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Remedial Design Report No. 2 for Treatment Facilities C and F Lawrence Livermore National Laboratory Livermore Site

September 10, 1993

Technical Editors

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Environmental Protection Department

Environmental Restoration Division

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Summary

This is the second in a series of five reports that describe plans for implementing ground water and soil cleanup at the Lawrence Livermore National Laboratory (LLNL) Livermore Site. The cleanup has been divided into five specific geographic areas. The Department of Energy (DOE)/LLNL will prepare these reports, called Remedial Design reports, over a 3-year period. The cleanup plans described in each report are designed to optimize the overall site cleanup and be consistent with projected funding levels. The overall cleanup approach for the LLNL Livermore Site is explained in the Remedial Action Implementation Plan (Dresen *et al.*, 1993a), which can be found in the Information Repositories located at the LLNL Visitors Center and at the Livermore Library.

This particular Remedial Design report is for Treatment Facilities C and F (TFC and TFF). This report discusses the equipment at the treatment facilities, and the associated extraction wells and piezometers. The extraction wells are used to pump contaminated ground water to the treatment facility. Piezometers are used to measure water levels. Monitoring the water levels in piezometers provides information about the size of the area being remediated by the extraction wells.

Treatment Facility C

Treatment Facility C will treat ground water in the northwestern corner of the LLNL Site. The main ground water contaminants in that area are perchloroethylene, trichloroethylene, chloroform, 1,1-dichloroethylene, and trichlorotrifluoroethane. Ground water in the Treatment Facility C area also contains chromium in concentrations above its drinking water standard. This chromium appears to be naturally occurring. Facility systems will consist of an air stripper and an ion-exchange unit. Contaminated ground water will be pumped from the extraction wells to the air stripper tank. As the water passes through the tank, a large blower aerates the water, and strips the chemicals from it. The chemicals are released into the air inside the tank, and are collected by filtering the air through two granular activated carbon filters. The air stripper will remove all of the above-described contaminants from the ground water except for the chromium that will be removed by the ion-exchange unit. In ion exchange, water is pumped through a fixed bed of ion-exchange resin. The chromium ions to be removed are exchanged for nonhazardous ions on the resin.

The facility will be designed with a capacity to remediate up to 60 gallons per minute of ground water. Seven ground water extraction wells and associated piezometers are planned to supply water to TFC. The extraction wells will be placed to stop any further migration of the plume in that area. Treated ground water from the facility will be discharged to a drainage ditch that eventually flows to Arroyo Las Positas. Any contaminants that remain in the treated water will be within the limits set by the California Regional Water Quality Control Board, as detailed in Waste Discharge Requirement Order No. 91-091. This Order is included in Appendix A of this report.

An additional extraction well and associated piezometers may be necessary in the northwest corner of the Livermore Site. That decision will depend on two factors: 1) the extent of the plume area that the facility extraction well network is ultimately able to "capture"; and 2) the locations and pumping rates of extraction wells northwest of the Livermore Site to cleanup the plume that is the responsibility of another party. The private parties responsible for this offsite contaminant plume will be developing and implementing a cleanup plan sometime in the future, in coordination with the California Regional Water Quality Control Board. As that cleanup plan is developed, DOE/LLNL will evaluate its likely impact on the Livermore Site plume. Appropriate actions, such as installation of an additional extraction well and monitoring network, will be considered and presented in an addendum to this report.

Treatment Facility C is scheduled to begin operating in October 1993. The estimated total design and construction cost of the facility is $1,627,566.

Treatment Facility F

Treatment Facility F was constructed as part of a pilot study approved by the U. S. Environmental Protection Agency. It is located adjacent to East Avenue at the southern boundary of the Livermore Site. This facility can effectively treat up to 100 gallons per minute of contaminated ground water. The primary contaminants in this area are fuel hydrocarbons (including toluene, benzene, and xylene), and small concentrations of volatile organic compounds (such as trichloroethylene, 1,2-dichloroethylene, chloroform, ethylene dibromide, perchloroethylene, carbon tetrachloride, trichlorotrifluoroethane, 1,1-dichloroethylene, and 1,1,1-trichloroethane) and perhaps lead. The facility was recently enhanced to treat ground water for an experimental project called the Dynamic Underground Stripping Demonstration Project.

Most of the ground water treated at the facility will be used in LLNL cooling towers. In addition, up to 50 gpm of the treated water can be discharged to the sanitary sewer, in accordance with the terms of the LLNL sanitary sewer discharge permit. This permit is included in Appendix A of this report.

This treatment facility treats ground water using an ultraviolet/hydrogen peroxide treatment system, followed by air stripping. The ultraviolet/hydrogen peroxide process destroys organic compounds using hydrogen peroxide and ultraviolet light. The ultraviolet/hydrogen peroxide system removes all volatile organic compounds, except 1,2-dichloroethylene and ethylene dibromide, to concentrations below discharge limits. The air stripping unit further reduces the 1,2-dichloroethylene and ethylene dibromide to concentrations below discharge limits. Granular activated carbon is used to remove fuel hydrocarbons and volatile organic compounds from the vapors.

Although not part of the original design, the Dynamic Underground Stripping Demonstration Project has enhanced fuel hydrocarbon removal. This project consists of a steam injection process and electrical resistance heating of fine-grained sediments, along with geophysical and temperature monitoring, and ground water and vapor extraction. This project is scheduled to end in June 1993. After that time, Treatment Facility F will consist of the ultraviolet/hydrogen peroxide system, the air stripper, and granular activated carbon for vapor treatment. If funding is available, some aspects of the Dynamic Underground Stripping Demonstration Project might be continued. The piping and power, vapor modification, and construction support activation costs of this facility are approximately $2,529,618.

Ground water will be extracted from nine extraction wells near this facility to capture and remediate the fuel hydrocarbon and volatile organic compound plumes. The first and second zones of water below the ground surface will be dewatered locally to allow further vapor extraction.

Fuel hydrocarbons and volatile organic compounds in excess of concentration levels considered to be safe by the federal government (i.e., above the Maximum Contaminant Levels), extend offsite about 750 feet south of East Avenue. Up to two additional extraction wells and associated piezometers may be installed south of the Livermore Site if either of the following two conditions occur: (1) if field monitoring shows that complete capture of the fuel hydrocarbons and volatile organic compounds is not achieved by pumping at the proposed extraction locations, or (2) if it is judged that additional wells will significantly reduce cleanup time based on cost/benefit analysis, or if public safety and health are threatened.

Common to Both Facilities

LLNL will conduct volatile organic compound sampling and water level monitoring for the wells and piezometers around Treatment Facilities C and F. This will be used to monitor the progress of the cleanup and determine the size and shape of the area being affected by the extraction wells. Results of all treatment system, extraction well, and piezometer monitoring will be included in the LLNL Monthly, Quarterly, and/or Annual Reports.

LLNL will manage the extraction well field by varying the rates and locations of ground water extraction. The goal is to optimize volatile organic compound mass removal, and ensure hydraulic capture in all portions of the plume that exceed cleanup standards. In addition, LLNL is evaluating reinjection of the treated water, possibly in conjunction with the use of heat, surfactants and/or microbes, and cyclic pumping, to accelerate the cleanup.

Appendices to this report contain the Quality Assurance and Health and Safety Plans for the operation and maintenance for Treatment Facilities C and F. The appendices also contain the effluent discharge permits and sampling procedures for Treatment Facilities C and F. The Quality Assurance/Quality Control and Health and Safety Plans for construction were presented in the Remedial Design Report No. 1 (Boegel *et al.,* 1993).

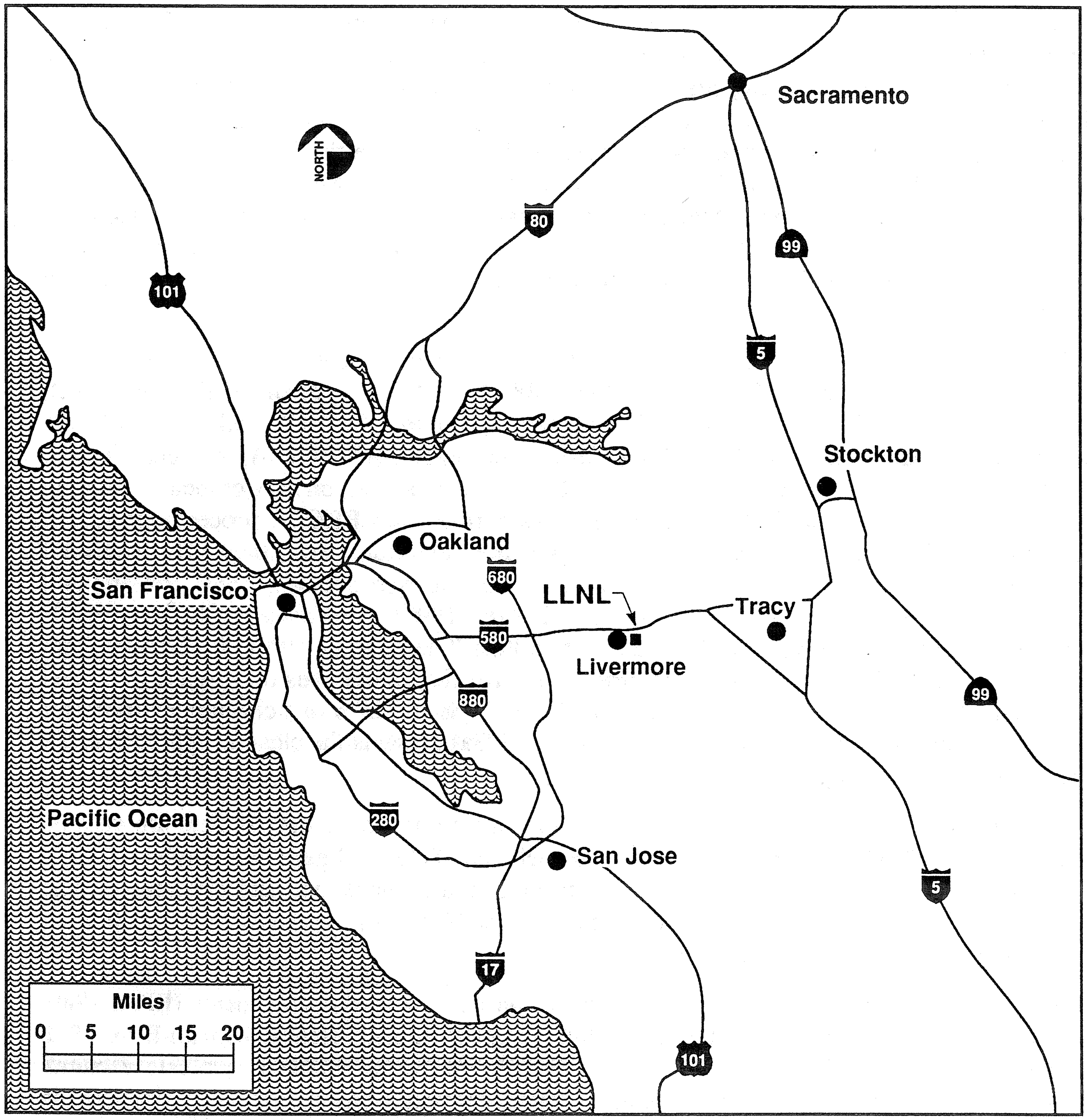
1. Introduction

This report is the second of five Remedial Design (RD) reports for the Lawrence Livermore National Laboratory (LLNL) Livermore Site, which is located about 40 miles east of San Francisco, California (Fig. 1). This RD report is for Treatment Facility C (TFC) and Treatment Facility F (TFF) and their respective extraction wells and piezometer networks. Subsequent RD reports will cover the remaining planned treatment facilities and their extraction well and piezometer networks. The five RD reports are being prepared over a 3-year period according to the schedule in the Remedial Action Implementation Plan (RAIP) for the Livermore Site (Dresen *et al.*, 1993a). As described in the RAIP, the remedial actions presented in the Record of Decision (ROD) for the Livermore Site (DOE, 1992) will be phased-in over a 3-year period to be consistent with projected funding levels, and to enable determination of the actual, rather than predicted, effectiveness of the planned extraction and treatment systems before proceeding with subsequent phases.

The Livermore Site was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List in 1987. In November 1988, the U.S. Department of Energy (DOE), EPA, the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB), signed a Federal Facility Agreement (FFA) to facilitate compliance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended. As part of the CERCLA process, the LLNL Environmental Restoration Division (ERD) has prepared a series of documents: the Remedial Investigation (Thorpe *et al.*, 1990) characterizes the site hydrogeology and contaminant distribution, the Feasibility Study (FS) (Isherwood *et al.*, 1990) screens and evaluates possible remedial alternatives, the Proposed Remedial Action Plan (Dresen *et al.*, 1991) further evaluates conceptual remedial alternatives and recommends a particular alternatives for ground water and soil cleanup, the ROD (DOE, 1992) codifies and binds DOE and EPA to a cleanup approach for ground water and soil, and the RAIP (Dresen *et al.*, 1993a) presents the cleanup approach and a schedule for the remaining remedial actions.

As discussed in the ROD, the contaminants of concern at the Livermore Site are volatile organic compounds (VOCs), primarily trichloroethelyene (TCE) and perchloroethylene (PCE); fuel hydrocarbons (FHCs) including benzene; tritium; and perhaps lead and chromium. The Applicable or Relevant and Appropriate Requirements (ARARs) for the Livermore Site are detailed in the FS (Isherwood *et al.*, 1990).

The scope and format for this report are based on EPA guidance documents (EPA, 1989; 1990), an outline provided by the EPA (Gill, 1993), and subsequent discussions with EPA. TFF was constructed for an EPA-approved pilot study (Nichols *et al.*, 1988) to evaluate vacuum-induced venting and treatment of FHC vapor. Vacuum-induced venting tests were conducted in 1991 (Dresen *et al.*, 1993a). TFF was subsequently modified for the Dynamic Underground Stripping Demonstration Project (DUSDP). When the ROD for the Livermore Site was signed in August 1992, TFF was converted from pilot study to Remedial Action status. As specified by EPA, each RD report contains engineering design specifications for the ground water extraction and treatment systems, including piping and instrument diagrams (P&IDs), system descriptions, monitoring and construction schedules, and cost estimates. The RD reports will also include a Remedial Action Work Plan that contains Quality Assurance/Quality Control (QA/QC) Plans



ERD-LSR-93-0070

Figure 1. Location of the LLNL Livermore Site.

and Health and Safety Plans for operation and maintenance, and the requirements for offsite shipment of hazardous waste and for project closeout. The QA/QC and Health and Safety Plans for construction are the same for all RD reports. Therefore, these documents were only submitted with the initial RD report (Boegel *et al.*, 1993).

This document was prepared by LLNL for DOE with oversight from the EPA, the DTSC, and the RWQCB. The five RD reports are primary documents under the FFA for the LLNL Livermore Site.

Sections 2 and 3 of this report are the remedial designs for TFC and TFF, respectively. Section 4 is the Remedial Action Work Plan for TFC and TFF. Appendices A through D present the waste discharge permits, the Operations and Maintenance (O&M) QA/QC and Health and Safety Plans, and sampling plans for TFC and TFF, respectively.

2. Remedial Design for Treatment Facility C

2.1. TFC Design Summary

TFC is a ground water treatment facility located in the northwest part of the Livermore Site (Fig. 2). Ground water in the TFC vicinity will be pumped to hydraulically control the northwestern portion of the ground water VOC and chromium plumes. The principal contaminants in ground water are PCE, TCE, total chromium, hexavalent chromium, chloroform, 1,1-dichloroethylene (1,1-DCE) and trichlorotrifluoroethane (Freon 113) (see Table 3, Section 2.2.2.1). Although Freon 113 does not exceed its Maximum Contaminant Level (MCL), it is present in excess of the 5 parts per billion (ppb) total VOC discharge limit for treated water (Section A.2, Appendix A). TFC will consist of a commercially available air stripper to treat VOCs and a commercially available ion-exchange unit to remove chromium. The air stripper effluent air stream will be passed through a carbon filter to remove VOCs from the air. The treated effluent water will be discharged, via pipeline into a ditch that eventually flows into the Arroyo Las Positas, and/or will be used onsite at LLNL for landscape irrigation. Treated water may also be used for infiltration or reinjection in accordance with RWQCB Waste Discharge Requirement (WDR) Order No. 91-091 and ARARs to enhance cleanup or to maintain hydraulic control of the plume.

2.2. Design Specifications

Design specifications for the TFC extraction wells and piezometers and for the treatment facility are described in Sections 2.2.1 and 2.2.2, respectively.

2.2.1. Extraction Wells and Piezometers

As discussed in the RAIP (Dresen *et al.*, 1993a), extraction locations 8 and 9 will supply ground water to TFC (Fig. 2). A total of seven extraction wells are tentatively planned at these locations. Five of the seven extraction wells are currently installed, and the remaining wells are planned for installation in Fiscal Years (FY) 93-95, if required. Design specifications for the

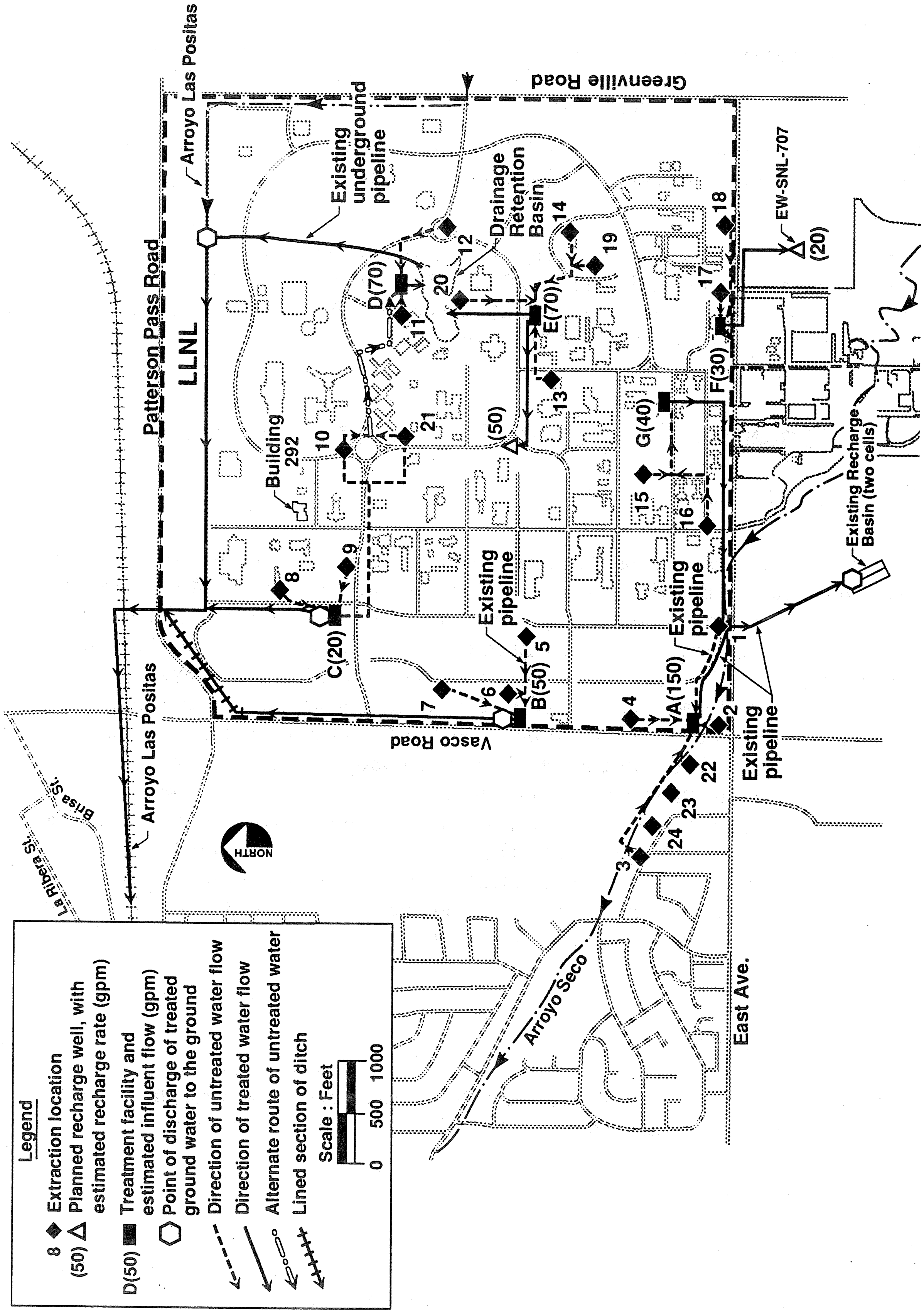


Figure 2. Planned ground water extraction locations for TFC and TFF (modified from the RAIP).

TFC extraction wells are shown in Table 1, and proposed TFC extraction well and piezometer locations are shown in Figure 3. All existing and planned wells will be secured in locked enclosures.

TFC area extraction well locations are based on ground water modeling results (Chapter 3 and Appendix B in Isherwood *et al.*, 1990; Tompson, 1990; Tompson *et al.*, 1991; and Tompson *et al.*, 1993, in preparation), local hydrogeology (Thorpe *et al.*, 1990; Isherwood *et al.*, 1990), and the current understanding of subsurface VOC distribution. In all cases, extraction locations were selected to capture ground water from all water-bearing zones where compounds of concern exceed cleanup goals (i.e., MCLs). The area in the TFC vicinity where one or more VOCs in ground water exceed an MCL is shown on Figure 3.

Low activities of tritium, slightly above the detection limit of 1,000 picocuries per liter (pCi/L), and well below the 20,000 pCi/L MCL, have been detected in a few isolated wells in the vicinity of the TFC well field. The only known source of tritium in the area is a tank leak at Building 292 (Devany *et al.*, 1990; Macdonald *et al.*, 1991), approximately 1,100 ft east of TFC (Fig. 2). This leak is being extensively monitored. Based on available data, the tritium associated with the leak is almost entirely confined to the vadose zone. The low tritium activities detected in ground water in the TFC area are expected to be below the detection limit by the time water reaches TFC because most of the wells supplying ground water to TFC contain no tritium. DOE/LLNL will continue to monitor for tritium at TFC and will comply with drinking water standards when discharging treated ground water.

As shown in Figure 4, extraction locations 8 and 9 are key locations for establishing hydraulic control of the leading edge of the VOC plumes in the TFC area. Analyses of geologic, chemical and hydraulic data after the ROD and RAIP were issued indicates that it may be necessary to extract ground water at locations north and perhaps west of extraction location 8 to achieve plume capture goals. Recent hydraulic tests on newly installed wells indicate the flow rates from wells in the TFC area are lower than those assumed in the 2-dimensional model used to estimate the size of capture zones in the RAIP. Therefore, additional wells may be necessary to achieve full plume margin capture in the TFC area. Due to the heterogeneous nature of the subsurface and low ground water yields, the extraction well locations shown in Figures 3 and 4 are preliminary and may be modified based on new data obtained during extraction well and piezometer installation and future source investigations. Additional extraction wells may be required if water levels in adjacent piezometers indicate that any part of the leading edge of the VOC plumes is not being captured.

Three extraction wells are planned for extraction location 8 (Fig. 3). Extraction wells EW-8-1/2 (MW-5) and EW-8-2B (MW-454) are close to the leading edge of the VOC plumes in the northwest corner of LLNL (Fig. 3). TCE and PCE are the primary VOCs of concern in this part of the LLNL site. Extraction wells EW-8-1/2 and EW-8-2B are positioned to prevent further downgradient VOC migration and to prevent further commingling with a downgradient offsite TCE plume northwest of the LLNL Livermore Site (Iovenitti *et al.*, 1991). The source of this offsite TCE plume is unknown, but appears unrelated to LLNL activities. Because the offsite plume appears unrelated to LLNL activities, the planned ground water extraction locations in this area are positioned to ensure cleanup within DOE property boundaries shown in Figure 3. Based

Table 1. TFC extraction well specifications.

Well name	Extraction well name[a]	Well design[b]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval (ft)	Sand pack interval (ft)	Water-bearing zone[c]	Estimated maximum long-term steady state yield (gpm)[d]	Pump type[e]	Pump intake depth (ft)
Extraction location 8											
MW-5	EW-8-1/2	Multiple	21-Oct-80	93.5	90	56-71 81-86	49-90	First and second	4	5S05-13	84
TBI	EW-8-2A[f]	---	---	---	---	(70-90)	---	Second (first and second?)	(3)	---	(80)
MW-454	EW-8-2B	Single	09-May-88	196	83.5	73-83.5	71-83.5	second	3	5S05-13	78
Extraction location 9											
TBI	EW-9-1	Single	---	---	---	(50-60)	---	First	(5)	---	(55)
P-702	EW-9-2A	Single	24-Oct-90	180.5	95	77-95	75-95	Second	3	5S05-13	86
MW-4	EW-9-2B	Single	28-Jul-80	92	90	75-90	58.5-90	(Second)	5	10S05-9	83
P-701	EW-9-2C	Single	10-Oct-90	159	86	74-86	72-86	Second	20	25S10-7	80

Notes:
TBI = To be installed.
Estimates are shown in parentheses.

[a]Extraction well names provide the well type (EW), its location as shown in Figures 2 and 3 (EW-8), and its depth relative to other extraction wells at the same location (i.e., EW-9-1 is shallower than EW-9-2). When multiple extraction wells are screened in the same water-bearing zone, a letter follows the zone designation (i.e., EW-8-2A, EW-8-2B, etc.). When a single extraction well is screened in more than one zone, the zones are indicated (i.e., EW-8-1/2 is screened in the first and second water-bearing zone).

[b]The two extraction well designs are:
Single = a well screened and sand-packed in only one water-bearing zone.
Multiple = a well fully screened and sand-packed in multiple water-bearing zones.
Additional information regarding these well designs and their applications is presented in the RAIP (Dresen *et al.*, 1993a).

[c]Numbered consecutively downward from ground surface at each extraction location. A water-bearing zone is defined as saturated permeable sediment greater than about 3 ft thick, separated from other permeable sediments above and below by at least 5 ft of low-permeability sediment.

[d]Estimated yield based on pumping test results. Actual long-term pumping rates will generally be lower. Where the extraction well is not yet installed, estimates of sustainable flow rates are shown in parentheses. These rates are based on the flow rates from nearby wells screened in similar zones and/or local hydrogeologic conditions.

[e]Pump type currently installed. All are Grundfos stainless steel submersible pumps. Nominal pump flow rates are 5S05-13 = 5 gpm, 25S10-7 = 25 gpm, and 10S05-9 = 10 gpm.

[f]The borehole for EW-8-2A will be depth-sampled (Hoffman and Dresen, 1990) for VOCs during drilling. The well will be completed in the water-bearing zones containing VOCs.

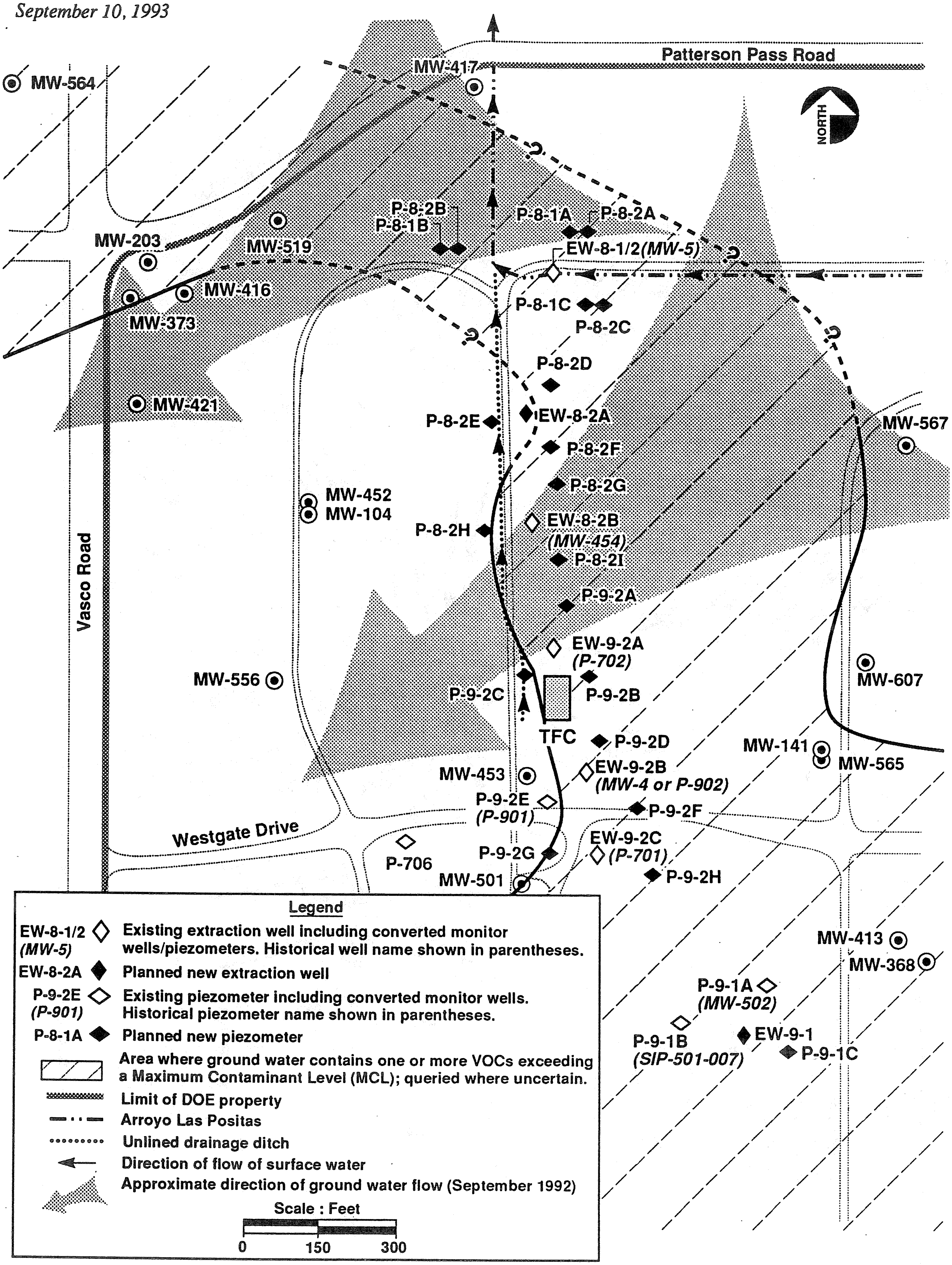


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Figure 3. TFC area extraction well and piezometer locations.

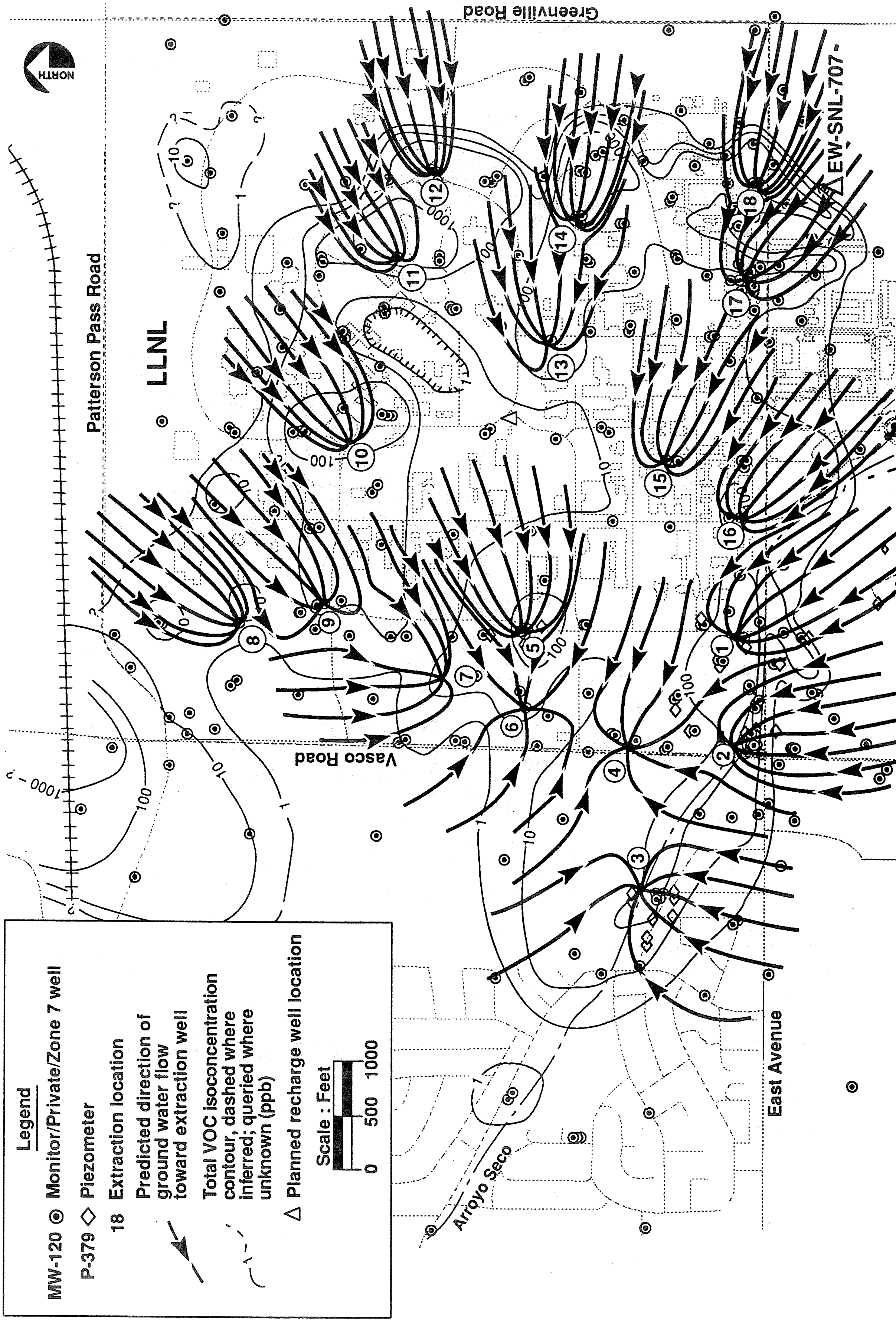

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Figure 4. Extraction well hydraulic capture zones and recharge well locations (modified from the Record of Decision for the LLNL Livermore Site).

on new source investigation information, and the size of actual hydraulic capture areas of EW-8-1/2 and EW-8-2B, extraction well EW-8-2A (Fig. 3; Table 1) may be added to achieve full plume capture.

Depending on the size of actual capture areas for the extraction wells as determined by field monitoring, and on the scope of remedial actions conducted by offsite responsible parties, an additional extraction well and associated piezometers may be necessary in the vicinity of monitor well MW-519 (Fig. 3) to capture VOCs originating on DOE property. Ground water from MW-519 contains VOCs similar to those in EW-8-1/2 (MW-5) (Fig. 3). Those VOCs, including 1,1,1-TCA, 1,1-DCE and Freon 113, are absent in MW-417 to the north, and in MW-416 and MW-203 to the south, indicating they are probably migrating in relatively narrow, permeable channel-type deposits oriented west-northwest between EW-8-1/2 and MW-519. Although the source of these VOCs is currently not known and under investigation, concentrations are highest (up to 38 ppb) in MW-5, suggesting that they originate within current Livermore Site boundaries. Because of the proximity of MW-519 to the TCE plume originating north of Patterson Pass Road (Iovenitti *et al.*, 1991), it is premature for DOE/LLNL to install an extraction well near MW-519 until the responsible parties develop and implement a remediation plan for their plume. This is especially important because pumping at MW-519 may capture portions of the offsite plume. In addition, because of the channelized nature of subsurface deposits between MW-519 and EW-8-1/2, it is plausible that pumping EW-8-1/2 may capture VOCs in the MW-519 area.

Remediation strategies for the MW-519 area will be re-evaluated and will be presented in an addendum to this report when the issues described above are resolved. To ensure that the migration of the offsite plume in the MW-519 area will not be adversely influenced by pumping at extraction well EW-8-1/2, water levels in surrounding wells will be monitored monthly and ground water from MW-519 will be sampled and analyzed quarterly for VOCs and hexavalent chromium. If water level data indicate that offsite the ground water plume is being affected, the extraction rates at extraction location 8 will be appropriately modified. In addition, DOE/LLNL plan to monitor other key wells in this area (see Table 17 in Section 4.2.2) to track changes in VOC and hexavalent chromium concentrations.

