SLAC-R-486

1995 Site Environmental Report
January—December 1995

ENVIRONMENT, SAFETY,
AND
HEALTH DIVISION

SLAC-Report-486
September 1996

Prepared for the Department of Energy
under contract number DE-AC03-76SF00515

STANFORD LINEAR ACCELERATOR CENTER
Stanford University Stanford, California

Table of Contents

[This page intentionally left blank.]

Figures

[This page intentionally left blank.]

Tables

Appendices

[This page intentionally left blank.]

1 Executive Summary

This report provides information about environmental programs and compliance with environmental regulations in calendar year 1995 (CY95) at the Stanford Linear Accelerator Center (SLAC). SLAC is a national laboratory operated by Stanford University under contract with the US Department of Energy (DOE) and is devoted to experimental and theoretical research in elementary particle physics, in basic sciences using synchrotron radiation, and in accelerator physics and technology.

SLAC's Environment, Safety, and Health (ES&H) Division consists of five departments and a Program Planning Office (PPO). Their shared goal is to help ensure that SLAC operates in compliance with federal, state, and local regulations, as well as DOE Orders related to environment, safety, and health. The five departments are:

- Environmental Protection and Restoration (EPR)
- Operational Health Physics (OHP)
- Radiation Physics (RP)
- Safety, Health, and Assurance (SHA)
- Waste Management (WM)

The EPR Department oversees the majority of SLAC's environmental programs, including programs for environmental restoration; waste minimization; air quality; storm water and industrial wastewater; polychlorinated biphenyls (PCBs); and groundwater. The WM Department coordinates disposal of hazardous, radioactive, and mixed waste. The OHP Department, in cooperation with the EPR Department, oversees environmental radiological monitoring and dosimetry at SLAC. The SHA Department oversees quality assurance for SLAC's environmental activities. The RP Department conducts beam checkouts of new experiments to ensure shielding adequacy for the protection of the workers and members of the general public.

The most significant information in this report is summarized briefly in the following sections.

1.1 Releases

In CY95, as in CY94, there were no known releases of radioactive material by SLAC to the environment in excess of DOE or regulatory limits. In addition, there were no reportable releases of hazardous material by SLAC to the environment.

1.2 Environmental Restoration

SLAC's Environmental Restoration Program (ERP) performed removal actions, further developed program documents, and continued active participation in various public participation activities. Removal actions were completed at several locations to remediate contamination resulting from historical use of PCB-containing transformers.

The ERP prepared the *IR-6 Drainage Channel: Engineering Evaluation and Cost Analysis* (EECA) to obtain approval from the Regional Water Quality Control Board (RWQCB) for the subsequent removal of PCB-contaminated sediments in the unlined Interaction Region 6 (IR-6) drainage channel. In addition, PCB-contaminated sediments were removed from the Storm Drain Catch Basin System which drains into the IR-6 drainage channel.

Program guidance documents used in these removals included the *Quality Assurance Project Plan,* and the *Standard Operating Procedures.* ERP also completed the following final reports in CY95, summarizing removal actions completed in CY94:

- *Interim Removal Action (IRA) for the 3.0 Megawatt Power Supply Area*
- *IRA Report for Substations 502, 510, and 009*
- *IRA Report for the IR8 Power Supply Area*

1.3 Hazardous and Radioactive Waste

The Radioactive Waste Management Group of the WM Department manages the low-level activated metals that are the primary source of radioactive waste at SLAC. The metal comes in the form of beam line components that are managed as radioactive material. In the early 1990's, SLAC changed the designation of some of the accumulated radioactive material into radioactive waste. The program for the management of radioactive waste is being revised by WM in CY96 to meet disposal criteria for sites regulated by the DOE.

In CY95, SLAC combined the Hazardous and Radioactive Waste Management Groups into the WM Department. The department has hired a Technical Writer to aid in the development and revision of documents, and an Administrative Associate for data entry and clerical functions.

SLAC complied with all waste management requirements for the disposal of hazardous waste in CY95 as required under federal, state and local regulations. During CY95, all hazardous waste for off-site disposal was successfully shipped from SLAC within 90 days of generation. SLAC also continued to improve its computerized hazardous waste tracking system, which was developed in CY91.

1.4 Air Quality

SLAC did not exceed permit limits in CY95 for the 32 air pollution sources that are listed with the Bay Area Air Quality Management District (BAAQMD). During CY95, the BAAQMD did not inspect SLAC. Also during CY95, SLAC formed an interdepartmental committee to evaluate alternatives to Ozone-Depleting Substances (ODSs). ODSs are being phased out per the requirements of the Montreal Protocol and Executive Order #12843. Alternative solvents and cleaning methods (such as a closed system vapor degreaser using non-ODSs) are being implemented.

1.5 Storm Water and Industrial Wastewater

SLAC implemented the Storm Water Monitoring Program in January 1993 to comply with its California General Industrial Storm Water Permit. Monitoring results show that some chemical constituents are slightly above Basin Plan Objectives (BPO), but within normal ranges for urban and industrial areas. Overall, SLAC does not contribute significant pollution to its storm water. Best Management Practices (BMPs) will be developed to address those constituents found to be above BPO levels.

SLAC is currently addressing issues identified in a letter from the RWQCB (March 21, 1995) regarding deficiencies in SLAC's Storm Water Program. The RWQCB has not yet indicated that further action is required by SLAC beyond the initial response, which included both a timeline for mitigation of illicit connections and descriptions of projects to address the deficiencies.

SLAC completed a draft of the Storm Water Pollution Prevention Plan (SWPPP) and initiated a pilot program to assess pollutant loading in selected catch basins. The monitoring data collected at the Rinse Water Treatment Plant (RWTP) and the Flow Meter Station (FMS) confirm SLAC's compliance with mandatory wastewater discharge permits for CY95.

1.6 Polychlorinated Biphenyls (PCBs)

The Toxic Substances Control Act (TSCA) regulates equipment that is filled with oil or other dielectric fluids containing PCBs. SLAC has some equipment that falls into this category. In CY95, SLAC significantly reduced its inventory of PCBs by disposing of the majority of its PCB capacitors (large and small) as well as other PCB-containing equipment. The three PCB transformers remaining in SLAC's inventory and the three PCB-contaminated transformers were effectively retro-flushed. This allowed reclassification to lower categories. SLAC is planning to remove, or retrofill and reclassify, the remaining 14 PCB-contaminated transformers over the next few years.

1.7 Assessments

SLAC has participated actively in DOE initiatives to identify a set of "Necessary and Sufficient ES&H Standards" and to develop performance measures that will serve as the principal means of measuring contract performance. These areas were the subject of developmental effort in CY95 and will be implemented in CY96.

Progress continued in CY95 toward completing the corrective actions developed in response to the 1991 Tiger Team assessment and subsequent appraisals. There were no environmental functional appraisals performed by DOE at SLAC in CY95.

SLAC's self-assessment program continues to provide for ongoing assessment by the line organizations and SLAC's internal independent auditing organization of environmental performance. Assessments in CY95, which focused on water quality and hazardous waste management practices, revealed no significant problems.

1.8 Environmental Radiological Program

SLAC monitors potential radiological releases to the environment through wastewater, air emissions, and direct radiation from accelerator operations. SLAC did not exceed regulatory limits for radioactivity released to the environment in CY95. In addition, there were no known instances of noncompliance for radionuclide air emissions in CY95.

1.9 Groundwater

The Groundwater Protection Management Program (GPMP) describes the comprehensive program in place for groundwater protection at SLAC. The GPMP is managed through EPR. Quarterly groundwater monitoring data were collected from the two networks of groundwater monitoring wells at SLAC. The results of monitoring for organic contaminants in groundwater in CY95 were similar to the results from CY94.

The increasing trend noted in CY93 in Well MW-24 of levels of total trichloroethene (TCE) and 1,2-dichloroethane (DCA) had stabilized or decreased in CY95. This area will be further characterized during the Remedial Investigation/Feasibility Study (RI/FS) as described in the Environmental Restoration section of this report.

2 Introduction

2.1 General

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the Department of Energy (DOE). SLAC is located on the San Francisco Peninsula, about halfway between San Francisco and San Jose, California (see Figure 2-1). The site area is in a belt of low rolling foothills, lying between the alluvial plain bordering San Francisco Bay on the east and the Santa Cruz Mountains on the west. The accelerator site varies in elevation from 53 to 114 meters (m) above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 m above sea level; the mountains to the west rise abruptly to over 610 m (see Figure 2-2).

The SLAC site occupies 170 hectares of land owned by Stanford University and leased in 1962 to the DOE (then the AEC) for fifty years for purposes of research in the basic properties of matter. The land is part of Stanford's "academic reserve," and is located west of the University and the City of Palo Alto, in an unincorporated portion of San Mateo County. The site is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek. The laboratory is located on a roughly 300 m-wide parcel, 3.2 kilometers (km) long, running in an east-west direction. The parcel widens to about 910 m at the target (east) end to allow space for buildings and experimental facilities (see Figure 2-3).

The SLAC population currently numbers about 1,350 people, 150 of which are Ph.D. physicists. At any given time there are between 900 and 1,000 users, or visiting scientists. Approximately 800 staff members are professional, composed of physicists, engineers, programmers, administrative associates, and other scientific-related personnel. The balance of the staff is composed of support personnel including technicians, crafts personnel, laboratory assistants, and clerical and administrative employees.

2.2 Description of Program

The SLAC program centers around experimental and theoretical research in elementary particle physics using accelerated electron beams and a broad program of research in atomic and solid state physics, chemistry, and biology using synchrotron radiation from accelerated electron beams. There is also an active program in the development of accelerators, detectors, and new sources and instrumentation for synchrotron radiation research.

The main instrument of research is the 3.2 km linear accelerator (linac) that generates high intensity beams of electrons and positrons up to 50 GeV, which are amongst the highest energy electron and positron beams available in the world. The linac is also used for injecting electrons and positrons into colliding beam storage rings for particle physics research.

The Positron-Electron Project (PEP) storage ring is about 800 meters in diameter. The PEP program was completed several years ago. PEP is now being upgraded to serve as an Asymmetric B Factory (or PEP-II) that will study the b meson. PEP-II will make use of much of PEP's existing equipment and infrastructure, and is scheduled for completion in 1998.

A smaller storage ring, the Stanford Positron Electron Asymmetric Ring (SPEAR) has its own smaller linac and a booster ring for injecting accelerated beams of electrons. SPEAR is fully dedicated to synchrotron radiation research. The synchrotron light generated by the SPEAR storage ring is used by the Stanford Synchrotron Radiation Laboratory (SSRL) to perform experiments.

Scientists from all parts of the United States and from throughout the world participate in the experimental programs at SLAC.

2.3 Local Climate

The climate in the SLAC area is Mediterranean. Winters are cool and moist, and summers are mostly warm and dry. Long-term weather data describing conditions in the area have been assembled from official and unofficial weather records at Palo Alto Fire Station Number 3 which is 4.8 km east of SLAC. The SLAC site is 60 to 120 m higher than the Palo Alto Station and is free of the moderating influence of the city; temperatures therefore average about two degrees lower than those in Palo Alto. Daily mean temperatures are seldom below zero degrees Centigrade or above 30 degrees Centigrade.

Rainfall averages about 560 millimeters (mm) per year. The distribution of precipitation is highly seasonal. About 75% of the precipitation including most of the major storms occurs during the four-month period from December through March. Most winter storm periods are from two days to as much as a week in duration. The storm centers are usually characterized by relatively heavy rainfall and high winds. The combination of topography and air movement produces short fluctuations in intensity, which can best be characterized as a series of storm cells following one another so as to produce heavy precipitation for periods of five to fifteen minutes with lulls in between.

2.4 Site Geology

The SLAC site is underlain by sandstone with some basalt at the far eastern end of the site boundary. In general, the bedrock on which the western half of the SLAC linac rests is of Eocene age (over 50 million years old), and that under the eastern half is of Miocene age (over ten million years old). On top of this bedrock at various places along the accelerator alignment are found alluvial deposits of sand and gravel, generally of Pleistocene age (one million years old). At the surface is a soil overburden of non-consolidated earth material averaging from 0.1 to 1.5 m in depth.

2.5 Site Water Usage

Use of water by SLAC is about equally divided between accelerator and equipment cooling, and domestic uses (such as landscape irrigation, sanitary sewer and drinking water). The average water consumption by SLAC is about 2.09×10^5 gallons per day (7.92×10^5 liters per day). Since half of the water is necessary for machine cooling, the daily consumption of this component of water usage varies directly with the accelerator running schedule, and hence also varies directly with electric power demand (the domestic water usage is relatively constant and is insensitive to the accelerator schedule).

The relationship between power and water consumption can be appreciated if one considers that 85% of the power used in linac operation is finally dissipated by water evaporation, in the ratio of about 630 kilowatt-hours (kWh) per cubic meter of water. SLAC now employs six cooling-water towers comprising a total cooling capacity of 79 mega watts (MW) to dissipate the heat generated by the linac and other experimental apparatuses.

