5090
Ser 10122/8105
13 Mar 1998

From: Commanding Officer, Engineering Field Activity (EFA), West, Naval Facilities Engineering Command
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Subj: TECHNICAL MEMORANDUM CONFIRMATION GROUNDWATER SAMPLING IN THE TIDAL AREA SITES, NAVAL WEAPONS STATION, CONCORD

Encl: (1) Technical Memorandum Confirmation Groundwater Sampling in the Tidal Area Sites, Naval Weapons Station, Concord

1. Enclosed is the Technical Memorandum Confirmation Groundwater Sampling in the Tidal Area sites, Naval Weapons Station Concord, California dated February 28, 1998.

2. Please review and submit any written comments to the Navy within 60 days of receipt of this letter, or 19 May 1998.

3. If there are any questions regarding this correspondence, please contact Mr. Clint Fisher at (650) 244-2769.

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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN I)
Northern and Central California, Nevada, and Utah
Contract Number N62474-88-D-5086
Contract Task Order No. 0281

Prepared For

DEPARTMENT OF THE NAVY
Mr. Clint Fisher, Remedial Project Manager
Engineering Field Activity West
Naval Facilities Engineering Command
San Bruno, California

TECHNICAL MEMORANDUM
CONFIRMATION GROUNDWATER SAMPLING IN THE TIDAL AREA SITES

NAVAL WEAPONS STATION CONCORD
CONCORD, CALIFORNIA

March 19, 1998

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1.0 INTRODUCTION

Tetra Tech EM Inc. (TtEMI), formerly known as PRC Environmental Management, Inc. (PRC), received Contract Task Order (CTO) No. 0281 in 1994 from the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command, Engineering Field Activity West under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62474-88-D-5086. CTO No. 0281 directs TtEMI to conduct a remedial investigation of four tidal area sites at Naval Weapons Station (NWS) Concord. The draft remedial investigation (RI) report submitted in April 1997 (PRC 1997a) summarized the nature and extent of contamination in tidal area soils, sediments, and surface water, but did not address groundwater quality. The Navy and regulatory agencies agreed to postpone addressing groundwater quality issues until after reviewing data from soils, sediments, and surface water. Based on the results presented in the draft RI, the Navy and regulatory agencies agreed to perform a groundwater confirmation study to address outstanding issues regarding groundwater in the tidal area. The groundwater confirmation study performed in September and October 1997 is the subject of this technical memorandum.

Specific objectives of the confirmation groundwater sampling study were to (1) confirm existing analytical results regarding concentrations of metals and organic compounds in tidal area groundwater, (2) obtain data to define postclosure groundwater monitoring parameters at the landfill, (3) determine whether groundwater exhibits contamination by radionuclides, (4) better define the geologic conditions in the area east of the tidal area landfill, and (5) obtain data to better understand the hydrodynamic regime of the wetlands.

This technical memorandum discusses the results of the groundwater confirmation study and presents relevant background information pertaining to groundwater. The RI report contains additional information regarding soil, sediment, and surface water contamination (PRC 1997a). This technical memorandum consists of six sections and six appendices. Section 1 (this section) describes the basic framework and objectives of the project. Section 2 provides site background information including the site history and describes previous groundwater sampling in the tidal area. Section 3 describes the field procedures performed during this investigation. Section 4 discusses the site geology and hydrogeology. Section 5 presents results of the groundwater confirmation study. Section 6 summarizes overall conclusions and recommendations. Tables and figures follow the references section. Supporting information and data are presented in Appendices A through F.

2.0 SITE BACKGROUND

NWS Concord is located approximately 30 miles northeast of San Francisco, California (Figure 1). The station occupies three discontinuous areas: the tidal area, the inland area, and a radiography facility in Pittsburg, California. The tidal area at NWS Concord occupies a site originally owned by the Pacific Coast Shipbuilding Company. In 1927, the Navy chose the site for naval ordnance operations because of the remoteness of the site and the presence of three major rail lines. In response to the need for a permanent loading terminal to supply munitions to Naval vessels, construction of waterfront handling facilities began in January 1942. In April 1942, the facility was commissioned as Naval Magazine Port Chicago. The base was officially renamed NWS Concord in 1963.

This technical memorandum focuses on the area surrounding the tidal area landfill, which is located in the west central portion of the tidal area (Figure 2). There are three sites in the vicinity of the tidal area landfill that are also addressed in this technical memorandum: (1) the R Area disposal site, (2) the wood hogger site, and (3) the Froid and Taylor Roads site (Figure 3). In the following sections of this report, the history and previous investigations of each site are discussed and summarized. More detailed historical information is available in the site investigation report (IT Corporation [IT] 1992) and in the RI report (PRC 1997a).

2.1 TIDAL AREA LANDFILL

The tidal area landfill is a flat mound immediately west of Johnson Road (Figure 3). The landfill is elevated about 10 feet above the surrounding marsh plain and covers about 13 acres. The landfill reportedly contains about 33,000 tons of waste (IT 1992).

2.1.1 Tidal Area Landfill Site History

The landfill served as the primary refuse disposal area for NWS Concord from approximately 1944 to 1979. NWS Concord and surrounding communities disposed of household garbage at the landfill. In addition, the weapons station reportedly disposed of solvents, acids, paint cans, creosote-treated timbers, asphalt, concrete, asbestos, and ordnance materials, including inert munitions and the tritanol filler from one 750 pound general-purpose bomb (Ecology and Environment, Inc. [E&E] 1983).

Historical aerial photographs indicate that most of the waste was deposited in the landfill between 1959 and 1974. The photographs indicate that the wastes were placed directly on the marsh surface and covered with fill soil; the marsh was evidently not excavated before waste disposal. A total thickness of up to 13 feet of waste and soil cover is estimated from the current topographic elevation of the top of the landfill. The degree of subsidence of native soils beneath the landfill due to consolidation or displacement of the underlying Bay Mud is not known. The surface of the landfill has a soil cover, but metal, concrete, and wood debris currently protrude from the surface of the landfill, suggesting that a significant proportion of the wastes in the landfill are construction debris. Animal burrows perforate the soil cover, and differential subsidence has created a highly uneven surface.

2.1.2 Previous Investigations of the Tidal Area Landfill

In 1983, the Navy conducted an initial assessment study (IAS) at NWS Concord (E&E 1983). The IAS consisted of a historical records search, a visual inspection of the site, and interviews with NWS Concord personnel. The IAS report identified the landfill as a potentially hazardous site and recommended further investigation of the landfill.

Site Investigation

Because the IAS recommended further investigation of the landfill, a site investigation (SI) was conducted by IT from 1988 to 1992. The purpose of the SI was to confirm or deny the presence of contamination and to make a preliminary evaluation of potential risks associated with each site. As a part of the SI, 10 borings were drilled in the landfill; 7 monitoring wells were installed along the perimeter of the landfill; and soil, sediment, groundwater, and surface water samples were collected and analyzed. Results of the SI at the landfill are discussed in detail in the SI report (IT 1992). Significant findings of the soil, sediment, and surface water sampling are briefly summarized below. The quarterly groundwater sampling is discussed in Section 2.6.1.

Soil samples were collected at 10 locations along a north-south and east-west transect through the center of the landfill at depths of up to 11 feet below grade. Several organic compounds, including polynuclear aromatic hydrocarbons (PAH) and toluene were detected at various depths and locations within the landfill at concentrations up to 39,000 micrograms per kilogram (µg/kg) and 25 µg/kg, respectively. Aroclor-1260, a polychlorinated biphenyl (PCB), was detected at one location at an estimated

concentration of 1,800 µg/kg. Elevated concentrations of lead and copper were detected at several locations in the landfill at maximum concentrations of 4,550 milligrams per kilogram (mg/kg) and 4,730 mg/kg, respectively. Analytical results for landfill soils are included as Appendix A.

Sediment samples collected from two locations southwest of the landfill contained slightly elevated concentrations of arsenic and zinc. Surface water samples collected from the same two locations reportedly exhibited low pH (1.6 to 2.5) and elevated concentrations of calcium, sodium, and nickel. The high salt contents of the samples indicate an apparent concentration of salts in surface water at these locations.

Remedial Investigation

The Navy conducted an RI in the tidal area from 1993 to 1997 to evaluate the nature and extent of contamination at the four tidal area sites (PRC 1997a). The investigation of the landfill during the RI was very limited because the contents of the landfill were qualitatively characterized by the SI and because more detailed characterization was not required since the landfill investigation was evaluated for a presumptive remedy of capping. As part of the RI, surface and subsurface soil samples were collected from eight locations around the perimeter of the landfill. PAHs, dichlorodiphenyltrichloroethane (DDT) pesticides, low concentrations of PCBs, and elevated concentrations of lead and copper were detected in the samples. The RI results are documented in detail in the draft RI report (PRC 1997a).

2.2 R AREA DISPOSAL SITE

The R Area disposal site is a broad, flat marshy area west of the landfill. For the purposes of the RI, the R Area disposal site was assumed to encompass the entire wetland area bounded by Baker Road, Pickett Road, Johnson Road, and Froid Road, up to the boundary of the tidal area landfill (Figure 3).
The entire disposal area is surrounded by the earthen berms that form the road beds, creating a closed, low-lying basin.

2.2.1 R Area Disposal Site History

From the late 1940s until about 1976, the area along the eastern side of Baker Road between Froid Road and Pickett Road was used for the disposal of materials generated during the segregation of conventional munitions returned from Pacific operations (E&E 1983). The term "segregation" refers to a process of

grouping and repackaging munitions, rather than dissembling the munitions themselves. Typical wastes associated with munitions segregation are expected to include packing crates and containers, steel banding, paint waste, and wood debris, rather than explosives, propellants, fuses, and ordnance.

Although the disposal area was reported to be a 10-foot-wide, 5-foot-deep strip of debris along the east side of Baker Road (E&E 1983), it appears that the segregation wastes were actually disposed of in small, isolated piles of debris rather than a continuous 5-foot-deep strip. During the Phase IA RI, segregation wastes including metal casings and cans were observed on the ground surface and submerged beneath the water along Baker Road. Piles of asphalt paving and mattress springs were also present on the ground surface. Metal containers and debris were also observed along the south side of Pickett Road.

2.2.2 Previous Investigations of the R Area Disposal Site

In 1983, the Navy conducted an IAS at NWS Concord (E&E 1983). The IAS concluded that the R Area disposal site was potentially hazardous and recommended further investigation of the site.

Site Investigation

Because the IAS recommended further investigation of the R Area disposal site, an SI was conducted by IT from 1988 to 1992. As a part of the SI, seven monitoring wells were installed and soil samples were collected from 20 borings in the western half of the R Area. Benzene, toluene, ethylbenzene, and xylene (BTEX) compounds and PAHs were detected in several borings at concentrations up to 35 µg/kg and 970 µg/kg, respectively. The pesticide 4,4'-DDT was detected a concentration of 17 µg/kg in one boring, and elevated concentrations of lead (615 mg/kg) and copper (452 mg/kg) were detected at isolated locations.

Surface water and sediment samples were collected from four locations along Baker Road and from the north and south boundaries of the R Area. Sediment samples contained elevated concentrations of lead (1,590 mg/kg), zinc (517 mg/kg), N-nitrosodiphenylamine (1,000 µg/kg), and 2,6-dinitrotoluene (290 µg/kg). Surface water samples from the same locations did not exhibit significant levels of contamination, although N-nitrosodiphenylamine was detected at three locations.

The SI reported that sediments at one location contained mercury at a concentration of 46 mg/kg (IT 1992). This appears to be a laboratory reporting error because such a high concentration of mercury

would be very unusual and because nickel at the same location was also reported to be present at a concentration of 46 mg/kg. Nickel immediately follows mercury on the laboratory reports. Elevated mercury concentrations have not been verified by subsequent sampling.

Remedial Investigation

The Navy conducted an RI in the tidal area from 1993 to 1997 to evaluate the nature and extent of contamination at the R Area disposal site. As part of the RI, surface and subsurface soil samples were collected from 111 locations in the R Area disposal site. Most of the samples were collected at a 200-foot grid spacing, and additional samples were collected at the northwest and southwest corners of the site in areas of known waste disposal. The surface soil samples contained elevated concentrations of lead (up to 1,160 mg/kg) over much of the central portion of the R Area disposal site, and elevated concentrations of chromium (up to 319 mg/kg) and DDT pesticides (up to 28 µg/kg) in isolated areas. PAHs and PCBs were also detected in various locations at low concentrations (1,100 mg/kg and 4 µg/kg, respectively).

2.3 FROID AND TAYLOR ROADS SITE

The Froid and Taylor Roads site is a diamond shaped area, about 1,200 feet long and 300 feet wide, immediately southeast of the landfill (Figure 3). The slough that once passed through the four sites of the tidal area was partially filled in the vicinity of the Froid and Taylor Roads site to construct roads and buildings. A curved portion of the slough is still present in the Froid and Taylor Road site. The site is bounded by bermed roads or railroad tracks on three sides and forms a semienclosed basin that is open to the southwest.

2.3.1 Froid And Taylor Roads Site History

The Froid and Taylor Roads site has no previous history of industrial activity or waste disposal. During the IAS, a piece of ordnance was found on the shoulder of Froid Road near its intersection with Taylor Road, which was later identified by explosive ordnance disposal personnel as a spent 5-inch white phosphorus rocket round. An investigation of the surrounding area revealed scrap metal and other debris in the area south of the intersection of the two roads. Although no specific incidents of hazardous materials disposal were linked directly to this site, the Froid and Taylor Roads site was identified as an area of concern during the IAS (E&E 1983).

2.3.2 Previous Investigations of the Froid And Taylor Roads Site

On the basis of the piece of ordnance found on the shoulder of Froid Road, the IAS identified the Froid and Taylor Roads site as potentially hazardous and recommended further investigation of the site (E&E 1983).

Site Investigation

Because the IAS recommended further investigation of the Froid and Taylor Roads site, an SI was conducted by IT from 1988 to 1992. As a part of the SI, five monitoring wells were installed, soil samples were collected from five locations, and surface water and sediment samples were collected from two locations. Analytical data from the soil samples shows that soils contained low concentrations of PAHs. Pentachlorophenol (PCP), a common wood preservative, was detected at a concentration of 130 µg/kg in one sample. Elevated concentrations of metals or other contaminants were not detected in soils. Elevated concentrations of copper (644 mg/kg) were detected in sediment samples at one location. Surface water samples did not exhibit significant levels of contamination.

Remedial Investigation

The Navy conducted an RI in the tidal area from 1993 to 1997 to evaluate the nature and extent of contamination at the Froid and Taylor Roads site. As part of the RI, surface and subsurface soil samples were collected from nine locations in the Froid and Taylor Roads Site. Soils exhibited elevated concentrations of petroleum hydrocarbons, DDT pesticides, and lead. Contamination by petroleum hydrocarbons was ubiquitous.

2.4 WOOD HOGGER SITE

The wood hogger site is located south of the tidal area landfill (Figure 3). The site consists of a paved central storage yard, the area surrounding the storage yard, and an incinerator and wood hogger at the southwest corner of the site. The paved central storage yard was designated as solid waste management unit (SWMU) 37 during the Resource Conservation and Recovery Act (RCRA) facility assessment performed by the Department of Toxic Substance Control (DTSC) in 1992. The open areas to the north and south of the storage yard are intermittently sparsely to densely vegetated. The open areas adjacent to the asphalt pavement contain debris that was windblown or disposed of in these areas. Less debris is

present further from the asphalt storage yard. The site is bounded by Froid Road to the north and by Otter Sluice on the south and west.

2.4.1 Wood Hogger Site History

Wood debris and dunnage from tidal area operations were burned, chipped, and disposed of at the wood hogger site from the early 1950s to the present. Aerial photographs indicate that the incinerator was used to burn wood from the early 1950s to the early 1970s. A conveyor system was used to move wood from the storage yard to the incinerator. The concrete foundation of the incinerator remains on the site.

Between 1959 and 1974, a wood hogger was installed southwest of the storage yard, and the wood hogging machinery was used to chip wood scrap and dunnage from tidal area operations. Until about 1972, the wood chips were sold to the Fiberboard Company in Antioch, California (E&E 1983). When a market for the chips could no longer be found, they were deposited on the ground in the area surrounding the wood hogger and storage yard. The chips were estimated to cover a 10-acre area at a thickness of up to 3.5 feet (IT 1992).

Some of the wood scrap chipped at the site came from ordnance crates returned from Vietnam. Most ammunition shipping crates used by the Marines in Vietnam were treated with PCP. Based on the total amount of munitions shipped from NWS Concord and on the amount of munitions returned to NWS Concord during retrograde operations, the total amount of PCP-treated wood that may have been chipped and disposed of at the site was estimated at 20 tons (E&E 1983).

Historical photographs indicate that wood, scrap metal, and other materials have been stored in sections of the yard at various times up to the present. No treated or preserved wood is currently stored or handled at the site. The wood hogger was dismantled and removed from the site during the fall of 1997.

2.4.2 Previous Investigations of the Wood Hogger Site

The wood hogger site was the fourth tidal area site identified as potentially hazardous in the IAS report (E&E 1983). Because the IAS recommended further investigation of the wood hogger site, IT conducted an SI from 1988 to 1992. Four monitoring wells were installed, and soil samples were collected from 15 locations in the southern half of the wood hogger area. Copper and zinc were detected at elevated

concentrations (up to 4,760 mg/kg and 2,570 mg/kg, respectively) in soils at several locations. In addition, a variety of PAHs were detected at several locations at concentrations up to 5,200 µg/kg. The pesticide 4,4'-DDT was detected at three locations at estimated concentrations up to 620 µg/kg, and PCP was detected at one location at an estimated concentration of 1,100 µg/kg.

Sediment and surface water samples were collected at four locations along the south and west boundaries of the wood hogger site. Elevated concentrations of copper (553 mg/kg) and zinc (643 mg/kg) were detected in sediments. Surface water samples did not exhibit unusual levels of metals or organic compounds.

Remedial Investigation

The Navy conducted an RI in the tidal area from 1993 to 1997 to evaluate the nature and extent of contamination at the wood hogger site. Soil samples were collected at 71 locations in the wood hogger site and at an additional 12 locations within SWMU 37. A number of organic and inorganic compounds were detected in the wood hogger site samples, indicating widespread contamination. Elevated concentrations of lead (728 mg/kg), mercury (18.5 mg/kg), and zinc (3,010 mg/kg) were detected in soils and wood chips. Elevated concentrations of DDT pesticides (280 µg/kg) and PCBs (15 µg/kg) were also detected at a number of locations. Elevated concentrations of PAHs were detected in the southwestern portion of the site, and dioxins were detected in a single sample collected from the former incinerator area. PCP was detected in four samples at concentrations up to 720 µg/kg. Petroleum hydrocarbons were detected in several samples.

2.5 UNDERGROUND STORAGE TANK INVESTIGATIONS

In addition to the investigations at the tidal area sites described above, underground storage tank (UST) investigations were conducted at two nearby sites: a 300-gallon kerosene tank north of building A-3A, about 1,200 feet northwest of the landfill, and a 500-gallon diesel fuel tank near the firehouse (building E-111), about 1,000 feet southeast of the landfill (Figure 3). The tanks were removed in 1991 and 1993, and the Navy drilled soil borings and installed monitoring wells at both sites to ascertain whether contamination associated with the tanks had been adequately addressed by the removal. The UST investigation concluded that soils in the vicinity of the kerosene tank had been adequately remediated, but that soils in the vicinity of the diesel fuel tank were contaminated with total petroleum hydrocarbons

(TPH) as diesel (TPH-d), and that approximately 150 cubic yards of soil should be excavated and removed (PRC 1997b).

2.6 GROUNDWATER SAMPLING HISTORY

Twenty-three monitoring wells were installed in the tidal area by IT in 1989 (Figure 3). These monitoring wells have been sampled during four separate sampling events: (1) quarterly sampling in 1990 and 1991, (2) limited confirmation sampling in 1993, (3) limited low flow-rate sampling in 1994, and (4) confirmation sampling of all wells in 1997. Each sampling event is described briefly in this section. Analytical results from all groundwater sampling in the tidal area are presented in Appendix B.

In addition, two sets of three monitoring wells each were installed as part of the UST investigations at buildings A-3A and E-111, and several grab groundwater samples were collected as a part of the Geoprobe® investigation of SWMU 37. Analytical results for these samples are discussed after the discussion of sampling the monitoring well network in the four tidal area sites.

2.6.1 Quarterly Sampling

From May 1990 to January 1991, the monitoring wells were sampled quarterly for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), metals, pesticides and PCBs, anions, total organic carbon (TOC), and total dissolved solids (TDS) as a part of the SI (IT 1991). Metals of potential concern, including arsenic, copper, lead, nickel, and silver, were consistently detected in monitoring wells in one or more of the four areas. In addition, cobalt was detected at unusual concentrations in some areas. Organic compounds were not detected consistently in any well. Analytical results for the quarterly sampling are presented in Appendix B. For unknown reasons, portions of the metals data were rejected during data validation. Rejected results are shown in Appendix B as though the samples were not analyzed.

2.6.2 Limited Confirmation Sampling

To confirm the results of the quarterly sampling conducted during the SI, a limited groundwater confirmation study was conducted in January 1993. The organic compounds that were detected during the SI were typically detected in only one or two of the four quarterly sampling rounds, and many of the

results were flagged with a "J" qualifier, indicating possible data quality problems. To verify that the possible data quality problems did not mask groundwater contamination by organic compounds, groundwater samples were collected from the seven monitoring wells where VOCs and SVOCs were intermittently detected (TLW-1, TLW-3, FTW-2, FTW-3, RDW-5, WHW-3, and WHW-4). The confirmation samples were only analyzed for VOCs and SVOCs. Organic compounds were not detected in any of the 1993 confirmation samples (James M. Montgomery, Consulting Engineers, Inc. 1993).

An additional sample collected from well RDW-5 was analyzed for pesticides because the pesticide aldrin was detected at a low concentration in one of the four SI quarterly samples. Aldrin was not detected in the confirmation sample. Confirmation sampling results are presented in Appendix B.

2.6.3 Low Flow Rate Sampling

A low flow rate sampling study was conducted in September 1994 to address concerns about appropriate sampling techniques for metals and the validity of samples collected previously. Four wells (FTW-3, RDW-5, TLW-3, and WHW-4) were selected for low flow rate sampling to represent the full range of hydrogeologic conditions at the site. Two sets of filtered and unfiltered metals samples were collected from each of the four wells. One set of samples was collected using low flow rate sampling techniques. The second set of samples was collected using more traditional purging and bailing sampling techniques. Filtered samples were passed through 5 micron in-line filters. The results of the study are documented in a technical memorandum (Montgomery Watson 1994). Analytical results from the low flow rate purging study are presented in Appendix B.

The study proved to be inconclusive because the recharge rates in the monitoring wells were very low, and the water samples collected using the low flow rate technique consisted primarily of stagnant water from the well casing rather than water from the formation. The wells were sampled at flow rates of 50 milliliters per minute (0.05 liters per minute), but the wells recharged even more slowly, as evidenced by the continuous drawdown in the wells during sampling.

Results from samples collected using traditional purging and bailing techniques are presented with other historical analytical results in Appendix B. Only results for filtered samples collected using traditional sampling methods are presented in the table because these results are most comparable with analytical results from the quarterly sampling.

2.6.4 Groundwater Samples Collected During Geoprobe® Investigation of Solid Waste Management Unit 37

To further investigate results of a RCRA facility assessment performed by DTSC in 1992, the Navy collected additional soil and groundwater samples at 24 SWMUs in 1995 using Geoprobe® direct push sampling techniques (PRC 1997c). SWMU 37 is the only SWMU within the tidal area sites. Three grab groundwater samples were collected from SWMU 37 as a part of this investigation. Locations of the three Geoprobe® borings are shown in Figure 3. Unfiltered groundwater samples were collected from locations S37-11 and S37-12 to investigate whether compounds have leached to groundwater from adjacent scrap wood piles. The samples were analyzed for metals, VOCs, SVOCs, pesticides, PCBs, TOC, and explosives. No VOCs, SVOCs, pesticides, or PCBs were detected. Arsenic was detected in S37-11 at a concentration of 404 milligrams per liter (mg/L). To confirm the elevated arsenic concentration, a new boring (S37-13) was advanced nearby, and a filtered metals sample was collected. The filtered metals sample from the new boring had an arsenic concentration of 4.1 micrograms per liter. Complete analytical results from the Geoprobe grab samples are included in Appendix B.

2.6.5 Groundwater Sampling for Underground Storage Tank Investigation

Groundwater samples were also collected from monitoring wells in association with the UST investigation described in Section 2.5. Three wells are located near building A-3A, about 1,200 feet northwest of the landfill, and three other wells are located near the firehouse (building E-111), about 1,000 feet southeast of the landfill. The wells were sampled for aromatic volatiles (BTEX compounds, chlorobenzene, and dichlorobenzene isomers) and TPH on several occasions. Analytical results from the building A-3A wells show that TPH-d and TPH as motor oil (TPH-m) were detected in groundwater at low concentrations (up to 0.2 mg/L). Analytical results from the building E-111 wells show that TPH-d and TPH-m were detected at moderate concentrations (up to 7 mg/L). Individual aromatic hydrocarbons were not detected in any of the wells. Analytical results for these wells are presented in Appendix B.

3.0 CONFIRMATION STUDY FIELD ACTIVITIES

The confirmation study consisted of the following field activities:

- Monitoring well inspection
- Hand auger survey
- Soil boring and piezometer installation
- Water level measurement
- Groundwater sampling
- Surface water sampling

Field procedures used to accomplish these tasks are documented in the following subsections. Results of the activities are discussed in Sections 4 and 5.

3.1 MONITORING WELL INSPECTION

There are currently 29 wells and 6 piezometers in the immediate vicinity of the tidal area sites (Figure 3). Twenty-three of these wells were installed by IT in 1989 during the SI (IT 1992). Six wells were installed in 1995 during UST investigations (PRC 1997b). Two piezometers were installed in the R Area disposal site in 1995 to better define groundwater flow conditions in the northern part of the tidal area sites. Finally, four new piezometers were installed in the area east of the landfill in October 1997 as a part of this confirmation study.

TtEMI inspected the wells and piezometers on June 11, 1997, to verify that the wells are in good condition, will yield good, representative groundwater samples, and comply with California monitoring well standards (California Department of Water Resources 1981 and 1991). Piezometers PZ-3 through PZ-6 were not yet installed at the time of the inspection, and the locations of the UST wells were not known; therefore, only the 23 wells installed by IT and the two R Area disposal site piezometers were inspected.

Field tasks also included measuring the depth to well bottom and inspecting the surface pads, external casings, and caps. Well logs and published well construction details were also reviewed.

California monitoring well standards establish minimum design requirements for groundwater monitoring wells. The design requirements specify that wells must be equipped with a concrete surface

pad that is not cracked or damaged and that effectively precludes surface runoff from entering the well annulus. The design requirements also specify that the well must have a locking outer cover and an inner well cap and that the annular space between the borehole wall and well casing must be at least 2 inches. The tidal area monitoring wells and piezometers are in good condition and meet all of the monitoring well design requirements.

Measured depths to well bottom did not agree well with depths reported in the SI report (IT 1992). Measured well depths were more than 0.5 foot deeper than reported for 18 of the 23 wells. Eight of the measured depths were more than a foot deeper than reported in the IT report, and one well (RDW-5) was 2.3 ft deeper than reported. The reason for the disparity between measured and reported depths is unknown, but empirical evidence indicates that the wells are typically 0.5 to 1 foot deeper than previously reported.

3.2 HAND AUGER SURVEY

Historical aerial photographs of the landfill area presented in the RI report show that a slough meandered through the R Area disposal site and intersected the southwestern and southern margins of the area currently occupied by the landfill (PRC 1997a). Portions of this slough have subsequently been filled; in some areas, sandy soil was used as fill material, creating possible preferential groundwater flow paths. The presence of possible preferential flow paths in channel fill southwest of the landfill was not fully investigated during previous investigations. To investigate the presence of possible preferential flow pathways, several shallow borings were drilled with a hand auger in the filled portions of the slough southwest of the landfill. The borings were drilled with a hand auger because the area is currently inaccessible to drill rigs because of saturated soils in the area.

The hand auger survey was conducted on September 11, 1997. Lithology of the slough fill material was examined at the three locations near the landfill where the slough was filled. Borings were advanced in the center of the slough near the terminus of the fill material to ensure that the borings penetrated the fill material rather than native materials on the sides of the sloughs. Approximate hand auger boring locations are shown on Figure 4. Soil borings were advanced through the fill material and the native Bay Mud to the water table. The soil borings showed that coarse materials were used to fill the slough in some areas, but that the slough is very shallow and the water table was below the base of the fill material

in all cases. Consequently, the filled portions of the slough cannot act as preferential groundwater flow pathways in the area southwest of the landfill.

Additional borings were advanced in the bottom of the unfilled portions of the slough at several locations. The lithology in all of these borings consisted of dark gray silty clay.

3.3 SOIL BORING AND PIEZOMETER INSTALLATION

To better characterize the lithology and hydrodynamic regime in the vicinity of the landfill, soil borings were drilled at 11 locations east and northeast of the landfill, and four piezometers were installed. Soil boring locations are shown in Figure 4. Soil borings were drilled with a truck-mounted rotary drill rig using hollow-stem augers. Split-spoon samples were collected continuously from 2 to 4 feet below grade to the bottom of each boring to characterize lithology of the borings. Split spoon samples were collected to define borehole lithology only and were not submitted for chemical analysis. Lithology of each soil boring was described, logged, and classified according to the unified soil classification system (USCS).

Seven borings (B-1 through B-7) were drilled northeast of the landfill in an effort to locate a filled manmade sluice that appears on aerial photographs from 1939 that may act as a potential preferential groundwater flow pathway. The borings were drilled to a depth of 8 feet below grade, at least 1 foot into native material. Borings were abandoned by grouting from the surface with cement-bentonite grout.

One piezometer (PZ-4) was installed east of the landfill to verify groundwater flow directions in this area. A previously undiscovered sand unit was encountered at that location from 16 to 19.5 feet below grade. To determine the lateral extent of the sand unit, additional borings were drilled at locations PZ-3, PZ-6, and B-9. Piezometers were installed at two of these locations; no piezometer was installed in boring B-9 because the sand unit was not encountered in that boring. An additional shallow piezometer (PZ-5) was install adjacent to PZ-4 to allow an assessment of hydraulic communication between the sand unit and shallower lithologic intervals. Screened intervals for the piezometers were selected to intersect specific lithologic intervals such as sand units.

The construction of the piezometers conforms to existing monitoring wells at the site, so that the piezometers can function as monitoring wells if necessary. Piezometer construction details are shown on

the lithologic logs included in Appendix C. Each piezometer consists of 4-inch-diameter polyvinyl chloride (PVC) riser pipe and 10-foot-long, 0.010-inch (10 slot) PVC well screens.

The filter pack for each well consists of clean-graded Lone Star Lapis Luster Monterey sand no. 2/12, which extends from approximately 6 inches below the base of the well to 2 feet above the top of the screen. The level of the filter pack sand was checked continuously with a weighted tape during emplacement to ensure that no gaps or bridging occurred. A 2-foot filter collar of bentonite chips was emplaced immediately above the filter pack. The remainder of the annular space from the top of the filter collar to 1 foot below grade was pressure grouted with a cement-bentonite slurry. The grout was emplaced via a hose or tremmie pipe from bottom to top to ensure that the entire annular space was sealed. To allow enough space for a good annular seal, the shallow piezometer (PZ-5) had only 1 foot of filter pack above the top of the screen and a 1-foot bentonite chip filter collar.

The piezometers are completed with aboveground, locking protective casings and concrete surface pads. The concrete surface pads are approximately 3 feet across, centered at the well, and sloped smoothly away from the well to facilitate drainage. The wells are protected from vehicular damage with concrete-filled bumper posts.

The new piezometers were developed on October 3, 1997, using standard surging and pumping techniques. The piezometers were surged vigorously with a tight-fitting surge block for 10 to 15 minutes and then pumped with a submersible pump until water quality improved. Each piezometer was surged and pumped at least three separate times, except for piezometer PZ-5; piezometer PZ-5 was surged once and bailed dry, but it did not recharge appreciably for more than 1 week. Development of the remaining three piezometers ceased when further pumping and surging did not produce an appreciable improvement in water clarity. Each of the piezometers was able to produce water with turbidity below 50 nephelometric turbidity units (NTU), except for PZ-5. Piezometer development records are included as Appendix D.

Locations and elevations of the new piezometers and borings were surveyed by a licensed surveyor on October 3, 1997.

3.4 WATER LEVEL MEASUREMENT

Water levels in the tidal area wells were measured on the following three occasions during the confirmation sampling investigation: (1) on June 11, 1997, during the well inspection, (2) on October 3, 1997, at the conclusion of the dry season, and (3) on January 28, 1998, during the rainy season. Water levels were measured in the 23 tidal area monitoring wells and in piezometers PZ-1 and PZ-2 to the nearest 0.01 foot using a Solinst electronic water level indicator. Water levels were not measured in the A-3A and E-111 UST wells during the first two water level monitoring events because the wells had not yet been identified as providing information relevant to the confirmation groundwater study. Water levels were not measured in PZ-3 through PZ-6 before January 1997 because the piezometers had not yet been installed. Water levels in several of the piezometers did not stabilize for several days following well development; therefore, water levels were measured again in these piezometers on October 15, at the conclusion of the confirmation sampling. Water level in piezometer PZ-5 had not recovered to equilibrium yet on October 15, so this water level is omitted from the potentiometric maps presented in Section 4.2.

3.5 GROUNDWATER SAMPLING

The 23 tidal area monitoring wells were sampled from October 6 to October 15, 1997. Where possible, groundwater samples were collected using low flow-rate purging techniques. In many cases, the recharge rate in the wells would not support low flow rate sampling, and the wells were sampled using a natural settling technique to reduce sample turbidity. Both well sampling techniques are discussed below.

Recent studies by the U.S. Environmental Protection Agency (EPA) have shown that low flow rate purging techniques can be used to obtain more accurate and representative groundwater samples for metals analyses than conventional sampling and filtering techniques (Puls and Powell 1992). A principal objective of low flow rate purging is to avoid entraining silt- and clay-sized particles in groundwater samples by purging wells at low velocities. Low velocity purging is intended to establish direct flow from the water-bearing formation to the sample container at velocities and flow conditions comparable to in situ flow velocities. By using low flow rate purging techniques, the sampling process more closely matches natural groundwater flow conditions and transport of suspended solids, and analytical problems and uncertainties caused by turbidity are reduced.

Low flow rate purging techniques were used to obtain groundwater samples from 9 of the 23 wells. The low flow rate purging and sampling technique that was used in this investigation was as follows:

1. The depth to water and depth to well bottom was measured and the volume of water in the well casing was calculated using an appropriate conversion factor (0.652 gallons per foot for a 4-inch monitoring well).

2. A Tygon® tube weighted with a 1-foot length of PVC piping was gently lowered into the well to a depth of about 4 feet below the water table and secured to the outer well casing with duct tape.

3. Water in the well was rapidly pumped to about 2 feet below the equilibrium water level to stimulate recharge into the well.

4. Purge water was discharged into a graduated bucket. Pumping rates were calculated by recording the time required to raise the water level in the bucket by 1 liter.

5. The pumping rate was decreased to about 0.2 liter per minute (L/min), and purge water stabilization parameters (pH, temperature, electrical conductivity, dissolved oxygen [DO_2], and turbidity) were recorded at intervals of 1 to 2 liters. A minimum of eight measurements (8 liters purged) were recorded for each well.

6. Water levels were measured at the same time as each of the stabilization parameter measurements. The pumping rate was adjusted between 0.1 L/min and 0.25 L/min to achieve a static water level. If water level continued to decline at a pumping rate of 0.1 L/min, the well was sampled using the natural settling technique described below.

