 or F-76 sources) within the treatment ponds area
- Estimations of hydrocarbon migration rates within the treatment ponds and associated areas through determination of ranges of hydraulic conductivities in the highly heterogeneous materials within these area
- The installation of monitoring wells in the vicinity of existing Navy extraction wells used to monitor the efficiency of any operating extraction well

3.0 CHARACTERIZATION ACTIVITIES AND FIELD PROCEDURES

The following sections describe characterization activities that will be implemented within the treatment ponds area. These activities will provide adequate physical or chemical data for design requirements or assessment of alternative remedial actions.

3.1 SUBSURFACE STRUCTURES AND UTILITIES SURVEY

Several subsurface characterization activities will be implemented during this investigation, including soil borings, monitoring well or piezometer installation, extraction well installation, and trenching. Prior to the initiation of these activities, a utilities inspection and subsurface survey will be completed within the area of each activity. The utilities survey will require coordination among NFD Point Molate personnel, PWC personnel, or City of Richmond utilities personnel. Subsurface structural surveys will be completed with surface geophysical methods in areas of investigation. Both utilities surveys and subsurface structural surveys will be completed prior to initiation of subsurface characterization activities; however, in the event that subsurface utilities or structures are encountered or damaged, repair will be initiated as quickly as possible, utilizing appropriate agencies or subcontractors. These repairs will incur additional costs not included in the field characterization program, and will require an amendment of funds appropriated for CTO 143. Negligent operation of equipment by subcontractors resulting in damage of underground structures or utilities will require full subcontractor responsibility coordination and completion of repair(s).

3.1.1 Utilities Clearance

Both above and below ground utilities clearances will be initiated prior to subsurface characterization activities. These clearances will require coordination among NFD Point Molate personnel, PWC personnel, City of Richmond personnel, or other applicable agencies. Several active and inactive utilities within the treatment ponds area will require identification and clearance. These include water distribution piping, hot water and return lines (abandoned in place), telecommunications lines, steam and condensate lines (abandoned in place), storm sewer lines, sanitary sewer lines, gas lines, fire lines, fuel product lines, and electrical lines. Utility systems maps obtained from NFD Point Molate provide the most complete source of utilities information. These maps will provide a useful reference, although, they are dated July 1984. Updated utilities maps or as-built information have not been located and it is assumed they are not available.

A visual survey of each site will be completed to identify the presence of features that might affect the planned activities. Equipment access considerations will be identified and sampling locations will be marked. Completion of the underground utilities survey will depend, in part, on the accuracy of utility systems maps as well as construction information identified from additional records research.

3.1.2 Surface Geophysical Surveys

Surface geophysical surveys at NFD Point Molate will assist in locating features such as utilities, pipelines, subsurface structures, and a sheet piling cutoff wall. The surveys may include use of GPR, electromagnetic induction (EM), or magnetometry (MAG) methods. The results of the geophysical surveys will help to finalize the locations for new soil borings and ground water monitoring wells and to identify undocumented subsurface utilities or features.

The following subsections describe the equipment and procedures used with each of the three geophysical techniques and analysis of the data collected.

3.1.2.1 Ground Penetrating Radar

GPR uses high-frequency radio waves to obtain a reflection profile of shallow subsurface features and conditions. GPR detects natural hydrogeologic conditions and the presence of both natural and man-made anomalies. GPR will be used to locate excavation boundaries and buried metallic objects, and to provide information for soil boring and well locations. The radar system consists of a control unit, an antenna assembly (transmitter/receiver), and a recording device for analog field recordings.

The GPR to be used will be the ground impulse type. Energy radiates downward into the subsurface from a transmitting antenna that is pulled slowly across the ground over the survey grid. This radio wave energy is reflected from surfaces where there is a contrast in electrical properties of subsurface materials. The reflected energy is received, processed, and displayed as a continuous strip-chart recording of distance versus time, where time is proportional to depth. Penetration depth will be on the order of a few feet to tens of feet depending upon specific site conditions. Depth of penetration is primarily a function of the radar signal attenuation within the subsurface media.

A grid system for sampling points will be tied into an existing permanent feature for future reference at each site. After completion of a visual survey of the site, the line spacing will be chosen. A spacing of 10 to 20 feet should allow for complete coverage and identification of the anomalous zones at a given area.

GPR data will be interpreted visually from the graphic recorder. A rapid qualitative analysis can thus be made in the field from the raw data. Quantitative assessment of field depth measurements stored on magnetic tape will be correlated with direct data processed by computer. Computer analysis of the recorded signal produces a cross-sectional profile of the subsurface conditions. Anomalous objects will be extracted from profile data and plotted on a map of the site.

3.1.2.2 Electromagnetic Induction

EM induction methods allow for measurement of the apparent electrical conductivity of subsurface materials. The basic operation uses a transmitter coil energized with an alternating current at an audio frequency. Eddy current loops are induced in the subsurface beneath the instrument. Each of these eddy current loops produces a secondary electromagnetic field which is proportional to the magnitude of the current flowing within that loop. A receiver coil located a short distance away intercepts part of the secondary electromagnetic field and produces an output voltage which is approximately linearly related to subsurface conductivities. This voltage is a composite measurement of the conductivity of the soil and surface objects between the surface and the effective depth of the instrument.

EM will be used to assist in the location and mapping of contaminant plumes, excavations, and buried objects. When used, the EM survey will be run over the same grid system as the GPR survey. A Geonics EM31-DL terrain conductivity meter with an effective exploration depth of 20 feet will be used. The EM31-DL can provide discrete readings and continuous data profiling across a site, making it less likely to miss a small conductor. Data output will be in both the quadrature-phase (conductivity) and the in-phase component (magnetic susceptibility) modes to allow for simultaneous mapping of contaminant plumes and buried objects.

Field data will be recorded on a digital data logger and transferred to a portable field computer at the end of each day. The data will be presented as a contour map of the measured values as well as a three-dimensional composite view of the surfaces generated from these contours. Unwanted noise will be filtered out with the computer. Anomalous near-surface areas will appear as higher conductivity contours on the data output maps.

3.1.2.3 Magnetometry

A magnetometer measures the intensity of the earth's magnetic field. Ferrous metal objects, such as drums, will cause variations in the local strength of that field. The response of the magnetometer is proportional to the mass of the buried ferrous object. A fluxgate magnetometer will be used where appropriate within the treatment ponds area. Two sensors are separated by a small, fixed vertical spacing that gives an indication of the change in intensity of the total field with vertical distance (gradient). The electronic signals produced by these variations in field strength are amplified and recorded by a digital recorder.

When used, the MAG survey will use the same grid system established for both the GPR and EM surveys to allow for a greater degree of spatial resolution and comparison of different applied geophysical techniques. A fluxgate magnetometer will provide a continuous measurement of the vertical gradient of the magnetic field across a site. The continuous survey supplies a high degree of resolution to the data. At this time, the specific magnetometer equipment to be used has not been determined.

A strip chart and digital record of the field data will be made from the continuous survey readings. Graphic profile data from the MAG survey will first be interpreted qualitatively to identify anomalous locations along a profile line. Simple contour maps will be made to show areas of high concentrations of suspected ferrous anomalies. A filtering process to reduce the effects of unwanted magnetic disturbances, such as fences, can be employed. A computer-processed, three-dimensional view will be generated from these contours.

3.2 SEDIMENT, SOIL, AND BEDROCK CHARACTERIZATION

Sediment, soil, and bedrock characterization is required within the treatment ponds area to further define the nature and extent of contamination; to define hydraulic parameters within soil, fill material, or bedrock; and to provide information necessary for design requirements for potential remedial activities. This section describes sediment, soil, or bedrock sampling methods and proposed sampling locations. Procedures for each sampling method are described as follows and are based on standard operating procedures established by PRC.

3.2.1 Sediment Sampling Methods and Locations

Eight sediment samples are proposed in the near-shore tidal flats within the treatment ponds area, as shown in Plate 2. Two such samples were collected during the SI investigation approximately 10 feet from the protective boulders below the treatment ponds. These sediment samples, collected at 1 to 2-feet depth, contained detectable concentrations of ethylbenzene, toluene, xylene, and TPH concentrations up to 4,710 mg/kg.

Near-surface sediment samples may be collected by means of hand-driven core samplers, hand-driven soil augers, trowels, or spoons.

It is anticipated that most shallow sediment samples will be collected with a soil auger, as this method was successful during the SI investigation. Near-shore samples will be collected during periods of low tide, and it may be possible to obtain samples at depths of approximately 3 to 4 feet. Due to the immediate near-surface presence of bay water, the remaining auger hole is expected to collapse below these depths. It may not be possible, therefore, to collect and identify sediments contaminated with hydrocarbons below these depths.

At shoreline locations it may also be possible to excavate a small pit or trench using a shovel and collect near-surface samples with a stainless steel trowel or spoon.