Power-consuming devices are directly cooled by a recycling closed-loop system of low conductivity water (LCW). The LCW is piped from the accelerator (or other devices to be cooled) to the cooling towers, where the heat is exchanged from the closed system to the domestic water in the towers. Prior to discharge, the LCW from the closed system is sampled and analyzed. A portion of the tower water is ultimately evaporated into the atmosphere. Because of this constant evaporation during operation, the mineral content of the remaining water gradually increases and eventually must be discarded as "blowdown" water. SLAC discharged a total of 12,744,233 gallons of wastewater to the sanitary sewer system in 1995, an average of 34,916 gallons per day.

The SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPMWD) whose source is the City of San Francisco-operated Hetch Hetchy aqueduct system from reservoirs in the Sierra Nevada. SLAC and the neighboring Sharon Heights development, including the shopping center, receive water service from a separate independent system (called Zone 3) within the MPMWD. This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7,600 cubic meter reservoir west of Sand Hill Road. The Zone 3 system was constructed in 1962 under special agreements between the City of Menlo Park, the developer of Sharon Heights, Stanford University, and the DOE. Since the cost of construction, including reservoir, pump station, and transmission lines, was shared among the various parties; each party has a vested interest in, and is entitled to, certain capacity rights in accordance with these agreements.

2.6 Land Use

San Mateo County has the ultimate planning responsibility with respect to University lands that are within the county, but not within an incorporated city. The San Mateo County General Plan is the primary land use regulatory tool with respect to such lands. Adherence will be made to all applicable federal, state, and local regulations, including chemical and sanitary discharges that might (directly or indirectly) adversely affect environmental quality.

The Board of Trustees of Stanford University is responsible for preserving and protecting Stanford's land endowment for the use of present and future generations of students and faculty. While financial and political influences on land-use policy are taken into account, the dominant and prevailing consideration is the appropriateness of those policies in the furtherance of the University's academic mission. Board policies are designed to encourage land uses consistent with the institutional characteristics and purposes of Stanford, and to discourage those uses or claims which do not relate to or support the mainstream activities of the University. SLAC falls into the former category.

The purpose of the Stanford land endowment is to provide adequate land for facilities and space for the instructional and research activities of the University. The use of lands is planned in a manner consistent with the characteristics of Stanford as a residential teaching and research university, and provides flexibility for unanticipated changes in academic needs. Cooperation with adjoining communities is important and the concerns of neighboring jurisdictions are considered in the planning process.

2.7 Demography

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single family housing, and pasture. SLAC is mainly surrounded by 5 communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population and housing unit data from the most recent census (1990) of these five communities are shown in Table 2-1.

Table 2-1 Demographic Data

Geographic Area	Population (persons)	Pop. Density (per sq mile)	Housing (units)	Land Area (sq mile)
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6,569.14	4,770	2.755
Total	38,448	NA	12,556	29.105

A population estimate within 80 km of SLAC was determined as part of the required input to the CAP88-PC computer code used to demonstrate compliance with the Clean Air Act (CAA). Population data from the 1990 census of San Mateo County and Santa Clara County were used in this study. The area was divided into 13 concentric circles and 16 compass sectors. The population distribution is summarized in Table 2-2.

Table 2-2 Radial Population Data for CAP88-PC

0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	8.0 km	10.0 km	30.0 km	40.0 km	60.0 km	80.0 km	Total
0	0	1,214	2,825	14,106	31,679	42,832	131, 629	114,377	665,574	1,232,353	1,716,571	964,283	4,917,443

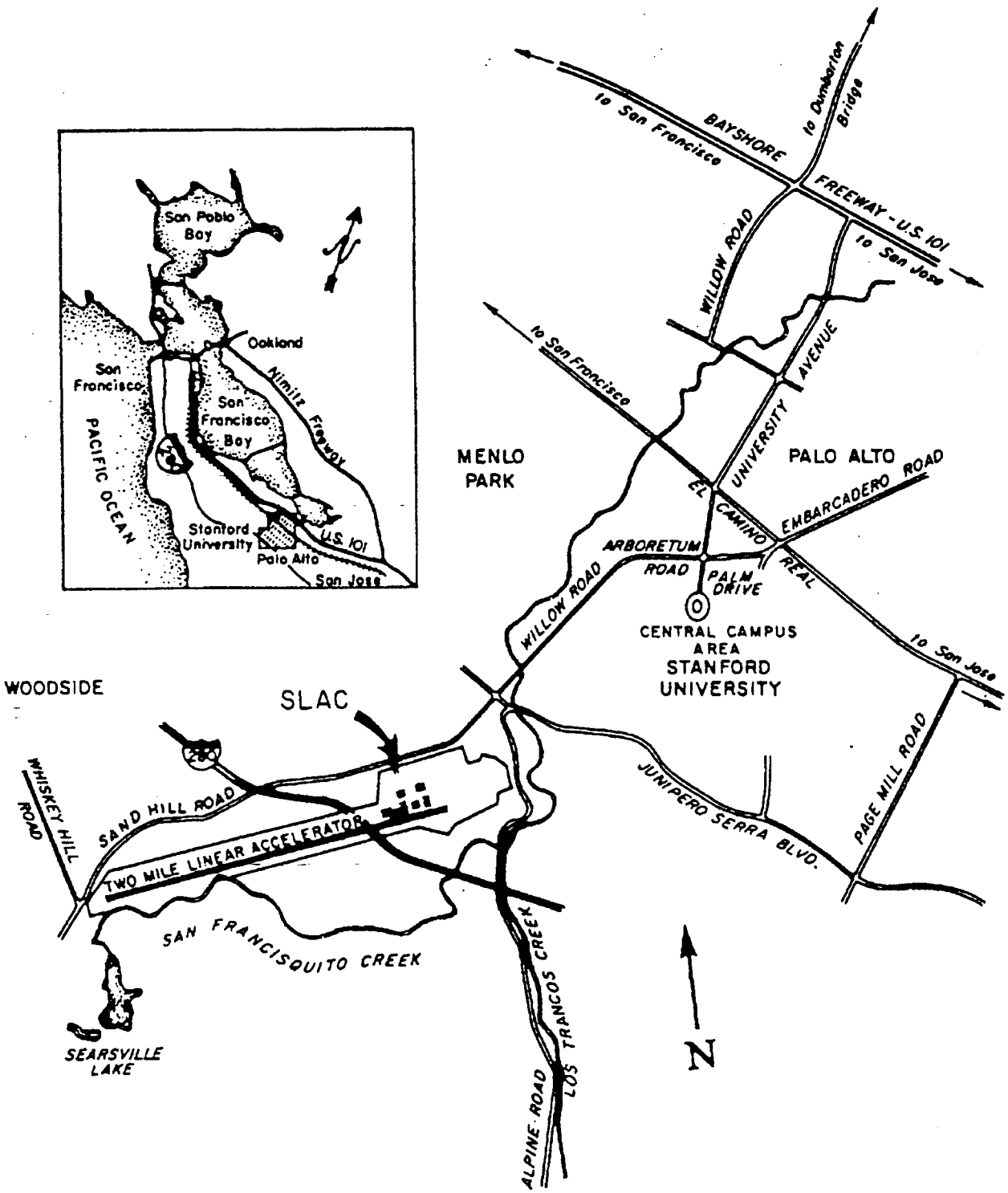

Figure 2-1 SLAC Site Location

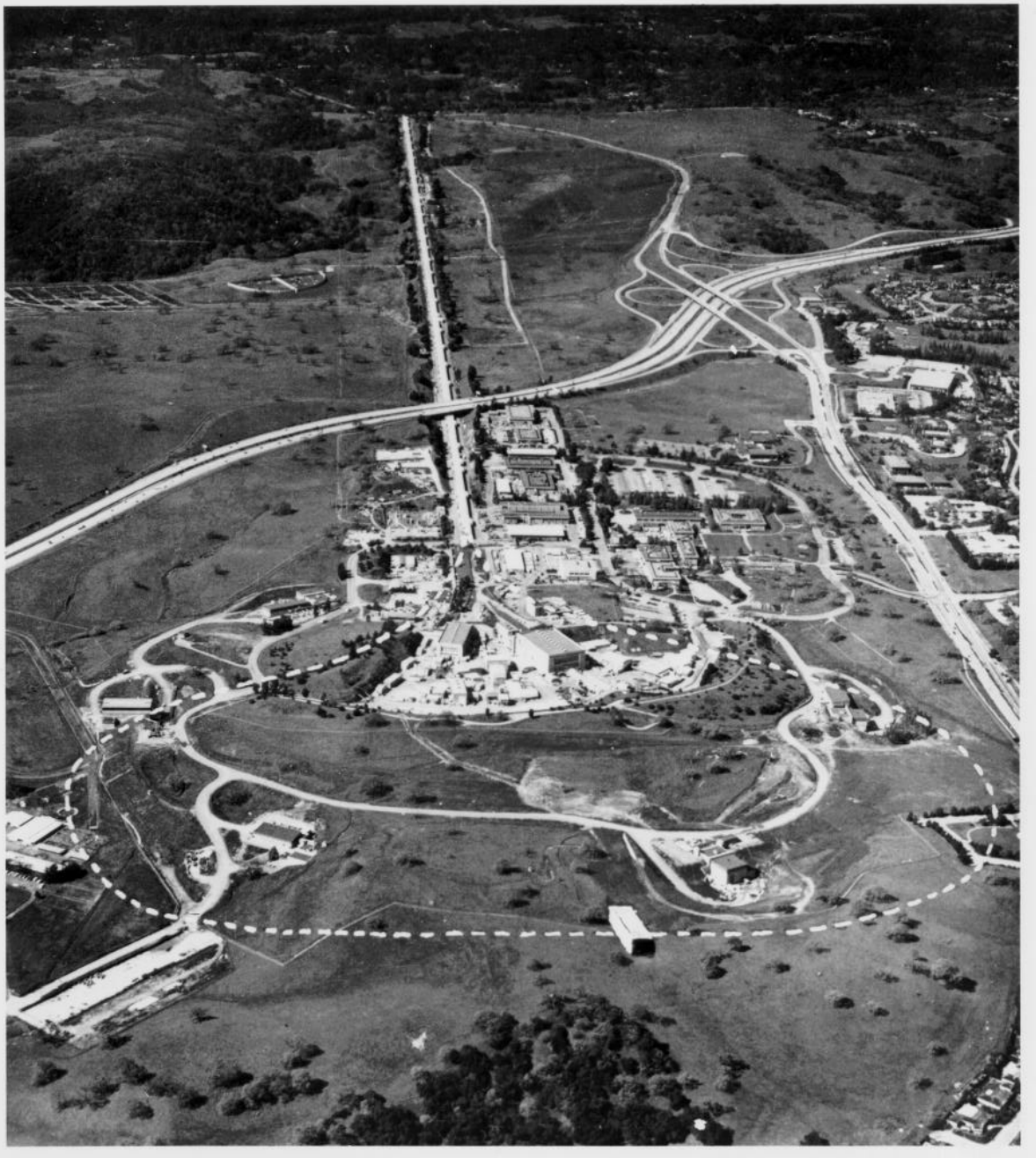

Figure 2-2 Aerial View of SLAC Site

Figure 2-3 SLAC Research Yard and the Surrounding Community

3 Compliance Summary

This section of the *1995 Site Environmental Report* provides a summary of the Stanford Linear Accelerator Center's (SLAC's) compliance with environmental laws and regulations. Specific instances of noncompliance are discussed and descriptions of corrective actions are included. More detailed descriptions of environmental programs are presented in the environmental program information sections (see chapters 4, 5, and 6).

3.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3.1.1 Environmental Restoration

SLAC follows general CERCLA technical guidance in investigating and remediating soil and groundwater contamination. SLAC is not, however, listed in the National Priorities List (NPL) as a Superfund site. SLAC is not, therefore, required to follow formal CERCLA procedures.

In calendar year 1995 (CY95), SLAC's Environmental Restoration Program (ERP), following the general CERCLA guidance, completed clean-up of the Interaction Region 6 (IR-6) off-site drainage channel containing soil contaminated with polychlorinated biphenyls (PCBs). This clean-up is described in Section 4.5.1.3 under Interim Removal Actions (IRAs). The remedial investigation (RI) leading to the clean-up is described below. In addition, planning, budgeting, and some preliminary work on program plans continued to be prepared for the CY96 field remedial investigation/feasibility study (RI/FS) work at the four sites of groundwater contamination. Section 6.0 describes this work.

All of these groundwater sites are monitored. One of these groundwater sites is monitored on a semester basis under state Regional Water Quality Control Board (RWQCB) Waste Discharge Order No. 85-88. RI/FS work and clean-up of groundwater sites are done under RWQCB lead. As long as work continues at the presently acceptable pace, SLAC will not be subject to written compliance and/or clean-up agreements.

In CY91, the first phase of an RI was performed in two unlined drainage ditches located between the IR-6 off-site drainage and IR-8. PCB contamination was found in portions of the eastern ditch originating on SLAC property and extending approximately 350 feet off-site onto adjacent undeveloped property owned by Stanford but once leased to a private party. SLAC constructed a fence to prevent uncontrolled access to this contaminated area.

Sampling and analysis of sediments in San Francisquito Creek, located downstream of the drainage ditches, indicated that the contamination had not migrated to that area. However, examination of the upstream (on-site) drainage system revealed PCB and lead contamination.