The source of PCE in the EW-8-2B (MW-454) area is currently being investigated. Although up to 150 ppb PCE is present in ground water from MW-454, the estimated maximum long-term steady-state yield from MW-454 is only about 2 to 3 gallons per minute (gpm). To provide additional flow and a larger hydraulic capture zone, the planned location of EW-8-2B may be changed if more permeable sediments are encountered in the target zone during subsequent drilling.

Four extraction wells are planned for extraction location 9 (Fig. 3). EW-9-2B (MW-4) and EW-9-2C (P-701) are located to hydraulically control the leading edge of the VOC plume in the southern part of the TFC area and to prevent offsite VOC migration in ground water. Initial ground water extraction will begin at EW-9-2C. If pumping EW-9-2C and EW-9-2B does not completely capture the plume, EW-9-2A (P-702) will also be pumped. Because the estimated maximum long-term steady-state yield of EW-9-2A is about 2 to 3 gpm, this well may also be relocated to maximize capture and mass removal. The final location of EW-9-2B (at MW-4 or P-902) will depend on the results of recent ground water sampling.

EW-9-1 is in an area recently identified as having relatively high VOC concentrations (Devany *et al.*, 1992). A ground water sample collected from P-9-1B (SIP-501-007) in January 1993 contained 1,600 ppb TCE, indicating a nearby source area. EW-9-1 will be located to control further VOC migration from this recently identified potential source area and maximize VOC mass removal. Installation of EW-9-1 will receive a high priority to accomplish plume margin and source control in the northwestern part of LLNL.

Source investigations have not been funded for FY 93 or FY 94, although it is anticipated that preliminary subsurface investigations will be conducted in FY 94 for the drilling of future extraction wells associated with TFC.

Figure 2 shows a 20 gpm influent flow rate to TFC from extraction locations 8 and 9. Locally increasing VOC concentrations and recent identification of evidence of a possible VOC source south of extraction location 9 may require up to four additional extraction wells near TFC (Fig. 3) to enhance plume capture. Consequently, influent flows to TFC are expected to be higher than originally estimated. Table 1 shows estimates of the maximum sustainable yields from each TFC extraction well based on the most recent hydraulic and hydrogeologic data. Because pumping data are relatively limited, the estimates in Table 1 probably represent upper bounds for long-term steady-state yields. These upper bounds are shown on Table 1 so that pumps with adequate capacity can be installed to enable maximum initial flow rates for plume capture and during cyclic pumping, if conducted. In most cases, as long-term ground water extraction progresses, flow rates will decline as shallow sediments dewater, distant hydraulic boundaries are encountered, and/or local gradients decrease. The estimated maximum long-term steady-state yields of the TFC area wells are shown in Table 1 and total 43 gpm. The long-term yield of these wells may be about 26 to 35 gpm.

Piezometers near the extraction wells will be monitored to determine hydraulic capture zones and identify areas of stagnant ground water. To monitor drawdown in areas where low sustainable yields are anticipated (EW-8-1/2, EW-8-2B, and EW-9-2A, for example), the planned piezometers at extraction locations 8 and 9 have been sited within about 100 feet of the wells. Up to 23 piezometers are planned for the TFC area. P-9-2E (P-901), P-9-1A (MW-502), and P-9-1B (SIP-501-007) are already installed. Up to 20 additional piezometers may be installed in phases during FY 93-95. Preliminary design specifications for the additional piezometers, along with the design specifications of the existing piezometers, are shown in Table 2. A discussion of the ground water chemistry monitoring plan for the TFC monitoring network is presented in Section 4.2.2.

Pumping will begin at existing extraction wells as soon as piping to TFC is completed. Initial flow rates will be maximized to establish capture zones as quickly as possible. Hydraulic data from EW-415 for a pilot study indicate it will take about 4 to 6 weeks for the pumping wells to establish their full hydraulic capture zones. Modeling for the FS (Isherwood *et al.*, 1990) suggested that a cumulative sustained flow rate of about 20 gpm will be required from extraction locations 8 and 9 to capture the plume margins. As discussed above, recent analysis indicates the cumulative flow will be higher.

Extraction flow rates and ground water elevation and chemistry data will be monitored to determine if the planned extraction scenario is completely capturing the VOC plume in the TFC area. Determination of full plume capture will be established in collaboration with the regulatory

Table 2. TFC piezometer specifications.

Name	Piezometer name[a]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval[b] (ft)	Sand pack interval (ft)	Approximate flow rate (gpm)
Extraction location 8							
TBI	P-8-1A	---	---	---	(56-71)	---	---
TBI	P-8-1B	---	---	---	(56-71)	---	---
TBI	P-8-1C	---	---	---	(56-71)	---	---
TBI	P-8-2A	---	---	---	(81-86)	---	---
TBI	P-8-2B	---	---	---	(81-86)	---	---
TBI	P-8-2C	---	---	---	(81-86)	---	---
TBI	P-8-2D	---	---	---	(70-90)	---	---
TBI	P-8-2E	---	---	---	(70-90)	---	---
TBI	P-8-2F	---	---	---	(70-90)	---	---
TBI	P-8-2G	---	---	---	(73-83.5)	---	---
TBI	P-8-2H	---	---	---	(73-83.5)	---	---
TBI	P-8-2I	---	---	---	(73-83.5)	---	---
Extraction location 9							
MW-502	P-9-1A	25-Oct-88	158	59	55-59	53-59	<0.5
SIP-501-007	P-9-1B	16-Nov-92	64	59	53-59	51-59	0.1
TBI	P-9-1C	---	---	---	(50-60)	---	---
TBI	P-9-2A	---	---	---	(77-95)	---	---
TBI	P-9-2B	---	---	---	(77-95)	---	---
TBI	P-9-2C	---	---	---	(77-95)	---	---
TBI	P-9-2D	---	---	---	(79-83)	---	---
P-901	P-9-2E	25-Feb-93	98	88	80-83	78-86	1
TBI	P-9-2F	---	---	---	(74-86)	---	---
TBI	P-9-2G	---	---	---	(74-86)	---	---
TBI	P-9-2H	---	---	---	(74-86)	---	---

Notes:
NA = Not available.
TBI = To be installed.

[a]Piezometer names show their location (i.e., P-8-1A is at extraction location 8) and the zone monitored (i.e. , P-8-1A is screened in the first zone). Letters following the zone designation indicate that multiple piezometers are screened in that zone.

[b]The perforated interval listed for piezometers not yet installed is the perforated interval of the extraction well they are designed to monitor. The actual perforated interval will be based on the hydrostratigraphy encountered during drilling. These estimates are shown in parentheses.

agencies. If actual flow rates do not capture any part of the plume margin, or mass removal rates appear too low to achieve the 53-year cleanup goal, additional extraction wells may be necessary. The locations of any new wells would be based on field water level data and recalibrated modeling results. If additional extraction wells are needed to establish full hydraulic capture of the VOC plumes in the TFC area, we estimate that the new wells, piezometers, and pipelines will be installed and operating about one year later.

2.2.2. TFC Specifications, Design, Treatability Tests, Controls, and Safeguards

The specifications, design, treatability tests, controls, and safeguards for TFC and its associated piping are described in Sections 2.2.2.1 through 2.2.2.3.

2.2.2.1. Specifications and Design

TFC will be designed to treat up to 60 gpm of extracted ground water to allow a factor of safety over the maximum 43 gpm estimated from hydraulic and hydrogeologic data (Section 2.2.1).

VOCs and hexavalent chromium are the chemicals of concern at TFC. Design VOC influent concentrations from the LLNL FS (Isherwood *et al.*, 1990) are shown in Table 3. Recent water sampling from wells in the TFC area indicate that the chromium is predominately hexavalent, and influent hexavalent chromium concentrations are not expected to exceed 50 ppb. RWQCB National Pollution Discharge Elimination System (NPDES) Permit No. CA 0029289, WDR Order No. 91-091 (Appendix A) limits the TFC effluent concentration to less than or equal to 5 ppb total VOCs (detection limit is 0.5 ppb) and the hexavalent chromium effluent concentration to less than or equal to 11 ppb (detection limit is 10 ppb). A table summarizing effluent discharge requirements is presented in Section A.2 in Appendix A. The Bay Area Air Quality Management District's (BAAQMD) Best Available Control Technology (BACT) guidelines (BAAQMD, 1992) are met if VOC emissions to the atmosphere are less than 6 parts per million (ppm) on a volume per volume basis ($ppm_{V/V}$) (detection limit is 1 $ppm_{V/V}$). LLNL has applied for an air permit for TFC and is awaiting response from BAAQMD.

Table 3. Design influent concentrations for TFC (modified from Isherwood *et al.*, 1990).

	Concentration (ppb)		
	Maximum influent	**Average influent**	**Effluent discharge requirements**
PCE	6	5	5
TCE	25	20	5
1,1-DCE	3	2	5
Chloroform	4	3	5
Freon 113	125	100	5
Total VOCs	163	130	5
Hexavalent chromium	50	30	11

The process equipment at TFC will be designed such that the inorganic ground water chemistry will not cause excessive system component degradation. Some carbonate scaling is expected to occur in the air stripper, which will be controlled through routine maintenance. Table 4 presents inorganic ground water chemistry data using data from monitor well MW-4.

Table 4. Inorganic ground water chemistry for TFC area wells (from well MW-4).

Constituent/Parameter	Concentration
pH	7.8 - 8.0
Chromium	35 ppb
Sodium	120 ppm
Calcium	62 ppm
Magnesium	22 ppm
Silicon (Si)	15 ppm
Bicarbonate (HCO_3)	360 ppm
Chloride	114 ppm
Nitrate (as NO_3)	22 ppm
Sulfate (as SO_4)	45 ppm

ppm = parts per million.
ppb = parts per billion.

The specifications and design for TFC are presented below. The equipment specifications are presented in Table 5. A location plan and a P&ID are presented as Plates 1 and 2*, respectively.

Ground water containing VOCs will be extracted for treatment using Grundfos submersible pumps. These pumps are centrifugal stainless steel with a variety of horsepower and flow ratings.

From the wellhead, the ground water will be pumped to TFC through a 3-inch polyvinyl chloride (PVC) Schedule 80 pipeline. Underground pipelines will be doubly contained with a leak detection system inside the outer pipe. Ground water will then enter a Cuno No. 12 DC3 stainless steel filter canister with 5-micron filters.

From the Cuno No. 12 DC3 filter canisters, ground water will flow to the air stripping tanks through Schedule 80 3-inch PVC pipe. The total average VOC concentration in water entering the stripping tank will be about 130 ppb (Table 3), and the aeration process will reduce these residual VOCs in the water to less than or equal to the discharge limit of 5 ppb. The air stripper is a commercially available Breeze Series 6 from Aeromix Corporation.

Table 5. Summary of TFC equipment specifications.

Equipment	Specification
TFC Building	Prefabricated steel or wood frame, 35 x 35 ft
Extraction well pumps	Grundfos stainless steel model numbers 5S05-13, 25S10-7, and 10S05-9, or equivalent.
Influent pipeline from extraction wells to TFC	Schedule 80 PVC
Leak detection system for double-contained underground piping to extraction well	Trace Tek 300 Longline System, Raychem Corporation

* Plates 1 and 2 are located in a pocket inside the back cover of this report.

Table 5. Continued.

Equipment	Specification
Filter canister	Cuno Model No. 12 DC3, stainless steel
Filter cartridges	Micro-Klean III, or equivalent, nominal 5 microns
Filters cartirdiges	Micro-Klean III, or equivalent, nominal 5 microns
Air stripping tanks	Aeromix System, Inc., Breeze Series 6
Blowers	Fuji Model No. VFC904A with a rating of 575 scfm at 0.0-in.; 510 scfm at 30-in.; 435 scfm at 90-in.; and 225 scfm at 120-in. of water
Carbon filters for air effluent	Carbtrol Model No. G3, 500 standard cubic feet per minute (scfm), 140 lb GAC
Level control diagnostic	Magnetostrictive level gauge
Discharge pump and motor	Bell & Gossett Series 1510 1 1/2 AB, 1 hp, 6 gpm, at 20-ft head, or equivalent
Variable speed control unit	To control speed of pump from 5-60 gpm
Ion-exchange unit for removal of hexavalent chromium	Remco Engineering, or equivalent. Ion-exchange unit capable of 60 gpm, reducing chromium from 50 ppb to less than or equal to 11 ppb. Regeneration generates a maximum of 1,000 gal of waste.
pH adjustment and monitor	Carbon dioxide or acid injection with pH sensor
Effluent tank	Baker tank; 20,000 gal

Two Fuji VFC 904A blowers will supply the air for the air stripper. Each blower will have an output of at least 360 standard cubic feet per minute (scfm) with an operating level of 2 feet of water in the air stripping tanks.

Once removed from the water, the VOCs will be exhausted from the air stripper and pass through two Carbtrol No. G3S carbon canisters, in parallel, where the residual VOCs will be adsorbed to the carbon. The carbon canisters contain 140 pounds of carbon each, with a 375-scfm flow rate and a 3-inch pressure drop. The carbon will be replaced to keep the air discharge below the Bay Area Quality Management District (BAAQMD) limit of 6 $ppm_{v/v}$. Assuming the average influent ground water concentrations are those listed in Table 3 and a flow rate of 60 gpm, the VOC mass loading rate of the carbon canisters will be 34 pounds/year. VOC loading on carbon of 10% is typical for ground water remediation projects. Assuming a carbon change-out at 3% loading, the carbon would be changed every 3 months.

The last cell of the second air stripping tank will contain the level controls for the discharge system (Plate 2). The level control system will consist of a level-sensing device in the tank which, in a closed-loop feedback system, controls the speed of the stripping tank discharge pump to keep the water level in the tank constant. The water will be pumped directly into an ion-exchange unit for chromium removal.

The ion-exchange unit will be commercially purchased and will reduce total and hexavalent chromium to concentrations at or below the discharge limits of 50 and 11 ppb, respectively (detection limit of 5 ppb and 10 ppb, respectively). The hexavalent chromium will be flushed out of the resin in the ion-exchange unit, as needed, by rinsing the resin with a sodium chloride solution. The sodium chloride solution containing the hexavalent chromium will be pumped to an outside container for removal and disposal.

Following the ion-exchange unit, a pH monitor and an acid or carbon dioxide injection system will be installed in the event that the effluent pH exceeds WDR Order No. 91-091 discharge limit of 8.5. It is not anticipated that the pH will decrease below the lower discharge limit of 6.5.

The treated effluent from TFC will be stored in a Baker tank and discharged through a gravity drain from a catch basin to a ditch that eventually flows to Arroyo Las Positas. The pipe from the ion-exchange removal unit is 70 feet long, and the pipe from the catch basin to the ditch is 12 inches in diameter and approximately 15 feet long.

All underground piping to TFC which cannot be visually monitored will be double-walled and instrumented with a leak detection system. This pipeline will consist of a 3-inch PVC, Schedule 80 inner pipeline surrounded by a 6-inch Schedule 40 outer pipeline. The leak detection system will be a Trace Tek 300 Longline System manufactured by Raychem Corporation that will be monitored and alarmed at TFC. This system will be installed within the 6-inch outer pipeline and will simultaneously detect the presence of aqueous fluids at any point along the cable's length, sound an alarm at TFC, and pinpoint the distance from TFC to the leak.

2.2.2.2. Treatability Tests

Treatability tests were conducted with ground water containing TCE concentrations similar to those expected at TFC. The test consisted of introducing ground water into a skid-mounted single Breeze Series-6 air stripper tank at varying flow rates. The results of the treatability test are presented in Table 6. The amount of air was also varied, and the effluent VOC concentrations were plotted as a function of the ratio of blower air in cubic feet per minute to water flow in gallons per minute (Fig. 5). This result was scaled up to the 60-gpm design flow to arrive at a required air quantity per gallon of water. The assumptions made were (1) the results are linear and indeed scalable, and (2) the stripping process in the actual treatment facility will be at least as efficient as that in the treatability test. The treatability test results indicate that an air to water ratio of 11.6 scfm/gpm is required to reduce total VOC concentrations to 0.5 ppb or less. This ratio was rounded up to 12, and at 60 gpm the required air flow rate is 60 x 12, or 720 scfm. Therefore, two Fuji 904A blowers in parallel and two air strippers in series, with a minimum air flow of 360 scfm to each air stripper will be used at TFC.

Table 6. TFC air stripper treatability test results.

Test No.	TCE influent concentration (ppb)	Water flow rate (gpm)	Air flow rate (scfm)	TCE effluent concentration (ppb)
1	85	13	65	3.3
2	82	13	117	<0.5
3	82	13	130	0.7
4	79	13	182	0.3

2.2.2.3. Controls and Safeguards

TFC will be equipped with an interlock control system. If one of the components listed below malfunctions, the entire system, including the associated extraction well pumps, will automatically shut down and trigger a visual alarm at the facility (Plate 2). The interlock control

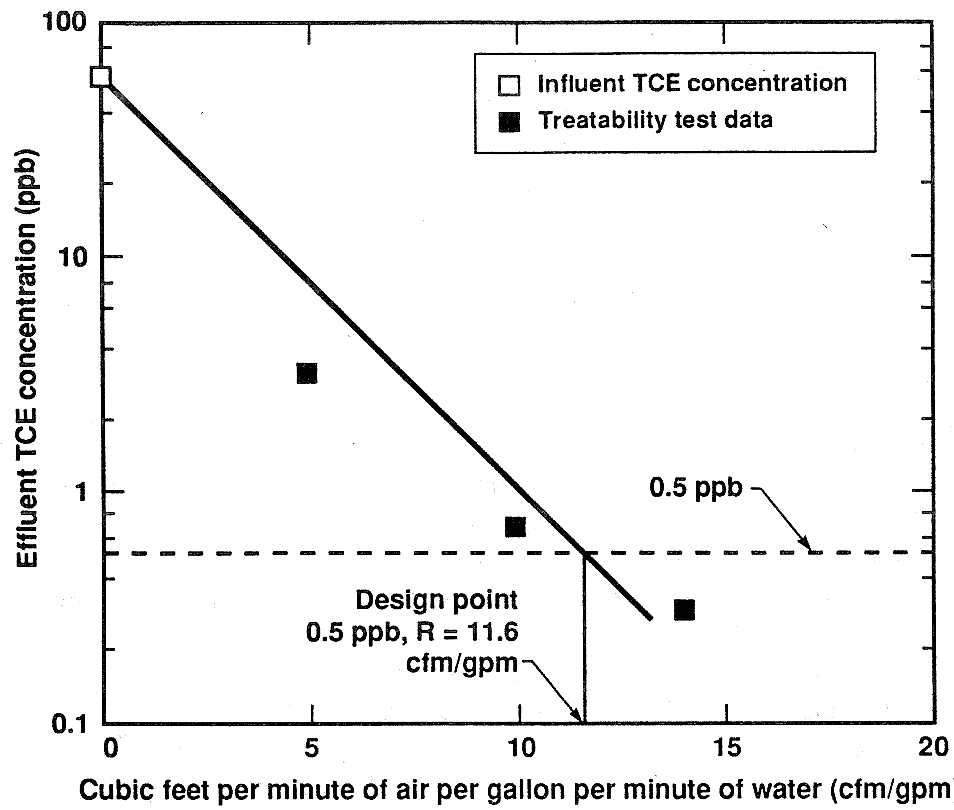

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Figure 5. Airflow design graph for TFC.

system will indicate the cause of the shutdown. The operator must determine and correct the problem before the system can be manually restarted.

A system shutdown involves de-energizing the following equipment:

- Well pumps.
- Blowers.
- Discharge pump.
- Metals treatment unit.
- Chemical injection pump (if pH control is used).

A systemwide shut down would be initiated by any of the following:

- A high water level in the aeration tanks.
- A high water level in the tanks in the ion-exchange unit.
- A high water level in Baker tank.
- Low air compressor pressure.
- High or low pressure downstream of the blowers.
- pH out-of-range as sensed by the effluent pH monitor.
- Loss of power to control and instrumentation.
- A leak detected within underground pipelines.
- Low pressure in the air stripper discharge pump.

In addition, accessible pipelines will be visually monitored for leaks on a daily basis.

2.2.3. Discharge of Treated Ground Water

Ground water treated at TFC will be discharged to an unlined, north-flowing drainage ditch located north of Westgate Drive, along Avenue A (Fig. 3). Treated water may also be used for onsite irrigation and/or in LLNL cooling towers to reduce the amount of water imported to LLNL, or reinjected for hydraulic control and/or enhanced remediation in accordance with RWQCB WDR Order No. 91-091 and ARARs.

As shown in Figures 2 and 3, the TFC drainage ditch flows into Arroyo Las Positas about 1,200 feet north of the discharge point. Arroyo Las Positas subsequently flows north and then west from LLNL. As discussed in Section 4.2, self-monitoring receiving water samples will be collected from the drainage ditch between 50 and 100 feet from the discharge point. Analyses of receiving water samples will be conducted according to the specifications outlined in WDR Order No. 91-091 (Appendix A).

2.3. Construction and Startup Schedule and Cost Estimates

Technology evaluations and conceptual designs for TFC were conducted by ERD. The conceptual design presented in this RD report was also simultaneously submitted to LLNL Plant Engineering for detailed design. Construction of portions of the facility started in October 1992 (Table 7) and it is scheduled to be operational by October 30, 1993 (Dresen *et al.*, 1993a). Following completion of the conceptual design, LLNL Plant Engineering will complete the final design that will be used for construction. TFC will be constructed by a subcontractor, including excavation and piping from the extraction wells.

Table 7. TFC design and construction schedule.

Item	Design		Construction	
	Start	End	Start	End
TFC design and construction	10/92	6/93	5/93	9/93
TFC activation	---	---	9/93	10/93

The estimated costs for design and construction of TFC are shown in Table 8. The costs associated with building construction, as shown in Table 8, include design and construction costs for the influent and effluent pipelines, facility power, and power to the wellheads.

The costs associated with the air stripper and associated equipment include the blowers, in-line water filters, effluent air carbon filters, stripping tank discharge pump and control, and the pH adjustment metering pump and control.

The costs associated with the ion-exchange unit and associated equipment include the cost of the commercially purchased treatment unit, which includes all pumps, piping, tanks, and control hardware.

Table 8. TFC cost summary.

Item	Cost[a]	Annual O&M [a]	53 Year Cleanup O&M[a]
TFC building (including design, construction, piping, and power)	$1,080,000	----	----
Air stripper and associated equipment	130,000	----	----
Ion-exchange unit and associated equipment	162,000	----	----
Activation costs	40,000	----	----
MPC[b] 9.7%	28,324	----	----
Subtotal	*1,440,324*	----	----
TFC Operations & Maintenance:			----
Labor:			
ERD Personnel[c]	----	$516,000	$16,251,420
HWM[d]	----	30,000	1,590,000
Plant Support	----	60,000	3,180,000
Subtotal	----	*606,000*	*21,021,420*
Materials:			
Extraction wells	----	1,200	63,600
Ion-exchange unit	----	12,900	683,700
Air compressor	----	600	31,800

Table 8. Continued.

Item	Cost[a]	Annual O&M [a]	53 Year Cleanup O&M[a]
Pumps	----	240	12,720
Filters	----	3,600	190,800
Carbon housing	----	12,840	680,520
Blowers	----	240	12,720
Baker tanks	----	13,200	699,600
pH metering	----	5,400	286,200
Miscellaneous piping	----	1,200	63,600
Miscellaneous electronics	----	600	31,800
Sample analysis	----	24,000	1,272,000
HWM[d]	----	132,720	7,034,160
MPC[b] 9.7%	----	5,046	267,438
Subtotal		*213,786*	*11,330,655*
G&A/LDRD[e] charge 13%	187,242	106,572	4,205,770
Total	$1,627,566	$926,358	$36,557,845

[a]Cost are based on FY 93 estimated cost and do not include yearly escalation.

[b]Material Procurement Charge.

[c]ERD personnel labor estimates include hydrogeologist, chemist, engineer, technician and analyst time to meet the requirements in the ROD and milestones in the RAIP. The 53-year cleanup cost reflects time for these staff to maintain and improve treatment systems, effectively manage the well field as conditions change over the life of the cleanup, and evaluate and potentially implement new cleanup technologies as they are developed in the future. The estimated cost for ERD personnel is based on a constant level of effort for the first 5 years of the cleanup, about 83% of that effort for years 6 through 10, about 67% of that effort for years 11 through 15, and half the initial effort for years 16 through 53.

[d]LLNL Hazardous Waste Management.

[e]General and Administrative/Laboratory Directed Research and Development cost.

3. Remedial Design for Treatment Facility F

3.1. TFF Design Summary

TFF is a ground water and soil vapor treatment facility located adjacent to East Avenue at the Gasoline Spill Area in southern LLNL (Fig. 2). The principal contaminants in ground water in the TFF area are FHCs and lesser VOCs. The ground water treatment portion of TFF consists of an oil/water separator system to remove free-product FHCs, an ultraviolet/hydrogen peroxide (UV/H_2O_2) unit to treat most of the VOCs and FHCs dissolved in the water, and an air stripping system to treat VOCs that are not destroyed by the UV/H_2O_2 unit. The soil vapor treatment portion of TFF consists of vacuum blowers and a rechargeable dual bed granular activated carbon (GAC) treatment trailer for the vapor phase of effluent. A change from catalytic oxidation to GAC for treatment of vapor at TFF is described in an *Explanation of Significant Difference* (Dresen *et al.*, 1993b).

The field phase of a temporary dynamic steam/electric heating remediation, the DUSDP (Aines *et al.*, 1992), has just been completed in the Gasoline Spill Area to assess whether steam injection and electrical heating of fine-grained sediments can effectively mobilize free-phase fuel hydrocarbons in the central part of the spill area for removal by vacuum-induced venting and ground water extraction. The results of this demonstration project are pending. After the demonstration results are available, ground water and vapors will be extracted and treated from extraction locations 17 and 18 (Fig. 2) using the TFF oil/water separator, UV/H_2O_2 unit, air stripping, and the GAC vapor treatment system. The changes to the TFF design to accommodate DUSDP include a ground water heat exchanger, vapor condenser with associated demister and condensate return, and piping suitable for high temperatures.

The chemicals of concern in ground water in the TFF area are toluene, benzene, xylenes, TCE, 1,2-dichloroethane (1,2-DCA), chloroform, PCE, carbon tetrachloride, Freon 113, 1,1-DCE, 1,1,1-trichloroethane (1,1,1-TCA), and perhaps lead (see Table 11, Section 3.2.2.1).

The treated ground water from TFF is currently discharged to LLNL cooling towers and the sanitary sewer under discharge permit requirements shown in Appendix A. LLNL has submitted a permit application to BAAQMD and received an Authority to Construct. The BAAQMD Authority to Construct allows discharge of 6 $ppm_{v/v}$ for the vapor extraction system and 10 $ppm_{v/v}$ for the ground water air stripper. If the treated effluent from TFF satisfies the requirements of RWQCB WDR Order No. 91-091 (Appendix A), it may be used for infiltration, reinjection in accordance with ARARs (Fig. 6), or discharge to the storm drain.

3.2. Design Specifications

Design specifications for the planned TFF extraction wells and piezometers and for the treatment system are described in Sections 3.2.1 and 3.2.2, respectively.

3.2.1. Extraction Wells and Piezometers

As discussed in the RAIP (Dresen *et al.*, 1993b), extraction locations 17 and 18 will supply ground water to TFF (Fig. 2). A total of nine ground water extraction wells will be pumped at these two locations. Eight of the nine extraction wells are already installed. Other extraction wells and/or locations may be added if complete hydraulic capture in the TFF area is not achieved with these nine wells. As-built design specifications for the existing TFF extraction wells and the design specifications for the planned new well are shown in Table 9. TFF area extraction well and piezometer locations are shown in Figures 6 and 7. All existing and planned wells will be secured in locked enclosures.

Planned TFF area extraction well locations are based on ground water modeling results (Chapter 3 and Appendix B in Isherwood *et al.*, 1990; Tompson, 1990; Tompson *et al.*, 1991; and Tompson *et al.*, 1993, in preparation), local hydrogeology (Thorpe *et al.*, 1990; Isherwood *et al.*, 1990), and the current understanding of FHC and VOC distribution. In all cases, extraction well locations were selected to capture ground water from all water-bearing zones where compounds of concern exceed MCLs.

One ground water extraction well is planned for extraction location 18 (Fig. 6). Extraction well EW-18-1 (MW-112), located southwest of Building 518, will capture VOCs migrating offsite onto DOE property to the south. This VOC plume consists of up to 300 ppb TCE, and generally less than 20 ppb carbon tetrachloride, 1,1-DCE, and PCE. The Freon 113 concentration is currently about 43 ppb, far below its 1,200 ppb MCL.

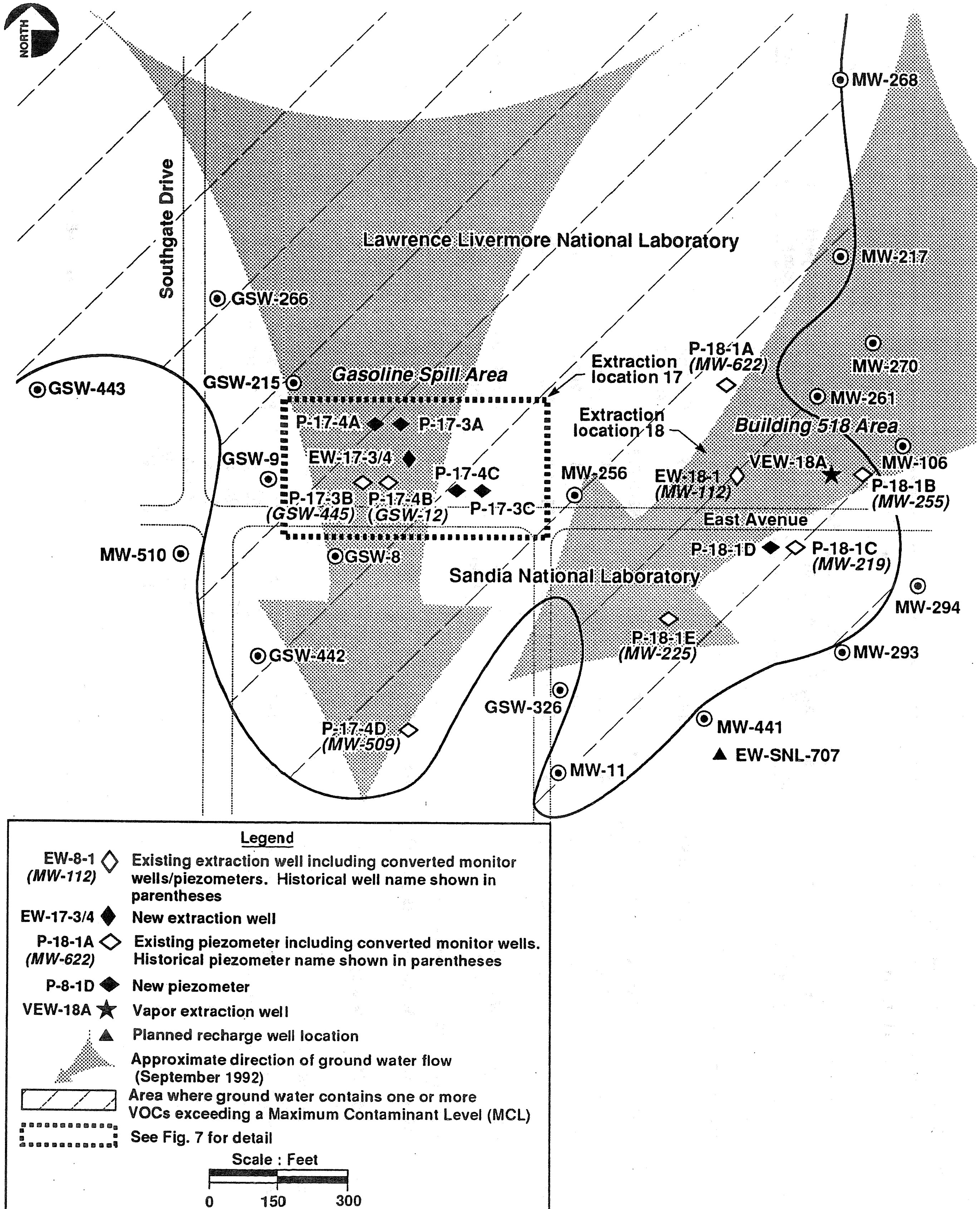

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Figure 6. TFF area extraction well and piezometer locations.

Table 9. TFF extraction well specifications.

Well name	Extraction well name[a]	Well design[b]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval (ft)	Sand pack interval (ft)	Water-bearing zone[c]	Estimated maximum long-term steady state yield (gpm)[d]	Pump type[e]	Pump intake depth (ft)
Extraction location 17											
Ground water extraction wells											
GEW-710	EW-17-1/2A	Multiple[f]	02-Aug-91	162	157	94-137	91-141	First and second	(15)	---	129
GIW-820	EW-17-1A	Single	16-Jul-92	143.3	105	85-105	82-105.3	First	(3)	---	(103)
GIW-820	EW-17-2A	Single	16-Jul-92	143.3	132	112-132	111-137	Second	(12)	---	122
GIW-815	EW-17-2B	Single	06-Jun-92	143	97	77-97	75-98	First	(3)	---	(95)
GIW-815	EW-17-1B	Single	06-Jun-92	143	132.5	112.5-132.5	110-139	Second	(12)	---	122.5
TBI	EW-17-3/4	Multiple/ sealed	---	---	---	145-160 (175-190)	---	Third and fourth	(5) (5)	---	(183)
Ground water and vadose zone extraction wells											
GEW-808	EW-17-1/2B	Multiple[f]	05-Jun-92	164	150	50-140	44-153	First and second	30	Ejector Systems[g]	128
GEW-816	EW-17-1/2C	Multiple[f]	03-Jun-92	161.7	150	50-140	42.8-147	First and second	30	Ejector Systems[g]	130
Vadose zone extraction well											
GSW-16	VEW-17	Multiple/ sealed	19-Oct-87	146	145	23-28 38-43 50-55 61-66 78-83 95-105 120-130	20.5-30 35-45 48-55 59-68 74-83.5 92.5-108 114-131	First and second	5	Ejector Systems[h]	(139)

Table 9. Continued.

Well name	Extraction well name[a]	Well design[b]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval (ft)	Sand pack interval (ft)	Water-bearing zone[c]	Estimated maximum long-term steady state yield (gpm)[d]	Pump type[e]	Pump intake depth (ft)
Extraction location 18											
Ground water extraction well											
MW-112	EW-18-1	Single	10-May-85	129	123.5	111-123.5	110.5-123.5	First	10	---	121
Vadose zone extraction well											
SIB-518-201	VEW-18A	Single	3-May-93	60	50	34-50	33-60	---	---	---	---

Notes:

TBI = To be installed.

Estimates are shown in parentheses.

[a]Extraction well names provide the well type (EW), its location (EW-17) as shown on Figures 2 and 7, and its depth relative to other extraction wells at the same location (e.g., EW-17-1A is shallower than EW-17-2A). When multiple extraction wells are screened in the same water-bearing zone, a letter follows the zone designation (e.g., EW-17-2A, EW-17-1B, etc.). When a single extraction well is screened in more than one zone, the zones are indicated (e.g. EW-17-1/2A is screened in the first and second water-bearing zone).

[b]The three extraction well designs are:

Single= a well screened and sand-packed in only one water-bearing zone.

Multiple/sealed= a well screened and sand-packed in more than one water-bearing zone with annular grout seals between screened zones.

Multiple= a well fully screened and sand-packed in multiple water-bearing zones.

Additional information regarding these well designs and their applications is presented in the RAIP (Dresen *et al.*, 1993a).

[c]Numbered consecutively downward from ground surface at each extraction location. A water-bearing zone is defined as saturated permeable sediment greater than about 3 ft thick, separated from other permeable sediments above and below by at least 5 ft of low-permeability sediments.

[d]Estimated yield based on pumping test results. Actual long-term pumping rates will generally be lower. Where the extraction well is not yet installed, estimates of sustained flow rates are shown in parentheses. These rates are based on the flow rates from nearby wells screened in similar zones and/or local hydrogeologic conditions.

[e]Pump type will be determined following the completion of the Dynamic Underground Stripping Demonstration Project.

[f]Wellhead will be modified for concurrent vapor and ground water extraction, if necessary.

[g]Ejector Systems, Inc. pneumatic pump; 45 gpm.

[h]Ejector Systems, Inc. pneumatic pump; 30 gpm.