Hand-driven core samplers may be used where more competent surficial materials exist. A steel drive shoe on the lead end of the sampler will penetrate more consolidated strata. The drive shoe may be loaded with a 2-inch by 6-inch acrylic, brass, or stainless steel sampling tube. The tube may be capped and sealed and submitted for laboratory analysis, thus allowing little disturbance of the collected sample. Depths are generally limited to approximately 5 to 7 feet when using the hand-driven core sampler.

All sampling equipment described above, including the acrylic, brass, or stainless steel sampling tubes used in the hand-driven core sampler, will be decontaminated prior to sample collection at each location. Decontamination procedures are outlined in Section 3.7.

3.2.2 Soil and Bedrock Sampling Methods and Locations

Twenty-four borings will be drilled within the vicinity of the treatment ponds to determine the vertical and horizontal extent of hydrocarbon contamination in soils, fill material, or bedrock. Proposed locations for these borings are shown on Plate 2. Three soil horizons are targeted at each boring: near the surface, the vadose zone, and the capillary fringe. Where visible evidence or field screening methods indicate contamination within other horizons, additional samples will be collected. Two to three of these borings are proposed on the southeast side of the existing treatment ponds, between the ponds and the administration building, and near Tank F. Two to three borings are proposed north-northeast of the ponds to assess the extent of hydrocarbons near the northernmost Navy extraction well near Tank E. At least one boring is proposed near the access gate to the treatment ponds, near the northern end of the administration building. The remaining borings are proposed on the shoreline side of the treatment ponds and will assess the movement of hydrocarbons toward San Francisco Bay, toward Valve Box 26 to the north-northwest, as well as within the vicinity of the fueling station west-southwest of the treatment ponds.

These borings will require hollow stem auger (HSA) drilling methods. Core drilling will be implemented where the vertical extent of hydrocarbon contamination cannot be assessed with HSA methods due to competent strata. Most soil borings will be drilled to a depth of 25 feet, but at locations where visible evidence or field screening methods indicate hydrocarbon contamination continues deeper than 25 feet, the vertical extent of contamination will be assessed with deeper borings. Approximately five borings will be drilled to a maximum of 50 feet to determine site wide lithology.

Soil borings will be drilled with a truck-mounted or track-mounted, HSA drill rig using 6.25-inch inside diameter (ID) by 9.625 outside diameter (OD) auger flights. Soil samples in unconsolidated materials will be collected in either a 2 foot by 2 or 2½-inch split spoon samplers or a 4.25-inch ID by 5-foot long Central Mine Equipment (CME) split spoon barrel which will be advanced with the lead auger. The CME sampler is locked into position several inches ahead of the lead auger to allow collection of representative (nondisturbed) soil samples. Shorter or smaller diameter split spoon barrels may also be used at the discretion of the site geologist.

Samples within competent materials or within bedrock will be collected inside a 2-inch ID (nominal) by 3-inch outside diameter (OD) NX core barrel. The same drill rig using HSA techniques should be capable of using coring techniques. Generally, HSA will be advanced until refusal is encountered, to be followed by coring techniques. Coring techniques will require the use of either potable water or bentonite mud for lubrication and cooling of the diamond bit and may, therefore, drive off volatile compounds and/or dissipate contaminants occurring within the competent matrix. These factors will be considered when sampling these media.

Samples will be collected where field screening and visual methods (described below) indicate contaminated intervals within the 5-foot split sampler or within the NX core barrel. In the absence of visual and detectable indications of contamination, samples will be generally collected from three horizons: (1) surficial soil or fill material, (2) unsaturated vadose zone, and (3) at the capillary fringe within the first saturated horizon. Each boring will be logged by a geologist and soil types will be categorized according to the Unified Soil Classification System. An example of the field borelog form used by PRC is shown in Figure 2. A Munsell or Geological Society of America soil color chart will be used to describe soil color.

Field screening methods consist of the following procedures. Upon opening the split spoon or following extrusion of the sample from the core barrel, the material will be immediately screened with a photoionization detector (PID). Any material exhibiting PID readings or obvious staining will be quickly transferred to widemouth sample bottles. Where PID readings or soil staining is not evident, a representative sample will be collected for that interval. Material collected from the CME sampler or from split spoons will be selected to avoid slough or other non-representative materials within the sampler. Each sample collected will be further screened for volatile constituents using a

FIELD BORELOG

PRC ENVIRONMENTAL MANAGEMENT, INC.

SHEET ____ OF ____

LOCATION OF BOREHOLE		
	JOB NO.:	BOREHOLE DESIGNATION:
	CLIENT:	SURFACE ELEVATION:
	SITE:	DEPTH TO WATER:
	SUBSITE:	LOGGED BY:
	DRILLING CO.:	DRILLING DATE(S):
	DRILLING PERSONNEL/METHOD:	

SAMPLER TYPE	SAMPLE DEPTH TOP BOT	BLOWS/6" SAMPLE	RECOVERED/DRIVEN	TIME	PID ppm	ANLYS PPM	WELL Info.	DEPTH IN Ft	USCS SOIL TYPE / GRAPHIC LOG	SOIL DESCRIPTION
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								0		
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								0		

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FIGURE 2
FIELD BORELOG FORM

PID after collecting the sample. Aluminum foil will be placed tightly over the sample jar and the cap inserted if possible. After 10 to 15 minutes (consistently timed for each sample), the sample will be field screened with the PID. The tip of the PID will be punctured through the aluminum foil but not allowed to touch the sample within. The sample jar will then be capped immediately. PID readings will be recorded in the field log book or sampling form. This field screening technique will be used as partial criteria in selecting samples for laboratory analysis.

Alternative methods of soil sampling from split spoons include the use of brass sleeves. The CME sampler can be loaded with 12, 3-by-6-inch brass sleeves. Upon opening the split spoon, the openings between each sleeve will be immediately screened with a PID. Intervals with PID readings or obvious staining will be isolated and capped and taped on either end. Soils may also be collected within brass sleeves which are not previously loaded into the split spoons. The sleeve can be driven into the portion of sample to be collected for analysis. Brass sleeves will then be capped and taped following collection of the sample. It should be noted that the use of brass sleeves which are preloaded into the split spoons limits the lithologic identification of the samples, but allows less disturbance of the sample upon retrieval from the borehole.

Sample collection methods will be determined in the field and will depend on the consolidation and texture of the sample, and will minimize the loss of volatile components.

Selected soil samples will be designated and prepared for laboratory analysis as described in Section 3.9.

All borings will be backfilled with grout composed of cement mixed with approximately 5 percent powdered bentonite. Drill cuttings will be drummed and labeled with the borehole number and date. Cuttings from each area may be combined in a single drum to conserve space. Soil sample analysis results will be used to determine disposal methods for drill cuttings. Drill cuttings will be stored on-site in drums. Following analysis of soil samples, cuttings may be redistributed for on-site remediation or disposal. If remediation is not possible, the cuttings may be hauled off-site to an appropriate disposal facility by a licensed waste hauler.

3.2.3 Analytical Parameters

Sediment samples collected in the tidal flats near the treatment ponds area will be analyzed for BTEX and extractable and purgeable TPH. Sample data will be used to determine the nature and extent of hydrocarbon contamination and its relationship to the occurrence of hydrocarbons in soil borings and monitoring wells near the shoreline.

Target analytes for all soil samples will be BTEX and extractable and purgeable TPH. At least 103 soil samples will be analyzed for extractable and purgeable TPH and BTEX. Twenty-four soil samples will be analyzed for SVOCs in locations where heavy hydrocarbon fractions are encountered. Twelve field equipment rinsate blanks will be taken and analyzed for BTEX. Section 3.8 describes QA/QC field samples.

3.3 GROUND WATER CHARACTERIZATION

Sixteen monitoring wells are proposed to evaluate shallow ground water quality for the treatment ponds and near-shore areas. These wells will also provide long-term monitoring capabilities for the occurrence and extent of free-phase (floating) hydrocarbons, concentrations of aqueous-phase hydrocarbons, and the extent of saltwater intrusion in near-shore locations. In addition, the monitoring wells will be used in aquifer tests to determine hydraulic properties within the treatment pond area. The placement of these wells will be determined following evaluation of data from the soil borings, but will generally extend between Tank E and the fueling depot along Burma Road. In addition, two to three monitoring wells are proposed to assess the adequacy of the existing extraction well system. These wells will the located in closer proximity to the Navy extraction wells and will serve to monitor product thicknesses and water table drawdown during the operation of the extraction well system. The locations of proposed monitoring wells appear on Plate 2. The monitoring wells will be installed with HSA drilling methods to a nominal depth of 25 feet. Monitoring wells will be constructed according to the specifications discussed in the following sections. All completed monitoring wells will be surveyed to provide vertical control and to establish water level elevations.

3.3.1 Monitoring Well Design and Construction

The monitoring wells at NFD Point Molate will be designed to monitor contaminants detected and identified during PRC's SI investigation and to monitor changes in ground water physical and chemical parameters. As the majority of the contaminants detected were hydrocarbons, and consequently float on top of the water table, the well screen will be positioned to permit floating product to enter the casing and the thickness of the hydrocarbons to be measured. Product migration can be detected and predicted by monitoring the change in contaminant thickness in strategically placed wells over a period of time. The exact placement of the screen above the top of the water table will depend on product thickness.