In CY94, SLAC performed two additional studies to determine whether contamination existed upstream. Soil and sediment samples were taken along a 2.5-mile length of San Francisquito Creek and analyzed for a variety of constituents. The results showed no detectable PCBs in the creek between Searsville Lake and the confluence with Los Trancos Creek. Lead analysis indicated only background levels. Sample analysis of the storm drain catch-basin sediments upstream of the contaminated areas indicated both PCB and lead contamination.

Additional study of the drain system and removal and off-site disposal of contaminated sediments from the catch basins and the IR-6 off-site drainage channel occurred in CY95. The *IR-6 Drainage Channel: Engineering Evaluation and Cost Analysis* (EECA) was written in CY95 to establish clean-up standards based on risk analysis, and to guide the removal action. As the lead regulatory agency, the RWQCB reviewed the EECA. This clean-up is described in Section 4.5.1.3 under IRAs.

A community relations plan was completed and distributed to the surrounding community in CY93. Extensive community relations activities continued in CY95.

3.1.2 Superfund Amendments and Reauthorization Act (SARA)

The Emergency Planning and Community Right-to-Know Act (EPCRA), otherwise known as the Superfund Amendments Reauthorization Act (SARA) Title III report, and the State equivalent, known as the Hazardous Materials Business Plan (HMBP) report were submitted to the San Mateo County Department of Health Services for CY95. See Table 3-1 for report information.

Table 3-1 EPCRA Compliance Information

Article	Title	REPORT		
		Required and Submitted	Required but Not Submitted	Required
302-303	Planning Notification	**YES**	NA	NA
304	EHS Release Notification	**YES**	NA	NA
311-312	MSDS/Chemical Inventory	**YES**	NA	NA
313	TRI Reporting	NA	NA	**NO**

3.2 Resource Conservation and Recovery Act (RCRA)

SLAC is a generator of hazardous waste, and as such is not permitted to treat hazardous waste or store it for longer than 90 days. The San Mateo County Department of Health Services is the local agency responsible for inspecting generators of hazardous waste for compliance with federal, state, and local hazardous waste laws and regulations. SLAC was not inspected by the county during CY95.

SLAC shipped all hazardous waste for off-site disposal within 90 days of generation in CY95. DOE/OAK performed semi-annual and monthly surveillance for various regulations (OSHA, RCRA, DOE Orders) during CY95 of the Waste Management (WM) Department and had no significant observations or findings.

To date, 505 employees have completed training covering general hazardous chemical and waste management, including waste minimization and pollution prevention. An annual "refresher" course was provided, as required, to Hazardous Waste Management Group (HWMG) personnel, Hazardous Waste and Material Coordinators (HWMCs) and assistant HWMCs. As required under RCRA, all hazardous waste minimization certifications for disposal of hazardous waste were properly made.

3.3 National Environmental Policy Act (NEPA)

SLAC formalized a NEPA program in CY92. Under this program, proposed project and action descriptions are reviewed to determine if NEPA Documentation is required. If NEPA Documentation is required, the proper paperwork is prepared and submitted. The project or action is entered in a database and tracked. In CY95, SLAC submitted 18 Categorical Exclusions (CXs) for General Plant Projects (GPPs), Accelerator Improvement Projects, and Capital Equipment Projects.

3.4 Clean Air Act (CAA)

The Bay Area Air Quality Management District (BAAQMD) implements the CAA through a set of rules and regulations for operations or equipment that may cause air pollution. SLAC had a total of 32 air pollution sources listed with the BAAQMD in CY95 (20 permitted, 12 exempt). No permit limitations were exceeded in CY95. SLAC was not inspected by the BAAQMD in CY95.

As required by the Montreal Protocol and Presidential Executive Order #12843, the manufacture of most Class I Ozone-Depleting Substances (ODSs) were phased out at the end of 1995. Regulation 9, Rule 7, of the BAAQMD regulations limits nitrogen oxides and carbon monoxide from industrial boilers. To meet these new requirements, SLAC has replaced two boilers.

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) program requires that facilities that release radionuclides into the air report those releases to the appropriate regional office of the Environmental Protection Agency (EPA). In accordance with this requirement, SLAC completed the Radionuclide Air Emissions Annual Report for CY95, which was provided to SLAC's DOE Operations Office in Oakland, CA(DOE/OAK) in June 1996. There were no instances of non-compliance reported.

3.5 Clean Water Act (CWA)

3.5.1 Groundwater Monitoring Program

The Groundwater Protection Management Program (GPMP) summarizes the groundwater program including planning, integration, and coordination of all supporting activities. Completed documents include:

- *Remedial Investigation/Feasibility Study (RI/FS) Workplan.*
- *Sampling and Analysis Plan* and associated *Standard Operating Procedures,* and *Quality Assurance Project Plan.*
- *Field Sampling Plan.*

3.5.1.1 Site-Wide Monitoring Network

SLAC has a groundwater monitoring network comprised of 21 wells constructed in areas of the facility that historically and/or currently store, handle, or use chemicals that may pose a threat to groundwater quality. In CY95, samples were collected from the wells on a quarterly or semester basis and analyzed for a wide range of chemical constituents. As reported in previous Site Environmental Reports (SERs), results of the analyses indicated that water in several of the wells contained levels of chlorinated solvents at or above the State of California Maximum Contaminant Levels (MCL) for drinking water.

The four sites identified are described in Section 6.0. The general water quality naturally occurring at SLAC, as measured by total dissolved solids (TDS) values, indicates that the groundwater is not suitable for drinking water. Further definition of the extent of contamination will be performed during the site-wide RI/FS that is planned to begin in CY96 as part of the comprehensive ERP at the site.

3.5.1.2 Radiological Monitoring of Groundwater

Tritium has historically been detected in one well, EXW-4. This well is located next to Beam Dump East (BDE). As shown in Table F-19 in Appendix F, the tritium levels steadily decreased over the last several years. In fact, the tritium levels have steadily decreased from about one half to one third of the Maximum Concentration Level (MCL) of 20,000 pCi/l for drinking water. This well was not sampled in CY95. However, EXW-4 will be sampled in CY96 and once each year thereafter to confirm decreasing or stable levels.

3.5.2 Surface Water

Two storm water sampling events were conducted during the 1995 wet season (October 1995 through May 1996). The annual storm water report was submitted to the RWQCB on July 1, 1996. The sampling data indicated that SLAC did not contribute significant levels of contaminants to the site's storm water runoff. However, collection of first-flush samples continued to be unrealistic, so the total contribution of pollutants in storm water remains to be determined.

In order to facilitate collection of first-flush storm water samples, SLAC began developing an autosampler program. During CY95 SLAC received several autosamplers, rain gages, solar panels and a flow meter from representatives of the State of California Agreement In Principle (AIP) program for this purpose. The program was not implemented, however, due to resource contraints.

SLAC continues to investigate the existence of illicit connections to the storm drain system as required by the California General Industrial Activities Storm Water Permit. Projects to inventory the storm drain and sanitary sewer systems and eliminate illicit connections have begun. Underground sumps in the Stanford Linear Collider (SLC) Arcs and PEP tunnel will be plumbed to the sanitary sewer as part of the illicit connection elimination activities. Other illicit connections and non-storm water discharges to the storm drain system will be addressed in SLAC's Storm Water Best Management Practice (BMP) Program.

A Storm Water Working Group comprised of representatives from all six divisions on site was formed during CY95. The Group met monthly to develop a list of storm water BMPs for submission to SLAC's Environment, Safety, and Health Coordinating Council (ESHCC). Once approved, the BMPs would become policy and would be enforceable.

Deficiencies in SLAC's Storm Water Program were identified by the RWQCB in a February 17, 1995 site inspection. In late CY95 the Storm Water Working Group began developing BMPs to address these deficiencies. For reference, the deficiencies noted by the RWQCB that are currently being addressed by the Working Group are as follows:

- Erosion control and catch basin protection measures were absent in construction areas
- Catch basins were clogged with debris
- Scrap material, engine parts containing oil, electrical equipment, and refuse were found in storage areas without protective measures to preclude or contain pollution runoff
- Non-storm water discharges had not been eliminated
- BMP's were not being implemented
- Pollution prevention personnel were not identified

In early 1996 SLAC's Storm Water Pollution Prevention Program and BMP list were approved by the ESHCC. As of June 6, 1996 the BMP Program, which included BMPs specifically for construction activities, was in the beginning of the implementation phase.

3.5.3 Industrial Wastewater

No discharge limits were exceeded in CY95. Data from CY95 indicated that SLAC's average discharge of wastewater to the sanitary sewer was 34,916 gallons per day.

As in previous years, SLAC discharged many batches of low conductivity water (LCW) to the sanitary sewer. All batches, as well as the cumulative total for the year, had contaminant levels that were within applicable radiological regulatory limits. The total number of gallons of LCW discharged to the sanitary sewer during CY95 was 307,887. The total amount of tritium discharged was 10.8 millicuries.

3.6 Safe Drinking Water Act (SDWA)

Drinking water and process water are supplied to SLAC by the City of Menlo Park from the Hetch Hetchy water system. Drinking water and process water are transported throughout the facility by a distribution system partially protected by backflow prevention devices. There are no drinking-water wells at SLAC.

3.7 Toxic Substances Control Act (TSCA)

SLAC has some equipment filled with oil or other dielectric fluids which contain PCBs. PCBs, their use, and their disposal, are regulated by TSCA. TSCA includes provisions in the regulation for phasing out of PCBs and other chemicals that pose a risk to health or the environment. The EPA is responsible for assuring that facilities are in compliance with TSCA. The State of California further regulates PCBs as a non-RCRA Hazardous Waste.

SLAC continued to make significant progress in reducing its inventory of PCBs in CY95. This was achieved through the disposal of numerous PCB capacitors (large and small), as well as other PCB-containing equipment.

In addition, transformers were retro-flushed to reduce PCB concentrations to levels which allowed reclassification to lower categories. This eliminated the three remaining PCB transformers (PCB levels greater than 500 ppm) from SLAC's PCB inventory.

Of six transformers retro-flushed, four have been reclassified as non-PCB equipment. One is going through final tests to be reclassified as non-PCB equipment, and the last was reclassified as PCB-contaminated.

Of the transformers currently in use at SLAC, there are 14 PCB-containing transformers and no PCB transformers. SLAC is planning to remove, or retrofill and reclassify the remaining PCB-contaminated transformers over the next few years.

Other activities and actions completed or initiated at SLAC in CY95 include:

- Prepared 1995 PCB Annual Report
- Completed PCB Transformer Quarterly Inspection Reports, per TSCA.
- Updated and validated the PCB/TSCA transformer and capacitor inventories.

3.8 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA regulates pesticide use in the United States. The term "pesticide" refers to insecticides, rodenticides, and herbicides. SLAC uses licensed subcontractors to apply "registered use" pesticides. SLAC personnel apply "general use" pesticides only. In CY95, SLAC used pesticide and herbicide handling and storage procedures that were developed in CY94. These procedures were incorporated into the subcontracts for landscape maintenance and pest control, and have been implemented by the subcontractors.

3.9 Endangered Species Act (ESA)

Six threatened or endangered species (plants and animals) have been recorded for the general area around SLAC, but not on SLAC property. Sensitive species and their presence at SLAC are evaluated when preparing environmental assessments for proposed projects, as required under NEPA.

3.10 National Historic Preservation Act (NHPA)

There are no eligible NHPA sites at SLAC.

3.11 Executive Order 11988, "Floodplain Management"

According to the Federal Emergency Management Agency (FEMA) floodplain maps for the area, a 100-year flood would not reach the SLAC facility, but would be confined to the San Francisquito Creek channel south of the facility.

3.12 Executive Order 11990, "Protection of Wetlands"

As part of an environmental assessment conducted in CY91, SLAC had a subcontractor perform a survey to determine whether any area(s) within or next to the SLAC facility should be formally designated as wetlands, which are specifically protected under Section 404 of the CWA. The field survey and evaluation were performed using established fed-

eral guidance. According to the survey, the IR-8 drainage ditch showed characteristics of wetlands, but a definitive evaluation was not possible because of continuing drought conditions and because the study was performed in the fall, when reproductive structures on vegetation were generally absent.

The report concluded that the natural hydrology of the area would probably not be capable of supporting the wetlands community due to seasonal drought, even under normal conditions. The portion of the IR-8 drainage channel that represents the great majority of the potential wetlands at and around SLAC is approximately 4,000 square feet, less than one-tenth of an acre. By comparison, the Army Corps of Engineers in practice uses ten acres as their functional cutoff for "significant" wetlands.

3.13 Releases to the Environment

3.13.1 Radiological

There were no reportable quantity (RQ) releases of radioactive material to the environment in CY95.

3.13.2 Non-Radiological

There were no RQ releases of hazardous material to the environment during CY95.

3.14 Assessments

An AIP was established by DOE with the State of California to provide oversight of the SLAC environmental programs. Under the AIP:

- The RWQCB did a pump test at the Former Underground Storage Tank (FUST) location (see Section 6.2).
- Auto samplers were supplied for storm water monitoring.
- There were three AIP-posted environmental thermoluminescent dosimeter (TLD) exchanges and one California Department of Health Services, Radiation Health Branch TLD exchange in 1995.