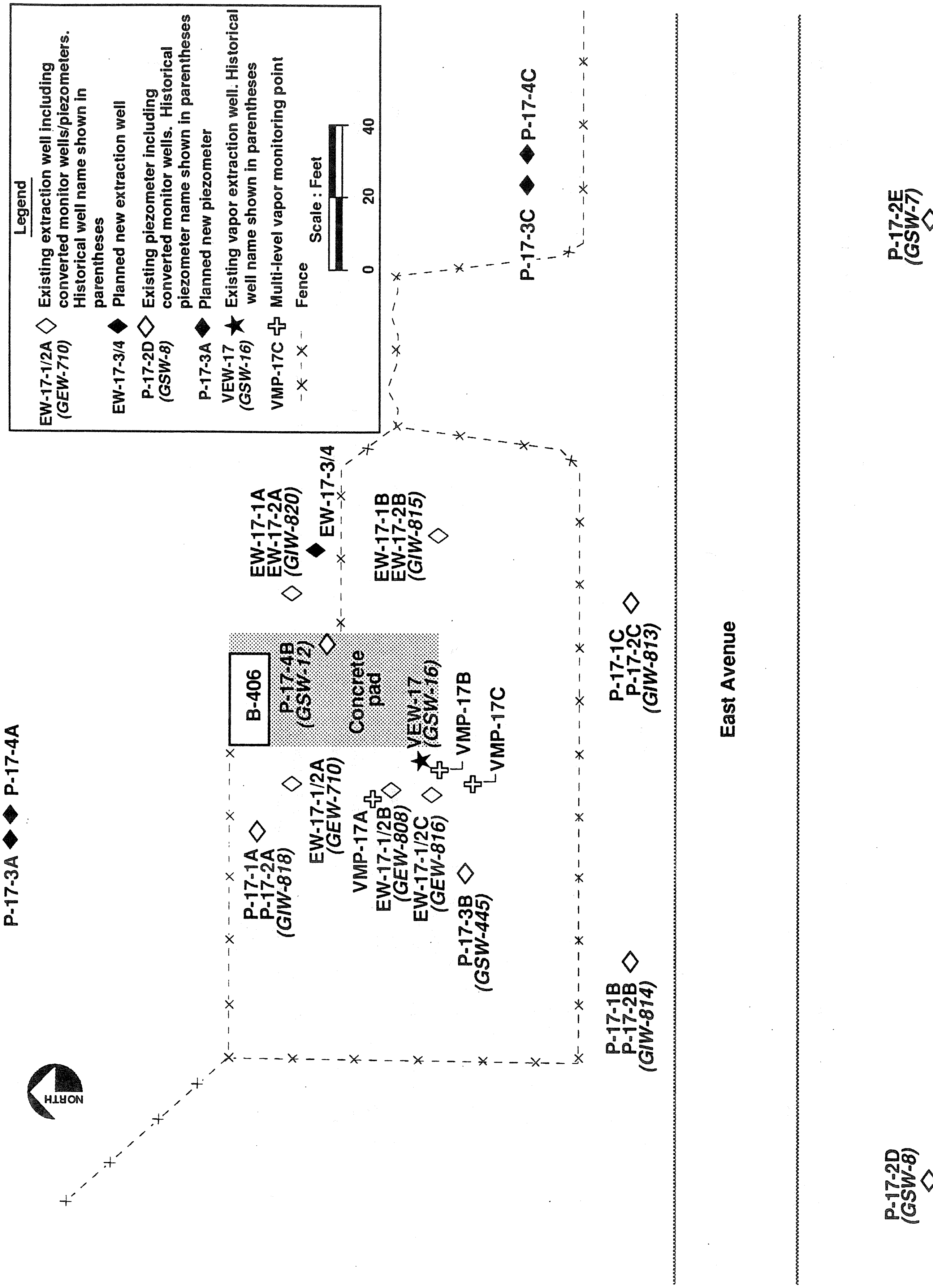

Figure 7. TFF extraction wells and piezometers, extraction location 17.

Test soil vapor extraction well VEW-18A was completed southwest of Building 518 in March 1993 (Fig. 6). A soil vapor extraction and treatability study was conducted in June 1993 at VEW-18A to evaluate vapor flow rate and VOC concentrations. The results of this treatability study will be presented in RD Report No. 3. Depending on results of the treatability study, vapor from the Building 518 area may be piped to TFF for treatment, or may be treated at a separate facility in the Building 518 area. The vapor extraction trailer currently at TFF is capable of treating VOCs and would not require any upgrade. The Building 518 vapor extraction well field and treatment facility design, if a separate facility at Building 518 is required, will be presented in a subsequent RD report.

Eight extraction wells are planned for extraction location 17 (Figs. 6 and 7). EW-17-3/4 will extract ground water containing VOCs from the third and fourth water-bearing zones between a depth of 150 and 190 feet. The DUSDP will evaluate whether steam flooding of the first and second water-bearing zones coupled with electrical heating of fine-grained sediments can accelerate the mobilization of VOCs and FHCs for cleanup in the Gasoline Spill Area.

After the DUSDP, six existing extraction wells and EW-17-1/2A (GEW-710) (Fig. 7) will be used to capture remaining FHCs and VOCs in the two upper water-bearing zones. The first and second water-bearing zones will be dewatered locally to allow for vapor extraction. Once dewatering has occurred, existing ground water/vapor extraction well GSW-16 (VEW-17A) will be used to extract gasoline vapor from the unsaturated zone. Vadose zone vapor monitoring points VPM-17A, VPM-17B, and VPM-17C and ground water monitor wells completed in the dewatered first and second water-bearing zones will be used to monitor pneumatic response to vapor extraction from VEW-17A. Depending on the distribution of gasoline following the DUSDP, and on the size of the zone of influence of VEW-17A, EW-17-1/2A, EW-17-1/2B, and EW-17-1/2C, other wells may also be used for vapor extraction to complete the vadose zone remediation. The TFF extraction well locations are preliminary, pending the results of the DUSDP.

Figure 2 shows a 30 gpm influent flow to TFF from extraction locations 17 and 18. Recent pumping data from extraction location 18 wells indicate that long-term flow rates from the proposed extraction wells (Fig. 6) are higher than the original estimate. Table 9 shows estimates of the maximum long-term steady-state yields from each of these extraction wells based on the most recent hydraulic and hydrogeologic data. Because pumping data for most TFF extraction wells are limited, the sustainable yield estimates represent upper bounds for long-term yields. Although the maximum sustainable yields shown in Table 9 total 120 gpm, the long-term yield of these wells will probably be about 72 to 96 gpm.

As shown in Figure 6, a network of piezometers surrounding the TFF extraction wells will be monitored to determine hydraulic capture zones and identify stagnant areas during pumping. A network of 20 piezometers is planned for TFF extraction wells. Fifteen of these piezometers are existing monitor wells and piezometers, and the five remaining new piezometers are planned for installation in phases in FY 93-95. Design specifications for the 15 existing and 5 planned piezometers are shown in Table 10. A discussion of the monitoring plan for the TFF piezometers is presented in Section 4.2.2.

Four existing and one new piezometers are planned for monitoring extraction well EW-18-1 (MW-112) (Fig. 6). Although the screened intervals for the two existing piezometers south of

Table 10. TFF piezometer specifications.

Well name	Piezometer name [a]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval[b] (ft)	Sand pack interval (ft)	Approximate flow rate (gpm)
Extraction location 17							
GIW-818	P-17-1A	06-Jul-92	150	102	82-102	80-105.7	NA
GIW-818	P-17-2A	06-Jul-92	150	140	120-140	120-142	NA
GIW-814	P-17-1B	19-Jun-92	149.6	106.5	86.5-106.5	84.5-107	NA
GIW-814	P-17-2B	19-Jun-92	149.6	141	121-141	120-147	NA
GIW-813	P-17-1C	15-Jun-92	143	97	77-97	75-98	NA
GIW-813	P-17-2C	15-Jun-92	143	112.5	112.5-132.5	110-139	NA
GSW-8	P-17-2D	01-Apr-86	176	133	127.5-133	124.5-132	2
GSW-7	P-17-2E	14-Mar-86	176.5	123.4	110.8-123.4	108-123	2
TBI	P-17-3A	---	---	---	(145-190)	---	---
TBI	P-17-4A	---	---	---	(175-190)	---	---
GSW-12	P-17-4B	27-May-86	205	191	186.5-191	184.5-190.5	1
GSW-445	P-17-3B	09-Dec-87	319	161	155-161	153-161	3
TBI	P-17-3C	---	---	---	(145-160)	---	---
TBI	P-17-4C	---	---	---	(145-190)	---	---
MW-509	P-17-4D	13-Mar-89	305	184	179-184	178-185	1
Vapor monitoring points							
SVB-GP-008A	VMP-17A	24-Oct-91	90	90	---	39-41 55.5-57 63.5-65 69-71.5 79-81.5	---
SVB-GP-013	VMP-17B	06-Mar-91	90	90	---	25-28 34-36.5 41.5-44 49.5-52 57-59 70.5-72 79-81	---

Table 10. Continued.

Well name	Piezometer name [a]	Date completed	Borehole depth (ft)	Casing depth (ft)	Perforated interval (ft)	Sand pack interval (ft)	Approximate flow rate (gpm)
SVB-GP-014	VMP-17C	14-Mar-91	90	90	---	23.5-26 31.5-35 44.5-47 57-59.5 67-69.5 77.5-80	---
Extraction location 18							
MW-622	P-18-1A	28-Sep-90	206	112	104-112	103-112.5	<0.5
MW-255	P-18-1B	05-Dec-85	187	124	115-124	113-124	1
MW-219	P-18-1C	13-Jun-86	214	148	141-148	139-148	2
TBI	P-18-1D	---	---	---	(120-130)	---	---
MW-225	P-18-1E	09-Sep-86	238	166	152-166	150-164	2.5

Notes:
NA = Not available.
TBI = To be installed.

[a] Piezometer names show their location (e.g., P-18-1A is at extraction location 18) and the zone monitored (e.g., P-18-1A is screened in the first zone). Letters following the zone designation indicate that multiple piezometers are screened in that zone.

[b] The perforated interval listed for piezometers not yet installed is the perforated interval of the extraction well they are designed to monitor. The actual perforated interval will be based on the hydrostratigraphy encountered during drilling. The estimates are shown in parentheses.

EW-18-1 are deeper than the screened interval in extraction well EW-18-1, a long-term pumping test indicates good hydraulic communication between the well and piezometers. Geophysical and geologic well logs suggest that the sedimentary units in the area dip south. Accordingly, sediments correlating with the first water-bearing zone at EW-18-1 are progressively deeper toward the south from EW-18-1. Planned new piezometer P-18-1D will be completed in a saturated zone occurring above the screened interval of P-18-1C (MW-219) (Fig. 6). Based on geochemical and hydrogeologic data, these saturated sediments appear to constitute part of the first water-bearing zone at P-18-1C. If, however, P-18-1D does not respond to long-term pumping at EW-18-1, P-18-1D will be converted to an extraction well and three additional piezometers will be installed around P-18-1D to monitor this zone.

As shown in Figure 6, compounds of concern exceeding MCLs extend offsite about 750 feet south of East Avenue. This area is hydrogeologically complex because of the Las Positas Fault Zone to the south and south-dipping sediments. To ensure that the plume margins are captured in this area, water levels in the wells south of East Avenue will be monitored monthly. If complete capture of the plume margin is not achieved by pumping at extraction locations 17 and 18, or if it is judged that it will significantly reduce cleanup time based on cost/benefit analysis, or if public safety and health are threatened, up to two additional extraction wells and associated piezometers may be installed in the vicinity of MW-509 and/or MW-11. In order to enhance cleanup, and/ or if dewatering occurs due to future pumping of these wells or other nearby extraction wells, treated ground water may be reinjected at a former DUSDP "clean site" demonstration extraction well (EW-SNL-707) near MW-441 (Fig. 6), as discussed in the RAIP (Dresen *et al.*, 1993b). Reinjection well locations will be selected to be in compliance with the State Water Resources Control Board Resolution 68-16.

All extraction wells will begin pumping soon after the DUSDP is complete and the remaining piping to TFF is installed. Initial flow rates will be maximized to establish capture zones as quickly as possible. Hydraulic test data indicate that it will take about 4 to 6 weeks for the pumping wells to establish their full hydraulic capture zones. Modeling results suggest that sustained flow rates of about 20 gpm will be required for extraction locations 17 and 18 to capture the plume margins. As discussed above, recent analysis indicates the influent flow to TFF will be higher. If the observed steady-state drawdown fails to capture any part of the plume margin, additional extraction wells may be necessary. The locations of any new wells would be based on new field water level data and recalibrated modeling results.

3.2.2. TFF Specifications, Design, Performance, Controls, and Safeguards

The specifications, design, performance, controls, and safeguards for TFF and its associated piping are described in Sections 3.2.2.1 through 3.2.2.3.

3.2.2.1. Specifications and Design

The TFF ground water treatment system was designed to treat up to 100 gpm of extracted ground water from the Gasoline Spill Area. Design FHC and VOC influent concentrations from the LLNL (Isherwood *et al.*, 1990) are shown in Table 11. The process equipment at TFF is designed such that the inorganic ground water chemistry will not cause excessive system component degradation. Scaling is controlled through routine maintenance. Table 12 presents inorganic chemistry data for the TFC area using data from well GSW-403-6.

Table 11. Design influent concentrations for TFF (modified from Isherwood *et al.*, 1990).

	Concentration (ppb)		
Constituents	**Maximum influent**	**Average influent**	**Effluent discharge requirements**
PCE	13	10	5
TCE	250	200	5
1,1-DCE	13	10	5
1,1,1-TCA	4	3	5
1,2-DCA	163	130	5
Carbon tetrachloride	13	10	5
Chloroform	25	20	5
Freon 113	13	10	5
Benzene	25,000	20,000	0.7
Toluene	38,000	30,000	5
Xylenes	19,000	15,000	5
Total VOCs plus FHCs	82,494	65,393	5
Lead	38	30	5.6

Table 12. Inorganic ground water chemistry for TFF area wells (from well GSW-403-6).

Constituent/Parameter	Concentration
pH	7.1
Chromium	<10 ppb
Sodium	86 ppm
Calcium	126 ppm
Magnesium	46 ppm
Bicarbonate (HCO_3)	640 ppm
Nitrate (as NO_3)	20 ppm
Sulfate (as SO_4)	53 ppm

ppm = parts per million
ppb = parts per billion

TFF ground water treatment consists of three sequential treatment steps. Ground water is pumped from the wells and passes through an oil/water separator system to remove as much of the free-product FHCs as possible. An UV/H_2O_2 system destroys most of the VOCs and FHCs remaining in the water. UV light disassociates the H_2O_2 to form the hydroxyl radical ($OH^{\bullet}$). The hydroxyl radical oxidizes the FHCs and VOCs to water, chloride ions, and carbon dioxide. The TFF UV/H_2O_2 treatment unit efficiently oxidizes most FHCs and TCE. The double carbon-to-carbon bond of these compounds is readily oxidized under the influence of the hydroxyl radical. Ground water in the vicinity of extraction location 17 also contains 1,2-DCA and ethylene dibromide (EDB), which have single carbon-to-carbon bonds and are not as readily oxidized. Ground water in the vicinity of extraction location 18 also contains 1,1,1-TCA, carbon tetrachloride, chloroform and Freon 113, which are also difficult to oxidize. An air stripping system removes the few residual VOCs that are not completely destroyed by the UV/H_2O_2 process, and collects them in a GAC filter.

The vapor extraction system is a self-contained trailer-mounted system. Its liquid ring pump can extract up to 400 actual cubic feet per minute (acfm) of soil vapor containing FHCs which are adsorbed by a GAC filter. When the first carbon vessel becomes saturated, the vapor flow is diverted to the second carbon vessel while the first is regenerated in-place by steam from a boiler. FHCs, VOCs, and steam are recovered by a condenser connected to a product separator. Recovered FHCs and VOCs are delivered to the LLNL Hazardous Waste Management Division for recycling and/or offsite disposal at a Resource Conservation and Recovery Act (RCRA) permitted facility.

As discussed in Section 3.1, the field phase of the DUSDP was recently completed at the Gasoline Spill Area. Steam was injected through a ring of injection wells near the periphery of the free-phase gasoline plume. Electrical resistance heating was used to heat the less permeable sediments before steam injection. The liquid and vapor effluent from this project were treated by TFF. Some of the equipment required for the DUSDP will probably not be used for dewatering and vapor extraction. For example, heat exchange equipment will be removed or modified once the extracted water and vapor temperatures drop to 90°F.

The specifications and design for TFF are presented below. Table 13 presents the equipment specifications and notes equipment used for the DUSDP. A location plan and a P&ID are presented as Plates 3 and 4*, respectively.

3.2.2.1.1. Ground Water Treatment

If free-phase FHCs remain after the DUSDP, selected wells will be equipped with positive displacement pumps to minimize mixing of free-phase FHCs and ground water, and enhance subsequent mechanical separation of FHCs and water during treatment. In the positive displacement pumps, compressed air will displace the ground water within the pump body, forcing the ground water to the surface. The compressed air is then released to allow the pump body to refill. The average flow rate from these pumps is controlled by the pressure, duration of fill, and discharge. When a bubbler line senses insufficient water head to fill the pump, the pump controller will skip pumping cycles until sufficient head is available.

From the wellhead, the ground water is pumped to TFF through 4-inch abovegrade fiberglass pipe. The DUSDP at TFF generated water from the wells as hot as 200°F. Therefore, pipelines to TFF from extraction location 17 are constructed with fiberglass to withstand this relatively high temperature. A 15-horsepower (hp) Chiller Manufacturing Company Model No. ACFC-132-6R-XPR forced-air-cooled heat exchanger cools the water to a temperature less than 116°F before it enters two parallel oil/water separators. The oil/water separator will separate the free-phase FHCs from the ground water. Piping from extraction location 18 and downstream of the heat exchanger will be constructed of 4-inch chlorinated polyvinyl chloride (CPVC).

If overdriven, the pneumatic positive displacement pumps can introduce a small amount of entrained air in the extracted ground water. A surge tank separates this air from the liquid. The air passes through one Cameron-Yakima 120-pound GAC unit prior to release to the atmosphere.

* Plates 3 and 4 are located in a pocket inside the back cover of this report.

Table 13. Summary of TFF equipment specifications.

Equipment	Specifications
Compressor	Kobelco KNWO-B/H; 223 scfm at 150 pounds per square inch gauge (psig), 60 hp, 460 volts (V), 3 phase
Air receiver	Roy E. Hanson, Jr. Mfg. 24VP120L; 120 gal, 150 psig
Pneumatic pumps	Two Ejector Systems, Inc., Model WETB; top and bottom fill, 45 gpm, 6-in. diam. x 12 ft long, with S2 controller (for wells GEW-808 and GEW-816)
	One Ejector Systems, Inc., Model WETB; top and bottom fill, 30 gpm, 5-in. diam. x 12 ft long, with electronic control panel (for well GSW-16)
Ground water heat exchanger[a]	Chiller Mfg. Co. ACFC-132-6R; three fans, three 5 hp each, explosion-proof motors, 230/460 V
	Can cool 100 gpm from 200°F to 116°F when air is 95°F or cooler
Gasoline storage tank	Safewaste 1000-R; 1,044 gal, 135% secondary containment, Underwriter's Laboratory listed
Oil/water separator	Two Megator 4-A-1; 60 gpm each, eliminates all free-phase FHCs
Transfer tank	Poly Cal Plastics SPC51; closed-top cone, 350 gal
Transfer pump	Bell & Gossett series 1510 model 2AC; variable speed, 120 gpm at 41 ft, 2 hp, 1,750 revolutions per minute (rpm) at 60 Hertz, explosion-proof motor, 208/230 V, 3 phase
Turbidity meter	Monitek oil-in-water meter 160/829; 1-100 ppm
Filter housing	Two Cuno 12DC3; 100 gpm each
UV/H_2O_2 oxidation system	Perox-pure LVB-60; four UV lamps, 15 kilowatts (kW) each, 460-480 V, 3 phase
H_2O_2 storage and feed system	Perox-pure PM-300B; doubly contained hydrogen peroxide tank, 300 gal. Two Liquid Metronics A141-152 pumps; 24 gpd each, 115 V, 1 amp (A)
Air stripper tanks	Six Aeromix Breeze Series 6; 300 gpm max. each, 400 scfm max., inlet air diffusers, water baffles, outlet chamber not aerated
Blowers	Six Fuji VF903A-7W; 400 scfm at 70-in. water gauge, 20 hp each, 200-230/460 V, 48-44/22 A each, 3 phase; Universal silencer U5-3
Vapor phase carbon	Cecasorb V3000 canister; 1,600 lb of GAC for vapor phase adsorption, radial flow, 3,000 scfm maximum
Discharge pump to storage tanks	Bell & Gossett series 1510 model 2 1/2 AB; 34 ft at 220 gpm, 3 hp, 1,750 rpm, 208/230 V, 3 phase
Effluent tanks	Two Baker tanks; 20,000 gal capacity each
Vapor extraction trailer	Continental Recovery Systems, Wellesley, MA Nash SC4 liquid ring vacuum pump; 400 acfm, 25 hp, 1,750 rpm, 460 V, 3 phase Two carbon canisters, 750-lb carbon each Columbia Boiler Co. L-22 boiler, 8 hp Economite DS45 burner, natural gas pressure equals 10-in. of water vapor extraction trailer/steam condenser requires 50 gpm cooling water Automatic fire detection/suppression system GAC protection/fire suppression sensors GAC cool-down system Flammable vapor detector Explosion-proof room and equipment Emergency stop buttons Air compressor for control valves

Table 13. Continued

Equipment	Specifications
Condenser[a]	Schmidt-Bretten, Sigma 65W-100; 7.5 M British thermal units/hour
Condensate system[a]	Burks 5GV6-23-SR; 20 pounds per square inch (psi) at 22.5 gpm, 23-gallon tank, 1/2 hp, 110 V, 1 phase
Cooling tower pump	Bell & Gossett series 1510 model 2 1/2 AB; 165 gpm at 38 ft, 3 hp, 1,750 rpm, 208/230 V, 3 phase
Demister[a]	Clean Gas Systems AS92-240-1; ≥95% water droplet removal efficiency at 250-425 acfm
Surge tank	Poly Cal Plastics 706-U; closed top, 95 gal
Drain system	Burks 5GV6-23-SR; 23 gallons, 22.5 gpm at 20 psi, 1/2 hp, 110 V, 1 phase
Vapor system cooling tower[a]	Marley NC3012; 540-ton capacity, two cells, two 15 hp fans, 460 V, 3 phase
Vapor system cooling tower pump[a]	Bell & Gossett series 1510 Model 4BC; 600 gpm at 63 ft, 1,750 rpm, 3 phase

[a]Equipment used for the DUSDP.

From the surge tank, the liquid flows by gravity to two parallel oil/water separators. The separators are Megator Model No. 4-A-1 and have a capacity of 60 gpm each. The separators contain oleophilic (oil attracting) coalescing media to enhance separation. Dissolved gasoline is contained in the oil/water separator effluent at up to the saturation concentration (about 60 ppm).

Separated FHCs are stored in a LRS, Inc. 1,044-gal Safewaste Model No. 1000-R doubly contained tank. The unit is an Underwriters Laboratory (UL)-listed, aboveground, flammable liquid primary storage tank with 135% secondary containment capacity. Free-phase FHCs will be recycled or disposed by the LLNL Hazardous Waste Management Division.

The ground water flows from the separators to a transfer tank equipped with a high-level alarm system shutdown mechanism. From the transfer tank, water is pumped to the UV/H_2O_2 unit by a variable speed centrifugal pump through a 5-micron filter to remove particulates. A Monitek Model No. 160/829 oil-in-water monitor then measures FHC content by detecting turbidity. An alarm connected to the interlock control system (Section 3.2.2.3) will shut down the facility if there is a high (100 ppm) oil-in-water content.

As water enters the UV/H_2O_2 treatment unit, H_2O_2 is injected into the influent water to achieve a concentration of 60 to 150 ppm H_2O_2. The 50% H_2O_2 solution is stored in a 200-gallon doubly contained tank. The two H_2O_2 feed pumps are LMI Model A151-192SPX positive-displacement diaphragm pumps with adjustable stroke length and frequency. The maximum flow rate is 24 gallons/day each. This results in a maximum 167 ppm H_2O_2 concentration when the treatment unit is processing 100 gpm.

The water is then treated by a self-contained Perox-Pure LVB-60 UV/H_2O_2 treatment system with four 15-kilowatt (kW) mercury-vapor UV lamps. The LVB-60 is designed to treat 100 gpm. At the maximum influent flow rate of 100 gpm, the water residence time is 48 seconds and the specific energy input to the ground water by the UV lamps is 8 kilowatt hours (kWh)/1,000 gal. A drain system is used to drain the LVB-60 for maintenance. The drain water is pumped to the transfer tank to be treated by the facility later.

An air stripper is used after the UV/H_2O_2 treatment unit to remove 1,2-DCA and EDB from the water. The aeration system consists of six parallel, Aeromix Breeze series-6 air strippers. Each air stripper has a 80- x 30- x 32-inch polypropylene tank that contains 12 Cyclone stainless steel air diffusers. The water is subjected to intense aeration using six Fuji VFC903A centrifugal blowers injecting air at 440 scfm each. The minimum aeration ratio is 26 scfm/gpm. After air stripping, treated water is transferred to two 20,000-gallon Baker tanks.

The vapor from the stripping tanks passes through a GAC filter bed which prevents discharge of volatilized VOCs to the atmosphere. The Cecasorb V-3000 GAC filter adsorbs volatilized VOCs such that no detectable VOCs (less than 6 $ppm_{v/v}$ at a detection limit of 1 $ppm_{v/v}$) are emitted to the air from TFF. The Cecasorb V-3000 GAC can operate to 3,000 scfm and contains 1,600 lb of GAC. GAC influent and effluent VOC concentrations are monitored with a flame ionization detector. Carbon will be replaced, as needed, to remain in compliance with the BAAQMD limit of 10 $ppm_{v/v}$. A mass balance calculation will be made to determine actual loading rate.

The GAC will be delivered to the LLNL Hazardous Waste Management Division to be subsequently recycled or disposed offsite at a RCRA-permitted facility. Treated water is pumped to effluent tanks and then to the LLNL cooling towers near Building 324 in southern LLNL. The LLNL cooling towers evaporate about 95% of the water, the other 5% is discharged to the sanitary sewer.

To date, lead has not been detected in extracted ground water at a detection limit of 2 ppb. If lead is ever detected above discharge limits, it will be treated with GAC immediately after the air stripping system, and prior to transfer to the Baker tanks.

3.2.2.1.2. Vapor Extraction System

Vapors will be extracted from wells GSW-16, GEW-808, and GEW-816 and sent to the vapor extraction system. During the DUSDP, the soil vapor temperature was as high as 200°F. A water-cooled plate-type heat exchanger cools extracted vapors before they enter the vapor treatment system. The vapors are cooled, and water and gasoline are condensed by a Schmidt-Bretten Sigma 65-150 plate-type heat exchanger. Cooling water is supplied to the heat exchanger at 400 gpm. Heat exchanger cooling water is cooled by a Marley NC3012 cooling tower. A centrifugal demister is used to remove entrained water droplets. Condensed liquid (water and FHCs) drain to a condensate system. Liquid in the condensate system is pumped to the ground water treatment system before the heat exchanger.

The vapor extraction system is a self-contained, trailer-mounted system manufactured by Continental Recovery Systems. The system consists of a liquid ring vacuum pump, demister, GAC, steam generator (to regenerate the carbon), condenser, separator, and controls.

Vapors are drawn into the system from the vapor extraction wells by a 400-acfm liquid ring vacuum pump. The pump exhausts to a demister to remove entrained moisture, which is then routed into the ground water treatment system influent. The vapor stream passes through one of two 750-pound GAC canisters where VOCs and FHCs are adsorbed. The treated vapors pass a FHC sensor before discharge to the atmosphere. Every three hours, pneumatically controlled valves redirect the vapor flow to the other carbon canister. The first canister is then flushed with steam to heat the carbon, desorb, and remove the FHCs and VOCs. The steam, FHCs, and VOCs then leave the canister and are condensed with a plate-type heat exchanger, which is cooled by clean process water that is cooled by an Evapo AT4-99A cooling tower. The condensed steam (water), FHCs, and VOCs are collected in a separation tank. Level switches within the separation tank activate pumps for light FHCs (compounds lighter than water, such as benzene) and heavy (heavier than water, such as TCE) compounds. Condensed water is routed to the ground water treatment system influent.

Collection tanks outside of the vapor extraction trailer have sensors that will sound an alarm alerting the treatment system operator when the first tank in a series of three is nearly full. This allows ample time to empty the tanks. The vapor extraction trailer will shut down if the tank is not emptied.

The vapor extraction trailer system is controlled by an American Auto-Matrix microprocessor-based control system. The control system performs start/stop operation of the equipment. Process variables, such as regeneration duration, can be changed by the user.

Soil vapor extraction is planned for the Building 518 area. Based on the results of the soil vapor treatability test, vapors may be piped to and treated at TFF, or if determined more economical, vapors may be treated with a system in the Building 518 area.

3.2.2.2. Performance Tests

TFF treatability tests show that the UV/H_2O_2 system generally reduces the majority of FHC and VOC concentrations in the ground water to allowable limits after passing the first UV lamp. After passing the fourth lamp, all VOCs, except 1,2-DCA and EDB, are not detected at a detection limit of 0.5 ppb. The results of a typical UV/H_2O_2 system treatability test are presented in Table 14. This test indicates that 1,2-DCA remained at detectable concentrations after the fourth lamp. Additional tests indicated that the destruction efficiency of EDB is approximately the same as 1,2-DCA.

Table 14. TFF UV/H_2O_2 system treatability test results (January 1991).

	<------ Concentration (ppb) ------>				
Constituent	**Initial**	**After lamp #1**	**After lamp #2**	**After lamp #3**	**After lamp #4**
Benzene	602	20	< 0.5	< 0.5	< 0.5
Toluene	507	10	< 0.5	< 0.5	< 0.5
Ethylbenzene	124	< 0.5	< 0.5	< 0.5	< 0.5
P,M-Xylene	316	3	< 0.5	< 0.5	< 0.5
O-Xylene	164	< 0.5	< 0.5	< 0.5	< 0.5
Xylene	480	3	< 0.5	< 0.5	< 0.5
EDB	4.1	- -	2.3	- -	1.0
1,2-DCA	29	22	17	11	7
TCE	117	8	< 0.5	< 0.5	< 0.5

After treatment by the UV/H_2O_2 system, ground water is then treated in six parallel air stripping tanks with an air/water flow ratio of at least 22.5 scfm/gpm. The concentrations of 1,2-DCA and EDB in water entering the stripping tanks are expected to be about 17 and 3.5 ppb, respectively, and the aeration process reduces them to concentrations less than the analytic detection limit of 0.5 ppb. Vapor from the stripping tanks passes through a GAC filter bed. The vapor has less than 10 $ppm_{v/v}$ FHCs and VOCs after passing through the GAC filter as measured by a photoionization detector or flame ionization detector. The vapor extracted from the wells and treated by the GAC filters also contains less than 6 $ppm_{v/v}$ FHCs and VOCs .

3.2.2.3. Controls and Safeguards

All TFF pipelines are visually inspected daily for leaks, and no leakage has been observed to date. As new wells are added, accessible portions of new pipelines will also be visually inspected daily for leakage. Inaccessible pipelines or portions thereof will be double-contained with a leak detection system installed inside the outer pipe.

TFF was designed to be fail-safe and is equipped with an interlock control system. If a component malfunctions as listed below, the entire treatment system, including the associated extraction wells, automatically shutdown. The treatment system operator is notified of a system shutdown at the alarm interface panel. In addition, the alarm interface panel will indicate the cause of the alarm on a display panel. An operator must determine and correct the problem before the system can be manually restarted.

Sensors are connected to the alarm interface panel. The facility will shutdown upon:

- High water level in the surge tank.
- High water level in the air stripper system.
- High water level in the oil/water separator.
- High gasoline level in the oil/water separator.
- High water temperature exiting the ground water heat exchanger.
- Shutdown of the air stripper blower.
- Pressure loss in the air stripper supply air (e.g., pipe break).
- High level in the gasoline storage tank.
- High water level in the transfer tank.
- High water level in the Baker tank.
- High gasoline content as measured by the Monitek meter.
- Activation of the LVB-60 influent over-pressure relief valve or rupture disk.
- Activation of the manual emergency shutdown.
- The process control computer going offline.

The LVB-60 has internal interlocks which can also shut the facility down. The following will initiate an LVB-60 shutdown:

- High water temperature in the reactor.

- Low-water flow rate.
- UV lamp failure.
- Excessive moisture in the UV lamp enclosures.
- Pressure below two pounds per square inch (psi) in the H_2O_2 system.
- An open UV lamp enclosure.
- High temperature (> 120°F) in the lamp drive enclosure.
- A remote shutdown.

The vapor extraction system has internal interlocks. Alarm conditions which shut down the vapor extraction system include:

- High VOC concentration in the explosion-proof room.
- High VOC concentration in the equipment room.
- High VOC concentration in the control room.
- Remote shut down.
- High condensate level.
- High condenser water temperature.
- High vapor pressure to the carbon.
- Low pressure in the compressor.
- High liquid levels in the storage tank.

The pneumatic pumps used in TFF extraction wells have water level sensors to prevent pumping when there is insufficient water above the pump.

Additional vapor extraction controls were installed at TFF to accommodate potentially high FHC concentrations during the DUSDP. Therefore, the vapor extraction trailer is designed to accommodate high FHC/VOC mass surges without shutting down. If breakthrough of a GAC canister is detected before the set regeneration time, the system will automatically switch to the second canister and regenerate the first. When regeneration cycles are so frequent that effluent concentrations rise, air is allowed into the vapor piping upstream of the liquid ring vacuum pump. This reduces the vapor flow from the wells, reduces the VOC mass rate to be treated, and allows the vapor extraction system to slow down rather than shut down.

3.2.3. Discharge of Treated Ground Water

Most of the ground water treated at TFF will be used in LLNL cooling towers. However, up to 50 gpm of treated water may also be discharged to the LLNL sanitary sewer under conditions outlined in the LLNL sanitary sewer discharge permit (Appendix A). An estimated 95% of the treated water used in the LLNL cooling towers will evaporate to the atmosphere. The remaining 5% will be discharged to the sanitary sewer. LLNL has voluntarily adopted stricter discharge limits than outlined in the sanitary sewer discharge permit by requiring that discharge water to cooling towers contains less than 5 ppb total VOCs and FHCs.

If the TFF effluent satisfies the requirements of RWQCB WDR Order No. 91-091 (Appendix A), it may be used to recharge the ground water via infiltration trenches or reinjection wells in accordance with ARARs, and/or discharged from TFF to the drainage retention basin, located about 2,800 feet north of the treatment facility.

3.3. Construction and Startup Schedule and Cost Estimates

TFF was constructed to treat ground water and soil vapors from the Gasoline Spill and the Building 518 areas. Treatability tests were conducted to design the process treatment equipment. Later, during the design phase, the requirements changed to accommodate DUSDP. The DUSDP steam injection phase lasted for about 2 months and was recently completed. TFF will operate afterwards to treat residual FHCs and VOCs in soil and ground water.

The changes to the TFF design to accommodate DUSDP include a ground water heat exchanger, vapor condenser with associated demister and condensate return, and piping suitable to high temperatures. These changes added time and cost to the TFF construction. The TFF design and construction schedule and cost summary are presented in Tables 15 and 16, respectively.

Table 15. TFF design and construction schedule.

	Design		Construction	
Item	**Start**	**End**	**Start**	**End**
TFF piping and power	**12/91**	**6/92**	**6/92**	**1/93**
Vapor modification (DUSDP)	**5/92**	**8/92**	**9/92**	**12/93**
Discharge pipeline	**4/92**	**7/92**	**9/92**	**10/93**
Activation (construction support only)	**---**	**---**	**1/93**	**3/93**

Table 16. TFF cost summary.

Item	**Costs[a]**	**Annual O&M[a]**	**53 Year Cleanup O&M[a]**
TFF piping and power	**$1,511,700**	**---**	**---**
Process equipment	**400,000**	**---**	**---**
Vapor modification (DUSDP)	**159,900**	**---**	**---**
Discharge pipeline	**87,000**	**---**	**---**
Activation (construction support only)	**80,000**	**---**	**---**
Subtotal	***2,238,600***	**---**	**---**
TFF Operations & Maintenance:		**---**	**---**
Labor:			
ERD personnel[b]	**---**	**$606,000**	**$19,085,970**
HWM[c]	**---**	**30,000**	**1,590,000**
Plant Engineering support	**---**	**60,000**	**3,180,000**
Subtotal		***696,000***	***23,855,970***

Table 16. Continued.