7. The purge water was considered stabilized if three successive measurements of each of the stabilization parameters fell within the following ranges. The DO_2 stabilization criterion of ± 0.2 mg/L is recommended by Barcelona and others (1994) and is a reasonable criterion based on water quality measurements at NWS Concord in the past. The turbidity and electrical conductivity criteria are based on field experience:

    - pH: ± 0.25
    - Electrical conductivity: ± 1 microSiemens per centimeter
    - Temperature: ± 0.5 °C (± 1 °F)
    - DO_2: ± 0.2 mg/L
    - Turbidity: ± 15 percent relative percent difference (RPD) or three successive measurements less than 15 NTUs

8. Water quality parameters and other relevant sampling information was recorded on the monitoring well sampling records that are included with this report as Appendix E.

9. Samples were collected after the well stabilization parameters verified that the purge water had stabilized. Samples were collected by discharging water from the pump

directly into the appropriately preserved sample bottles without altering the pumping rate.

10. Sample preservation, handling, labeling, documentation, and shipping were as described in the field sampling plan (PRC 1995a) and the quality assurance project plan (QAPP) (PRC 1995b). Samples for metals analysis were not filtered. Gamma spectroscopy samples were preserved with nitric acid and were not filtered. Stable isotope samples were neither filtered nor preserved.

In 14 of the 23 wells sampled, rates of groundwater recharge to the wells from the formation were lower than the lowest pumping rates (less than 0.1 L/min). Because samples collected from these wells using low flow rate techniques would have consisted predominantly of stagnant water from the well casing rather than water from the water-bearing formation, these 14 wells were sampled using a natural settling technique rather than a low flow rate technique.

The natural settling technique consisted of purging the wells dry, allowing the wells to recharge overnight, and collecting samples the following day. Particles that may have been entrained in the water that recharged the wells after purging were allowed to settle naturally from the water within the well casing. Samples were collected by attaching the peristaltic pump to the free end of the tubing and gradually increasing pumping rate to 0.25 L/min, taking care to avoid agitating the tubing and sample. The tubing that was used to purge the well was left suspended in the well overnight to prevent disturbing the water column and resuspending sediments when inserting the tubing to collect a sample. At least 3 liters of water were purged, and three rounds of well stabilization parameters were measured to characterize water quality before the samples were collected. Groundwater samples collected from these wells were not filtered. Well RDW-5 recharged very slowly (5.6 feet in 5 days) and was sampled 5 days after purging. All other wells were sampled the day after the wells were purged.

3.6 SURFACE WATER SAMPLING

Surface water samples were collected to characterize isotopic composition and total and dissolved solids concentrations in surface water adjacent to the tidal area sites. Samples of surface water at the inlet to Otter Sluice and in Otter Sluice itself were collected at high and low tides. These samples were analyzed for stable isotopes of oxygen and hydrogen and for TDS and total suspended solids (TSS). In addition, a surface water sample was collected from near the shoreline of Suisun Bay at the Port Chicago Memorial to characterize background radioisotope concentrations in Suisun Bay. Samples were collected by immersing sample bottles about 6 inches below the surface and opening the caps and allowing the bottles

to fill. Surface water sample preservation and handling was as described for other samples. Surface water sampling locations are shown in Figure 5.

3.7 SAMPLE ANALYSIS

All groundwater samples collected in October 1997 were analyzed for metals, TDS, TSS, and stable isotopes of oxygen and hydrogen. Selected wells were sampled for VOCs, SVOCs, pesticides, PCBs, and gamma emissions, as discussed in Section 5.0. Samples were analyzed in accordance with procedures described in the QAPP (PRC 1995b) using analytical methods in the following list:

Analyte Group	Analytical Method
Metals	EPA Contract Laboratory Program (CLP) Statement of Work for Inorganic Analyses ILM04.0
TDS/TSS	EPA Method 160.1/160.2
VOCs	EPA CLP Statement of Work for Organic Analyses OLM02.1
SVOCs	EPA CLP Statement of Work for Organic Analyses OLM02.1
Pesticides and PCBs	EPA CLP Statement of Work for Organic Analyses OLM02.1
Stable isotopes	Mass spectrometer
Gamma Spectroscopy	EPA Method 901.1

In addition to the investigative samples described above, quality assurance and quality control (QA/QC) samples were collected to ensure that accurate and representative data was obtained during the investigation. QA/QC samples collected during this sampling event included three duplicate samples, one matrix spike duplicate sample, two equipment blanks, and four trip blanks.

Duplicate samples were collected by simply collecting double sample volume and labeling the samples with different sample numbers. Equipment blank samples were collected by pumping deionized water through the peristaltic pump and approximately 25 feet of Tygon® tubing in exactly the same manner as the groundwater samples were collected. Duplicate and equipment blank samples were submitted to the laboratory without any notation that could identify them as QA/QC samples.

Trip blank samples were included with each sample cooler containing samples for VOC analyses. The trip blank samples consisted of deionized laboratory-grade water packaged in sample bottles by the laboratory.

4.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

This section describes the geologic and hydrogeologic setting of the tidal area sites based on previous investigations and information collected during the confirmation study.

4.1 SITE GEOLOGIC SETTING

NWS Concord is situated in a tectonically active area with complex geology. The geologic setting of the site is characterized by a blanket of unconsolidated sediments resting on an eroded and deformed bedrock surface, which is cut by faults. The unconsolidated sediments are muds and sands left behind during sea level fluctuations caused by glacial advances and retreats. The bedrock in the vicinity of NWS Concord consists predominantly of Tertiary sedimentary rocks with occasional late Tertiary volcanics. The regional geology of NWS Concord is discussed in detail in the RI report (PRC 1997a).

4.1.1 Shallow Unconsolidated Sediments

Geologic conditions at the landfill and at other tidal area sites are illustrated in cross section in Figures 6 through 10. The lithology depicted in these cross sections differs somewhat from previous interpretations because the new cross sections rely exclusively on lithologies recorded on soil boring logs, rather than on monitoring well logs. The lithologies recorded for the monitoring wells installed during the SI appear to based on drill cuttings brought to the surface during drilling, rather than on depth-discrete split-spoon samples. Because lithologic logs based solely on drill cuttings are often inaccurate, the new cross sections are based solely on lithologic logs that indicate that actual depth-discrete samples were examined. Monitoring wells have been projected to the lines of cross section to illustrate the spatial relationships between the wells and the lithology.

The cross sections show that the subsurface in the tidal area sites is dominated by a dark gray to black silty clay, commonly known as the Bay Mud. The Bay Mud is variously described as silty clay, clayey silt, silt, and in the southern portion of the wood hogger site, sandy clay. This material is often described as organic-rich, or peaty, indicating a high proportion of organic material. The Bay Mud typically exhibits low permeability, restricting movement of groundwater and causing low recharge in wells screened in the formation.

The Bay Mud is interrupted in various locations in the tidal areas by a peat body, fill materials of various kinds, and sand lenses. The peat body has very limited lateral extent and was detected only in several soil borings beneath the center of the landfill (cross section C-C', Figure 9). Because the original surface of the tidal marsh was probably close to sea level, almost all of the material that is currently elevated above sea level is likely to be fill material. Fill material underlies all of the roads, railroad tracks, and buildings near the tidal area sites and much of the wood hogger site. The fill material is typically a mixed lithology that contains varying proportions of clay, silt, sand, and gravel. Wood chips were used as fill material over large portions of the wood hogger site.

The sand lenses typically appear to have short lateral extent; most are recorded in a single soil boring and were not encountered in adjacent borings. The only sand lenses that could be correlated between adjacent borings occur near the eastern margin of the landfill. Two of the shallow sand lenses encountered in boring B-9 correlate with similar bodies in piezometer PZ-6 (see cross section B-B', Figure 8). A deeper sand body of limited lateral extent was encountered at depths of approximately 16 to 18 feet below grade while installing three new piezometers east of the landfill (see cross section C-C', Figure 9).

The deeper sand body was encountered in piezometers PZ-3, PZ-4, and PZ-6, but was not encountered in a fourth boring (B9, adjacent to monitoring well TLW-5). The sand body consists of a 3- to 3.5-foot-thick, medium-grained, brown sand that flowed into the augers during drilling in the eastern two borings, where the sand was encountered. In contrast, the sand units encountered in PZ-6 at the eastern margin of the landfill were very fine grained, silty, thin, and did not flow into the augers during drilling. The deeper of the three sands in piezometer PZ-6 has been tentatively correlated with the sand body in PZ-3 and PZ-4 and is interpreted as the margin of a discontinuous sand unit that grades laterally westward into silty clay. The lateral extent of this sand body east of piezometers PZ-3 and PZ-4 is unknown.

4.1.2 Deeper Unconsolidated Sediments

Cross section C-C' presented in the draft RI report (PRC 1997a) shows that the shallow geologic units discussed previously are underlain by a thick sequence of alluvial clays and silts, which overlies an estuarine micaceous sand. The geometric configuration of these units is based on geotechnical boring logs from 1973; detailed lithologic descriptions are not available. The estuarine sand unit is an extensive

aquifer that underlies the entire tidal area. The full thickness of the micaceous sand is not known, but the unit is at least 20 feet thick in the vicinity of the landfill. This aquifer is separated from the landfill by a 40- to 60-foot-thick alluvial silt and clay sequence and an additional 10 to 15 feet of Bay Mud. The thick sequence of silt and clay is expected to effectively isolate the estuarine sand aquifer from the landfill.

4.2 SITE HYDROGEOLOGIC SETTING

Groundwater at the NWS Concord tidal area occurs in a shallow unconfined water-bearing zone that is predominantly composed of silty clays. As NWS Concord developed, site drainage was modified by digging drainage channels and filling both natural and manmade channels with sandy fill materials and silty clays, leaving a complex subsurface characterized by silty clays and linear bodies of sandy fill material. The hand auger survey and the new borings installed northeast of the landfill have shown that the linear fill bodies are discontinuous and do not appear to act as preferential groundwater flow pathways. In addition, natural peat bodies present in the tidal area appear to have limited horizontal extent and are unlikely to act as preferential flow pathways. Consequently, the primary mode of shallow groundwater movement at the tidal area sites appears to be flow through the silty clay materials that dominate the subsurface.

Water level surveys were conducted at the tidal area sites on June 11 and October 3, 1997, and on January 28, 1998. Groundwater elevations for these water level surveys are reported in Table 1. Potentiometric surfaces showing groundwater elevations and flow directions for these dates are included as Figures 11 through 13. The water level surveys conducted on June 11 and October 3 (Figures 11 and 12) reflect groundwater conditions in the middle and end of the dry season, respectively. Potentiometric surfaces for these two events share the same general features. Both surfaces show radial flow towards depressions in the water table in the R Area disposal site. In both cases, groundwater elevations are below sea level over large parts of the R Area disposal site. The lowest groundwater elevation detected during the water level surveys was 3.62 feet below mean sea level (msl). Groundwater elevations are higher at the margins of the tidal area sites, indicating that groundwater flows from the edges of the tidal area sites towards the center. Groundwater does not appear to discharge to Suisun Bay via subsurface flow or groundwater/surface water interaction, although limited groundwater/surface water interaction occurs along a narrow strip adjacent to Otter Sluice, as discussed below in Section 4.2.2.

The most probable cause of the closed depressions in the water table in the center in the R Area disposal site is excessive evapotranspiration from wetland plants. This phenomenon, known as phreatophytic pumping, is a common feature of wetlands in semiarid climates that allows groundwater to discharge directly to the atmosphere (Freeze and Cherry 1979). Because only water is lost through evapotranspiration, the residual groundwater that is not discharged to the atmosphere becomes enriched in dissolved solids. Therefore, phreatophytic pumping may also account for the elevated dissolved solids concentrations that have been measured in the R Area disposal site.

The water level survey conducted on January 28, 1998 (Figure 13) reflects groundwater conditions at the height of the wet season. Surface water covered most of the R Area disposal site, wood hogger site, and Froid and Taylor Roads site at the time of the survey. Two to three feet of surface water was common at the wellheads, but none of the wells was completely immersed. Groundwater levels in the monitoring wells were consistently 4 to 12 inches below the surrounding surface water, indicating that groundwater and surface water are not in equilibrium but that hydraulic gradients are directed downward. At the time of the survey, surface water was observed flowing from Otter Sluice across Baker Road into the R Area disposal site, indicating that storm-related tidal surges are the primary source of the ponded surface water in the R Area disposal site. Rainfall and local surface runoff also contribute to the ponded water. The downward gradient between surface water and groundwater indicates that groundwater is recharged by surface water.

The wet season potentiometric surface (Figure 13) shares the same general features as the dry season surfaces: groundwater flows radially towards the center of the R Area disposal site. The dry season potentiometric surfaces show a single large depression that extends across Froid Road into the wood hogger site. The wet season surface shows that the water table elevation in well TLW-7 is higher than surrounding areas, and the central depression in the water table is resolved into two distinct depressions centered on well RDW-6 in the R Area disposal site and on FTW-2 near the eastern edge of the wood hogger site.

The lowest point in the wet season water table surface in the R Area disposal site is in well RDW-2, which indicates that there are transient flow reversals in the vicinity of this well. During the dry season, groundwater appears to flow to the east near well RDW-2, but during the wet season, groundwater could be interpreted to flow to the west, toward Otter Sluice. The wet season potentiometric surface map (Figure 13) has been contoured to indicate eastward flow because the net flow is probably to the east.

Surface water elevations in Otter Sluice at the time of the measurement were at least 4 feet above msl, so groundwater elevation directly adjacent to Otter Sluice is almost certainly higher than water elevation in RDW-2. Nevertheless, the potentiometric elevations measured on January 28 could be interpreted to indicate that groundwater discharges to Otter Sluice at this location during low points in the tidal cycle when water levels in Otter Sluice drop in response to tidal fluctuations. Transient flow reversals could cause limited groundwater discharge to Otter Sluice in the area surrounding RDW-2 during low tides during the wet season, but the overall groundwater flow directions during both wet and dry seasons appear to be directed radially towards the center of the R Area disposal site. Groundwater discharge to Otter Sluice is expected to be an insignificant component of overall discharge.

In addition to the shallow silty clay water-bearing zone discussed above, groundwater occurs in a subsurface sand body enclosed within the silty clay in the area east of the landfill. The sand body is about 3.5 feet thick in piezometers PZ-3 and PZ-4 and appears to pinch out to the west in the vicinity of the landfill (see Figure 9). The sand unit was about 1.5 feet thick in piezometer PZ-6 and was not present at all in boring B9, adjacent to well TLW-5. The lateral extent of the sand body east of piezometers PZ-3 and PZ-4 is unknown.

Three piezometers penetrate the sand body (PZ-3, PZ-4, and PZ-6), and two of these piezometers form wells nests with other wells screened in the shallow silty clay water-bearing zone (PZ-4/PZ-5 and PZ-6/TLW-4). Differences in water elevations in the wells attest that the sand body is a confined aquifer. Groundwater elevations and vertical hydraulic gradients are presented below. Groundwater elevations are not presented for the PZ-5/PZ-4 well nest for October 15, 1997, because water levels in PZ-5 had not yet stabilized after well development at the time of the water level measurements. Vertical gradients were calculated for each well nest based on the midpoints of the screened intervals for each well. Vertical gradients ranged from gentle to very strong and were directed both up and down. The strongest vertical gradients were directed down.

Well Nest	Date	Groundwater Elevation	Vertical Hydraulic Gradient (direction)
TLW-4 / PZ-6	10/15/97	0.87 / 0.91	0.005 (up)
TLW-4 / PZ-6	1/28/98	3.54 / 3.35	0.024 (down)
PZ-5 / PZ-4	1/28/98	6.37 / 3.38	0.60 (down)

Groundwater within the confined sand unit flows to the northwest during both dry and wet seasons, based on groundwater levels measured on October 15, 1997, and January 28, 1998 (Figures 14 and 15). The horizontal gradient within the sand body appears to vary seasonally from a moderate horizontal gradient of 0.0095 at the end of the dry season to a weaker gradient of 0.0015 during the wet season. Because groundwater in the confined sand body is not downgradient from the landfill, groundwater samples were not collected from the newly installed piezometers.

4.2.1 Groundwater Flow Velocity

Groundwater flow velocity was evaluated by estimating seepage velocity based on aquifer parameters and site-specific hydraulic measurements. Seepage velocity, representing the average rate at which groundwater moves between two points, was calculated using the following equation:

$$\text{seepage velocity} = Ki/\eta_e \qquad \text{(Fetter 1994)}$$

where

K = hydraulic conductivity (centimeters per second [cm/sec])
i = hydraulic gradient (unitless)
η_e = effective porosity (unitless)

Site-specific values for hydraulic conductivity were obtained from rising head permeability test data presented in the SI report (IT 1992). Rising head in situ permeability tests (commonly known as slug tests) were performed in 11 of the tidal area monitoring wells during November 1991 as a part of the SI. Because the initial interpretation of the data did not closely match the curves presented in the SI report, the well recharge data was reinterpreted using both the software program AQTESOLV and the method of Hvorslev (Hvorslev 1951). Reinterpreted hydraulic conductivities are presented below:

Well	Hydraulic Conductivity (cm/sec)	
	AQTESOLV	Hvorslev
FTW-3	4.18×10^{-6}	5.00×10^{-6}
FTW-5	6.49×10^{-5}	7.58×10^{-5}
RDW-1	3.78×10^{-6}	4.57×10^{-6}
RDW-4	2.24×10^{-6}	2.82×10^{-6}
RDW-5	1.17×10^{-6}	1.35×10^{-6}
TLW-1	1.60×10^{-5}	1.95×10^{-5}

Well	Hydraulic Conductivity (cm/sec)	
	AQTESOLV	Hvorslev
TLW-3	1.25×10^{-5}	1.58×10^{-5}
TLW-5	6.66×10^{-5}	8.00×10^{-5}
WHW-1	2.65×10^{-5}	3.24×10^{-5}
WHW-2	4.26×10^{-6}	5.12×10^{-6}
WHW-4	7.13×10^{-6}	8.09×10^{-6}
Geometric mean	**8.93×10^{-6}**	**1.07×10^{-5}**

Site-specific measurements of effective porosity are not available for the tidal area sites; therefore, reasonable values were assumed based on ranges reported in the literature. Effective porosity was approximated by using specific yield values because specific yield values are more representative of interconnected porosity in fine-grained materials than bulk porosity values (Todd 1980). Todd (1980) reports specific yields of 0.08 for silt and 0.03 for clay; therefore, an intermediate value of 0.06 was assumed to be the effective porosity of the Bay Mud that underlies the tidal area sites. The steepest site hydraulic gradients were 0.008 in June 1997, 0.011 in October 1997, and 0.012 in January 1998.

Using the geometric mean conductivity calculated by AQTESOLV (8.93×10^{-6} cm/sec) and other values listed above, seepage velocities ranging from approximately 0.12 to 0.19 cm/day (1.5 to 2.2 feet/year) were estimated for the tidal area sites. These velocities do not account for retardation or dispersion; therefore, the velocities listed above should be considered the upper range of potential analyte transport rates.

4.2.2 Tidal Influence

A tidal influence study conducted as part of the RI showed that groundwater levels in wells closest to Otter Sluice fluctuate in response to tidal variations in Otter Sluice (PRC 1997a). Water levels in eight monitoring wells (RDW-2, RDW-3, RDW-4, RDW-5, WHW-2, WHW-3, FTW-3, and TLW-2) were monitored for 1 week and compared to water levels in Otter Sluice. Water levels in the wells nearest Otter Sluice (RDW-2, RDW-3, and WHW-3) varied by as much as 1 foot in response to tidal perturbations of 2.5 feet in nearby surface water. The wells that exhibited a tidal response were located within about 90 feet of Otter Sluice, but one of the wells that did not exhibit a tidal response (RDW-4) is located about 60 feet from the Otter Sluice, suggesting that local lithology exerts an influence on tidal response.

It is important to note that reversals of flow direction caused by tidal fluctuations in Otter Sluice have short duration and are localized in the area immediately adjacent to the sluice. Even if tidal fluctuations cause local flow reversals toward Otter Sluice, overall groundwater flow will still be directed towards the center of the R Area disposal site. The area where groundwater actually interacts with surface water during a tidal cycle appears to be limited to a narrow band adjacent to Otter Sluice. Groundwater in the vicinity of the landfill does not appear to be interconnected with surface water.

In October 1997, water level in well TLW-4 was monitored for 54 hours using a down-hole pressure transducer to determine whether the sandy fill material at that location is subjected to tidal influences. Water levels in the well did not vary over the monitoring period, indicating that the sandy fill material adjacent to the landfill is not subjected to tidal influence.

4.2.3 Preferential Flow Pathways

Historical aerial photographs of the tidal area sites show that portions of a slough that meandered through the tidal area sites and a manmade sluice were subsequently filled, creating possible preferential groundwater flow paths near the surface. The hand auger survey during this investigation established that coarse materials were used to fill the natural slough in some areas, but that the fill material is shallow and the water table is below the base of the fill material in all cases. Likewise, the seven borings drilled into the filled manmade sluice during this investigation established that the sluice has been partially filled with sand and silty sand, but that the water table is below the base of the fill materials. Consequently, the filled portions of the slough and sluice cannot act as preferential groundwater flow pathways.

The filled manmade sluice could conceivably act as a preferential flow pathway if the groundwater surface rises during the wet season and saturates the sandy fill material. Well TLW-5 is screened within the sandy fill material (see Figure 4 and cross section B-B') and can be used to assess concentrations of contaminants within the sandy fill during the wet season.

The sand and peat bodies shown on the geologic cross sections consist of coarser, more porous material than the Bay Mud. Although these bodies would be expected to act as preferential flow pathways, their function as flow pathways is limited by their restricted aerial extent. The peat body and all of the sand

lenses, except for the deeper sand body described above, were detected in only one or two wells. Consequently, these bodies can not function as flow pathways to allow contaminated groundwater to move significant distances. The deeper sand body could act as a preferential flow pathway because it is more laterally extensive than the other sand lenses and because it occurs within the saturated zone. As discussed in Section 4.2, however, the deeper sand body is not downgradient from the landfill or other tidal area sites.

5.0 CONFIRMATION SAMPLING ANALYTICAL RESULTS

This section presents and interprets the results of the October 1997 confirmation groundwater sampling. The primary objectives of the confirmation sampling were to:

- Verify existing metals data
- Confirm that groundwater is not contaminated with organic compounds
- Obtain data necessary to define postclosure groundwater monitoring parameters at the landfill
- Determine whether groundwater exhibits contamination by radionuclides
- Obtain data required to better understand hydrodynamic regime of the wetland area

To accomplish these objectives, monitoring wells were sampled for different groups of analytes as detailed in Table 2. All monitoring wells were sampled for metals, TDS, TSS, and stable isotopes of oxygen and hydrogen to verify existing metals data and to obtain hydrological data. The seven landfill monitoring wells were also sampled for a full range of analytes (VOCs, SVOCs, metals, pesticides, and PCBs) to define analytical parameters for ongoing monitoring of the landfill. Landfill well samples were not analyzed for TPH because the VOC and SVOC analyses provide sufficient information to characterize hydrocarbons. Hydrocarbon compounds, such as BTEX and PAHs, are included in the VOC and SVOC analyte lists. Wells RTW-5, RTW-6, and FTW-3 were sampled for pesticides, PCBs, and/or SVOCs because these analytes were detected in nearby surface soils (PRC 1997a). In addition, selected wells were sampled for radioisotopes to determine whether groundwater in the tidal area is contaminated by radiological sources.

In the following sections of the report, analytical results for the confirmation sampling are presented, discussed, and interpreted.

5.1 INORGANICS

Analytical data for metals, TDS, and TSS samples collected during the confirmation groundwater sampling event in October 1997 are presented in Table 3. The analytical results from the confirmation sampling are also presented alongside all historical data for each well in Appendix B.

One factor that motivated the confirmation sampling for metals in the tidal area was concern that sampling techniques used to collect the quarterly groundwater samples may not have yielded metals data that are truly representative of conditions in the subsurface. The quarterly metals samples were collected using traditional purging and filtering techniques, and the samples were filtered in the field with 0.45 micron filters (IT 1992). Recent EPA studies have shown that filtered samples may not be representative of the metals that are mobile under natural groundwater flow conditions and that low flow rate purging techniques can be used to obtain more accurate and representative groundwater samples for metals (Puls and Powell 1992). By using low flow rate purging techniques, the sampling process more closely matches natural groundwater flow conditions and transport of suspended solids, and analytical problems and uncertainties caused by turbidity are reduced.

The groundwater samples collected during this investigation were collected using low flow rate sampling techniques where possible. Nine of the 23 wells were sampled using low flow-rate techniques, as noted on Table 3. Recharge rates in the remaining 14 wells were too low to support low flow rate sampling. Recharge rates in these 14 wells did not meet the lowest pumping rate recommended by EPA (0.1 L/min) (EPA 1996). As discussed in Section 3.5, these wells were purged dry, allowed to recharge, and sampled the following day. Suspended solids in these wells were allowed to settle out of the water column naturally. None of the samples collected for metals analysis were filtered.

The turbidity, TDS, and TSS data presented in Table 3 demonstrate that both sampling techniques were able to successfully reduce the amount of solids present in the samples. With the exception of samples from three wells (TLW-1, WHW-3, and FTW-2), all of the samples had turbidities lower than 25 NTU. All but four wells (TLW-1, TLW-2, RDW-2, and RDW-3) had suspended solids concentrations below 100 mg/L. Turbidities and suspended solids concentrations are roughly comparable between the wells sampled using the natural settling technique and the low flow rate purging. Therefore, the different sampling techniques used in the confirmation sampling are not expected to have an influence on reported metals concentrations.

Data quality for inorganics was assessed by calculating relative percent differences (RPD) for duplicate samples and comparing to predetermined limits set forth in the QAPP (PRC 1995b). RPDs calculated for the three duplicate samples collected during this investigation are presented in Table 4. RPDs for most metals were within the data quality objective of 20 percent that is specified in the QAPP (PRC 1995b), indicating that the data was generally of acceptable quality. However, RPDs in one of the three samples (RDW-1) exceeded the data quality objective for 8 out of 26 analytes. Several of the exceedances can be attributed to numerical artifacts associated with analytical results at concentrations near the detection limit. Others, such as those for arsenic, iron, and vanadium, cannot be attributed to numerical artifacts, and instead appear to be related to analytical difficulties caused by high TDS concentrations. High dissolved solids concentrations can interfere with the analytical techniques used to quantify metals concentrations. As a result, the error bars associated with this data set may be higher than for comparable data sets in areas with less saline groundwater conditions.

Comparison of the October 1997 confirmation sampling data with the data obtained in previous investigations fails to reveal any systematic differences between the two data sets, except for cobalt, as noted below. There is some variability between the October 1997 data and previous sampling events, but the variations typically fall within the ranges of seasonal or natural variation indicated by the quarterly sampling. Because there are few systematic differences between the historical data and the data collected more recently using more refined sampling techniques, it is evident that the quarterly data does not misrepresent natural groundwater conditions in the subsurface. Both the quarterly data from 1990/1991 and the more recent confirmation sampling data appear to be accurate and representative. The comparability of the data sets from 1990/1991 and 1997 indicates that conditions in the subsurface are somewhat static and that metals concentrations have no long-term trend.

Cobalt was detected at lower concentrations and in fewer wells during the confirmation sampling than during previous sampling events. The significance of this single systematic difference between the two data sets is unclear.

The TDS distribution map (Figure 16) shows that TDS is generally quite high in the tidal area sites. TDS concentrations in each well exceed 3,000 mg/L, and exceed that of sea water (35,000 mg/L) over much of the area. Because TDS concentrations exceed 3,000 mg/L in each of the wells, groundwater in the tidal area sites is not considered potable (California Regional Water Quality Control Board 1995). TDS

concentrations are generally high in the R Area disposal site and are lowest at the upgradient edge of the landfill.

Because both precipitation and local surface water are expected to have low concentrations of dissolved solids, the hypersaline groundwater conditions provide evidence that evaporative concentration is an important process occurring in the tidal area. The hydrodynamics of the tidal area appears to be dominated by overland flow of brackish surface water from Otter Sluice during winter storm-related tidal extremes, entrapment of the surface water by road berms and other surface features, and evaporative concentration of salts, resulting in high salinity groundwater. The progressive accumulation of salts in the groundwater also provides evidence that groundwater does not discharge to surface water. If groundwater discharged continuously from the tidal area sites to Suisun Bay, salts would continually discharge along with the groundwater rather than accumulating. In effect, salts appear to be impounded in groundwater beneath the low parts of the tidal area by evaporative processes and phreatophytic pumping.

Maps showing the geographic distribution of selected metals in groundwater are presented as Figures 17 through 21. Concentration maps were prepared for metals that exceeded the lower of the marine chronic or freshwater chronic ambient water quality criteria (AWQC) (EPA 1992) in at least one well. Maps were not constructed for copper or silver because these compounds were detected at low estimated concentrations in only a few wells. AWQC have not been selected as appropriate regulatory limits for NWS Concord groundwater. Rather they have been used as preliminary screening criteria to select metals that could conceivably pose a risk to marine aquatic organisms. As noted in Section 4.2, the overall groundwater flow directions during both wet and dry seasons appear to be directed radially towards the center of the R Area disposal site. Groundwater discharge to Suisun Bay either through direct subsurface discharge or through discharge from Otter Sluice is expected to be an insignificant component of overall discharge.

The geographic distribution of metals in groundwater varies from metal to metal, but is generally characterized by isolated hot spots. Metals concentrations were generally highest in the center of the R Area disposal site and the north central part of the wood hogger site, but it is important to note that each metal was also detected at relatively high concentrations in at least one of the upgradient wells along Taylor or Johnson Roads. For example, the second highest arsenic concentration was detected in well FTW-4, and the highest concentration of nickel was detected in TLW-5. This distribution suggests that

metals are concentrated in the R Area disposal site by evaporative processes, but that local geochemical and hydrogeologic conditions are also significant. The metals concentrations maps may also be affected by the analytical difficulties associated with analyzing water with high dissolved solids contents, as discussed previously. The metals distribution maps do not show evident plumes of metals-contaminated groundwater emanating from the tidal area sites.

5.2 ORGANIC COMPOUNDS

Ten of the monitoring wells were sampled for organic compounds in October 1997. These wells included the seven landfill monitoring wells and three wells (FTW-3, RDW-5, and RDW-6) where SVOCs, pesticides, or PCBs were detected in nearby soils. Analytical results from the confirmation sampling are presented in Table 5. The analytical results from the confirmation sampling are also presented alongside all historical data for each well in Appendix B.

Analytical results presented in Table 5 indicate that tidal area groundwater is not affected to any significant extent by organic compounds. The common laboratory contaminants bis (2-ethylhexyl) phthalate and 2-butanone were detected in two samples, and carbon disulfide was detected at trace concentrations in three of the landfill monitoring wells. Carbon disulfide occurs naturally in marshy environments (U.S. Department of Health and Human Services 1995), so it is unlikely that the trace amounts of carbon disulfide represent contamination by anthropogenic sources. Phenanthrene and 4-methyl-2-pentanone were detected at estimated trace concentrations of 1 mg/L in one well each.

The analytical results for the most recent sampling event are consistent with earlier sampling events. Historical analytical data presented in Appendix B indicate that organic compounds other than carbon disulfide were not detected consistently in any of the tidal area monitoring wells. The lack of organic contamination of groundwater has been confirmed by the quarterly groundwater sampling in 1990/1991 (see Section 2.6.1), the limited confirmation study in 1993 (see Section 2.6.2), and by the confirmation study discussed in this report. Groundwater in the tidal area is not affected to any significant extent by organic compounds.

5.3 STABLE ISOTOPES

Natural waters are known to have distinctive compositions of stable isotopes of oxygen (^{16}O and ^{18}O) and hydrogen (^{1}H and D [^{2}H, also known as deuterium]) that can be used as isotopic signatures to differentiate waters from different sources (Mazor 1987). To further characterize the groundwater in the tidal area and to better understand the hydrodynamic setting of the site, groundwater and surface water samples were collected and analyzed for stable isotopes of oxygen and hydrogen. Stable isotope samples were collected from each of the monitoring wells and from two surface water locations: the inlet to Otter Sluice on the Suisun Bay side of the tide gate and from Otter Sluice midway along the western border of the R Area disposal site (Figure 5). Analytical results are presented in Table 6 and are illustrated graphically in Figure 22.

Data quality for stable isotope samples was assessed by calculating RPDs for duplicate samples and comparing them to the data quality objective of 20 percent set forth in the confirmation study work plan (TtEMI 1997). RPDs calculated for the three duplicate samples collected during this investigation are presented in Table 7. RPDs for the stable isotope samples were well within the data quality objective of 20 percent, indicating that the data is of superior quality.

Figure 22 shows analytical results for all of the isotope samples collected during this investigation. Isotopic data are shown in delta (δ) notation, expressing difference between the ratios of the stable isotopes of oxygen and hydrogen ($^{18}O/^{16}O$ or $D/^{1}H$) for the sample and corresponding ratios for sea water in parts per thousand ($^{o}/_{oo}$). The diagonal line on the diagram is the meteoric water line, which shows expected isotope ratios for precipitation. According to Mazor (1987), $\delta^{18}O$ and δD values vary in precipitation (meteoric water) but maintain a more or less constant ratio; therefore, water that falls as precipitation is expected to plot on the diagonal line shown on the figure. Isotopic values that plot to the right of the meteoric line signify water that has been partially evaporated, because ^{1}H is preferentially lost during evaporation, and the remaining water is enriched in deuterium (Williams and Rodoni 1997).

The surface water locations were sampled at both low and high tides to ascertain the degree to which isotopic composition is linked with tidal stage. The isotopic composition of the surface water samples follows an expected pattern. At the sluice inlet, the isotopic composition became closer to that of sea water at high tide and moved farther from sea water at low tide. This behavior reflects the relative abundance of sea water at that location during high and low tides; at high tide, surface water is expected

to be more brackish because of the influence of sea water traveling up the delta. At low tide, Sacramento River water flushes the brackish water downstream, and the isotopic composition at the tidal inlet becomes more like that of the Sacramento River. Within Otter Sluice, the isotopic composition follows the same pattern, but varies within a smaller range. The restricted range of isotopic compositions in Otter Sluice reflects the fact that Otter Sluice never empties completely, and surface water entering Otter Sluice at high tide is mixed with water already resident in the sluice.

The isotopic composition of groundwater was similar to that of surface water, supporting the idea that surface water recharges groundwater in the tidal area. Both sets of data plot to the right of the meteoric line, indicating that both groundwater and surface water have been evaporated. The groundwater data varies over a wider range, and many of the groundwater samples plot farther to the right of the meteoric line than the surface water, indicating that groundwater in these areas has been subjected to more evaporation than surface water. Some of the groundwater samples plot to the left of the surface water samples (closer to the meteoric line), suggesting that infiltration of precipitation also recharges groundwater in parts of the tidal area.

The geographic variation of oxygen and hydrogen isotopes is illustrated in Figures 23 and 24. The isotope distribution maps show a general trend of increasing (less negative) $\delta^{18}O$ and δD values to the northeast and relatively high values in the southwest corner of the wood hogger site. The groundwater samples with the highest (least negative) deuterium concentrations (TLW-3, WHW-1, WHW-4, and RDW-7) coincide with areas of high TDS concentrations (see Figure 16), indicating that evaporative concentration in these areas has caused high dissolved solids concentrations and excess deuterium. Groundwater with isotopic composition most similar to precipitation ($\delta^{18}O$ less than -8 $^{o}/_{oo}$) occurs in the southwestern corner of the R Area disposal site and the western half of the Froid and Taylor Roads site, suggesting that infiltration of precipitation is a significant source of groundwater recharge in these areas.

In summary, the stable isotope data show that tidal area groundwater has been subjected to evaporation and that precipitation is a source of groundwater recharge in some parts of the tidal area. Groundwater and surface water share a common isotopic composition, supporting the hypothesis that groundwater is derived primarily from recharge by surface water.

5.4 RADIONUCLIDES

Cobalt was consistently detected in groundwater in several wells in the wood hogger site at concentrations up to 133 mg/L during the 1990/1991 quarterly sampling, and was detected at lower levels (up to 30.7 mg/L) during the confirmation sampling. Detection of cobalt at these concentrations is unusual, and because some isotopes of cobalt are radioactive, additional testing was suggested to resolve this potential concern. To determine whether the cobalt represents a potential radioisotope contamination problem, groundwater samples from four wells where cobalt was detected were analyzed using gamma spectroscopy techniques. Samples from Suisun Bay and from five other wells where cobalt was not detected were also analyzed to evaluate ambient concentrations of gamma emitting radionuclides in groundwater and surface water at the site. Radioisotope data collected during this investigation is presented in Table 8, and laboratory data reports are included as Appendix F.