3.15 Summary of Permits

SLAC has the following permits:

- 1 California General Industrial Storm Water Permit
- 2 Wastewater discharge permits
- 4 California Extremely Hazardous Waste Disposal Permits
- 32 Air pollution permits/listed sources

A complete list of permit numbers and the administering agencies can be found in Section 4.8.

3.16 Other Major Environmental Issues

During CY95 SLAC identified a set of "Necessary and Sufficient ES&H Standards" in accordance with the process developed by the Department of Energy (DOE) Standards Committee. In early CY96 this set of standards was incorporated by reference into SLAC's management and operating contract. The set included all applicable statutory and regulatory requirements for public and worker safety and environmental protection. It also included a number of industry standards that were found to be necessary to control spe-

cific hazards present at SLAC. One impact of this modification of SLAC's contract was that most DOE Orders that had previously been the basis for SLAC's Environment, Safety, and Health (ES&H) program were no longer applicable.

Progress continued during CY95 toward completing the corrective actions developed in response to the CY91 Tiger Team assessment and subsequent appraisals. Of the 120 environmental commitments that have been tracked since 1992, including the 50 Tiger Team findings, 89 have been fully addressed, 14 are proceeding on schedule, and 17 are overdue. Most of these items were primarily concerned with the adequacy of SLAC's documented plans and procedures; no significant threats to the environment have been noted.

An assessment of SLAC's radioactive waste management practices by Westinghouse Hanford Corporation resulted in a "restricted" status. This status was subsequently changed to "approved" following SLAC's response to concerns raised during the assessment. Since early in 1996, SLAC has been permitted to ship its low-level radioactive waste to DOE's Hanford disposal site.

SLAC's self-assessment program provides for ongoing assessment by the line organizations and SLAC's internal independent auditing organization of environmental performance. Assessments in CY95 focused on water quality and hazardous waste management practices. No significant problems were identified in those areas. Of the 21 environmental findings made by SLAC's Quality Assurance and Compliance organization, all but one have been fully addressed.

The remaining self-assessment finding relates to establishing policy for designating Waste Accumulation Areas (WAAs). New policy and procedures are in development and scheduled for issuance in 1996.

4 Environmental Program Information

This section of the *1995 Site Environmental Report* provides an overview of the Stanford Linear Accelerator Center's (SLAC's) environmental activities performed in order to comply with laws and regulations, to enhance environmental quality, and to improve understanding of the effects of environmental pollutants from site operations. Included is a summary of non-radiological environmental monitoring, environmental permits, and significant environmental activities at the site.

4.1 Clean Air Act (CAA)

Federal air pollution regulations require states to conduct certain activities and to institute specific controls in support of the CAA. The states, in turn, delegate portions of their power and authority to local or regional agencies. Each of these agencies must adopt and enforce rules and regulations necessary to achieve and maintain both the Federal National Ambient Air Quality Standards and the State Ambient Air Quality Standards. The local agency regulating non-radiological stationary air pollution sources at SLAC is the Bay Area Air Quality Management District (BAAQMD).

Non-radiological air emissions at SLAC are primarily Volatile Organic Compounds (VOCs) from solvent cleaning operations; nitrogen oxides (NO_X) from industrial boilers; and particulates (PM10[1]) from metal and wood-working activities in the various shops. SLAC currently has 32 air pollution sources listed with the BAAQMD. These sources and their calendar year 1995 (CY95) emissions are identified in Table 4-1.

The breakdown of listed sources is as follows: 20 are permitted sources; five are sources that are exempt from permit but are listed because they have an air pollution abatement device associated with them; six are diesel tanks which are exempt from permit but the BAAQMD requested permit applications; and one is an exempt booth used to apply aerosol paint to metal parts.

As required by the BAAQMD, SLAC maintains records for solvent usage for permitted solvent sources. Permit conditions may limit the amount of solvent which can be used at an individual source on an annual basis. Records for individual sources are compared to permit limits, to assure that the limits have not been exceeded. No permit limits were exceeded in CY95.

[1] PM10 = Particulate matter less than 10 microns

Table 4-1 BAAQMD Permits and Emissions Annual Average (lbs/day)

S#	Source Description	Particulates	Organics	NO_X[a]	SO_2[b]	CO[c]
1	Boiler	—	—	—	—	—
2	Boiler	—	—	2	15	1
3	Degreaser	—	—	—	—	—
4	Degreaser	—	22	—	—	—
5	Spray-booth	—	2	—	—	—
6	Boiler	—	—	2	—	—
9	Degreaser	—	1	—	—	—
10	Woodworking operations (exempt)	—	—	—	—	—
11	Metal cutting operations (exempt)	—	—	—	—	—
13	Metal grinding operations (exempt)	—	—	—	—	—
14	Sandblast booth	—	—	—	—	—
16	Sandblast booth	—	—	—	—	—
17	Metal and epoxy glass grinding (exempt)	—	—	—	—	—
18	Degreaser	—	4	—	—	—
21	Anodizing, pickling and bright dip operations	—	—	—	—	—
22	Degreaser	—	1	—	—	—
26	Cold cleaner	—	—	—	—	—
30	Sludge dryer	—	—	—	—	—
32	Cold cleaner	—	—	—	—	—
34	Cold cleaner	—	—	—	—	—
36	Wipe cleaning	—	18	—	—	—
37	Cold cleaner	—	2	—	—	—
38	Solvent distillation unit	—	—	—	—	—
40	Diesel Storage Tank P-1 (exempt)	—	—	—	—	—
41	Diesel Storage Tank P-2 (exempt)	—	—	—	—	—
42	Diesel Storage Tank P-3 (exempt)	—	—	—	—	—
43	Diesel Storage Tank P-4 (exempt)	—	—	—	—	—
44	Diesel Storage Tank P-5 (exempt)	—	—	—	—	—
45	Diesel Storage Tank P-6 (exempt)	—	—	—	—	—
46	Aerosol Paint Booth (exempt)	—	—	—	—	—
49	Cyanide Room Scrubber	—	—	—	—	—
50	Sandblasting booth (exempt)	—	—	—	—	—

[a] Nitrogen Oxide
[b] Sulfur Dioxide
[c] Carbon Monoxide

As required by the Montreal Protocol and Presidential Executive Order #12843, the manufacture of most Class I Ozone-Depleting Substances (ODSs) were phased out at the end of 1995. Through SLAC's Alternative Solvents Program, suitable alternatives were identified and are being implemented.

Regulation 9, Rule 7, adopted by the BAAQMD in CY92, limits the emissions of nitrogen oxides and carbon monoxide from boilers. In CY95, SLAC replaced two boilers with two new boilers using lower emission burners.

SLAC is required to comply with the reporting requirements of the Toxic Release Inventory (TRI). This report summarizes the uses and releases during the CY of certain chemicals such as sulfuric acid and 1,1,1-trichloroethane (TCA). Information sources such as purchases of certain chemicals, usage records, and the annual chemical inventory were used to determine which chemicals exceeded the reporting thresholds.

If the usage of these specific chemicals exceeds the reporting thresholds, a Form R report must be submitted for each chemical that exceeds the threshold. In CY95, SLAC did not exceed the 10,000 pounds use threshold for these chemicals, therefore, no report was required. Sulfuric acid was delisted for CY95, and, due to a successful ODS solvent substitution program, TCA use declined significantly below the TRI threshold of 10,000 pounds per year.

The 33/50 Program is an Environmental Protection Agency (EPA) voluntary program for industries that release any of the top 17 hazardous chemicals identified under TRI. The intent of the program is to reduce the use of these chemicals by 33 and 50 percent within specified time increments. The 33/50 Program Information Report was provided for the *1994 Site Environmental Report*. Since SLAC did not submit any Form R reports for CY95, a 33/50 Program Information Report was not required.

4.2 Clean Water Act (CWA)

The Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), was enacted nearly thirty years ago in order to halt the degradation of our nation's waters. Amendments to the CWA in 1972 established the National Pollutant Discharge Elimination System (NPDES), which regulates discharges of wastewater from point sources such as Publicly Owned Treatment Works (POTWs) and categorically regulated industrial facilities such as electroplating shops. In 1987, the CWA was amended again to include non-point source discharges such as storm water runoff from industrial, municipal, and construction activities. The CWA is the primary driver behind SLAC's water compliance programs.

4.2.1 Surface Water

Federal regulations allow authorized states to issue general permits to regulate industrial storm water, or "non-point source", discharges. California is an authorized state, and on November 19, 1991, the State Water Board adopted the California General Industrial Activities Storm Water Permit (General Permit). SLAC filed a Notice of Intent (NOI) to comply with the General Permit on March 27, 1992. The General Permit was amended on September 17, 1992 to include simplified monitoring and reporting requirements.

The goal of the General Permit was to reduce pollution in the waters of the state. This was achieved by regulating the amounts of pollutants in industrial storm waters which were discharged to waters of the state.

Specifically, the General Permit required industrial dischargers to:

- Eliminate most non-storm water discharges to the storm drain system.
- Develop and implement a Storm Water Pollution Prevention Plan (SWPPP).
- Perform monitoring of discharges to storm drain systems.

Since submitting the NOI, SLAC has eliminated many non-storm water discharges, fully implemented a monitoring program, and developed nearly all requirements of the SWPPP. Working with the Regional Water Quality Control Board (RWQCB), SLAC has determined that two compliance items remain to be completed:

1. Elimination of unpermitted non-storm water discharges to the storm drain system.
2. Implementation of a best management practices (BMP) program.

SLAC is currently conducting projects to complete these items, as discussed below.

1. Non-Storm Water Discharges
   - Projects to identify and eliminate the remaining non-storm water discharges are currently being conducted by the Business Services and Technical Divisions, and are scheduled for completion by November 1997.
   - A combination of smoke, dye and video testing will be used to identify improper connections to the storm drain system. Any improper connections considered to be significant will be corrected promptly, and the remaining ones will be prioritized and corrected as resources allow.
   - The storm drain system drawings will be updated, and a program will be implemented to ensure they are kept current.
   - Non-storm water discharges other than improper connections will be addressed in SLAC's BMP Program (see next item).
2. BMP Program Implementation
   - The General Permit requires that the SWPPP:
     1. Identify sources of storm water pollutants.
     2. Describe and assure the implementation of BMPs to reduce these pollutants.
   - SLAC has identified storm water pollutants and formed a storm water working group to develop the BMPs. Though many BMPs are already in place, some elements such as housekeeping and construction activities will require more emphasis.
   - The working group has determined appropriate BMPs for SLAC, and the BMP Program document is expected to be finalized and disseminated in late 1996. Implementation of some aspects of the program has already begun.

SLAC's progress on the outstanding compliance items was discussed in bimonthly meetings with the RWQCB. SLAC volunteered to host the meetings so that the RWQCB could be kept apprised of progress and contribute guidance to SLAC in a timely manner.

4.2.1.1 Storm Water Monitoring Program

SLAC's storm water monitoring program consists of:

1. Two storm water sampling events per wet season.
2. Monthly visual observations during the wet season.
3. Two visual observations during the dry season.
4. An annual site inspection.

During the 1995-1996 wet season, SLAC analyzed storm water samples for pH, Electrical Conductivity (EC), Total Petroleum Hydrocarbons (TPHs) such as diesel and motor oil, Polychlorinated Biphenyls (PCBs), pesticides, general minerals, heavy metals, 1,2-dichloroethane (DCA), pesticides, and radioactivity.

The pHs of all samples tested were within acceptable bounds (7.68-8.51), and the ECs ranged from 110 to 2100 micro-mhos (Sector 14-4 on February 28, 1995). Results of 2100 micro-mhos can indicate a problem in the water, although this is not necessarily the case. The source of the elevated EC at the Sector 14-4 sampling point was uncertain.

Many heavy metals results were slightly elevated. SLAC has developed and implemented a Storm Water Best Management Practices Program to address loading of heavy metal pollutants in storm water.

Total Suspended Solids (TSS) ranged from a low of 9 mg/l (found at Interaction Region 6 (IR-6) on March 10, 1995) to a high of 430 mg/l (found at Sector 14-4 on March 10, 1995). Though storm water discharges are, by definition, non-point sources, the 1995 San Francisco Bay Basin Plan only lists a TSS objective for "point sources". Table 4-2 specifies 45 mg/l as the 7-day average objective for TSS.

Roughly half of the samples collected had TSS concentrations above the objective. Of these, Sector 14-4 (March 10, 1995) was the highest at nearly ten times the objective (430 mg/l). One half of the split sample collected at IR-8 (March 10, 1995) was the next highest at approximately three times the objective (120 mg/l). The other samples, including the other half of the split IR-8 sample, were within 50% of the objective. (All other parameters were in very close agreement between the two splits of the IR-8 sample.)

On February 28, 1995, the concentrations of TPHs detected (as diesel) were:

- 0.68 mg/l at IR-6.
- 0.59 mg/l at IR-8.
- 0.41 and 0.97 mg/l for both aliquots of the North Adit split sample.
- 0.27 mg/l at the Main Gate.