Item	Costs[a]	Annual O&M[a]	53 Year Cleanup O&M[a]
Materials			
Extraction Wells	---	3,600	190,800
LV-60	---	15,000	795,000
Vapor trailer	---	1,200	63,600
Misc. process equipment	---	1,800	95,400
Filters	---	15,600	826,800
Baker tanks	---	13,200	699,600
Misc. piping, pumps, blowers	---	2,040	108,120
Misc. electronics	---	600	31,800
Sample analysis	---	24,000	1,272,000
HWM[c]	---	19,200	1,017,600
MPC[d] 9.7%	---	7,473	396,063
Subtotal		*103,713*	*5,496,789*
G&A/LDRD[e] charge 13%	291,018	103,963	3,815,859
Total	$2,529,618	$903,676	$33,168,618

[a]Cost are based on FY93 estimated cost and do not include yearly escalation.

[b]ERD personnel labor estimates include hydrogeologist, chemist, engineer, technician and analyst time to meet the requirements in the ROD and milestones in the RAIP. The 53-year cleanup cost reflects time for these staff to maintain and improve treatment systems, effectively manage the well field as conditions change over the life of the cleanup, and evaluate and potentially implement new cleanup technologies as they are developed in the future. The estimated cost for ERD personnel is based on a constant level of effort for the first 5 years of the cleanup, about 83% of that effort for years 6 through 10, about 67% of that effort for years 11 through 15, and half the initial effort for years 16 through 53.

[c]LLNL Hazardous Waste Management.

[d]Material Procurement Charge.

[e]General and Administrative/Laboratory Directed Research and Development cost.

4. Remedial Action Workplan

The Remedial Action Workplan for TFC and TFF includes QA/QC and Health and Safety Plans for construction, operation, and maintenance. Included also are monitoring and reporting programs, requirements for onsite storage and offsite shipment of hazardous waste, and procedures for facility and well closure. As discussed in the RAIP (Dresen *et al.*, 1993a), DOE/LLNL will update the Community Relations Plan (CRP) for the post-ROD period. The Revised CRP was issued in July 1993 (Anderson *et al.*, 1993).

4.1. Quality Assurance/Quality Control and Health and Safety Plans

The QA/QC Plan for construction is applicable to all treatment facilities and was presented as Appendix B of RD1 (Boegel *et al.*, 1993). The Health and Safety Plan for construction of all treatment facilities, including TFC and TFF, was included as Appendix C of RD1.

The QA/QC Plans for O&M of TFC and TFF are presented in Appendix B. These plans describe the organizational structure, responsibilities, and authority for O&M QA/QC, and the objectives, quality goals, and QA levels for O&M of TFC and TFF. Appendix C contains the Health and Safety Plans for O&M of TFC and TFF. These plans analyze the hazards and present hazard control measures and training requirements for TFC and TFF O&M, and present emergency safety procedures.

4.2. Monitoring and Reporting

The following sections discuss planned monitoring and reporting for TFC and TFF. The programs include self-monitoring, ground water quality sampling, capture zone monitoring, criteria for determining when remediation is complete, and requirements for system closeout.

QA/QC procedures for collection, analysis, and documentation of influent and effluent ground water samples are included in the LLNL Quality Assurance Project Plan (QAPP) (Rice, 1989), which was prepared according to EPA guidance and was approved by EPA. In addition, the procedures for collection, analysis, and documentation of water samples are described in LLNL Standard Operating Procedures (SOPs) (Rice *et al.*, 1990) Nos.: 2.6, Sampling for Volatile Organic Compounds; 4.1, General Instructions for Field Personnel; 4.2, Sample Control and Documentation; 4.3, Sample Containers and Preservation; 4.4, Guide to Handling, Packaging, and Shipping of Samples; 4.6, QA/QC Requirements for Data Generated by Analytical Laboratories; and 4.8, Calibration and Maintenance of Field Instruments Used in Measuring Parameters of Surface and Ground Water and Soils. The procedures for sample collection at TFC and TFF are presented in Appendix D.

A Compliance Monitoring Plan will be prepared in FY 95 that will describe the data types and interpretative methods to be used for the duration of the cleanup.

4.2.1. Treatment Facility Self-Monitoring Programs

This section describes TFC and TFF self-monitoring programs. The TFC self-monitoring program satisfies the requirements of NPDES Permit No. CA 0029289, WDR Order No. 91-091 (Appendix A) for the Livermore Site. The TFF self-monitoring program satisfies the requirements of the sanitary sewer discharge permit for the Livermore Site (Appendix A). Water samples will be collected at TFC and TFF sampling stations (Figs. 8 and 9) according to the schedules presented in Tables 17 and 18, respectively. If treated effluent from TFF satisfies the requirements of RWQCB WDR Order No. 91-091, it may be used for infiltration, reinjection in accordance with ARARs, or discharged to the storm drain or the drainage retention basin. If this ever occurs, water samples will be collected according to a similar schedule as TFC (Table 17) except tritium will be sampled annually rather than quarterly because there are no elevated tritium concentrations near TFF.

TFC and TFF influent samples TFC-I003 and TFF-I006, respectively, will be collected at sampling stations immediately prior to treatment. TFC and TFF effluent samples TFC-E003 and TFF-E006, respectively, will be collected at sampling stations following treatment and prior to discharge (Figs. 8 and 9).

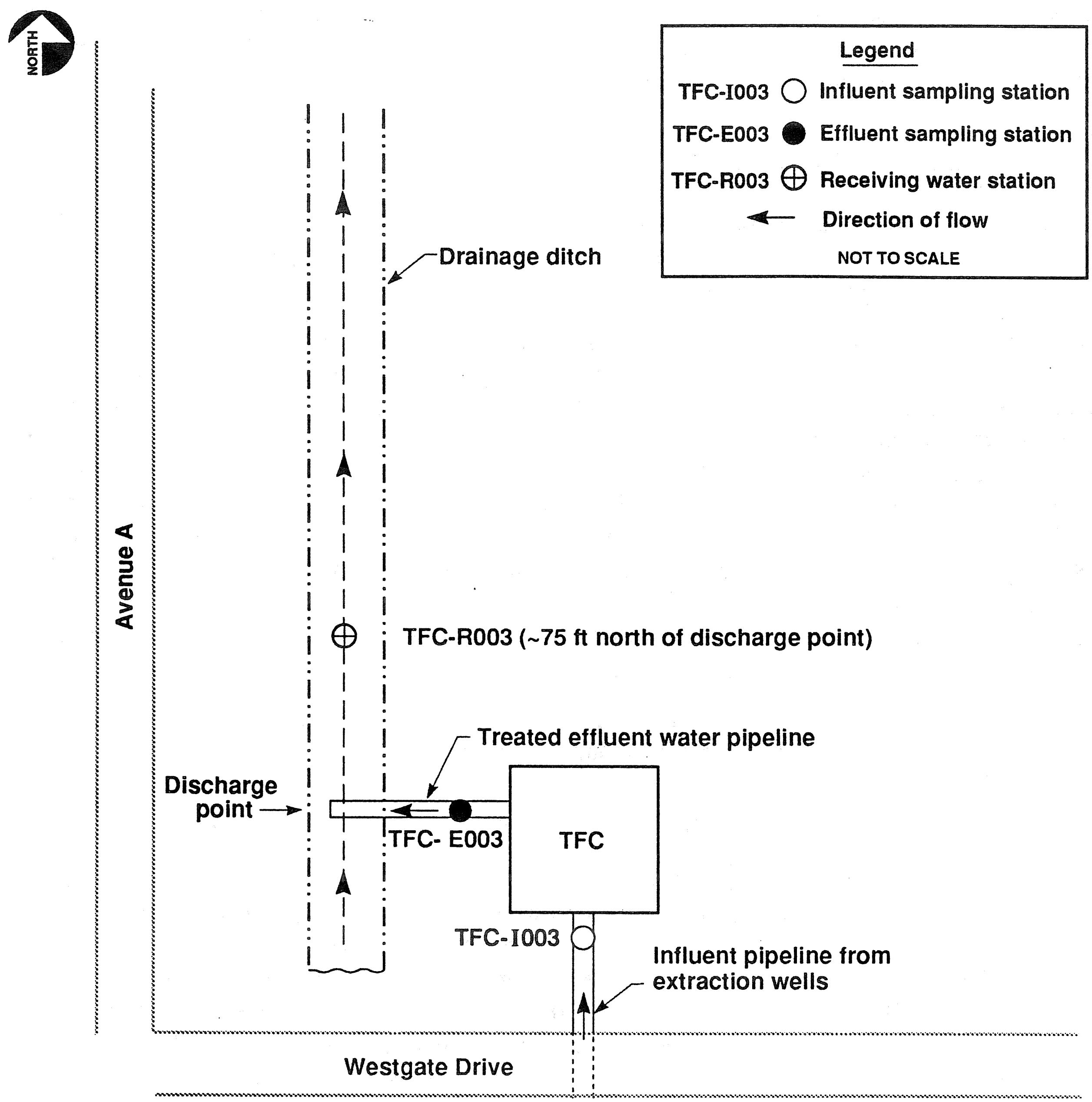

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Figure 8. TFC self-monitoring program sampling stations.

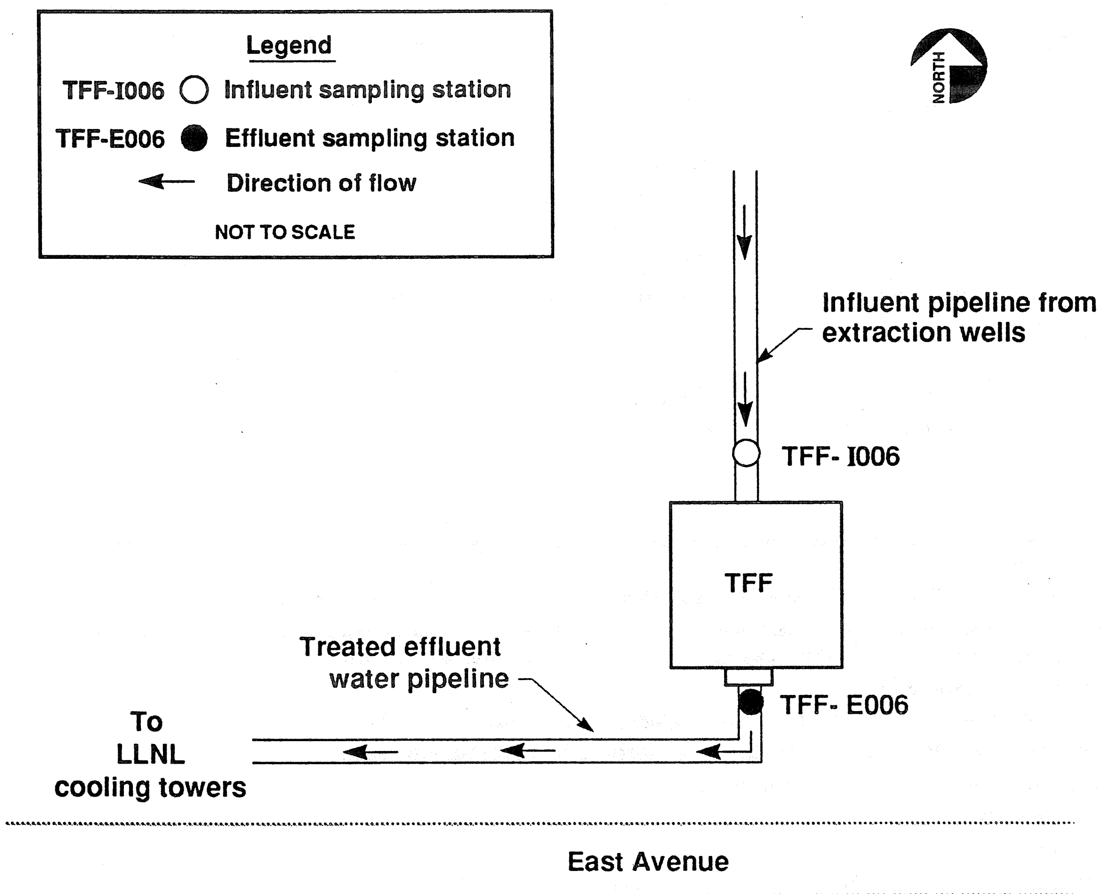

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Figure 9. TFF self-monitoring program sampling stations.

Table 17. TFC self-monitoring sampling schedule.

Sample location[a]	Influent TFC-I003[a]	Effluent TFC-E003[a]	Receiving water TFC-R003[a]	Land observations[b]
Frequency		**Analysis**		
Daily	Flow Rate	Flow Rate	Flow Rate	---
Weekly	---	EPA 601[c]	---	Perform
Monthly	EPA 601[c] pH	Temperature pH	EPA 601[c] Temperature pH	Complete Report
Quarterly	Chlorides	Chlorides Fish Toxicity[d] Turbidity[e] Gross alpha and beta particles, and tritium	Chlorides	
Semiannually	Metals[f]	Metals[f]	Metals[f] Fish Toxicity[d] Turbidity[e]	---
Annually	EPA 624[g,h] EPA 625[j]	EPA 624[g,h] EPA 625[j]	EPA 602[i] EPA 625[j] Gross alpha and beta particles, and tritium	---

RWQCB specifications:

- **Sampling of TFC-R003 should be coincident with TFC-I003 and TFC-E003 sampling.**
- **If any instantaneous maximum limit is exceeded, the sampling frequency shall be increased to daily until two samples collected on consecutive days show compliance with instantaneous maximum.**

[a]Sample locations are shown in Figure 8.

[b]As required by RWQCB NPDES Permit No. CA 0029289, WDR Order No. 91-091.

[c]EPA 601 = EPA Method 601; analysis for volatile halocarbons by gas chromatography.

[d]Fish toxicity, 96 hours, survival in undiluted waste.

[e]Jackson turbidity units.

[f]Priority Pollutant Metals:

antimony	chromium (total)	mercury	silver
arsenic	copper	nickel	thallium
beryllium	lead	selenium	zinc
cadmium			

PLUS: boron, chromium (+6), iron, manganese, and cyanide.

[g]When schedule calls for coincident EPA 601 and 624 analyses, only EPA 624 is conducted.

[h]EPA 624 = EPA Method 624; analysis for VOCs by gas chromatography/mass spectrometry.

[i]EPA 602 = EPA Method 602; analysis for volatile aromatic hydrocarbons by gas chromatography.

[j]EPA 625 = EPA Method 625; analysis for semivolatile organic compounds by gas chromatography/mass spectrometry.

Table 18. TFF self-monitoring sampling schedule.

Station TFF-E006[a]	Effluent TFF-E006[a]
Frequency	**Analysis**
Daily	Flow Rate[b]
Quarterly	EPA 624[c]
Annually[d]	EPA 625[e]
	Metals[f]

City of Livermore specifications:
[a]Sample location TFF-E006 is shown in Figure 9.
[b]Maximum discharge rate to the LLNL sanitary sewer is 50 gpm.
[c]EPA 624 = EPA Method 624; analysis for VOCs by gas chromatography/mass spectrometry.
[d]Initial sampling will be coincident with the initial quarterly sampling.
[e]EPA 625 = EPA Method 625; analysis for semivolatile organic compounds by gas chromatography/mass spectrometry.
[f]Metal with discharge limits (from Section 13.32.100 of the Livermore Municipal Code)(See Appendix A):

arsenic	cyanide	nickel
cadmium	lead	silver
chromium (total)	mercury	zinc
copper		

Ground water treated at TFC will be discharged to a north-flowing, unlined drainage ditch that eventually flows into Arroyo Las Positas in the northwest corner of LLNL (Fig. 3). As shown in Figure 8, the TFC receiving water sample, TFC-R003, will be collected between 50 and 100 feet downstream from the effluent discharge point.

Ground water treated at TFF will be either used in LLNL cooling towers or discharged to the LLNL sanitary sewer. If the effluent satisfies the requirements of RWQCB WDR Order No. 91-091, treated water from TFF may be discharged to injection wells or the retention basin.

Because treated water from TFF normally will not be discharged to the ground surface, collection of receiving water samples is not required. Receiving water sample, TFF-R006, will be collected only if treated water from TFF is discharged to the drainage retention basin. Overflow from the drainage basin is conveyed to Arroyo Las Positas via an underground pipeline.

A photoionization detector or flame ionization detector will be used to determine if any residual compounds of concern remain in the air effluent stream at both TFC and TFF. The photoionization detector uses UV light to ionize a vapor sample and measure the organic constituents within the vapor. The photoionization detectors used at LLNL are Organic Vapor Meters made by Thermo Environmental Instruments, Model No. 580. They are equipped with 10.0 electron volt (eV) lamps and detect double- and triple-bonded molecules. The flame ionization detector uses the same principle as the photoionization detector, but a flame is used to ionize the vapor sample. LLNL uses Foxboro/Century Organic Vapor Analyzers equipped with flame ionization detectors. These instruments have a range of 1 to 100,000 ppm. The detection limits for these instruments, about 1 to 2 ppm, are sufficiently low to ensure compliance with air discharge limits. Fig. 8

Results of TFC self-monitoring activities will be reported in the LLNL Monthly Progress Reports. As required by the City of Livermore, results of the TFF self-monitoring program will continue to be reported to the City bi-annually as recently renegotiated with the City of Livermore.

4.2.2. Ground Water Monitoring Sampling Schedule

Ground water samples will be collected from existing monitor wells and piezometers in the vicinity of TFC and TFF according to the schedule shown in Tables 19 and 20, respectively.

Well and piezometer locations are shown in Figure 10. Ground water samples will also be collected quarterly from new monitor wells and piezometers installed to monitor the progress of the cleanup. This sampling schedule will be evaluated quarterly as the distribution of contaminants in ground water changes according to procedures detailed in McConachie (1993).

When all wells and piezometers are installed, analytic results of self-monitoring influent water samples will be collected monthly at TFC and TFF to evaluate remediation effectiveness and calculate VOC mass removal. The TFC and TFF influent samples will be analyzed for VOCs, semivolatiles, chlorides, and metals on the schedules presented in Tables 17 and 18, respectively.

Water levels in all monitor wells and piezometers will continue to be monitored on a monthly basis either manually or using pressure transducers and data loggers. Depth to water and pumping rates in extraction wells will be measured using pressure transducers and mechanical or electronic flow meters. The data will be automatically recorded using data loggers. These data will be used to determine actual hydraulic capture zones and areas of little or no ground water movement. Based on hydraulic data, pumping locations and rates will be varied, and/or new extraction wells may be installed, to ensure complete hydraulic capture and an expeditious remediation.

Treatment system monitoring will be presented in the LLNL Monthly Progress Reports. Chemical analytic results and quarterly ground water level measurements will be presented in the LLNL Quarterly Reports. Estimated ground water flow lines and capture zones will also be presented according to a schedule developed with regulatory agency oversight.

4.2.3. Extraction Well Pumping Strategy

Current simulations of long-term pumping and contaminant transport indicate that an estimated 50 years of sustained ground water pumping may be required to reach remediation goals. Modeling results are summarized in Tompson (1990), Tompson *et al.* (1991), and Tompson *et al.* (1993, in preparation). All extraction wells will initially be pumped at the maximum sustainable rates to achieve the most rapid plume capture possible. After steady state is achieved, monitoring data will be used to refine and update the ground water models. As these results and new data are interpreted, changes in the well field configuration and pumping rates will likely be needed to optimize mass removal rates, maximize treatment and minimize dilution of contaminants, ensure hydraulic capture in all zones exceeding cleanup standards, and eliminate stagnant zones. Well condition will be periodically addressed by evaluating pumping rates, drawdown, water clarity, and by visual inspection. As required, extraction wells, monitor wells, and piezometers will be rehabilitated or replaced. All of these activities will be reported in LLNL Monthly Progress Reports.

Table 19. Ground water quality sampling schedule for monitor wells and piezometers in the vicinity of TFC extraction wells.

Well number	Analyses	Sampling frequency	Planned months of sampling
MW-4	Cr(VI),601	S[a]	March, September
	Tritium	A	September
MW-5	601	Q	March, June, September, December
MW-5A	601	A	March
MW-104	601	A	June
MW-105	Cr(VI),601	S	June, September
	Tritium	A	September
MW-141	Cr(VI),DDWM,601	Q	March, June, September, December
	Tritium	A	September
MW-203	601	A	June
MW-324	DDWM,601	Q	January, March, September, December
MW-368	601	S	March, September
MW-371	Cr(VI),601	A	September
MW-373	Cr(VI),601	Q	March, June, September, December
MW-409	Cr(VI),601	Q	March, June, September, December
MW-413	Cr(VI),601	S	March, September
MW-416	Cr(VI),601	Q	March, June, September, December
MW-417	Cr(VI),601	A	June
MW-421	Cr(VI),601	A	June
MW-452	601	A	June
	Tritium	A	September
MW-453	Cr(VI),DDWM,601	Q	January, March, September, December
MW-454	Cr(VI),DDWM,601	Q	January, March, September, December
MW-486	Cr(VI),601	A	September
MW-501	Cr(VI),601	Q	January, March, September, December
MW-502	Cr(VI),601,Tritium	A	September
MW-503	Cr(VI),601	A	June
MW-507	Cr(VI),601	A	September
MW-515	Cr(VI),601	Q	January, March, September, December
MW-516	Cr(VI),601	Q	January, March, September, December
MW-517	Cr(VI),601	Q	January, March, September, December
MW-519	Cr(VI),601	Q	March, June, September, December
MW-553	Cr(VI),601	Q	January, March, September, December
MW-556	Cr(VI),601	A	June
MW-563	Cr(VI),601	S	March, September
MW-564	Cr(VI),601	Q	January, March, September, December

Table 19. Continued.

Well number	Analyses	Sampling frequency	Planned months of sampling
MW-565	Cr(VI),DDWM,601	Q	January, March, September, December
MW-567	601	S	March, September
	Tritium	A	September
MW-607	Cr(VI),601,Tritium	A	March
MW-608	Cr(VI),601	A	March
P-701	Cr(VI),601	Q	January, March, September, December
P-702	Cr(VI),601	Q	January, March, September, December
	Tritium	A	September
P-706	Cr(VI),601	Q	January, March, September, December
11C1	601	Q	January, March, September, December

[a]If the well is used as an extraction well prior to issuing the Compliance Monitoring Plan, the sampling frequency will be increased to quarterly.
A = Annual.
S = Semiannual.
Q = Quarterly.
Cr(VI) = Hexavalent chromium.
601 = EPA Method 601 for halogenated VOCs.
DDWM = Dissolved Drinking Water Metals.
Note: New piezometers and wells will be sampled quarterly for the first year. Subsequent monitoring frequency will be based on concentration and location within or relative to the plume according to the procedure in McConachie (1993).

Table 20. Ground water quality sampling schedule for monitor wells and piezometers in the vicinity of TFF extraction wells.

Well number	Analyses	Sampling frequency	Planned months of sampling
MW-11	601	Q	March, June, September, December
MW-12	624	S	June, December
MW-19	601	A	June
MW-106	601	A	March
MW-107	601	A	June
MW-112	601	Q	March, June, September, December
MW-117	601	A	December
MW-205	Cr(VI),601	Q	March, June, September, December
MW-210	624,Tritium	A	September
MW-211	601	A	June
MW-217	601	S	March, September
	Tritium	A	September
MW-219	601	S	June, December
MW-223	624	A	September
MW-225	624	S	March, September
MW-255	601	Q	March, June, September, December
MW-256	Cr(VI),601	A	March
MW-261	601,Tritium	A	September
MW-270	601,Tritium	A	September
MW-274	624	S	June, December

Table 20. Continued.

Well number	Analyses	Sampling frequency	Planned months of sampling
MW-275	Cr(VI),601	S	June, December
MW-291	Cr(VI),601	A	September
MW-293	601	A	March
MW-294	601	A	March
MW-358	601	S	June, December
MW-359	601	Q	March, June, September, December
MW-509	601	Q	March, June, September, December
MW-510	Cr(VI),601	S	March, September
MW-511	601	S	June, December
MW-512	601	Q	March, June, September, December
MW-622	601	Q	March, June, September, December
	Tritirum	A	September
GSW-1A	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-2	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-3	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-4	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-5	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-6	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-7	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-8	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-9	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-10	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-11	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-12	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-13	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-15	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-208	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-209	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-215	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-266	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-367	BTEX/GAS,GM,601	Q	March, June, September, December
	Tritium	A	September
GSW-442	BTEX/GAS,GM,601	Q	March, June, September, December
GSW-443	BTEX/GAS,GM,601	Q	March, June, September, December
18D1	601	S	June, December

A = Annual.
S = Semiannual.
Q = Quarterly.
601 = EPA Method 601 for halogenated VOCs.
624 = EPA Method 624 for volatile organics. EPA Methods 601 and 602 are occassionally substituted for EPA Method 624. EPA Methods 601 and 602 together detect the compounds of concern at the Livermore Site.
Cr (VI) = Hexavalent chromium.
BTEX/GAS = Sum of benzene, toluene, ethylbenzene and xylene isomers, and total gasoline.
GM = General minerals.
Note: New piezometers and wells will be sampled quarterly for the first year. Subsequent monitoring frequency will be based on concentration and location within or relative to the plume according to the procedure in McConachie (1993).

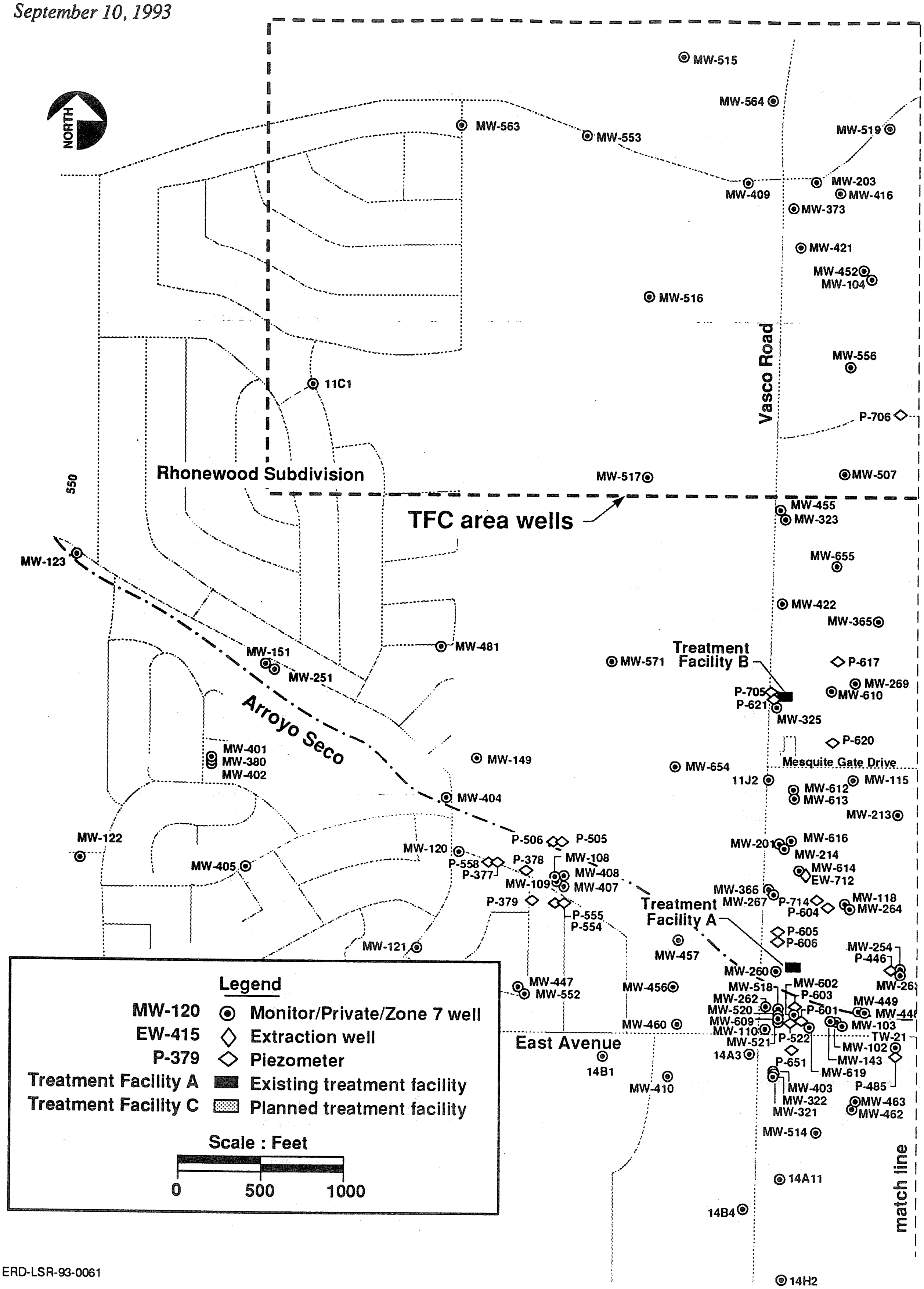

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Figure 10. Monitor well, extraction well, and piezometer locations in the vicinity of TFC and TFF.

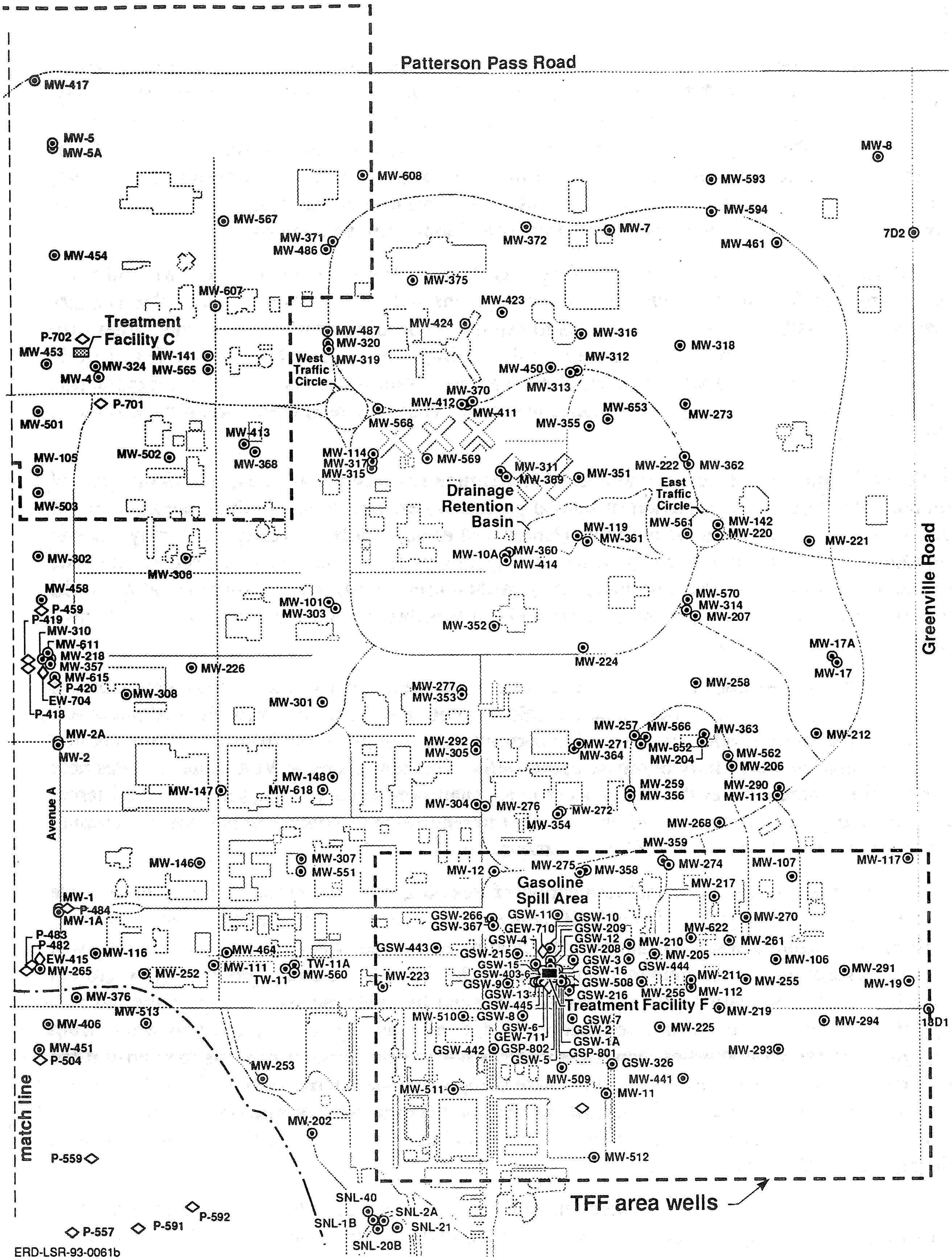


Figure 10 (continued).

Based on the results of LLNL pilot studies and data from other sites, the VOC concentrations in ground water are expected to decrease rapidly at first, then stabilize, or decrease very slowly. Estimates of VOC mass removal over time at TFC and TFF are shown in Figures 11 and 12, respectively. The VOC mass removal rates were estimated using results from our two-dimensional, finite-element ground water flow and transport model (Tompson *et al.*, 1991; Tompson *et al.*, 1993, in preparation). Actual VOC mass removal rates will depend on the concentration of VOCs in extracted ground water and long-term well yields.

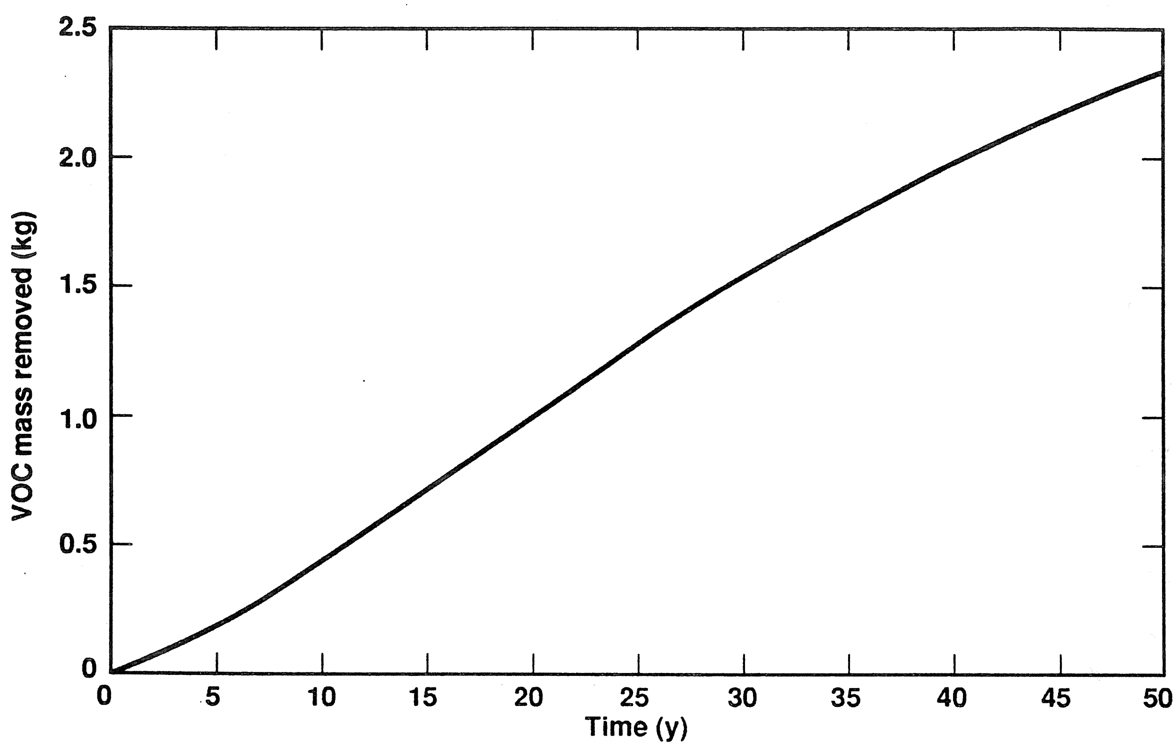
The mass removal analysis for TFF (Fig. 12) shows that pumping may cease after 35 years because the model indicates that VOC concentrations will be less than 5 ppb. The primary purpose of the TFC area wells (Fig. 11) is to capture the leading edge of the plume, rather than for mass removal. In the model, the wells at the leading edge of the plume in the TFC area do not show an appreciable increase in VOC mass removal rate because the upgradient extraction wells are removing the higher VOC concentrations. Thus, the predicted mass removal rate is fairly constant.

Several methods are being evaluated to maximize mass removal rates, including cyclical pumping and increased reinjection of treated ground water, which may include the injection of heat, surfactants, microbes, or nutrients (Isherwood *et al.*, 1992). Investigations may include laboratory and field studies to evaluate the effectiveness of the methods used to enhance contaminant mobility and mass removal. Any method used to maximize mass removal rates will comply with State Water Resources Control Board Resolution 68-16 and will be implemented with regulatory oversight.