Variations in the water table are expected adjacent to the shoreline in direct response to tidal fluctuations. Monitoring wells installed near shoreline areas will be installed such that screened intervals will bracket tidal variations of the water table. Water level measurements collected at the shoreline monitoring wells have previously indicated vertical changes up to 0.5 feet throughout a 24-hour period. Additionally, the San Francisco Bay area is currently experiencing lower than normal precipitation conditions. The below average condition is entering the seventh year, with annual precipitation approximately 25 percent below average annual precipitation (NOAA, 1988). This condition directly affects ground water recharge rates and water table elevations. The screened intervals will therefore be placed sufficiently above the top of the observed water table in order to allow variances during periods of rising water table conditions.

RWQCB requires monitor well screens to be no longer than 10 feet and even shorter where applicable. This requirement is to assure that ground water can be sampled from discrete intervals thus allowing samples from representative horizons. PRC will use this criterion in the design of monitoring wells at NFD Point Molate. However, should the observations noted during drilling indicate product thicknesses directly above the saturated zone greater than that which can be accommodated by a 10-foot screened interval, additional screened interval will be installed. This design will permit monitoring of the entire floating product thickness and the ground water in the contaminated interval directly beneath it. The on-site geologist will determine the appropriate screen length based on information obtained during each boring and following subsequent observation of water levels within each boring or at adjacent monitoring wells.

Ground water monitoring wells will be installed with 4-inch diameter screen and casing with threaded and flush joints. The screen material will be polyvinyl chloride (PVC) or stainless steel and will be selected based on the quantity and concentration of contaminants encountered during drilling. Both materials have advantages and disadvantages. Screen failure is possible when using PVC material because the contaminants can attack the PVC, weakening the material and causing swelling of the screen slots. Stainless steel screen is resistant to degradation by organic compounds but susceptible to reduction/oxidation (redox) reactions that can attack the screen material or precipitate deposits on the screen and reduce the effective screen opening. As many of the proposed ground water monitoring wells will be located near the shoreline, chloride redox corrosion would be a chemical reaction of concern. According to Driscoll (1986), in most cases chloride concentration greater than 500 μg/l is sufficient to cause corrosion; however, type 304 stainless steel will perform satisfactorily in most cases.

The monitoring wells will be installed in unconsolidated or poorly consolidated colluvium, fill material, and marine sediments using HSA drilling methods. These wells will be installed in pre-existing soil borings or borings dedicated only to well installation. The boreholes used as soil borings will be reamed to a larger diameter (approximately 10-inches) prior to the installation of well casing.

If the driller encounters auger refusal in a monitoring well borehole before reaching total depth, the PRC on-site geologist will determine whether to complete the monitoring well at shallower depth or abandon the borehole and relocate the proposed monitoring well. If the driller repeatedly encounters auger refusal, the site geologist will reassess the adequacy of the proposed location. All decisions regarding changes from the work plan will be confirmed with the PRC project manager.

All wells will be installed in the water table with the top of the screen placed approximately 1 to 2 feet above the static water level. All casing and down hole material will be steam cleaned prior to installation. Screen slot size will be determined in the field and based on the formation material adjacent to the monitored interval. PRC anticipates the use of 0.010-inch slots for the majority of well installations, based on previous work and PRC's SI investigation. However, 0.020-inch slot screen will be used where extremely viscous hydrocarbons (NSFO) are encountered. The larger slot size will allow more effective entrance of oil into the well screen. Similarly, filter pack (sand pack) will be placed throughout the screened interval and sized appropriate to both the adjacent

formation and the slot size chosen. The filter pack will extend approximately 2 feet above the top of the screen. A seal of bentonite pellets, approximately 1.5 to 2 feet thick, will be placed above the filter pack and then hydrated. The remaining annular space will be filled with a cement grout containing 5 percent powdered bentonite or with a Volclay slurry. Tremie pipe will be used to place the filter pack or grout where caving or sloughing of formation materials occurs. The depths below ground to the top of the filter pack and the top of the bentonite seal will be verified with a weighted measuring tape. Casing lengths will be measured to the nearest 0.01 foot prior to installation. A diagram illustrating a typical well installation is presented in Figure 3.

The wells will be completed above ground where possible and completed with traffic rated flush mount installations where vehicular traffic is anticipated. For above ground completions, 8-inch diameter surface casing will be installed at least 24 inches below ground surface and anchored with aggregate concrete. The concrete will be finished such that it slopes away from the surface casing for a minimum distance of 2 feet. The surface casing will extend approximately 24 to 36 inches above ground surface, will be painted, and will have weep holes near the base. Protective posts will be installed around the surface casing where necessary to protect the wellheads from vehicular damage.

Flush mounted boxes will be anchored in aggregate concrete and placed approximately 1 inch above ground surface. The concrete anchor will be finished as a low cone sloping away from the top surface of the box lid. Grout will be added inside the box to assure the well annular space is sealed from the surface contamination. All wells will be secured with locking caps. The wells installed in flush mounted boxes will be secured with a water tight locking cap. All construction details for each monitoring well will be documented on a monitoring well installation record. An example of the installation record is presented in Figure 4.

During well construction, flowing sands, caving formations, or unconsolidated fill are anticipated at NFD Point Molate and their presence will require one or more contingencies. The following is a description of one possible contingency. After a borehole has been drilled and flowing sands encountered, the auger flights will be removed and a tapered wooden plug will be placed in the lead auger in place of a drill bit. The borehole flights will again be reamed to total depth and the auger flights will be flooded with water, creating a hydrostatic head to counter the force of flowing sands. The plug will be knocked free and the screen installed within the auger. Typically the

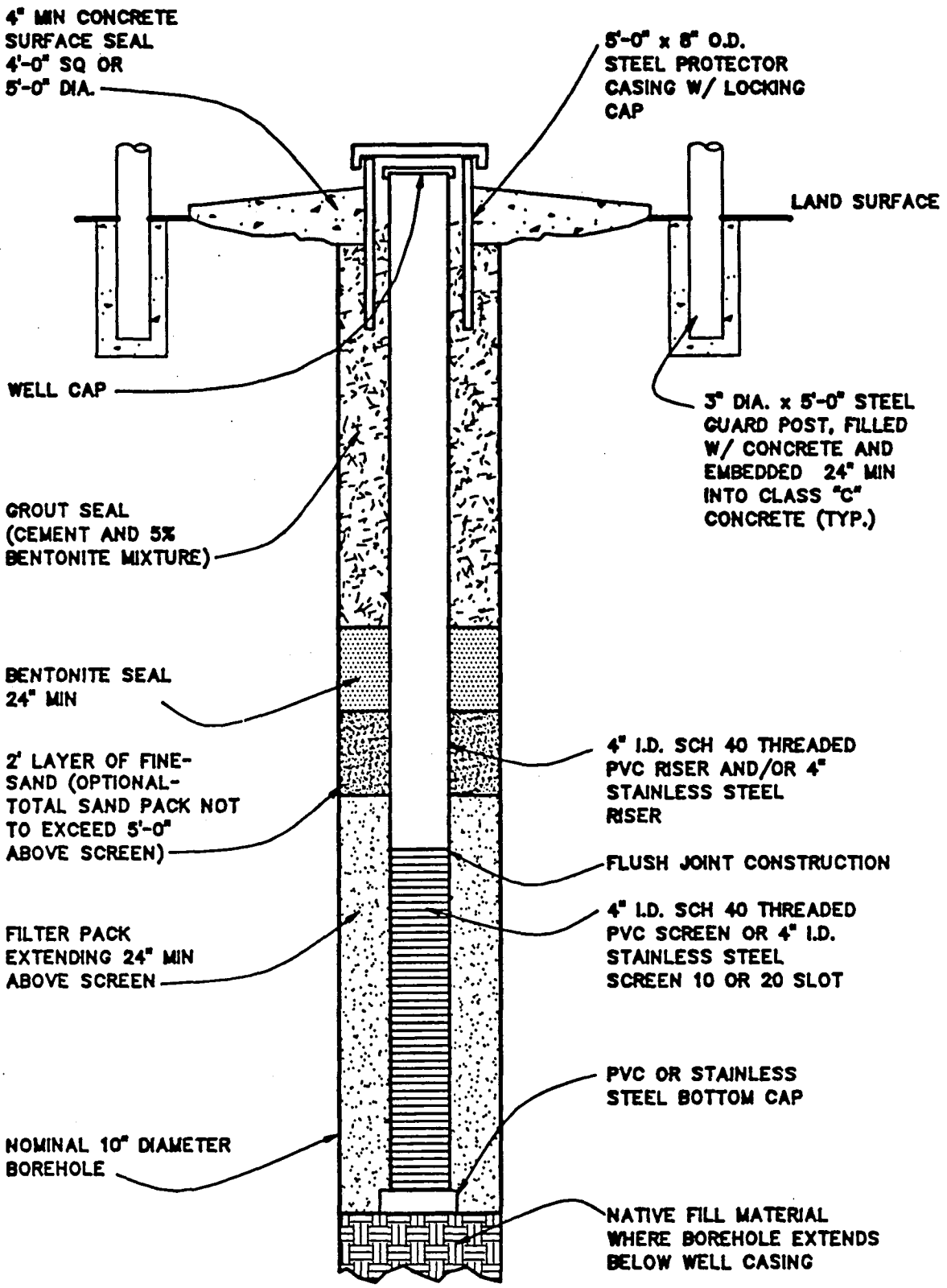


FIGURE 3
WELL INSTALLATION DIAGRAM

PRC
ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL INSTALLATION RECORD
NONTELESCOPING WELL

WELL LOCATION INFORMATION

WELL NO. _____
BOREHOLE NO. _____
SITE _____
SUBSITE _____
DATE _____
RECORDED BY _____
WELL PERMIT NO. _____

SURFACE COMPLETION INFORMATION

TYPE OF INSTALLATION
- ☐ ABOVE GROUND INSTALLATION
  - ☐ PROTECTIVE POSTS INSTALLED
- ☐ FLUSH MOUNT INSTALLATION
  - TYPE _____
  - ☐ TRAFFIC RATED
  - ☐ WATERTIGHT SEAL
  - ☐ WATERTIGHT WELL CAP