All of these were below the point source 7-day average objective of 20 mg/l. No objective was listed for non-point source discharges. The IR-6, IR-8, North Adit, and Main Gate sampling points receive runoff from paved areas which include roads and parking lots.

The finding of TPH as diesel at these locations, therefore, is not unusual. SLAC is developing a Storm Water Best Management Practices Program to control loadings of pollutants such as petroleum hydrocarbons.

Split samples were collected from each location and analyzed for radioactivity. One aliquot of each was sent to SLAC's state certified contract analytical laboratory, and the other was analyzed in-house. There was no reason to suspect radiological contamination of water at these sampling locations. The analysis was performed merely for completeness of the monitoring program.

The contract laboratory's results for the February 28, 1995 sampling event showed 1,490 and 2,226 pico curies per liter (pCi/l) of tritium in the IR-8 and Sector 14-4 samples, respectively, and their results from the March 10, 1995 sampling event showed 2,863 and 696 pCi/l of tritium in the Main Gate East and North Adit samples, respectively. All other samples showed less than 500 pCi/l (non-detected).

The positive tritium results conflicted with our in-house results of less than 500 pCi/l for all of the samples including those from the four locations in question. Both the contract laboratory and SLAC's in-house laboratory were asked to confirm their own results. SLAC's in-house lab confirmed its initial results of less than 500 pCi/l, and the contract laboratory sent SLAC an amended report saying that the tritium concentrations in the Main Gate East and North Adit samples were less than 500 pCi/l.

The report did not address the IR-8 and Sector 14-4 results. When contacted, the contract laboratory stood behind their initial results of 1,490 and 2,226 pCi/l for the IR-8 and Sector 14-4 samples. SLAC retrieved the remainder of the IR-8 and Sector 14-4 samples from the contract laboratory and sent them to a second state certified analytical lab for tritium analysis. The second laboratory reported that the concentrations of tritium in both samples were below 500 pCi/l, which agreed with SLAC's in-house laboratory.

SLAC has concluded, and is satisfied with the rigor of this conclusion, that the positive tritium results were erroneously reported by the contract lab. However, in the interest of being conservative, storm water samples collected in the coming 1996 and 1997 wet season will be analyzed for tritium. For reference, the drinking water standard for tritium is 20,000 pCi/l.

4.2.2 Industrial and Sanitary Wastewater

SLAC's industrial and sanitary wastewaters are treated by South Bayside System Authority (SBSA) in Redwood City, California before being discharged to San Francisco Bay. SLAC has two wastewater discharge permits: (1) WB 920415-P, which regulates industrial wastewater, and (2) WB 920514-F, which regulates SLAC as a whole, including industrial and sanitary wastewaters.

SLAC discharged a total of 12,744,233 gallons of wastewater to the sanitary sewer system in 1995, an average of 34,916 gallons per day. There were no violations of permit conditions for either permit during CY95. Both permits were automatically renewed on June 15, 1995. Permit requirements included:

1. Quarterly sampling for heavy metals, tritium, and pH at the Rinse Water Treatment Plant (RWTP).
2. Quarterly sampling for cyanide at the Plating Shop cyanide treatment tank.
3. Biennial sampling for Total Toxic Organics (TTOs) at the RWTP clarifier .
4. Signs posted throughout the site advising personnel not to discharge non-permitted material to the sanitary sewer and providing emergency response numbers should there be an accidental release.
5. Surveys of batches of potentially radioactive wastewater prior to discharge to the sanitary sewer. Once the result has been logged, the water is discharged to the sanitary sewer in accordance with SLAC's mandatory wastewater discharge permit (WB 920415-F). Each quarter, SLAC submits a radiological wastewater report to the POTW, SBSA, reflecting the respective batches, their tritium concentrations, and the total per quarter and cumulative per year tritium amounts.

In CY95, SLAC's Sanitary Wastewater Monitoring Program consisted of:

1. Quarterly sampling for heavy metals, tritium and pH at the Sand Hill Road Flow Meter Station (FMS) and the RWTP.
2. 24-hour monitoring of flow at the FMS during each quarterly sampling event. SBSA used this flow and the heavy metal results to calculate the mass loading of pollutants in SLAC's wastewater. SBSA submitted quarterly compliance reports to SLAC.
3. At the end of the calendar year, SLAC submitted an annual wastewater flow report to the West Bay Sanitary District (WBSD). WBSD used the flow data from this report to calculate SLAC's annual wastewater bill. SLAC's maximum allowable discharge to the sanitary sewer was 69,577 gallons per day.

There were no wastewater discharge permit violations during CY95.

4.2.2.1 Rinse Water Treatment Plant (Permit: No. WB 920415-P)

SLAC conducted metal finishing operations in an on-site electro-plating shop during CY95. Non-hazardous rinsewaters from the plating shop were processed through the RWTP prior to being discharged to the sanitary sewer. Effluent from the RWTP was required to meet federal metal finishing pre-treatment standards which are specified in the permit.

As required by the federal standards, the SBSA periodically monitored the metal finishing discharges, as well as the effluent from a cyanide treatment tank in the Plating Shop. SLAC and SBSA collected "split" samples from the RWTP and cyanide tank for quality assurance purposes.

The sampling locations are shown in Figure 4-1. Discharge limitations and sampling frequencies are presented in Table 4-2. SBSA and SLAC's analytical results for CY95 are presented in Table 4-3. SLAC also analyzed samples from the RWTP for radioactivity (see Table 4-4).

4.2.2.2 Total Facility Discharge (Permit: No. WB 920415-F)

This wastewater discharge permit covers SLAC's total[2] contribution to the sanitary sewer, including the combined flow from the RWTP and all other wastewater discharges on site. The sampling location is shown in Figure 4-1.

SBSA monitors the discharge quarterly to assure compliance with the permit. SLAC collects "split" samples during these monitoring events and analyzes them to compare results with SBSA for quality assurance purposes.

The discharge limits and the monitoring frequency for this location are provided in Table 4-5. SBSA's analytical results from samples collected in CY95 are presented in Table 4-6. SLAC's analytical results from samples collected in CY95 are presented in Table 4-7. SLAC also analyzed samples from the FMS for tritium, and these results are presented in Table 4-4.

SLAC's permit allows the discharge of low concentrations of radioactive contaminants in wastewater in compliance with federal and state discharge limitations. The permit calls for a certified quarterly wastewater discharge report which compares radioactivity discharged to regulatory limitations. Data for radioactive wastewater discharges to the sanitary sewer are provided in Section 5.2 of this report. No discharge limitations were exceeded in CY95.

4.3 Resource Conservation and Recovery Act (RCRA)

RCRA, enacted in 1976, provides "cradle-to-grave" authority to control hazardous wastes from their generation to their ultimate disposal. This is accomplished through a system of transportation manifests, record keeping, permitting, monitoring, and reporting.

Management of hazardous waste at SLAC is performed by the Waste Management (WM) Department. SLAC is a generator of hazardous waste, but is not permitted to treat hazardous waste or store it for longer than 90 days. The San Mateo County Department of Health Services (County) is the agency responsible for inspecting SLAC as a generator of hazardous waste for compliance with federal, state, and local hazardous waste laws and regulations. SLAC was last inspected by the County in December 1992.

SLAC utilizes a self-developed, site-specific computerized hazardous waste tracking system (WTS). Hazardous waste containers are tracked from the time they are issued to the generator to eventual disposal off-site. The WTS is being expanded in CY96 to include new data fields which will generate information for the Biennial, Superfund Amendments and Reauthorization Act (SARA) Title III, and Toxic Substances Control Act (TSCA) PCB annual reports.

[2] A small portion of SLAC's domestic wastewater is carried off-site via the sanitary sewer on the south side of the facility. The amount of wastewater is considered by the POTW to be trivial, and is not routinely monitored.

Hazardous waste generated from operations throughout the site are accumulated in Waste Accumulation Areas (WAAs). Each WAA is managed by a Hazardous Waste and Material Coordinator (HWMC), who is provided training and written guidelines on the proper management of WAAs. Training includes spill response preparedness, waste minimization, SLAC's WTS, and required "refresher" generator training.

Table 4-2 Standards for Metal Finishing Operations Wastewater Discharge Permit No. WB 920415-P Monitoring Location: Pre-treatment effluent at clarifier outfall, Uncombined with other waste streams

Constituent	Allowable Maximum	Monitoring Frequency	Sample Type
Oil and grease[a]	100 mg/l	na[b]	Grab
pH (minimum-maximum)[c]	6.0-12.5	Quarterly	Grab
Cadmium	0.69 mg/l	Quarterly[d]	Composite
Chromium (total)	2.77 mg/l	Quarterly[d]	Composite
Copper	3.38 mg/l	Quarterly[d]	Composite
Lead	0.69 mg/l	Quarterly[d]	Composite
Nickel	3.98 mg/l	Quarterly[d]	Composite
Silver	0.43 mg/l	Quarterly[d]	Composite
Zinc	2.61 mg/l	Quarterly[d]	Composite
Cyanide (total)[e]	1.2 mg/l	Quarterly[d]	Grab
Toxic organics[f]	2.13 mg/l	Semi-annual[d]	(None Specified)

[a] Oil and grease of mineral or petroleum origin.
[b] Not analyzed for that parameter.
[c] pH of pre-treatment effluent continuously monitored by industrial discharger.
[d] Sampling and analysis by SBSA and SLAC.
[e] Cyanide samples were collected at the Plating Shop pre-treatment tank uncombined with other waste streams.
[f] Compliance with toxic organics limit is based on all compounds detected by EPA Analytical Methods 601/602.

Table 4-3 CY95 Analytical Results of Metal Finishing Effluent

	SAMPLE DATES												PERMIT DISCHARGE LIMIT
	1/18/95		5/2/95		5/15/95		8/9/95		10/11/95		10/25/95		
	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	
pH	na[a]	7.1	na[a]	na[a]	na[a]	8.6	na[a]	8.2	na[a]	na[a]	na[a]	8.3	6.0-12.5
Cyanide (mg/l)	<0.02	0.018	na[a]	na[a]	<0.02	<0.038	<0.020	0.022	na[a]	na[a]	<0.020	0.0230	1.2
Cadmium (mg/l)	<0.001	<0.02	na[a]	na[a]	<0.001	<0.007	0.0018	<0.007	na[a]	na[a]	0.026	0.014	0.69
Chromium(mg/l)	0.053	0.05	na[a]	na[a]	0.08	0.06	0.022	0.228	na[a]	na[a]	<0.010	<0.040	2.77
Copper(mg/l)	0.029	0.03	na[a]	na[a]	0.34	0.36	0.17	0.180	na[a]	na[a]	0.15	0.170	3.38
Lead(mg/l)	<0.002	<0.08	na[a]	na[a]	0.0022	<0.05	0.0092	<0.05	na[a]	na[a]	<0.005	<0.100	0.69
Nickel(mg/l)	0.10	0.07	na[a]	na[a]	<0.10	<0.03	0.0080	0.04	na[a]	na[a]	0.22	0.200	3.98
Silver(mg/l)	0.023	0.02	na[a]	na[a]	0.004	<0.003	0.021	0.049	na[a]	na[a]	0.035	<0.006	0.43
Zinc(mg/l)	<0.02	0.019	na[a]	na[a]	<0.05	0.007	0.17	0.016	na[a]	na[a]	<0.020	0.012	2.61
Toxic Organics (mg/l)	na[a]	na[a]	0.011	0.0118	na[a]	na[a]	na[a]	na[a]	0.0577	0.0171	na[a]	na[a]	2.13
Flow (gal/day)	na[a]	2,120	na[a]	na[a]	na[a]	4,830	na[a]	9,250	na[a]	na[a]	na[a]	6,250	None

[a] Not analyzed for that parameter.

Table 4-4 1995 Tritium Results of FMS and RWTP

SAMPLING STATION	SAMPLE DATES			
	1/18/95	5/16/95	8/10/95	10/26/95
FMS (pCi/l)	<500	<500	<500	<500
RWTP (pCi/l)	<500	<500	<500	<500

Table 4-5 Sanitary Sewer Standards
Wastewater Discharge Permit No. WB 920415-F
Monitoring Location: Flow Meter Station adjacent to Sand Hill Road

Constituent	Limitation	Units	Monitoring Frequency	Sample Type
Oil and grease[a]	100	mg/l	Quarterly	Grab
pH (Minimum-Maximum)	6.0-12.5	pH	Quarterly	Grab
Arsenic	0.058	lbs/day	None	NA[b]
Cadmium	0.020	lbs/day	Quarterly	Composite
Chromium (total)	0.10	lbs/day	Quarterly[c]	Composite
Copper	0.79	lbs/day	Quarterly[c]	Composite
Lead	0.12	lbs/day	Quarterly[c]	Composite
Mercury	0.001	lbs/day	None	NA[b]
Nickel	0.37	lbs/day	Quarterly[c]	Composite
Silver	0.070	lbs/day	Quarterly[c]	Composite
Zinc	0.68	lbs/day	Quarterly[c]	Composite
Cyanide (total)	0.035	lbs/day	None	NAb
Polycyclic Aromatic Hydrocarbons	0.12	lbs/day	None	NA[b]
Methylene Chloride	0.041	lbs/day	None	NA[b]
Chloroform	0.017	lbs/day	None	NA[b]
Perchloroethylene	0.017	lbs/day	None	NA[b]
Benzene	0.0012	lbs/day	None	NA[b]
Carbon Tetrachloride	0.00058	lbs/day	None	NA[b]
Carbon Disulfide	0.0046	lbs/day	None	NA[b]
Phenols	1.5	mg/l	None	NA[b]

[a] Oil and grease of mineral or petroleum origin.
[b] Not Applicable
[c] Split samples were collected by both SLAC and SBSA.