In one approach, some of the LLNL extraction wells (i.e., those in source areas with VOCs in the shallowest ground water) may be periodically shut off and the water levels allowed torecover. During the pump-off cycles, VOCs will desorb into the ground water from the sediments that were dewatered in the vicinity of the pumping wells. This may increase VOC removal rates near source areas, where most of the VOCs occur in the shallower water-bearing sediments. Different pump-on and pump-off cycles will be evaluated to determine the optimum periods of pumping and nonpumping to maximize VOC mass removal rates.

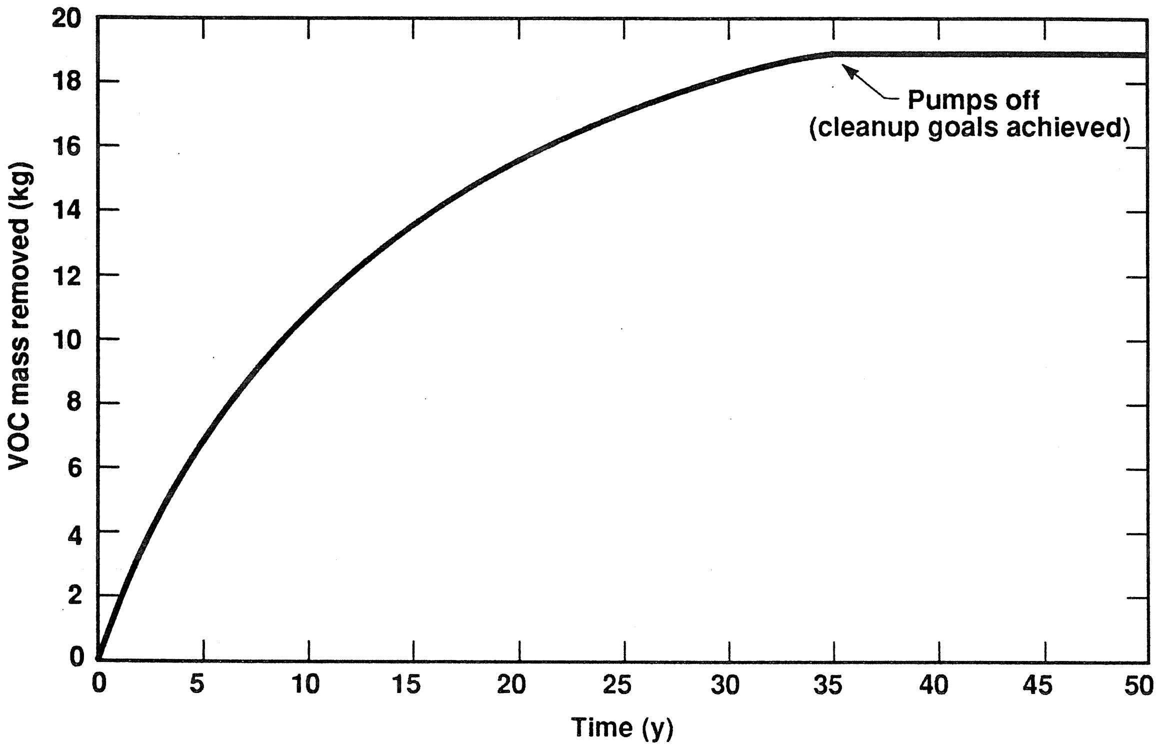
In another approach, additional reinjection of treated ground water may be used to increase the rate of flushing in regions of high VOC concentrations, and to mitigate excessive dewatering resulting from ground water extraction. Reinjection of treated water in selected locations will enhance desorption of contaminants and increase the flushing rate in regions of slow ground water flow. The reinjection process may be enhanced by other means to increase the cleanup rate. If the water is heated prior to reinjection, VOCs will have a greater tendency to desorb from the solids into the ground water than if the water is not heated. Similar benefits may arise if the reinjected water contains surfactants, which are compounds that increase the tendency for VOCs to dissolve in ground water. Such surfactants may be manufactured or microbially produced. If these or other methods are shown to be beneficial and cost-effective, they will be implemented with regulatory agency oversight.

As discussed in the RAIP, all injection well locations will be within the capture area of an extraction well since the reinjected water may contain up to 5 ppb total VOCs. Reinjection well locations will be selected to be in compliance with State Water Resources Control Board Resolution 68-16, which is an ARAR for the LLNL Livermore Site.



ERD-LSR-93-0067

Figure 11. Estimated VOC mass removed over time from ground water by TFC.



ERD-LSR-93-0068

Figure 12. Estimated VOC mass removed over time from ground water by TFF.

4.3. Requirements for Onsite Storage and Offsite Shipment of Hazardous Waste

If necessary, GAC filters, or bulk carbon removed from a filter canister containing sorbed VOCs, and particulate filters will be shipped offsite for regeneration or disposal, and will be managed as hazardous waste if appropriate. LLNL can temporarily store hazardous waste onsite for up to 90 days. Shipment and disposal is in accordance with Department of Transportation (DOT) 49 Code of Federal Regulations (CFR) and EPA 40 CFR, respectively. Additionally, waste shipments are made in accordance with California Title 22 requirements. The spent carbon filters will be packaged and labeled for shipment by LLNL's Hazardous Waste Management Division (HWMD). LLNL's HWMD operates under Interim Status and has submitted a RCRA Part B permit application to the DTSC. (California is a fully RCRA-authorized state). Once packaged, the carbon filters will be shipped to one of several RCRA-permitted facilities for regeneration or disposal.

When a treatment facility is closed, the remaining H_2O_2 and the mercury vapor lamps will be categorized as excess product and reused if possible. Shipping of the H_2O_2 will be in accordance with DOT 49 CFR and California 40 CFR and Title 22 regulations.

4.4. Requirements for Closeout

Decisions regarding when extraction should cease at specific wells, and when a particular treatment facility and its influent extraction wells should be decommissioned, will be based on achievement of MCLs in all the piezometers and wells in the capture zone for the well/treatment facility. Such decisions will be made with regulatory agency oversight. Because the size and orientation of capture zones will change over the course of the cleanup, analysis of the vertical and horizontal distribution of the compounds of concern at the time MCLs are achieved will also be conducted. As specified in the ROD, sitewide cleanup will be complete when ground water samples taken from the plume demonstrate that the regulatory standards have been met.

It is expected that VOC concentrations may rise in wells after extraction ceases due to slow desorption from fine-grained sediments. Therefore, contaminant concentrations will be monitored quarterly for 2 years after pumping ceases. If concentrations rise above MCLs, extraction will resume at the appropriate wells until MCLs are again achieved. Several iterations of this pumping cycle may be required to achieve the remediation standards. Cleanup will be considered complete when contaminant concentrations remain below the remediation standards for 2 years. Cleanup completion will be determined in conjunction with the regulatory agencies. After concurrence from the regulatory agencies that cleanup is complete, most of the LLNL extraction wells and piezometers will be sealed and abandoned. All wells screened in more than one water-bearing zone will be sealed to prevent potential vertical migration of compounds of concern. Wells will be sealed by pressure grouting using a grout mixture of 98% Portland cement and 2% bentonite powder by weight, as described in LLNL SOP 1.7 (Rice *et al.*, 1990). A minimal monitoring network, consisting of perhaps 10 to 20% of the existing wells, will remain in place for general ground water quality monitoring. Most of these monitor wells will be located at downgradient plume margins and in former source areas.

TFC and TFF and their influent and discharge piping will be decommissioned after remediation is complete. The portions of the process equipment and piping that contact ground water will not contain hazardous FHC or VOC concentrations because the equipment will have been thoroughly flushed with ground water containing FHC or VOC concentrations below MCLs. The process equipment will be sold or recycled if possible. Any wash water containing hazardous materials will be collected, sampled, and disposed at one of several RCRA-permitted facilities. The portions of the facilities that contain hazardous materials, such as H_2O_2 in the tank and feed lines, the mercury vapor lamps, and GAC with sorbed VOCs, will be disposed according to specifications in Section 4.3 "Requirements for Offsite Shipment of Hazardous Waste."

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5.2. References for LLNL Facilities Standards, Specifications, and Guide Documents

5.2.1. General

Designs, construction drawings, and specifications will conform to and comply with the applicable requirements of the latest adopted edition of the references listed herein, which will be considered minimum requirements.

5.2.2. Regulations

U.S. Department of Energy (DOE)

DOE 5480.7A	Fire Protection Program
DOE 6430.1A	General Design Criteria

Code of Federal Regulations (CFR)

10 CFR 435	Energy Conservation Standards
29 CFR 1910	Occupational Safety and Health Standards (OSHA)

29 CFR 1910.7	Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
47 CFR 15	Telecommunication (FCC Rules, Part 15)

<u>State of California Department of Labor (DOL)</u>

DOL Labor Code	Division 5—Safety in Employment; Chapter 9—Miscellaneous Labor Provisions

<u>California Codes of Regulations (CCR)</u>

CCR Title 8	Industrial Relations; Chapter 4, Subchapter 6
CCR Title 20	Public Utilities; Chapter 53—Energy Conservation in New Building Construction

<u>University of California, Lawrence Livermore National Laboratory (UCRL)</u>

UCRL 15910	Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards
UCRL 15714	Suspended Ceiling System Survey and Seismic Bracing Recommendations

5.2.3. Codes

<u>American Concrete Institute (ACI)</u>

ACI 318	Building Code Requirements for Reinforced Concrete

<u>American Institute of Steel Construction (AISC)</u>

AISC	Steel Construction Manual (Allowable Stress Design)

<u>American National Standards Institute (ANSI)</u>

ANSI A58.1	Building Code Requirements for Minimum Design Loads for Buildings and Other Structures

<u>American Welding Society (AWS)</u>

AWS D 1.1	Structural Welding Code—Steel

<u>International Conference of Building Officials (ICBO)</u>

ICBO UBC	Uniform Building Code
ICBO UMC	Uniform Mechanical Code
ICBO UPC	Uniform Plumbing Code

<u>National Fire Protection Association (NFPA)</u>

NFPA 70	National Electrical Code

NFPA 72	Installation, Maintenance, and Use of Protective Signaling Systems
NFPA 72E	Automatic Fire Detectors
NFPA 72H	Test Procedures for Protective Signaling Systems
NFPA 90A	Installation of Air Conditioning and Ventilating Conditioning Systems

5.2.4. Standards

American Concrete Institute (ACI)

ACI 347	Recommended Practice for Concrete Form Work

American Society for Testing and Materials (ASTM)

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

ASHRAE 90A	Energy Conservation in New Building Design

American Water Works Association (AWWA)

Construction Specifications Institute (CSI)

National Electric Manufacturers Association (NEMA)

Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACCNA)

5.2.5. LLNL Manuals and Reports

M-010 LLNL Health and Safety Manual

LLNL Site Development and Facilities Utilization Plan

LLNL Landscape Master Plan and Design Guidelines

5.2.6. Facility As-Built Drawings for TFF

PLM 92-406-001E through 008E

PLA 92-406-001E

PLS 92-406-001E through 003E

PLE 92-406-001E through 016E

5.2.7. Facility Construction Drawings for TFC

PLC 93-187-001D through 003D

PLA 93-187-001D and 002D

PLM 93-187-001D through 006D

PLE 93-187-001D through 008D

PLL 93-187-001D

6. Acronyms and Abbreviations

1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethylene
1,1,1-TCA	1,1,1-trichloroethane
A	amps
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
acfm	actual cubic feet per minute
AISC	American Institute of Steel Construction
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BACT	Best Available Control Technology
CAL/OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CI	Construction Inspector
CPR	cardiopulmonary resuscitation
CPVC	chlorinated polyvinyl chloride
CRP	Community Relations Plan
CSI	Construction Specifications Institute
dB	decibel
DDWM	Dissolved Drinking Water Metals
diam.	diameter
DOE	U.S. Department of Energy
DOL	Department of Labor
DOT	Department of Transportation
DTSC	California Department of Toxic Substances Control
DUSDP	Dynamic Underground Stripping Demonstration Project
EE	Electronic Engineering
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
ERD	Environmental Restoration Division
ES&H	Environmental Safety & Health
eV	electron volt
F	Farenheit
FFA	Federal Facility Agreement
FHC	fuel hydrocarbon
FS	Feasibility Study
FY	fiscal year

GAC	granular activated carbon
GA/LDRD	General and Administrative/ Laboratory Directed Research and Development
gal	gallons
gpd	gallons per day
gpm	gallons per minute
HCRU	hexavalent chromium removal unit
hp	horsepower
H_2O_2	hydrogen peroxide
HSP	Health and Safety Plan
HWM	Hazardous Waste Management
ICBO	International Conference of Building Officials
kW	kilowatt
kWh	kilowatt hour
L	liter(s)
lb	pound(s)
LEL	lower explosive limit
LLNL	Lawrence Livermore National Laboratory
LSRSL	Livermore Site Restoration Section Leader
LWRP	Livermore Water Reclamation Plant
MCL	Maximum Contaminant Level
ME	Mechanical Engineering
M&I	materials and items
MPC	Material Procurement Charge
MSDS	Material Safety Data Sheet
M&TE	measuring and test equipment
MW	monitor well
NEMA	National Electric Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NQA	National Quality Assurance
NRTL	Nationally Recognized Testing Laboratory
$OH^{\bullet}$	hydroxyl radical
O&M	operations and maintenance
OSHA	Occupational Safety and Health Adminstration
OSP	Operational Safety Procedure
OSWER	U.S. EPA Office of Solid Waste and Emergency Response
OTL	Operations Team Leader
OVM	Organic Vapor Meter
PCE	perchloroethylene
PEPE	Plant Engineering Project Engineer
PEPM	Plant Engineering Project Manager
P&ID	piping and instrument diagram
PID	photoionization detector
PO	purchase order
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	polyvinyl chloride
QA	quality assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan

QC	quality control
RAIP	Remedial Action Implementation Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDOSL	Remedial Design and Operations Section Leader
RE	Remediation Engineer
ROD	Record of Decision
rpm	revolutions per minute
RWQCB	California Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
scfm	standard cubic feet per minute
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SOP	Standard Operating Procedure
TBD	to be determined
TBI	to be installed
TCE	trichoroethylene
TFC	Treatment Facility C
TFF	Treatment Facility F
TTO	total toxic organics
TWA	time-weighted average
UCRL	University of California, Lawrence Livermore National Laboratory
UEL	upper explosive limit
UL	Underwriter's Laboratory
UV	ultraviolet
UV/H_2O_2	ultraviolet light/hydrogen peroxide
V	volts
VES	vapor extraction system
VOC	volatile organic compound
v/v	volume per volume basis
WDR	Waste Discharge Requirement

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UCRL-AR-112814

Appendix A

Waste Discharge Requirement Order No. 91-091

and

City of Livermore Ground Water Discharge Permit No. 1508G

Waste Discharge Requirement

Order No. 91-091

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 91-091
NPDES NO. CA0029289

WASTE DISCHARGE REQUIREMENTS FOR:

U.S DEPARTMENT OF ENERGY
and
LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region, (hereinafter the Board) finds that:

1. Lawrence Livermore National Laboratories (LLNL) operates a research facility under contractual agreements with the U.S. Department of Energy (DOE). LLNL and DOE are both hereinafter referred to as dischargers. For the purposes of this Order, DOE will be responsible for compliance in the event that LLNL fails to comply with its requirements.

2. By a report dated April 1991, the dischargers have applied for a revision of their current waste discharge requirements to include groundwater disposal/recharge via an infiltration trench and injection wells. These requirements will be permitted under the National Pollutant Discharge Elimination System.

3. Hazardous materials have been used, stored, and disposed of on the property since it was first used by the federal government in the 1940's as a Naval Air Station, and later as a research for DOE and its predecessor, the U.S. Atomic Energy Commission.

4. Soil and groundwater beneath the site are polluted with chemicals and solvents that have either current or historical usage onsite. These pollutants include trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene, 1,1-dichloroethylene, 1,1-dichloroethane, carbon tetrachloride, and other halogenated and petroleum hydrocarbons.

5. Suspected sources of hazardous waste releases are form onsite landfills, spillage from outdoor storage facilities that existed throughout the site, leakage from underground storage tanks and pipelines, and past discharges to the LLNL storm drain system. Hazardous waste releases from current research or maintenance activities is not presently ongoing.

6. More than 300 monitoring wells have been installed by the dischargers, both onsite and offsite. Groundwater monitoring data indicate that the groundwater is polluted in several locations beneath the site and that a plume of polluted groundwater extends offsite from the southwest, flowing in a northwesterly direction.

7. Volatile organic compounds (VOCs) in the groundwater occur in large but relatively diffuse plumes that underlie about 85% of the LLNL site and cover a total of about 1.1 miles. VOC plumes are from 30 to 100 feet thick and are rarely found below a depth of 200 feet. VOCs have migrated offsite in two areas: about 2,500 feet west of Vasco Road onto private property and about 800 feet south of the South East Corner Area onto DOE property used by Sandia Laboratories.

8. This permit covers several investigative and remedial activities that will generate treated groundwater as waste. These activities are proposed to be conducted in both onsite and offsite areas, and include:

<u>Short Term Discharge</u>

a. Routine sampling -	3 to 5 well bore volumes removed from monitoring wells prior to obtaining regular groundwater samples for water quality analyses
b. Well development -	preparation of new monitoring wells
c. hydraulic testing -	1 hour to 2 day pump tests

<u>Long Term Discharge</u>

a. Pilot study pump test -	long term pump test to develop remedial design criteria
b. remedial treatment -	subject to approval by EPA, but may consist of groundwater extraction and treatment prior to discharge at effluent limitations set by this Order.

9. Waste generated from routine sampling, well development, and hydraulic testing will reach flows ranging from approximately 800 to 40,000 gallons per day (gpd). These activities will most likely occur on an intermittent basis, but if all three activities are conducted simultaneously maximum flows may reach approximately 51,000 gpd.

10. Presently, two pilot study treatment facilities discharge about 180,000 gpd of treated wastewater. Of the 180,000 gallons, 144,000 will be discharged under separate Waste Discharge Requirements. When a permanent remedial alternative is selected by EPA, and it consists of groundwater extraction and treatment, remedial treatment may reach an anticipated total flow of approximately 504,000 gpd.

11. Treated waste groundwater will be discharged to the ground, to storm sewers which flow into Arroyo Seco or Arroyo Las Positas, or directly into the arroyos. When there is sufficient storm water flow in the arroyos, treated groundwater may flow through Alameda Creek into into San Francisco Bay north of the Dumbarton Bridge.

12. LLNL proposes to discharge treated waste groundwater to an infiltration trench west of Greenville Road in southern LLNL, and injections wells located 100 feet south of MW-441. The infiltration trench and injection wells will serve to expedite groundwater cleanup, hydraulically control existing VOC plumes, minimize anticipated water table decreases, and conserve groundwater resources.

13. The portion of the Livermore-Amador Valley groundwater basin which LLNL occupies, part of the Spring and Mocho I subbasins, is recognized as a groundwater recharge area in the San Francisco Bay Basin Plan and in technical reports submitted by the dischargers. One goal of this Order is to maximize retention of discharged groundwater within the Spring and Mocho I subbasins.

14. This Order will allow discharge of treated groundwater directly to the ground surface, into the surface drainage system (surface drainage channels, storm drains, Arroyo Seco, or Arroyo Las Positas), into an infiltration trench, or injection wells. Discharge from the pilot study treatment systems will be allowed under this permit until a permanent remedial alternative is selected by EPA,

15. The Board adopted a revised Water Quality Control Plan (Basin Plan) for the San Francisco Bay Region on December 17, 1986, The Basin Plan contains objectives and discharge prohibitions for the Livermore-Amador Valley and its subbasins.

16. The existing and potential beneficial uses for surface waters in the Livermore-Amador Valley groundwater basin including Arroyo Mocho, Arroyo Seco, Arroyo Las Positas, Arroyo de la Laguna and their tributaries are:

    a. Contact and non-contact water recreation,
    b. Wildlife habitat,
    c. Groundwater recharge, and
    d. Fish migration and spawning.

17. The existing and potential beneficial uses for groundwater underlying the Livermore-Amador Valley groundwater basins and its subbasins are:

    a. Municipal and domestic supply,
    b. Industrial supply,
    c. Industrial service supply, and
    d. Agricultural supply.

18. The Basin Plan prohibits discharge of wastewater which has "particular characteristics of concern to beneficial uses":

    a. "at any point where the wastewater does not receive a minimal initial dilution of at least 10:1 or onto any nontidal water, dead-end slough, similar confined water, or any immediate tributary thereof", and

    b. "to Alameda Creek (watershed) where no natural flow occurs."

19. The Basin Plan allows for exemptions to the prohibitions referred to in Finding 18 above when it can be demonstrated that a net environmental benefit can be derived as a result of the discharge.

20. LLNL's discharge can be exempt from the Basin Plan prohibition because it is an integral part of a program to clean up contaminated groundwater and thereby produces a net environmental benefit. Receiving water concentrations are expected to be below levels that would affect beneficial uses. Should studies indicate unanticipated chronic effects, the Board will review the requirements of this Order based upon Receiving Water Limitations B.1.e.

21. The Basin Plan prohibits discharge of "all conservative toxic and deleterious substances, above those levels which can be achieved by a program acceptable to the Board, to waters of the Basin." The dischargers' groundwater extraction and treatment system and associated operation, maintenance, and monitoring plan constitutes an acceptable control program for minimizing discharge of toxicants to waters of the State.

22. Effluent limitations of this Order are based on the Basin Plan, State plans and policies, U.S. Environmental Protection agency guidance, and best engineering and geologic judgement as to the best available technology that is economically achievable.

23. The issuance of waste discharge requirements for this discharge is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code (CEQA) pursuant to Section 13389 of the California Water Code.

24. The Board has notified the dischargers and interested agencies and persons of its intent to reissue waste discharge requirements for the discharge and has provided them with the opportunity for a public hearing and an opportunity to submit their written views and recommendations.

25. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the dischargers; in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Clean Water Act and regulations and guidelines adopted thereunder; shall comply with the following:

A. EFFLUENT LIMITATIONS

1. Any effluent discharged to the ground surface onsite shall:

   a. not exceed 10,000 gallons per day,

   b. be treated before discharge to meet concentrations of less than two times the action level for each compound specified by the California Department of Health Services, and

   c. be less than 100 ppb of total volatile organic compounds.

2. The effluent at the point of discharge to Arroyo Seco, Arroyo Las Positas, surface drainage channels, storm drains, LLNL infiltration trench, or LLNL injection wells shall not contain constituents in excess of the following:

Constituent	Unit	Instantaneous Maximum
Metals		
Antimony	ug/l	1460
Arsenic	ug/l	20
Beryllium	ug/l	0.7
Boron	ug/l	7000
Cadmium	ug/l	5
Chromium, Total	ug/l	50
Chromium +6	ug/l	11
Copper	ug/l	20
Iron	ug/l	3000
Lead	ug/l	5.6
Manganese	ug/l	500
Mercury	ug/l	1
Nickel	ug/l	7.1
Selenium	ug/l	100

Silver	ug/l	23
Thallium	ug/l	130
Zinc	ug/l	58
Volatile Organic Compounds (VOCs)		
Benzene	ug/l	0.7
Tetrachloroethylene	ug/l	4
Vinyl Chloride	ug/l	2
Total VOCs	ug/l	5

Total VOCs include but are not limited to:

Benzene, Bromoform, Carbon Tetrachloride, Chlorobenzene, Chlorodibromomethane, Chloroethane, Chloroform, 1,1-Dichloroethane, 1,2-Dichloroethane, Ethylbenzene, Tetrachloroethylene, Toluene, trans-1,2,-Dichloroethylene, 1,1,1-Trichloroethane, Trichloroethylene, trichlorofluoromethane, Xylene(s), and Vinyl Chloride.

Total Petroleum Hydrocarbons As identified by modified EPA Method 8015	ug/l	50
Ethylene Dibromide As identified by EPA Method 504	ug/l	0.02
Polynuclear Aromatic Hydrocarbons Total, as identified by EPA Method 610 or 625	ug/l	15
Base/Neutral, Acid, and Pesticide Compounds Per constituent, as identified by EPA Method 610 or 625	ug/l	5

3. The pH of the discharge shall not exceed 8.5 nor be less than 6.5.

4. In any representative set of samples, the discharge of wastes shall meet the following limit of quality:

   TOXICITY: The survival of test fishes acceptable to the Executive Officer in 96-hour bioassays of the effluent as discharged shall be a median of 90% survival and a 90 percentile value of not less than 70% survival.

B. RECEIVING WATER LIMITATIONS

1. The discharge of wastes shall not cause the following conditions to exist in waters of the State at any place:

   a. floating, suspended, or deposited macroscopic particulate matter or foam;

b. bottom deposits or aquatic growths;

c. alteration of temperature or apparent color beyond present natural background levels;

d. visible, floating, suspended, or deposited oil or other products of petroleum origin; and

e. toxic or deleterious substances to be present in concentrations or quantities which will cause deleterious effects on aquatic biota, wildlife, or water fowl, or which render any of these unfit for human consumption at levels created in the receiving water or as a result of biological concentrations.

2. The discharge of waste shall not cause the following limit to be exceeded in waters of the State within one foot of the water surface:

pH: The pH shall not be depressed below 6.5 nor raised above 8.5, nor caused to vary from normal ambient pH levels by more than 0.5 pH units.

3. This discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Board or the State Water Resources Control Board as required by the Federal Water Pollution Control Act and regulations adopted thereunder. If more stringent applicable water quality standards are promulgated or approved pursuant to Section 303 of the Federal Water Pollution Control Act or amendments thereto, the Board will revise and modify this Order in accordance with the more stringent standards.

C. PROVISIONS

1. The dischargers shall comply with all sections of this Order immediately upon adoption. For the purposes of enforcing this Order, DOE shall be responsible for achieving full compliance with this Order within 60 days of the Executive Officer's determination that LLNL has failed to comply with the requirements of this Order.

2. The dischargers shall comply with the self-monitoring program as adopted by the Board and as may be amended by the Executive Officer.

3. Board Order 90-106 is hereby rescinded.

4. The dischargers shall notify the Board if the Self-monitoring program results indicate, or if discharge or any activity (to include all site investigation activity) has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited by this Order.

5. Discharge of treated groundwater to the ground may occur only:

a. within LLNL legal site boundaries while conducting routine sampling, well development, or hydraulic testing,

b. if the total effluent volume does not exceed 10,000 gallons per day,

c. if the total VOCs in the discharge do no exceed concentrations of two times the action level for each compound specified by the California Department of Health Services, or does not exceed the limit under Effluent Limitation A.1, and

d. in offsite areas while conducting routine sampling, well development, or hydraulic testing if it has been shown that the pumped water contains VOC concentrations less that those listed in Item a.2 and permission is obtained from the owners.

6. Discharge of treated waste groundwater to the storm sewers may occur only:

a. within LLNL legal site boundaries,

b. in offsite areas if the discharge point to a waterway can be identified, and a receiving water sample point is established (if the new discharge point is downstream from all existing receiving water sample points) as discussed under item I.C., Part B, Self-monitoring program.

c. for any investigative or remedial activity that generates effluent at all volumes, and

d. if the discharge complies with all Effluent Limitations.

7. Discharge of treated waste groundwater to the Arroyo Seco, Arroyo Las Positas, LLNL infiltration trench, or LLNL injection wells may occur only:

a. in offsite or onsite areas,

b. for any investigative or remedial activity that generates effluent at all volumes, and

c. if the discharge complies with all Effluent Limitations.

8. Total discharge from all pilot studies treatment systems shall not exceed 360,000 gallons per day. Discharge from the pilot studies will be allowed under this permit until a Record of Decision for final remediation has been reached.

9. Effluent generated from treatment Facility A shall not be discharged at any point of the arroyo that crosses or is upstream of the main body of the offsite plume unless the channel is lined to prevent infiltration from the point of discharge downstream through the body of the plume. Discharge from treatment Facility A will be managed under separate Waste Discharge Requirements.

10. Any discharge to a location other than the discharge point(s) specified in Provisions 5 through 7 of this Order, or discharge of any hazardous constituent, will require a modification of this Order or submission of a second NPDES application.

11. For additional injection wells, the dischargers must submit a report describing well locations, well construction, and other information to show that discharge from the additional wells have adequate hydraulic control and monitoring. This report shall be to the satisfaction of the Executive Officer.

12. The dischargers shall comply with all items of the attached "Standard Provisions & Reporting Requirements, and Definitions dated December, 1986 except items A.10, B.2, C.8, and C.11.

13. This Order expires June 18, 1996. The dischargers must file a report of waste discharge in accordance with Title 23, Chapter 3, Subchapter 9 of the California Administrative Code no later than 180 days in advance of such expiration date as application for issuance of new waste discharge requirements.

14. This Order is issued to the dischargers in support of investigation and cleanup activities undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. Pursuant to CERCLA, all response actions taken by the dischargers must be consistent with guidelines, rule regulations, and criteria developed by the EPA. Issuance of this Order does not constitute approval by the State of California or EPA for any response activities. This Order is meant to facilitate the investigation of the extent of pollution, the evaluation of potential remedies, and the initiation of any selected remedies by specifying the manner in which waste groundwater from investigation and cleanup activities may be discharged.

15. This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Clean Water Act or amendments thereto and shall become effective 10 days after the date of its adoption provided the Regional Administrator, EPA has no objection. If the Regional Administrator objects to its issuance, the permit shall not be effective until such objection is withdrawn.

I, Steven R. Ritchie, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region on June 19, 1991.

Steven R. Ritchie
Executive Officer

Attachments:
a. Standard Provisions & Reporting Requirements, Dec 1986
b. Self-Monitoring Program

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
DECEMBER 1986

STANDARD PROVISIONS AND REPORTING REQUIREMENTS

A. General Provisions

1. All Provisions and Reporting Requirements apply to all regulated discharges unless otherwise noted.

2. Neither the treatment nor the discharge of pollutants shall create a pollution, contamination, or nuisance as defined by Section 13050 of the California Water Code.

3. The discharger shall take all reasonable steps to minimize or prevent any discharge in violation of this order and permit which has a reasonable likelihood of adversely affecting public health or the environment, including such accelerated or additional monitoring as requested by the Regional Board or Executive Officer to determine the nature and impact of the violation. [40 CFR 122.41(d)]

4. All discharges authorized by this Order shall be consistent with the terms and conditions of this Order.

5. Pursuant to Environmental Protection Agency regulations the discharger must notify the Regional Board as soon as it knows or has reason to believe (1) that they have begun or expect to begin, use or manufacture of a pollutant not reported in the permit application, or (2) a discharge of toxic pollutants not limited by this permit has occurred, or will occur, in concentrations that exceed the limits specified in 40 CFR 122.42(a).

6. If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307 (a) of the Clean Water Act, or amendments thereto, for a toxic pollutant which is present in the discharge authorized herein and such standard or prohibition is more stringent than any limitation upon such pollutant in a Board adopted Order, discharger must comply with the new standard or prohibition. the Board will revise or modify the Order in accordance with such toxic effluent standard or prohibition and so notify the discharger.

7. If more stringent applicable water quality standards are approved pursuant to Section 303 of the Clean Water Act, or amendments thereto, the discharger must comply with the new standard. The Board will revise and modify this Order in accordance with such more stringent standards.

8. The discharge of any radiological, chemical, or biological warfare agent waste is prohibited.

9. Solids storage prior to final disposal shall be maintained to minimize runoff, to prevent leaching, and shall comply with all requirements contained in Title 23, Chapter 3, Subchapter 15 of the California Administrative Code.

10. All facilities used for transport, treatment, or disposal of wastes shall be adequately protected against overflow or washout as the result of a 100-year frequency flood.

11. Collection, treatment, storage and disposal systems shall be operated in a manner that precludes public contact with wastewater, except where excluding the public is inappropriate, warning signs shall be posted.

12. Collected screenings, sludges, and other solids removed from liquid wastes shall be disposed of at a legal point of disposal, and in accordance with the provisions of Chapter 15 of Title 23 of the California Administration Code. For the purpose of this requirement, a legal point of disposal is defined as one for which waste discharge requirements have been prescribed or waived by a Regional Water Quality Control Board and which is in full compliance therewith.

13. This Order and Permit does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to the property of another, nor protect the discharger from liabilities under federal, state or local laws, nor create a vested right for the discharge to continue the waste discharge or guarantee the discharger a capacity right in the receiving water. [40 CFR 122.41(g)]

14. The Regional Board or its authorized representatives shall be allowed:

   a. Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of the order and permit;

   b. Access to and copy at reasonable times any records that must be kept under the conditions of the order and permit;

   c. To inspect at reasonable times any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under the order and permit; and

   d. To photograph, sample, and monitor at reasonable times for the purpose of assuring compliance with the order and permit or as otherwise authorized by the Clean Water Act any substances or parameters at any locations. [40 CFR 122.41(i)]

15. This Order and Permit may be modified, revoked and reissued, or terminated in accordance with applicable State and/or Federal regulations. Cause for taking such action includes, but is not limited to any of the following:

    a. Violation of any term or condition contained in the Order and Permit;

    b. Obtaining the Order and Permit by misrepresentation, or by failure to disclose fully all relevant facts;

    c. Endangerment to public health or environment that can only be regulated to acceptable levels by order and permit modification or termination; and

    d. Any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

16. The filing of a request by the discharger for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit conditon. [40 CFR 122.41(f)]

17. The discharger shall furnish, within a reasonable time, any information the Regional Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit. The discharger shall also furnish to the Regional Board, upon request, copies of records required to be kept by its permit. [40 CFR 122.41(h)]

18. Bypass (the intentional diversion of waste streams from any portion of a treatment facility) is prohibited. The Regional Board may take enforcement action against the discharger for plant bypass unless:

    a. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. (Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.);

    b. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

c. The permittee submitted advance notice of the need for a bypass to the Regional Board. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 10 days before the date of the bypass. The permittee shall submit notice of an unanticipated bypass as required by 40 CFR 122.41(1)(6) (24 hour notice), as required in paragraph C.10.

The permittee may allow a bypass to occur that does not cause effluent limitations to be exceeded, but only if it is for essential maintenance to assure efficient operation. In such a case, the above bypass conditions are not applicable.

B. Treatment Reliability

1. The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment disposal and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with this order and permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. All of these procedures shall be described in an Operation and Maintenance Manual. The discharger shall keep in a state of readiness all systems necessary to achieve compliance with the conditions of this order and permit. All systems, both those in service and reserve, shall be inspected and maintained on a regular basis. Records shall be kept of the tests and made available to the Regional Board. [40 CFR 122.41(e)]

2. Safeguard to electric power failure:

a. The discharger shall, within ninety (90) days of the effective date of this permit, submit to the Regional Board for approval a description of the existing safeguards provided to assure that, should there be reduction, loss, or failure of electric power, the discharger shall comply with the terms and conditions of its Order. Such safeguards may include alternate power sources, standby generators, retention capacity, operating procedures or other means. A description of the safeguards provided shall include an analysis of the frequency, duration, and impact of power failures experienced over the past five years on effluent quality and on the capability of the discharger to comply with the terms and conditions of the Order. The adequacy of the safeguards is subject to the approval of the Regional Board.

b. Should the Regional Board not approve the existing safeguards, the discharger shall, within ninety (90) days of having been advised by the Regional Board that the existing safeguards are inadequate, provide to the Regional Board and the Environmental Protection Agency a schedule of compliance for providing safeguards such that in the event of reduction, loss, or failure of electric power, the permittee shall comply with the terms and conditions of this permit. The schedule of compliance shall, upon approval of the Regional Board Executive Officer, become a condition of the Order.

c. If the discharger already has approved plan(s), the plan shall be revised and updated as specified in the plan or whenever there has been a material change in design or operation. A revised plan shall be submitted to the Regional Board within ninety (90) days of the material change.

3. POTW facilities subject to this order and permit shall be supervised and operated by persons possessing certificates of appropriate grade pursuant to Chapter 3, Subchapter 14, Title 23 of the California Administrative Code.

C. General Reporting Requirements

1. All reports required by the order and permit and other information requested by the Regional Board or EPA Region 9 shall be signed by a principal executive officer or ranking elected official of the discharger, or by a duly authorized representative of that person. [40 CFR 122.22(b)]

2. All reports signed by a duly authorized representative shall contain the following certification:

"I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. [40 CFR 122.22(d)]

3. Should the discharger discover that it failed to submit any relevant facts or that it submitted incorrect information in any report, it shall promptly submit the missing or correct information. [40 CFR 122.41(1)(8)]

4. Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall be subject to enforcement procedures as identified in Section D of these Provisions.