TYPE OF PROTECTIVE CASING
- ☐ STEEL SIZE _____
- ☐ _____

SURFACE SEAL
- ☐ NONSHRINKING CEMENT
- ☐ CONCRETE
- ☐ _____
- ☐ CHECKED FOR SETTLEMENT
- ☐ INTERNAL MORTAR ADDED

GROUND SURFACE ELEVATION
- ☐ SURVEYED
  - DATE _____

MEASURING POINT
- ☐ TOP OF WELL CASING
- ☐ TOP OF PROTECTIVE CASING
- ☐ GROUND SURFACE
- ☐ _____

DRILLING INFORMATION

DRILLING COMPANY/PERSONNEL
_____
_____
_____

DRILL RIG _____

DRILLING METHOD
- ☐ HOLLOWSTEM AUGER
- ☐ AIR ROTARY
- ☐ MUD/WATER ROTARY
- ☐ _____

DRILLING BEGAN
- DATE _____ TIME _____

WELL COMPLETION BEGAN
- DATE _____ TIME _____

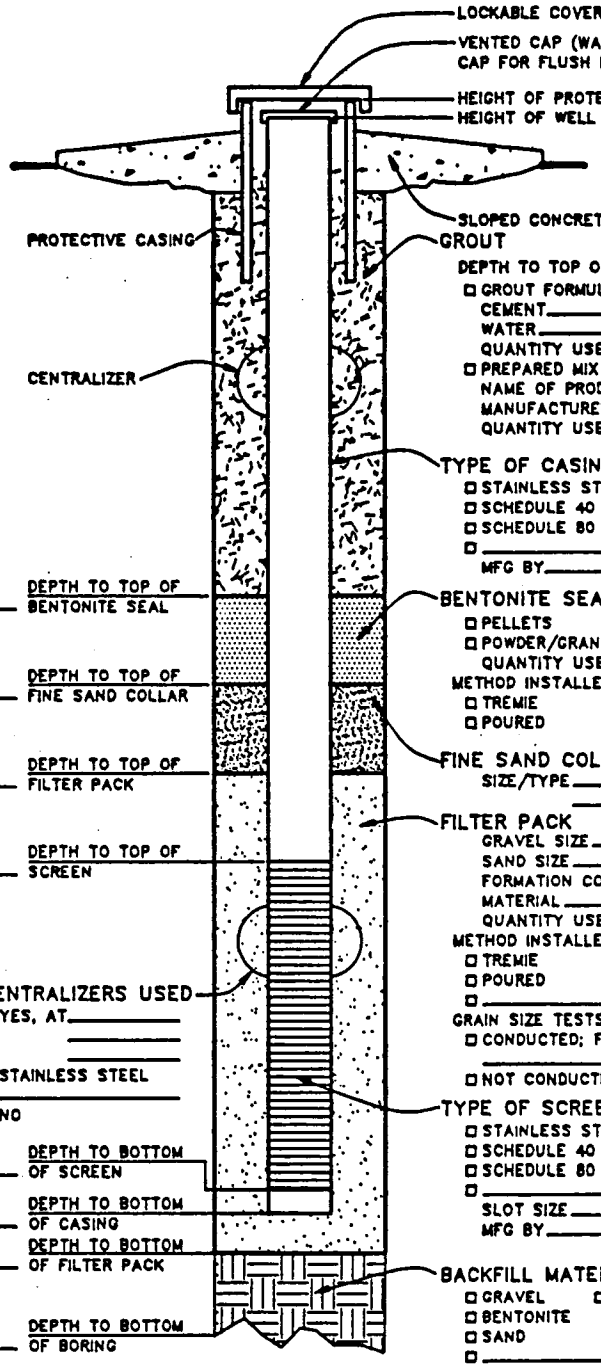
WELL COMPLETION FINISHED
- DATE _____ TIME _____

DRILLING FLUID TYPE
- ☐ BENTONITE ☐ WATER
- ☐ POLYMER ☐ _____

DRILLING FLUID LOSS
- ☐ YES _____ GALLONS
- ☐ NO

WATER ADDED DURING COMPLETION
- ☐ YES _____ GALLONS
- ☐ NO

TOTAL FLUID LOSS TO FORMATION
_____ GALLONS



NOTES:
1. SCALE: NONE
2. RECORD FRACTIONAL FEET IN DECIMAL, NOT IN INCHES
3. RECORD CONSTRUCTION DEPTHS BELOW GROUND LEVEL

DATE: 02/2*/91 JAA FILE NAME: D:\STAND\INSTALOG.DWG

FIGURE 4
MONITORING WELL INSTALLATION RECORD

the formation sand flows upward around the screen and creates a natural filter pack. The desired sand pack will then be added but typically mixes with the native material. An attempt to force the placement of sand pack may require the use of tremie pipe and possibly water injection. All water used during the construction process will be approved and supplied by the facility. As the drill string is retrieved above the flowing sands the well is completed in the normal manner previously described.

In addition, unconsolidated material tends to slough into the borehole creating an unsuitable filter pack or causing bridges within the filter pack, bentonite seal, or cement grout. Should bridging occur, the driller will use a tremie pipe to emplace the completion materials at the correct location in the annular space as discussed above. The borehole will be redrilled or relocated if bridging or excessive sloughing cannot be avoided.

3.3.2 Monitoring Well Development

The monitor wells installed at NFD Point Molate will be developed to maximize the flow of formation water into the well casing, remove any fluids introduced during drilling, to allow the ground water and potential contaminants to equilibrate following the disturbance during drilling, and to create representative aquifer conditions near the monitoring well prior to sampling. Various established development techniques will be utilized including swabbing, bailing, surging, and pumping. Water generated during development will be containerized and will subsequently be characterized, then treated as necessary and disposed of in accordance with applicable regulations.

Initially, the wells will be developed using a large capacity bailer supplied by the drilling contractor. Development may be initiated no sooner than 24 hours after well installation is complete. A minimum of five casing and filter pack volumes will be removed during development. In addition, where water was added during the installation process, no less than an equivalent quantity of water will be developed from any such well and up to five times the amount of water added will be developed where possible. The pH, temperature, electrical conductivity, and nephelometric turbidity units (NTU) of the development water will be monitored at an approximate rate of one measurement of each parameter per each casing and filter pack volume removed. These measurements will be used as indications of stability of the formation ground water. Where these measurements do not stabilize (within 20 percent after five volumes), development will continue for up to five additional volumes if

stability of parameters is not recognized. Where formations are not capable of yielding five continuous volumes, the well will be developed until the casing is dewatered. If recharge requires many hours, the well will be left overnight, and dewatered again the following day. Assuming extremely slow recharge, three casing and sandpack volumes will be considered adequate.

Other development methods to be implemented may include surging with a surge block, swabbing with a swab flange, and pump surging and backwashing. Care will be taken when using a surge block to assure that the bentonite seal is not disrupted. Any development methods requiring the addition of water to the formation will be implemented only as a final technique if development procedures have failed to stimulate sufficient water production. All development procedures will be documented on a well development data sheet. An example of this data sheet is presented in Figure 5.

3.3.3 Ground Water Sampling Procedures

Ground water from existing and proposed monitoring wells will be sampled for chemical analysis. All newly installed monitoring wells will be developed as described above, and ground water samples will be collected no sooner than 48 hours after development. As necessary, existing monitoring wells will also be redeveloped prior to collection of ground water samples.

Wells will be purged prior to collection of ground water samples, and ground water quality parameters will be collected as indication of the stability of the ground water. A minimum of three casing volumes will be purged prior to sampling. Information, including water levels, PID readings at the well head, purge volumes, ground water quality, and well construction information, will be recorded in the ground water sampling form shown in Figure 6. The following procedure describes collection of ground water samples.