Samples were not analyzed for gross alpha or gross beta radioactivity because the high dissolved solids in the groundwater were expected to interfere with the analytical procedures and because those methods are not specific to cobalt. When samples are evaporated for alpha analysis, dissolved solids are expected to form a crust that will impede the movement of alpha particles. For beta analysis, the high potassium concentrations are expected to create elevated levels of naturally occurring beta radiation that will dominate beta emissions from other radioisotopes. Potassium concentrations in site groundwater generally range from 50 to 500 mg/kg.

Because gamma spectroscopy results are often difficult to distinguish from background, a relative error ratio (RER) approach described by the International Organization of Standardization (1995) was used to assess data quality for the radioisotope analyses. RERs for the matrix duplicate sample from well RDW-4 were well below 2.0, indicating that the radioisotope data is of acceptable quality.

Cobalt-60 (^{60}Co), the radioactive isotope of cobalt, was not detected in any of the samples at a detection limit of 5 picoCuries per liter (pCi/L); therefore, the cobalt detected in the groundwater does not appear to result from nuclear-related activities. Other radionuclides were detected at low concentrations in both the samples and the method blank. Most of these compounds were detected at concentrations very close to the method detection limit and at comparable concentrations to the method blank; therefore, these detections are not considered significant and may be only an artifact of the analytical method. Several

isotopes related to fallout from atmospheric nuclear testing (cerium-141 and cesium-137) were also detected at low concentrations.

Potassium-40 (^{40}K) and radium-226 (^{226}Ra) were detected in each of the wells at concentrations of more than 100 pCi/L. These compounds occur naturally in sea water and were detected in the background sample from Suisun Bay. The concentrations in groundwater were higher than in Suisun Bay and appear to be another expression of the evaporative concentration process that is active in the tidal area sites. Evaporative concentration appears to have caused both hypersaline groundwater conditions and deuterium enrichment. Maps showing the distribution of these isotopes are included as Figures 25 and 26. The distribution of the isotopes in groundwater does not indicate a plume of contamination emanating from the landfill or from other site sources.

Radium-224 (^{224}Ra) was detected in each of the monitoring wells, but not in the sample from Suisun Bay. ^{224}Ra occurs naturally in sea water as a decay product of thorium (Shleien and others 1998), and is probably present at low concentrations in Suisun Bay. Concentrations of both ^{40}K and ^{226}Ra were higher in groundwater than in the sample from Suisun Bay. Because the concentrations of ^{224}Ra detected in groundwater were generally close to the method detection limit, it is likely that ^{224}Ra was present at a lower concentration in the sample from Suisun Bay, but was not detected because the level was below the detection limit. The distribution of ^{224}Ra in groundwater (Figure 27) does not indicate a plume of contamination emanating from the landfill or from other site sources.

In summary, groundwater in the tidal area sites does not appear to be contaminated by radioactive isotopes. Groundwater samples were subjected to testing by gamma spectroscopy to determine whether the cobalt detected in the quarterly sampling represented a possible radioactive contamination problem. Radioactive isotopes of cobalt were not detected in the samples. The radioisotopes ^{40}K, ^{224}Ra, and ^{226}Ra were detected in each of the groundwater samples and are ubiquitous in normal sea water. As these radioisotopes occur naturally and the distribution of the isotopes in groundwater does not indicate a plume of contamination emanating from the landfill or from other site sources, they will not be considered further. Traces of several fallout-related isotopes were also detected at low concentrations.

6.0 RESULTS AND RECOMMENDATIONS

Based on the confirmation groundwater sampling discussed in this technical memorandum, the objectives regarding groundwater in the tidal area of the investigation were satisfied as follows:

Objective 1: ***Confirm existing analytical results regarding concentrations of metals and organic compounds in tidal area groundwater.***

Results:

- Comparison of the October 1997 confirmation sampling data with the data obtained in previous investigations fails to reveal systematic differences between the two data sets. Because there are few systematic differences between the historical data and the data collected more recently using more refined sampling techniques, it is evident that the quarterly data do not misrepresent natural groundwater conditions in the subsurface. Both the quarterly data from 1990/1991 and the more recent confirmation sampling data appear to be accurate and representative.

- The geographic distribution of metals in groundwater varies from metal to metal, and is generally characterized by isolated hot spots. Metals concentrations were generally highest in the center of the R Area disposal site and the north central part of the wood hogger site, but it is important to note that each metal was also detected at relatively high concentrations in at least one of the upgradient wells along Taylor or Johnson Roads. This distribution suggests that although metals are concentrated in the R Area disposal site by evaporative processes, local geochemical and hydrogeologic conditions are also significant. The metals distribution maps do not show evident plumes of metals-contaminated groundwater emanating from the tidal area sites.

- Groundwater in the tidal area is not affected to any significant extent by organic compounds. The analytical results for the most recent sampling event are consistent with previous sampling events. The lack of organic contamination of groundwater has been confirmed by the quarterly groundwater sampling in 1990/1991, the limited confirmation study in 1993, and by the confirmation study discussed in this technical memorandum.

Recommendation:

- Because groundwater conditions have been adequately defined by the quarterly sampling, the limited confirmation sampling, and the confirmation sampling discussed in this technical memorandum, no further groundwater sampling is recommended to characterize groundwater at the tidal area sites.

Objective 2: ***Obtain data to define postclosure groundwater monitoring parameters at the landfill for the presumptive remedy of closure by capping.***

Results:

- Repeated sampling has shown that metals are the only contaminants of potential concern that are present in groundwater around the tidal area landfill. Variations in metals concentrations may be related to variations in TDS and TSS concentrations across the landfill.

Recommendation:

- Under California postclosure monitoring requirements (California Code of Regulations Section 2550.8 [e]), the owner must propose a list of monitoring parameters for ongoing postclosure monitoring. The Navy proposes to sample the landfill wells only for metals, TDS, and TSS during postclosure monitoring of the landfill.

Objective 3: ***Determine whether groundwater exhibits contamination by radionuclides.***

Results:

- Groundwater in the tidal area sites does not appear to be contaminated by radioactive isotopes. Groundwater samples were subjected to testing by gamma spectroscopy to determine whether the cobalt detected in the quarterly sampling represented a possible radioactive contamination problem. Radioactive isotopes of cobalt were not detected in the samples.

- The radioisotopes ^{40}K, ^{224}Ra, and ^{226}Ra were detected in each of the groundwater samples and are ubiquitous in normal sea water. These radioisotopes occur naturally and the distribution of the isotopes in groundwater does not indicate a plume of contamination emanating from the landfill or from other site sources. Traces of several fallout-related isotopes were also detected at low concentrations.

Recommendation:

- Because the radioisotopes present in groundwater at the tidal area sites occur naturally and their distribution does not indicate a plume of contamination, radioisotopes in groundwater at the tidal area sites should not be considered further.

Objective 4: ***Better define the geologic conditions in the area east of the tidal area landfill.***

Results:

- A confined sand body is present in the area east of the landfill. The sand body occurs about 16 feet below grade, is about 3.5 feet thick in piezometers PZ-3 and PZ-4, and appears to pinch out to the west in the vicinity of the landfill. Groundwater flows to the northwest within the sand body, and was not sampled during this investigation because the sand body is not downgradient from the landfill.

- Portions of a natural slough and a manmade sluice were filled with coarse-grained fill material, creating the potential for preferential flow pathways. Filled portions of the slough and sluice were examined during this investigation. In all cases, the fill material did not extend below the water table; therefore, the filled slough and sluice do not appear to act as preferential flow pathways.

- The shallow geologic units overlie a thick sequence of alluvial clays and silts and an estuarine sand aquifer that occur beneath the entire tidal area. This aquifer is separated from the landfill by a 40- to 60-foot-thick alluvial silt and clay sequence and an additional 10 to 15 feet of Bay Mud. The thick sequence of silt and clay is expected to effectively isolate the estuarine sand aquifer from the landfill.

Recommendation:

- Groundwater in the 16- to 20-foot-deep sand lens at the eastern margin of the landfill flows to the northwest during both wet and dry seasons and is not downgradient from the landfill or other tidal area sites. Sampling groundwater from this unit is not recommended.

Objective 5: Obtain data to better understand the hydrodynamic regime of the wetlands.

Results:

- The hydrodynamics of the tidal area appears to be dominated by overland flow of brackish surface water from Otter Sluice during winter storm-related tidal extremes; entrapment of the surface water by road berms and other surface features; evaporative concentration of salts, deuterium, and ^{18}O; and recharge of surface water to groundwater.

- Groundwater flows predominantly toward the center of the R Area disposal site during both the dry and wet seasons, where it appears to discharge directly to the atmosphere through phreatophytic pumping. Groundwater elevations below mean sea level are common in the R Area disposal site and the wood hogger site during the dry season, indicating that groundwater does not discharge to Otter Sluice or to Suisun Bay through subsurface discharge to any significant extent.

- Groundwater flow rates in the tidal area sites are extremely slow; flow velocities up to 2.2 feet per year were estimated from site-specific hydraulic parameters.

- Reversals of flow direction caused by tidal fluctuations in Otter Sluice are localized in the area immediately adjacent to the sluice. The area where groundwater actually interacts with surface water during a tidal cycle appears to be limited to a narrow band adjacent to Otter Sluice. Groundwater in the vicinity of the landfill is not affected by tidal fluctuations in Otter Sluice.

- Groundwater flows to the west or southwest across the landfill during both the wet and dry seasons. There is no evidence of groundwater mounding beneath the landfill.

- TDS concentrations are generally quite high in the tidal area sites. TDS concentrations in each well exceed 3,000 mg/L and exceed that of sea water (35,000 mg/L) over much of the tidal area.

Because TDS concentrations exceed 3,000 mg/L in each of the wells, groundwater in the tidal area sites is not considered potable. TDS concentrations are generally high in the R Area disposal site and are lowest at the upgradient edge of the landfill. The hypersaline groundwater conditions provide evidence that evaporative concentration is an important process occurring in the tidal area. In effect, salts appear to be impounded in groundwater beneath the low parts of the tidal area by evaporative processes and phreatophytic pumping.

- The stable isotope data show that tidal area groundwater has been subjected to evaporation and that precipitation is a source of groundwater recharge in some parts of the tidal area. Groundwater and surface water share a common isotopic composition, supporting the hypothesis that groundwater is derived primarily from recharge by surface water.

Recommendations:

- Groundwater flow in the shallow water-bearing zone in the area east of the landfill has not been assessed during the dry season because piezometer PZ-3 did not fully recover from well development when water levels were measured in mid-October 1997. Water levels in this piezometer and in the landfill wells should be measured during the summer to verify that groundwater mounding does not occur beneath the landfill during the dry season.

- Because tidal influence has been measured in several wells near Otter Sluice, limited exchange of groundwater and surface water occurs in a narrow zone adjacent to the sluice. In addition, the wet season potentiometric surface could be interpreted to allow some discharge of groundwater to Otter Sluice in the southwest corner of the R Area disposal site during low tides in the wet season. To verify that metals in the groundwater are not affecting the quality of surface water in Otter Sluice, the Navy should consider annual or semiannual monitoring of surface water in the sluice.

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TABLE 1

GROUNDWATER ELEVATIONS IN TIDAL AREA WELLS

NWS CONCORD TIDAL AREA

Well ID	Top of Casing Elevation	Measured Depth to Water 6/11/97	Measured Depth to Water 10/3/97	Measured Depth to Water 1/28/98	Groundwater Elevation 6/11/97	Groundwater Elevation 10/3/97	Groundwater Elevation 1/28/98
TLW-1	3.05	3.67	5.45	0.66	-0.62	-2.40	2.39
TLW-2	3.12	3.51	4.40	1.12	-0.39	-1.28	2.00
TLW-3	3.93	5.02	5.76	1.57	-1.09	-1.83	2.36
TLW-4	10.18	8.61	9.31	6.64	1.57	0.87	3.54
TLW-5	8.74	7.25	7.90	5.38	1.49	0.84	3.36
TLW-6	9.08	9.30	9.47	5.99	-0.22	-0.39	3.09
TLW-7	2.98	3.66	5.35	0.50	-0.68	-2.37	2.48
FTW-1	4.32	3.89	4.09	1.61	0.43	0.23	2.71
FTW-2	5.35	6.30	6.50	5.17	-0.95	-1.15	0.18
FTW-3	5.35	3.89	5.99	2.15	1.46	-0.64	3.20
FTW-4	6.17	5.46	5.57	3.41	0.71	0.60	2.76
FTW-5	3.69	2.67	3.04	0.93	1.02	0.65	2.76
RDW-1	6.57	7.09	7.46	4.31	-0.52	-0.89	2.26
RDW-2	5.54	5.04	4.90	4.41	0.50	0.64	1.13
RDW-3	4.28	3.18	3.18	1.05	1.10	1.10	3.23
RDW-4	10.22	8.93	8.94	6.95	1.29	1.28	3.27
RDW-5	8.57	9.30	12.19	6.15	-0.73	-3.62	2.42
RDW-6	3.40	3.60	4.89	1.50	-0.20	-1.49	1.90
RDW-7	3.15	3.68	4.76	1.05	-0.53	-1.61	2.10
WHW-1	6.36	5.28	5.61	4.40	1.08	0.75	1.96
WHW-2	4.92	5.02	5.49	2.90	-0.10	-0.57	2.02
WHW-3	4.40	2.73	--	1.38	1.67	--	3.02
WHW-4	3.08	1.59	1.69	0.54	1.49	1.39	2.54
RD-PZ1	4.01	4.35	5.31	1.66	-0.34	-1.30	2.35
RD-PZ2	4.37	6.15	7.71	1.64	-1.78	-3.34	2.73
PZ-3	10.77	--	12.43 [a]	7.80	--	-1.66 [a]	2.97
PZ-4	10.45	--	9.54 [a]	7.07	--	0.91 [a]	3.38
PZ-5	10.07	--	16.14 [b]	3.70	--	-6.07 [b]	6.37
PZ-6	10.67	--	11.64 [a]	7.32	--	-0.97 [a]	3.35
A3AMW002	9.4 [c]	--	--	4.52	--	--	4.9
A3AMW003	9.9 [c]	--	--	5.25	--	--	4.7
E11MW001	10.70	--	--	1.94	--	--	8.76
E11MW003	10.14	--	--	7.52	--	--	2.62

Notes:

All elevations are reported in feet with respect to mean sea level

All depths to water are reported in feet below top of casing

-- = not measured

[a] Water levels measured on 10/15/97; levels had not fully recovered from well development

[b] Water level in PZ-5 still rising on 10/15/97; level not fully recovered from well development

[c] Top of casing elevations for A3A wells are estimated from ground surface elevations

TABLE 2

ANALYTICAL PARAMETERS FOR OCTOBER 1997 CONFIRMATION SAMPLING

NWS CONCORD TIDAL AREA

WELL ID	Metals	VOCs	SVOCs	Pesticides/ PCBs	TDS	TSS	Stable Isotopes	Gamma Spectroscopy	Comments
TLW-1	✓	✓	✓	✓	✓	✓	✓		
TLW-2	✓	✓	✓	✓	✓	✓	✓	✓	
TLW-3	✓	✓	✓	✓	✓	✓	✓		
TLW-4	✓	✓	✓	✓	✓	✓	✓	✓	
TLW-5	✓	✓	✓	✓	✓	✓	✓		
TLW-6	✓	✓	✓	✓	✓	✓	✓		
TLW-7	✓	✓	✓	✓	✓	✓	✓		
FTW-1	✓				✓	✓	✓	✓	Cobalt consistently detected in groundwater
FTW-2	✓				✓	✓	✓		
FTW-3	✓		✓	✓	✓	✓	✓		SVOCs and PCBs detected in nearby soils
FTW-4	✓				✓	✓	✓	✓	
FTW-5	✓				✓	✓	✓		
RDW-1	✓				✓	✓	✓	✓	
RDW-2	✓				✓	✓	✓		
RDW-3	✓				✓	✓	✓	✓	
RDW-4	✓				✓	✓	✓	✓	Cobalt consistently detected in groundwater
RDW-5	✓			✓	✓	✓	✓		PCBs detected in nearby soils
RDW-6	✓			✓	✓	✓	✓		PCBs detected in nearby soils
RDW-7	✓				✓	✓	✓	✓	Cobalt consistently detected in groundwater
WHW-1	✓				✓	✓	✓	✓	Cobalt consistently detected in groundwater
WHW-2	✓				✓	✓	✓		
WHW-3	✓				✓	✓	✓		
WHW-4	✓				✓	✓	✓		
Sluice Inlet					✓	✓	✓		Sampled at low and high tide
Otter Sluice					✓	✓	✓		Sampled at low and high tide
Suisun Bay								✓	

Notes:
VOC = Volatile organic compounds
SVOC = Semivolatile organic compounds
PCB = Polychlorinated biphenyls
TSS = Total suspended solids
TDS = Total dissolved solids

TABLE 3

CONFIRMATION SAMPLING ANALYTICAL RESULTS FOR INORGANICS

NWS CONCORD TIDAL AREA

Well ID	AWQC	TLW-1	TLW-2	TLW-3	TLW-4	TLW-5	TLW-5 Dup.	TLW-6	TLW-7
Sampling Method			low flow rate		low flow rate	low flow rate	low flow rate		
Metals (µg/L)									
Aluminum		--	427	--	86.5	--	--	--	--
Antimony		--	--	--	--	--	--	--	--
Arsenic	36 (190)	29.8	83.5	--	23.8	6.1 J	4.2 J	12.7 J	14.4
Barium		267	275	52.4 J	13.3 J	110 J	112 J	565	189 J
Beryllium	(5.3)	0.97 J	--	0.97 J	1.2 J	--	--	--	--
Cadmium	9.3 (1.1)	--	--	--	--	--	--	--	--
Calcium		665,000	247,000	557,000	9,310	49,100	50,100	313,000	184,000
Chromium	50 (11)	19.7	--	--	20.7	--	4.7 J	--	--
Cobalt		--	--	--	--	--	--	--	--
Copper	2.9 (12)	--	--	--	8.9 J	--	--	--	--
Iron	(1000)	5,480	415	1,960	227	957	1,010	3,240	839
Lead	8.5 (3.2)	--	--	--	--	--	--	--	--
Magnesium		1,750,000	1,320,000	2,680,000	29,000	90,600	91,700	426,000	462,000
Manganese		10,300	155	2,620	21.7	639	650	3,600	89.5 J
Mercury	0.025 (0.012)	--	--	--	--	0.2 J	0.16 J	--	--
Molybdenum		76	49 J	118	118	71.5	65.6	44 J	50.9
Nickel	8.3 (160)	156	--	147	30.9 J	287	292	55.2	--
Potassium		247,000	223,000	442,000	39,400	47,900	48,200	71,000	103,000
Selenium	71 (5)	--	--	--	--	--	--	--	--
Silver	(0.12)	--	--	--	--	--	--	--	--
Sodium		8,550,000	8,400,000	15,600,000	1,470,000	1,850,000	1,850,000	2,360,000	3,230,000
Thallium		--	1.8 J	--	--	1.7 J	--	--	--
Vanadium		54.3	--	--	50.7	--	6.9 J	--	68.9 J
Zinc	86 (110)	--	--	--	--	--	--	39.2	--
Solids (mg/L)									
Total dissolved solids		34,100	31,400	61,000	3,930	5,580	5,480	9,790	11,800
Total suspended solids		226	155	--	--	--	--	--	--
Turbidity (NTU)		54	15.4	5.3	0.7	13	13	17	3

Notes:

-- = Not detected

J = Estimated concentration

µg/L = Micrograms per liter

mg/L = Milligrams per liter

AWQC = Ambient Water Quality Criteria, marine chronic (freshwater chronic values are shown in perenthesis).

Turbidity is reported in nephelometric turbidity units (NTU).

Samples collected in October 1997.

TABLE 3 (Continued)

CONFIRMATION SAMPLING ANALYTICAL RESULTS FOR INORGANICS

NWS CONCORD TIDAL AREA

Well ID	RDW-1	RDW-1 Dup.	RDW-2	RDW-3	RDW-4	RDW-5	RDW-6	RDW-7
Sampling Method				low flow rate				low flow rate
Metals (µg/L)								
Aluminum	--	--	200	807	--	104	94.6	350
Antimony	8.2	6.3	--	--	--	--	--	--
Arsenic	35.2	57	38.8	6.4 J	14.4 J	65	32.8	7.6 J
Barium	399	495	642	306	78.9 J	1,010	170 J	121 J
Beryllium	1.2 J	0.73 J	1.2 J	--	--	--	--	--
Cadmium	--	--	--	--	--	--	--	--
Calcium	189,000	185,000	464,000	245,000	196,000	876,000	285,000	732,000
Chromium	--	--	5.3 J	--	53.4	8.4 J	14.5 J	43.6
Cobalt	--	--	--	--	--	--	--	16.1 J
Copper	--	--	--	--	--	--	--	--
Iron	2,110	4,470	1,150	36,200	4,300	5,190	2,230	7,050
Lead	--	--	--	--	--	--	--	--
Magnesium	478,000	465,000	1,470,000	459,000	321,000	1,520,000	758,000	2,740,000
Manganese	1,150	1,470	209	3,010	520	10,600	1,320	16,000
Mercury	--	--	--	--	--	--	--	--
Molybdenum	33.5 J	30.9 J	56.8 J	68.9	14.4 J	72.5	55.7	88.8
Nickel	45	41.6	--	--	91.8	19 J	59	69.8
Potassium	137,000	123,000	184,000	98,000	113,000	48,600	159,000	425,000
Selenium	--	--	--	--	--	3.6 J	--	4.4 J
Silver	--	--	--	2.1 J	1.4 J	--	--	--
Sodium	2,740,000	2,810,000	7,880,000	2,980,000	2,920,000	4,510,000	4,060,000	14,100,000
Thallium	--	--	--	--	2 J	--	--	--
Vanadium	115	83.8	42 J	14.2 J	7.5 J	26.2 J	36.5 J	--
Zinc	--	68	--	14.4 J	12 J	10.5 J	19.6 J	47
Solids (mg/L)								
Total dissolved solids	9,600	9,470	27,300	12,500	11,300	25,200	17,700	65,600
Total suspended solids	67	58	163	158	--	9	--	32
Turbidity (NTU)	7.9	7.9	18	16	1.9	0.5	19	41

Notes:

-- = Not detected

J = Estimated concentration

µg/L = Micrograms per liter

mg/L = Milligrams per liter

AWQC = Ambient Water Quality Criteria, marine chronic (freshwater chronic values are shown in perenthesis).

Turbidity is reported in nephelometric turbidity units (NTU).

Samples collected in October 1997.

TABLE 3 (Continued)

CONFIRMATION SAMPLING ANALYTICAL RESULTS FOR INORGANICS

NWS CONCORD TIDAL AREA

Well ID	WHW-1	WHW-2	WHW-3	WHW-4	FTW-1	FTW-1 Dup.	FTW-2	FTW-3	FTW-4	FTW-5
Sampling Method					low flow rate	low flow rate			low flow rate	low flow rate
Metals (µg/L)										
Aluminum	--	276	--	--	--	--	84.3	--	--	412
Antimony	--	--	--	--	--	--	--	--	--	--
Arsenic	14.9 J	42.5	23.7	31.7	11.2 J	15.3 J	25.7	24.5	76.4	3.3 J
Barium	397	992	2,740	1140	1,500	1,500	826	3370	264	2,370
Beryllium	--	--	--	--	--	0.61 J	0.73 J	0.97 J	--	--
Cadmium	--	--	--	--	--	--	--	--	--	--
Calcium	748,000	302,000	296,000	914,000	1,100,000	1,170,000	385,000	283,000	301,000	257,000
Chromium	--	--	--	93.9	--	--	--	--	--	39.6
Cobalt	--	10.6 J	--	--	30.1 J	30.7 J	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--	--
Iron	9,120	504	6,560	6,790	22,600	22,400	11,900	562	30,400	666
Lead	--	--	--	--	--	--	--	--	--	--
Magnesium	2,140,000	620,000	519,000	1,670,000	1,230,000	1,310,000	700,000	490,000	714,000	673,000
Manganese	6,580	3,950	5,680	7,060	16,400	16,500	4,910	449	459	--
Mercury	--	--	--	--	--	--	--	--	0.16 J	--
Molybdenum	80	62.1	46.5 J	67.8	69.1	90.4	62.8	22.1 J	60.2	--
Nickel	6.5 J	68.5	12.9 J	--	34.9 J	38.8 J	27.6 J	--	--	27.1 J
Potassium	160,000	112,000	65,100	170,000	16,100	16,800	126,000	107,000	131,000	120,000
Selenium	--	--	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--	--	2.4 J
Sodium	15,200,000	3,640,000	3,410,000	8,940,000	5,410,000	5,950,000	3,890,000	2,990,000	5,550,000	4,360,000
Thallium	--	--	--	--	--	--	--	--	--	1.6 J
Vanadium	25.6 J	61.4 J	13.2 J	33.4 J	--	9.3 J	44.6 J	16.3 J	--	11.7 J
Zinc	11.5 J	36.8	18.6 J	7.4 J	--	5.8 J	--	--	164	16.4 J
Solids (mg/L)										
Total dissolved solids	53,100	14,300	14,000	35,700	25,800	26,500	14,200	11,400	20,100	18,000
Total suspended solids	40	--	14	--	60	60	38	--	74	23
Turbidity (NTU)	21	22.5	26	16	2.5	2.5	46	1.2	0.1	0.5

Notes:

-- = Not detected

J = Estimated concentration

µg/L = Micrograms per liter

mg/L = Milligrams per liter

AWQC = Ambient Water Quality Criteria, marine chronic (freshwater chronic values are shown in perenthesis).

Turbidity is reported in nephelometric turbidity units (NTU).

Samples collected in October 1997.

TABLE 4

QUALITY CONTROL DATA: RELATIVE PERCENT DIFFERENCES FOR DUPLICATE SAMPLES
NWS CONCORD TIDAL AREA

Well ID	TLW-5		TLW-5 Dup.		Relative Percent	RDW-1		RDW-1 Dup.		Relative Percent	FTW-1		FTW-1 Dup.		Relative Percent
Sampling Method	low flow rate		low flow rate		Difference					Difference	low flow rate		low flow rate		Difference
Metals (µg/L)															
Aluminum	--		--			--		--			--		--		
Antimony	--		--			8.2		6.3		26.2%	--		--		
Arsenic	6.1	J	4.2	J	36.9%	35.2		57		47.3%	11.2	J	15.3	J	30.9%
Barium	110	J	112	J	1.8%	399		495		21.5%	1,500		1,500		0.0%
Beryllium	--		--			1.2	J	0.73	J	48.7%	--		0.61	J	N.C.
Cadmium	--		--			--		--			--		--		
Calcium	49,100		50,100		2.0%	189,000		185,000		2.1%	1,100,000		1,170,000		6.2%
Chromium	--		4.7	J	N.C.	--		--			--		--		
Cobalt	--		--			--		--			30.1	J	30.7	J	2.0%
Copper	--		--			--		--			--		--		
Iron	957		1,010		5.4%	2,110		4,470		71.7%	22,600		22,400		0.9%
Lead	--		--			--		--			--		--		
Magnesium	90,600		91,700		1.2%	478,000		465,000		2.8%	1,230,000		1,310,000		6.3%
Manganese	639		650		1.7%	1,150		1,470		24.4%	16,400		16,500		0.6%
Mercury	0.2	J	0.16	J	22.2%	--		--			--		--		
Molybdenum	71.5		65.6		8.6%	33.5	J	30.9	J	8.1%	69.1		90.4		26.7%
Nickel	287		292		1.7%	45		41.6		7.9%	34.9	J	38.8	J	10.6%
Potassium	47,900		48,200		0.6%	137,000		123,000		10.8%	16,100		16,800		4.3%
Selenium	--		--			--		--			--		--		
Silver	--		--			--		--			--		--		
Sodium	1,850,000		1,850,000		0.0%	2,740,000		2,810,000		2.5%	5,410,000		5,950,000		9.5%
Thallium	1.7	J	--		N.C.	--		--			--		--		
Vanadium	--		6.9	J	N.C.	115		83.8		31.4%	--		9.3	J	N.C.
Zinc	--		--			--		68		148.0%	--		5.8	J	N.C.
Solids (mg/L)															
Total dissolved solids	5,580		5,480		1.8%	9,600		9,470		1.4%	25,800		26,500		2.7%
Total suspended solids	--		--			67		58		14.4%	60		60		0.0%

Notes:

The data quality objective for relative percent differences for metals was 20 percent.

-- = not detected

J = estimated concentration

µg/L = micrograms per liter

mg/L = milligrams per liter

N.C. = Not calculated. Relative percent differences were not calculated for duplicate samples where an analyte was detected in only one sample at an estimated concentration below the method detection limit.

TABLE 5

CONFIRMATION SAMPLING ANALYTICAL RESULTS FOR ORGANIC COMPOUNDS

NWS CONCORD TIDAL AREA

Compound Name	TLW-1	TLW-2	TLW-3	TLW-4	TLW-5	TLW-5 Dup.
VOCs (µg/L)						
2-Butanone	---	---	14	---	---	---
4-Methyl-2-Pentanone	1 J	---	---	---	---	---
Carbon Disulfide	2	---	10	---	---	---
Bis (2-Ethylhexyl) Phthalate	38	---	---	---	---	---
SVOCs						
Phenanthrene	---	---	---	1 J	---	---
Pesticides/PCBs						
none detected	---	---	---	---	---	---

Compound Name	TLW-6	TLW-7	FTW-3	RDW-5	RDW-6
VOCs (µg/L)					
2-Butanone	---	---	..	..	..
4-Methyl-2-Pentanone	---	---	..	..	..
Carbon Disulfide	---	2 J	..	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	..	..	..
SVOCs					
Phenanthrene	---	---	---	..	..
Pesticides/PCBs					
none detected	---	---	---	---	---

Notes:

Compounds that were not detected in any sample are not shown on this table.

--- = Not detected

.. = Not analyzed

µg/L = Micrograms per liter

J = Estimated concentration

Samples collected in October 1997.

TABLE 6

ANALYTICAL RESULTS FOR STABLE ISOTOPE SAMPLES

NWS CONCORD TIDAL AREA

Sample Location	$\delta^{18}O$ ($^{o}/_{oo}$)	δD ($^{o}/_{oo}$)
Groundwater:		
TLW-1	-6.7	-57
TLW-2	-6.7	-54
TLW-3	-4.3	-39
TLW-4	-6.5	-47
TLW-5	-6.8	-53
TLW-5 (Duplicate)	-6.9	-47
TLW-6	-6.0	-50
TLW-7	-7.9	-62
FTW-1	-6.5	-50
FTW-1 (Duplicate)	-6.5	-51
FTW-2	-8.1	-58
FTW-3	-8.4	-63
FTW-4	-7.4	-55
FTW-5	-7.6	-57
RDW-1	-8.2	-58
RDW-1 (Duplicate)	-8.1	-57
RDW-2	-7.2	-54
RDW-3	-7.2	-53
RDW-4	-6.5	-48
RDW-5	-6.4	-46
RDW-6	-8.0	-58
RDW-7	-6.2	-46
WHW-1	-5.9	-46
WHW-2	-7.7	-58
WHW-3	-7.3	-52
WHW-4	-5.6	-42
Surface Water:		
Sluice Inlet - low tide	-7.0	-50
Sluice Inlet - high tide	-6.3	-47
Otter Sluice - low tide	-6.6	-47
Otter Sluice - high tide	-6.4	-48

Note:

Analytical results are expressed as difference from sea water (δ) in parts per thousand ($^{o}/_{oo}$).

TABLE 7

QUALITY CONTROL DATA: RELATIVE PERCENT DIFFERENCES FOR STABLE ISOTOPE SAMPLES

NWS CONCORD TIDAL AREA

Analyte	$\delta^{18}O$	δD
TLW-5	-6.8	-53
TLW-5	-6.9	-47
RPD	*1.5%*	*12.0%*
FTW-1	-6.5	-50
FTW-1	-6.5	-51
RPD	*0.0%*	*2.0%*
RDW-1	-8.2	-58
RDW-1	-8.1	-57
RPD	*1.2%*	*1.7%*

Notes:

Analytical results are expressed as difference from sea water (δ) in parts per thousand ($^{o}/_{oo}$).

RPD = relative percent difference

TABLE 8

CONFIRMATION SAMPLING ANALYTICAL RESULTS FOR RADIOISOTOPES

NWS CONCORD TIDAL AREA

Compound Name	TLW-2	TLW-5	TLW-5 Dup	RDW-1	RDW-3	RDW-4	RDW-4 Lab Dup.
Radio Isotopes (pCi/L)							
Bismuth-211	--	52.3 ± 34.1	--	24.1 ± 19.3	--	--	--
Cerium-141	--	--	9.82 ± 9.3	9.15 ± 8.3	--	--	--
Cesium-137	--	2.38 ± 3.6	--	--	--	--	--
Cobalt-60	--	--	--	--	--		--
Krypton-85	--	--	--	--	--	--	--
Lead-212	10.8 ± 7.5	8.7 ± 7.1	9.7 ± 6.5	9.7 ± 5.7	7.5 ± 6.8	9.1 ± 5.8	5.6 ± 5.0
Lead-214	--	--	--	8.39 ± 6.7	--	--	--
Molybdenum-99	--	--	--	--	--	--	--
Potassium-40	340 ± 104	317 ± 100	144 ± 63	157 ± 64	180 ± 77	175 ± 77	173 ± 69
Radium-224	121 ± 85	98.3 ± 80	109 ± 74	110 ± 65	84.6 ± 77	102 ± 66	63.1 ± 56
Radium-226	101 ± 84	151 ± 108	443 ± 205	415 ± 184	235 ± 141	123 ± 91	175 ± 106
Strontium-85	--	--	--	--	--	--	--
Technetium-99m	--	--	--	--	--	--	--
Tellurium-123M	--	--	--	--	--	--	--
Thallium-208	2.6 ± 3.8	3.8 ± 3.9	--	--	--	2.7 ± 2.6	--
Uranium-235	--	--	26.9 ± 12.5	25.2 ± 11.2	--	--	--
Xenon-131M	--	--	727 ± 901.0	--	--	--	--

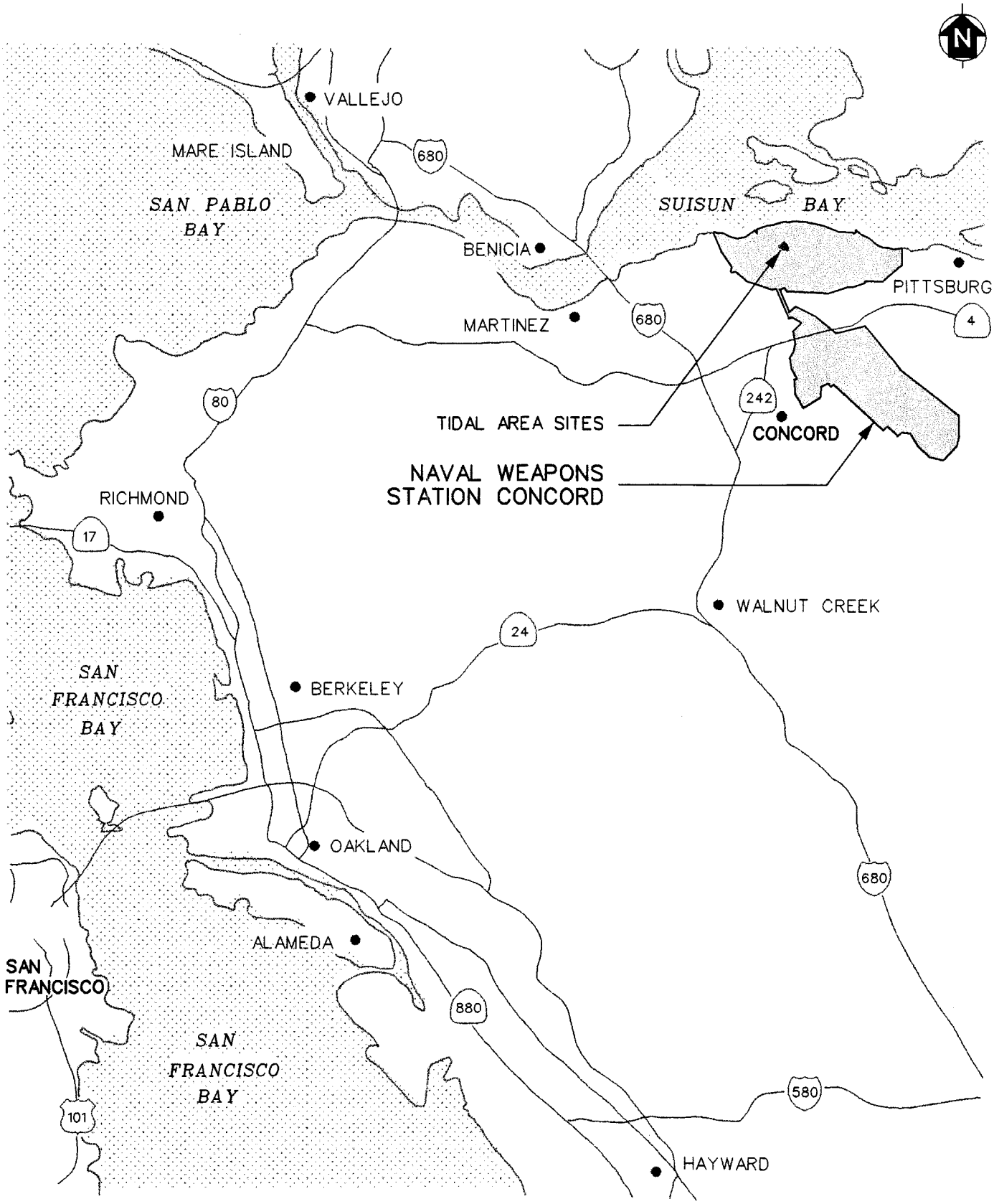
Compound Name	RDW-7	FTW-1	FTW-4	WHW-1	Suisun Bay	Method Blank
Radio Isotopes (pCi/L)						
Bismuth-211	--	37.4 ± 30.8	15.2 ± 18.5	--	--	24.5 ± 10.0
Cerium-141	--	--	11.5 ± 8.2	15.4 ± 8.1	--	--
Cesium-137	--	--	--	--	--	--
Cobalt-60	--	--	--	--	--	--
Krypton-85	--	--	--	--	--	--
Lead-212	8.5 ± 6.1	12.4 ± 7.7	8.0 ± 5.2	10.0 ± 6.3	--	6.7 ± 2.6
Lead-214	--	--	--	--	--	--
Molybdenum-99	--	--	--	--	--	4.9 ± 1.6
Potassium-40	602 ± 163	284 ± 89	210 ± 71	175 ± 61	228 ± 75	--
Radium-224	95.6 ± 69	140 ± 87	90.7 ± 59	113 ± 72	--	75.1 ± 29.4
Radium-226	88.6 ± 75	221 ± 130	485 ± 218	483 ± 209	201 ± 114	145 ± 49
Strontium-85	--	--	--	--	--	3.2 ± 1.7
Technetium-99m	--	--	--	--	--	20.2 ± 6.4
Tellurium-123M	--	--	--	--	--	--
Thallium-208	5.8 ± 4.2	4.1 ± 3.6	--	--	--	6.9 ± 2.3
Uranium-235	--	--	29.5 ± 13.3	29.3 ± 12.7	--	--
Xenon-131M	--	--	--	--	--	--

Notes:

Concentrations are reported in picoCuries per liter (pCi/L)

-- = Below minimum detectable concentration (MDC). The nuclide was not identified by the Canberra Nuclear NID program.