Table 4-6 SBSA Results of Sanitary Sewer Discharges from Sand Hill Road Flow Meter Station

	Sample Dates								
	1/17/95		5/15/95		8/9/95		10/25/95		Permit Discharge Limits
Flow (gpd)	32,240		44,878		43,279		38,011		69,577
pH	8.4		8.1		8.2		8.5		6.0-12.5
	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	lb/d
Cadmium	<0.03	0.0054	<0.007	0.0026	<0.007	0.0025	<0.007	0.0022	0.02
Chromium	<0.04	0.0108	<0.02	0.0075	<0.02	0.0072	0.04	0.0127	0.1
Copper	0.16	0.0430	0.17	0.0636	0.21	0.0758	0.35	0.1110	0.79
Lead	<0.08	0.0215	0.08	0.0299	<0.05	0.018	<0.05	0.0159	0.12
Nickel	<0.06	0.0161	<0.03	0.0112	<0.03	0.0108	0.08	0.0254	0.37
Silver	<0.01	0.0027	<0.003	0.0011	0.023	0.0083	0.0250	0.0079	0.07
Zinc	0.3240	0.0871	0.3060	0.1145	0.1770	0.0639	0.3860	0.1224	0.68

Table 4-7 SLAC Results of Sanitary Sewer Discharges from Sand Hill Road Flow Meter Station

	Sample Dates								
	1/18/95		5/15/95		8/9/95		10/25/95		Permit Discharge Limits
Flow (gpd)	na[a]		na[a]		na[a]		na[a]		69,577
pH	na[a]		na[a]		na[a]		na[a]		6.0-12.5
	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	Result (mg/l)	(lb/d)	lb/d
Cadmium	0.0017	0.0005	0.0021	0.0008	0.0018	0.0007	0.0290	0.0092	0.02
Chromium	0.016	0.0044	0.011	0.0041	0.022	0.008	0.0016	0.0005	0.1
Copper	0.12	0.0333	0.18	0.0675	0.17	0.0614	0.3000	0.0952	0.79
Lead	0.0096	0.0027	0.017	0.0064	0.0092	0.0033	0.0560	0.0178	0.12
Nickel	0.04	0.0111	<0.10	0.0375	0.008	0.0029	0.0540	0.0171	0.37
Silver	0.0027	0.0007	0.0110	0.0041	0.0210	0.0076	0.0180	0.0057	0.07
Zinc	0.27	0.0749	0.27	0.1012	0.17	0.0614	0.4900	0.1555	0.68

[a] Not analyzed for that parameter.

4.3.1 Waste Minimization

4.3.1.1 Site-Wide Program Planning and Development

SLAC has been implementing its waste minimization program on schedule in accordance with its waste minimization plans. SLAC has two waste minimization plans. One was prepared to comply with California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill-14). This plan was reviewed for the September 1995 reporting period and revised in accordance with California regulations.

The second plan was prepared to comply with the waste minimization and pollution prevention requirements of the Department of Energy (DOE) and EPA. This plan was revised as of November 1994 and is being implemented.

SLAC is continuing to develop its capability to track hazardous waste for the EPA Hazardous Waste Biennial Report by incorporating process or source identification codes into the database of a SLAC computerized WTS. The WTS was successfully developed to assist in the preparation of the 1995 California Hazardous Waste Source Reduction and Management Review Plan and Report by allowing hazardous waste information to be sorted and categorized by California's hazardous waste identification code, waste quantity, and SLAC's various hazardous waste generators by department.

Implementation of waste minimization and pollution prevention is a SLAC line responsibility. Some of the highlights of SLAC implementation of waste minimization and pollution prevention measures are discussed below.

4.3.1.2 Employee Awareness/Training Measures

On-site training programs were developed and presented to employees to instruct them on how to minimize waste and to increase their awareness of the importance of the Waste Minimization and Pollution Prevention Program. The following training was developed and/or provided to SLAC personnel during CY95:

1. For personnel who handled hazardous material and hazardous waste as part of their job:
   - Provided a 3-1/2 hour class, "Introduction to Hazardous Waste and Materials Management".
   - Distributed the SLAC *Hazardous Materials Management Handbook.*
   - Developed a program and schedule to provide this training to new employees. To date, 505 employees have received this introductory training class.
2. For personnel who were scheduled for refresher training:
   - Developed a course for hazardous waste and materials management, as required by RCRA.

3. For HWMCs:
   - Developed and provided advanced HWMC training.
   - Completed a Waste Minimization and Pollution Prevention training session on measures for reducing hazardous waste in February 1995.
   - Established a quarterly seminar/workshop for HWMCs to discuss common problems and concerns and to provide training on specific topics selected by the HWMCs
4. For WM and Environmental Protection and Restoration (EPR) Departments:
   - Presented training sessions in March and April 1995 on Waste Minimization/Pollution Prevention Planning in Hazardous Waste.
5. For SLAC's Operational Safety Committee:
   - Presented the Waste Minimization/Pollution Prevention hierarchy and the SLAC program on October 4, 1995.
6. For site personnel:
   - Completed and distributed the Environment, Safety, and Health (ES&H) Manual Chapter on Waste Minimization/Pollution Prevention.
   - Provided numerous presentations and site-wide guidance to increase SLAC employee awareness and to update DOE on SLAC's Waste Minimization and Pollution Prevention Program.
   - Prepared a SLAC newsletter article on alternatives to ozone-depleting substances.
   - Updated the information posted in the five information centers around SLAC. These centers provide information to employees on recycling and pollution prevention for home use.

Additional measures to increase employee awareness are planned during CY96.

4.3.1.3 Waste Minimization and Pollution Prevention Activities/Implementation

To address the replacement of ODSs, SLAC set up an inter-departmental committee and has held biweekly meetings since February 1993. The meetings address the replacement of ODSs in vapor degreasing operations used for special cleaning needs in SLAC's high-energy physics equipment.

Of particular concern is equipment used in SLAC's ultra vacuum service and in high-voltage, high-power applications. In December 1993, committee members from the SLAC Mechanical Fabrication Department (MFD) and Physical Electronics Laboratory (PEL) Department tested and identified some potential alternative solvents.

A status report was prepared in March 1994 to identify potential alternatives based on initial testing and technology review.

One alternative is the replacement of an existing vapor degreaser system that uses 1,1,1-TCA with an advanced vapor degreaser system. This replacement system is a closed-system (a near-zero emissions, vapor degreaser system) that uses an alternative solvent (non-ozone depleting) such as perchloroethlyene. The closed-system vapor degreaser has been procured and is due for delivery in CY96.

While perchloroethylene has an increased health hazard over TCA, the use of perchloroethylene in the advanced vapor degreaser is expected to be safe and not increase the threat of worker exposure. Because of the stringent and diverse cleaning needs for ultra high vacuum applications, the closed-system vapor degreaser was selected as an alternative over other cleaning options, such as aqueous-phase cleaning. Aqueous cleaning is not considered feasible for meeting all of SLAC's cleaning applications due to development cost and space and water usage limitations.

A second alternative is a petroleum-based combustible (low-vapor pressure) solvent to be used in less stringent cleaning applications. This solvent is currently in use in applications associated with the cleaning of vacuum pump system cold traps used by the Stanford Synchrotron Radiation Laboratory (SSRL) and inMFD machining operations.

SLAC's Plant Engineering Department (PED) and MFD have obtained funding for Waste Minimization/Pollution Prevention projects through DOE Waste Management capital funds.

The projects include:

- Metals Recovery System ($53,000).
- Deionized Water Recycling ($139,000).
- Storm Water Processing/Recycling ($80,000).
- Storm Water Inventory ($70,000).

All of these projects, except for the Storm Water Inventory project, began in September 1995 and in CY96 are progressing at the design or construction phases. Bids are being finalized for the Storm Water Inventory project.

In April 1995, a contractor reviewed SLAC's CY95 hazardous waste quantities, handling methods, and tracking practices. The contractor also interviewed personnel in those departments that are generating significant quantities of hazardous waste. Various waste reduction opportunities have been identified. A final report identifying these opportunities is planned for May 1996.

SLAC's WM Department implemented waste minimization and reclamation activities with other departments. Such activities included:

- Investigating the recycle potential of alkaline batteries.
- Reclaiming empty freon cylinders (14 cubic yards).

- Sending out old equipment for reclamation (such as cathode ray tubes, and steel process tanks).

The PEP-II Division is currently engaged in modifying the old PEP facility for reuse in the SLAC B Factory Project. They had on hand approximately 1,000 tons (200 blocks) of concrete magnet support blocks that had been used in the old PEP facility in CY95.

PEP-II sent approximately 120 of the concrete support blocks to the Menlo Park Fire Department and National Rescue Facility for re-use. The other concrete blocks were re-used on site for construction of retaining walls, and some re-construction of PEP Interaction Regions (IRs).

By identifying potential reuses for these blocks for both in-house and outside-user projects, PEP-II was able to divert these blocks from landfill disposal as waste.

4.3.1.4 Waste Minimization Reporting

SLAC's Waste Minimization Coordinator attends bimonthly meetings on waste minimization and pollution prevention along with Waste Minimization Coordinators from other DOE facilities and DOE/OAK.

The Waste Minimization Coordinators have been working with representatives of DOE Headquarters (Office of Energy Research) and the DOE/OAK (Office of Environmental Restoration and Waste Management), to promote the implementation of waste minimization and pollution prevention, in accordance with DOE Order 5400.1 and Secretary of Energy Notice SEN 37-92.

Results of these efforts included:

- The 1994 DOE Annual Waste Reduction Report (November 1995).
- The plan and report for California's Hazardous Waste Source Reduction and Management Review Act (due in September 1995).
- Presentation of the status of SLAC's Waste Minimization and Pollution Prevention Program to:
  - DOE on March 28, 1995 at DOE/OAK.
  - A joint DOE Waste Minimization/Pollution Prevention Workshop under Energy Research, Environmental Restoration/Waste Management, and Defense Programs, on October 25, 1995.

The trends in sanitary waste generation from 1990 through 1995 are shown in Figures 4-2 and 4-3. Because of the PEP-II project, sanitary waste generation was higher than in previous years. However, recycling of the concrete blocks discussed earlier, as well as recycling of paper and cardboard, diversion of garden wastes, and recycling of scrap metals are expected to result in a percent recycling that will far exceed previous years. The one-time recycling of concrete blocks will cause SLAC to exceed the 50 percent level in recycling for 1995.

Figure 4-4 shows the trends in the generation of hazardous waste for three major categories: operational, Toxic Substances Control Act (TSCA), and remediation. Operational hazardous waste include those generated to support facility operations and maintenance and that are relatively routine compared with the non-periodic generation of TSCA and remediation wastes. The reduction in operational hazardous waste is shown in Figure 4-5.

SLAC showed a reduction in operational hazardous waste from 1992 through 1995 relative to the 1990 baseline year. Reductions were achieved through a combination of programmatic measures and through reduced equipment fabrication and construction activity.

To comply with Executive Order 12873 (Affirmative Procurement), SLAC has prepared a Standards Catalogue which identifies products with recycle content, particularly paper products. The ES&H Manual chapter on Waste Minimization and Pollution Prevention encourages personnel to purchase such products.

4.4 Toxic Substances Control Act (TSCA)

SLAC has some equipment filled with oil or other dielectric fluids which contain PCBs. PCBs, their use, and their disposal are regulated by TSCA. TSCA includes provisions in the regulation for phasing out of PCBs and other chemicals that pose a risk to health or the environment. The EPA is responsible for assuring that facilities are in compliance with TSCA. The State of California further regulates PCBs as a non-RCRA Hazardous Waste. No EPA inspections regarding TSCA were conducted at SLAC during CY95.

SLAC continued to make significant progress in reducing its inventory of PCBs in CY95. This was achieved through the disposal of numerous PCB capacitors (large and small), as well as other PCB-containing equipment.

Transformers were also retro-flushed to reduce PCB concentrations to levels which allowed reclassification to lower categories. This eliminated the three remaining PCB transformers (greater than 500 ppm) from SLAC's PCB inventory. Of six transformers retro-flushed, four have been reclassified as non-PCB equipment. One is going through final tests to be reclassified as non-PCB equipment, and the last was reclassified as PCB-contaminated.

Of the transformers currently in use at SLAC, there are 14 PCB-containing transformers and no PCB transformers. SLAC is planning to remove, or retrofill and reclassify the remaining PCB-contaminated transformers over the next few years.

Other activities and actions completed or initiated at SLAC in CY95 included:

- Prepared 1994 PCB Annual Report.
- Completed PCB Transformer Quarterly Inspection Reports, per TSCA.
- Updated and validated the PCB/TSCA transformer and capacitor inventories.