(1) The breathing zone will be monitored with a PID meter during removal of the well cap.

(2) The presence of light or dense immiscible phases in all wells will be monitored with an interface probe. If an immiscible phase is present the thickness of the phase will be determined using the interface probe. A clear teflon bailer will then be carefully lowered into the well until it starts to fill. The bailer will be allowed to fill slowly and as much of the immiscible phase captured as possible. A sample of the immiscible phase will be collected for analysis.

PRC Environmental Management Inc. Sheet ___ of ___

WELL DEVELOPMENT DATA SHEET

Boring No. _____ Well No. _____

Project _____
Project No. _____
Date(s) of Installation _____
Date(s) of Development _____
Personnel/Company _____
_____
Type of Rig Used _____

Casing Diameter/Type _____
Borehole Diameter _____
Screened Interval(s) _____
Total Length of Well Casing _____
Measured Total Depth (TOC) Initial _____
Final _____
Initial Depth to Water
(TOC) _____ Date _____ Time _____
Stabilized Depth to Water
(TOC) _____ Date _____ Time _____

DEVELOPMENT

TECHNIQUE(S)	EQUIPMENT TYPE/CAPACITY
___ Jetting (Airlift)	_____
___ Surge Block	_____
___ Bailing	_____
___ Pumping	_____
___ Other	_____

FLUIDS ADDED

Lost Drilling Fluid: _____ Gallons
Lost Purge Water: _____ Gallons
Water During Installation: _____ Gallons
Total Fluids Added: _____ Gallons
Source of Added Water: _____
Ground Water Quality Parameters of
Added Water Measured: Y N
Sample Collected of Added Water: Y N
Sample Designation of Added Water: _____

PURGE VOLUME CALCULATION

Casing Volume: _____ Feet of Water
X _____ Gallons/Foot
= _____ Gallons per Single Casing Volume
Sand Pack Volume: _____ Ft. of Saturated Sand Pack
X _____ Gallons/Ft. (Borehole Dia.)
= _____ Gallons (in Borehole)
- _____ Gallons of Casing Volume
= _____ x 0.3 (Assuming porosity = 30%)
= _____ Gallons within Sand Pack
Single Purge Volume: _____ Gallons (Casing Vol. + Sand Pack Vol. + Fluids Added)
Minimum Purge Volume: _____ Gallons
Actual Purge Volume: _____ Gallons
Volume Measured by: _____
Rate of Development _____ Gallons/Minute (Hour,Day)
Pumping Rate/Depth _____ @ _____ Ft. (Below Grd.)
Immiscible Phases Present: Y N Thickness _____

INSTRUMENT CALIBRATION

pH Meter: _____
pH 4.0 = _____ @ ___ °C
pH 7.0 = _____ @ ___ °C
pH 10.0 = _____ @ ___ °C
Dissolved Oxygen Meter: _____
Spec. Conductance Meter: _____
Standard _____ µmhos/cm@ 25°C
Reading _____ µmhos/cm @ _____ °C
Turbidity Meter: _____
Other: _____

Total Volume Discharged	Rate of Discharge	Time	Temp	pH	Specific* Conductance	Turbidity or D.O.	Clarity, Odor PID Readings, Other:

Development Completed at _____ Gallons Discharged. Date: _____ Time: _____
Criteria: _____ Personnel: _____

* Specific Conductance readings temperature compensated to 25°C, if not, report temperatures at which reading obtained.

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FIGURE 5
WELL DEVELOPMENT DATA SHEET

PRC GROUND WATER SAMPLING DATA SHEET

PAGE ____ OF ____

DATE _____

WELL NUMBER _____

PROJECT _____
PROJECT No. _____
WELL LOCATION _____
SAMPLING DATE(S) _____
SAMPLING PERSONNEL _____

STATION ELEVATON _____ GND ____ TOC ____
STATIC WATER LEVEL (from TOC) _____
WELL STICK UP _____
STATIC ELEV. _____
WELL DEPTH _____ MEAS ____ RPTD ____
FEET OF WATER _____
GALLONS/FOOT _____
CASING VOLUME _____

IMMISCIBLE PHASES PRESENT YES ____ NO ____
TYPE _____
MEASURED WITH _____
PID READINGS (BCKGRD) _____
PID READINGS (TOC) _____
WELL INSTALLED BY _____
INSTALLATION DATE _____
DEVELOPMENT DATE(S) _____

FIELD CHEMISTRY CALIBRATIONS

DATE/TIME: _____ SPEC. CONDUCTANCE: STANDARD _____ UMHOS/CM AT 25°C READING _____ UMHOS/CM AT ____ °C

pH: pH 4.00 = _____ AT ____ °C pH 7.00 = _____ AT ____ °C pH 10.00 = _____ AT ____ °C SLOPE _____

DISSOLVED OXYGEN: D.O. METER _____ MG/L AT ____ °C PID: CALIBRATION GAS _____ PPM ____ SPAN ____ READING _____

TIME	DISCHARGE RATE (GPM)	DISOLVED OXYGEN (MG/L)	pH	TEMP. (°C)	SPECIFIC CONDUCTANCE (UMHOS/CM AT °C)	CUMULATIVE VOL. OF WATER REMOVED GALLONS	CASING VOLS	PID/OVA READING LOCATION	VALUE	COMMENTS

CONDITION OF WELL _____
REMARKS _____

FIELD EQUIPMENT

pH METER _____ SERIAL NUMBER _____
SPEC. COND. METER _____ SERIAL NUMBER _____
PUMP _____ SERIAL NUMBER _____
BAILER _____ SIZE _____
WATER LEVEL METER _____ SERIAL NUMBER _____
D.O. METER _____ SERIAL NUMBER _____
FILTER APPARATUS _____ FILTERS _____
TEMPERATURE MEASURE _____
INTERFACE PROBE _____ SERIAL NUMBER _____
PID/OVA _____ SERIAL NUMBER _____

SAMPLING DESCRIPTION

FRACTIONS _____
NUMBER OF BOTTLES _____
SAMPLE DEPTH _____
FIELD NOTEBOOK _____
SAMPLE METHOD _____

DISCHARGE WATER CONTAINERIZED YES ____ NO ____

GJB C:\JUNK\DRAWINGS\GROUND.DRW 7-8-91

FIGURE 6
GROUND WATER SAMPLING DATA SHEET

(3) The water level and total depth within the well casing will be measured, and casing volumes will be calculated.

(4) If a nonaqueous phase is not present, the water in the well will be purged to obtain a representative water sample. The casing volume of the well will be calculated using the water level and total depth measurements (cross-sectional area times h, where h equals the total depth of the well minus the depth to water). All the wells will be purged with a bailer or submersible pump. A bailer will be used to remove the first portion of water. In all wells the water sample will be collected from the top of the water column. The water in the bailer will be visually inspected for any oily sheen or droplets. Three casing volumes of water will be purged from the well. The pH, conductivity, and temperature of the purged water will be measured and recorded regularly throughout the purging process. If, after removing three casing volumes, these parameters have not stabilized, purging will be continued until they have stabilized. The pH, conductivity, and temperature of the sampled water will be measured immediately.

(5) Prior to purging any well that has an immiscible hydrocarbon layer, a sample of the hydrocarbons will be obtained using a bottom filling Teflon or stainless steel bailer. To sample the ground water beneath the hydrocarbon layer, an attempt will be made to evacuate the hydrocarbon layer by using a bailer. An interface probe will be used to detect any recharge of the hydrocarbon layer. If recharge of the hydrocarbon layer is not detected, ground water will be purged and sampled as described above. If the hydrocarbons recharge to the well faster than they can be bailed, an alternative method of obtaining a ground water sample will be employed. This alternative method will involve inserting sections of 2-inch inside diameter flush-joint PVC pipe inside the existing well, through the hydrocarbon layer, and into the ground water below. The leading end of the 2-inch insert pipe will be shielded with plastic wrap secured with a stainless steel hose clamp or inert tape. Following insertion of the 2-inch pipe, a Teflon bailer will be lowered through the insert pipe, rupturing the plastic wrap shield. If the bailer does not penetrate the plastic wrap, a weighted probe will be used as an alternative. The ground water will be purged through the insert pipe with a peristaltic pump, bladder pump, or a bailer. A sample of the ground water beneath the hydrocarbon layer will then be withdrawn through the insert pipe.

(6) The bottles used to hold samples for analysis of BTEX, VOCs, and SVOCs will be filled first. The bottles will be maintained in a cool environment prior to sample collection to minimize the loss of contaminants. After sealing the bottle with a Teflon-lined cap, the bottle will be inverted and tapped lightly, and the presence of air bubbles visually inspected. If any head space is present, the bottles will be topped-off or refilled accordingly. Containers for TPH analyses will then be filled. A small amount of air-filled head space will be allowed for TPH extractable samples. The bottles for other analytes and general water quality parameters will be filled last.