Reported error is total propagated error



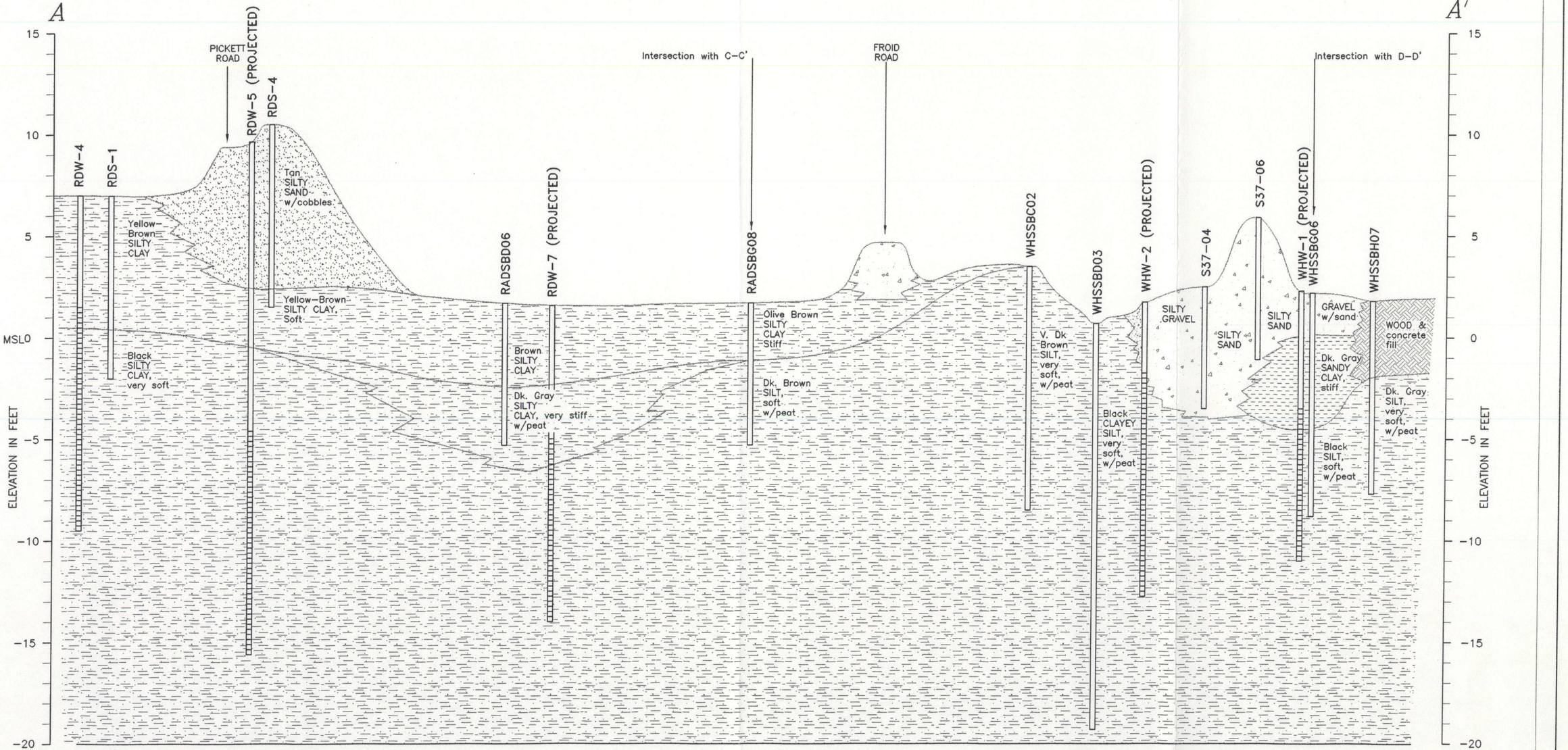
NWS CONCORD
CONCORD, CALIFORNIA

FIGURE 1
SITE LOCATION MAP

j:\concord1\dgn\fig1.dgn

Figures 2 - 6

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



NOTE:

THIS CROSS–SECTION REPRESENTS ONE INTERPRETATION BASED ON AVAILABLE DATA, OTHER INTERPRETATIONS ARE POSSIBLE

HORIZONTAL SCALE

300' 0 150' 300'

SCALE IN FEET

VERTICAL SCALE = 20 x HORIZONTAL SCALE

FIGURE 7

GEOLOGIC CROSS SECTION A–A'
NWS CONCORD

KCH (SF) (044-0281) XSECTEST.DWG 01/18/98 MVIEW=1: 100 4RL

B

B′

Landfill

PICKETT ROAD

FROID ROAD

Intersection with C–C′

Intersection with D–D′

A3AMW003

RADSBJ02

TLW-3 (PROJECTED)

TLSSB001

TLW-4 PZ-6 (B8)

TLW-5 B9

TLW-6 (PROJECTED)

WHSSBL03

FTW-2 (PROJECTED)

WHS-1

WHSBK06

WHSSBM08

mottled SILTY CLAY

Black CLAYEY SILT

Dark Brown SANDY SILT

Brown CLAYEY SILT

SILTY SAND

loose Coarse SAND

Dk. Gray SILT and CLAY with Peat

CLAYEY SILT

Black SILT

Dk. Gray SILTY CLAY with Peat

Dark Gray SILTY CLAY

Brown SILTY CLAY, stiff

Brown SILTY SAND, very fine

Tan SILTY CLAY

Tan SILTY SAND

Tan SILTY CLAY, very stiff

Tan SILTY SAND, stiff

Tan CLAYEY SILT, very stiff

GRAVEL

Black SILTY CLAY

Tan SILTY CLAY, very stiff

Tan CLAYEY SAND/ SAND, loose

Tan SAND

Tan SILTY CLAY, very stiff

<1-inch angular limestone pebble

CLAYEY SAND

SANDY CLAY

GRAVEL w/Clayey Sand

Dk. Gray SILTY CLAY w/peat

SILTY CLAY

GRAVEL w/Silty clay

Soil

Decayed WOOD

Dk. Gray SANDY CLAY w/peat

GRAVEL (ROAD BASE)

Dk. Gray SILTY CLAY w/sand

Black SILT

15
10
5
MSL 0
−5
−10
−15
−20

ELEVATION IN FEET

NOTE:

THIS CROSS–SECTION REPRESENTS ONE INTERPRETATION BASED ON AVAILABLE DATA, OTHER INTERPRETATIONS ARE POSSIBLE

HORIZONTAL SCALE

300′ 0 150′ 300′

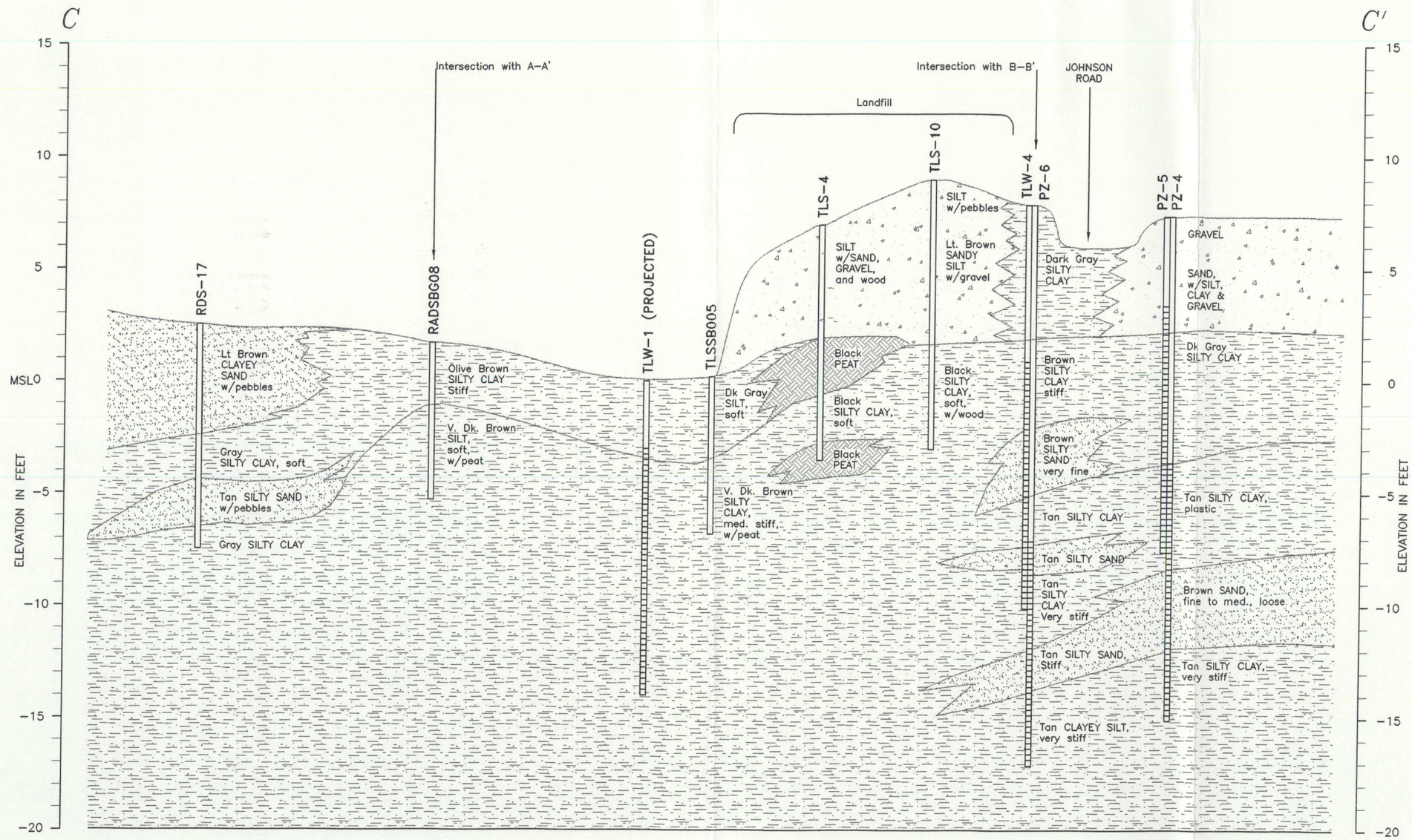
SCALE IN FEET

VERTICAL SCALE = 20 x HORIZONTAL SCALE

FIGURE 8

GEOLOGIC CROSS SECTION B–B′
NWS CONCORD

KCH (SF) (044-0281) XSECTEST.DWG 01/18/98 MVIEW=1: 100 4RL



NOTE:

THIS CROSS–SECTION REPRESENTS ONE INTERPRETATION BASED ON AVAILABLE DATA, OTHER INTERPRETATIONS ARE POSSIBLE

HORIZONTAL SCALE

300' 0 150' 300'

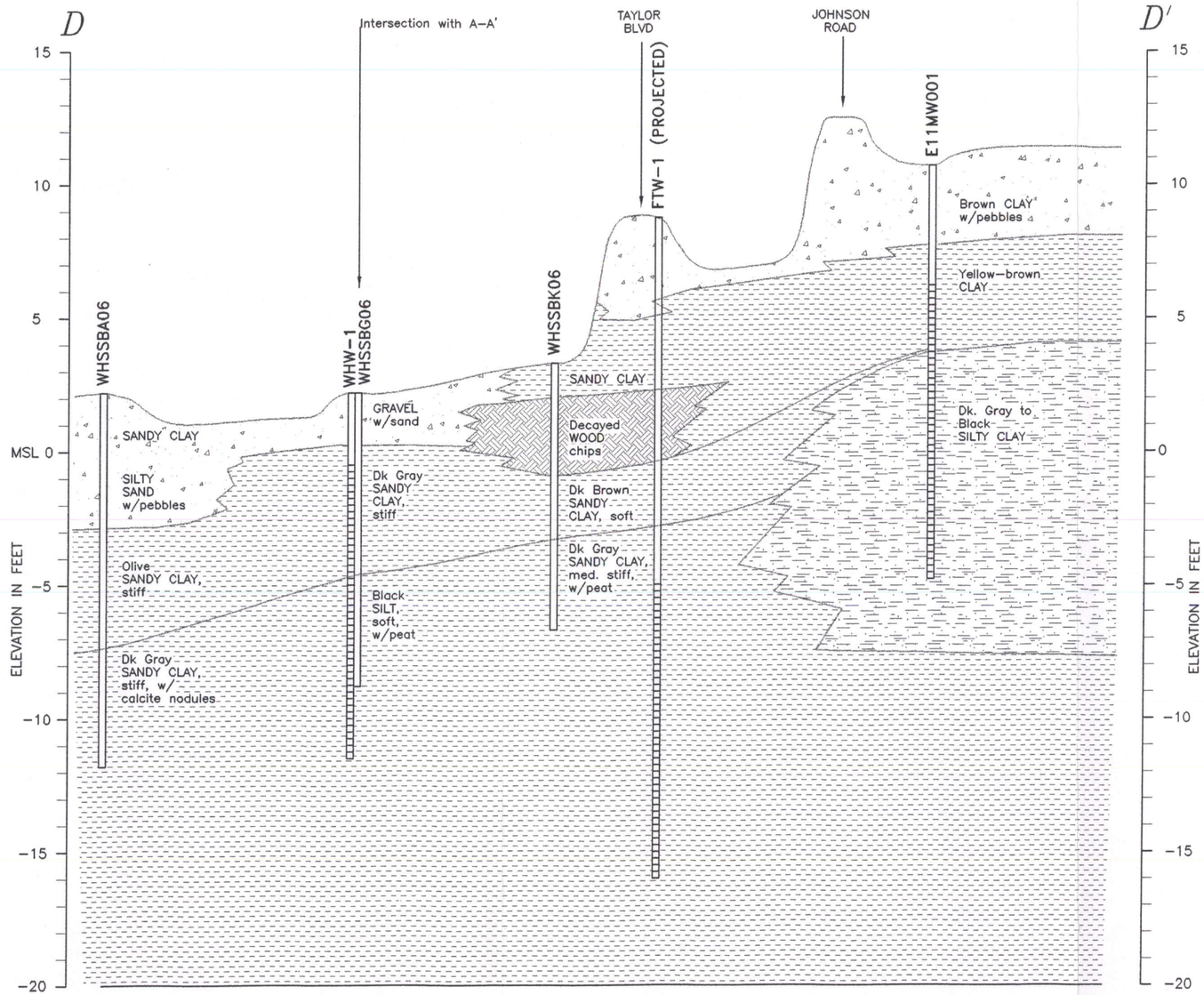
SCALE IN FEET

VERTICAL SCALE = 20 x HORIZONTAL SCALE

FIGURE 9

GEOLOGIC CROSS SECTION C–C'
NWS CONCORD

KOH (SF) (044-0281) XSECTEST.DWG 01/18/98 MVIEW=1: 100 4RL



NOTE:

THIS CROSS–SECTION REPRESENTS ONE INTERPRETATION BASED ON AVAILABLE DATA, OTHER INTERPRETATIONS ARE POSSIBLE

HORIZONTAL SCALE

300' 0 150' 300'

SCALE IN FEET

VERTICAL SCALE = 20 x HORIZONTAL SCALE

FIGURE 10

GEOLOGIC CROSS SECTION D–D'
NWS CONCORD

KCH (SF) (044–0281) XSECTEST.DWG 01/18/98 MVIEW=1: 100 4RL

Figures 11 - 14

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

APPENDIX A

LANDFILL SOILS DATA FROM SITE INVESTIGATION REPORT

Compounds Detected in Landfill Soil

NWS Concord Tidal Area

Compound	TLS-SS-01-0.2	TLS-SS-01-5.0	TLS-SS-01-9	TLS-SS-02-0.2	TLS-SS-02-6.0	TLS-SS-02-11.0
Metals						
Antimony		5.2 J	5.5 J			
Arsenic	3.8	2.6 J	4.9	4.4	8.3	3.4
Beryllium	0.87 J	0.90 J	1.2	1	1.5	1.4
Cadmium						
Calcium	9,440 J	6,690 J	24,300 J	20,100 J	2,270 J	3,380 J
Chromium	26.0 J	44.2 J	46.6 J	26.2 J	45.2 J	39.4 J
Copper	53.2	80.4	50.1	22	44.6	220
Lead	5.89 J	6.02 J	8.1 J	5.75 J	0.75 J	8.81 J
Magnesium	13,100	9,920	10,900	7,450	8,960	7,170
Mercury	0.17					0.084 J
Nickel	28.5	84	70.9	29.5	59.9	51.2
Potassium	648 J	390 J	1,430	2,240	3,720	2,260
Selenium						
Silver	0.94 J					
Sodium	542 J	1,480	1,850	515 J	4,460	3,370
Thallium	0.17 J	0.32 J	1.0 J	0.63 J	0.50 J	0.59 J
Zinc	45.5 J	79.7 J	92.3 J	59.2 J	74.7 J	150 J
Pesticide/PCBs						
Aroclor-1260						
Dieldrin						
VOCs						
Carbon Disulfide						
Toluene						
1,4-Dichlorobenzene		91 J				
4-Methylphenol			320 J			
SVOCs						
Acenaphthene						790 J
Anthracene						
Benzo (a) Anthracene						
Benzo (a) Pyrene						590 J
Benzo (b) Fluoranthene						1,800 J
Benzo (g,h,i) Perylene						
Benzo (k) Fluoranthene						
Benzoic Acid			170 J			
Chrysene						
Dibenzo (a,h) Anthracene						
Dibenzofuran						
Diethyl Phthalate			170 J			
Dimethyl Phthalate			47 J			
Fluoranthene						820 J
Flourene						
Indeno (1,2,3-cd) Pyrene						
Naphthalene						
Phenanthrane						620 J
Phenol						
Pyrene						650 J
Nitrobenzene						
TOC	500	2,300	2,300	4,700	850	6,800
Common Lab Contams						
2-Butanone						
Acetone		180 J			160 J	79 J
Bis (2-Ethylhexyl) Phthal	230 J	44 J	2,400		66 J	2,000 J
Di-N-Butyl Phthalate						
Methylene Chloride						
2-Methylnaphthalene						

Source: IT Corporation. 1992. "Draft Site Investigation Report, Tidal Area Sites, Naval Weapons Station Concord, California."

Compounds Detected in Landfill Soil

NWS Concord Tidal Area

Compound	TLS-SS-03-0.2	TLS-SS-03-5.0	TLS-SS-03-9	TLS-SS-04-0.2	TLS-SS-04-5.0	TLS-SS-04-8
Metals						
Antimony					13.2 J	
Arsenic	3.4 J	9.8	12.7	3.2	16.6	13.4
Beryllium	1.0 J	0.27 J	0.79 J	1.3	0.40 J	1.8 J
Cadmium			2.6			
Calcium	6,600 J	3,300 J	4,570 J	10,900 J	2,740 J	5,610 J
Chromium	23.7 J	20.1 J	29.8 J	19.9 J	9.0 J	82.8 J
Copper	19.7	140	497	28.1	33.4	1,180
Lead	5.16 J	4730 J	78.8 J	11.6 J	48.0 J	37.7 J
Magnesium	5,180	2,340	4,500	6,930	2,530 J	14,200
Mercury	0.058 J	0.79	0.19	0.53	0.18 J	0.11 J
Nickel	27	25	29.9	22.7	9.9 J	81.6
Potassium	1,320	514 J	763 J	1,250	704 J	3,790
Selenium		0.54 J			1.1 J	
Silver				0.68 J		
Sodium	201 J	649 J	1,950	222 J	5,370	13,600
Thallium	0.60 J	0.48 J				
Zinc	47.0 J	199 J	5,570 J	68.2 J	51.8 J	419 J
Pesticide/PCBs						
Aroclor-1260						
Dieldrin						
VOCs						
Carbon Disulfide						
Toluene		2 J				
1,4-Dichlorobenzene						
4-Methylphenol					6,400 J	1,200 J
SVOCs						
Acenaphthene		5,600 J	4,700 J		1,800 J	1,600 J
Anthracene		6,200 J	7,800 J		970 J	850 J
Benzo (a) Anthracene		10,000 J	17,000 J			530 J
Benzo (a) Pyrene		7,400 J	3,500 J		400 J	290 J
Benzo (b) Fluoranthene		16,000 J	17,000 J		770 J	580 J
Benzo (g,h,i) Perylene		3,600 J	5,700 J			
Benzo (k) Fluoranthene			9,900 J			
Benzoic Acid						
Chrysene		12,000 J	1,200 J			600 J
Dibenzo (a,h) Anthracen					170 J	
Dibenzofuran			1,800 J		1,300 J	1,200 J
Diethyl Phthalate					140 J	1,200 J
Dimethyl Phthalate						
Fluoranthene		20,000 J	39,000 J		3,300 J	2,600 J
Flourene		3,800 J	3,800 J		1,700 J	1,500 J
Indeno (1,2,3-cd) Pyrene		4,000 J	4,200 J			
Naphthalene			1,100 J		2,000 J	1,800 J
Phenanthrane		22,000 J	32,000 J		6,100 J	4,600 J
Phenol					6,000 J	1,400 J
Pyrene		23,000 J	24,000 J		2,800 J	2,100 J
Nitrobenzene					1.1 J	
TOC	1,300	58	29,000	31,000	28,000	43,000
Common Lab Contams						
2-Butanone						
Acetone		140	260 J			
Bis (2-Ethylhexyl) Phthal	380 J		1,800 J		510 J	230 J
Di-N-Butyl Phthalate						
Methylene Chloride						
2-Methylnaphthalene					820 J	690 J

Compounds Detected in Landfill Soil

NWS Concord Tidal Area

Compound	TLS-SS-05-0.2	TLS-SS-05-5.0	TLS-SS-05-10.0	TLS-SS-06-0.2	TLS-SS-06-5.0	TLS-SS-06-8
Metals						
Antimony	4.2 J					
Arsenic	3.5	17.5	10.4	1.9 J	3.5	4.5
Beryllium	1.2	1.5 J	1.5 J	1.5	1.7	2
Cadmium						
Calcium	25,400 J	8,640	6,770	10,200	10,800	8,250
Chromium	25.3 J	65.5	58.5	21.8	30	37.8
Copper	51.1	3,300	226	18.7	69.7	78.9
Lead	20.1 J	10.8	7.19	7.45	22.2	32.3
Magnesium	7,810	15,100	11,200	4,680	6,400	6,680
Mercury	0.36		0.19 J	0.08 J	0.12 J	0.15 J
Nickel	40.4	67.5 J	46.2 J	12.0 J	31.6 J	37.3 J
Potassium	813 J	3,410 J	2,990 J	1,140 J	1,100	1,390
Selenium			2.8 J			
Silver			2.2 J			
Sodium	295 J	33,500	18,600	335 J	326 J	1,770
Thallium		0.98 J			1.4 J	2.6 J
Zinc	136 J	1,090 J	226 J	68.4 J	175 J	189 J
Pesticide/PCBs						
Aroclor-1260						
Dieldrin					34 J	
VOCs						
Carbon Disulfide		20 J				
Toluene		25				2 J
1,4-Dichlorobenzene						
4-Methylphenol						
SVOCs						
Acenaphthene						1,200 J
Anthracene						490 J
Benzo (a) Anthracene						
Benzo (a) Pyrene						
Benzo (b) Fluoranthene						
Benzo (g,h,i) Perylene						
Benzo (k) Fluoranthene	470 J					
Benzoic Acid						
Chrysene	810 J					
Dibenzo (a,h) Anthracen						
Dibenzofuran						930 J
Diethyl Phthalate						
Dimethyl Phthalate						
Fluoranthene					360 J	1,100 J
Flourene						1,300 J
Indeno (1,2,3-cd) Pyrene						
Naphthalene						2,100 J
Phenanthrane						2,800 J
Phenol						
Pyrene						970 J
Nitrobenzene						
TOC	4,500	29,000	38,000	5,600	4,300	16,000
Common Lab Contams						
2-Butanone						
Acetone		670 J	230			210 J
Bis (2-Ethylhexyl) Phthal				130 J	1,200 J	
Di-N-Butyl Phthalate					1,700 J	
Methylene Chloride		160	87			
2-Methylnaphthalene						980 J

Compounds Detected in Landfill Soil

NWS Concord Tidal Area

Compound	TLS-SS-07-0.2	TLS-SS-07-5.0	TLS-SS-07-10.	TLS-SS-08-0.2	TLS-SS-08-5.0	TLS-SS-08-10
Metals						
Antimony					9.8 J	11.0 J
Arsenic	1.9 J	3.6	2.4	2.8	3.3 J	12.4 J
Beryllium	2.7	2.4	1.2	1.7	1.6	4.7
Cadmium						9
Calcium	7,670	10,700	2,150	18,800	6,920	8,630
Chromium	60.4	41.6	21.1	29.1	26.9	68.8
Copper	59.5	50.9	52.9	24.6	20.1	4,550
Lead	3.71	9.46	265	6.89	93.8	84.8
Magnesium	12,500	12,000	4,110	7,820	5,440	10,900
Mercury	0.16	0.06 J	0.09 J	0.05 J	0.09 J	0.20 J
Nickel	132 J	64.2 J	37.0 J	29.4 J	25.0 J	93.3 J
Potassium	556 J	1,180	1,710	1,890	1,090 J	2,360
Selenium						0.52 J
Silver			0.67			
Sodium	169 J	428 J	2,010	317 J	732 J	13,400
Thallium	1.4 J	1.8 J	3.2 J	4.0 J	3.0 J	1.7 J
Zinc	92.9 J	97.9 J	119 J	54.3 J	118 J	2,030 J
Pesticide/PCBs						
Aroclor-1260						
Dieldrin						
VOCs						
Carbon Disulfide						
Toluene						
1,4-Dichlorobenzene						
4-Methylphenol						
SVOCs						
Acenaphthene					1,300 J	3,200 J
Anthracene					2,000 J	1,000 J
Benzo (a) Anthracene					5,600 J	990 J
Benzo (a) Pyrene					5,800 J	
Benzo (b) Fluoranthene					7,800 J	
Benzo (g,h,i) Perylene					1,600 J	
Benzo (k) Fluoranthene					4,800 J	
Benzoic Acid						
Chrysene						560 J
Dibenzo (a,h) Anthracen						
Dibenzofuran					500 J	2,300 J
Diethyl Phthalate					1,700 J	1,200 J
Dimethyl Phthalate						
Fluoranthene			69 J		13,000 J	5,300 J
Flourene					1,100 J	2,800 J
Indeno (1,2,3-cd) Pyrene					2,000 J	
Naphthalene						2,600 J
Phenanthrane					7,600 J	8,600 J
Phenol						
Pyrene			53 J		8,900 J	2,900 J
Nitrobenzene						
TOC	2,500	2,000	6,600	2,800	22,000	24,000
Common Lab Contams						
2-Butanone						200 J
Acetone		42 J			54	1,600 J
Bis (2-Ethylhexyl) Phthal	35 J	150 J	74 J	42 J	6,200 J	
Di-N-Butyl Phthalate						
Methylene Chloride						120
2-Methylnaphthalene						2,100 J

Compounds Detected in Landfill Soil

NWS Concord Tidal Area

Compound	TLS-SS-09-0.2	TLS-SS-09-4	TLS-SS-09-6	TLS-SS-10.0.2	TLS-SS-10-5.0	TLS-SS-10-10
Metals						
Antimony				4.4 J		
Arsenic	4.7 J	3.6 J	8.6	5.3 J	5.3	7.0 J
Beryllium	2.4	2.1	2.5	1.6	2.1	2.5
Cadmium						
Calcium	6,130	3,460	5,420	14,500	10,100	10,100
Chromium	37.1	28.4	92.4	23.8	47.8	44.8
Copper	37.1	36	615	25.2	82.1	302
Lead	9.9	6.1	9.3	9.2	162	92
Magnesium	9,610	7,790	11,400	5,980	6,860	6,150
Mercury	0.08 J	0.05 J	0.16 J	0.04 J		0.14 J
Nickel	60.6 J	51.4 J	55.9 J	24.8 J	29.0 J	28.5 J
Potassium	1,150	1,300	3,890	2,240	1,230 J	1,300 J
Selenium			0.40 J			
Silver						
Sodium	253 J	277 J	6,070	175 J	578 J	1,810
Thallium	2.9 J	3.1 J	0.72 J		6.1 J	0.89 J
Zinc	83.4 J	76.3 J	320 J	57.4 J	259 J	316 J
Pesticide/PCBs						
Aroclor-1260					1,800 J	
Dieldrin						
VOCs						
Carbon Disulfide						
Toluene						
1,4-Dichlorobenzene						
4-Methylphenol						
SVOCs						
Acenaphthene						
Anthracene						8,500 J
Benzo (a) Anthracene					600 J	2,100 J
Benzo (a) Pyrene					480 J	800 J
Benzo (b) Fluoranthene					640 J	930 J
Benzo (g,h,i) Perylene						
Benzo (k) Fluoranthene					470 J	770 J
Benzoic Acid						
Chrysene					670 J	2,300 J
Dibenzo (a,h) Anthracen						
Dibenzofuran						6,700 J
Diethyl Phthalate			17,000 J	1,800 J		
Dimethyl Phthalate						
Fluoranthene					1,500 J	14,000 J
Flourene						9,800 J
Indeno (1,2,3-cd) Pyrene						
Naphthalene						6,000 J
Phenanthrane					910 J	31,000 J
Phenol						
Pyrene					950 J	9,000 J
Nitrobenzene						
TOC	3,700	7,400	27,000	4,000	3,600	13,000
Common Lab Contams						
2-Butanone						40
Acetone			1,100 J			370
Bis (2-Ethylhexyl) Phthal		42 J	3,000 J	41 J	1,200 J	2,300 J
Di-N-Butyl Phthalate						
Methylene Chloride			84			
2-Methylnaphthalene						5,400 J

APPENDIX B

HISTORICAL GROUNDWATER ANALYTICAL DATA

Tidal Area Landfill Site
TLW-1

Compound Name	May-90	Aug-90	Oct-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	60 J	---	---	..	---
Antimony	---	---	60.9	..	---
Arsenic	14	26.6 J	20 J	13.4 J	29.8
Barium	200 J	226 J	141 J	..	267
Beryllium	---	---	---	..	0.97 J
Cadmium	---	---	---	..	---
Calcium	747,000	672,000	557,000	..	665,000
Chromium	---	---	10 J	..	19.7
Cobalt	---	---	28.2 J	..	---
Copper	24 J	---	10 J	..	---
Iron	3,090 J	4,950	591,000	..	5,480
Lead	---	..	..	10.6 J	---
Magnesium	1,540,000	1,550,000	1,230,000	..	1,750,000
Manganese	11,300 J	7,500	6,220	..	10,300
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	76
Nickel	53	---	---	..	156
Potassium	214,000	189,000	146,000	..	247,000
Selenium	..	---	..	---	---
Silver	---	11.1	24.7	..	---
Sodium	7,880,000	8,360,000	6,450,000	..	8,550,000
Thallium	---	---	..	..	---
Vanadium	---	---	34.2 J	..	54.3
Zinc	---	---	---	..	---
Organic Compounds (µg/L)					
2-Butanone	..	..	---	---	---
4-Methyl-2-Pentanone	---	---	---	---	1 J
Acetone	..	---	---	---	---
Carbon Disulfide	2 J	---	---	---	2
Toluene	---	---	1 J	---	---
2,6-Dinitrotoluene	---	---	..	---	---
2-Nitroaniline	3 J	---	..	---	---
4-Bromophenyl phenyl ether	7 J	---	..	---	---
4-Chlorophenyl Phenly Ether	---	---	..	---	---
4-Methylphenol	---	..	..	---	---
4-Nitrophenol	---	..	..	---	---
Benzoic Acid	---	..	..	---	---
Bis (2-Ethylhexyl) Phthalate	5 J	---	..	5 J	38
Diethyl Phthalate	3 J	---	..	---	---
Dimethyl Phthalate	5 J	---	..	---	---
N-Nitrosodiphenylamine	---	---	..	---	---
Phenanthrene	---	---	..	---	---
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	1,300	1,800	1,080	..
Carbonate As CaCO3	---	---	---	---	..
Chloride	4,400	..	16,000	..	..
Sulfate	1,400	..	---	..	..
Total Dissolved Solids	33,500	29,000 J	26,000	32,000	34,100
Total Suspended Solids	..	..	..	..	226
Total Organic Carbon	18	24	23	18	..