5. This permit is not transferable to any person except after notice to the Regional Board. The Regional Board may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

6. Transfer of control or ownership of a waste discharge facility under an National Pollutant Discharge Elimination System permit must be preceded by a notice to the Regional Board at least 30 days in advance of the proposed transfer date. The notice must include a written agreement between the existing discharger and proposed discharger containing specific dates for transfer of responsibility, coverage, and liability between them. Whether an order and permit may be transferred without modification or revocation and reissuance is at the discretion of the Regional Board. If order and permit modification or revocation and reissuance is necessary, transfer may be delayed 180 days after the Regional Board's receipt of a complete application for waste discharge requirements and an NPDES permit.

7. The discharger shall file with the Board a report of waste discharge at least 120 days before making any material change or proposed change in the character, location or volume of the discharge.

8. The discharger shall file with the Board, for Executive Officer review and approval within ninety (90) days after the effective date of this Order, a technical report or a statement that the existing plan(s) was reviewed and updated, as appropriate, on preventive (failsafe) and contingency (cleanup) plans for controlling accidental discharges, and for minimizing the effect of such events. The technical report or updated revisions should:

   a. Identify the possible sources of accidental loss, untreated or partially treated waste bypass, and polluted drainage. Loading and storage areas, power outage, waste treatment unit outage, and failure of process equipment, tanks and pipes should be considered.

   b. Evaluate the effectiveness of present facilities and procedures and state when they became operational.

   c. Predict the effectiveness of the proposed facilities and procedures and provide an implementation schedule containing interim and final dates when they will be constructed, implemented, or operational.

This Board, after review of the technical report or updated revisions, may establish conditions which it deems necessary to control accidental discharges and to minimize the effects of such events. Such conditions may be incorporated as part of this Order, upon notice to the discharger. If the discharger already has an approved plan(s) he shall update them as specified in the plan(s).

9. Reports of compliance or noncompliance with, or any progress reports on, interim and final compliance dates contained in any compliance schedule shall be submitted within 10 working days following each scheduled date unless otherwise specified within this order and permit. If reporting noncompliance, the report shall include a description of the reason for failure to comply , a description and schedule of tasks necessary to achieve compliance and an estimated date for achieving full compliance. A final report shall be submitted within 10 working days of achieving full compliance, documenting full compliance

10. Twenty-four hour reporting:

(a) The permittee shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five working days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times and, if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

(b) The following shall be included as information that must be reported within 24 hours under this paragraph:

(A) Any unanticipated bypass that exceeds any effluent limitation in the permit.

(B) Any upset that exceeds any effluent limitation in the permit.

(C) Violation of a maximum daily discharge limitation for any of the pollutants listed in this permit to be reported within 24 hours.

(c) The Regional Board may waive the above-required written report on a case-by-case basis.

11. All POTWs must provide adequate notice to the Regional Board of:

    (a) Any introduction of new pollutants into the POTW from an indirect discharger that would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants.

    (b) Any substantial or material change in the volume or character of pollutants being introduced into that POTW by an input source at the time of issuance of the permit.

    Adequate notice shall include information on the quality and quantity of influent introduced into the POTW as well as any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

D. Enforcement

1. The provision contained in this enforcement section shall not act as a limitation on the statutory or regulatory authority of the Regional Board.

2. Any violation of the permit constitutes violation of the California Water Code and regulations adopted thereunder and the provisions of the Clean Water Act, and is the basis for enforcement action, permit termination, permit revocation and reissuance, denial of an application for permit reissuance; or a combination thereof.

3. The Regional Board may impose administrative civil liability, may refer a discharger to the State Attorney General to seek civil monetary penalties, may seek injunctive relief or take other appropriate enforcement action as provided in the California Water Code or federal law for violation of Regional Board orders.

4. It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this order and permit.

5. A discharger seeking to establish the occurrence of any upset (See Definitions, E.23) has the burden of proof. A discharger who wishes to establish the affirmative defense of any upset in an action brought for noncompliance shall demonstrate, through properly signed contemporaneous operating logs, or other relevant evidence that:

    a. an upset occurred and that the permittee can identify the cause(s) or the upset;

    b. the permitted facility was being properly operated at the time of the upset;

c. the permittee submitted notice of the upset as required in paragraph c.10.; and

d. the permittee complied with any remedial measures required under A.3.

No determination made before an action for noncompliance, such as during administrative review of claims that noncompliance was caused by an upset, is final administrative action subject to judicial review.

In any enforcement proceeding, the permittee seeking to establish the occurrence of any upset has the burden of proof. [40 CFR 122.41(n)]

E. Definitions

1. Bypass means the intentional diversion of waste streams from any portion of treatment facility.

2. Daily discharge means:

   a. For flow rate measurements, the average flow rate measured during a calendar day or during any 24-hour period reasonably representative of the calendar day for purposes of sampling.

   b. For pollutant measurements, the concentration or mass emission rate measured during a calendar day or during any 24-hour period reasonably representative of the calendar day for purposes of sampling.

3. Daily Maximum Limit means the maximum acceptable daily discharge. For pollutant measurements, unless otherwise specified, the results to be compared to the daily maximum limit are based on composite samples.

4. DDT and Derivatives shall mean the sum of the p,p' and o,p' isomers of DDT, DDD (TDE), and DDE.

5. Duly authorized representative is one whose:

   a. Authorization is made in writing by a principal executive officer or ranking elected official;

   b. Authorization specifies either an individual or a position having responsibilility for the overall operation of the regulated facility or activity, such as general manager in a partnership, manager, operator of a well or a well field, superintendent, positon of equivalent responsibility, or an individual or positon having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named positon.); and

c. Written authorization is submitted to the Regional Board and EPA Region 9. If an authorization becomes no longer accurate because a different individual or positon has responsibilility for the overall operation of the facility, a new authorization satisfying the requirements above must be submitted to the Regional Board and EPA Region 9 prior to or together with any reports, information, or applications to be signed by an authorized representative.

6. Hazardous substance means any substance designated under 40 CFR 116 pursuant to Section 311 of the Clean Water Act.

7. HCH shall mean the sum of the alpha, beta, gama (Lindane), and delta isomers of hexachlorocyclohexane.

8. Inadequately Treated Waste is wastewater receiving partial treatment but failing to meet discharge requirements.

9. Incompatible pollutants are:

a. Pollutants which create a fire or explosion hazard in the POTW;

b. Pollutants which will cause corrosive structural damage to the POTW, or wastewaters with pH lower than 5.0 pH units, unless the facilities are specifically designed to accommodate such wastewater;

c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;

d. Any pollutant, including oxygen-demanding pollutants (e.g., BOD) released into the wastewater system at a flow rate and/or pollutant concentration which will cause interference with the POTW.

e. Heat in amounts which will inhibit biological activity in the POTW and result in interference, or heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C (104°F) unless the works is designed to accommodate such heat or the Regional Board approves alternate temperature limits.

10. Indirect discharger means a non-domestic discharger introducing pollutants into a publicly owned treatment and disposal system.

11. Initial dilution is the process which results in the rapid and irreversible turbulent mixing of wastewater with receiving water around the point of discharge.

12. Mass emission rate is obtained from the following calculation for any calendar day:

$$\text{Mass emission rate (lb/day)} = \frac{8.345}{N} \sum_{i=1}^{N} Q_i C_i$$

$$\text{Mass emission rate (kg/day)} = \frac{3.785}{N} \sum_{i=1}^{N} Q_i C_i$$

in which 'N' is the number of samples analyzed in any calendar day. 'Q_i' and 'C_i' are the flow rate (MGD) and the constituent concentration (mg/L), respectively, which are associated with each of the 'N' grab samples which may be taken in any calendar day. If a composite sample is taken, 'C_i' is the concentration measured in the composite sample and 'Q_i' is the average flow rate occurring during the period over which samples are composited. The daily concentration measured over any calendar day of all constituents shall be determined from the flow-weighted average of the same constituents in the combined waste streams as follows:

$$C_d = \text{Average daily concentration} = \frac{1}{Q_t} \sum_{i=1}^{N} Q_i C_i$$

in which 'N' is the number of component waste streams. 'Q' and 'C' are the flow rate (MGD) and the constituent concentration (mg/L), respectively, which are associated with each of the 'N' waste streams. 'Q_t' is the total flow rate of the combined waste streams.

13. Maximum allowable mass emission rate, whether for a 24-hour, weekly 7-day, monthly 30-day, or 6-month period, is a limitation expressed as a daily rate determined with the formulas in paragraph above, using the effluent concentration limit specified in the order and permit for the period and the specified allowable flow. (Refer to Section C of Part A of Self-monitoring Program for definitions of limitation period)

14. Overflow is defined as the intentional or unintentional spilling or forcing out of untreated or partially treated wastes from a transport system (e.g. through manholes, at pump stations, and at collection points) upstream from the plant headworks caused by excess flow in the transport system.

15. POTW means Publically Owned Treatment Works.

16. POTW Removal efficiency is expressed as the percentage of the ratio of pollutants removed by the treatment facilities to pollutants entering the treatment facilities. Removal efficiencies of a treatment plant shall be determined using monthly averages of pollutant concentration of influent and effluent samples collected at about the same time and using the following equation (or its equivalent):

Removal Efficiency (%) = 100 X [1-(Effluent Conc/Influent Conc)]

When preferred, the discharger may substitute mass loadings and mass emissions for the concentrations.

17. Priority pollutants are those constituents referred to in 40 CFR S122, Appendix D and listed in the EPA NPDES Application Form 2C, (dated 6/80) Items V-3 thru V-9.

18. Sludge means the solids, semi-liquid suspensions of solids, residues, screenings, grit, scum, and precipitates separated from, or created in wastewater by the unit processes of a treatment system. It also includes but is not limited to, all supernatant, filtrate, centrate, decantate, and thickener overflow/underflow in the solids handling parts of the wastewater treatment system.

19. Toxic pollutant means any pollutant listed as toxic under Section 307(a)(1) of the Clean Water Act or under 40 CFR S401.15.

20. Total Identifiable Chlorinated HydroCarbons (TICH) shall be measured by summing the individual concentrations of DDT, DDD, DDE, aldrin, BHC, chlordane, endrin, heptachlor, lindane, dieldrin, PCBs and other indentifiable chlorinated hydrocarbons.

21. Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass or overflow. It does not mean economic loss caused by delays in production.

22. Untreated waste is defined as raw wastewater.

23. Upset means an exceptional incident in which there is unintentional temporary noncompliance with effluent technology based permit limitations in the order and permit because of factors beyond the reasonable control of the discharger. It does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

24. Waste, waste discharge, discharge of waste, and discharge are used interchangeably in this order and permit. The requirements of this order and permit are applicable to the entire volume of water, and the material therein, which is disposed of to surface and ground waters of the State of California.

Table 3
LAND OBSERVATIONS IN IRRIGATED AREAS
DISCHARGERS' SELF-MONITORING REPORT

1. Dischargers: U. S. Department of Energy, and Lawrence Livermore National Laboratory,

2. Reporting Period: Month_______________ Year__________

3. Circle dates treated waste ground water discharged to land by irrigation: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

4. Total flow volume for reporting month: ____________ gallons

5. Estimated recharge:

6. Weather conditions:
   Average Air Temperature_______ Total Precip_______________ Wind Velocity_______

7. Required weekly land observations, as 'yes' or 'no', for weeks of reporting month:

	Weeks for Reporting Month
Date and Time	
Escape waste water, as surface flow or spray	
Evidence for ponding or mosquito problem	
Odor from waste water	
Warning signs posted	

8. If yes to any of above, a written report shall be submitted as per section VII.1., Self-Monitoring Program.

9. I certify that the information in this report, to the best of my knowledge, is true and correct.

   Inspector Signature________________________________ Date______________

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

SELF-MONITORING PROGRAM
FOR:

U.S. DEPARTMENT OF ENERGY

and

LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

NPDES NO. CA 0029289
ORDER NO. 91-091

CONSISTS OF:

PART A, January 1987

and PART B, Adopted June 19, 1991

December 1986
Mod. SBTD 1/23/87

SELF-MONITORING PROGRAM
PART A

A. GENERAL

Basis

Reporting responsibilities of waste dischargers are specified in Sections 13225(a), 13267(b), 13268, 13383 and 13387(b) of the California Water Code and this Regional Board's Resolution No. 73-16 and the Environmental Protection Agency's Discharge Monitoring Report (Form 3320-1).

Purpose

The principal purposes of a monitoring program by a waste discharger, also referred to as self-monitoring program, are: (1) to document compliance with waste discharge requirements and prohibitions established by this Regional Board, (2) to facilitate self-policing by the waste discharger in the prevention and abatement of pollution arising from waste discharge, (3) to develop or assist in the development of effluent or other limitations, discharge prohibitions, national standards of performance, pretreatment and toxicity standards, and other standards, and (4) to prepare water and wastewater quality inventories.

B. SAMPLING AND ANALYTICAL METHODS

Sample collection, storage, and analyses shall be performed according to the 40 CFR 136 or other methods approved and specified by the Executive Officer of this Regional Board. (See Appendix E, attached)

Water and waste analyses shall be performed by a laboratory approved for these analyses by the State Department of Health Services (DOHS) or a laboratory waived by the Executive Officer from obtaining a certification for these analyses by the DOHS. The director of the laboratory whose name appears on the certification or his/her laboratory supervisor who is directly responsible for analytical work performed shall supervise all analytical work including appropriate quality assurance/quality control procedures in his or her laboratory and shall sign all reports of such work submitted to the Regional Board.

All monitoring instruments and equipment shall be properly calibrated and maintained to ensure accuracy of measurements.

C. DEFINITION OF TERMS

1. A grab sample is defined as an individual sample collected in a short period of time not exceeding 15 minutes. Grab samples shall be collected during normal peak loading conditions for the parameter of interest, which may or may not be during hydraulic peaks. It is used primarily in determining compliance with daily maximum limits and instantaneous maximum limits. Grab samples represent only the condition that exists at the time the wastewater is collected.

2. A composite sample is defined as a sample composed of individual grab samples mixed in proportions varying not more than plus or minus five percent from the instantaneous rate (or highest concentration) of waste flow corresponding to each grab sample collected at regular intervals not greater than one hour, or collected by the use of continuous automatic sampling devices capable of attaining the proportional accuracy stipulated above throughout the period of discharge for 8 consecutive or of 24 consecutive hours, whichever is specified in Table 1 of Part B.

3. A flow sample is defined as the accurate measurement of the average daily flow volume using a properly calibrated and maintained flow measuring device.

4. Duly authorized representative is one whose:

   a. Authorization is made in writing by a principal executive officer or ranking elected official;

   b. Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as general partner in a partnership, sole proprietor in a sole proprietorship, the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibililty for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

5. Average values for daily and monthly values are obtained by taking the sum of all daily values divided by the number of all daily values measured during the specified period.

6. Daily Maximum limit is the total discharge in a calendar day for pollutants measured by mass or the average measurement obtained for other pollutants.

7. Instantaneous maximum is defined as the highest measurement obtained for the calendar day.

8. Median of an ordered set of values is that value below and above which there is an equal number of values, or which is the arithmetic mean of the two middle levels, if there is no one middle value

9. A 6-month median means a moving median of daily values for any 180 day period in which daily values represent flow-weighted average concentrations within a daily or 24-hour period. For intermittent discharges, the daily value shall be considered to equal zero for days on which no discharge occurred.

D. SPECIFICATIONS FOR SAMPLING AND ANALYSES

The discharger is required to perform sampling and analyses according to the schedule in Part B in accordance with the following conditions:

1. Influent

   a. Samples of influent shall be collected on varying days selected at random and shall not include any plant recirculation or other sidestream wastes. Deviation from this must be approved by the Executive Officer.

2. Effluent

   a. Samples of effluent shall be collected on days coincident with influent composite sampling unless otherwise stipulated. At least one sampling event/day shall be taken during major unit operation shutdown or startup. The Board or Executive Officer may approve an alternative sampling plan if it is demonstrated to the Board's satisfaction that expected operating conditions for the facility warrant a deviation from the standard sampling plan.

   b. Grab samples of effluent shall be collected during periods of maximum peak flows and shall coincide with effluent sample days.

   c. Fish bioassay samples shall be collected on days coincident with effluent sampling.

      1) Bioassay sample should be collected after chlorination, if chlorination is part of the treatment process. Bioassay test should be performed on dechlorinated samples. Dechlorination may be performed at the laboratory before testing.

      2) Total ammonia nitrogen shall be analyzed and un-ionized ammonia calculated whenever fish bioassay test results fail to meet the specified percent survival.

   d. If two consecutive samples of a constituent monitored on a weekly or monthly basis in a 30 day period exceed the effluent limit for any parameter, (or if the required sampling frequency is once per month and the monthly sample exceeds the limit), the sampling frequency shall be increased to daily until the additional sampling shows that the most recent three (3) days are in compliance.

e. If any instantaneous maximum limit is exceeded, the discharge shall be terminated until the cause of violation is found and corrected.

f. If the final or intermediate results of any single bioassay test indicate a threatened violation (i.e. the percentage of surviving test organisms is less than the required survival percentage), a new test will begin and the discharger shall investigate the cause of the mortalities and report the finding in the next self-monitoring report.

g. Chlorine residual analyzers shall be calibrated against grab samples as frequently as necessary to maintain accurate control and reliable operation. If an effluent violation is detected, grab samples shall be collected at least every 30 minutes until compliance is achieved.

h. When any type of bypass occurs, grab samples shall be collected on a daily basis for all constituents at all affected discharge points which have effluent limits for the duration of the bypass.

3. Receiving Waters

a. Receiving water sampling shall be conducted on days coincident with sampling of effluent.

b. Receiving water samples shall be collected at each station on each sampling day during the period within 1 hour following low slack water. Where sampling at lower slack water period is not practical, sampling shall be performed during higher slack water period. Samples shall be collected within the discharge plume and downcurrent of the discharge point so as to be representative, unless otherwise stipulated.

c. Samples shall be collected within one foot below the surface of the receiving water body, unless otherwise stipulated.

E. Standard Observations

1. Receiving Water

a. Floating and suspended materials of waste origin (to include oil, grease, algae, and other macroscopic particulate matter): presence or absence, source, and size of affected area.

b. Discoloration and turbidity: description of color, source, and size of affected area.

c. Odor: presence or absence, characterization, source, distance of travel, and wind direction.

d. Evidence of beneficial water use: presence of water-associated waterfowl or wildlife, fishermen, and other recreational activities in the vicinity of the sampling stations.

e. Hydrographic condition:

1) Time and height of corrected high and low tides (corrected to nearest NOAA location for the sampling date and time of sample and collection).

2) Depth of water columns and sampling depths.

f. Weather condition:

1) Air temperatures.

2) Wind - direction and estimated velocity.

3) Precipitation - total precipitation during the previous five days and on the day of observation.

2. <u>Wastewater Effluent</u>

a. Floating and suspended material of waste origin (to include oil, grease, algae, and other macroscopic particulate matter): presence or absence.

b. Odor: presence or absence, characterization, source, distance of travel.

3. <u>Beach and Shoreline</u>

a. Material of waste origin: presence or absence, description of material, estimated size of affected area, and source.

b. Beneficial use: estimated number of people sunbathing, swimming, waterskiing, surfing, etc.

4. <u>Land Retention or Disposal Area</u>

This applies both to liquid and solid wastes confined or unconfined.

a. For each impoundment determine amount of the freeboard at lowest point of dikes confining liquid wastes.

b. Evidence of leaching liquid from area of confinement and estimated size of affected area. (Show affected area on a sketch and volume of flow (gpm, etc.))

c. Odor: presence or absence, characterization, source, and distance of travel.

d. Estimated number of waterfowl and other water-associated birds in the disposal area and vicinity.

5. Periphery of Waste Treatment and/or Disposal Facilities

   a. Odor: presence or absence, characterization, source, and distance of travel.

   b. Weather condition: wind direction and estimated velocity.

F. RECORDS TO BE MAINTAINED

1. Written reports, strip charts, calibration and maintenance records, and other records shall be maintained by the discharger and accessible (at the waste treatment plant), and retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge or when requested by the Regional Board or Regional Administrator of the U.S. Environmental Protection Agency, Region IX. Such records shall show the following for each sample:

   a. Identity of sampling and observation stations by number.

   b. Date and time of sampling and/or observations.

   c. Method of sampling (See Section C - Definition of Terms)

   d. Type of fish bioassay test (96 hour static or flow-through bioassay)

   e. Date and time that analyses are started and completed, and name of personnel performing the analyses.

   f. Complete procedure used, including method of preserving sample and identity and volumes of reagents used. A reference to a specific section of Standard Methods is satisfactory

   g. Calculations of results.

   h. Results of analyses and/or observations.

2. A tabulation shall be maintained showing the following flow data for influent and effluent stations and disposal areas:

   a. Total waste flow or volume for each day.

   b. Maximum and minimum daily flows for each month.

3. A tabulation reflecting bypassing and accidental waste spills shall be maintained showing information items listed in Sections F -1 and F-2 for each occurrence.

G. REPORTS TO BE FILED WITH THE REGIONAL BOARD

1. Spill Reports

If any hazardous substance is discharged in or on any waters of the state, or discharged and deposited where it is, or probably will be discharged in or on any waters of the state, the discharger shall report such a discharge to this Regional Board, at (415) 464-1255 on weekdays during office hours from 8 a.m. to 5 p.m., and to the Office of Emergency Services at (800) 852-7550 during non-office hours. A written report shall be filed with the Regional Board within five (5) working days and shall contain information relative to:

a. nature of waste or pollutant,

b. quantity involved,

c. duration of incident,

d. cause of spilling,

e. Spill Prevention, Control, and Countermeasure Plan (SPCC) in effect, if any,

f. estimated size of affected area,

g. nature of effects (i.e.,fish kill, discoloration of receiving water, etc.),

h. corrective measures that have been taken or planned, and a schedule of these activities, and

i. persons/agencies notified.

2. Reports of Plant Bypass, Treatment Unit Bypass and Permit Violation

In the event the discharger violates or threatens to violate the conditions of the waste discharge requirements and prohibitions or intends to permit a plant bypass or treatment unit bypass due to:

a. Maintenance work, power failures, or breakdown of waste treatment equipment, or

b. accidents caused by human error or negligence, or

c. other causes, such as acts of nature,

The discharger shall notify the Regional Board office by telephone as soon as he or his agents have knowledge of the incident and confirm this notification in writing within 5 working days of the telephone notification. The written report shall include time, date, duration and estimated volume of waste bypassed, method used in estimating volume and person notified of the incident. The report shall include pertinent information explaining reasons for the noncompliance and shall indicate what steps were taken to prevent the problem from recurring.

In addition, the waste discharger shall promptly accelerate his monitoring program to analyze the discharge at least once every day (Section D.2.h). Such daily analyses shall continue until such time as the effluent limits have been attained, until bypassing stops or until such time as the Executive Officer determines to be appropriate. The results of such monitoring shall be included in the regular Self-Monitoring Report.

3. The discharger shall file a written technical report to be received at least 30 days prior to advertising for bid (or 60 days prior to construction) on any construction project which would cause or aggravate the discharge of waste in violation of requirements; said report shall describe the nature, cost, and scheduling of all action necessary to preclude such discharge. In no case will any discharge of wastes in violation of permit and order be permitted unless notification is made to the Executive Officer and approval obtained from the Regional Board.

4. Self-Monitoring Reports

Written reports shall be filed regularly for each calendar month (unless specified otherwise) and filed no later than the fifteenth day of the following month. The reports shall be comprised of the following:

a. Letter of Transmittal:

A letter transmitting self-monitoring reports should accompany each report. Such a letter shall include:

1) Identification of all violations of waste discharge requirements found during the reporting period,

2) Details of the magnitude, frequency, and dates of all violations,

3) The cause of the violations, and

4) Discussion of the corrective actions taken or planned and the time schedule for completion. If the discharger has previously submitted a detailed time schedule for correcting requirement violations, a reference to the correspondence transmitting such schedule will be satisfactory.

Monitoring reports and the letter transmitting reports shall be signed by a principal executive officer or ranking elected official of the discharger, or by a duly authorized representative of that person.

The letter shall contain the following certification:

"I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

b. Compliance Evaluation Summary

Each report shall be accompanied by a compliance evaluation summary sheet prepared by the discharger. The report format will be prepared following the example shown in APPENDIX A (attached). The discharger will prepare the format using those parameters and requirement limits for influent, effluent and receiving water constituents specified in the permit.

c. Map or Aerial Photograph

A map or aerial photograph shall accompany the report showing sampling and observation station locations.

d. Results of Analyses and Observations

Tabulations of the results from each required analysis specified in Part B by date, time, type of sample, detection limit and station, signed by the laboratory director. The report format will be prepared using the examples shown in APPENDIX B.

1) If the permittee monitors any pollutant more frequently than required by this permit using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Self-Monitoring Report.

2) Calculations for all limitations that require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

3) The report shall also identify a table identifying by method number the analytical procedures used for analyses. Any special methods shall be identified and should have prior approval of the Board's Executive Officer.

4) Lab results shall be copied and submitted as an appendix to the regular report.

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e. Influent and Effluent Data Summary

Summary tabulations of the data to include for each constituent total number of analyses, maximum, minimum, and average values for each period. The report format will be the NPDES Discharge Monitoring Report, EPA Form 3320-1. Flow data shall be included.

1) The original is to be submitted to EPA:

Regional Administrator
U.S. Environmental Protection Agency
Attention: Enforcement Division (W-5)
215 Fremont Street
San Francisco, CA 94105

2) with a copy to the Regional Board:

Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1111 Jackson Street, Room 6000
Oakland, CA 94607

f. List of Approved Analyses

1) Listing of analyses for which the discharger is approved by the State Department of Health Services.

2) List of analyses performed for the discharger by another approved laboratory (and copies of reports signed by the laboratory director of that laboratory shall also be submitted as part of the report).

3) List of "waived" analyses, as approved by the Executive Officer.

g. Flow Data

1) The tabulation pursuant to Section F-2.

5. Annual Reporting

By January 31 of each year, the discharger shall submit an annual report to the Regional Board covering the previous calendar year. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous year. In addition, the report shall contain a comprehensive discussion of the compliance record and the corrective actions taken or planned which may be needed to bring the discharger into full compliance with the waste discharge requirements. The report format will be prepared by the discharger using the examples shown in APPENDIX C (attached) and should be maintained and submitted with each regular self-monitoring report.

PART B

U.S. DEPARTMENT OF ENERGY
and
LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

I. DESCRIPTION OF STATIONS

A. INFLUENT

Station	Description
I-001	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility A; immediately prior to treatment.
I-002	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility B; immediately prior to treatment.
I-003	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility C; immediately prior to treatment.
I-004 to I-XXX	At a point in groundwater extraction and treatment that uses a single or multiple well treatment system, immediately prior to treatment. These points will be assigned by the dischargers to all monitoring or extraction wells listed in Finding 8 of Board Order 91-XXX when such activities are initiated. Once assigned, each number will be used in all future extraction events for the same well.

B. EFFLUENT

Station	Description
E-001	At a point in ground water extraction and treatment using Treatment Facility A; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-002	At a point in ground water extraction and treatment using Treatment Facility B; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-003	At a point in ground water extraction and treatment using Treatment Facility C; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-004 to E-XXX	At a point in groundwater extraction and treatment that uses a single or multiple well treatment system, immediately following treatment and prior to discharge onto the ground site storm drain systems, surface waters, drainage ways, or injection wells. These points will be assigned by the dischargers to all monitoring or extraction wells listed in Finding 8 and provisions 5 to 7 of Board Order 91-XXX when such activities are initiated. Once assigned, each number will be used in all future extraction events for the same well.

C. RECEIVING WATERS

Station	Description
R-001	At a point in the north flowing drainage ditch east of Vasco Road, between 50 and 100 feet downstream from the effluent discharge point for Treatment Facility B.
R-002	At a point in Arroyo Seco between 50 and 100 feet downstream from the effluent discharge point for Treatment Facility C.
R-003 to R-XXX	At a point in Arroyo Las Positas, Arroyo Seco, or any surface drainage way between 50 and 100 feet downstream from the effluent discharge point established by the dischargers

II. SCHEDULE OF SAMPLING AND ANALYSIS

The schedule of sampling and analysis is provided in Table 1.

III. MODIFICATIONS TO PART A

A. ADDITIONS

Add Section E.1.e.3) to read:

Stream gage height measurements and their conversion to stream flow measurements.

B. DELETIONS

Sections D.2.b., D.2.g., E.1.e.1), E.3., and E.4.

C. MODIFICATIONS

All items of Self Monitoring Program Part A, dated January 1987 shall be complied with except for the following modifications:

1. Section D.2.a. shall be changed to read as follows:

   Samples of effluent shall be collected on days coincident with effluent grab samples unless otherwise stipulated. The Board or Executive Officer may approve an alternative sampling plan if it is demonstrated to the Board's satisfaction that expected treatment facility operation warrant a deviation from the standard sampling plan.

2. Section D.2.e. shall be changed to read as follows:

   If the instantaneous maximum limit is exceeded, the sampling facility shall be increased to daily until two samples collected on consecutive days show compliance with the instantaneous maximum limit.

3. Section D.3.b. shall be changed to read as follows:

3. Section D.3.b. shall be changed to read as follows:

   Receiving water samples shall be collected at each station on each sampling day. Samples shall be collected within the discharge plume and downcurrent of the discharge point so as to be representative, unless otherwise stipulated.

4. In Section F.1., the phrase:

   "... shall be maintained by the dischargers and accessible (at the waste treatment plant) ..."

   shall be changed to read as follows:

   "... shall be maintained by the dischargers and accessible (at the dischargers' facility) ..."

5. Information requested in Section G.4.e. shall be prepared in a format similar to EPA form 3320-1 and shall be submitted to the EPA's Superfund Division rather than the Enforcement Division.

6. Tha Annual Report required in Section G.5. shall be submitted in place of the end of year monthly report.

I, Steven R. Ritchie, Executive Officer, hereby certify that the foregoing Self-Monitoring Program:

1. Has been developed in accordance with procedures set forth in this Regional Board's Resolution No. 73-16 in order to obtain data and document compliance with waste discharge requirements established in Regional Board Order No 91-091.

2. Was adopted by the Board on June 19, 1991, and

3. May be reviewed at any time subsequent to the effective date upon written notice from the Executive Officer or request from the dischargers, and revisions will be ordered by the Executive Officer or the Regional Board.

Steven R. Ritchie
Executive Officer

Attachments:
1. Table 1
2. Site Map

...g Station	I001- I003	I004- IXXX		E001- E003	E004- EXXX		R001- R002	R003- RXXX					
OF SAMPLE	G	G		G	G		G	G					
...y ...& kg/day)	1/S	1/S		1/S	1/S		1/S	1/S					
... & kg/day)	*	*		*	*		*	*					
& kg/day)	*	*		*	*		*	*					
...c Compounds & kg/day)													
...pplicable ...ard Observations				E	E		E	E					
...m Sediment Analyses Observations													
...l Identifiable Chlorinated ...ocarbons (mg/l & kg/day)													
601 (ug/l & kg/l)	W/M	W/M		D/W	D/W		W/M	W/M					
624 (ug/l & kg/l)	1/A*	1/A*		1/A*	1/A*								
6?? & 625 (ug/l & kg/l)	1/A	W/M		1/A	D/W		1/A	W/M					
...al Dissolved Solids &													
...ides (mg/l & kg/l)***	O	O		O	O		O	O					

* When EPA 624 is performed, it is not necessary to perform EPA 601

LEGEND FOR TABLE

TYPES OF SAMPLES

G = grab sample
C-24 = composite sample - 24-hour
C-X = composite sample - X hours (used when discharge does not continue for 24-hour period)
Cont = continuous sampling
DI = depth-integrated sample
BS = bottom sediment sample
O = observation

TYPES OF STATIONS

I = intake and/or water supply stations
A = treatment facility influent stations
E = waste effluent stations
R = receiving water stations
P = treatment facilities perimeter stations
L = basin and/or pond levee stations
B = bottom sediment stations
G = groundwater stations

FREQUENCY OF SAMPLING

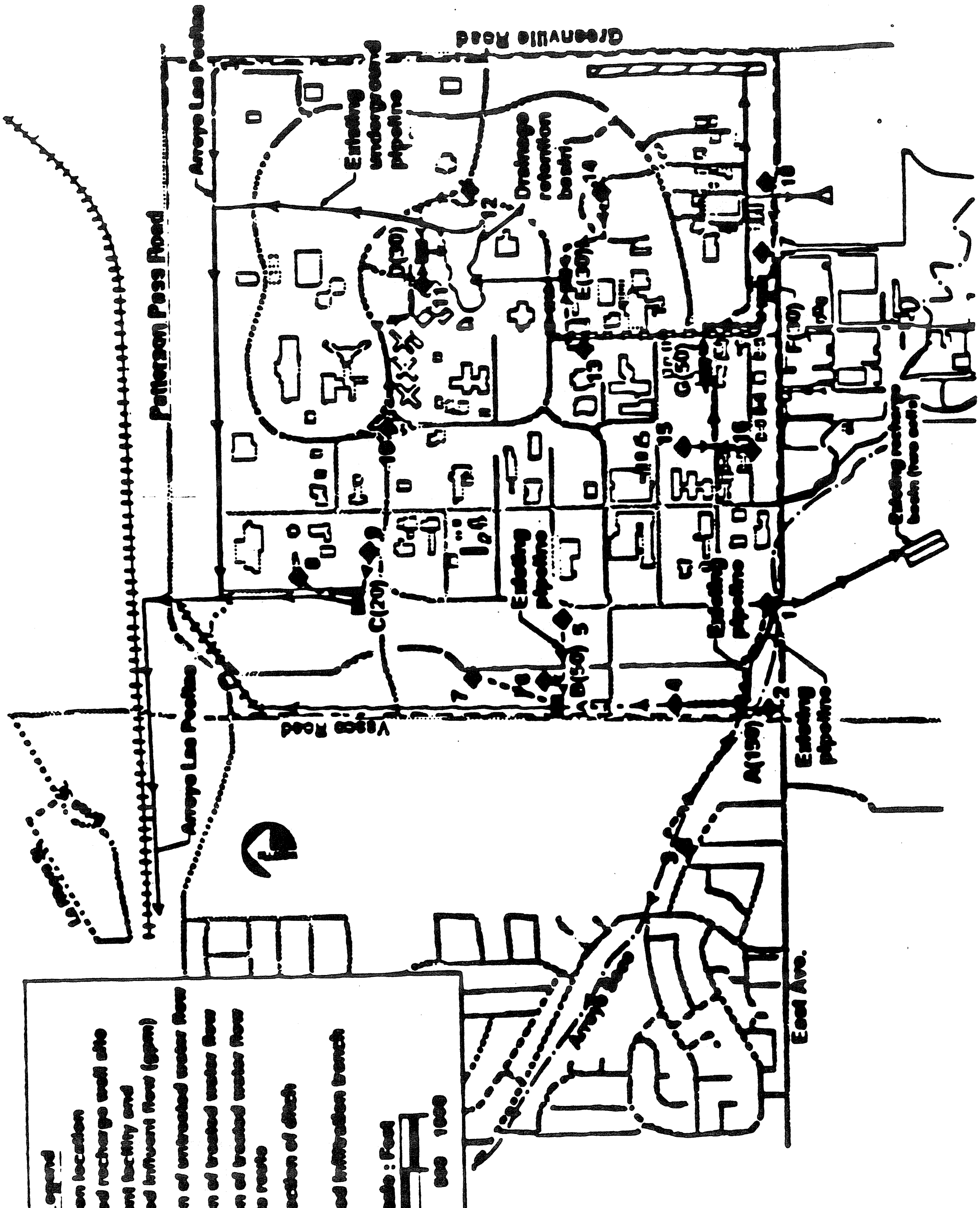
E = each occurence
H = once each hour
D = once each day
W = once each week
M = once each month
Y = once each year
D/W = Daily for the first week, weekly thereafter
W/M = Weekly for the first 4 weeks, monthly thereafter
1/A = One sample during the first week of discharge, annually thereafter
1/S = One sample during the first week of discharge, semi-annually thereafter

2/H = twice per hour
2/W = 2 days per week
5/W = 5 days per week
2/M = 2 days per month
2/Y = once in March and once in September
Q = quarterly, once in March, June, Sept. and December

2H = every 2 hours
2D = every 2 days
2W = every 2 weeks
3M = every 3 months
Cont = continuous

SCHEDULE FOR SAMPLING, MEASUREMENTS, AND ANALYSIS

Sampling Station	1001-1003	1004-XXXX		E001-E003	E004-EXXX		R001-R002	R003-RXXX
TYPE OF SAMPLE	C	C		C	C		C	C
Flow Rate (mgd)	D	D		D	D		D	D
BOD, 5-day, 20 C, or COD (mg/l & kg/day)								
Chlorine Residual & Dosage (mg/l & kg/day)								
Settleable Matter (ml/l-hr. & cu. ft./day)								
Total Suspended Matter (mg/l & kg/day)								
Oil and Grease (mg/l & kg/day)								
Coliform (Total or Fecal) (MPN/100 ml) per req't								
Fish Toxicity 96-hr. % Surv'l in undiluted waste				Q	Q		2/Y	2/Y
Ammonia Nitrogen (mg/l & kg/day)								
Nitrate Nitrogen (mg/l & kg/day)								
Nitrite Nitrogen (mg/l & kg/day)								
Total Organic Nitrogen (mg/l & kg/day)								
Total Phosphate (mg/l & kg/day)								
Turbidity (Jackson Turbidity Units)				Q	Q		2/Y	2/Y
pH (units)	M	M		M	M		M	M
Dissolved Oxygen (mg/l and % Saturation)								
Temperature (°C)				M	M		M	M
Apparent Color (color units)								
Secchi Disc (inches)								
Sulfides (if DO<5.0 mg/l) Total & Dissolved (mg/l)								
Arsenic (mg/l & kg/day)	1/S	1/S		1/S	1/S		1/S	1/S
Cadmium (mg/l & kg/day)	•	•		•	•		•	•
Chromium, Total (mg/l & kg/day)	•	•		•	•		•	•
Copper (mg/l & kg/day)	•	•		•	•		•	•
Cyanide (mg/l & kg/day)	•	•		•	•		•	•
Silver (mg/l & kg/day)	•	•		•	•		•	•
Lead (mg/l & kg/day)	•	•		•	•		•	•
Antimony, Berrylium, Boron, Iron, Manganese, Selenium, Thallium (mg/l & kg/day)	•	•		•	•		•	•
Gross Alpha Particles, Gross Beta Particles, Tritium (pCi/l)				1/A	1/A		1/A	1/A



Preliminary ground water extraction and treatment facility locations (modified from Isherwood *et al.*, 1990).