SECTION 3.3.4 – ANALYTICAL PARAMETERS

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SECTION 3.4 – DETERMINATION OF PHYSICAL PROPERTIES

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SECTION 3.5 – DETERMINATION OF HYDRAULIC PROPERTIES

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SECTION 3.5.1 – FIELD AQUIFER TESTS

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SECTION 3.5.2 – FIELD PERMEABILITY TESTS

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SECTION 3.5.3 – POTENTIOMETRIC MONITORING

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SECTION 3.5.4 – IDENTIFICATION OF SUBSURFACE STRUCTURES

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SECTION 3.5.5 – TIDAL MONITORING

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SECTION 3.6 – LAND SURVEYING

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SECTION 3.7– DECONTAMINATION PROCEDURES

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SECTION 3.7.1 – DRILLING EQUIPMENT

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SECTION 3.7.2 – SAMPLING EQUIPMENT
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SECTION 3.7.3 – PERSONNEL AND PROTECTIVE EQUIPMENT

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SECTION 3.8 – QUALITY ASSURANCE/QUALITY CONTROL FIELD SAMPLES

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SECTION 3.9 – SAMPLE HANDLING

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SECTION 3.9.1 – DESIGNATION AND DOCUMENTATION OF SAMPLES

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A soil sample from soil boring 7 at site 9 collected from the 3- to 4-foot depth interval will be designated:

SB09-07(03.0 - 04.0)

QA/QC samples will be submitted for analysis as blind samples, or without indications designating these samples as duplicates or blanks. To designate blind duplicate samples, artificial boring numbers will be assigned to the original sample designation. These duplicate designations will be recorded for internal use in the field book or field tracking forms.

Additional QA/QC samples, such as equipment blanks or trip blanks will also be submitted blind. Site-specific designators will be used, based on the area from which the equipment blank was collected or which sample shipment the trip blank accompanies.

A MS/MSD will also be submitted for each sample matrix to be analyzed. This sample is not submitted to the laboratory as a blind sample. Moreover, ground water samples require triplicate volumes for each analyte. The sample designation for the MS/MSD ground water samples is identical to the normal sample; however, one suite of the triplicate volume will be labeled as MS and the other volume as MSD. Soil boring samples selected for MS/MSD analysis will be designated in a similar manner.

Sample Labels: A sample label will be affixed to each sample container as samples are obtained and containerized. The label will indicate the sample designation, sample depth, analysis required (as shown below), the name of the sampler, the time and date of sample collection and, any preservatives used. Once the label is completed, clear plastic tape will be placed over the label to protect it from damage. PID readings for these samples will be recorded on a separate field form and can also be included on the sample label if space permits.

The analysis to be conducted for each sample will be included on the sample label. An abbreviated version of the analysis will be written on the sample label as follows:

Volatile organics analysis	=	VOA
Semivolatile organics analysis (base, neutral, acid extractables)	=	BNA
Benzene, toluene, ethyl benzene, and xylene analysis	=	BTEX
Total petroleum hydrocarbons, purgeable	=	TPH (purg)
Total petroleum hydrocarbons, extractable	=	TPH (ext)
Inorganic metals	=	Metals
Major cations and anions	=	Cations/Anions

Sample Documentation: Field tracking sheets will be used to document the sample collection process and other pertinent information regarding sample location, sampling times, and conditions. The field tracking sheet will completed as samples are obtained. The field tracking sheet includes spaces to indicate the site; sample designations; analysis required; sample depths; date and time of sample collection; the name of the sampler; and comments, such as weather conditions or field equipment readings.

3.9.2 Sample Containerization and Preservation

This section describes the sample containerization and preservation procedures to be followed during field activities.

Containers: All samples will be properly containerized and packaged to maintain sample integrity and chain-of-custody during delivery to the analytical laboratory. Soil samples will be collected from the split spoon sampler from a soil auger, core sampler, or from a hand trowel/scoop where appropriate.

Soil samples will be containerized in the appropriate glass, plastic, or brass containers as appropriate. Containers will be precleaned to laboratory specifications. Preservatives for ground water samples will be added to containers prior to collection, except for metals, which may be added following collection. Ground water samples for VOA, BTEX, or purgeable TPH analysis will completely fill each container until a meniscus forms at the top. The containers will be visually inspected for air bubbles, and any bubbles present will be removed by tapping the container to bring them to the top and adding additional liquid or a new sample collected. The cap, complete with Teflon inner lining, will be tightly sealed. A sample label will then be affixed to the container, and clear tape will be used to cover the label.

Preservation: Soil samples will not be preserved other than storing the sample in a chilled cooler. Ground water samples collected for VOA, BTEX, and TPH (purgeable and extractable) will be preserved with hydrochloric acid (HCl). Ground water samples to be analyzed for inorganic metals will be preserved with nitric acid (HNO_3). The required volume of preservative will be added to the sample after a field titration to a pH $\leq$ 2 for both HCL and HNO_3 preserved samples. Sample labels will indicate that a preservative was used. Additionally, samples will be placed in Ziploc bags, stored in coolers with cubed ice, and the ice will be distributed around the samples immediately following collection.

3.9.3 Sample Shipment and Chain of Custody

All samples will be shipped directly to the analytical laboratory in sealed storage coolers. Chain-of-custody begins at the time of sample collection. All the sample containers will be labeled with the date, time, sample designation, required analysis, preservative used, and names of samplers. The bottles will be packed in bubble wrap or equivalent packing and placed in a cooler containing cubed ice. When necessary, additional ice will be added to ensure samples are stored at approximately 4 degrees Celsius (°C). Field documentation will be completed at this time, and samples will be in the possession of a designated field sample custodian. At the end of the day, once all sample documentation and chain-of-custody forms are completed, the samples will be stored in a locked vehicle or on-site facility. Chain-of-custody forms will be sealed in plastic Ziploc bags and taped to the inside lid of the coolers. Coolers will then be sealed, and custody seals attached prior to shipment. When coolers are picked up, custody will then be transferred to the sample carrier.

A copy of a typical chain-of-custody form is presented in Figure 7. The following procedures will be followed when completing the chain-of-custody form:

Project Name:	The project name will be entered.
Project Number:	The complete project number will be entered.
Samplers:	The signature and the names of people who participated in collecting the sample and who should be contacted if questions arise during sample log-in will be entered. If the field sample custodian is not listed as a sampler, receipt documentation should be indicated.
Sample Number:	The sample designation will be entered.
Date and Time:	The date and time of sample collection will be entered.
Sample Location:	The sample location will correspond to one of the 12 area designations.
Parameters:	The parameters will be analyzed for each sample listed. The analysis method will be identified if not indicated on the form.
Number of Containers:	The total number of sample containers for a given location will be entered.
Remarks:	Any remarks related to sample identification, chain-of-custody, or field observations will be entered.

When all line items are completed or when the samples are picked up, the custodian will sign and date the form, list the time, and confirm the completeness of all descriptive information contained on the form. Each individual who subsequently assumes responsibility for the sample will sign the chain-of-custody form and indicate the reason for assuming custody. The field chain-of-custody terminates when the laboratory receives the samples. The field sample custodian should retain a copy of the chain-of-custody form for project files.

3.10 ANALYTICAL PROCEDURES

Soil and ground water samples will be analyzed following standard EPA protocols as described in Test Methods for Evaluating Solid Waste Volume I (U.S. EPA, 1986) and DOHS protocols as described in the Leaking Underground Fuel Tank Manual (SWRCB, 1989). Soil and ground water samples from sites suspected of hydrocarbon contamination will be analyzed for BTEX

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CONTACT: _____

TELEPHONE: _____

PROJECT REF. #	ELI ORDER #	PROJECT NAME	ANALYSIS REQUIRED	COMMENTS

SAMPLERS (Signature)

CLIENT SAMPLE ID	SAMPLE LOCATION	COMP.	GRAB	DATE/TIME	CONTAINER TYPE																	TYPE OF PRESERVATIVE USED	CONTAINER CONDITION	

RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)	RECEIVED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)	RECEIVED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED FOR LABORATORY BY: (Signature)	DATE/TIME		

ELI SM-01

FIGURE 7
CHAIN-OF-CUSTODY FORM

by method 8020 and purgeable and extractable TPH by method 8015 (modified). TPH results will be compared to chromatograms of standard F-76, diesel, and NSFO samples to determine likely sources of soil or ground water contamination. This comparison (fingerprinting) will require consideration of losses due to volatilization, organic degradation, and dissolution of fuel constituents. These fuel samples will be obtained from NFD Point Molate. Selected soil and ground water samples will be analyzed for semivolatile compounds by method 8270. At locations where design requirements are necessary for remedial alternatives, other ground water quality parameters, such as total organic carbon, will be established. Ground water samples collected at shoreline locations will be analyzed for major cations by method 6010, for chloride by method 9250, and for sulfate by method 9035 or 9036. These analyses will be used to determine potential impacts from salt water intrusion in nearshore locations, as well as for remedial design requirements.