--- = not detected µg/L = micrograms per liter J = estimated value
.. = not analyzed/rejected data mg/L = milligrams per liter

Tidal Area Landfill Site
TLW-2

Compound Name	May-90	Jul-90	Oct-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	148 J	75.6 J	44.4 J	..	427
Antimony	---	---	---	..	---
Arsenic	106	95.5 J	94	121	83.5
Barium	272	337 J	244 J	..	275
Beryllium	2 J	---	---	..	---
Cadmium	---	---	---	..	---
Calcium	616,000	595,000	573,000	..	247,000
Chromium	---	---	---	..	---
Cobalt	---	---	---	..	---
Copper	50	---	15.4 J	..	---
Iron	203	137	158	..	415
Lead	47	..	..	26 J	---
Magnesium	1,940,000	1,960,000	1,730,000	..	1,320,000
Manganese	3,480	2,330	1,320	..	155
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	49 J
Nickel	---	---	---	..	---
Potassium	216,000	236,000	178,000	..	223,000
Selenium	..	---	..	---	---
Silver	---	9.9 J	28	..	---
Sodium	10,400,000	11,600,000	10,800,000	..	8,400,000
Thallium	---	---	..	..	1.8 J
Vanadium	---	---	---	..	---
Zinc	---	---	---	..	---
Organic Compounds (µg/L)					
2-Butanone	..	..	---	---	---
4-Methyl-2-Pentanone	---	---	---	---	---
Acetone	---	---	---	---	---
Carbon Disulfide	---	1 J	---	1 J	---
Toluene	---	---	---	---	---
2,6-Dinitrotoluene	---	---	---	---	---
2-Nitroaniline	---	---	---	..	---
4-Bromophenyl phenyl ether	---	---	---	---	---
4-Chlorophenyl Phenly Ether	---	---	---	---	---
4-Methylphenol	---	---	---	---	---
4-Nitrophenol	---	---	---	..	---
Benzoic Acid	---	---	---	---	---
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---
Diethyl Phthalate	---	---	---	---	---
Dimethyl Phthalate	---	---	---	---	---
N-Nitrosodiphenylamine	---	---	---	---	---
Phenanthrene	---	---	---	---	---
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	2,700	2,700	2,900	..
Carbonate As CaCO3	---	---	---	---	..
Chloride	..	..	22,000	..	..
Sulfate	..	..	2,600	..	..
Total Dissolved Solids	46,400	44,000	39,000	38,400	31,400
Total Suspended Solids	..	..	..	..	155
Total Organic Carbon	---	77	55	56	...

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Tidal Area Landfill Site
TLW-3

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Jan-93	Sep-94	Oct-97
Metals (µg/L)							
Aluminum	72 J	---	---	..	..	---	---
Antimony	---	---	---	..	..	3.5	---
Arsenic	81	99.2	90	71.2 J	..	12.6	---
Barium	510	336	184 J	..	..	46.2	52.4 J
Beryllium	1 J	---	---	..	..	---	0.97 J
Cadmium	---	---	---	..	..	0.30	---
Calcium	812,000	859,000	592,000	..	..	267,000	557,000
Chromium	131	1,390	34.1 J	..	..	11.1	---
Cobalt	---	79.4	---	..	..	1.1	---
Copper	13 J	---	---	..	..	---	---
Iron	572	1,390,000	649	..	..	1,330	1,960
Lead	---	---	70.8 J	..	..	---	---
Magnesium	2,450,000	2,700,000	1,770,000	..	..	2,000,000	2,680,000
Manganese	7,870	44,600	3,270	..	..	1,570	2,620
Mercury	---	---	---	---	..	..	---
Molybdenum	..	..	..	..	..	6.3	118
Nickel	---	65.8	---	..	..	9.3	147
Potassium	313,000	341,000	207,000	..	..	708,000	442,000
Selenium	---	..	..	---	..	3.8	---
Silver	---	112 J	41	..	..	..	---
Sodium	14,500,000	15,000,000	12,200,000	..	..	18,200,000	15,600,000
Thallium	---	..	..	..	..	---	---
Vanadium	17 J	67.9	19.7 J	..	..	---	---
Zinc	---	89.4	---	..	..	---	---
Organic Compounds (µg/L)							
2-Butanone	..	..	13	4 J	---	..	14
4-Methyl-2-Pentanone	---	---	---	---	---	..	---
Acetone	..	..	41	41	---	..	---
Carbon Disulfide	5	2 J	7	10	---	..	10
Toluene	---	---	---	---	---	..	---
2,6-Dinitrotoluene	---	---	---	---	---	..	---
2-Nitroaniline	---	---	---	---	---	..	---
4-Bromophenyl phenyl ether	---	---	---	---	---	..	---
4-Chlorophenyl Phenly Ether	---	---	---	---	---	..	---
4-Methylphenol	---	12	9 J	---	---	..	---
4-Nitrophenol	---	---	---	---	---	..	---
Benzoic Acid	59 J	---	---	---	---	..	---
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	..	---
Diethyl Phthalate	---	---	---	---	---	..	---
Dimethyl Phthalate	---	---	---	---	---	..	---
N-Nitrosodiphenylamine	---	---	---	---	---	..	---
Phenanthrene	---	---	---	---	---	..	---
Water Quality (mg/L)							
Bicarbonate As CaCO3	---	800	2,300	858	..	..	..
Carbonate As CaCO3	---	---	---	---	..	..	..
Chloride	28,000 J	..	23,000	..	..	..	..
Sulfate	3,900 J	..	2,500	..	..	..	..
Total Dissolved Solids	---	58,000	44,000	60,500	..	..	61,000
Total Suspended Solids	..	..	..	..	..	..	---
Total Organic Carbon	---	..	50	48	..	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Tidal Area Landfill Site
TLW-4

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Jan-93	Oct-97
Metals (µg/L)						
Aluminum	40 J	---	---	..	..	86.5
Antimony	---	---	---	..	..	---
Arsenic	17	13.4	13.5	17.4	..	23.8
Barium	11 J	10.6 J	12.1 J	..	..	13.3 J
Beryllium	---	---	---	..	..	1.2 J
Cadmium	---	---	---	..	..	---
Calcium	19,800 J	13,200	12,600	..	..	9,310
Chromium	---	---	---	..	..	20.7
Cobalt	---	---	---	..	..	---
Copper	26	---	21.4 J	..	..	8.9 J
Iron	97 J	14.1 J	61.8 J	..	..	227
Lead	..	---	..	3.0 J	..	---
Magnesium	30,000 J	28,700	26,600	..	..	29,000
Manganese	120 J	90.4	68	..	..	21.7
Mercury	---	---	---	---	..	---
Molybdenum	..	..	..	..	..	118
Nickel	88 J	31.5 J	40.7	..	..	30.9 J
Potassium	47,300 J	34,600	35,200	..	..	39,400
Selenium	---	..	..	---	..	---
Silver	73 J	---	---	..	..	---
Sodium	1,330,000	1,220,000	1,410,000	..	..	1,470,000
Thallium	..	..	..	..	..	---
Vanadium	30 J	28.6 J	---	..	..	50.7
Zinc	442 J	23.4	19.6 J	..	..	---
Organic Compounds (µg/L)						
2-Butanone	..	..	---	---	---	---
4-Methyl-2-Pentanone	..	---	---	---	---	---
Acetone	---	2 J	---	---	---	---
Carbon Disulfide	---	---	---	---	---	---
Toluene	---	---	---	---	---	---
2,6-Dinitrotoluene	---	---	---	---	---	---
2-Nitroaniline	---	---	---	..	---	---
4-Bromophenyl phenyl ether	---	---	---	---	---	---
4-Chlorophenyl Phenly Ether	---	..	---	---	---	---
4-Methylphenol	---	---	---	---	---	---
4-Nitrophenol	3 J	---	---	..	---	---
Benzoic Acid	4 J	---	---	---	---	---
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	---
Diethyl Phthalate	---	---	---	---	---	---
Dimethyl Phthalate	---	---	---	---	---	---
N-Nitrosodiphenylamine	3 J	---	---	---	---	---
Phenanthrene	---	---	---	---	---	1 J
Water Quality (mg/L)						
Bicarbonate As CaCO3	1,300	1,400	1,300	1,150	..	..
Carbonate As CaCO3	---	---	---	100	..	..
Chloride	810 J	..	880	..	..	..
Sulfate	490 J	..	750	..	..	..
Total Dissolved Solids	3,750	3,400	4,000	3,530	..	3,930
Total Suspended Solids	..	..	..	..	..	---
Total Organic Carbon	11 J	6	13	12	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Tidal Area Landfill Site
TLW-5

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Oct-97	Oct-97 Dup.
Metals (µg/L)						
Aluminum	---	---	---	..	---	---
Antimony	---	---	---	..	---	---
Arsenic	12	10.7	7.4 J	9.7 J	6.1 J	4.2 J
Barium	14 J	73.8 J	112 J	..	110 J	112 J
Beryllium	---	---	---	..	---	---
Cadmium	---	---	---	..	---	---
Calcium	7,510 J	50,400	48,200	..	49,100	50,100
Chromium	---	---	---	..	---	4.7 J
Cobalt	---	---	---	..	---	---
Copper	14 J	---	10.6 J	..	---	---
Iron	343 J	858	842	..	957	1,010
Lead	..	---	..	---	---	---
Magnesium	13,200 J	57,000	85,200	..	90,600	91,700
Manganese	81 J	632	591	..	639	650
Mercury	---	0.27 J	0.2	---	0.2 J	0.16 J
Molybdenum	..	..	..	..	71.5	65.6
Nickel	64	136	67.4	..	287	292
Potassium	24,000 J	41,700 J	41,300	..	47,900	48,200
Selenium	---	..	..	---	---	---
Silver	10	72.8 J	---	..	---	---
Sodium	737,000	1,610,000	2,010,000	..	1,850,000	1,850,000
Thallium	..	..	..	..	1.7 J	---
Vanadium	12 J	---	---	..	---	6.9 J
Zinc	99 J	---	6.3 J	..	---	---
Organic Compounds (µg/L)						
2-Butanone	..	..	---	---	---	---
4-Methyl-2-Pentanone	..	---	---	---	---	---
Acetone	---	..	---	---	---	---
Carbon Disulfide	---	---	---	---	---	---
Toluene	---	---	---	---	---	---
2,6-Dinitrotoluene	---	---	---	---	---	---
2-Nitroaniline	---	---	---	---	---	---
4-Bromophenyl phenyl ether	---	---	---	---	---	---
4-Chlorophenyl Phenly Ether	---	---	---	---	---	---
4-Methylphenol	---	---	---	---	---	---
4-Nitrophenol	---	---	---	---	---	---
Benzoic Acid	..	---	---	---	---	---
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	---
Diethyl Phthalate	---	---	---	---	---	---
Dimethyl Phthalate	---	---	---	---	---	---
N-Nitrosodiphenylamine	42 J	---	---	---	---	---
Phenanthrene	---	---	---	---	---	---
Water Quality (mg/L)						
Bicarbonate As CaCO3	780	1,100	..	1,060	..	..
Carbonate As CaCO3	10	---	..	..	..	..
Chloride	390 J	..	..	..	..	..
Sulfate	260 J	..	..	..	..	..
Total Dissolved Solids	2,050	4,600	..	3,000	5,580	5,480
Total Suspended Solids	..	..	..	..	---	---
Total Organic Carbon	8 J	..	..	13	..	..

--- = not detected µg/L = micrograms per liter J = estimated value
.. = not analyzed/rejected data mg/L = milligrams per liter

Tidal Area Landfill Site
TLW-6

Compound Name	Apr-90	Jul-90	Nov-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	57 J	---	---	..	---
Antimony	---	---	---	..	---
Arsenic	5 J	2.7 J	28.1	7.1 J	12.7 J
Barium	795 J	916	233	..	565
Beryllium	---	---	---	..	---
Cadmium	---	---	---	..	---
Calcium	366,000	437,000	222,000	..	313,000
Chromium	---	---	---	..	---
Cobalt	---	---	---	..	---
Copper	24 J	---	29.5	..	---
Iron	6,520	11,400	27,900	..	3,240
Lead	..	---	---	4	---
Magnesium	423,000	462,000	504,000	..	426,000
Manganese	2,980	5,310	2,710	..	3,600
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	44 J
Nickel	---	---	---	..	55.2
Potassium	48,000	39,500	89,600	..	71,000
Selenium	---	..	---	---	---
Silver	---	9.2 J	11.3	..	---
Sodium	2,360,000	2,550,000	3,220,000	..	2,360,000
Thallium	---	..	---	..	---
Vanadium	---	---	---	..	---
Zinc	11 J	66.4	160 J	..	39.2
Organic Compounds (µg/L)					
2-Butanone	..	---	---	---	---
4-Methyl-2-Pentanone	---	---	---	---	---
Acetone	---	---	18	---	---
Carbon Disulfide	---	---	---	---	---
Toluene	---	---	---	---	---
2,6-Dinitrotoluene	---	---	..	---	---
2-Nitroaniline	---	---	..	---	---
4-Bromophenyl phenyl ether	---	---	..	---	---
4-Chlorophenyl Phenly Ether	---	..	..	---	---
4-Methylphenol	---	---	..	---	---
4-Nitrophenol	---	---	..	---	---
Benzoic Acid	---	---	..	---	---
Bis (2-Ethylhexyl) Phthalate	---	---	..	---	---
Diethyl Phthalate	---	---	..	---	---
Dimethyl Phthalate	---	---	..	---	---
N-Nitrosodiphenylamine	---	---	..	---	---
Phenanthrene	---	---	..	---	---
Water Quality (mg/L)					
Bicarbonate As CaCO3	370	790	1,290	1,020	..
Carbonate As CaCO3	---	---	---	---	..
Chloride	..	..	..	..	..
Sulfate	..	..	..	..	..
Total Dissolved Solids	9,980	11,000	9,530	10,900	9,790
Total Suspended Solids	..	..	..	..	---
Total Organic Carbon	30	10	..	16	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Tidal Area Landfill Site
TLW-7

Compound Name	May-90	Jul-90	Nov-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	52 J	---	84 J	..	---
Antimony	---	---	---	..	---
Arsenic	17	7.4 J	35.7 J	12.2	14.4
Barium	118 J	141 J	115 J	..	189 J
Beryllium	---	---	---	..	---
Cadmium	---	---	---	..	---
Calcium	225,000	251,000	226,000	..	184,000
Chromium	---	---	---	..	---
Cobalt	---	---	---	..	---
Copper	16 J	---	32.2	..	---
Iron	23,200 J	2,030	2,130	..	839
Lead	---	---	20 J	20	---
Magnesium	529,000	563,000	544,000	..	462,000
Manganese	1,050 J	691	420	..	89.5 J
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	50.9
Nickel	---	---	---	..	---
Potassium	96,200	98,900	101,000	..	103,000
Selenium	..	..	---	---	---
Silver	---	8.5 J	11.1	..	---
Sodium	3,240,000	3,300,000	3,810,000	..	3,230,000
Thallium	---	..	---	..	---
Vanadium	---	---	---	..	68.9 J
Zinc	---	---	46.1 J	..	---
Organic Compounds (µg/L)					
2-Butanone	..	..	---	---	---
4-Methyl-2-Pentanone	---	---	---	---	---
Acetone	..	..	---	---	---
Carbon Disulfide	---	---	---	---	2 J
Toluene	---	---	---	---	---
2,6-Dinitrotoluene	3 J	---	---	---	---
2-Nitroaniline	---	---	---	---	---
4-Bromophenyl phenyl ether	---	---	---	---	---
4-Chlorophenyl Phenly Ether	5 J	..	---	---	---
4-Methylphenol	---	---	---	---	---
4-Nitrophenol	..	---	---	---	---
Benzoic Acid	..	---	---	---	---
Bis (2-Ethylhexyl) Phthalate	---	2 J	3 J	---	---
Diethyl Phthalate	---	---	---	---	---
Dimethyl Phthalate	2 J	---	---	---	---
N-Nitrosodiphenylamine	---	---	---	---	---
Phenanthrene	---	---	---	---	---
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	1,200	1,630	1,750	..
Carbonate As CaCO3	---	---	---	---	..
Chloride	7,600	..	..	..	..
Sulfate	710	..	..	..	..
Total Dissolved Solids	13,500	13,000	12,300	12,800	11,800
Total Suspended Solids	..	..	..	..	---
Total Organic Carbon	32	40	..	50	..

--- = not detected µg/L = micrograms per liter J = estimated value
.. = not analyzed/rejected data mg/L = milligrams per liter

R Area Disposal Site
RDW-1

Compound Name	Apr-90	Jul-90	Oct-90	Feb-91	Oct-97	Oct-97 Dup.
Metals (µg/L)						
Aluminum	---	---	---	190 J	---	---
Antimony	---	---	---	---	8.2	6.3
Arsenic	24	24.9	90.4	16.3	35.2	57
Barium	150 J	198 J	308 J	208	399	495
Beryllium	2 J	---	---	---	1.2 J	0.73 J
Cadmium	---	---	---	---	---	---
Calcium	168,000	192,000	184,000 J	183,000	189,000	185,000
Chromium	---	---	---	---	---	---
Cobalt	---	---	---	---	---	---
Copper	21 J	---	34.5 J	16.6 J	---	---
Iron	5,550	10,700	22,200	5,990	2,110	4,470
Lead	---	---	..	---	---	---
Lithium	..	..	..	..	..	..
Magnesium	390,000	396,000	426,000	38,400	478,000	465,000
Manganese	2,930	2,900	2,680	2,100	1,150	1,470
Mercury	0.3	---	---	---	---	---
Molybdenum	..	..	..	..	33.5 J	30.9 J
Nickel	---	---	---	---	45	41.6
Potassium	83,000	88,900	92,800	86,400 J	137,000	123,000
Selenium	..	..	..	---	---	---
Silver	---	11.8 J	8.9 J	10.7	---	---
Sodium	2,490,000	2,600,000	2,810,000	2,620,000	2,740,000	2,810,000
Thallium	---	..	..	---	---	---
Vanadium	---	---	---	15.3 J	115	83.8
Zinc	42 J	---	---	51.3 J	---	68
Organic Compounds (µg/L)						
Aldrin	---	---	..	..	..	..
Acetone	---	..	5 J	8 J	..	..
Carbon Disulfide	---	---	---	---	..	..
2-Nitroaniline	---	---	---	---	..	..
Benzoic Acid	---	---	---	---	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..	..
Di-N-Butyl Phthalate	---	---	---	---	..	..
N-Nitrosodiphenylamine	---	---	---	---	..	..
Water Quality (mg/L)						
Bicarbonate As CaCO3	1,600	1,500	1,600	1,520	..	..
Chloride	..	..	3,600	..	..	..
Sulfate	..	..	---	..	..	..
Total Dissolved Solids	9,060	9,000	9,600	9,440 J	9,600	9,470
Total Suspended Solids	..	..	..	..	67	58
Total Organic Carbon	14	..	24	17	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

R Area Disposal Site
RDW-2

Compound Name	Apr-90	Jul-90	Oct-90	Feb-91	Oct-97
Metals (µg/L)					
Aluminum	---	72.3 J	63.7 J	3,930	200
Antimony	---	---	---	---	---
Arsenic	121	80.8	31.8 J	28.4	38.8
Barium	426	460	364 J	475	642
Beryllium	1 J	---	---	---	1.2 J
Cadmium	---	---	---	---	---
Calcium	418,000	511,000	---	532,000	464,000
Chromium	---	---	---	31.3	5.3 J
Cobalt	---	---	---	---	---
Copper	23 J	42.2	18.3 J	26.5 J	---
Iron	580	739	---	7,580	1,150
Lead	---	---	129 J	---	---
Lithium	..	..	..	..	..
Magnesium	1,300,000	1,470,000	---	1,390,000	1,470,000
Manganese	1,380	994	---	210	209
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	56.8 J
Nickel	---	---	---	---	---
Potassium	139,000	164,000	---	173,000	184,000
Selenium	..	..	..	---	---
Silver	---	51.5 J	7.5 J	6.6 J	---
Sodium	7,010,000	7,970,000	---	7,440,000	7,880,000
Thallium	---	..	..	---	---
Vanadium	---	29.2 J	26.8 J	44.8 J	42 J
Zinc	74 J	53.5	---	106 J	---
Organic Compounds (µg/L)					
Aldrin	---	---	..	..	..
Acetone	---	..	---	..	..
Carbon Disulfide	---	2 J	---	---	..
2-Nitroaniline	---	---	---	---	..
Benzoic Acid	230 J	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Di-N-Butyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	---	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	3,200	3,300	---	3,480	..
Chloride	..	..	---	..	..
Sulfate	..	..	---	..	..
Total Dissolved Solids	25,200	28,000	---	29,100 J	27,300
Total Suspended Solids	..	..	..	..	163
Total Organic Carbon	42 J	..	31 J	47	..

--- = not detected µg/L = micrograms per liter J = estimated value
.. = not analyzed/rejected data mg/L = milligrams per liter

R Area Disposal Site
RDW-3

Compound Name	Apr-90	Jul-90	Oct-90	Feb-91	Oct-97
Metals (µg/L)					
Aluminum	54 J	82 J	101 J	2,040	807
Antimony	---	---	43.7 J	---	---
Arsenic	6 J	11.3 J	6.5 J	8.3 J	6.4 J
Barium	367	393	226 J	357	306
Beryllium	---	---	---	---	---
Cadmium	---	---	---	---	---
Calcium	260,000	540,000	---	322,000	245,000
Chromium	---	---	---	---	---
Cobalt	---	---	---	---	---
Copper	---	11.5 J	---	---	---
Iron	47,200	112,000	---	80,800	36,200
Lead	---	---	..	2.9 J	---
Lithium	..	27.6	..	..	..
Magnesium	515,000	653,000	---	609,000	459,000
Manganese	3,000	4,970	---	2,970	3,010
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	68.9
Nickel	---	---	---	---	---
Potassium	100,000	..	---	112,000	98,000
Selenium	..	..	..	10 J	---
Silver	---	75.8 J	---	9.4 J	2.1 J
Sodium	3,940,000	..	---	4,340,000	2,980,000
Thallium	---	..	..	---	---
Vanadium	12 J	16.2 J	16.2 J	15.5 J	14.2 J
Zinc	76 J	---	---	38.3 J	14.4 J
Organic Compounds (µg/L)					
Aldrin	---	---	..	..	..
Acetone	---	..	---	..	..
Carbon Disulfide	---	---	---	---	..
2-Nitroaniline	---	---	---	---	..
Benzoic Acid	---	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Di-N-Butyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	---	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	970	1,200	---	1,020	..
Chloride	..	..	---	..	..
Sulfate	..	..	---	..	..
Total Dissolved Solids	14,400	18,000	---	16,300 J	12,500
Total Suspended Solids	..	..	..	..	158
Total Organic Carbon	69	..	38 J	130	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

R Area Disposal Site
RDW-4

Compound Name	Apr-90	Jul-90	Oct-90	Feb-91	Oct-97
Metals (µg/L)					
Aluminum	45 J	---	45.9 J	1,890	---
Antimony	---	---	---	---	---
Arsenic	7	16.6	18.5 J	20.8	14.4 J
Barium	99 J	143 J	145 J	174 J	78.9 J
Beryllium	3 J	---	---	---	---
Cadmium	---	---	---	---	---
Calcium	159,000	327,000	---	484,000	196,000
Chromium	---	35.8 J	---	2,270	53.4
Cobalt	---	69.7	---	84.7	---
Copper	17 J	---	14.1 J	28.3 J	---
Iron	862	36,900	---	43,500	4,300
Lead	---	---	---	4.41 J	---
Lithium	..	..	..	..	..
Magnesium	244,000	680,000	---	1,120,000	321,000
Manganese	768	3,060	---	4,670	520
Mercury	---	0.56	---	---	---
Molybdenum	..	..	..	..	14.4 J
Nickel	258	3,410	---	3,660	91.8
Potassium	74,900	152,000	---	241,000	113,000
Selenium	---	..	..	---	---
Silver	---	11.6	7 J	---	1.4 J
Sodium	2,580,000	5,000,000	---	8,340,000	2,920,000
Thallium	---	..	..	---	2 J
Vanadium	---	---	---	23.3 J	7.5 J
Zinc	18 J	---	---	156 J	12 J
Organic Compounds (µg/L)					
Aldrin	---	---	..	..	..
Acetone	..	..	---	..	..
Carbon Disulfide	---	---	---	---	..
2-Nitroaniline	---	---	---	---	..
Benzoic Acid	---	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Di-N-Butyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	---	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	..	480	---	718	..
Chloride	7,700 J	..	---	..	..
Sulfate	640 J	..	---	..	..
Total Dissolved Solids	---	20,000	---	30,500 J	11,300
Total Suspended Solids	..	..	..	..	---
Total Organic Carbon	---	30	32 J	29	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

R Area Disposal Site
RDW-5

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Jan-93	Sep-94	Oct-97
Metals (µg/L)							
Aluminum	47 J	---	114 J	..	..	---	104
Antimony	---	---	---	..	..	3.7	---
Arsenic	33	31.2 J	---	30.6	..	50.5	65
Barium	816	755	625 J	..	..	605	1,010
Beryllium	1 J	---	---	..	..	---	---
Cadmium	---	---	---	..	..	1.2	---
Calcium	914,000	971,000	---	..	..	945,000	876,000
Chromium	---	---	---	..	..	4.4	8.4 J
Cobalt	---	25.4 J	---	..	..	2.3	---
Copper	---	---	---	..	..	---	---
Iron	27,100	37,600	---	..	..	17,500	5,190
Lead	---	---	..	21 J	..	---	---
Lithium	..	..	---	..	..	..	..
Magnesium	1,560,000	1,580,000	---	..	..	1,610,000	1,520,000
Manganese	20,100	18,500	---	..	..	10,300	10,600
Mercury	---	---	---	---	..	..	---
Molybdenum	..	..	---	..	..	7.3	72.5
Nickel	---	34.4 J	31.7 J	..	..	10.2	19 J
Potassium	50,700	45,200	---	..	..	180,000	48,600
Selenium	---	..	..	---	..	4.8	3.6 J
Silver	---	---	---	..	..	..	---
Sodium	5,830,000	4,830,000	---	..	..	6,600,000	4,510,000
Thallium	---	..	..	..	..	7.0	---
Vanadium	10 J	14.6 J	---	..	..	14.5	26.2 J
Zinc	1,360 J	---	---	..	..	---	10.5 J
Organic Compounds (µg/L)							
Aldrin	0.15 J	---	..	..	---	..	---
Acetone	..	---	---	---	---	..	..
Carbon Disulfide	---	---	---	1 J	---	..	..
2-Nitroaniline	---	---	---	---	---	..	..
Benzoic Acid	---	..	---	---	---	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	..	..
Di-N-Butyl Phthalate	34	8 J	---	8 J	---	..	..
N-Nitrosodiphenylamine	---	---	---	---	---	..	..
Water Quality (mg/L)							
Bicarbonate As CaCO3	..	1,500	---	1,230	..	..	..
Chloride	18,000 J	..	---	..	..	..	..
Sulfate	460 J	..	---	..	..	..	..
Total Dissolved Solids	---	24,000	---	21,500	..	..	25,200
Total Suspended Solids	..	..	..	..	..	..	9
Total Organic Carbon	---	52	44 J	33	..	..	..

--- = not detected µg/L = micrograms per liter J = estimated value
.. = not analyzed/rejected data mg/L = milligrams per liter

R Area Disposal Site
RDW-6

Compound Name	Apr-90	Jul-90	Oct-90	Feb-91	Oct-97
Metals (µg/L)					
Aluminum	48 J	41.4 J	----	490	94.6
Antimony	----	----	----	---	---
Arsenic	8 J	27 J	27 J	27.2	32.8
Barium	122 J	140 J	130 J	145 J	170 J
Beryllium	2 J	---	---	---	---
Cadmium	----	---	---	---	---
Calcium	330,000	366,000	---	317,000	285,000
Chromium	---	---	---	18	14.5 J
Cobalt	---	---	---	---	---
Copper	---	---	---	13.5 J	---
Iron	18,400	16,200	---	25,600	2,230
Lead	---	..	..	---	---
Lithium	..	..	..	..	..
Magnesium	934,000	944,000	---	812,000	758,000
Manganese	2,770	2,330	---	1,560	1,320
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	55.7
Nickel	---	---	---	---	59
Potassium	143,000	156,000	---	151,000	159,000
Selenium	---	---	..	---	---
Silver		15.3	8.6 J	9.6 J	---
Sodium	5,410,000	5,430,000	---	5,020,000	4,060,000
Thallium	---	---	..	---	---
Vanadium	---	---	12.6 J	---	36.5 J
Zinc	289 J	---	---	106	19.6 J
Organic Compounds (µg/L)					
Aldrin	---	---	..	..	---
Acetone	..	---	---	..	..
Carbon Disulfide	---	---	---	---	..
2-Nitroaniline	---	---	---	---	..
Benzoic Acid	---	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Di-N-Butyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	---	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	1,500	---	1,610	..
Chloride	11,000 J	..	---	..	..
Sulfate	1,400 J	..	---	..	..
Total Dissolved Solids	..	21,000 J	---	19,500 J	17,700
Total Suspended Solids	..	..	..	..	---
Total Organic Carbon	---	43	35 J	41	..

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µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

R Area Disposal Site
RDW-7

Compound Name	May-90	Jul-90	Oct-90	Feb-91	Oct-97
Metals (µg/L)					
Aluminum	1,670	267	95.3 J	2,660	350
Antimony	---	---	---	---	---
Arsenic	---	20	---	10.6	7.6 J
Barium	59 J	140 J	178 J	188 J	121 J
Beryllium	---	---	---	---	---
Cadmium	---	---	---	---	---
Calcium	881,000	1,020,000	---	908,000	732,000
Chromium	194	107 J	22.5 J	668	43.6
Cobalt	103 J	27.4 J	---	22.4 J	16.1 J
Copper	39 J	---	---	24.5 J	---
Iron	46,200 J	38,500	---	16,000	7,050
Lead	---	..	..	---	---
Lithium	..	..	..	..	..
Magnesium	2,680,000	3,290,000	---	2,730,000	2,740,000
Manganese	10,800 J	12,300	---	8,720	16,000
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	88.8
Nickel	640	204 J	---	415	69.8
Potassium	480,000	489,000	---	427,000	425,000
Selenium	..	---	..	---	4.4 J
Silver	---	7.5 J	---	---	---
Sodium	15,300,000	18,100,000	---	15,200,000	14,100,000
Thallium	---	---	..	---	---
Vanadium	10 J	---	---	15.7 J	---
Zinc	1,260	---	---	212 J	47
Organic Compounds (µg/L)					
Aldrin	---	---	..	..	..
Acetone	..	---	---	..	..
Carbon Disulfide	---	---	---	---	..
2-Nitroaniline	3 J	---	---	---	..
Benzoic Acid	---	..	---	---	..
Bis (2-Ethylhexyl) Phthalate	3 J	4 J	---	2 J	..
Di-N-Butyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	11 J	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	380	---	756	..
Chloride	3,800 J	..	---	..	..
Sulfate	770	..	---	..	..
Total Dissolved Solids	65,000	68,000 J	---	59,800 J	65,600
Total Suspended Solids	..	..	..	..	32
Total Organic Carbon	67	64	69 J	54	..

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J = estimated value

Froid and Taylor Road Site Monitoring Well
FTW-1

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Oct-97	Oct-97 Dup.
Metals (µg/L)						
Aluminum	58 J	---	---	..	---	---
Antimony	---	---	---	..	---	---
Arsenic	14	21.6 J	15.1	15.2 J	11.2 J	15.3 J
Barium	182 J	154 J	153 J	..	1,500	1,500
Beryllium	---	---	---	..	---	0.61 J
Cadmium	---	---	---	..	---	---
Calcium	1,480,000	1,380,000	1,200,000	..	1,100,000	1,170,000
Chromium	---	---	10 J	..	---	---
Cobalt	100	133	88.7 J	..	30.1 J	30.7 J
Copper	22 J	---	---	..	---	---
Iron	12,300	20,800	11,000	..	22,600	22,400
Lead	..	10.6 J	..	10.1 J	---	---
Magnesium	1,400,000	1,450,000	1,220,000	..	1,230,000	1,310,000
Manganese	23,600	24,300	20,000	..	16,400	16,500
Mercury	---	---	---	---	---	---
Molybdenum	..	..	..	..	69.1	90.4
Nickel	174	184	124	..	34.9 J	38.8 J
Potassium	12,000	10,900	15,000	..	16,100	16,800
Selenium	---	..	..	---	---	---
Silver	---	---	---	..	---	---
Sodium	6,430,000	6,500,000	6,670,000	..	5,410,000	5,950,000
Thallium	---	..	..	..	---	---
Vanadium	---	---	---	..	---	9.3 J
Zinc	---	---	---	..	---	5.8 J
Organic Compounds (µg/L)						
4-Methyl-2-Pentanone	---	---	---	---	..	..
Acetone	---	---	---	2 J	..	..
Carbon Disulfide	---	---	---	---	..	..
4-Methylphenol	---	..	---	---	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	2 J	3 J	..	..
Diethyl Phthalate	---	---	---	---	..	..
N-Nitrosodiphenylamine	---	---	---	---	..	..
Diphenylamine	---	---	---	..	..	..
Water Quality (mg/L)						
Bicarbonate As CaCO3	1,100	1,100	1,120	1,050	..	..
Chloride	2,300	..	..	..	..	..
Sulfate	1,200	..	..	..	..	..
Total Dissolved Solids	27,800	33,000	25,200	25,400	25,800	26,500
Total Suspended Solids	..	..	..	..	60	60
Total Organic Carbon	16	18	..	14	..	..