City of Livermore Ground Water Discharge Permit No. 1508G

WATER RECLAMATION PLANT
1250 Kitty Hawk Road
Livermore, California 94550
(510) 373-5230

CITY OF LIVERMORE
GROUNDWATER DISCHARGE PERMIT

JTHORIZATION: The below named party is hereby authorized to discharge wastewater to the City of Livermore nmunity sewer subject to compliance with the City of Livermore wastewater control ordinance and the condi-.ns set forth in this permit.

PERMITTEE Lawrence Livermore National Laboratory

ADDRESS 7000 East Avenue

Livermore,

California ZIP 94551

— PERMIT CONDITIONS —

☐ **NONE** ☒ **SEE ATTACHED**

This permit is issued for the discharge of treated groundwater to the sanitary sewer system from the building 403 gasoline facility clean-up. This permit may be terminated at any time during its effective term at the discretion of the Water Resources Manager.

Permit #1508G (92-93)

The above named shall report to the City of Livermore Water Reclamation Plant any change, (permanent or temporary) to the premise or operation that significantly change the quality or volume of the Groundwater discharge or deviate from the terms and conditions under which this permit is granted.

EFFECTIVE DATE: July 13, 1992 EXPIRATION DATE: July 12, 1993

DATED: July 13, 1992 APPROVED BY: [signature] 7-13-92

POST PERMIT IN PLAIN VIEW

ATTACHMENT A-1

SELF MONITORING SAMPLE PROGRAM

The permittee, **Lawrence Livermore National Laboratory**, must perform the following Self Monitoring Sample Program as a condition of the groundwater discharge permit. Samples shall be collected after appropriate treatment and prior to discharge to the sanitary sewer and be analyzed using EPA approved methods.

Groundwater Discharge

Sample Parameters	Sample Frequency	Sample Type	Discharge Limitations	Units
BETX**	1 per 3 months	Grab	0.25	mg/L
TTO*	1 per 12 months	Grab	1.00	mg/L

* TTO-- Total Toxic Organics, as defined by the Livermore Municipal Code. TTO monitoring must be completed using EPA method 624 & 625.

** BETX monitoring must be completed using EPA method 624.

ATTACHMENT B-1

EFFLUENT LIMITATIONS

No person shall discharge wastewater containing in excess of:

0.06	mg/L	Arsenic
0.14	mg/L	Cadmium
1.00	mg/L	Copper
0.62	mg/L	Chromium (Total)
0.20	mg/L	Lead
0.01	mg/L	Mercury
0.61	mg/L	Nickel
0.20	mg/L	Silver
3.00	mg/L	Zinc
0.04	mg/L	Cyanide
1.00	mg/L	Total Toxic Organics*

From Section 13.32.100 of the Livermore Municipal Code

* For a Definition of TTO see the Glossary of Terms

ATTACHMENT C-1

Compliance Schedule

The permittee, **Lawrence Livermore National Laboratory**, is not required at this time to perform a compliance schedule. However, if the Water Resources Manager finds that a discharge of wastewater is taking place, has been taking place or threatens to take place in violation of prohibitions or limitations prescribed in the City of Livermore Municipal Code, Chapter 13, or wastewater source control requirements, effluent limitations or pretreatment standards, or the provisions of the groundwater discharge permit, the Manager may require the permittee to perform a detailed Compliance Schedule. The Compliance Schedule will list the specific actions which the permittee must take within the designated time period in order to prevent or correct a violation or the requirements.

UCRL-AR-112814

Appendix B

Operations and Maintenance Quality Assurance/ Quality Control Plan

Appendix B

Operations and Maintenance Quality Assurance/Quality Control Plan

B-1. Introduction

This QA/QC plan has been developed in support of the O&M of TFC for ground water remediation in the western portion of LLNL, and of TFF for ground water and soil remediation in southern LLNL. This plan was prepared to meet the O&M requirements of TFC and TFF using the American Society of Mechanical Engineers (ASME) National Quality Assurance (NQA)-1-1989 Edition as a guideline.

The purpose of this plan is to define the quality objectives and areas of responsibility in accordance with the requirements of the O&M of TFC and TFF.

B-2. Organization

This section documents the organizational structure, functional responsibilities, levels of authority, and lines of communications for those aspects of the O&M of TFC and TFF that affect quality.

Figure B-1 shows the organizational structure for QA activities. The descriptions below generally describe the QA responsibilities of those mainly involved in carrying out the QA program for the O&M of TFC and TFF. The LLNL ERD Livermore Site Restoration Section Leader, the Quality Assurance Manager, the Remediation Engineer, and the other individuals shown in Figure B-1 have the following responsibilities:

- The Livermore Site Restoration Section Leader (LSRSL) issues this QA plan and periodically reviews the implementation of the QA plan. The LSRSL may request an independent review or formal audit of the QA program.

- The Quality Assurance Manager (QAM) is responsible for the development and implementation of the QA plan, establishment and control of the QA document files, coordination with appropriate project personnel to assure compliance within groups over which the quality organization has no administrative control, and development of tracking and reporting systems to provide management visibility of implementation activities and results.

- The Remediation Engineer (RE) is responsible for overseeing facility startup and monitoring its performance and operations.

- The LLNL Plant Engineering Project Manager (PEPM) reports to the ERD LSRSL and RE. The PEPM is Plant Engineering's primary contact with ERD for each assigned project. Working as the project team leader, the PEPM is responsible for achieving the objectives of each specific project within the allocated budget and schedule while meeting the established performance criteria, as well as DOE, LLNL, and regulatory standards.

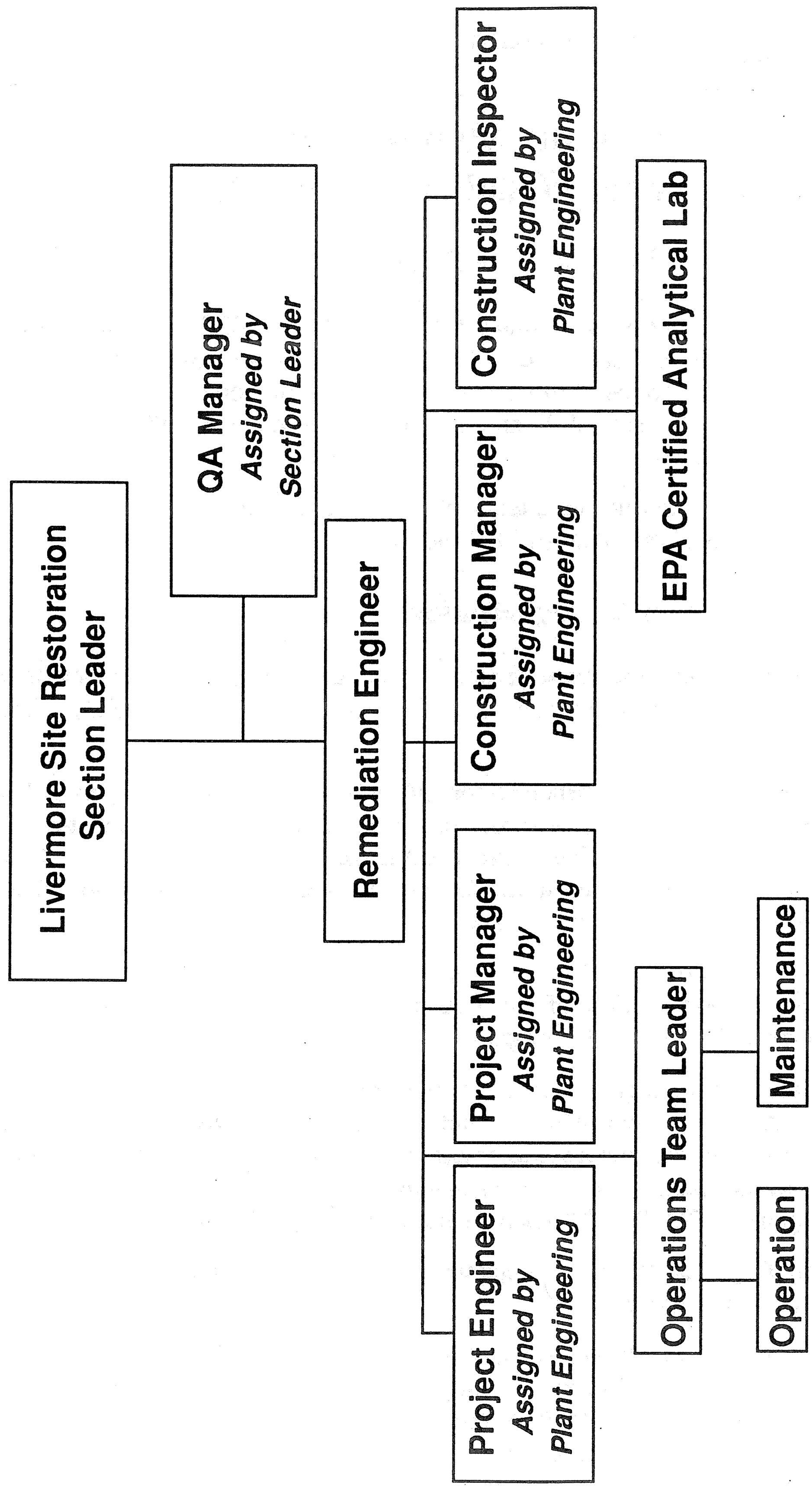


Figure B-1. Organization chart for operations and maintenance quality assurance/quality control for TFC and TFF.

- The LLNL Plant Engineering Project Engineer (PEPE) performs the design or monitors and provides direction to engineers/architects with regard to design concepts, schedule, and budget. The PEPE reports operationally to the PEPM.

- The Construction Manager (CM) acts as the single point contact with construction subcontractors, and reports and advises on status, projected cost, and time of completion. Working in conjunction with the construction inspector, the CM protects LLNL's interest by assuring that all work is accomplished safely and in conformance with the contract documents. The CM reports operationally to the PEPM.

- The Construction Inspector (CI) will perform all inspector's duties as specified in the "Construction Inspector's Policy and Procedures Manual", the "Construction Manager Manual," and this QA plan. The CI is assigned to specific projects as the LLNL field representative, and provides quality control and status of all construction activities. The CI reports operationally to the CM.

- The Operations Team Leader (OTL) is responsible for the day to day maintenance and operation of ground water and soil treatment facilities. This includes scheduling required maintenance and ensuring that the maintenance requested is completed in a timely fashion.

- State Certified Analytical Laboratories using EPA methods are responsible for providing independent chemical analytical results on soil and ground water samples. For TFC and TFF, these samples are submitted as part of the self-monitoring program required by LLNL's discharge permits, in addition to operational testing samples collected prior to the official operation of a facility, and routine samples taken to evaluate facility performance.

B-3. Quality Assurance Program

This section covers objectives, quality goals, and QA levels. The procedures for implementation of QA are included in the plan or cited in the list of codes, standards, and specifications (Table B-1).

B-3.1. Objectives

The objectives of the project supported by this QA plan are to:

- Assure excellence in maintenance services and operations to achieve quality.

- Provide the QA requirements to meet all programmatic and institutional needs.

This QA plan defines the process for providing confidence that these QA objectives will be achieved and that achievement will include due consideration for health, safety, property, and the environment. Table B-2 shows a list of auditable records (including responsible personnel) that are required to document compliance with the requirements of this plan. Table B-3 shows the 18 elements of NQA-1 and their applicability to the Livermore Site Restoration Section activities.

Table B-1. Applicable Codes, Specifications, and Standards for Operation and Maintenance QA for TFC and TFF.

"LLNL Procurement Manual," Vol II, Books 1, 2, and Book 4 (Construction Subcontract Manual).
"LLNL Plant Engineering Manual," Volumes 1-5, latest revision.
"LLNL Plant Engineering Drafting Manual," PEL-P-02065.
"Guidelines For In-House Design Reviews and Project Presentations," Frank Tokarz/ Roger Lake, Plant Engineering Department, Engineering/ Construction Division, LLNL, March 27, 1989 (with May 25, 1989 Rev.).
"Construction Manager Manual, Subcontracted Construction Projects," Plant Engineering Department, LLNL, W. Kleck, January 1989.
"Construction Inspector's Policy and Procedures Manual," Plant Engineering Department, LLNL (July 1984).
LLNL "Health and Safety Manual" (M010-May 1991).
Electronics Engineering / Instrument Services Calibration and Certification Manual, LER 87-1007-99.
Quality Assurance Plan for Calibration Services, Engineering Measurements and Analysis Section, Engineering Sciences Division, M.E.
LLNL Management Policy Memorandum MPM 02.2 "National Environmental Policy Act (NEPA) Compliance."
DOE Order 4330.4A, Real Property Maintenance Management.
Plant Engineering (PE) QA Program Plan, Rev. 1.
PE QA Manual PEL-P-01010, Rev. 0.
LLNL Environmental Protection Handbook, issued by the Environmental Protection Department.
PE Policy and Operations Manual PEL-P-01000.
PE Maintenance and Operations QA Plan, M-078-30.6, September 1990.
PE Maintenance and Operations Electric Utilities QA Plan, M-078-30.10, October 1990.
PE Maintenance Services/Operations QA Plan, M-078-30.9, December 1990.
PE Maintenance and Operations Utilities QA Plan, M-078-30.7, July 1991.
PE Maintenance and Operations Maintenance Engineering and Production Control QA Plan, M-078-30.8, September 1991.
PE Maintenance and Operations Electric Utilities QA Plan, M-078-30.10, October 1991.
PE Specification, PEL-P-02075, Rev. B.

Table B-2. Required QA records.

QA files	QA record title	Person responsible
TFC/F-2-1	Personnel Training Records	QAM
TFC/F-3-1	Design Criteria	PEPE
TFC/F-3-2	Design Calculations	PEPE
TFC/F-3-3a	Design Changes	PEPE
TFC/F-3-3b	Specifications	PEPE
TFC/F-3-4a	Drawing List	PEPM
TFC/F-3-4b	Specifications List	PEPM
TFC/F-3-6	NEPA Compliance Documents	PEPM
TFC/F-4-1	Design or Construction Purchase Orders	PEPM
TFC/F-5	Work Performance and Facility Operations log	OTL
TFC/F-6-1	As-Built Prints	CM
TFC/F-7-1	Notice of Completion	CM
TFC/F-9-1	Welder Certification	CI
TFC/F-9-2	Welding Test Reports	CI
TFC/F-9-3	Cemented Joints Test Reports	CI
TFC/F-10-1	Inspection Prints	CI
TFC/F-10-2	Final Inspection Report	CI
TFC/F-10-3	Final Acceptance Report	CI
TFC/F-18-1	Audit Requests and Reports	PEPM

Table B-3. Applicability of NQA-1 Elements to the Quality Assurance of TFC and TFF.

NQA-1 requirement	Title	Applicable ?
Basic 1	Organization	Y
Supplement S-1	Terms and Definitions	Y
Supplement 1S-1	Supplementary Requirements for Organization	N
Basic 2	Quality Assurance Program	Y
Supplement 2S-1	Supplementary Requirements for the Qualification of Inspection and Test Personnel	N
Supplement 2S-2	Supplementary Requirements for the Qualification of Nondestructive Examination Personnel	N
Supplement 2S-3	Supplementary Requirements for the Qualification of Quality Assurance Program Audit Personnel	N
Supplement 2S-4	Supplementary Requirements for Personnel Indoctrination and Training	N
Basic 3	Design Control	Y
Supplement 3S-1	Supplementary Requirements for Design Control	N
Basic 4	Procurement Document Control	Y
Supplement 4S-1	Supplementary Requirements for Procurement Document Control	N
Basic 5	Instructions, Procedures, and Drawings	Y
Basic 6	Document Control	Y
Supplement 6S-1	Supplementary Requirements for Document Control	N
Basic 7	Control of Purchased Items and Services	Y
Supplement 7S-1	Supplementary Requirements for Control of Purchased Items and Services	N
Basic 8	Identification and Control of Items	Y
Supplement 8S-1	Supplementary Requirements for Identification and Control of Items	N
Basic 9	Control of Processes	Y
Supplement 9S-1	Supplementary Requirements for Control of Processes	N
Basic 10	Inspection	Y
Supplement 10S-1	Supplementary Requirements for Inspection	N
Basic 11	Test Control	Y
Supplement 11S-1	Supplementary Requirements for Test Control	N
Supplement 11S-2	Supplementary Requirements for Computer Program Testing	N
Basic 12	Control of Measuring and Test Equipment	Y
Supplement 12S-1	Supplementary Requirements for Control of Measuring and Test Equipment	N
Basic 13	Handling, Storage, and Shipping	Y

Table B-3. Continued

NQA-1 requirement	Title	Applicable ?
Supplement 13S-1	Supplementary Requirements for Handling Storage and Shipping	N
Basic 14	Inspection, Test, and Operating Status	Y
Basic 15	Control of Nonconforming Items	Y
Supplement 15S-1	Supplementary Requirements for the Control of Nonconforming Items	N
Basic 16	Corrective Action	Y
Basic 17	Quality Assurance Records	Y
Supplement 17S-1	Supplementary Requirements for Quality Assurance Records	N
Basic 18	Audits	Y
Supplement 18S-1	Supplementary Requirements for Audits	N

B-4. Operations and Maintenance

B-4.1. Scope

TFC and TFF will operate to treat ground water containing VOCs. TFF will also treat FHCs and VOC vapor. The ground water at TFC will be treated to meet the requirements specified in California RWQCB WDR Order No. 91-091 (NPDES Permit No. CA 0029289). A table summarizing the effluent discharge requirements is presented in Section A.2 in Appendix A. Ground water at TFF is treated to meet the requirements of the City of Livermore Discharge Permit No. 1508G. This permit is renewed annually. Therefore, O&M activities at these facilities shall be controlled by quality procedures.

B-4.2. Operations

The LSRSL is responsible for ensuring the quality of operations at these facilities. The OTLs are responsible for ensuring that all field operations, including maintenance and operations, are performed with the appropriate quality procedures and are completed in a timely fashion. Each treatment facility, per their respective permits, has a required Self-Monitoring Program. This involves collecting water samples for submission to State certified analytical laboratories for analysis by EPA methods. The results of these analyses are used by LLNL, EPA, RWQCB, and DTSC to monitor the performance of each treatment facility. The OTLs are responsible for ensuring that the technicians are properly trained to collect these samples according to documented procedures.

Each treatment facility has its own set of operating procedures. These procedures, which are being developed, cover the different modes of operation including startup and shutdown and are described in the TFC and TFF operating procedure manuals.

Daily operational logs are kept at each facility. These logs record the operating parameters of each system (i.e., temperature, pressure, etc.), the number and type of samples taken, all maintenance performed on the system and all adjustments made by the operators to the system.

B-4.3. Maintenance

Two types of maintenance are performed at TFC and TFF:

- Preventive.
- Corrective.

B-4.3.1. Preventive Maintenance

Preventive maintenance is performed on those components that need routine servicing and are part of systems related to quality. The preventive maintenance schedule is kept at each facility with the operations procedures for TFC and TFF. The OTL is responsible for ensuring that the preventive maintenance items are scheduled and completed. Maintenance is performed by the LLNL Plant Operations and/or ERD personnel and follows the QA/QC manuals to ensure quality maintenance is performed.

TFC and TFF are treatment facilities designed to operate on a 24-hour-per-day, 7-day-per-week schedule. To keep these systems in continuous 24-hour operation, a preventive maintenance program is required.

B-4.3.1.1. TFC Preventive Maintenance Plan

Table B-4 is a tentative schedule of the preventive maintenance to be performed for TFC.

Table B-4. Preventive Maintenance for TFC.

Action	Frequency/Comments
Check all components and pipelines for leaks.	Daily. If leaks are found, determine potential effects of leak and take appropriate action.
Check prefilter pack #1 and #2.	Daily. Pressure drop across filter greater than 2 psi (maximum variation of 5 psi is allowable) indicates a need to change filters.
Check air stripper tank for scale build-up (calcium carbonate deposits/iron scale) on the aeration diffusers.	Daily. Scale build-up on any of the indicators requires system shut down and lock-out of power to the blowers and source well pumps. Exchange the scaled diffusers for both tanks with refurbished diffusers using manufacturers procedures.
Sample effluent.	Weekly. See WDR Order No. 91-091 (NPDES Permit No. CA 0029289).
Clean organic debris from area surrounding the building.	Weekly, or as needed. Notify the gardeners (Ext. 3-0495).
Check for proper operation of eye wash and shower.	Weekly. Open eye wash valve. Dust covers should pop off as water flows from eye wash ports, and water should spray up a minimum of 6 inches.

Table B-4. Continued

Action	Frequency/Comments
Regenerate one of the two resin columns for the ion exchange unit with 1 to 2 molar NaCl (microprocessor does automatically).	Every 12 days or as required.
Recharge the ion-exchange unit with NaCl with 500 gal of 1 to 2 molar NaCl.	Every 12 days or as required.
Remove waste 1 to 2 molar NaCl hexavalent chromium (500 gal) from the ion-exchange unit.	Every 12 days or as required.
Top off the ion-exchange unit columns at regular intervals.	To be determined. Requires approximately 5 ft^3 per year.
Shut down and clean out the ion-exchange unit tanks with built-up deposits of calcium bicarbonate, or other precipitates.	As required.
Replenish the acid supply (HCl) for the pH adjustment tank. The use rate is approximately 55 gal per 10 days.	Change the 55 gal drums three times per month.
Floor maintenance.	Semiannually. Contact custodians (Ext. 2-9744) to set up date for stripping and waxing of floors.
Replace ion-exchange unit pump seals and lubricating bearings, according to manufacturer's recommendations.	About every 6 months.
Service blower motors and discharge pump meters on air stripper tank.	Annually. Motors and pumps to be serviced by Plant Engineering motor shop (Ext. 2-7751), Bldg. 511.
Replace the entire resin charge for the ion-exchange unit.	Every 5 years. Requires about 60 ft^3.
Service the ion-exchange unit hydraulic valves.	Interval and method to be determined.
Service well pumps.	Annually.
Service air stripper discharge pump.	Annually.
Cycle the carbon filters.	Annually.
Operational verification and/or service of level sensors.	Annually.
Test interlock control system.	Monthly.
Service air compressor.	Annually.
Replace deminster pads.	Annually.

B-4.3.1.2. TFF Preventive Maintenance Plan

To ensure reliable and safe operation of TFF, preventive maintenance is performed regularly by vendors of certain treatment system components and by LLNL Plant Operations and ERD personnel according to LLNL QA/QC manuals. Maintenance records and the preventive maintenance schedule are stored in Building 406.

The following maintenance tasks are performed by Peroxidation Systems, Inc., or ERD personnel on the LVB-60 UV/H_2O_2 Oxidation Unit:

- Replace UV lamp.
- Replace ruptured disc.

- Perform routine and corrective maintenance on the Liquid Metronics, Inc., H_2O_2 pumps.
- Replace and/or service UV lamp ballast.
- Repair and/or service internal LBV-60 electrical components.

The following maintenance tasks are performed by Continental Recovery Systems or other qualified personnel on the GAC vapor treatment system:

- Perform routine and corrective maintenance on the carbon steam regeneration boiler.
- Test and maintain control system, as necessary.
- Inspect Nash positive displacement blower, lubricate bearings as necessary.

Additional preventive maintenance tasks on all other TFF components include:

- Inspect pneumatic ground water extraction pump.
- Inspect pump controller, replace worn rubber parts.
- Inspect air compressor, replace air filter, and change oil.
- Inspect and lubricate bearings in water transfer pumps.
- Inspect ground water heat exchanger and rout flue tubes as necessary.
- Inspect Megator oil/water separators.
- Inspect particulate filters on UV/oxidation unit influent, replace as needed. Flush spent filters with clean air introduced into the vapor extraction system for GAC treatment. Dispose of filters after hydrocarbon concentrations in flush air drop to nondetectable levels.
- Inspect air stripping blowers.
- Inspect air stripping tanks.
- Replace GAC air stripping vapor stream.
- Inspect water condensate transfer tank on vapor extraction system.
- Inspect heat exchanger on vapor extraction system.
- Inspect demister cyclone.
- Inspect miscellaneous hoses, seals, fittings, valves, etc.

Table B-5 is a preventive maintenance schedule to be performed for TFF.

Table B-5 Preventive maintenance at TFF.

Action	Frequency
Inspect pneumatic ground water extraction pump	Monthly/as needed
Inspect pump controller, replace worn rubber parts	Monthly/as needed
Inspect air compressor, replace air filter and change oil	Weekly/as needed
Inspect and lubricate water transfer pumps on bearings	Weekly
Inspect ground water heat exchanger, rout flue tubes as necessary	Weekly
Inspect Megator oil/water separators	Weekly/as needed
Inspect particulate filters on UV/oxidation unit influent	Daily
Inspect air stripping blowers	Daily
Inspect air stripping tanks for abnormal conditions	Daily
Replace GAC on air stripping vapor stream	As needed
Inspect water condensate transfer tank on vapor extraction system	Daily
Inspect heat exchanger on vapor extraction system	Daily
Inspect demister cyclone	Daily
Inspect miscellaneous hoses, seals, fittings, valves, etc.	Weekly
Inspect and test eye wash station	Weekly
Test interlock control system	Monthly

B-4.3.2 Corrective Maintenance

Corrective maintenance is performed when a system component fails or is beginning to fail and the quality of facility operations could be compromised if operation continues. Root cause analyses are performed each time a component fails before the corrective maintenance action commences. This is to ensure that the nature of the problem is understood and can be prevented. This root cause analysis is also used to modify the preventive maintenance plan where appropriate. The results of the root cause analyses are documented in the daily facility operations log. As with preventive maintenance, corrective maintenance is performed by the Plant operations personnel or ERD in accordance with their maintenance procedures and QA/QC plan.

All corrective maintenance actions and their time of completion are recorded in the facility daily operations log. Once complete, the specific component or system is started up and operated. This ensures that the maintenance was correctly performed and that system quality is maintained. An entry in the facility log is made, indicating that an operational check was made following preventive or corrective maintenance and the performance of the system's new component is noted. If successful, the system is allowed to resume normal operations.

B-4.4. Drawing and Specification

The PEPM is responsible for preparing and updating complete drawing and specification lists. The lists shall include all drawings, specifications, and changes for Purchase Order (PO) contracts, labor only contracts, Job Orders, and Mechanical and Electronic Engineering Department drawings. This list will serve as the index for the QA print files and as the list of prints required in the QA files.

QA records to be filed as required in Table B-2:

(TFC/F-3-4a) A current and/or final copy of the drawing list.

(TFC/F-3-4b) A current and/or final copy of the specification list.

B-4.5. National Environmental Policy Act (NEPA)

The PEPM is responsible for assuring compliance with NEPA requirements. Completed documentation consists of LLNL Plant Engineering Form 1, NEPA Compliance Project Notification Form, and the NEPA Compliance Environmental Checklist. Memos to and from DOE, and Environmental Impact Studies, as applicable, are evidence of NEPA compliance.

QA records to be filed as required in Table B-2:

(TFC/F-3-6) NEPA Compliance Documents.

B-5. Procurement

B-5.1. Procurement Contracts

Preparation and approval of PO contracts, when necessary for the purchase of equipment or services needed for maintenance, shall comply with standard LLNL purchasing policies.

QA records to be filed as required in Table B-2:

(TFC/F-4-1) Copy of all material and equipment POs over $5,000.

B-5.2. Documents

The approval and control of procurement documents shall conform to LLNL Procurement Manual, Vol. II, Books 1, 2, and 4. The control and approval of maintenance construction drawings shall conform to LLNL Plant Engineering Drafting Manual, PEL-P-02065. Control, format, and approvals of specifications shall conform to Plant Engineering Standard PEL-P-02075 Specifications.

All drawings shall be approved for maintenance construction and have all applicable approval signatures before the bidding process, or, for LLNL construction, before the estimate process. Approvals of major changes to instructions, drawings, and specifications shall be the same as for the original issue.

Minor technical design changes made in the field shall be approved by the CM and the CI on the inspection print, and on the as-built drawings.

QA records to be filed (as required in Table B-2):

(TFC/F-6-1) One set of as-built prints for each project.

B-5.3. Control of Purchased Items and Services

Purchased items and services shall be controlled in accordance with standard LLNL Purchasing Policies. A Notice of Completion shall be prepared with all required LLNL signature approvals, and sent to the LLNL Procurement Department before contract close-out.

QA records to be filed (as required in Table B-2):

(TFC/F-7-1) Copy of the Notice of Completion for each project.

B-5.4. Handling, Storage, and Shipping

Items and materials shipped to LLNL shall be packaged, shipped, and stored according to instructions on drawings, specifications, contracts, and POs. The RE or OTL will perform a receiving inspection and/or the CI shall inspect incoming items and materials to identify any damage that may have occurred during shipping and storage.

Handling equipment, such as fork lifts and cranes, shall be operated, maintained, and tested in compliance with DOE and California State regulations. When LLNL equipment is used, compliance with the LLNL Health and Safety Manual is required.

Inspection reports are initiated and maintained per the CI's Policy and Procedures Manual. No additional QA records are required for the QA files.

B-5.5. Control of Nonconforming Items

The CI and CM shall maintain cognizance of salvage (rejected or damaged) materials and items (M&I), and arrange for segregation, and prompt disposition of LLNL supplied rejected M&I. The construction subcontractor shall be notified to immediately remove any rejected subcontractor supplied M&I from LLNL. Any nonconformance which cannot be immediately corrected and verified by the CI shall be documented on a Deficiency Notice or punch list as applicable. Nonconformances to be dispositioned as "use as is" or "repair" (as opposed to rework) must be recorded on a Deficiency Report, approved and signed by the CM.

Inspection reports are initiated and maintained per the CI's Policy and Procedures Manual. No additional QA records are required for the QA files.

B-6. Maintenance Support

B-6.1. Identification and Control of Items

Material delivered to the job site is inspected to verify compliance with the approved submittals to assure that only correct and accepted items are used or installed.

The CM will request identification and inspection of items arriving at the construction site, when required. Acceptance of M&I not in conformance with requirements shall be approved by the LSRSL and PEPE, and shall comply with the LLNL Procurement Manual.

Inspection reports are initiated and maintained per the CI's Policy and Procedures Manual. No additional QA records are required for the QA files.

B-6.2. Inspection, Test, and Operating Status

The CI and CM shall maintain cognizance of incoming and stored M&I, and inspect or test them for conformance to requirements. When the CI or CM is concerned with maintaining identification of the status of a shipment of critical M&I, they shall tag them to ensure that untested or rejected items are not inadvertently used.

Lockout tags shall be tied on electrical equipment, lifts and hoists, valves, etc., where such items are unsafe to use, are uncertified, or to protect personnel working on the system.

Inspection reports are initiated and maintained per the CI's Policy and Procedures Manual. No additional QA records are required for the QA files.

B-6.3. Control of Processes

Procedures for welding, bonding, and other processes shall be called out in specifications or drawings, as required.

When required in construction specifications, bonded joints, welding tests, and inspections, welder certifications shall be verified by the CM and the CI, as required.

QA records to be filed (as required in Table B-2):

(TFC/F-9-1) Welder certifications.

(TFC/F-9-2) Welding test reports.

(TFC/F-9-3) Cemented joints test reports.

B-6.4. Inspection

All maintenance work, and LLNL acceptances within the scope of this QA plan, including PO contract and labor only contract are subjected to inspection. Work shall be inspected and documented according to the "Construction Inspector's Policy and Procedures Manual" and the "Construction Manager Manual." The inspection team shall delay progress payments to the subcontractor if the work is not in place, or is not up to contract quality.

During construction of modifications, the CI shall maintain a set of as-built marked prints to compare with the subcontractor's prints, and shall review and approve the subcontractor's prints.

After construction, the CI shall verify the accuracy of the as-built drawings in accordance with the construction inspector's policy and procedures manual. The CI and PEPM shall indicate approval of the subcontractors marked up print by signing the as-built drawing.

QA records to be filed (as required in Table B-2):

(TFC/F-10-1) All inspection prints, with copies of field memos, change orders, calculations, and sketches attached.

(TFC/F-10-2) Final inspection report per Construction Manager Manual.

(TFC/F-10-3) Final acceptance report per Construction Manager Manual.

B-6.5. Control of Measuring and Test Equipment

Certified testing laboratory subcontractors shall periodically calibrate measuring and test equipment used for LLNL work according to the requirements in the contract and according to Federal and State codes.

B-7. Activation

B-7.1. Activation of Measuring and Testing Equipment

All measuring and test equipment (M&TE) used in acceptance testing of electronic, monitoring, and interlocks systems and items shall be calibrated in accordance with the applicable LLNL calibration manual or plan. The individual conducting the test shall be responsible for assuring that all test equipment is calibrated and within its certification period.

The two major calibration laboratories at LLNL are the Engineering Measurements & Analysis Section, Mechanical Engineering (ME), and the Instrument Services Group, Engineering Services Division, Electronic Engineering (EE). The ME facility typically calibrates M&TE that make pressure, force, displacement, flow, humidity, acceleration, velocity, or temperature measurements. The EE facility services and calibrates M&TE that measures frequency, time, and electrical and magnetic measurements.

Calibration of M&TE may be performed by LLNL calibration laboratories or by outside vendors providing calibration services. Vendors providing calibration shall be required to meet the requirements of MIL-STD-45662, where necessary.

No additional QA records are required in QA files, but such records are filed in the EE and ME calibration facilities.

B-8. Quality Assurance Records

B-8.1. Quality Assurance Records

QA records shall be prepared, archived, and made readily available as evidence that TFC and TFF were specified, designed, constructed, operated, and maintained to meet the quality goals of this QA plan. They shall be protected and maintained for a minimum of 6 months after completion of the project, prior to being microfilmed and archived for long-term storage.

The QA records specified by this plan do not include all the project records generated in the project. In addition to the QA records, there are microfilmed records maintained by LLNL Plant Engineering, and contract records maintained by the LLNL Procurement Department. Although these records are not defined as QA records, they are available for examination if required.

B-8.2. Filing Systems

QA records required by this plan shall be filed in lockable cabinets in the order given in Table B-2. Before filing, each record shall be numbered and titled according to Table B-2, and stamped with a black ink stamp:

QA RECORD

QA PLAN NO. X-XXX-XX

DATE:_________

A file drawer insert shall be set up and labeled for each file number, and each record shall be placed in a labeled folder or binder and kept in the QAM's office. QA records are not working files, and shall not be so utilized. If files are borrowed, a file checkout system shall be used to track record location and to ensure their prompt return.