Specific extraction procedures are also required for analytical methods targeted at hydrocarbon characterization. The following methods and extraction procedures have been advised by RWQCB and will be implemented as applicable to soil, ground water, or sediment samples collected at NFD Point Molate. The specific extraction procedure or analytical method chosen will be based on instrumentation requirements specific to the laboratory as well as discussion of data quality objectives and reporting requirements with laboratory personnel.

For TPH analysis in gasoline, kerosene, and diesel ranges, extraction method 3550 will be used with method 8015 if sonication extraction is following by capillary gas chromatography - flame ionization detection (GC-FID) quantification.

Methods 5030 for extraction and 8015 (modified) for analysis, using purge and trap extraction followed by quantification of volatile hydrocarbons using GC-FID must be used to quantify total volatile components in jet fuel or gasoline ranges in soils. Analytical method 8015 (modified) used with extraction method 3550 is also suitable for jet fuel, diesel fuel, and heavier fuel analyses in soils.

Assessment of BTEX values will utilize methods 8020 or 8240 for gasoline, diesel, jet fuel, or kerosene ranges in soils. However, when method 8240 is used the laboratory must also identify the 10 highest peaks not included within this range.

For TPH and BTEX, method 8260 with cryogenic focusing is suitable for soils.

Water analysis for unknown fuels can combine extraction methods 5030 for gasoline and 3510 for diesel and jet fuel with analytical method 8015 (modified). For BTEX in any of these fuels, analytical methods 8020, 8240, or 8260 are suitable. Method 418.1 with silica gel cleanup followed by IR or gravimetric method may be suitable for tidal flat sediment samples. All analyses must be performed by a California-certified laboratory.

4.0 INTERIM CORRECTIVE ACTIONS

The priorities for characterization of interim corrective action for the treatment ponds area necessitates a method of controlling known hydrocarbon contamination. In at least one location, floating hydrocarbons are migrating toward San Francisco Bay (PRC, 1991b). This suggests that the Navy extraction wells in this vicinity are ineffective or are located incorrectly to control the migration of this specific product plume. Currently, the most appropriate interim corrective action is the installation of an additional extraction well to intercept the known product plume.

The lack of immediate source control options in the treatment ponds area has also necessitated containment options. PRC has therefore proposed a hydraulic barrier and extraction trench system for implementation under a new CTO. This option has been presented to RWQCB and has been approved as an appropriate alternative remedial action. The results of characterization activities proposed in this field work plan will provide the design requirements for the proposed containment and extraction trench. The design requirements for the extraction system to be implemented with the proposed extraction trench will also be provided under CTO 143.

In addition, CTO 143 will provide characterization data, including physical data to assess treatment technologies for oil-contaminated soil and ground water within the treatment ponds area. The implementation of alternative remedial actions will be based on an assessment of interim corrective actions and characterization activities. This assessment will be provided in the characterization and interim corrective actions report.

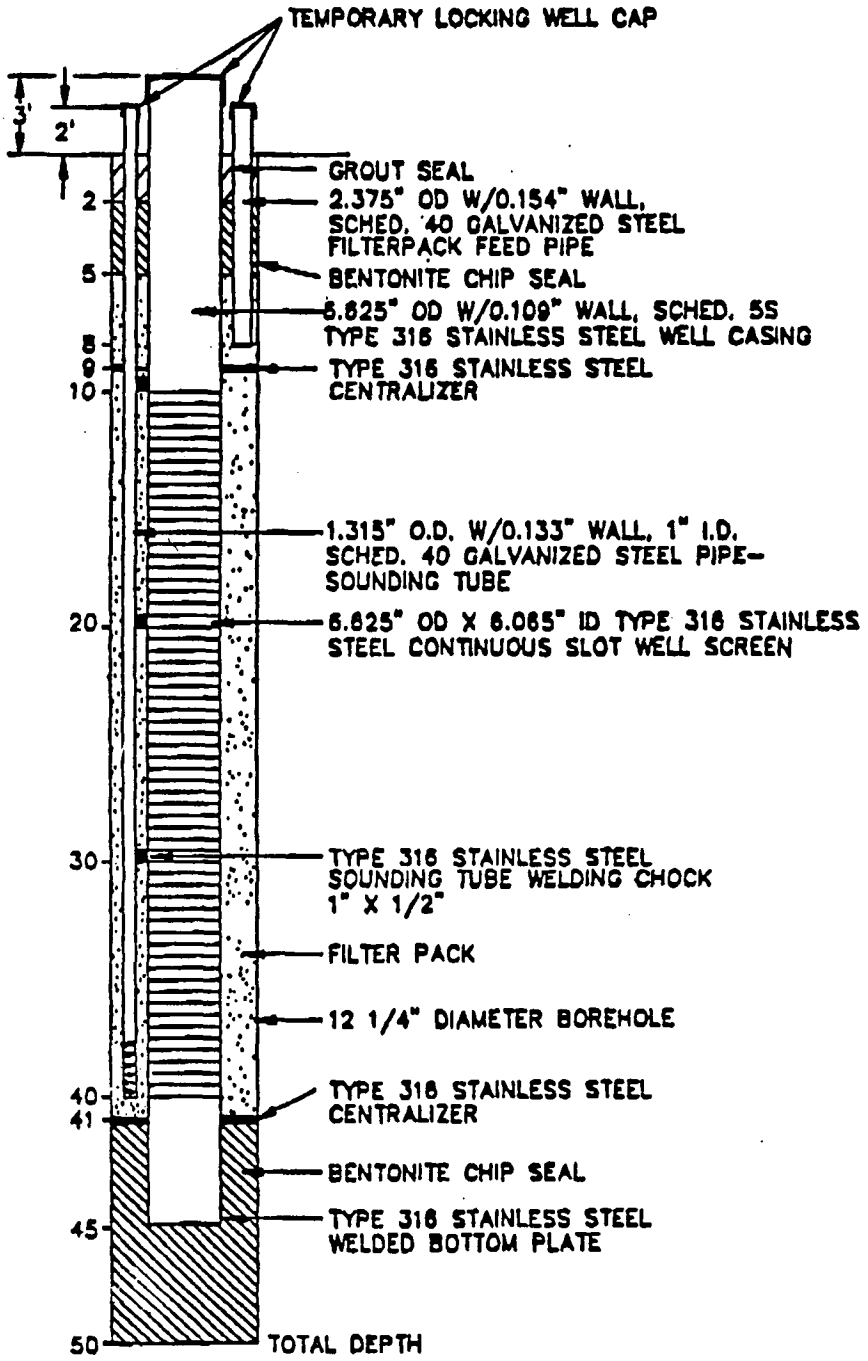
4.1 INSTALLATION OF EXTRACTION WELL

A large diameter extraction well will be installed in the vicinity of a known product plume within the treatment ponds area. The approximate location of the proposed extraction well appears on Plate 2. The purpose of this extraction well is to provide immediate interception of the known product within this area of the treatment ponds, and to assess the effectiveness of extraction wells as an alternative remedial action. Current Navy extraction wells are ineffectively providing containment of impending migration of the floating hydrocarbons within the treatment ponds area. It is not known if the current extraction wells are designed to meet the geologic and hydrologic conditions within the area of their installation. In addition, the operation and correct placement of the extraction system within each of these wells has not been properly monitored. An assessment of the existing extraction wells will be made to evaluate their usefulness. This assessment will include the operation of the water table depression pumps (drawdown pumps) in each well. During this operation, nearby wells or piezometers will be monitored to evaluate the capability of these wells to producing a water table gradient.

Soil borings described in Section 3.2.2 will be used to select the most appropriate location for the proposed extraction well. The well will be located such that it intercepts the product plume in the vicinity of monitoring well PRC 2. The location of the proposed extraction well is shown on Plate 2. Design requirements for the extraction well have been suggested by RWQCB, and will be implemented as appropriate. The extraction well design provided by RWQCB appears in Figure 8.

The installation method for the extraction well will be similar to that described for monitoring wells in Section 3.3.1. However, a large diameter borehole will be required to accommodate the larger diameter casing used in the extraction well, and may necessitate alternate drilling methods. The required borehole diameter will range from 12.25 inches to 16 inches, depending on the casing size employed. Drilling methodologies will be determined by a drilling subcontractor experienced in the installation of large diameter boreholes, and may include rotary or bucket auger methods.

It is anticipated that 0.020-inch screened casing will be employed as the product type encountered within this area of the treatment ponds is a heavy, viscous hydrocarbon, similar to NSFO. The filter pack used in the installation will be determined following the results of grain size distribution of formation material.



TYPICAL EXTRACTION WELL CONSTRUCTION DETAIL

SCALE: HORIZONTAL: 1"=1'-0"
VERTICAL: 1"=5'-0"

FIGURE 8
TYPICAL EXTRACTION WELL DIAGRAM

The extraction well will be installed with an exterior sounding tube permanently installed to the well casing. This sounding tube will allow sounding of both hydrocarbon levels (thicknesses) and water levels without interference with the extraction system inside the well casing.

The extraction well will be developed similar to the wells in Section 3.2.2.