4.5 The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Superfund"

4.5.1 Environmental Restoration

DOE Order 5400.1 provides standards and guidance and establishes requirements for environmental protection programs, including the preparation of this annual report. More specifically, as stated in DOE Order 5400.4, it is the policy of DOE to respond to releases of hazardous substances in accordance with the provisions of CERCLA, as amended, including the National Oil and Hazardous Substances Pollution Contingency Plan (abbreviated as the NCP) and Presidential Executive Order 12580. The NCP addresses both removal and remedial actions, performed as appropriate to reduce adverse impacts on public health and the environment from releases, regardless of whether or not the facility is listed on the National Priorities List (NPL).

In CY91, SLAC began to develop a comprehensive Environmental Restoration Program (ERP). The program delineates how SLAC will address environmental contamination problems from discovery and characterization through remediation and long-term monitoring or maintenance, if required. SLAC's restoration approach is as follows:

1. Identify sites with actual or potential contamination (involving soil, groundwater, surface water, and/or air).
2. Prioritize contaminated sites based on site complexity, nature of contamination, associated risks, remaining data needs, and projected remedy.
3. Perform a consolidated Remedial Investigation/Feasibility Study (RI/FS) beginning with the highest-priority sites.

SLAC is continuing to develop procedures for these restoration activities. In particular, Interim Removal Actions (IRAs), which are delineated in the NCP, are being performed at those sites sufficiently characterized to provide a basis for addressing the contamination present in soil. IRA activities are discussed in more detail below. Contaminated groundwater sites are discussed in Section 6.0.

4.5.1.1 Program Development

While not required to do so, SLAC has been following CERCLA procedures in the development of its ERP. However, SLAC is not a Superfund site and thus is not included on the NPL. Section 120 of CERCLA delegates regulatory authority from the federal EPA to the state level for SLAC and other non-NPL facilities. For SLAC, the lead agency is California's RWQCB. SLAC is under an RWQCB order for cleanup of the Former Underground Storage Tank (FUST) site (see Section 6.2.1).

Several program documents guide the SLAC ERP. Among these are the RI/FS Work Plan, which describes the approach and schedule for investigation and clean-up of contaminated sites. The Work Plan describes how SLAC will conduct its remedial activities in compliance with applicable CERCLA requirements. Two other site-wide program documents are required for the ERP. They are the *Quality Assurance Project Plan* and *Standard Operating Procedures* which are described in the Work Plan.

A budget baseline for the ERP was submitted to DOE and approved in CY94. As changes in the program occur, the baseline is modified through the change control process to reflect the program.

CERCLA sets a clearly defined path for performing investigations and other remedial activities and calls for public involvement during the entire process.

Despite being delegated to state authority as a non-NPL facility, SLAC endeavors to be proactive in following key aspects of CERCLA, as evidenced by the Community Relations Plan issued in CY93.

SLAC personnel continued to be actively involved in various public participation activities throughout CY95. In particular, the Comprehensive Resource Management and Planning (CRMP) process was used to establish a watershed management group for San Francisquito Creek.

Stanford University hosted the kickoff meeting in late CY93 and has continued to support the objectives of the CRMP throughout CY95. SLAC personnel attended the monthly meetings of the Steering Committee and the Natural Resources Task Force and participated in various developing programs.

4.5.1.2 Site Classification

Sites with chemicals of concern in groundwater or soil fall into two categories. One category comprises sites that require additional field sampling for adequate characterization and will be addressed by an RI/FS. Four groundwater sites and two or three soil sites fit into this category. Work done at groundwater sites is described in Section 6, Groundwater Protection. No work was done on the soil sites in this category in CY95.

The other category comprises sites that are sufficiently characterized and can be remediated as IRAs. These activities are delineated in the NCP. IRAs represented the primary remedial activities conducted at SLAC in CY95. IRA work in CY95 is described below.

4.5.1.3 Interim Removal Actions (IRAs)

In CY95, an IRA was completed at the IR-6 off-site drainage channel to remediate contamination resulting from historical use of PCB-containing transformers. In addition, the storm drain catch basins which convey contaminated sediments to the IR-6 off-site drainage channel were also cleaned out. This work is described below. In addition, the following final reports for CY94 IRA work were submitted to DOE and/or the San Mateo County Department of Health Services:

- *Interim Removal Action (IRA) for the 3.0 Megawatt Power Supply Area.*
- *IRA Report for Substations 502, 510, and 009.*
- *IRA Report for the IR-8 Power Supply Area.*

4.5.1.4 IR-6 Off-site Drainage Channel Remediation

In CY91, SLAC confirmed the presence of PCB-contamination in an on-site storm drain channel in an area of the facility known as IR-6. Concerns over potential off-site migration of contamination led to a remedial investigation (RI), which was initiated in CY91 to define the vertical and horizontal extent of contamination.

The draft RI report, entitled *Site Characterization and Baseline Risk Assessment, IR-6/IR-8 Drainage Ditches Site, January 1992,* indicated the presence of PCBs throughout the drainage ditch, with detectable levels of PCBs found as deep as five feet below grade.

A section of the contaminated IR-6 channel extends beyond SLAC's site boundary into an adjacent area, also owned by Stanford University but formerly leased to a private party. To prevent unauthorized access to the contaminated area, the affected three-acre parcel was fenced off and removed from the lease agreement with the adjacent leaseholder.

Since contamination was confirmed in the storm drain system near the SLAC boundary, two additional studies have been performed to determine whether contamination exists further upstream in the (on-site) storm drain system, and whether it has migrated downstream into San Francisquito Creek. In the latter study, soil and sediments from various points along an approximately 2.5-mile stretch of San Francisquito Creek were sampled and analyzed for a variety of constituents. The results showed no detectable PCBs in the creek between Searsville Lake (which is upstream of SLAC) and the confluence with Los Trancos Creek (downstream of SLAC).

Results of this investigation were presented in a report entitled *Assessment of San Francisquito Creek,* which was approved and distributed in CY94. Sampling and analyses were also performed for the storm-drain catch basins upstream of the contaminated areas. These results revealed PCB and lead contamination in the sediments of many catch basins on-site. Additional study of the catch basins was performed in late CY94 to better characterize the situation. Samples were collected from 109 of the 240 catch basins on-site, and sediment volume was determined for each containment.

In CY95, further characterization of the IR-6 drainage channel and the catch basins was performed to guide the removal action and to define waste disposal options. *The IR-6 Drainage Channel: Engineering Evaluation and Cost Analysis* (EECA) was prepared to establish clean-up standards based on a risk analysis to human health and the environment, and to guide the removal action. The RWQCB and the San Mateo County Department of Health Services reviewed the EECA and provided oversight of the ensuing removal action. Detailed specifications were prepared for bid proposals to make sure that adequate environment, health, and safety precautions were taken.

In the summer of CY95, SLAC removed all sediment from 282 catch basins on-site. In addition, about 262 cubic yards of contaminated sediment were removed from the IR-6 drainage channel and trans-

ported to a TSCA-approved Treatment, Storage, and Disposal Facility (TSDF) landfill in Kettleman City, California. The channel was restored to provide an optimal habitat for plants and animals in surrounding areas. A report summarizing this work was completed in CY96. In June 1996, the RWQCB accepted the removal action as complete. A report summarizing this work was completed in CY96 and the RWQCB accepted the removal action as complete in June 1996.

4.5.2 The Superfund Amendments and Reauthorization Act (SARA)

SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA) is primarily directed toward developing an inventory of the information needed to compile the various reports required by EPCRA. These reports also address the implementation requirements for statutes in the State of California (the La Follette and Waters Bills).

SLAC must prepare a Hazardous Materials Business Plan (HMBP) which details the response in the event of a release of hazardous material. This plan must designate an emergency coordinator, describe the first response and several levels of escalation, delineate the means by which all mandated notification will be made to the local authority (LA) and local fire department, and describe the facilities evaluation, containment, and clean up capability.

Under section 312 of EPCRA, SLAC must provide to the LA and the local fire department, on an annual basis, an annual inventory of hazardous substances that are present in quantities greater than 55 gallons, 500 pounds, or 200 cu. ft. The LA requires a report to be filed for each individual hazardous substance.

A form must be filled out for all hazardous material and waste meeting the criteria. This form has approximately twenty items of information which include physical characteristics of the substance, storage medium, quantities, days present, usage rate, and more.

Executive Order #12843 has committed SLAC to comply with the TRI reporting requirements under Section 313 of the EPCRA. SLAC, in accordance with DOE guidance, complied with EPCRA Section 313 in CY95.

4.6 National Environmental Policy Act (NEPA)

NEPA provides a three-level mechanism to ensure that all environmental impacts and alternatives to performing a proposed project are considered before it is carried out. The aspects that must be considered when scoping and preparing documentation for a proposed project include archaeological sites, wetlands, floodplains, sensitive species, and critical habitats. If any extraordinary circumstances are identified during project scoping, a range of options for the project must be developed and the impacts of those options evaluated.

SLAC formalized its NEPA program in CY92. All project or action proposals are reviewed to determine if NEPA documentation is required. If NEPA documentation is required, the project or action is entered into a database and tracked. The resulting draft NEPA document is reviewed by specified SLAC staff for concurrence, and is forwarded to the DOE Site Office for review and approval.

The three types of NEPA documentation, in order of increasing complexity, are Categorical Exclusions (CXs), Environmental Assessments (EAs), and Environmental Impact State-

ments (EISs). In CY95, SLAC submitted 18 CXs for General Plant Projects (GPPs), Accelerator Improvement Projects, and Capital Equipment Projects.

4.7 Assessments

SLAC's assessments during CY95 are described in Section 3.14.

4.8 Permits

The following list of permits were held by SLAC in CY95:

- California Regional Water Quality Control Board
  San Francisco Bay Region
  NPDES Permit CA0028398, Order 90-098.
- Waste Discharge Order 85-88 (for groundwater contamination around former leaking underground storage tank); in 1993, SLAC filed a request with the RWQCB to rescind this permit.
  Expiration date: July 18, 1995.
- West Bay Sanitary District and South Bayside System Authority
  Wastewater Discharge Permit No. WB920415-P
  Wastewater Discharge Permit No. WB920415-F
  Expiration date: April 14, 1997
- Bay Area Air Quality Management District (BAAQMD)
  Plant No. 556, 32 listed sources (found in Table 4-1).
- Environmental Protection Agency
  Hazardous Waste Generator EPA ID No. CA8890016126

SLAC has filed an NOI to comply with the following permit:

- California Regional Water Quality Control Board
  San Francisco Bay Region
  SLAC Permit Identification Number: 2 41 S 002417
  California General Industrial Storm Water Permit
  (as amended on September 17, 1992)
  Expiration date: November 19, 1996