B-8.3. Plant Engineering Records

In addition to the separate QA records file of this QA plan, the PEPM, PE, CM, and CI shall organize and maintain working engineering files for the project. These files are not QA records files; they are files normally kept when required for compliance or legal purposes. Records, as specified in the CM Manual and the Construction Inspector's Manual, shall be collected by the CM, CI, and the PEPE, and transmitted by the PEPM to the Standards and Documentation group of Plant Engineering for microfilming. These files shall be preserved for a period of not less than 6 years after project completion.

B-9. Audits

The PEPM shall arrange for periodic independent audits of the implementation of this QA plan.

QA records to be filed:

(TFC/F18-1) Audit requests and reports.

B-10. References

American Society of Mechanical Engineers (ASME), 1989, NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1-1989 edition.

MIL-STD-45662, "Calibration System Requirements."

PEL-01000, "Plant Engineering Policy and Operations Manual."

Appendix C

Operations and Maintenance Health and Safety Plan

Appendix C
Operations and Maintenance Health and Safety Plan

Section C-1 of this appendix is the O&M Health and Safety Plan (HSP) for TFC. The HSP for O&M of TFF is presented in Section C-2.

C-1. HSP for Ground Water Remediation at TFC

C-1.1. Reason for Issue

Safety procedures are required to operate and maintain the TFC air-stripping system, ion-exchange unit, and water filtering system. This HSP also serves as an administrative tool to summarize many of the requirements of the LLNL Health and Safety Manual which are pertinent to TFC's O&M. This HSP supplements the vendor's operating instruction manuals for the ion-exchange unit.

C-1.2. Work to be Done and Location of Activity

C-1.2.1.

TFC is located at Building U187, southwest of Trailer 1879 in northwestern LLNL.

C-1.2.2.

Ground water containing about 150 ppb total VOCs and 50 ppb chromium is to be extracted from extraction wells utilizing submersible pumps generating from 10 to 60 gpm output.

C-1.2.3.

The influent passes through two 5-micron filters that have differential pressure gauges across them in the range of 0 to 25 psi.

C-1.2.4.

Water passes through two air-stripping tanks in series, and acid is injected into the flow as needed to reduce the formation of precipitates.

C-1.2.5.

VOCs are removed from the water by injecting air into the bottom of the tanks and subjecting the water to intense aeration.

C-1.2.6.

The effluent passes through an ion-exchange unit to reduce the concentration of hexavalent chromium below the 11 ppb discharge limit (detection limit is 10 ppb).

C-1.2.7.

The vapors from each stripper tank pass through a demister pad to remove the water fraction. The air stream then passes through two GAC canisters placed in series that trap the VOCs.

C.1.2.8.

Treated ground water is discharged via a gravity drain to a north-flowing ditch that flows into Arroyo Las Positas.

C-1.3. Responsibilities

C-1.3.1.

Ed Folsom, phone number (510) 422-0389, LLNL pager number 02892, and home phone number (510) 490-7028 is responsible for the safety of this operation and for assuring that all work is performed in conformance with this HSP and applicable sections of the LLNL Health and Safety Manual and Environmental Protection Handbook. In the absence of the responsible individual, Sally Bahowick, phone number (510) 423-6773, LLNL pager number 05565, or Jerry Duarte, phone number (510) 423-2638, LLNL pager number 03180, shall assume these responsibilities.

C-1.3.2.

Any changes in operations that improve or do not significantly affect safety and environmental controls may be approved by the authorizing individuals in Section C-1.3.1. and the LLNL Environmental Safety & Health (ES&H) team leader. The responsible individual will ensure that this action is documented in a memorandum. Any changes in the operation that increase the hazard level, introduce additional hazards, or decrease safety shall not be made until a revision to this HSP has been reviewed and approved consistent with the review and approval process of the original HSP.

C-1.4. Hazard Analysis

C-1.4.1. Pressure Hazard

None is anticipated.

C-1.4.2. Chemical Hazard

Injury may occur from the ion-exchange unit to personnel exposed to the 1-2 Molar sodium chloride solution. Also, injury may occur from the pH adjustment unit to personnel exposed to the corrosive substances hydrochloric acid and sodium hydroxide.

C-1.4.3. Confined Space

Injury may occur while entering, working in, and leaving the Baker tanks and the treatment system stripping tanks.

C-1.4.4. Noise Hazard

Injury may occur if continued exposure to the aeration system's blowers exceeds 2 hours.

C-1.4.5. Electrical Hazard

Injury may occur if the ion-exchange unit panel door is open and contact is made with energized electrical components .

C-1.5. Hazard Control

C-1.5.1. Chemical Hazard Control

Corrosives are stored in doubly contained tanks in the ion-exchange unit. Facility operators will follow Health and Safety Manual Sections 21 and 21.05.

C-1.5.2. Confined Hazard Control

C-1.5.2.1.

Facility operators will follow Health and Safety Manual Section 26.14, Supplement 26.14, and will notify the responsible individual designated in Section C-1.3 of this HSP prior to entry into the confined space.

C-1.5.2.2.

Unauthorized access to the Baker tanks is controlled by removing the access ladder and securing the access with a chain and keyed lock. A key is stored in a lock box in Building U187. Unauthorized access to the polishing tank is accomplished by bolts and by attached equipment that require physical removal by two or more personnel.

C-1.5.2.3.

The stripping tanks will remain closed unless a facility operator with a second person is present to perform maintenance on the tanks.

C-1.5.3. Noise Hazard Control

C-1.5.3.1.

Noise protection is required in the aeration system blower room.

C-1.5.3.2.

The facility operator is required to follow noise safety precautions as outlined in the LLNL Health and Safety Manual, Section 10.08 and Supplement to 10.08.

C-1.5.4. Electrical Hazard Control

C-1.5.4.1.

An interlock system and panel doors with keyed locks prevent contact with energized electrical components. Keys to panel door locks are kept in a lock box in Building U187.

C-1.5.4.2.

All personnel will follow safety precautions as outlined in the Health and Safety Manual.

C-1.6. Environmental Concerns and Controls

C-1.6.1.

Concern: Discharge of untreated ground water.

Controls: Interlocks will shut off the flow and the system if physical damage to the treatment system occurs; scheduled sampling per discharge permit monitors discharge; and facility operator inspects the system daily.

C-1.7. Training

C-1.7.1.

Basic Facility Operators Courses:

- HS0039-SARA/OSHA Training (40-hour course with refreshers every year).
- HS0001-New Employee Safety Orientation.
- HS1620-Standard First Aid
- HS1640–CPR.
- HS5300-Back Care Workshop

C-1.7.2.

Facility Operator Courses:

- HS4150–Confined Space.
- HS4240–Chemical Safety.
- HS4360–Noise Safety.
- HS5220–Electrical Safety.
- HS5230–High Voltage Safety.
- HS0006–Hazardous Waste Handling Practices.

C-1.7.3.

Training courses identified in this section do not qualify a person to operate the treatment equipment and treatment systems located at Building U187. Only the responsible individual identified in Section C.1.3.1 of this HSP will determine if and when a person is qualified to operate the treatment facility at Building U187. Once qualified, each technician's personnel file is updated to reflect their status as a treatment facility operator.

C-1.8. Maintenance

Items requiring periodic maintenance do not impact the safety of the operation.

C-1.9. Quality Assurance

C-1.9.1.

Scheduled weekly, monthly, quarterly, and annual sampling of water at various parts in the system ensure compliance and quality.

C-1.10. Emergency Response Procedures

C-1.10.1.

In the event of an emergency, facility operations personnel will first dial 911 to report to the Emergency Dispatcher, then administer first aid if necessary to injured personnel. The Emergency Dispatcher uses reserved telephone lines to promptly relay the emergency call to the following members of the LLNL Emergency Response Team:

- Fire Department.
- Security Department.
- Hazards Control Safety Teams.

- Plant Engineering.
- Health Services.

The Emergency Response Team will go to the scene of the emergency immediately.

During off-shift hours, the phone numbers of individuals to be notified in the event of an emergency is posted at TFC. The LLNL Health and Safety Plan describes the emergency response procedures.

C-1.11. References

C-1.11.1.

Operating manual for the ion-exchange unit.

C-1.11.2. Health and Safety Manual Sections

1. LLNL General Policies and Responsibilities.
2. Work Planning and Safety Procedures.

10.08 Hearing Protection.

21. Chemicals.

21.04 Facilities and Equipment.

21.05 Handling Solid and Liquid Chemicals.

23.00 Electricity.

23.01 Introduction.

23.02 Biological Effects of Electrical Hazards.

23.03 Emergency Assistance and Rescue.

23.04 Personal Protective Equipment.

23.05 Design and Documentation Electrical Equipment.

23.06 Training Requirements for Electrical Work.

23.10 General Practices for Work on Electrical Equipment.

23.13 Work on Other Electrical Apparatus and Systems.

23.20 Clearances and Illumination for Electrical Enclosures.

23.21 Power Disconnect Points.

23.23 Extension Cords.

23.30 Portable Electric Tools and Equipment.

23.35 Power Supplies.

23.36 Microwave and Electromagnet Sources.

23.37 Electromagnets and Inductors.

23.38 Batteries.

23.39 Capacitors.

26.14 Working in Confined Spaces.

C-1.11.3. Health and Safety Manual Supplements

10.08 Noise–Its Measurements, Evaluation, and Control.

26.14 Working in Confined Spaces.

C-1.11.4. Environmental Protection Handbook

C-1.12. Reviewers

C-1.12.1.

Facility Supervisor.

Section Head or Group Leader.

Hazard Control Safety Team 4.

Individual assigned responsibility for safety.

Division/Department who authorized HSP.

Supervisor of matrixed technical personnel.

C-2. HSP for Ground Water Remediation at TFF

C-2.1. Reason for Issue

Safety procedures are required to operate and maintain the TFF ultraviolet light (UV) system, aeration system, and hydrogen peroxide (H_2O_2) delivery system. This HSP also serves as an administrative tool to summarize many of the requirements of LLNL Health and Safety Manual, which are pertinent to TFF's O&M. This HSP supplements the vendor's operating instruction manuals for the UV-LVB-60 treatment unit.

C-2.2. Work to be Done and Location of Activity

C-2.2.1.

TFF is located in the Gasoline Spill Area near Building 406 in southern LLNL.

C-2.2.2.

Ground water and vapors at temperatures up to 200°F from the subsurface will be extracted and treated. The concentration of gasoline in liquid or vapor phase can reach 100%. The TFF design is detailed on Plant Engineering drawing number PLM 92-406.

C-2.2.3.

The liquid stream will be extracted and treated with a multistage process at flows up to 100 gpm. The liquid (ground water with gasoline up to 100%) will be pumped from wells with a pneumatic, positive displacement pumps or centrifugal pumps. The liquid stream will be cooled to temperatures below 115°F using an air-cooled heat exchanger. Air in the liquid stream will be separated in a tank (air/water separator) and the air passed through GAC. Free product (100% gasoline) will be removed using an oil/water separator and stored in a 55-gal drum. Ground water after the separators is expected to contain a maximum of 15 ppm of gasoline. Particulate filters (5 micron) will remove silt from the ground water. A turbidity meter will monitor for break through of free product gasoline. The ground water will then be treated with a UV/H_2O_2 treatment system. The H_2O_2 (50%) is stored in a 300-gal doubly contained tank. The H_2O_2 is injected into ground water by a positive displacement pump to create a concentration of 50 to 200 ppm. The UV light disassociates the H_2O_2 in ground water into hydroxyl radicals. The high oxidation potential of the hydroxyl radicals allows oxidation of 99.8% of the remaining gasoline. Residual concentrations of 1,2-DCA and EDB remain due to incomplete oxidation of these saturated compounds. Air stripping of the remaining compounds will be accomplished by forcing 2,100 cfm of air through an air stripping tank. Effluent air from this tank will be passed through a GAC filter to remove FHCs and VOCs. The water will be transferred to a Baker tank(s) and then pumped to the LLNL cooling towers for use as make up water.

C-2.2.4.

The vapor stream of up to 4,000 cfm from the venting wells will be cooled to 80° to 90°F by a water-cooled condenser (heat-exchanger). A demister tank follows the condenser to separate water mist. Liquid water and gasoline, collected in a condensate tank, will be pumped to the water treatment system. Noncondensed air and vapors will be treated by a vapor extraction system (VES) with steam regeneration (specification ERD 91-0001). A blower extracts vapors at up to 425 cfm. The vapor stream passes through a GAC filter which absorbs the gasoline. When contaminant breakthrough of the GAC is monitored, the influent vapor is directed to a second GAC filter, while the first GAC filter is being steam regenerated. The steam is condensed and gasoline is separated and stored for recycle or disposal by the LLNL HWMD.

C-2.2.5.

Operation of TFF includes monitoring its status, maintaining and cleaning extraction and treatment equipment, and sampling liquid and vapor. Accumulated gasoline may be transferred to additional holding tanks and later removed by a gasoline recycling contractor or by HWMD. In the DUSDP, gasoline is mobilized in the subsurface by electrical resistance heating and injecting steam into the ground. Operations performed for the DUSDP are controlled by OSP L-52 (Ref. C-2.11.3).

C-2.2.6.

The hazardous materials and their maximum quantities at the facility at any given time are:

Material	Amount
Gasoline vapor	275 lb
Gasoline liquid (free product)	6,000 gal
Ground water containing gasoline in treatment facility	2,400 gal
Ground water containing gasoline in Baker tanks	40,000 gal (during startup testing only)
Hydrogen peroxide (50%)	300 gal
Natural gas	1 lb

C-2.3. Responsibilities

C-2.3.1.

Ed Folsom, phone number (510) 422-0389, LLNL pager number 02892, and home phone number (510) 490-7028, is responsible for the safety of this operation and for assuring that all work is performed in conformance with this HSP and applicable sections in the Health and Safety Manual and Environmental Protection Handbook. In the absence of Ed Folsom, Jerry Duarte, phone number (510) 423-2638, LLNL pager number 03180; Ben Johnson, phone number (510) 424-4451, LLNL pager number 05351; or Dennis White, phone number (510) 424-4451, LLNL pager number 05158, shall assume these responsibilities.

C-2.3.2.

Any changes in operations that improve or do not significantly affect safety and environmental controls may be approved by the authorizing individuals listed in Section C-2.3.1 and the ES&H Team Leader. The responsible individual will ensure that such actions are documented in a memorandum. Any changes in operations that increase the hazard level, introduce additional hazards, or decrease safety shall not be made until a revision of or supplement to this HSP has been reviewed and approved consistent with the review and approval process for the original HSP.

C-2.3.3.

Before starting operation, the responsible individual shall verify and document that the operating personnel have read and understand the HSP.

C-2.4. Hazards Analysis

C-2.4.1. Fire/Explosion Hazard

C-2.4.1.1.

Fire or explosion may occur if air with a concentration of gasoline or a component of gasoline within the explosive limits is in contact with an ignition source. This could result in serious injury or death to personnel and/or serious damage to equipment.

C-2.4.1.2.

The composition of gasoline in ground water influent to TFF is approximately as follows: benzene 10%, toluene 11%, ethylbenzene 5%, xylenes 23%, TCE 0.9%, 1,2-DCA 0.3%, EDB 0.06%, and other fuel hydrocarbons 50%. The composition of vapors in air will vary due to different rates of condensation/evaporation. A Lower Explosive Limit (LEL) of 1% and an Upper Explosive Limit of 8% generally are conservative limits for this suite of chemicals (NIOSH, 1990). The concentration of gasoline in air can be within these limits where free product is present, or if dissolved gasoline in ground water is high enough. A worst case assumption for vapor concentration in equilibrium with ground water is that total hydrocarbons are benzene, ethylbenzene, toluene, and/or xylene (BTEX) because these are the most volatile FHCs. For the BTEX vapor concentration to reach the LEL in a confined space, the required concentration in ground water is 120 ppm.

C-2.4.1.3.

Vapors in excess of the LEL may occur within the extraction wells; in the piping to the oil/water separators, including the ground water heat exchanger; and in the air/water separator. This condition may also occur within the condenser, demister, VES, condensate return tank, and piping from these components to the liquid treatment system. The oil/water separator and gasoline storage tank(s) may also contain flammable concentrations of gasoline vapor. The oil/water separator has a lid which must be opened to visually check for proper operation. Vapors are exposed to the atmosphere at this location only for treatment equipment. Operations outside of this HSP, such as the DUSDP process (Ref. C-2.11.3), may produce gasoline vapors in the vicinity of treatment equipment.

C-2.4.2. Chemical Hazards—Inhalation:

During maintenance operations, there is a potential for inhalation exposures to benzene, EDB, and gasoline component vapors. This may occur during maintenance operations on all components of the treatment facility. Gasoline recovered from the subsurface contains up to 10% benzene, an OSHA-regulated carcinogen due to its association with leukemia, as well as other blood disorders. The gasoline also contains 0.06% EDB, a CAL/OSHA regulated and National Toxicology Program listed nontarget organ specific carcinogen. Other components of gasoline may individually or collectively cause both acute and/or chronic central nervous system effects. Table C-1 presents the exposure limits for benzene, EDB, and gasoline.

Table C-1. Exposure limits for the primary constituents treated at TFF.

Substance	Permissible exposure limit	Short-Term exposure limit	Reference[a]
Benzene	1 $ppm_{v/v}$ 8-hr TWA	5 $ppm_{v/v}$ 15-min avg.	29 CFR 1910.1028
Ethylene dibromide	ALARA	ALARA	ACGIH
Gasoline	300 $ppm_{v/v}$ 8-hr TWA	500 $ppm_{v/v}$ 15-min avg.	ACGIH

[a]Per DOE Order 5480.4.
$ppm_{v/v}$ = parts per million on a volume per volume basis.
TWA = 8-hour time weighted average exposure.
ALARA = "As Low as Reasonably Achievable," per ACGIH Guidelines for Suspected Human Carcinogens.
ACGIH = American Conference of Governmental Industrial Hygienists.

C-2.4.3. Chemical Hazards—Dermal (Skin) Contact

C-2.4.3.1. Gasoline

Skin contact with gasoline components, as with other organic solvents, can remove essential oils from the skin, causing localized inflammation, cracking, and/or bacterial infections, referred to collectively as solvent dermatitis.

C-2.4.3.2. Hydrogen Peroxide

Hydrogen peroxide (50%) is a strong oxidizer. Burns will be produced upon contact with the liquid.

C-2.4.4. Thermal Exposure

System piping that conducts heat from steam flow can produce thermal burns if left uninsulated.

C-2.4.5. Confined Space Hazards

Injury may occur while entering, working in, and leaving Baker tanks. The two Baker tanks are open top and 12 feet high and can contain 20,000 gal each. Baker tanks may contain ground water containing gasoline during start up testing.

C-2.4.6. Noise Hazard

Injury may occur due to continuous exposure to operating fans and blowers.

C-2.4.7. Electrical Hazard

Injury may occur if the LVB-60 UV/H_2O_2 unit panel door is open and contact is made with energized electrical components.

C-2.4.8. Nonionizing Radiation

The LVB-60 unit contains a number of quartz-tube type UV lamps. UV radiation can cause skin burns and eye damage. Chronic exposures to certain wavelengths of UV light are associated with increases in skin cancer rates.

C-2.5. Hazard Control

The controls specified below will reduce risk to employees and the environment to acceptable levels.

C-2.5.1. Fire/Explosion Control

Fire/explosion control is accomplished by eliminating ignition sources in areas with potential gasoline vapor concentration between the LEL and the Upper Explosive Limit (UEL). Fire extinguishers (carbon dioxide or dry chemical, type BC or ABC) will be available on site.

C-2.5.1.1.

Only explosion proof or intrinsically safe equipment is to be used within the extraction wells, within the piping to the oil/water separators, including the ground water heat exchanger and air/water separator. Explosion proof or intrinsically safe equipment is also required within the condenser, demister, condensate return tank, and piping from these components to the liquid treatment system. Explosion proof or intrinsically safe equipment is also required within the oil/water separator and gasoline storage tank(s).

C-2.5.1.2.

The oil/water separator has a lid which must be opened to visually check for proper operation. Vapors are exposed to atmosphere at this location only for treatment equipment. The area within 3 horizontal feet of the oil/water separator or gasoline storage tank(s) is Class 1 Division 1 per National Electrical Code. The area within 3 to 10 horizontal feet of the oil/water separator or gasoline storage tank(s) is Class 1 Division 2 per National Electrical Code. Electrical equipment within these areas conforms to the appropriate requirements stated above.

C-2.5.1.3.

Operations outside of OSP No. L-52 (Ref. C-2.11.3) may produce gasoline vapors in the vicinity of treatment equipment. Monitoring with an approved LEL meter shall be conducted during any operation which may produce explosive concentrations of gasoline. If concentrations of 0.1 LEL (1,000 ppm) or greater are found, all operations will cease, the area shall be evacuated, and the fire department shall be phoned by dialing 911.

C-2.5.1.4.

Electrical design and construction of the VES (Ref. C-2.11.4) shall meet the general requirements of the National Fire Protection Association (NFPA)-70, and all electrical control devices shall comply with the National Electric Manufacturers Association (NEMA) ICS-2. Safety devices shall include improper-operation interlocks, overload relays, and circuit breaker disconnects. Fire protection system shall include hydrocarbon sensor for flammable vapors and automatic fire detection/suppression.

C-2.5.1.5.

Smoking shall not be permitted inside the controlled area. An adequate number of "NO SMOKING" signs shall be posted throughout the project area.

C-2.5.2. Chemical Hazards—Inhalation

C-2.5.2.1.

Warning signs with the following wording shall be placed on the perimeter fence so that they are clearly visible from any approach:

Danger
Benzene
Cancer Hazard
Flammable—No Smoking
Authorized Personnel Only
RESPIRATORS REQUIRED

The portion of the sign that reads "Respirator Required" shall be covered unless airborne benzene concentrations exceed the limits specified below.

C-2.5.2.2.

All maintenance operations shall be monitored to assess possible exposures, until sufficient replicate monitoring data are collected to permit the accurate characterization of potential exposures. Until exposures are fully characterized, all operations involving the opening of normally sealed separation and/or treatment equipment shall be performed following the procedures outlined in Section C-2.5.2.2.3.

C-2.5.2.2.1.

The LLNL Hazards Control ES&H Team 4 Industrial Hygienist shall be notified in advance of all routine or scheduled maintenance operations to permit the deployment of personal air sampling equipment. If exposure to benzene in excess of 5 $ppm_{v/v}$ measured as a 15-minute Time-Weighted Average (TWA), or 1 $ppm_{v/v}$ measured as an 8-hour TWA are detected, or if exposures to other chemical agents are detected in excess of their published Threshold Limit Values, the procedures outlined in Section C-2.5.2.2.3 shall be instituted.

C-2.5.2.2.2.

Unless otherwise instructed by Hazards Control ES&H Team 4, site personnel shall conduct breathing zone monitoring during all maintenance operations, both routine and emergency, using a photoionization detector (PID) equipped Organic Vapor Meter (OVM). The OVM does not provide chemical-specific measurements; however, all measurements made will be treated as if the equivalent levels of benzene were present (i.e., the "worst case" exposure scenario will be used). When equipped with a 10.0 electron volt (eV) lamp, the OVM should either be (a) calibrated to directly read benzene concentrations or (b) set with an instrument response factor of 0.7. For other lamps, the instrument must be calibrated to directly read benzene concentrations. When benzene exposures exceed 5 ppm for a period of one minute, the operation shall be suspended, Hazards Control ES&H Team 4 shall be notified immediately, and the controls specified in Section C-2.5.2.2.3 will be instituted.

C-2.5.2.2.3. Respiratory Protection

C-2.5.2.2.3.1.

All personnel working within the regulated work area shall don appropriately fitted full-facepiece respirators equipped with organic vapor cartridges, and disposable (Tyvek) coveralls.

C-2.5.2.2.3.2.

The "Respirators Required" portion of the benzene warning signs posted at each entrance to the regulated work area shall be uncovered.

C-2.5.3. Chemical Hazards—Dermal (Skin) Contact

Eye wash/shower stations shall be available within 10 seconds and 100 ft of travel for all areas where chemical splash may occur. Personnel shall be instructed to orient themselves relative to the nearest eyewash/shower station prior to performing maintenance work. A first-aid kit shall be available onsite.

C-2.5.3.1. Gasoline

C-2.5.3.1.1.

When the possibility of skin contact with pure gasoline (free product) occurs, personnel shall wear safety glasses, full face shields, Tyvek coveralls, and neoprene or nitrile (Buna-N) gloves.

C-2.5.3.1.2.

When the possibility contact with ground water containing gasoline occurs, personnel shall wear exam weight polyvinyl chloride or latex gloves and safety glasses. If systems being worked on are pressurized, faceshields shall be worn as a supplement to the safety glasses.

C-2.5.3.2. Hydrogen Peroxide

When the possibility of skin contact with 50% H_2O_2 occurs, personnel shall wear safety glasses, a faceshield, neoprene or nitrile gloves, and Tyvek coveralls or a plastic apron. A copy of the Material Safety Data Sheet (MSDS) for the H_2O_2 used shall be available onsite at all times.

C-2.5.4. Thermal Exposure Control

All exposed system components capable of producing burns shall be insulated. If insulation of some components is not practical, and requires handling or can be contacted inadvertently, proper protective equipment such as heat-insulating gloves shall be worn.

C-2.5.5. Confined Space Control

C-2.5.5.1.

Entries into confined spaces shall be performed in compliance with Health and Safety Manual Supplement 26.14 and ANSI Standard Z-117.1-1989. In advance of any entries into confined spaces, Hazards Control ES&H Team 4 shall be consulted to determine the procedures required. Depending on the space being entered and the history of contamination, the space may be classified as either an ANSI Non-Permit Confined Space (LLNL equivalent "Low Hazard Confined Space"), or an ANSI Permit Required Confined Space (LLNL equivalent "High-Hazard Confined Space"). In either case, a Confined Space Entry Permit shall be obtained from the area Health and Safety Technologist immediately prior to any confined space entry.

C-2.5.5.2.

Ladders are removed from Baker tanks and secured with a chain and keyed lock. A key is stored in a lock box in Building 406.

C-2.5.6. Noise Control

During the initial operation of TFF, Hazards Control ES&H Team 4 shall be contacted to arrange for a baseline noise survey. If 8-hour TWA noise exposures are projected to approach or exceed 85 dB(A), the following shall be enforced:

C-2.5.6.1.

Entrance to the area shall be posted with "Noise Hazard" warning signs.

C-2.5.6.2.

LLNL personnel shall be enrolled in the LLNL Hearing Conservation Program.

C-2.5.6.3.

Supplemental labor providers with personnel working within the facility shall be advised to enroll their employees in their company's Hearing Conservation Program.

C-2.5.6.4.

Other subcontractors shall be notified of the presence of potentially hazardous noise levels and advised to enroll employees in the company's Hearing Conservation Program.

C-2.5.6.5.

All employees within the facility shall receive Hazards Control course HS-4360—"Noise."

C-2.5.6.6.

All employees shall wear hearing protection when working within the hazardous noise area.

C-2.5.7. Electrical Hazard Control

Interlock system and panel doors with keyed locks prevent contact with energized electrical components. Keys to panel door locks are kept in a lock box at Building 406. If maintenance or use of equipment requires entry into areas of exposed wiring, general lock and tag procedures outlined in Health and Safety Manual Supplement 26.13—"General Lockout and Tagout Procedures" shall be followed.

C-2.5.8. UV Exposure Control

The UV lamps in the LVB-60 unit are completely enclosed, precluding UV light exposures from occurring during normal equipment operations. The interlocks which prevent the unit from operating while open, combined with the Electrical Hazard Control measures outlined in Section C-2.5.7, will prevent UV exposure during maintenance operations.

C-2.6. Environmental Concerns and Controls

C-2.6.1.

Release of gasoline, or ground water containing gasoline, to the ground is an environmental concern. All treatment system piping is above ground. Operations personnel shall monitor the equipment and piping and shut down the facility if a leak should occur.

C-2.6.2. Release of Water Containing Gasoline to Cooling Towers

TFF is equipped with interlocks that shut down the system, including pumps, upon failure of the oil/water separator, high water temperature, failure of LVB-60, blower failure, and failure of the air supply pipe to the air stripper. Concentration of total toxic organics (TTO) to the cooling towers is less than 5 ppb. Approximately 95% of the water sent to the cooling towers is evaporated. The remaining 5% is blown down to sanitary sewer. The Livermore Water Reclamation Plant (LWRP or sanitary sewer) allows this discharge. The TTO discharge limit for the LWRP is 1,000 ppb (refer to Appendix A).

C-2.6.3. Release of Gasoline Vapors to the Atmosphere

The air permit (Bay Area Air Quality Management District Permit No. 1464) for the Gasoline Spill Area has been amended to include TFF equipment described in this document . Following UV/H_2O_2 treatment of the influent water, any remaining FHCs or VOCs will be stripped from the water and adsorbed onto GAC. GAC is also used to treat vapors from the air/water separator, gasoline storage tank, and the transfer tank to prevent release to the atmosphere.

C-2.7. Training

C-2.7.1.

All authorized operators shall have completed the following safety courses:

- HS-0001—New Employee Safety Orientation.
- HS-0039—SARA/OSHA Training (40-hour course with 8-hour refreshers every year).
- HS-1620—Standard First Aid.
- HS-1640—Cardiopulmonary Resuscitation (CPR) repeated every 2 years.
- HS-4610 and HS-4611 before respirators are used.
- HS-4660 for personnel acting as respirator custodians.
- HS-4360— "Noise" if 8-hour TWA noise exposures exceed 85 dB(A).

C-2.7.2.

All personnel (LLNL and contract) who generate or handle hazardous waste shall attend the following Environmental Protection Department courses within 6 months of being newly hired and annually thereafter:

- EP-0006—Hazardous Waste Handling Practices (with refresher EP-0006R each year).
- EP-0056—Waste Certification.

C-2.7.3.

All personnel shall attend a prestart safety meeting to review the operation and the requirements of this HSP. If necessary, this safety meeting will be expanded to provide some of the training required in C-2.7.1, above.

C-2.7.4.

The following courses are recommended. Individual courses shall be required as the responsible individual determines necessary. Reading individual references (Section C-2.11) shall be required as the responsible individual determines necessary.

- HS-1680—Fire Extinguisher Training.
- HS-4050—Health Hazards Communication.
- HS-4150—Confined Space Entry.
- HS-4240—Chemical Safety.
- HS-5030—Pressure Safety Orientation.
- HS-5210—Capacitor Safety Orientation.
- HS-5220—Electrical Hazards Awareness.
- HS-5230—High Voltage Safety.
- HS-5300—Back Care Workshop.
- HS-6010—Radiation Safety.

C-2.7.5.

The responsible individual shall ensure that all required training, including on-the-job training if applicable, is complete and documented.

C-2.8. Maintenance

Items requiring periodic maintenance do not impact the safety of the operation. Routine maintenance will prevent silt from settling in the oil/water separator. Replacing the 5 micron particulate filter, cleaning and monitoring the LVB-60 UV/H_2O_2 unit, and cleaning the air to water ports in the air stripper will prevent clogging and backup of the facility. These items will be monitored and maintained as necessary.

C-2.9. Quality Assurance

Scheduled weekly, monthly, quarterly, and annual sampling and analysis ensure compliance and quality. These data will be analyzed by the Remediation Engineer to monitor performance and verify compliance with permits.

C-2.10. Emergency Response Procedures

C-2.10.1.

In case of fire or imminent threat to health and safety, phone the Fire Department at 911.

C-2.10.2.

When in doubt about handling a spill, phone the Fire Department at 911. Small spills may be cleaned up by operators if:

- Identity of spilled material is known.
- Material is commonly handled by the operators and operators are familiar with its hazards.
- Spill will take two people less than one hour to clean up.

C-2.10.3.

The Hazards Control Health and Safety Technician shall be notified of all spills.

C-2.11. References

C-2.11.1. Health and Safety Manual Sections

1. General Policies and Responsibilities.

10. Personal Protective Equipment.

21. Chemicals.

25. Fire.

26.14. Working in Confined Spaces.

32. Pressure.

ANSI Standard Section Z 117.1-1989.

C-2.11.2. Health and Safety Manual Supplements

10.08. Noise, Its Measurement, Evaluation and Control.

21.16. Safe Handling of Carcinogenic Substances.

26.14. Working in Confined Spaces.

C-2.11.3. OSP No. L-52 "Clean Up of Ground Water Contaminated With Gasoline by Using the Dynamic Underground Stripping Process"

C-2.11.4. ERD91-0001 "Vapor Extraction System With Carbon Regeneration"

C-2.11.5. "Operating and Maintenance Manual, Perox-Pure Oxidation System," LVB-60, Peroxidation Systems, Inc.

C-2.11.6. 29 CFR 1910.1028

C-2.11.7. Environment Protection Handbook

C-2.11.8 NIOSH, Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services, June 1990

C-2.12. Reviewers

C-2.12.1.

Facility Supervisor.

Section Head or Group Leader.

Hazard Control Safety Team.

Individuals assigned responsibility for safety.

Division/Department who authorized HSP.

Supervisor of matrixed technical personnel.

Appendix D

TFC and TFF Sampling Procedures

Appendix D

TFC and TFF Sampling Procedures

Section D-1 of this appendix is the TFC sampling plan and Section D-2 is the TFF sampling plan.

D-1. Treatment Facility C Sampling Plan

Water samples will be collected prior to and following treatment, and prior to discharge to the drainage ditch. Samples will be collected according to the schedule outlined in WDR Order No. 91-091 (NPDES Permit No. CA0029289) and presented in Table 15 of this report. Prior to collecting a sample, the office preparation procedures described in SOP No. 2.6— "Sampling for Volatile Organic Compounds" and SOP No. 4.2— "Sample Control and Documentation" will be followed (Rice *et al.*, 1990).

Samples will be collected from the designated sampling stations shown on Figure 8. The influent, effluent, and receiving water samples will be collected by opening the valve at the sampling port and allowing water to flow through it for about 15 seconds A bottle will be introduced into the flow stream and filled. If the bottle is not certified clean, it will be rinsed first with the water to be sampled. For the influent sample, the untreated water flowing through the valve prior to and during sampling will be captured with a bucket and returned to the system for treatment.

Depending on the analysis (see Table 15), a specific sample container is necessary. In addition, some analyses require that the sample be preserved. Such requirements for each analysis are described in SOP No. 4.3— "Sample Containers and Preservation." Samples are then packaged and shipped to a certified analytical laboratory according to SOP No. 4.4— "Guide to the Handling, Packaging, and Shipping of Samples."

Results of the treatment facility sampling are discussed in the self-monitoring section of the Ground Water Project Monthly Progress reports.

D-2. Treatment Facility F Sampling Plan

Water samples are collected prior to and following treatment. Samples are collected according to the schedule outlined in the City of Livermore ground water discharge permit No. 1508G and presented in Table 16 of this report. Prior to collecting a sample, the office preparation procedures described in SOP No. 2.6— "Sampling for Volatile Organic Compounds" and SOP No. 4.2— "Sample Control and Documentation" is followed (Rice *et al.*, 1990).

Samples are collected from the designated sampling stations shown on Figure 9. The influent and effluent samples are collected by opening the valve at the sampling port and allowing water to flow through it for about 15 seconds A bottle is introduced into the flow stream and filled. If the bottle is not certified clean, it is rinsed first with the water to be sampled. For the influent sample, the untreated water flowing through the valve prior to and during sampling is captured with a bucket and returned to the system for treatment.

Depending on the analysis (see Table 16), a specific sample container is necessary. In addition, some analyses require that the sample is preserved. Such requirements for each analysis are described in SOP No. 4.3— "Sample Containers and Preservation." Samples are then packaged and shipped to a certified analytical laboratory according to SOP No. 4.4— "Guide to the Handling, Packaging, and Shipping of Samples."

Vapor samples are collected at the TFF soil vapor extraction trailer prior to and following treatment. Vapor samples are also collected for the TFF ground water treatment system from the aeration tank effluent before and after vapor-phase granular activated carbon (GAC) treatment.

Vapor samples are collected in 0.5-L stainless steel gas sampling spheres. The spheres have two valved ports, one on each side. One port is connected to the sampling port on the pipeline to be sampled, and the other to a 0.125-horsepower, 0.25 cfm vacuum pump exhausted to the atmosphere. Because the vacuum pump is positioned downstream from the sample container, it cannot chemically alter the vapor sample.

To draw the sample, all three ports are opened (the sample port and both ports on the sampling sphere) and the vacuum pump is operated long enough to purge several sampling-sphere volumes (3 to 4 L are purged in 15 seconds). The pump is then turned off, the ports are quickly closed, and the sample is shipped to a State-certified analytic laboratory according to SOP No. 4.4- "Guide to the Handling, Packaging, and Shipping of Samples."

Results of the treatment facility sampling are discussed in the self-monitoring section of the Ground Water Project Monthly Progress reports.