In addition to the extraction well, monitoring wells or piezometers will be required as observation wells in the vicinity of the extraction well. These observation wells will be used to monitor the ability of the extraction well to produce a cone of depression, and therefore, an effective capture zone for floating hydrocarbons. At least three monitoring wells or piezometers will be required for this purpose. Where appropriate, existing or newly installed monitoring wells will be used as observation wells. If new observation wells are required, they will be installed exactly as monitoring wells described in Section 3.3.1; however, each will have 2-inch diameter PVC well casing. The screened interval for the observation wells will extend throughout the entire saturated aquifer thickness.

4.1.1 Determine Effectiveness of Extraction Well

Following the installation of the extraction well, a preliminary hydraulic evaluation will be performed within the well to design the necessary extraction system for the well. These design requirements will be based on an aquifer test, as described in Section 3.5.1. During this operation, specific observation wells will be monitored to assess the ability of the well to create an effective cone of depression.

4.1.2 Installation of Extraction System

The extraction system design will be based on the preliminary hydrologic evaluation discussed in the previous section. Various systems will be assessed, including separate drawdown and recovery pump systems, total recovery systems, or drawdown and skimming systems. Depending on the complexity of the system chosen, a subcontractor will be employed for installation. This installation will include appropriate above-ground control systems, piping of the system to either existing oily water discharge lines or temporary holding tanks, and wiring of the system to appropriate electrical sources.

4.2 DETERMINATION OF DESIGN REQUIREMENTS FOR HYDRAULIC CONTAINMENT AND EXTRACTION TRENCHES

Soil and bedrock characterization data, physical properties data, and hydraulic properties data will be used to provide design requirements for the proposed hydraulic contaminant and extraction trench system.

Design requirements will include the depth, length, and aerial extent of the trench system; the interaction of the proposed system with existing subsurface utilities, structures, or fuel product lines, and the necessity to reroute or redesign any of these utilities, structures, or pipelines; and the extent and type of extraction system to be implemented within the hydraulic containment system.

Factors to be considered in these design requirements will include the anticipated quantities of recoverable product and ground water; whether immiscible or aqueous dissolved phases will require extraction; affect of the proposed hydraulic containment and extraction trench on the existing wastewater treatment system, including the aeration basins; and the capacity of the existing wastewater treatment system to accept additional recovered product and ground water from the proposed extraction system.

These factors will be assessed and discussed in the characterization and interim corrective actions report.

4.3 ASSESSMENT OF TREATMENT TECHNOLOGIES FOR OIL-CONTAMINATED SOIL AND GROUND WATER

Chemical characterization data, physical properties data, hydraulic properties data, and biological or biochemical data will be used to assess various treatment technologies for oil-contaminated soil and ground water. This information will then be used to recommend appropriate alternative remedial actions, including potential source control or alternative containment options within the treatment ponds area. Included in the assessment will be technical considerations for above-ground bioremediation of oil-contaminated soil generated during soil boring or trenching activities.

This assessment will include 1) the screening of applicable technologies with respect to site-specific chemical, physical, or hydrologic data; 2) incorporation of selected technologies into source control or soil management alternatives; and 3) selection of preferred remedial action alternatives based on a comparative evaluation to site-specific criteria.

Examples of treatment technologies that will be evaluated include 1) physical or chemical processes such as enhanced volatilization, soil venting, soil washing, or vacuum and steam extraction; 2) thermal processes such as fluidized bed and rotary kiln incineration or low temperature stripping; and 3) biological treatment (bioreclamation) such as in-situ bioremediation or ex-situ (on-site) bioremediation. Of the above listed treatment technologies, bioreclamation is a proven, effective treatment process for petroleum contaminated soils. Under proper conditions, microorganisms can use organic compounds as fuel for respiration and synthesis and render the compounds harmless by converting them to carbon dioxide and water. Five elements are necessary for microbial degradation: a viable microbial population, a carbon source, nutrient supply, moisture, and oxygen. The presence and quantities of these elements will be determined under the characterization activities outlined in this field work plan. This information will be used in the subsequent assessments of treatment technologies. Biological and biochemical samples will be obtained from soil samples collected during the characterization activities.

5.0 REPORT GENERATION

The characteristic and interim correction activities report for the treatment ponds area will provide 1) presentation and evaluation of chemical characterization data, physical properties data, and hydraulic properties data; 2) evaluation of the interim corrective action(s) implemented, presentation of design requirements for the hydraulic containment and extraction trench, and assessment of treatment technologies for oil-contaminated soil and ground water; and 3) recommendations and design requirements for appropriate alternative remedial actions within the treatment ponds area.

In addition, the analytical data submitted by respective laboratories will be reviewed for completeness, accuracy, and precision. The resulting data, as well as assessment of QA/QC results, will be summarized within the final report.

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PLATES

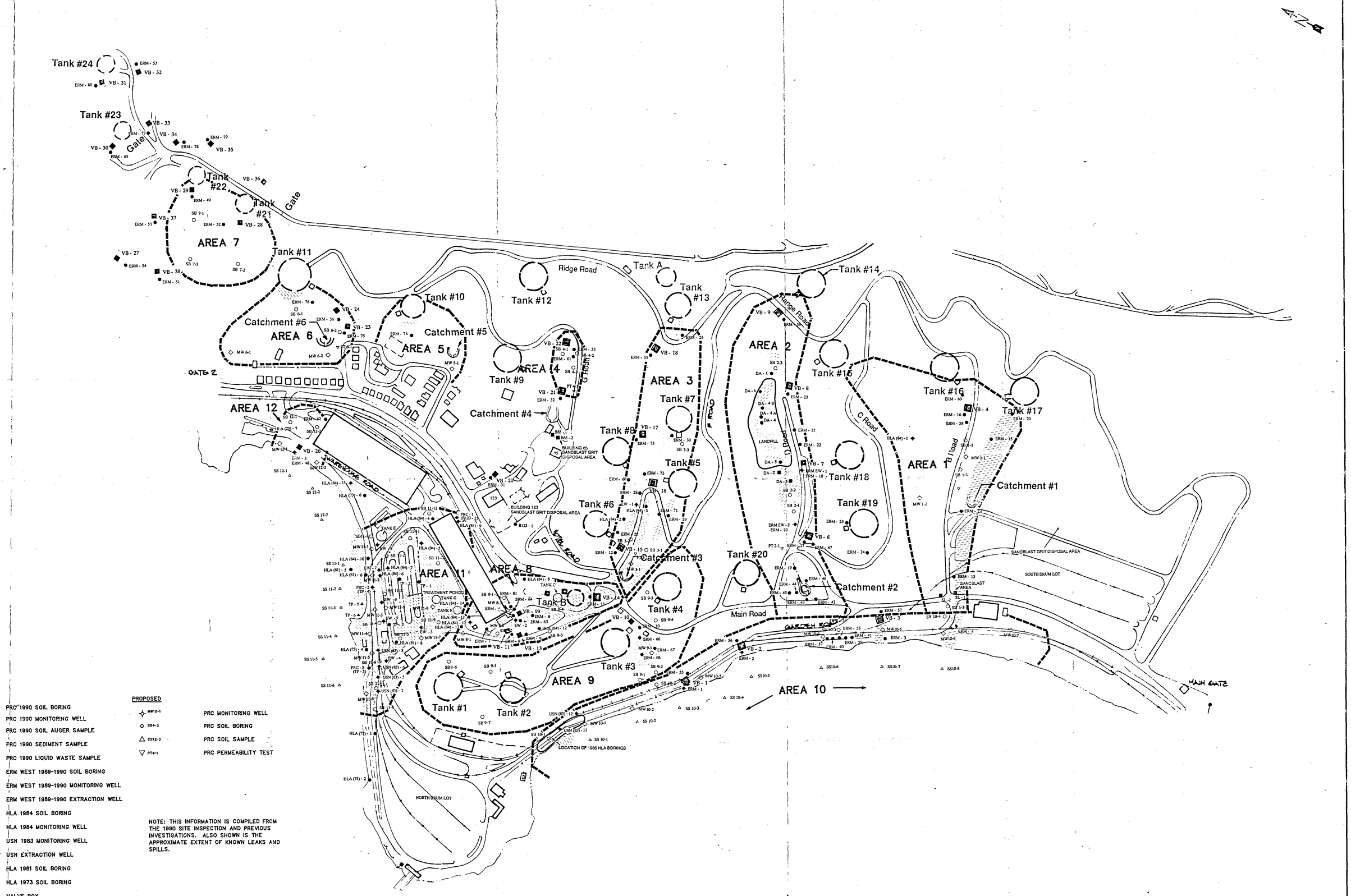

PLATE 1
POINT MOLATE NAVAL FUEL DEPOT
PROPOSED AND EXISTING SOIL BORING, MONITORING WELL, AND SAMPLE LOCATIONS

PLATE 2 – TREATMENT PONDS AREA, CHARACTERIZATION AND INTERIM CORRECTIVE ACTIONS, FIELD WORK PLAN, PROPOSED SOIL BORING MONITORING WELL, AND SAMPLE LOCATIONS

THIS PLATE IS NOT AVAILABLE.

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