--- = not detected
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µg/L = micrograms per liter
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J = estimated value

Froid and Taylor Road Site Monitoring Well
FTW-2

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Jan-93	Sep-94	Oct-97
Metals (µg/L)							
Aluminum	44 J	---	---	..	..	---	84.3
Antimony	30 J	---	---	..	..	7.2	---
Arsenic	---	20.4 J	34.7	23.9	..	24.9	25.7
Barium	849 J	668	534 J	..	..	456	826
Beryllium	---	---	---	..	..	---	0.73 J
Cadmium	5 J	---	---	..	..	0.51	---
Calcium	3,388,000 J	396,000	364,000	..	..	320,000	385,000
Chromium	---	---	---	..	..	---	---
Cobalt	---	---	---	..	..	2.9	---
Copper	10 J	---	---	..	..	---	---
Iron	4,530 J	8,840	22,500	..	..	14,700	11,900
Lead	..	---	..	6.3 J	..	---	---
Magnesium	788,000 J	676,000	630,000	..	..	530,000	700,000
Manganese	8,530 J	6,480	4,560	..	..	3,900	4,910
Mercury	---	---	---	---	..	---	---
Molybdenum	..	..	..	..	..	3.7	62.8
Nickel	---	---	---	..	..	15.2	27.6 J
Potassium	68,800 J	89,900	100,000	..	..	---	126,000
Selenium	---	..	..	---	..	---	---
Silver	---	10.5	11.3	..	..	..	---
Sodium	4,880,000 J	3,960,000	4,400,000	..	..	---	3,890,000
Thallium	---	..	..	..	..	---	---
Vanadium	10 J	---	---	..	..	---	44.6 J
Zinc	60 J	---	---	..	..	---	---
Organic Compounds (µg/L)							
4-Methyl-2-Pentanone	---	---	---	1 J	---	..	..
Acetone	---	---	---	4 J	---	..	..
Carbon Disulfide	---	---	---	---	---	..	..
4-Methylphenol	---	---	---	---	---	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	..	..
Diethyl Phthalate	---	---	---	---	---	..	..
N-Nitrosodiphenylamine	21 J	---	---	---	---	..	..
Diphenylamine	---	---	---	..	---	..	..
Water Quality (mg/L)							
Bicarbonate As CaCO3	1,300	1,400	1,630	1,580	..	..	..
Chloride	..	..	..	..	..	..	..
Sulfate	..	..	..	..	..	..	..
Total Dissolved Solids	19,000	17,000	14,600	16,000	..	..	14,200
Total Suspended Solids	..	..	..	..	..	..	38
Total Organic Carbon	87 J	70	..	44	..	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Froid and Taylor Road Site Monitoring Well
FTW-3

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Jan-93	Oct-97
Metals (µg/L)						
Aluminum	---	---	---	..	..	---
Antimony	---	---	---	..	..	---
Arsenic	13	22	20	21.5	..	24.5
Barium	1,990 J	1,610	1,560 J	..	..	3,370
Beryllium	---	---	---	..	..	0.97 J
Cadmium	---	---	---	..	..	---
Calcium	258,000	270,000	269,000	..	..	283,000
Chromium	---	---	---	..	..	---
Cobalt	---	---	---	..	..	---
Copper	12 J	---	---	..	..	---
Iron	6,810	11,900	57,100	..	..	562
Lead	..	---	..	3.1 J	..	---
Magnesium	483,000	498,000	496,000	..	..	490,000
Manganese	788	793	769	..	..	449
Mercury	---	---	---	---	..	---
Molybdenum	..	..	..	..	..	22.1 J
Nickel	---	---	---	..	..	---
Potassium	94,000	93,600	93,000	..	..	107,000
Selenium	---	..	..	---	..	---
Silver	---	11	11	..	..	---
Sodium	3,120,000	3,320,000	3,390,000	..	..	2,990,000
Thallium	---	..	..	..	..	---
Vanadium	---	---	---	..	..	16.3 J
Zinc	10 J	---	---	..	..	---
Organic Compounds (µg/L)						
4-Methyl-2-Pentanone	---	---	---	---	---	..
Acetone	---	---	..	---	---	..
Carbon Disulfide	---	---	---	---	---	..
4-Methylphenol	21	4 J	9 J	---	---	---
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	---
Diethyl Phthalate	---	---	---	---	---	---
N-Nitrosodiphenylamine	---	---	---	---	---	..
Diphenylamine	2.2	---	---	..	---	..
Water Quality (mg/L)						
Bicarbonate As CaCO3	1,000	1,000	883	1,110	..	..
Chloride	2,900	..	..	..	..	..
Sulfate	1,900	..	..	..	..	..
Total Dissolved Solids	11,300	13,000	11,200	11,600	..	11,400
Total Suspended Solids	..	..	..	..	..	---
Total Organic Carbon	15	10	..	13	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Froid and Taylor Road Site Monitoring Well
FTW-4

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	157 J	---	---	..	---
Antimony	---	---	---	..	---
Arsenic	43	17.3	11.6	17.8	76.4
Barium	138 J	51.1 J	33.7 J	..	264
Beryllium	4 J	---	---	..	---
Cadmium	189	---	---	..	---
Calcium	201,000 J	104,000	52,800	..	301,000
Chromium	---	---	---	..	---
Cobalt	---	---	---	..	---
Copper	34	---	---	..	---
Iron	19,900 J	8,200	2,420	..	30,400
Lead	58 J	---	..	29.8 J	---
Magnesium	442,000 J	186,000	46,700	..	714,000
Manganese	1,200	1,460	2,000	..	459
Mercury	---	---	---	---	0.16 J
Molybdenum	..	..	..	..	60.2
Nickel	---	---	---	..	---
Potassium	77,900 J	34,500	13,600	..	131,000
Selenium	---	..	..	---	---
Silver	---	---	---	..	---
Sodium	3,330,000	1,530,000	491,000	..	5,550,000
Thallium	..	..	..	..	---
Vanadium	---	---	---	..	---
Zinc	5,010 J	---	84.5	..	164
Organic Compounds (µg/L)					
4-Methyl-2-Pentanone	..	---	---	---	..
Acetone	---	---	..	---	..
Carbon Disulfide	---	---	---	---	..
4-Methylphenol	---	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Diethyl Phthalate	---	7 J	---	---	..
N-Nitrosodiphenylamine	6 J	---	---	---	..
Diphenylamine	---	---	---	..	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	1,100	520	391	414	..
Chloride	9,000 J	..	..	..	..
Sulfate	690 J	..	..	..	..
Total Dissolved Solids	20,000	6,100	16,800	2,360	20,100
Total Suspended Solids	..	..	..	..	74
Total Organic Carbon	17 J	8	..	9 J	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Froid and Taylor Road Site Monitoring Well
FTW-5

Compound Name	Apr-90	Jul-90	Oct-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	40 J	---	---	..	412
Antimony	30 J	---	---	..	---
Arsenic	37 J	16.9	5 J	7.2 J	3.3 J
Barium	1,180 J	1,530	1,490 J	..	2,370
Beryllium	---	---	---	..	---
Cadmium	---	---	---	..	---
Calcium	248,000 J	336,000	348,000	..	257,000
Chromium	---	---	---	..	39.6
Cobalt	---	---	---	..	---
Copper	10 J	14.6 J	---	..	---
Iron	88 J	78 J	36.2	..	666
Lead	---	---	..	32 J	---
Magnesium	814,000 J	888,000	830,000	..	673,000
Manganese	265 J	152	49	..	---
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	---
Nickel	---	---	---	..	27.1 J
Potassium	133,000 J	144,000	130,000	..	120,000
Selenium	---	..	..	---	---
Silver	---	9.4 J	10.1	..	2.4 J
Sodium	5,400,000 J	6,060,000	5,980,000	..	4,360,000
Thallium	..	..	..	..	1.6 J
Vanadium	11 J	11.9 J	11.8 J	..	11.7 J
Zinc	22 J	---	---	..	16.4 J
Organic Compounds (µg/L)					
4-Methyl-2-Pentanone	---	---	---	---	..
Acetone	---	..	..	---	..
Carbon Disulfide	---	1 J	---	1 J	..
4-Methylphenol	..	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Diethyl Phthalate	---	---	---	---	..
N-Nitrosodiphenylamine	13 J	---	---	---	..
Diphenylamine	---	0.002	---	..	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	2,000	2,000	2,090	1,990	..
Chloride	10,000 J	..	..	..	..
Sulfate	240 J	..	..	..	..
Total Dissolved Solids	21,000	21,000	19,400	20,300	18,000
Total Suspended Solids	..	..	..	..	23
Total Organic Carbon	39 J	..	..	47	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Wood Hogger Site
WHW-1

Compound Name	Apr-90	Jul-90	Nov-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	74 J	49.1 J	75.8 J	..	---
Antimony	---	---	---	..	---
Arsenic	---	25 J	21.7	..	14.9 J
Barium	373	455	406	649	397
Beryllium	1	---	---	..	---
Cadmium	---	---	---	20.8	---
Calcium	1,210,000	1,160,000	1,240,000 J	1,140,000	748,000
Chromium	---	---	---	15.5	---
Cobalt	104	67.5	133	93	---
Copper	23 J	---	173	54.3	---
Iron	4,990	4,990	7,440	..	9,120
Lead	---	---	---	20	---
Magnesium	2,290,000	2,530,000	2,420,000	..	2,140,000
Manganese	29,600	19,900	29,100	19,800	6,580
Mercury	0.3	---	0.41	..	---
Molybdenum	..	..	..	..	80
Nickel	191	135	271	168	6.5 J
Potassium	88,900	136,000	96,000	132,000	160,000
Selenium	---	..	---	---	---
Silver	---	---	---	..	---
Sodium	15,100,000	14,400,000	17,400,000	15,400,000	15,200,000
Thallium	---	..	---	..	---
Vanadium	19 J	19.8 J	28.1 J	..	25.6 J
Zinc	55 J	---	---	..	11.5 J
Organic Compounds (µg/L)					
Acetone	..	---	---	---	..
4-Methylphenol	---	---	---	---	..
Benzoic Acid	..	---	..	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Dibenzofuran	---	---	---	---	..
Diethyl Phthalate	3 J	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	2,000	2,600	2,420	2,460	..
Total Dissolved Solids	55,800	62,000	55,600	56,200	53,100
Total Suspended Solids	..	..	..	..	40
Total Organic Carbon	110	140	..	86	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Wood Hogger Site
WHW-2

Compound Name	May-90	Jul-90	Nov-90	Jan-91	Oct-97
Metals (µg/L)					
Aluminum	48 J	88.4 J	---	365	276
Antimony	---	---	---	..	---
Arsenic	14	32.8	36.7	24	42.5
Barium	2,620	884	992	2,320	992
Beryllium	---	---	---	..	---
Cadmium	---	---	---	..	---
Calcium	564,000	361,000	368,000 J	457,000	302,000
Chromium	---	---	---	..	---
Cobalt	60 J	---	---	..	10.6 J
Copper	22 J	---	18.3 J	..	---
Iron	19,700	29,000	22,800	65,300	504
Lead	---	---	---	6	---
Magnesium	608,000	792,000	709,000	689,000	620,000
Manganese	14,500	8,010	7,330	10,400	3,950
Mercury	---	---	---	---	---
Molybdenum	..	..	..	..	62.1
Nickel	259	---	---	..	68.5
Potassium	48,500	90,500	96,100	74,300	112,000
Selenium	..	..	---	---	---
Silver	---	11.4	9.8 J	..	---
Sodium	2,900,000	4,160,000	4,290,000	..	3,640,000
Thallium	---	..	---	..	---
Vanadium	---	---	---	..	61.4 J
Zinc	---	---	---	36.5	36.8
Organic Compounds (µg/L)					
Acetone	10	---	---	3 J	..
4-Methylphenol	---	---	---	---	..
Benzoic Acid	---	---	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	..
Dibenzofuran	---	---	---	---	..
Diethyl Phthalate	---	---	---	---	..
Water Quality (mg/L)					
Bicarbonate As CaCO3	---	1,800	1,590	1,350	..
Total Dissolved Solids	13,900	16,000	14,500	14,500	14,300
Total Suspended Solids	..	..	..	..	---
Total Organic Carbon	---	33	..	48	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Wood Hogger Site
WHW-3

Compound Name	Apr-90	Jul-90	Nov-90	Jan-91	Jan-93	Oct-97
Metals (µg/L)						
Aluminum	74 J	---	66.8 J	1,770	..	---
Antimony	---	---	---	..	..	---
Arsenic	17	6.5 J	35.1	14.2	..	23.7
Barium	1,280	2,390	1,920	2,010	..	2,740
Beryllium	---	---	---	..	..	---
Cadmium	---	---	---	..	..	---
Calcium	346,000	473,000	454,000 J	529,000	..	296,000
Chromium	---	---	---	..	..	---
Cobalt	---	---	---	..	..	---
Copper	11 J	---	---	..	..	---
Iron	17,200	40,100	43,700	28,700	..	6,560
Lead	---	..	---	385 J	..	---
Magnesium	744,000	925,000	840,000	758,000	..	519,000
Manganese	3,660	4,630	3,590	9,450	..	5,680
Mercury	---	---	---	---	..	---
Molybdenum	..	..	..	..	..	46.5 J
Nickel	25 J	---	---	..	..	12.9 J
Potassium	83,900	89,200	93,200	50,800	..	65,100
Selenium	---	---	---	---	..	---
Silver	11 J	13.5	8.3 J	..	..	---
Sodium	4,500,000	5,500,000	5,230,000	4,680,000	..	3,410,000
Thallium	---	---	---	..	..	---
Vanadium	---	---	12.9 J	..	..	13.2 J
Zinc	36 J	---	---	85.1	..	18.6 J
Organic Compounds (µg/L)						
Acetone	..	---	22	5 J	---	..
4-Methylphenol	---	---	10	---	---	..
Benzoic Acid	..	---	3 J	---	---	..
Bis (2-Ethylhexyl) Phthalate	---	3 J	---	---	---	..
Dibenzofuran	3 J	---	---	---	---	..
Diethyl Phthalate	---	---	---	---	---	..
Water Quality (mg/L)						
Bicarbonate As CaCO3	1,400	1,300	1,180	800	..	..
Total Dissolved Solids	17,400	19,000	18,300	17,000	..	14,000
Total Suspended Solids	..	..	..	..	..	14
Total Organic Carbon	24	36	..	21	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Wood Hogger Site
WHW-4

Compound Name	May-90	Jul-90	Nov-90	Jan-91	Jan-93	Sep-94	Oct-97
Metals (µg/L)							
Aluminum	71 J	..	88.2 J	523	..	---	---
Antimony	---	..	---	..	..	5.9	---
Arsenic	25 J	132	140	30.3	..	6.0	31.7
Barium	385	..	439	431	..	1,490	1,140
Beryllium	---	..	---	..	..	---	---
Cadmium	---	..	---	..	..	3.4	---
Calcium	1,830,000	..	1,130,000	1,550,000	..	1,600,000	914,000
Chromium	---	..	66.2	30.3	..	---	93.9
Cobalt	46 J	..	---	..	..	6.6	---
Copper	36	..	48.2	29	..	---	---
Iron	43,600	..	2,680	47,400	..	55,300	6,790
Lead	---	---	68.2	---	..	4.4	---
Magnesium	1,240,000	..	1,990,000	1,420,000	..	969,000	1,670,000
Manganese	29,800	..	9,380	20,200	..	13,300	7,060
Mercury	---	---	---	---	..	..	---
Molybdenum	..	..	..	..	..	3.4	67.8
Nickel	38 J	..	---	..	..	9.3	---
Potassium	16,600	..	159,000	63,600	..	117,000	170,000
Selenium	---	..	---	---	..	4	---
Silver	---	..	---	..	..	..	---
Sodium	4,930,000	..	12,400,000	..	..	6,940,000	8,940,000
Thallium	---	..	---	..	..	5.4	---
Vanadium	---	..	28.2 J	..	..	---	33.4 J
Zinc	---	..	12.9 J	..	..	49.0	7.4 J
Organic Compounds (mg/L)							
Acetone	8 J	2 J	---	---	..	..	..
4-Methylphenol	---	13	---	---	..	..	..
Benzoic Acid	---	---	---	---	---	..	..
Bis (2-Ethylhexyl) Phthalate	---	---	---	---	---	..	..
Dibenzofuran	---	---	---	---	..	..	..
Diethyl Phthalate	---	6 J	---	---	---	..	..
Water Quality (mg/L)							
Bicarbonate As CaCO3	..	3,400	1,030	1,760	..	..	..
Total Dissolved Solids	27,200	49,000	38,400	32,400	..	..	35,700
Total Suspended Solids	..	..	..	..	..	..	---
Total Organic Carbon	---	65	..	29	..	..	..

--- = not detected
.. = not analyzed/rejected data
µg/L = micrograms per liter
mg/L = milligrams per liter
J = estimated value

Buildings A3A and E111 - UST Investigation Groundwater Data

NWS Concord Tidal Area

Analyte	A3AMW001 2/20/95	A3AMW001 6/20/96	A3AMW001 7/30/96	A3AMW002 2/21/95	A3AMW002 Dup. 2/21/95	A3AMW002 6/20/96	A3AMW002 7/30/96	A3AMW003 2/20/95	A3AMW003 6/20/96	A3AMW003 7/30/96	A3AMW003 Dup. 7/30/96	E11MW001 2/20/95	E11MW002 2/20/95	E11MW003 3/27/95
VOCs (µg/L)														
1,2-Dichlorbenzene	---	..	..	---	---	..	..	---	..	..	..	---	---	---
1,3-Dichlorbenzene	---	..	..	---	---	..	..	---	..	..	..	---	---	---
1,4-Dichlorbenzene	---	..	..	---	---	..	..	---	..	..	..	---	---	---
Benzene	---	---	..	---	---	---	..	---	---	..	..	---	---	---
Chlorbenzene	---	..	..	---	---	..	..	---	..	..	..	---	---	---
Ethylbenzene	---	---	..	---	---	---	..	---	---	..	..	---	---	---
Toluene	---	---	..	---	---	---	..	---	---	..	..	---	---	---
Xylenes (total)	---	---	..	---	---	---	..	---	---	..	..	---	---	---
Petroleum Indicators (mg/L)														
Diesel	---	0.16	--- J	---	---	0.14	---	---	0.18	---	---	---	7.00 J	---
Kerosine	---	..	..	---	---	..	..	---	..	..	..	---	---	---
Motor Oil	---	0.18	--- J	---	---	0.10 J	---	---	0.17	---	---	---	---	0.72 J
Other Components	---	..	..	---	---	..		---		..	..	---	--- J	

Notes:

µg/L = micrograms per liter

mg/L = milligrams per liter

--- = not detected

.. = not analyzed

SWMU 37 - Geoprobe Grab Groundwater Data

NWS Concord Tidal Area

Analyte	S37-11	S37-12	S37-13
Metals (µg/L)			
Aluminum	733,000	177,000	..
Antimony	---	---	..
Arsenic	404.0	41.7	4.1
Barium	20,200	3,450	..
Beryllium	3.60	---	..
Cadmium	15.90	6.80	..
Calcium	1,330,000	1,640,000	..
Chromium	1,180	250	..
Cobalt	868	183	..
Copper	1,800	286	..
Iron		215,000	..
Lead	632.00	80.30	..
Magnesium	1,070,000	1,940,000	..
Manganese	62,600	53,000	..
Mercury	6.00	0.94	..
Molybdenum	---	48.60	..
Nickel	5,920	3,940	..
Potassium	155,000	72,000	..
Selenium	---	---	..
Silver	---	---	..
Sodium	2,270,000 J	4,990,000	..
Thallium	---	57.8	..
Vanadium	2,260	524	..
Zinc	3,220 J	627 J	..
Other Analytes			
Total Organic Carbon (mg/L)	9.3	14.7	..
pH	6.6 J	6.7 J	6.5
Salinity (parts per thousand)	..	..	7.30

Notes:

Analytical results are for unfiltered Geoprobe grab groundwater samples collected in 1995.

J = estimated concentration

.. = not analyzed

--- = not detected

mg/L = micrograms per liter

mg/L = micrograms per liter

LOW FLOW RATE SAMPLING STUDY GROUNDWATER DATA

NWS CONCORD TIDAL AREA

Point ID	FTW-2			FTW-2		
Sampling Technique	BAILED			LOW FLOW		
Matrix	WATER			WATER		
Sample Date	09/16/94			09/13/94		
	Result	Det. Lim.	Qual.	Result	Det. Lim.	Qual.
Total Metals (µg/L)						
ALUMINUM	ND	35.3	U	177		
ANTIMONY	ND	1.2	U	1.6		
ARSENIC	24.9			6.8		
BARIUM	460			415		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	0.54			ND	0.20	U
CALCIUM	315,000			286,000		
CHROMIUM	ND	0.70	U	3.5		
COBALT	2.8			1.2		
COPPER	ND	1.7	U	ND	1.7	U
IRON	15,300			8,670		
LEAD	1.7			ND	1.0	U
MAGNESIUM	519,000			504,000		
MANGANESE	3,820			3,530		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	3.4			1.9		
NICKEL	13.6			4.6		
POTASSIUM	281,000			298,000		
SELENIUM	3.4			ND	2.3	U
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	4,180,000			4,240,000		
THALLIUM	ND	2.0	U	4.3		
VANADIUM	5.2			2.1		
ZINC	11.9			5.6		
Dissolved Metals (µg/L)						
ALUMINUM	ND	35.3	U	ND	35.3	U
ANTIMONY	7.2			7.6		
ARSENIC	24.9			2.1		
BARIUM	456			365		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	0.51			ND	0.20	U
CALCIUM	320,000			297,000		
CHROMIUM	ND	0.70	U	ND	0.70	U
COBALT	2.9			0.89		
COPPER	ND	1.7	U	9.7		
IRON	14,700			41.6		
LEAD	ND	1.0	U	4.2		
MAGNESIUM	530,000			519,000		
MANGANESE	3,900			3,620		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	3.7			2.3		
NICKEL	15.2			4.3		
POTASSIUM	294,000			310,000		
SELENIUM	ND	2.3	U	4.2		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	4,400,000			4,550,000		
THALLIUM	ND	2.0	U	4.5		
VANADIUM	4.8			ND	1.1	U
ZINC	9.6			ND	3.1	U

µg/L = Micrograms per liter, mg/L = Milligrams per liter
ND; U = Not detected, J = Estimated value, Det. Lim. = Detection Limit, Qual. = Validation Qualifier
Inorganic results less than 10 are reported to two significant figures and results greater than 10 are reported to three significant figures.

LOW FLOW RATE SAMPLING STUDY GROUNDWATER DATA

NWS CONCORD TIDAL AREA

Point ID	RDW-5			RDW-5		
Sampling Technique	BAILED			LOW FLOW		
Matrix	WATER			WATER		
Sample Date	09/16/94			09/16/94		
	Result	Det. Lim.	Qual.	Result	Det. Lim.	Qual.
Total Metals (µg/L)						
ALUMINUM	1,500			7,140		
ANTIMONY	1.2			ND	1.2	U
ARSENIC	59.6			65.2		
BARIUM	642			630		
BERYLLIUM	ND	0.10	U	0.13		
CADMIUM	1.9			4.3		
CALCIUM	1,070,000			1,010,000		
CHROMIUM	13.8			39.4		
COBALT	3.4			7.4		
COPPER	ND	1.7	U	36.0		
IRON	22,800			45,600		
LEAD	2.6			6.5		
MAGNESIUM	1,810,000			1,730,000		
MANGANESE	10,900			10,900		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	8.0			6.3		
NICKEL	21.2			38.2		
POTASSIUM	180,000			198,000		
SELENIUM	4.1			2.8		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	6,530,000			7,280,000		
THALLIUM	6.5			ND	2.0	U
VANADIUM	19.8			37.8		
ZINC	18.4			166		
Dissolved Metals (µg/L)						
ALUMINUM	ND	35.3	U	ND	35.3	U
ANTIMONY	3.7			5.6		
ARSENIC	50.5			41.4		
BARIUM	605			585		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	1.2			0.98		
CALCIUM	945,000			905,000		
CHROMIUM	4.4			2.5		
COBALT	2.3			1.6		
COPPER	ND	1.7	U	ND	1.7	U
IRON	17,500			15,400		
LEAD	ND	1.0	U	ND	1.0	U
MAGNESIUM	1,610,000			1,600,000		
MANGANESE	10,300			9,920		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	7.3			7.6		
NICKEL	10.2			6.3		
POTASSIUM	180,000			203,000		
SELENIUM	4.8			5.1		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	6,600,000			8,070,000		
THALLIUM	7.0			6.7		
VANADIUM	14.5			11.9		
ZINC	ND	3.1	U	ND	3.1	U

µg/L = Micrograms per liter, mg/L = Milligrams per liter

ND; U = Not detected, J = Estimated value, Det. Lim. = Detection Limit, Qual. = Validation Qualifier

Inorganic results less than 10 are reported to two significant figures and results greater than 10 are reported to three significant figures.

LOW FLOW RATE SAMPLING STUDY GROUNDWATER DATA

NWS CONCORD TIDAL AREA

Point ID	TLW-3			TLW-3		
Sampling Technique	BAILED			LOW FLOW		
Matrix	WATER			WATER		
Sample Date	09/16/94			09/15/94		
	Result	**Det. Lim.**	**Qual.**	**Result**	**Det. Lim.**	**Qual.**
Total Metals (µg/L)						
ALUMINUM	72.3	1.2	U	ND	35.3	U
ANTIMONY	ND			2.4		
ARSENIC	8.1			44.5		
BARIUM	41.2			99.7		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	1.1			0.54		
CALCIUM	316,000			466,000		
CHROMIUM	56.6			257		
COBALT	1.9			2.2		
COPPER	ND	1.7	U	ND	1.7	U
IRON	6,130			5,960		
LEAD	ND	1.0	U	ND	1.0	U
MAGNESIUM	2,110,000			2,110,000		
MANGANESE	1,330			3,510		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	7.4			0.80		
NICKEL	15.7			32.4		
POTASSIUM	679,000			598,000		
SELENIUM	2.3			3.3		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	16,400,000			18,200,000		
THALLIUM	ND	2.0	U	3.6		
VANADIUM	ND	1.1	U	2.8		
ZINC	ND	3.1	U	39.3		
Dissolved Metals (µg/L)						
ALUMINUM	ND	35.3	U	ND	35.3	U
ANTIMONY	3.5			10.6		
ARSENIC	12.6			47.2		
BARIUM	46.2			96.7		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	0.30			ND	0.20	U
CALCIUM	267,000			481,000		
CHROMIUM	11.1			76.4		
COBALT	1.1			ND	0.70	U
COPPER	ND	1.7	U	ND	1.7	U
IRON	1,330			36.4		
LEAD	ND	1.0	U	ND	1.0	U
MAGNESIUM	2,000,000			2,510,000		
MANGANESE	1,570			3,630		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	6.3			1.1		
NICKEL	9.3			5.6		
POTASSIUM	708,000			635,000		
SELENIUM	3.8			4.3		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	18,200,000			18,000,000		
THALLIUM	ND	2.0	U	2.5		
VANADIUM	ND	1.1	U	1.2		
ZINC	ND	3.1	U	ND	3.1	U

µg/L = Micrograms per liter, mg/L = Milligrams per liter

ND; U = Not detected, J = Estimated value, Det. Lim. = Detection Limit, Qual. = Validation Qualifier

Inorganic results less than 10 are reported to two significant figures and results greater than 10 are reported to three significant figures.

LOW FLOW RATE SAMPLING STUDY GROUNDWATER DATA

NWS CONCORD TIDAL AREA

Point ID	WHW-4			WHW-4		
Sampling Technique	BAILED			LOW FLOW		
Matrix	WATER			WATER		
Sample Date	09/15/94			09/14/94		
	Result	Det. Lim.	Qual.	Result	Det. Lim.	Qual.
Total Metals (µg/L)						
ALUMINUM	108			ND	35.3	U
ANTIMONY	1.9			1.2		
ARSENIC	6.4			1.7		
BARIUM	1,380			375		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	3.1			ND	0.20	U
CALCIUM	1,960,000			822,000		
CHROMIUM	21.1			90.6		
COBALT	6.6			ND	0.70	U
COPPER	ND	1.7	U	ND	1.7	U
IRON	53,100			1,050		
LEAD	3.8			ND	1.0	U
MAGNESIUM	967,000			1,610,000		
MANGANESE	13,000			599		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	3.2			1.2		
NICKEL	8.7			3.3		
POTASSIUM	124,000			330,000		
SELENIUM	4.9			2.9		
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	7,380,000			11,800,000		
THALLIUM	2.4			ND	2.0	U
VANADIUM	1.1			2.2		
ZINC	8.1			ND	3.1	U
Dissolved Metals (µg/L)						
ALUMINUM	ND	35.3	U	ND	35.3	U
ANTIMONY	5.9			4.5		
ARSENIC	6.0			2.0		
BARIUM	1,490			388		
BERYLLIUM	ND	0.10	U	ND	0.10	U
CADMIUM	3.4			ND	0.20	U
CALCIUM	1,600,000			834,000		
CHROMIUM	ND	0.70	U	67.4		
COBALT	6.6			0.91		
COPPER	ND	1.7	U	ND	1.7	U
IRON	55,300			179		
LEAD	4.4			ND	1.0	U
MAGNESIUM	969,000			1,590,000		
MANGANESE	13,300			590		
MERCURY	ND	0.10	U	ND	0.10	U
MOLYBDENUM	3.4			1.3		
NICKEL	9.3			4.2		
POTASSIUM	117,000			302,000		
SELENIUM	4.0			ND	2.3	U
SILVER	ND	0.60	U	ND	0.60	U
SODIUM	6,940,000			11,100,000		
THALLIUM	5.4			3.1		
VANADIUM	ND	1.1	U	2.2		
ZINC	49.0			ND	3.1	U

µg/L = Micrograms per liter, mg/L = Milligrams per liter

ND; U = Not detected, J = Estimated value, Det. Lim. = Detection Limit, Qual. = Validation Qualifier

Inorganic results less than 10 are reported to two significant figures and results greater than 10 are reported to three significant figures.

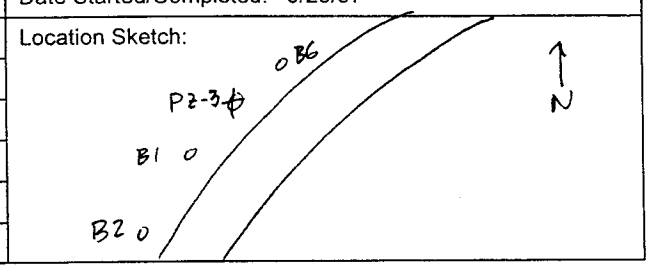
APPENDIX C

SOIL BORING AND PIEZOMETER LITHOLOGIC LOGS

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B1	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: N/A	
Depth to Water (ft. bgs., date): N/A	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

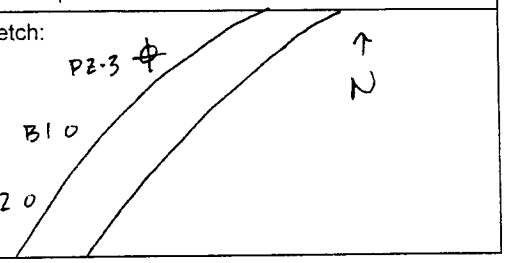
Soil Boring B1

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, angular, sandy	GP		
2		24/4	10/13/18/18	SILT, dark brown to black, stiff, laminated, with some fine sand and mica flakes	ML		
3							
4		24/2	4/3/3/4	SILTY SAND, medium, brown, moist	SP		
5							
6		24/24	1/1/2/3	SILTY CLAY, dark gray	C		
				PEAT, black, loose, wet	PT		
7				SILTY CLAY, black, organic-rich 7.25 - 8.0 is about 50% peat, slight septic odor	C		
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B2	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: N/A	
Depth to Water (ft. bgs., date)	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

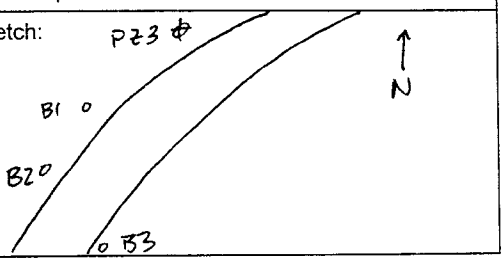
Soil Boring B2

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, with silt and clay	GP		
2		24/12	10/14/14/12	SILT, brown to dark gray, tightly packed, stiff, laminated	ML		
3				SAND, medium to fine, loose, very uniform, moist	SP		
4		24/18	4/2/3/4				
5				CLAYEY SAND, dark gray, wet	SC		
6				SILTY CLAY, dark gray, plastic, moist becomes organic rich (~50% organic material)	C		
7							
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B3	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: N/A	
Depth to Water (ft. bgs., date):	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Soil Boring B3

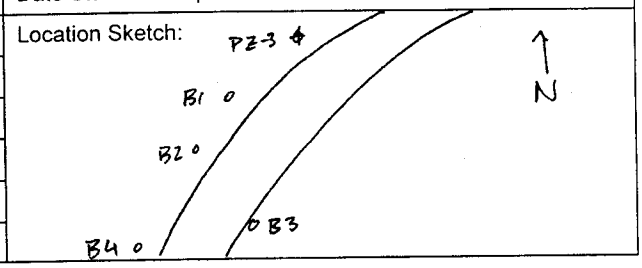
Lithologic Description

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, sandy			
2		24/18	11/16/11/12				
3				SILT, tightly packed			
4		24/24		SAND, brown, medium grained, loose, dry			
5				becomes wet at 5'			
6		24/24		SILTY CLAY, light gray, very plastic, moist SILTY CLAY, black, stiff (peat layer 5.5 - 5.6) SILTY CLAY, light gray, wet			
7				SILTY CLAY, light gray, very plastic, moist SILTY CLAY, black, organic rich			
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B4	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: NA	
Depth to Water (ft. bgs., date):	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

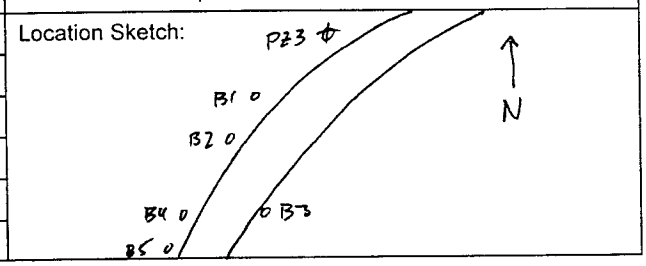
Soil Boring B4

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, sandy, fine to medium grained	GW		
2		24/12	7/8/19/19	CLAY, silty and sandy, mottled brown, dark brown, and tan, very stiff	C		
3							
4		24/18	7/5/4/4	SILTY SAND, brown, medium grained, uniform, moist	SP		
5				becomes wet at 5'			
				SILTY CLAY, light gray, soft	C		
				SILTY CLAY, black, organic rich	C		
6		24/24	1/3/2/3	SILTY CLAY, gray, soft, moist	C		
7				SILTY CLAY, black, organic rich mixed with peat intervals	C		
8				Total Depth = 8'			
9							
10				Becomes soft			

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B5	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: N/A	
Depth to Water (ft. bgs., date):	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

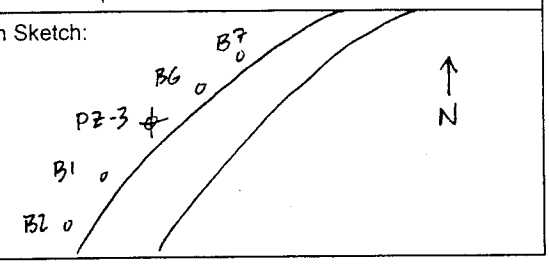
Soil Boring B5

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, angular, with sand and silt matrix	GP		
2		24/12	7/10/19/19	SILTY CLAY, laminated, mottled, Fe-stained, very stiff	C		
3				SAND, brown, medium grained, loose, moist			
4		24/18	5/5/7/8		SP		
5				silty intervals at 4 - 6'			
6		24/24	1/2/3/4	SILTY CLAY, dark gray, stiff	C		
7				SILTY CLAY, black, organic rich with peat intervals	C		
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B6	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: NA	
Depth to Water (ft. bgs., date):	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Soil Boring B6

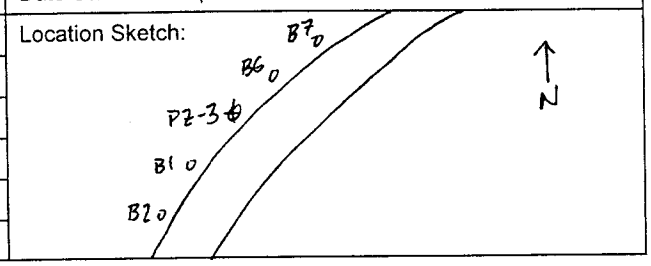
Lithologic Description

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, sandy and silty	GW		
2		24/12	11/14/14/19				
3				SILTY CLAY, dark gray to black, laminated, Fe-staining, mottled, stiff	C		
4				SAND, brown, fine to medium grained, loose, moist	SP		
		24/18	3/3/3/4	SILTY SAND, gray, dry	SM		
5				SILTY SANDY, black, medium grained, wet	SM		
				SILTY CLAY, dark gray, very soft, moist	C		
6		24/24	1/1/1/3	SAND, gray, dry	SP		
7				SILTY CLAY, black, organic rich, with peaty zones	C		
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B7	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing: N/A	
Depth to Water (ft. bgs., date):	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Soil Boring B7

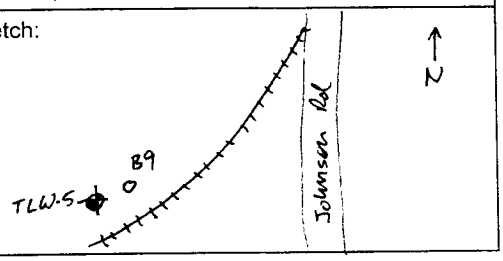
Lithologic Description

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, silty and sandy	GP		
2		24/12	8/20/14/18	SILTY CLAY, mottled, stiff, with abundant sand and fine gravel	C		
3							
4		24/16	2/4/4/3	SAND, brown, fine to medium grained, loose, micaceous	SP		
5							
6		24/24	1/1/2/2	SILTY CLAY, dark gray, moist, very soft	C		
				PEAT, black, wet	PT		
7				SILTY CLAY, black, organic rich, soft, moist	C		
8				Total Depth = 8'			
9							
10							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B9	Date Started/Completed: 10/2/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 8"	
Inner Diameter of Well Casing NA	
Depth to Water (ft. bgs., date)	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Soil Boring B9

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, angular, sandy with cobbles	GM		
2		24/1	8/12/11/10	SILTY CLAY, black			O
3					C		
4		24/8	5/5/6/7	becomes moist			O
5							
6		24/20	1/3/4/6	SANDY CLAY, tan, soft, moist	SC		O
7				SILTY CLAY, tan, very stiff			
8		24/18	5/6/8/12		C		
9							O
10				CLAYEY SAND, tan, soft, very moist	SC		

Soil Boring B9

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
		24/18	4/5/7/8	SAND, tan, soft, wet, loose	SP		0
11				SILTY CLAY, tan, very stiff	C		0
12		24/24	3/6/10/10	SAND, tan, soft, wet, loose	SP		
13				SILTY CLAY, tan, very stiff, dry, uniform			0
14		24/24	3/5/7/9				
15							0
16		24/20	3/4/6/10	becomes moist and less stiff	C		
17							0
18		24/20	3/7/8/10	same, medium stiff, moist			
19							0
20		24/20	4/6/9/13	same, medium stiff, moist			
21							0
22		24/22	4/5/8/11	same, medium stiff, moist			
23				Angular 1-inch limestone pebble, @ 23'			
24							

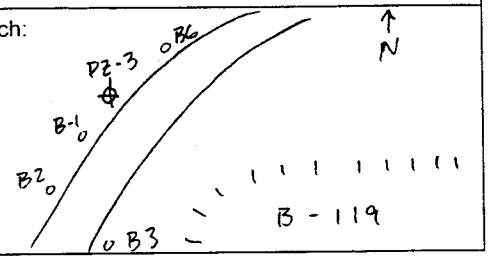
Soil Boring B9

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
		24/24	4/8/10/14	SILTY CLAY, tan, medium stiff, moist with Fe-staining	C		0
5							
26				Total Depth = 26'			

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO: 044-0281
Bldg./Site:
Project: Concord Tidal Area

Boring Number: PZ3	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 10"	
Inner Diameter of Well Casing 4"	
Depth to Water (ft. bgs., date) 6.6, 10/3/97	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Piezometer PZ3

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, Coarse, with sand and silt	GM		
2		24/0	11/17/20/19	No sample recovery, 2-6'			0
3							
4		24/0	4/6/5/3				0
5							
6		24/20	2/1/1/2	SILTY SAND, loose brown, fine to medium, micaceous	SM	▼	0
7				SILTY CLAY, soft, black, with abundant organics and peat lenses	C		
8		24/22	1/2/2/5	SILTY SAND, Loose, brown, fine to medium	SM		0
9				SILTY CLAY, stiff, gray, with rare organic material	C		
10							

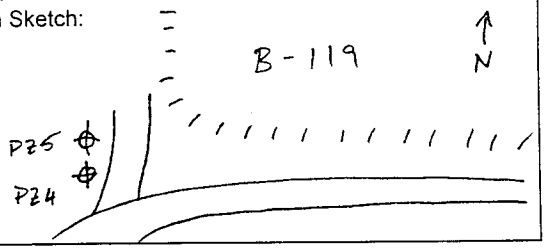
Piezometer PZ3

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
11		24/24	3/4/7/9	SILTY CLAY, stiff, gray with rare organic material	C		0
12		24/18	4/6/11/11	SILTY SAND, brown, stiff, 2-inch seam	SM		0
13				SILTY CLAY, greenish gray, stiff, no organic material	C		
14		24/24	6/8/13/20	SILTY CLAY, tan, very stiff, fractured with white precipitate on fracture surfaces	C		0
15							
16		24/24	7/15/19/21				0
17							
18		24/24	8/10/14/16	SILTY SAND, loose, wet, gray, fine to medium grained,	SM		0
19				becomes stiff from19.5 - 20			
20		24/24	4/8/20/27	Clayey and silty in some intervals			0
21				SILTY CLAY, light olive gray, very stiff, dry, Fe-stained and mottled	C		
22				Total Depth = 22'			
23							
24							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: PZ4	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 10"	
Inner Diameter of Well Casing: 4"	
Depth to Water (ft. bgs., date) 6.4, 10/3/97	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Piezometer PZ4

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, with fine sand and silt matrix	GM		
2				SILTY SAND, light tan, fine	SM		
3				SILTY CLAY, brown, mottled, fine	C		
4				SAND, brown, moist, medium	SP		
5		24/12	2/3/2/3	GRAVEL, gray, fine, rounded	GP		0
6				SILTY CLAY, dark gray, plastic, moist			
7		24/18	3/3/4/5	becomes mottled with root holes	C		0
8				Greenish hue on separation surfaces			
9		24/20	3/4/5/7	SILTY CLAY, greenish gray, mottled, stiff with light tan irregular dry silty zones	C		0
10							

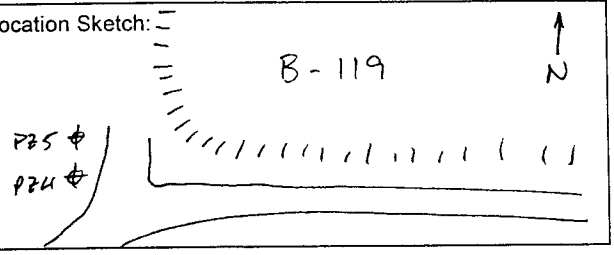
Piezometer PZ4

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
		24/18	4/4/5/7	SILTY CLAY, greenish gray, mottled, stiff	C		0
11				SILTY CLAY, light olive tan, moist, plastic, uniform			
					C		0
12							
		24/20	4/5/7/8				
13				same, fine sand partings 13.5 - 14.5			0
14							
		24/22	8/12/13/16	same, very stiff			
15							
				SANDY CLAY, olive tan, stiff	SC		
16							0
		24/24	8/13/22/27	SAND, brown, loose, wet, fine to medium, flowing			
17							
18					SP		
		24/24	8/13/22/27				0
19							
20				SILTY CLAY, light tan, mottled, very stiff, dry			
		24/18	10/17/28/25	Total Depth = 20.5 (split spoon only 20.5 - 22.5)			
21					C		0
22							
23							
24							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: PZ5	Date Started/Completed: 9/29/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 10"	
Inner Diameter of Well Casing: 4"	
Depth to Water (ft. bgs., date) 8.5 (rising), 10/15/97	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Piezometer PZ5 Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				GRAVEL, coarse, with fine sand and silt matrix	GM		
2				SILTY SAND, light tan, fine	SM		
3				SILTY CLAY, brown, mottled, fine	C		
4				SAND, brown, moist, medium	SP		
		24/12	2/3/2/3	GRAVEL, gray, fine, rounded	GP		0
5				SILTY CLAY, dark gray, plastic, moist			
6				becomes mottled with root holes	C		
		24/18	3/3/4/5				0
7							
8				Greenish hue on separation surfaces			
		24/20	3/4/5/7				0
9				SILTY CLAY, greenish gray, mottled, stiff with light tan irregular dry silty zones	C		
10							

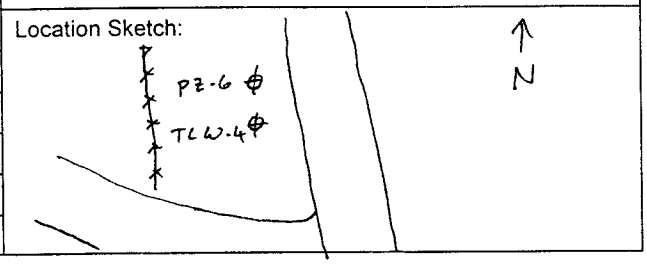
Piezometer PZ5

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
11		24/18	4/4/5/7	SILTY CLAY, greenish gray, mottled, stiff	C		0
				SILTY CLAY, light olive tan, moist, plastic, uniform			
12					C		0
13		24/20	4/5/7/8	same, fine sand partings 13.5 - 14.5			0
14							
15		24/22	8/12/13/16	same, very stiff Total Depth = 15			
16							
17							
18							
19							
20							
21							
22							
23							
24							

TETRA TECH EM INC.

SOIL BORING AND WELL INSTALLATION LOG

CTO:
Bldg./Site:
Project:

Boring Number: B8 (PZ-6)	Date Started/Completed: 10/2/97
Drilling Method: Hollow stem auger, continuous sampling	Location Sketch: 
Outer Diameter of Boring: 10"	
Inner Diameter of Well Casing 4":	
Depth to Water (ft. bgs., date) 7.0, 10/3/97	
Driller: Woodward Drilling, Rio Vista, CA	
Logged By: Rik Lantz, R.G.	

Piezometer PZ-6

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
1				SILTY CLAY, brown, dry	C		
2		24/10	7/10/15/14	SILTY CLAY, dark gray, very stiff, with irregular sand bodies	C		0
3							
4				SILTY SAND, tan fine	SW		
5		24/6	4/5/7/6	SILTY CLAY, dark gray, moist	C		0
6							
7		24/24	3/4/6/8	SILTY CLAY, medium brown, stiff, moist, uniform	C	▼	0
8		24/24	3/5/7/13	Same, with fine sandy zones			0
9							
10				Becomes soft			

Piezometer PZ-6

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
11		24/24	3/9/13/18	SILTY SAND, med. brown, very fine, uniform Wet brown SAND lens @ 11 - 11.25	SW		0
12		24/20	4/5/7/11				0
13				SILTY CLAY, tan, very stiff			
14		24/20	4/7/10/11		C		0
15				SILTY SAND, tan, very fine, moist but not wet	SW		
16		24/24	4/5/7/8	SILTY CLAY, tan, very stiff with small isolated organic inclusions			0
17					C		
18		24/20	6/7/10/12	Same, softer and more moist			0
19							
20		24/22	4/5/6/8	SANDY SILT, tan, stiff, fine	SW		0
21							
22		24/22	4/6/7/9	CLAYEY SILT, tan, very stiff, wet			0
23					ML		
24							

Piezometer PZ-6

Depth (ft) bgs	Sample Number	Drive Interval/ Recovered Interval	Blow Count (per 6 inches)	Lithologic Description	USCS Soil Symbol	Well Construction	OVM (ppm)
25		24/20	4/5/6/7	CLAYEY SILT, tan, very stiff, wet	ML		0
26				Total Depth = 26'			

APPENDIX D

PIEZOMETER WELL DEVELOPMENT RECORDS

PRC ENVIRONMENTAL MANAGEMENT, INC.

Well Development Log

~~MONITORING WELL SAMPLING SHEET~~

Monitoring Well No.: PZ 3 Date: 10/3/97

Personnel: R Lantz

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: _____ ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 10.15 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1120	20 gal	15.1	6.76	29.9	23.6	7999	1.91
1143	30 gal	14.7	6.79	30.4	24.0	7999	1.87
1155	40 gal	12.15	6.76	30.4	26.5	7999	1.80
1240	100 gal	19.6	6.80	30.7	23.0	525	1.91
115	115 gal	13.6	6.75	30.7	27.3	293	1.55
210	165	19.25	6.78	30.6	25.0	155	1.95
300	180	17.5	6.76	30.7	27.3	42	1.63

Begin Purge: _____ Method of Purging ☐ Pump ☐ Bailer

End Purge: _____ Purged Dry? NO

Total Volume Purged: 180 gal How Measured? Est. from 55-gal drum

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: Surged 3 times – 100 swings first time, 50 each 2nd & 3rd.

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PRC ENVIRONMENTAL MANAGEMENT, INC.

Well Development Log

~~MONITORING WELL SAMPLING SHEET~~

Monitoring Well No.: PZ4 Date: 10/3/97

Personnel: R Lantz

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: _____ ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: _____ ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
915	80 gal	10.51	8.15	4.54	20.6	7200	3.29
925	90 gal		8.16	4.51	23.0	7200 (223)	4.15
930	100 gal	16.4	8.16	4.58	20.0	180	2.6
940	115 gal		8.15	4.52	21.6	35	2.0
955	140	14.9	8.14	4.51	20.9	39	2.0
1000	150	16.2	8.14	4.52	20.7	36	1.96
1010	170	12	8.12	4.49	22.2	62	2.0
1025	190	12.35	8.13	4.49	22.1	380	1.9
1030	200	~~12.9~~ 12.3	8.12	4.50	21.9	779	2.3

Begin Purge: _____ Method of Purging ☐ Pump ☐ Bailer

End Purge: _____ Purged Dry? NO

Total Volume Purged: ~~83 gal (15 drums)~~ 200 gal How Measured? Drum Est from 55-gal

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: Developed bottom of screen very well - slowed pump down to allow WL to rise & developed top, but can't pump fast enough to develop and keep water level high.

PRC ENVIRONMENTAL MANAGEMENT, INC.

Well Development Log

~~MONITORING WELL SAMPLING SHEET~~

Monitoring Well No.: PZ-5 Date: 10/3/97

Personnel: R. Lantz

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: _____ ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: _____ ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L

Begin Purge: _____ Method of Purging ☐ Pump ☐ Bailer

End Purge: _____ Purged Dry? Yes

Total Volume Purged: ~ 15 gal How Measured? Est. from 55 gal drum

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: PZ 5 surged for 5 minutes then bailed dry
No measurements of water quality, turbidity, etc because well did not recharge sufficiently to take measurements

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PRC ENVIRONMENTAL MANAGEMENT, INC.

Well Development Log

~~MONITORING WELL SAMPLING SHEET~~

PZ-6

Monitoring Well No.: B9 (Next to TW4) Date: 10/3/97

Personnel: R. Lantz

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: _____ ft

Depth to Water: _____ ft

Water Column: _____ ft

Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
415	35 gal	25.43	7.46	25.9	27.4	880	1.51
445	45 gal	24.75	7.57	24.0	25.4	999	1.61
505	50 gal	25.62	7.48	~~25.2~~ 24.9	25.2	230	1.52
530	55 gal		7.48	25.0	27.2	36	1.37
545	60 gal		7.47	24.7	27.9	22.	1.40

Begin Purge: 405 Method of Purging ☐ Pump ☐ Bailer

End Purge: 545 Purged Dry? No

Total Volume Purged: 60 gal How Measured? Est from 55 gal drum

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: Draws down quickly - stop pump at 415 to allow recharge of sand pack & screened interval.

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APPENDIX E

MONITORING WELL SAMPLING RECORDS

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW-1 Date: 10/9/97

Personnel: Leslie Howard, Bruce Joab

Organic Vapor Concentration TOC: ppm Breathing Zone: ppm

Depth to Well Bottom: 17.5 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.20 ft

Water Column: 12.30 ft Well Volume: gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1537	10 L	8.37	6.38	38.6	18.2	4	2.61
1546	11 L	8.48	6.40	39.1	18.1	5.44	2.87
1555	12 L	8.61	6.40	39.6	18.1	4	2.92
10/10/97 0943	83.5 L	6.52	6.48	43.4	14.7	54.0	2.51
0946	84.5 L	6.96	6.52	42.9	16.0	54.0	2.25
0952	85.5 L	7.08	6.54	43.0	16.3	53.0	2.04
0958	86.5 L	7.31	6.55	43.1	16.3	54.0	2.30

Begin Purge: 15:21 Method of Purging ☒ Pump ☐ Bailer

End Purge: 10:47 10/10/97 Purged Dry? Not today, yesterday nearly dry

Total Volume Purged: 86.5L prior to sampling How Measured? graduated bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/10/97, 0950 Sample Number (s): TLSGW01

Comments: Ants (black) swarming on + in this well. Water has strong H_2S ~~smell~~ odor. 1747 stopped purge at 17.00 ft. water depth. Set hose to 14 ft. depth. Water at 6.52 ft. at 9:21 am (10/10/97) 9:26 ~~ok~~ on 10/10/97 began pumping. Error on DO Calibration

10:47 Sample complete

8.54 Final Depth

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW-2 Date: 10/9/97 (Fri)

Personnel: Lantz / Langevin

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 17.45 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 4.91 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
932	9L	7.81	7.36	38.4	19.7		8.06
935	10L	~~6.40~~ 7.27	7.27	44.7	18.5	8.4	8.6
939	11L	6.85	7.21	44.8	18.1	9.5	9.1
945	12L	6.89	7.23	44.3	19.0	9.7	8.9
954	13L	7.05	7.25	41.0	19.2	10.5	9.0
957	14L	7.12	7.23	43.4	19.9	12.8	8.8
1004	17L	7.70	7.30	35.8	19.6	12.0	9.1
1007	18L	7.72	7.18	44.5	19.5	11.0	9.1
1012	19L	7.75	7.21	45.4	19.3	13.0	9.2
1016	20L	7.75	7.19	45.2	19.4	15.4	9.2
Final 1100		7.76					

Begin Purge: 920 Method of Purging ☐ Pump ☐ Bailer

End Purge: 1016 Purged Dry? No

Total Volume Purged: 20 L How Measured? _____

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/10/97 1030 Sample Number (s): TLSGW02

Comments: Strong H_2S Odor — Very Strong eHexescence w/ HCl — Unpreserved VOCs

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW3 Date: 10/6/97

Personnel: Lantz / Rose

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 16.90 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.77 ft

Water Column: 11.13 ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
420	3L	6.40	—	75.2	19.5	15	10.3
424	4	6.60	—	76.2	19.7	17	10.2
431	5	6.70	—	76.8	19.1	9	10.3
436	6	6.90	—	76.7	18.7	9	10.5
441	7	7.09	—	76.7	18.6	10.3	9.9
446	8	7.25	—	76.7	18.6	9.6	10.7
453	9	7.40	—	76.8	18.4	13.0	10.7
617	67	15.94	—				
10/7 915		12.7	1.4	76.1	16.6	5.3	9.8
9 1055		13.95					

Begin Purge: ~~4:30~~ 4:12 Method of Purging ☒ Pump ☐ Bailer

End Purge: ~~630~~ 617 Purged Dry? YES

Total Volume Purged: 67 L How Measured? Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/7/97 930 Sample Number (s): _____

Comments: Salinity of water interfered w/ pH meter - no readings
Strong H_2S odor, Greenish mist on water & fine black particles. 7.5 L of sample + 3L purge on 10/7
12.7 - Depth to water - 10/7/97

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW4 Date: 10/6/97 (Mon)

Personnel: All

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 20.4 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 9.08 ft

Water Column: ~~20.4 - 10~~ 11.3 ft Well Volume: _____ gal

APT 1.45
50=1.5 LITERS

Time	Vol. Purged	Water Level	pH	Conductivity (~~umhos/cm~~ ms siemens/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
14:00	4 L	~~10.6~~ 10.29	8.8	6.32	20.6	8.1	1.55
14:09	6 L	10.76	8.91	6.34	20.6	2.0	1.91
14:17	8 L	10.96	8.92	6.35	20.9 (from 20.6)	2.0	1.91
14:26	10 L	11.15	8.84	6.25	20.6	1.2	2.06
14:35	12 L	11.30	8.83	6.38	20.6	0.9	1.95
14:40	13 L	11.37	8.83	6.37	20.6	1.0	2.06
14:48	14 L	11.41	8.84	6.37	20.5	0.8	2.05
14:53	15 L	11.44	8.83	6.40	20.5	0.7	2.00
17:00		12.21					

Begin Purge: 1345 Method of Purging ☒ Peristaltic Pump ☐ Bailer

End Purge: 1455 Purged Dry? No

Total Volume Purged: 15 L How Measured? Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☒ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/6 1500 Sample Number (s): TLSGW04

Comments: MS/MSD

pH meter reading 4.30 in 4.0 solution

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW5 Date: 10/7/97 (Tues)

Personnel: Lance / Jack

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 20.36 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 7.87 ft

Water Column: 12.49 ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
254	10L	10.71	7.79	7.47	21.4	23.4	3.26
259	11L	10.88	7.70	8.40	21.2	27.3 ~~21.2~~	~~2.55~~ 3.2
306	12L	10.41	7.67	8.67	21.4	24	3.0
315	13L	10.19	7.69	8.47	21.3	18	3.0
322	14L	10.23	7.74	8.13	21.1	16	3.3
325	15L	10.24	~~7.88~~	8.22	21.0	15	2.7
330	16L	10.27	7.72	8.27	21.0	15	3.2
336	17L	10.28	7.73	8.35	20.8	13	2.18
340	18L	10.31	7.70	8.39	20.8	13	2.80
345	19L	10.33	7.73	8.45	20.7	13	2.26
349	20L	10.33	~~7.75~~ 7.74	8.51	20.8	13	2.1

Begin Purge: 238 Method of Purging ☑ Pump ☐ Bailer

End Purge: 352 Purged Dry? NO

Total Volume Purged: 21 L How Measured? Bucket

QA\QC Sample Collected Here? ☒ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 1600 + 1700 Sample Number (s): TLS GW05 & GW05 (DUP)

Comments: Reverted pump rate @ 2:52 (10L)
10.52 at 5:10 PM

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: TLW6 Date: 10/7/97 (Tues)

Personnel: Lantz / Rose

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 20.4 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 9.45 ft

Water Column: 10.95 ft Well Volume: 1.24 gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1055	12 L	11.9	X	15.6	22.0	46.6	11.1
1110	14 L	12.74	1.26	15.8	21.9	13.2	11.2
1115	15 L	12.84	1.51	15.7	22.0	10.1	11.6
1120	16 L	12.98	1.70	15.8	21.6	10.6	11.7
1125	17 L	13.15	1.73	15.8	22	56.0	11.7
10/8/97 2000		12.75					
10/9/97 915		9.40	~~6.49~~	~~16.0~~	~~20.2~~	~~17.0~~	~~1.7~~ VAH
926	1L		6.49	16.0	20.2	17.0	1.7
932	2L		6.50	16.0	20.5	17	1.7
final 1004		10.8					

Begin Purge: 1040 Method of Purging ☑ Pump ☐ Bailer

End Purge: 1220 Purged Dry? yes

Total Volume Purged: 43 L How Measured? Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/9/97 1000 Sample Number (s): TLSGW06

Comments: well ~~dry~~ recharged too slowly for low flow lab sampling.
Purged dry & will sample on 10/7
No very little recharge on 10/8 - will sample with more recharge.
Problem with meter - DO + pH

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: ~~RDA-4~~ TLW-7 Date: 10/14/97

Personnel: R. LANTZ, C. LANGARI

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 17.7 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.12 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
152	38L	8.09	7.14	16.9	19.6	13	15.2
156	39L	8.13	7.16	17.2	20.0	13	13.5
202	40L	8.17	7.16	17.2	20.0	13	12.7
209	41L	8.21	7.16	17.3	20.3	13	12.8
10/15/97 1045	~~41L~~	8.94	6.70	17.2	18.9	3.0*	7.00 (unstable)
1051	~~42L~~	9.04	6.73	17.3	17.8	3.0*	4.20 (unstable)
1055	~~43L~~	9.15	6.74	17.4	17.8	3.0*	19.33 (unstable)

Begin Purge: 1251 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1556 Purged Dry? ☒ yes

Total Volume Purged: 80L How Measured? Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: Strong H_2S odor, water effervesces

10/14/97 pumped to depth of 16.7 ft.

* 10/15/97 LaMotte Turbidity Meter malfunctioning (negative readings) switched to using turbidity on the Horiba.

10/15/97 Final Depth to water at 11:37 AM was 10.67

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RDW-1 Date: 10/8/97 (Wed)

Personnel: Cantz / Vervaeren

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 20.4 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 7.55 ft

Water Column: _____ ft Well Volume: _____ gal

	Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
	435	12L	12.18	6.72	16.7	18.6	3.2	9.3
	439	14L	12.57	6.76	16.8	18.6	2.4	9.2
	450	16L	12.78	6.78	16.5	18.6	2.8	8.9
	503	25L	14.1					
10/9	1030		18.2					
10/10	1310		16.43					
	1327	1L		6.66	14.8	18.0	3.2	1.94
	1335	2L		6.62	15.7	17.7	9.0	1.97
	1340	3L		6.62	15.6	17.6	7.9	1.96

Begin Purge: 3:25 Method of Purging ☐ Pump ☒ Bailer

End Purge: 1815 Purged Dry? Y

Total Volume Purged: 28L How Measured? _____

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/10/97 1400 Sample Number (s): RDSGW01

Comments: Total Vol Purged - 67 L. Water level 19.95
10/9/97 water level 18.2

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RDW02 Date: 10/8/97

Personnel: Cindi Rose, Bruce Jacobs

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 19.93 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 4.92 ft

Water Column: 15.01 ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1627	21L	11.20	7.21	42.6	18.6	54.4	2.75
1633	22L	11.37	7.21	43.1	18.6	57	3.00
1642	23L	11.54	7.24	43.2	18.4	58	3.12
1650	24L	11.70	7.24	43.1	18.4	65	3.25
10/9/97→ 1058	54.5L	14.53	—	—	—	—	—
1150	82.5L	19.79	—	—	—	—	—
10/10/97→ 1335	82.5L	16.47	6.89	41.3	17.0	20.0	10.64
1st READING 1335	1L	16.80	6.82	43.2	16.9	20.20	10.35
~~1351~~	85.5	17.21	6.85	43.7	16.6	18	10.31
Final Reading 1416	—	17.63	—	—	—	—	—

Begin Purge: 1539 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1416 Purged Dry? yes

Total Volume Purged: 85.5L How Measured? grad. bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/10/97, 1400 Sample Number (s): 281RDSGW02

Comments: 1601 - 10L. *ped up purge rate at 1650. Greenish hue to water. Stopped purge at 16.63 ft due to both batteries dead. Total of 53.5L purged. Raised hose to 16ft depth. 10/9/97 Purged again 10/9/97. stopped at 1150, water at 19.79 ft. Set hose depth at 17 ft.

S:\rik\sample.frm.doc 10/10/97 Lowered hose to a depth of 18 ft. ~~bottom~~ to ensure reliable readings.
10/10/97 13:47 vial shattered in turbidity meter. Calibrated again but only read 3.5 NTU with 5.0 NTU standard.

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RDW 3 Date: 10/9/97

Personnel: Luntz | Howard

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 18.1 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 3.27 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1128	12L	5.50	6.45	20.6	20.2	40	10.55
1130	14L	5.10	6.45	20.5	20.3	36	10.53
1135	16L	4.42	6.45	20.3	20.3	34.5	10.6
1138	17L	4.10	6.49	20.2	20.2	34	10.6
1143	18L	3.75	6.42	20.0	20.4	20	10.6
1149	19L	3.55	6.41	~~20~~ 19.6	20.5	13	10.8
1153	20L	3.48	6.42	19.6	21.0	10	10.8
1200	21L	3.46	6.42	19.4	20.7	9	11.0
1206	22L	3.45	6.41	19.2	20.7	16	11.1
1225		3.4					

final WL

Begin Purge: 1115 Method of Purging ☐ Pump ☐ Bailer

End Purge: 1210 Purged Dry? No

Total Volume Purged: 22L How Measured? _____

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/9/97 1210 Sample Number (s): RDSGW03

Comments: water has hydrocarbon odor & sheen. Well bubbled at first, then ceased. High tide in Otay Slough ~25 ft West

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RDW-4 Date: 10/13/97

Personnel: Cindi Rose, Bruce Joab

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 20.38 ft

Depth to Water: ~~9.98~~ 9.06 ft

Water Column: ~~20.32~~ 11.32 ft

Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Well Volume: _____ gal

	Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
	1133	19L	12.02	6.50	17.0	20.0	12.0	3.25
	1143	20L	12.13	6.60	17.1	20.6	11.1	2.47
	1153	21L	12.25	6.53	17.1	21.3	11.6	2.38
	1201	22L	12.36	6.50	17.0	21.3	13.2	5.71
10/14	1125		13.51					
	1137	1L	14.10	6.98	15.8	19.9	4.0	10.9
	1142	2L	14.32	6.94	15.8	20.0	2.6	11.5
	1147	3L	14.40	6.95	15.8	20.3	1.9	11.4
Final	1210		14.65					
		(3.5L of sample)						

Begin Purge: 11:05 Method of Purging ☒ Pump ☐ Bailer

End Purge: _____ Purged Dry? yes

Total Volume Purged: ~~78L~~ 79L How Measured? graduated bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: _____ Sample Number (s): _____

Comments: 12:04 increased pump rate to purge well.

Water Level 19.31 At 1313. Purged 79L. Hose set to 16.5

10/14/97 at 10:45, water depth at 13.95 ft

10/14/97 Water level at other sluice at low tide

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

RDSGW05

Monitoring Well No.: RDW-5 Date: 10/8/97

Personnel: Cindi Rose, Bruce Joab

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 26.30 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 12.20 ft

Water Column: 14.10 ft Well Volume: _____ gal

	Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L	
	9:57	16.5L	17.0	6.73	33.5	17.9	10.8	2.03	
	10:03	18.L	17.33	6.74	33.1	18.5	16.3	2.12	
	10:08	19.L	17.48	6.77	31.7	18.6	20.5	2.02	
	10:16	20.L	17.62	6.77	31.3	18.5	21.6	1.92	
10/9	9:05		22.76						
			+19.13						
0/13	1103	2053.5	19.13	6.17	31.4	21.2	11.0	3.33	
	1115	54.5	19.42	6.17	31.4	20.4	8.0	7.20	*
	1124	55.5	19.6	6.17	31.7	20.7	4.0	5.00	*
	1134	56.5	19.8	6.17	31.4	20.7	0.5	4.00	*

Begin Purge: 09:32 Method of Purging ☒ Pump ☐ Bailer

End Purge: 12:07 (10/14/97) Purged Dry? yes

Total Volume Purged: _____ How Measured? graduated bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☒ No QA/QC Sample

Date and Time of Sample Collection: 10/14/97, 11:30 Sample Number (s): RDSGW05

Comments: Water has green color, smells slightly of H_2S. Bubbles flowing in tubing. oily sheen on water in bucket. 53.5L total volume purged. Stopped at 11:53. Depth of well at 24.71 ft. Hose set at 16 ft.

Well was purged to 23.5 ft on 10/8

S:\rik\sample.frm.doc 10/14/97 - water level depth at 20.31 ft after sampling was completed (12:07)

* - DO - Unstable. Many bubbles in line.

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RDW-6 Date: 10/8/97 (wed)

Personnel: Lantz / Vanderman

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 17.1 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 4.87 ft

Water Column: 12.2 ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
940	12 L	7.3				30	
950	17L	7.3				29	
1026	30L	7.94					
10:30	30.5 L	7.94					
10:42	33 L	8.15	6.90	28.3	15.9	8.080 NV	2.45
10:47	34 L	8.30	7.07	29.4	15.7	98	2.95
10:53	35 L	8.42	7.09	29.6	15.9	118	2.99
11:00	36 L	8.70	7.09	29.6	15.9	113	3.15
11:07	37L	8.95	7.06	28.6	15.7	72	3.22
end → 1220	89L	16.00					
10/9 Thurs → 0914	89L	10.71	6.72	23.3	15.7	26	10.66
0925	BMB 90L	11.03	6.72	26.0	16.2	24	10.28
0932	91L	11.20	6.74	26.3	16.2	19	10.31

Begin Purge: 9:26 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1220 Purged Dry? Yes

Total Volume Purged: 89 L How Measured? Graduated Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/9/97 945 Sample Number (s): RDSGW06

Comments: water Quality meter is not functioning so no pH, cond, etc. lowered hose 1.0 ft to draw water for sampling. Lowered 6 inches more to get TSS, TDS, & isotope samples due to dryness (drawing up air)
Final level = 11.96 ft. at 10:12 am.

PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: RPW-7 Date: 10-13-97

Personnel: R. Lantz, M. Rash

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 17.20 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 4.61 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
~~1145~~ AR	39L	6.47	6.25	69.7	19.4	24	11.2
1149	40L	6.10	6.25	705	19.7	28	11.9
1153	41L	6.0	6.22	70.9	20.3	35	12.68
1157	42L	5.9	6.23	71.2	20.5	39	13.39
1200	43L	5.85	6.18	70.5	20.6	38	13.16
1204	44L	5.82	6.20	71.0	20.4	36	13.92
1210	45L	5.80	6.17	70.3	20.62	39	14.0
1215	46L	~~5.80~~ 5.79	6.16	70.3	20.2	41	14.1
1219	47L	5.79	6.16	70.4	20.2	41	14.7
1223	48L	5.79	6.16	70.5	20.2	41	14.7
1238	—	5.81	—	—	—	—	—

Begin Purge: 1146 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1225 Purged Dry? NO

Total Volume Purged: 48 L How Measured? bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☑ No QA/QC Sample

Date and Time of Sample Collection: 10-13-97 1225 Sample Number (s): RDSGW07

Comments: Strong H_2S odor

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: FTW-1 Date: 10/14/97

Personnel: R.K Lantz, Bruce Joab

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 21.15 ft

Depth to Water: 3.97 ft

Water Column: 17.18 ft

Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1733	20L	6.84	~~7.33~~ 6.65	~~0.024~~ 32.4	21.5	4	13.7
1740	21L	6.20	6.60	32.8	21.5	1.6	13.8
1745	22L	5.93	6.59	32.8	21.3	1.7	13.3
1750	23L	5.76	6.58	32.9	21.0	2.0	12.8
1755	24L	5.62	6.56	32.9	20.8	1.5	12.5
1759	25L	5.52	6.55	33.0	20.7	1.5	12.6
1805	26L	5.43	6.54	33.0	20.7	1.3	12.8
1810	27L	5.37	6.54	33.0	20.6	2.0	12.8
1815	28L	5.33	6.56 ~~6.54~~	33.0	20.6	2.5	12.4
1820	29L	5.29	6.55	33.2	20.3	1.3	12.2
1825	30L	5.27	6.54	33.1	20.2	1.7	12.0
1830	31L	5.25	6.52	33.1	20.1	2.5	11.9

Final WL = ~~5.17~~

Begin Purge: 17:04 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1835 Purged Dry? NO

Total Volume Purged: 32L How Measured? graduated bucket

QA\QC Sample Collected Here? ☑ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/14/97 18:20 & 1840 Sample Number (s): FTSGW01 & FTSGW06

Comments: Samp Dup

4 Liters Samp + Dup

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET FTSGW02

Monitoring Well No.: FTW2 Date: 10/7/97

Personnel: Rox & Demetrios

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 18.9 ft

Depth to Water: ~~17~~ 16.5 ft

Water Column: 12.4 ft

Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft
0.1 ft = 0.5L 1.24

Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (umhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
~~1440~~	~~21~~						
1445	22L	11.5	2.9	21.2	21.7	85	7.21
1454	24L	11.78	3.2	21.2	22.6	242	6.9
1500	25L	11.91	3.25	21.2	18.2	152	6.4
1509	26L	12.12	3.3	21.2	19.2	290	9.5
1519	27L	12.42	3.2	21.1	20.8	250	9.5
10/8/97 1353		13.32					
1359	~~70~~ 1L		7.04	22.9	19.2	45	1.90
1406	2L		7.01	22.8	19.1	46	1.90

Begin Purge: 1420 Method of Purging ☒ Pump ☐ Bailer

End Purge: ~~10/8/97 14:14~~ bmp Purged Dry? Yes

Total Volume Purged: 29 L How Measured? graduated bucket.

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/8/97, 1405 Sample Number (s): FTSGW02

Comments: total purged - 55 L (10/7/97), 14.35 ~~ft~~ bmp at 14:14 when sampling was complete.

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

1... → 125

Monitoring Well No.: FTW - 3 Date: 10-7-97

Personnel: JOAB & DEMETRIOS

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 17.58 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.91 ft

Water Column: _____ ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
0955	8.2L	7.27	6.97	18.0	19 °C	~~10~~ 1733.7	2.7
1005	10.0L	7.41	7.00	~~16.5~~ 18.4	16.5°C	42.06	2.~~5~~
1010	11.0L	7.63	7.14	18.4	16.9	57.7	2.3
1015	12. L	~~7.73~~ 7.9 ~~10~~	7.01	18.2	14.1	~~5~~7.2	2.2
1101	~~23~~ 32L +11 +9	11.19	7.00	18.4	19.1	*	3.70
1106	33	11.33	7.02	18.4	17.5	* 13	3.65
1113	35	11.45	7.03	18.5	17.7	4	3.61
1119	36	11.54	7.00	~~18.0~~ 18.5	18.7	95	3.61
1125	37	11.63	7.01	18.5	19.5	4	3.4~~0~~
~~1235~~							
Wed 10-8-97 1407 → 1407	RJV —	@ 1407 9.27	6.88	17.3	18.3	1.6	9.4
1418			6.88	17.4	~~9.0~~ RJV 18.2	1.2	9.0
1500 → after sample collected RJV		10.67					

Begin Purge: 09:40 Method of Purging ☒ Pump ☐ Bailer

End Purge: _____ Purged Dry? Yes

Total Volume Purged: 14:40 10/8/97 How Measured? _____

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 14:40 10/8/97 Sample Number (s): 281 FTSGW03

Comments: * TURBIDITY Meter ran out of power. SWITCHED TO HORIBA Meter. 12:35 stopped pumping Water depth is 16.11 ft. Total volume purged is 61.5 Liters. Pulled hose up 3 ft (should now be at 14 ft

Water smells slightly of H_2S

10:15 - increased pump rate.

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: FTW-4 Date: 10/14/97

Personnel: Bruce Jack, Cindi Rose

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 16.28 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.48 ft

Water Column: 10.80 ft Well Volume: _____ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C) °F	Turbidity NTU	DO mg/L
14:03	41L	9.52	6.43	26.0	24.2	0.3	2.75 *
14:10	42L	9.15	6.44	26.8	22.3	0.3	2.53
1417	43L	8.86	6.44	26.5	22.2	0.2	2.51
1423	44L	8.62	6.46	26.5	22.0	0.2	2.71 *
1429	45L	8.39	6.43	26.3	22.4	0.2	2.57
1435	46L	8.14	6.43	26.4	22.3	0.2	2.12
1442	47L	7.90	6.45	25.9	21.9	0.1	2.63
1448	48L	7.70	6.44	25.8	21.9	0.1	2.06
15:20	—	6.79 final d	—	—	—	—	—

Begin Purge: 13:11 Method of Purging ☒ Pump ☐ Bailer

End Purge: 15:20 Purged Dry? No

Total Volume Purged: _____ How Measured? graduated bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☒ No QA/QC Sample

Date and Time of Sample Collection: 10/14/97, 14:50 Sample Number (s): FTSGW04

Comments: Obstruction (well cap) at 5½ ft moved enough to get bailer down well.
Bryan collecting sample at ~~14:34~~ ~~15:03~~ 14:45

* DO reading is unstable

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: FTW-5 Date: 10/14/97 (13 crossed out)

Personnel: Rose,

Organic Vapor Concentration TOC: ______ ppm Breathing Zone: ______ ppm

Depth to Well Bottom: 18.57 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 2.98 ft

Water Column: ______ ft Well Volume: ______ gal

Time	Vol. Purged	Water Level	pH	Conductivity (μmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1813	77L	8.66	6.58	23.4	19.8	ø.5	2.87
1822	78L	8.70	6.59	23.6	19.1	ø.5	3.15
1828	79L	8.65	6.78	24.0	18.7	ø.5	5.56
1835	80L	8.65	6.78	24.0	18.5	ø.5	6.34
1842	81L	8.60	6.79	23.9	18.0	ø.5	4.3
1845	82L	8.65	6.56	23.9	18.0	0.5	18.07 (?)
1853	83L	8.63	6.55	23.9	17.8	0.5	16.62
1901	84L	8.65	6.54	23.9	17.8	0.5	9.73

No sychronization between watches. Did watch change. ←

Begin Purge: ______ Method of Purging ☒ Pump ☐ Bailer

End Purge: ______ Purged Dry? No

Total Volume Purged: ______ How Measured? grad. bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/14/97, 19:15 Sample Number (s): FTSGWø5

Comments: Turn pump rate back at 76L, water level 8.66

10+10+10+10+10+10+10+10-
6:05

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: - FLW-1R WHW1 Date: 10/13/97

Personnel: Comfort / Nash

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 19.2 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.96 ft

Water Column: — 13.24 ft Well Volume: — 8.6 gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
1450	11L	7.90	6.48	61.1	24.2	8	12.6
1456	12L	7.75	6.49	61.42	24.0	11	11.6
1501	13L	7.80	6.46	61.3	23.9	9	10.9
1505	14L	7.82	6.47	61.4	24.1	13	10.8
1510	15L	7.87	6.47	61.5	24.0	14	10.7
1515	16L	7.92	6.47	61.6	23.8	18	10.7
1521	17L	7.91	6.48	61.5	24.1	25	10.5
1528	18L	7.87	6.44	61.3	24.0	22	10.5
1534	19L	7.86	6.45	61.5	24.1	21	10.4
1603	—	7.86	—	—	—	—	—

Begin Purge: 1433 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1535 Purged Dry? NO

Total Volume Purged: 19L How Measured? Bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☒ No QA/QC Sample

Date and Time of Sample Collection: 10/13/97, 1535 Sample Number (s): WHSGW01

Comments: _____

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: WHW2 Date: 10-13-97

Personnel: R. Lantz, M. Rash

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: 19.1 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 5.54 ft

Water Column: 13.56 ft Well Volume: 8.8 gal

	Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
	1635	9L	8.25	6.60 mv	20.4	22.1	26.0	11.25
	1640	10L	8.41	6.60	20.4	22.0	28 ne	10.82
	1645	11L	8.58	6.58	20.5	22.1	30	10.64
	1815	—	18.58	—	—	—	—	—
			~~3.24~~ (cm)					
10/15/97	0930	11L	13.20	6.51	18.5	19.0	8.50	10.69
	0938	12L	13.61	6.55	18.5	19.5	14.10	10.65
	0942	13L	13.72	6.54	18.5	19.5	21.20	10.90
	0948	14L	13.87	6.53	18.5	19.7	22.50	11.27

Begin Purge: 1623 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1815 Purged Dry? Yes

Total Volume Purged: 50L How Measured? bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☒ No QA/QC Sample

Date and Time of Sample Collection: 10/15/97, 0950 Sample Number (s): WHS6W02

Comments: Purged dry on 10/13 - Final water level = 18.58
10/14/97 - water level at 15.78ft at 10:23.
15.56 ft final water level after sampling at 10:11.

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: WH W3 Date: 10/14/97

Personnel: R. LANTZ, C. LANGARI

Organic Vapor Concentration TOC: ppm Breathing Zone: ppm

Depth to Well Bottom: 17.3 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 3.24 ft

Water Column: ~~3.2~~ 14.06 ft Well Volume: 9.1 gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L
(MW) ~~0854~~		3.24					
0915	9L	6.15	6.79	21.7	16.9	36.0	10.68
0919	10L	6.28	6.79	21.9	16.8	30.0	10.89
0925	11L	6.41	6.86	21.7	16.8	30.0	10.22
10/15 0923		3.28					
931	1L	3.80	6.25	19.4	17.6	24	13.9*
934	2L	4.09	6.27	19.3	17.9	24	8.4*
936	~~3~~ 3L	4.21	6.31	19.3	17.6	25	9.1*
942	4L	4.45	6.30	19.4	17.6	26	~~4.6~~ 3.6, 2 pretty stable
958		5.07 - Final		(Sample was 3L total)			

Begin Purge: 0903 Method of Purging ☒ Pump ☐ Bailer

End Purge: 1100 Purged Dry? ~~Y~~ yes

Total Volume Purged: 76 L How Measured? Bucket.

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☐ No QA/QC Sample

Date and Time of Sample Collection: 10/15/97 935 Sample Number (s): WHSGW03

Comments: Lots of organic matter floating in water, even at very low flow rates. Purged to 16.35 ft on 10/14/97

Turbidity meter has calibration problem - used Horriba

* DO is reading erratically

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PRC ENVIRONMENTAL MANAGEMENT, INC.

MONITORING WELL SAMPLING SHEET

Monitoring Well No.: WHW-4 Date: 10/13/97

Personnel: Cindi Rose, Bruce Jacob

Organic Vapor Concentration TOC: _____ ppm Breathing Zone: _____ ppm

Depth to Well Bottom: ~~20.40~~ 19.21 ft Well Volume: 2-inch well = water column x 0.163 gal/ft
3-inch well = water column x 0.367 gal/ft
4-inch well = water column x 0.652 gal/ft

Depth to Water: 2.00 ft

Water Column: 18.40 ft Well Volume: 12 gal

WHSGW04

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C) °F	Turbidity NTU	DO mg/L
15:00	21	7.90	6.58	54.7	20.8	3	2.63
15:07	22	7.99	6.59	55.2	20.4	4	3.42
15:15	23	8.14	6.60	55.0	20.3	3	3.39
15:23	24	8.31	6.60	55.2	20.3	3	3.58
10/14/97 0905	24	9.01	6.42	51.2	16.7	18	17.8
0913	25	9.35	6.47	48.5	15.9	15	8.20*
0922	26	9.86	6.56	47.6	17.9	23	4.44
0929	27	10.12	6.67	45.5	18.4	16	3.62

Begin Purge: 14:29 Method of Purging ☒ Pump ☐ Bailer

End Purge: 09:57 on 10/14/97 Purged Dry? X yes

Total Volume Purged: _____ How Measured? graduated bucket

QA\QC Sample Collected Here? ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank ☒ No QA/QC Sample

Date and Time of Sample Collection: 10/14/97, 09:20 Sample Number (s): WHSGW04

Comments: Standing water at base of well pipe. Water smells of H_2S. At 15:30 increased purge rate. Purged dry - 86 L (1722). Hose height set to 16 ft. Began collecting samples at 09:32. Final water level is at 10.97 ft at 09:57.

* - Unstable DO - Avg taken

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APPENDIX F

RADIOISOTOPE DATA LABORATORY REPORTS

Concord CTO-281

DATA CHEM LABORATORIES
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Case Narrative

Analysis:	γ - Spectrometry	**Client:**	Tetra Tech-EMI
Preparation SOP #:	WR-DC-200	**Account:**	03006
Analysis SOP#:	WR-EP-325	**Matrix:**	Water
DCL Set ID:	97C-0383-01	**Prep Group:**	G97B900F

General Set Information: These sets consisted of eleven field samples. They were received into the Radiochemistry laboratory on October 23, 1997.

Method Summary: The samples were counted following method WR-EP-325 (EPA 901.1). The analysis software employed a library of naturally occurring and manmade radiological nuclides as specified by the client.

Sample Preparation: The samples were placed in a 1.0 L Marinelli beaker according to procedure.

Holding Times: Holding times were not applicable to this project.

Dilutions: Dilutions were not required.

Method and Sample QC Data:

Laboratory Control: The laboratory control sample (LCS) used was an Amersham Mixed-γ source and was within the method acceptance criteria.

Blank: The blank consisted of acidified DI water, and was within the method acceptance criteria. Additional analytes listed on Form C are tracked in DataChem's quality control database.

Matrix Duplicate: The Relative Error Ratios (RER) between the sample and the duplicate were within the method acceptance criteria

Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

Flagging Codes: Sample results coded with a "U" indicate the nuclide was not identified by the Canberra Nuclear NID™ program. Activity values reported in the LIMS were calculated using the Canberra Nuclear MINACT™ program.

0003

Nonconformance/Corrective Action Report (NC/CAR): No NC/CARs were required.

Miscellaneous Comments: The client is advised to study the peak search, NID™ & MINACT™ reports then interpret the results according to specific knowledge of the sample origin. The MDA's for Co-60 were not met. In order to have met this level 2,000 + min counts would have had to be made and may still have not met MDA's due to diminishing returns. Counting this long would not have been feasible given the time element and detector availibility. The Cs-137 MDA's were met.

11/13/97

Analyst **Date**

B.H./Supt: will shoot for 5 or 6 pCi/L, depending on background, by extending the counts. Usually guarantee 10 pCi/L for a 1 L sample. Looks like 5 or 6 pCi/L was achieved.

DATA CHEM LABORATORIES
A Sorenson Company

COVER PAGE

ANALYTICAL REPORT FOR
Tetra Tech - EMI

Phone(415) 543-4880 Fax(415) 543-5480

Form COVER-V1.3
11139709034536
Page 1

G979H026

DCL Report Group..: 97C-0383-01

Date Printed.....: 13-NOV-97 09:03

Project Protocol #: P979H001
Client Ref Number.: Not Provided
Release Number....: Not Provided

Analysis Method(s): WR-EP-325

Tetra Tech - EMI
Attention: Rameen Moezzi
135 Main Street, Suite 1800
San Francisco, CA 94105

Client Sample Name	Laboratory Sample Name	Date Sampled	Date Received
Method Blank	BL-141125-1	NA	NA
LCS	QC-141125-1	NA	NA
TLSGW02	97C04612	10-OCT-97	16-OCT-97
TLSGW05	97C04613	07-OCT-97	16-OCT-97
TLSGW08	97C04614	07-OCT-97	16-OCT-97
RDSGW01	97C04615	10-OCT-97	16-OCT-97
RDSGW04	97C04616	14-OCT-97	16-OCT-97
RDSGW04	97C04616MD	14-OCT-97	16-OCT-97
RDSGW03	97C04617	09-OCT-97	16-OCT-97
RDSGW07	97C04618	13-OCT-97	16-OCT-97
FTSGW01	97C04619	14-OCT-97	16-OCT-97
FTSGW04	97C04620	13-OCT-97	16-OCT-97
WHSGW01	97C04621	13-OCT-97	16-OCT-97
SUISUN BAY	97C04622	15-OCT-97	16-OCT-97

Analyst: Peter M. Kligmann — Date 11/13/97

Reviewer: Thet-Thet S. Wi — Date 11/13/97

0006

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DATA CHEM LABORATORIES
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FORM H (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE GROUP COMMENTS

G979H026

DCL Report Group..: 97C-0383-01
Date Printed.....: 13-NOV-97 09:03

Client Name...: Tetra Tech - EMI

Release Number....: Not Provided

General Information

The DCL QC Database maintains all numerical figures which are input from the pertinent data source. These data have not been rounded to significant figures nor have they been moisture corrected. Reports generated from the system, however, list data which have been rounded to the number of significant figures requested by the client or deemed appropriate for the method. This may create minor discrepancies between data which appear on the QC Summary Forms (Forms B-G) and those that would be calculated from rounded analytical results. Additionally, if a moisture correction is performed, differences will be observed between the QC data and the surrogate data reported on Form A (or other report forms) and corresponding data reported on QC Summary Forms. In these cases, the Form A will indicate the "Report Basis" as well as the moisture value used for making the correction.
Report generation options: E3JX

Result Symbol Definitions

ND - Not Detected above the MDL or IDL (LLD or MDC for radiochemistry).
** - No result could be reported, see sample comments for details.

Qualifier Symbol Definitions

U - Not Detected above the MDL or IDL (LLD or MDC for radiochemistry).
For radiochemistry the nuclide was not identified by the Canberra Nuclear NID program, activity values reported are calculated using the Canberra Nuclear MINACT program.
B - For organic analysis the qualifier indicates that this analyte was found in the method blank.
For inorganic analysis the qualifier signifies the value is between the IDL and PQL.
J - The qualifier indicates that the value is between the MDL and the PQL. It is also used for indicating an estimated value for tentatively identified compounds in mass spectrometry where a 1:1 response is assumed.

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
11139709034536

S979H095

TLSW-2

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: **TLSGW02**
DCL Sample Name...: **97C04612**
DCL Report Group..: **97C-0383-01**

Matrix.....: WATER
Date Sampled.....: 10-OCT-97 10:30
Reporting Units...: pCi/L
Report Basis.....: ☒ As Received ☐ Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	10-NOV-97 09:45	4.82E1	3.40E2±8.41E1 ±1.04E2		1.0	
Thallium-208	10-NOV-97 09:45	4.08E0	2.64E0±3.78E0 ±3.81E0		1.0	
Lead-212	10-NOV-97 09:45	5.27E0	1.08E1±7.26E0 ±7.52E0		1.0	
Radium-224	10-NOV-97 09:45	5.92E1	1.21E2±8.22E1 ±8.51E1		1.0	
Radium-226	10-NOV-97 09:45	7.42E1	1.01E2±8.21E1 ±8.41E1		1.0	
Cobalt-60	10-NOV-97 09:45	4.75E0	-1.21E0±2.86E0 ±2.87E0	U	1.0	

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H096

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: TLSGW05 TW-5
DCL Sample Name...: 97C04613
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 07-OCT-97 16:00
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	10-NOV-97 09:46	4.65E1	3.17E2±8.18E1 ±9.97E1		1.0	
Thallium-208	10-NOV-97 09:46	3.85E0	3.76E0±3.80E0 ±3.86E0		1.0	
Lead-212	10-NOV-97 09:46	6.97E0	8.70E0±6.91E0 ±7.09E0		1.0	
Radium-224	10-NOV-97 09:46	8.18E1	9.83E1±7.82E1 ±8.01E1		1.0	
Radium-226	10-NOV-97 09:46	8.69E1	1.51E2±1.05E2 ±1.08E2		1.0	
Cobalt-60	10-NOV-97 09:46	5.38E0	3.79E0±2.84E0 ±2.93E0	U	1.0	
Cesium-137	10-NOV-97 09:46	4.00E0	2.38E0±3.52E0 ±3.55E0		1.0	
Bismuth-211	10-NOV-97 09:46	2.37E1	5.23E1±3.27E1 ±3.41E1		1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H097

TLW-5 Dup

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: **TLSGW08**
DCL Sample Name...: **97C04614**
DCL Report Group..: **97C-0383-01**

Matrix.....: WATER
Date Sampled.....: 07-OCT-97 17:00
Reporting Units...: pCi/L
Report Basis.....: ☒ As Received ☐ Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	10-NOV-97 09:47	4.45E1	1.44E2±5.68E1 ±6.25E1		1.0	
Lead-212	10-NOV-97 09:47	5.23E0	9.68E0±6.25E0 ±6.49E0		1.0	
Radium-224	10-NOV-97 09:47	5.98E1	1.09E2±7.08E1 ±7.35E1		1.0	
Radium-226	10-NOV-97 09:47	6.54E1	4.43E2±1.89E2 ±2.05E2		1.0	
Cobalt-60	10-NOV-97 09:47	4.12E0	1.90E-1±2.35E0 ±2.35E0	U	1.0	
Xenon-131M	10-NOV-97 09:47	8.21E2	7.27E2±8.91E2 ±9.01E2		1.0	
Cerium-141	10-NOV-97 09:47	9.05E0	9.82E0±9.17E0 ±9.34E0		1.0	
Uranium-235	10-NOV-97 09:47	3.97E0	2.69E1±1.15E1 ±1.25E1		1.0	

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SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
11139709034536
Page 8

S979H098

RDW-1

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: RDSGW01
DCL Sample Name...: 97C04615
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 10-OCT-97 14:00
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	10-NOV-97 09:48	3.85E1	1.57E2±5.76E1 ±6.42E1		1.0	
Lead-212	10-NOV-97 09:48	5.46E0	9.73E0±5.42E0 ±5.69E0		1.0	
Radium-224	10-NOV-97 09:48	5.91E1	1.10E2±6.14E1 ±6.45E1		1.0	
Radium-226	10-NOV-97 09:48	6.34E1	4.15E2±1.68E2 ±1.84E2		1.0	
Cobalt-60	10-NOV-97 09:48	4.21E0	-1.01E0±2.50E0 ±2.51E0	U	1.0	
Bismuth-211	10-NOV-97 09:48	1.84E1	2.41E1±1.88E1 ±1.93E1		1.0	
Cerium-141	10-NOV-97 09:48	7.56E0	9.15E0±8.15E0 ±8.32E0		1.0	
Uranium-235	10-NOV-97 09:48	3.85E0	2.52E1±1.02E1 ±1.12E1		1.0	
Lead-214	10-NOV-97 09:48	6.86E0	8.39E0±6.52E0 ±6.69E0		1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09B

RDW-3

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: RDSGW03
DCL Sample Name...: 97C04617
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 09-OCT-97 12:10
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:49	4.90E1	1.80E2±6.98E1 ±7.69E1		1.0	
Lead-212	11-NOV-97 09:49	5.73E0	7.49E0±6.64E0 ±6.77E0		1.0	
Radium-224	11-NOV-97 09:49	6.43E1	8.46E1±7.50E1 ±7.66E1		1.0	
Radium-226	11-NOV-97 09:49	6.83E1	2.35E2±1.34E2 ±1.41E2		1.0	
Cobalt-60	11-NOV-97 09:49	5.06E0	-2.02E0±3.12E0 ±3.14E0	U	1.0	

0016

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H099

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: RDSGW04 RDW-4
DCL Sample Name...: 97C04616
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 14-OCT-97 11:45
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:48	4.91E1	1.75E2±7.02E1 ±7.70E1		1.0	
Lead-212	11-NOV-97 09:48	5.50E0	9.06E0±5.61E0 ±5.84E0		1.0	
Radium-224	11-NOV-97 09:48	6.11E1	1.02E2±6.35E1 ±6.61E1		1.0	
Radium-226	11-NOV-97 09:48	7.00E1	1.23E2±8.82E1 ±9.09E1		1.0	
Cobalt-60	11-NOV-97 09:48	5.24E0	1.00E-1±2.92E0 ±2.92E0	U	1.0	
Tellurium-123M	11-NOV-97 09:48	3.30E0	2.65E0±2.54E0 ±2.58E0		1.0	

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Matrix Duplicate

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

Form RLIMS63A-V1.3
11139709034536

S97B900J

SAMPLE ANALYSIS DATA SHEET

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: RDSGW04 RDW-4
DCL Sample Name...: 97C04616MD
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 14-OCT-97 11:45
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	12-NOV-97 05:48	4.48E1	1.73E2±6.11E1 ±6.85E1		1.0	
Lead-212	12-NOV-97 05:48	5.37E0	5.59E0±4.87E0 ±4.97E0		1.0	
Radium-224	12-NOV-97 05:48	6.30E1	6.31E1±5.50E1 ±5.62E1		1.0	
Radium-226	12-NOV-97 05:48	6.90E1	1.75E2±1.01E2 ±1.06E2		1.0	
Cobalt-60	12-NOV-97 05:48	4.89E0	-2.05E0±2.92E0 ±2.94E0	U	1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09C

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: RDSGW07 RDW-7
DCL Sample Name...: 97C04618
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 13-OCT-97 12:25
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:50	4.22E1	6.02E2±1.21E2 ±1.63E2		1.0	
Thallium-208	11-NOV-97 09:50	3.90E0	5.77E0±4.04E0 ±4.17E0		1.0	
Lead-212	11-NOV-97 09:50	5.61E0	8.46E0±5.87E0 ±6.07E0		1.0	
Radium-224	11-NOV-97 09:50	6.10E1	9.56E1±6.65E1 ±6.87E1		1.0	
Radium-226	11-NOV-97 09:50	7.24E1	8.86E1±7.34E1 ±7.52E1		1.0	
Cobalt-60	11-NOV-97 09:50	5.29E0	-2.20E0±3.27E0 ±3.29E0	U	1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09D

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: FTSGW01 FTW-1
DCL Sample Name...: 97C04619
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 14-OCT-97 18:20
Reporting Units...: pCi/L
Report Basis.....: ☒ As Received ☐ Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:51	4.69E1	2.84E2±7.26E1 ±8.88E1		1.0	
Thallium-208	11-NOV-97 09:51	4.00E0	4.07E0±3.47E0 ±3.55E0		1.0	
Lead-212	11-NOV-97 09:51	6.78E0	1.24E1±7.34E0 ±7.67E0		1.0	
Radium-224	11-NOV-97 09:51	8.09E1	1.40E2±8.31E1 ±8.69E1		1.0	
Radium-226	11-NOV-97 09:51	8.92E1	2.21E2±1.24E2 ±1.30E2		1.0	
Cobalt-60	11-NOV-97 09:51	4.73E0	8.20E-1±2.62E0 ±2.62E0	U	1.0	
Bismuth-211	11-NOV-97 09:51	2.47E1	3.74E1±3.00E1 ±3.08E1		1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09F

FTW-4

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: **FTSGW04**
DCL Sample Name...: **97C04620**
DCL Report Group..: **97C-0383-01**

Matrix.....: WATER
Date Sampled.....: 13-OCT-97 14:50
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:52	4.71E1	2.10E2±6.06E1 ±7.14E1		1.0	
Lead-212	11-NOV-97 09:52	5.83E0	8.03E0±4.99E0 ±5.19E0		1.0	
Radium-224	11-NOV-97 09:52	6.45E1	9.07E1±5.65E1 ±5.88E1		1.0	
Radium-226	11-NOV-97 09:52	6.66E1	4.85E2±2.00E2 ±2.18E2		1.0	
Cobalt-60	11-NOV-97 09:52	4.76E0	7.49E-1±2.70E0 ±2.70E0	U	1.0	
Bismuth-211	11-NOV-97 09:52	2.04E1	1.52E1±1.83E1 ±1.85E1		1.0	
Cerium-141	11-NOV-97 09:52	8.35E0	1.15E1±7.94E0 ±8.20E0		1.0	
Uranium-235	11-NOV-97 09:52	4.04E0	2.95E1±1.22E1 ±1.33E1		1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09G

WHW-1

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: WHSGW01
DCL Sample Name...: 97C04621
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 13-OCT-97 15:35
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	11-NOV-97 09:53	4.39E1	1.75E2±5.20E1 ±6.08E1		1.0	
Lead-212	11-NOV-97 09:53	5.15E0	1.00E1±6.08E0 ±6.34E0		1.0	
Radium-224	11-NOV-97 09:53	5.75E1	1.13E2±6.88E1 ±7.18E1		1.0	
Radium-226	11-NOV-97 09:53	6.39E1	4.83E2±1.90E2 ±2.09E2		1.0	
Cobalt-60	11-NOV-97 09:53	4.58E0	6.26E-1±2.60E0 ±2.61E0	U	1.0	
Cerium-141	11-NOV-97 09:53	7.24E0	1.54E1±7.62E0 ±8.10E0		1.0	
Uranium-235	11-NOV-97 09:53	3.88E0	2.93E1±1.16E1 ±1.27E1		1.0	

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S979H09H

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 16-OCT-97 00:00

Client Sample Name: SUISUN BAY
DCL Sample Name...: 97C04622
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: 15-OCT-97 11:15
Reporting Units...: pCi/L
Report Basis.....: [X] As Received [ ] Dried

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Potassium-40	12-NOV-97 05:49	4.72E1	2.28E2±6.32E1 ±7.54E1		1.0	
Radium-226	12-NOV-97 05:49	6.94E1	2.01E2±1.08E2 ±1.14E2		1.0	
Cobalt-60	12-NOV-97 05:49	4.88E0	-1.88E0±3.00E0 ±3.02E0	U	1.0	

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Method Blank

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
11139709034536
Page 3

S97B900G

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Applicable
Release Number.....: Not Provided

Date Received.....: Not Applicable

Client Sample Name: BL-141125-1
DCL Sample Name...: BL-141125-1
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: Not Applicable
Reporting Units...: pCi/sample

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Thallium-208	10-NOV-97 09:42	3.94E0	6.93E0±2.21E0 ±2.29E0		1.0	
Lead-212	10-NOV-97 09:42	5.75E0	6.65E0±2.53E0 ±2.60E0		1.0	
Radium-224	10-NOV-97 09:42	6.15E1	7.51E1±2.86E1 ±2.94E1		1.0	
Radium-226	10-NOV-97 09:42	6.87E1	1.45E2±4.75E1 ±4.92E1		1.0	
Cobalt-60	10-NOV-97 09:42	4.59E0	-1.30E0±1.34E0 ±1.34E0	U	1.0	
Bismuth-211	10-NOV-97 09:42	1.88E1	2.45E1±9.73E0 ±9.97E0		1.0	
Krypton-85	10-NOV-97 09:42	2.41E1	-9.95E0±7.76E0 ±7.81E0	U	1.0	
Strontium-85	10-NOV-97 09:42	3.18E0	3.18E0±1.64E0 ±1.67E0		1.0	
Molybdenum-99	10-NOV-97 09:42	3.28E0	4.93E0±1.50E0 ±1.56E0		1.0	
Technetium-99m	10-NOV-97 09:42	1.34E1	2.02E1±6.13E0 ±6.40E0		1.0	

0008

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DATA VALIDATION REPORT

Site:	Concord Tidal Area
Contract Task Order (CTO) No.:	CTO 281
Laboratory:	DataChem
Data Reviewer:	Rameen Moezzi, TtEMI
Review Date:	November 25, 1997

Sample Delivery Group (SDG) No.: 97C-0383

Sample Nos.:	TLSGW02	RDSGW03	FTSGW04
	TLSGW05*	RDSGW04	WHSGW01
	TLSGW08	RDSGW07	Suisun Bay
	RDSGW01	FTSGW01	

* Full Validation Sample

Matrix: Water

Collection Date(s): October 7 through 15, 1997

The data were qualified according to the U.S. Environmental Protection Agency (EPA) documents "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (February 1994) and "USEPA Contract Laboratory Program National Functional Guidelines For Inorganic Data Review" (February 1994). In addition, the Tetra Tech EM Inc. (TtEMI) documents "Data Validation Guidelines for CLP Organic Analyses," "Data Validation Guidelines for CLP Inorganic Analyses," "Data Validation Guidelines for Non-CLP Organic Analyses," "Data Validation Guidelines for Non-CLP Inorganic and Physical Analyses" (March 1997), and the document entitled "TtEMI Comprehensive Long-term Environmental Action Navy II Analytical Services Statement of Work" (June 1995) were used along with other specified criteria in EPA methods. Data validation requirements are presented below.

I certify that all data validation criteria outlined in the above referenced documents were assessed, and any qualifications made to the data were in accordance with those documents.

Certified by Rameen Moezzi

DATA VALIDATION REQUIREMENTS

Full validation includes all parameters listed below. Cursory validation parameters are indicated by an asterisk (*).

CLP Organic Parameters

* Holding times
  GC/MS instrument performance check
* Initial and continuing calibrations
* Blanks
* Surrogate recovery
* Matrix spike/matrix spike duplicate
* Laboratory control sample or blank spike
* Field duplicates
* Internal standard performance
  Target compound identification
  Tentatively identified compounds
  Compound quantitation
  Reported detection limits
  System performance
* Overall assessment of data for the SDG

CLP Inorganic Parameters

* Holding times
* Initial and continuing calibrations
* Blanks
* Matrix spike
* Laboratory control sample or blank spike
* Field duplicates
* Matrix duplicates
  ICP interference check sample
  GFAA quality control
* ICP serial dilution
  Sample result verification
  Analyte quantitation
  Reported detection limits
* Overall assessment of data for the SDG

Non-CLP Organic and Inorganic Parameters

* Method compliance
* Holding times
* Initial and continuing calibrations
* Blanks
* Matrix spike/matrix spike duplicate
* Laboratory control sample or blank spike
* Field duplicates
* Matrix duplicates
* Surrogate recovery
  Analyte quantitation
  Reported detection limits
* Overall assessment of data for the SDG

DATA VALIDATION QUALIFIERS AND CODES

Data Validation Qualifiers

UJ	Estimated nondetected result
J	Estimated detected result
R	Rejected result
NJ	Tentatively Identified Compound (TIC)

Data Validation Qualifier Codes

a	Surrogate recovery exceedance
b	Laboratory method blank and common blank contamination
c	Calibration exceedance
d	Duplicate precision exceedance
e	Matrix spike/laboratory control sample (LCS) recovery exceedance
f	Field blank contamination
g	Quantification below reporting limit
h	Holding time exceedance
i	Internal standard exceedance
j	Other qualifications

TABLE 1
CURSORY DATA VALIDATION SUMMARY

Analysis	Holding Times	Surrogates	MS/MSD	Matrix Duplicates	LCS	Blanks	Calibration	Internal Standards	Field Duplicates	Other
gamma-spectrometry	Y	N/A	N/A	Y	Y	Y	Y	N/A	Y	Y

Notes:
Y indicates that all quality control criteria were met for the parameter as specified in the prescribed methods and data validation guidelines.
N/A indicates the parameter is not applicable to an analysis.
If criteria were not met and the data were qualified, a page number is indicated where the qualification is detailed.
The data were evaluated for all validation criteria and were found to be in control except where noted. Any outliers are described in the text.

TABLE 2
FULL DATA VALIDATION SUMMARY
Sample TLSGW05

Analysis	GC/MS Tuning	Target Compound List Identification	Compound or Analyte Quantification	Reported Detection Limits	Tentatively Identified Compounds	System Performance	Interference Check Sample	Graphite Furnace Quality Control
gamma - spectrometry	N/A	Y	Y	Y	N/A	Y	N/A	N/A

Notes:
Y indicates that all quality control criteria were met for the parameter as specified in the prescribed methods and data validation guidelines.
N/A indicates the parameter is not applicable to an analysis.
If criteria were not met and the data were qualified, a page number is indicated where the qualification is detailed.

DATA ASSESSMENT

GAMMA-SPECTROMETRY

I. Holding Times

A. All samples were analyzed within the holding time.

II. Blank Contamination

A. The following analytes were reported in the method blank:

Analyte	Result + Error + TPU Error	Detection Limit, pCi/L
Thallium-208	6.93 ± 2.21 ± 2.29	3.94
Lead-212	6.65 ± 2.53 ± 2.60	5.75
Radium-224	75.1 ± 28.6 ± 29.4	61.5
Radium-226	145 ± 47.5 ± 49.2	68.7
Bismuth-211	24.5 ± 9.73 ± 9.97	18.8
Strontium-85	3.18 ± 1.64 ± 1.67	3.18
Molybdenum-99	4.93 ± 1.50 ± 1.56	3.28
Technetium-99m	20.2 ± 6.13 ± 6.40	13.4

Sample results were not qualified on the basis of blank results.

III. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A. MS/MSD analyses were not performed.

IV. Blank Spike or Laboratory Control Sample (LCS)

A. Blank spike recoveries for Cesium-137 (96.2%) and Cobalt-60 (100%) met the 80-120% QC limits.

V. Calibrations

A. The multinuclide standard was NIST-traceable.

VI. Matrix Duplicate

A. The Relative Error Ratios (RER) for Cesium-137 (0.056) and Cobalt-60 (1.0) met the 0.00-2.00 QC limits for matrix duplicate sample RDSGW04.

Note that the same 1-L aliquot was analyzed for the sample and the duplicate.

*Full Validation Criteria for Sample TLSGW05**

VII. Compound Quantitation and Reported Detection Limits

A. Sample results and detection limits were correctly entered from the instrument readout.

OVERALL ASSESSMENT OF DATA

I. Method Compliance and Additional Comments

A. All analyses were conducted within all specifications of the requested methods.

II. Usability

A. No sample results were estimated or rejected in this SDG.

B. The quality control criteria reviewed were met and are considered acceptable. Sample results that were found to be rejected (R) are unusable for all purposes. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the cursory and full data validation all other results are considered valid and usable for all purposes. In general, the absence of rejected data and qualifiers added to the data indicate high usability.

DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
11139709034536

S97B900G

Date Printed.....: 13-NOV-97 09:03

Client Name.....: Tetra Tech - EMI
Client Ref Number....: Not Provided
Sampling Site.....: Not Applicable
Release Number.....: Not Provided

Date Received.....: Not Applicable

Client Sample Name: BL-141125-1
DCL Sample Name...: BL-141125-1
DCL Report Group..: 97C-0383-01

Matrix.....: WATER
Date Sampled.....: Not Applicable
Reporting Units...: pCi/sample

DCL Preparation Group: G97B900F
Date Prepared.....:
Preparation Method...: WR-DC-200
Aliquot Weight/Volume: 1.00E0 L
Net Weight/Volume....: Not Required

DCL Analysis Group: G97B900F
Analysis Method...: WR-EP-325
Instrument Type...: GAMMA
Instrument ID.....: GS
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	Detection Limit	Result±Error ±TPU Error	Qual.	Dilution	CRDL
Thallium-208	10-NOV-97 09:42	3.94E0	6.93E0±2.21E0 ±2.29E0		1.0	
Lead-212	10-NOV-97 09:42	5.75E0	6.65E0±2.53E0 ±2.60E0		1.0	
Radium-224	10-NOV-97 09:42	6.15E1	7.51E1±2.86E1 ±2.94E1		1.0	
Radium-226	10-NOV-97 09:42	6.87E1	1.45E2±4.75E1 ±4.92E1		1.0	
Cobalt-60	10-NOV-97 09:42	4.59E0	-1.30E0±1.34E0 ±1.34E0	U	1.0	
Bismuth-211	10-NOV-97 09:42	1.88E1	2.45E1±9.73E0 ±9.97E0		1.0	
Krypton-85	10-NOV-97 09:42	2.41E1	-9.95E0±7.76E0 ±7.81E0	U	1.0	
Strontium-85	10-NOV-97 09:42	3.18E0	3.18E0±1.64E0 ±1.67E0		1.0	
Molybdenum-99	10-NOV-97 09:42	3.28E0	4.93E0±1.50E0 ±1.56E0		1.0	
Technetium-99m	10-NOV-97 09:42	1.34E1	2.02E1±6.13E0 ±6.40E0		1.0	

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