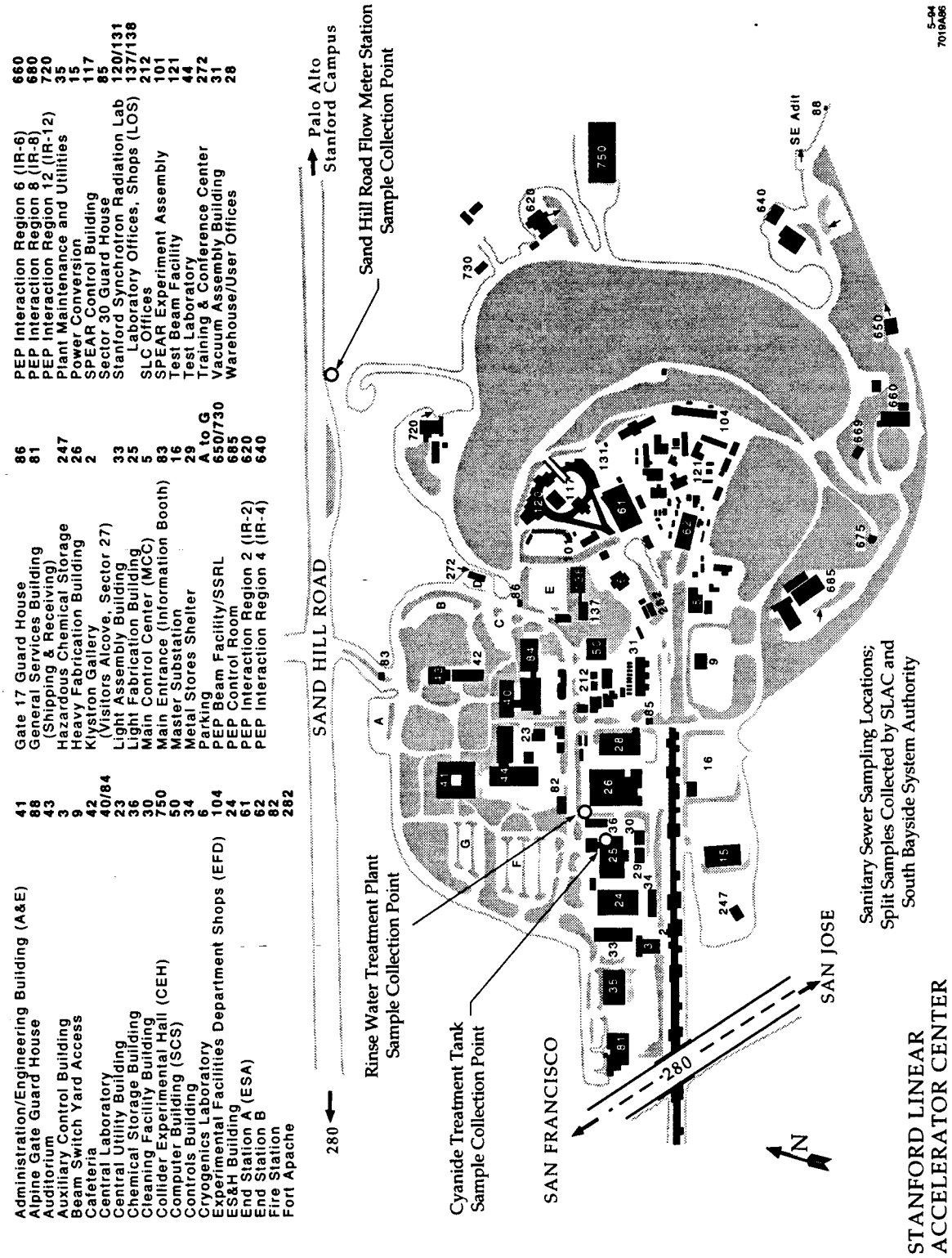

Figure 4-1 Sanitary Sewer Sampling Locations

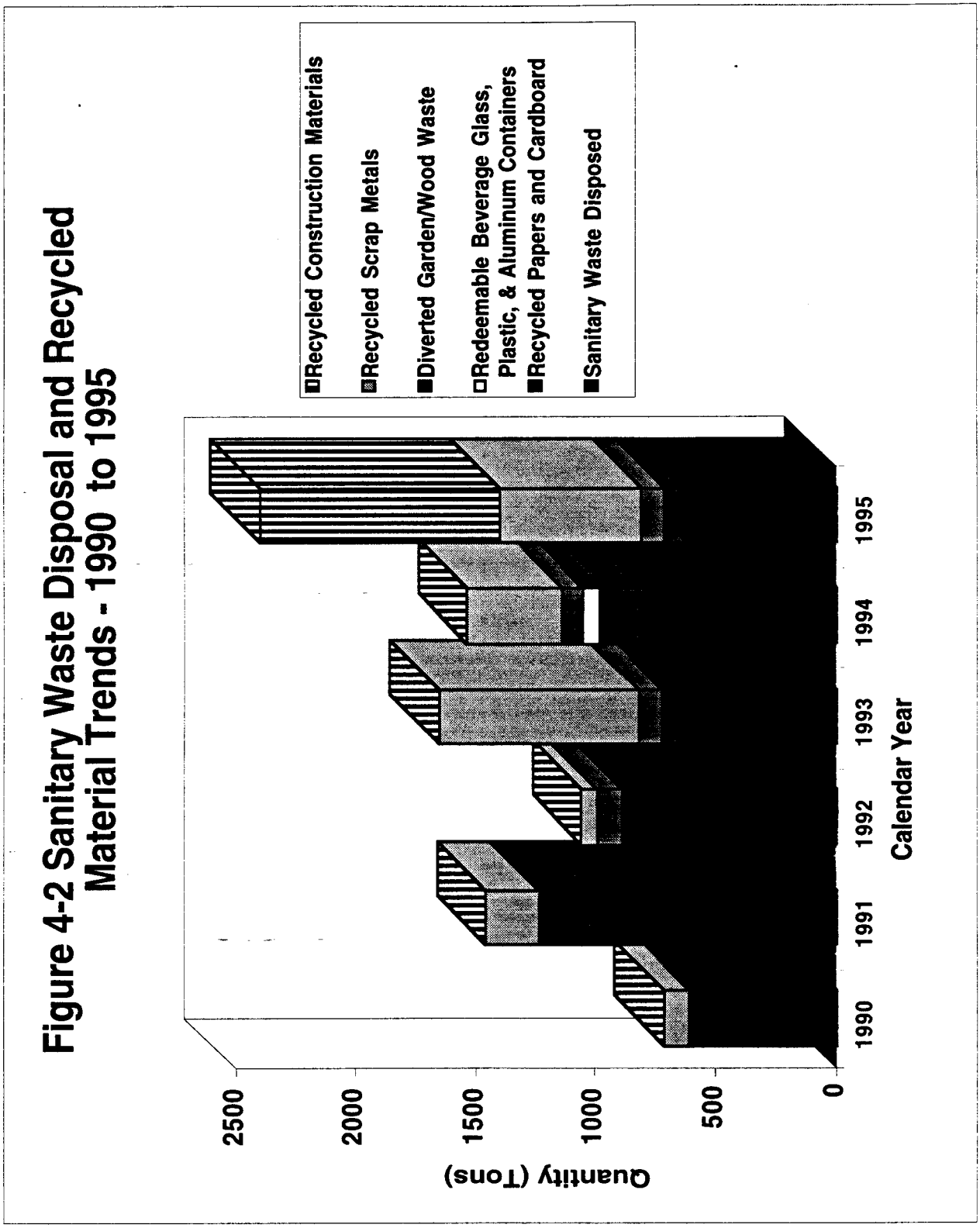

Figure 4-2 Sanitary Waste Disposal and Recycled Material Trends, 1990-1995

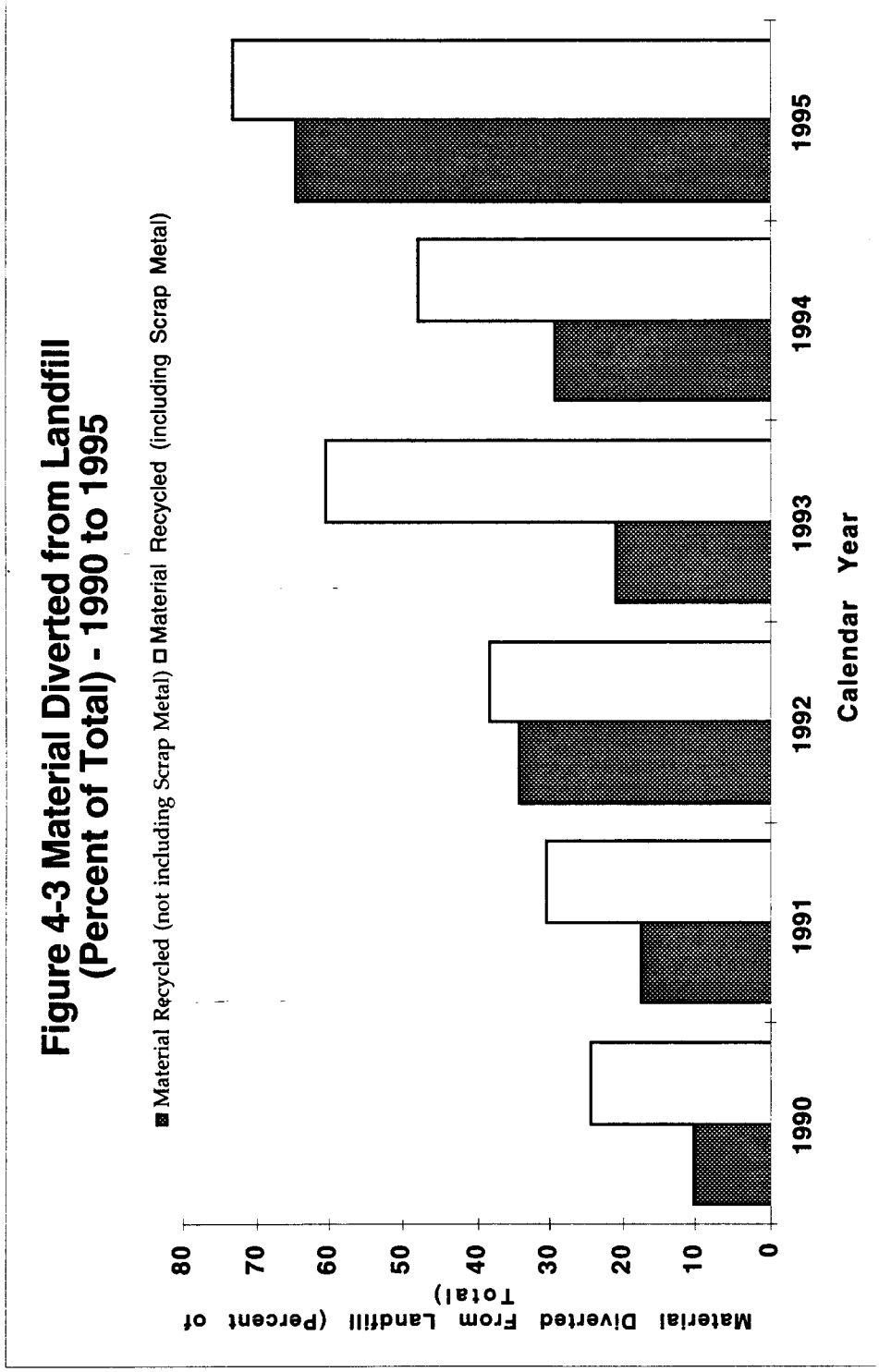

Figure 4-3 Material Diverted from Landfill, 1990 to 1995

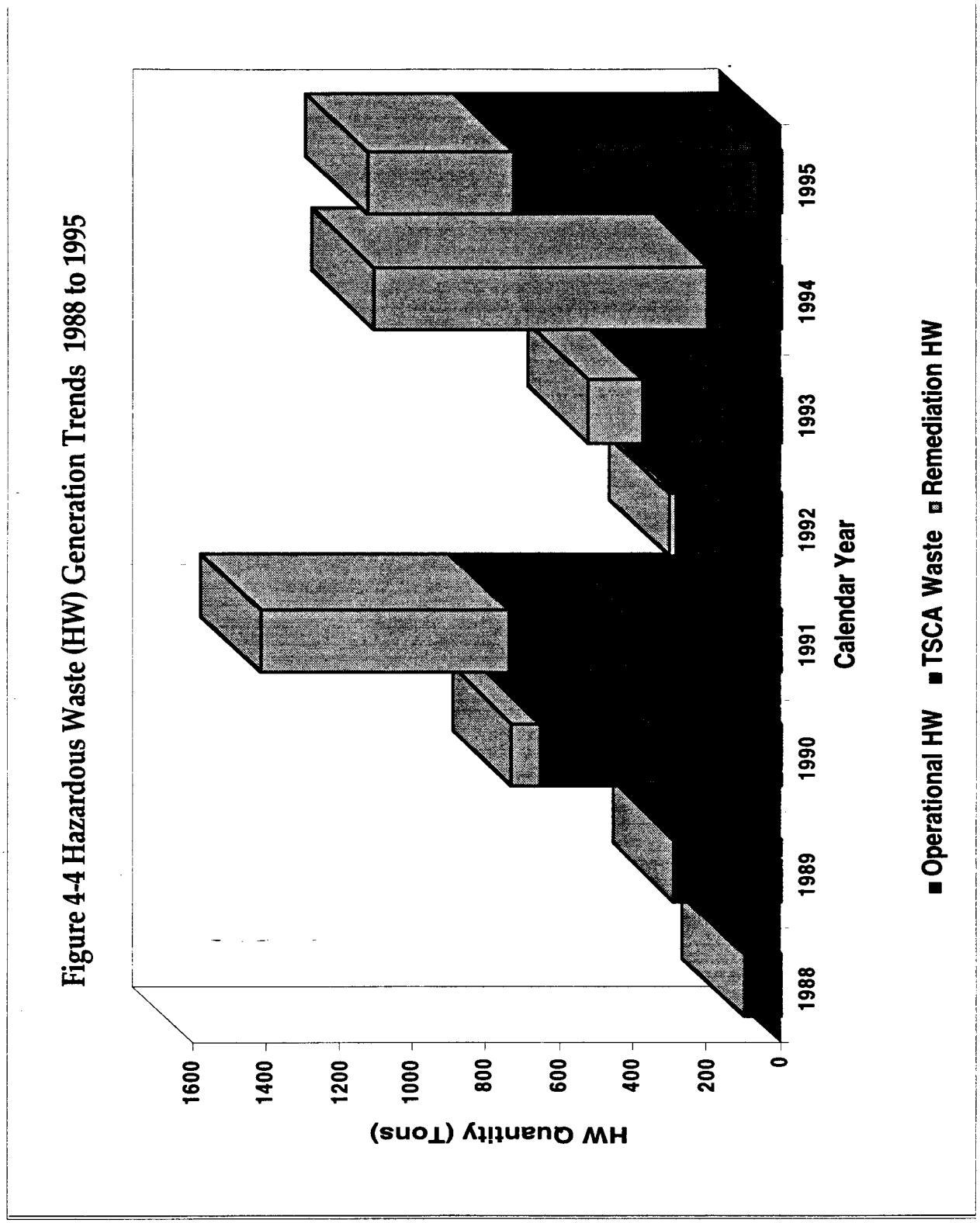

Figure 4-4 Hazardous Waste Generation Trends, 1988 to 1995

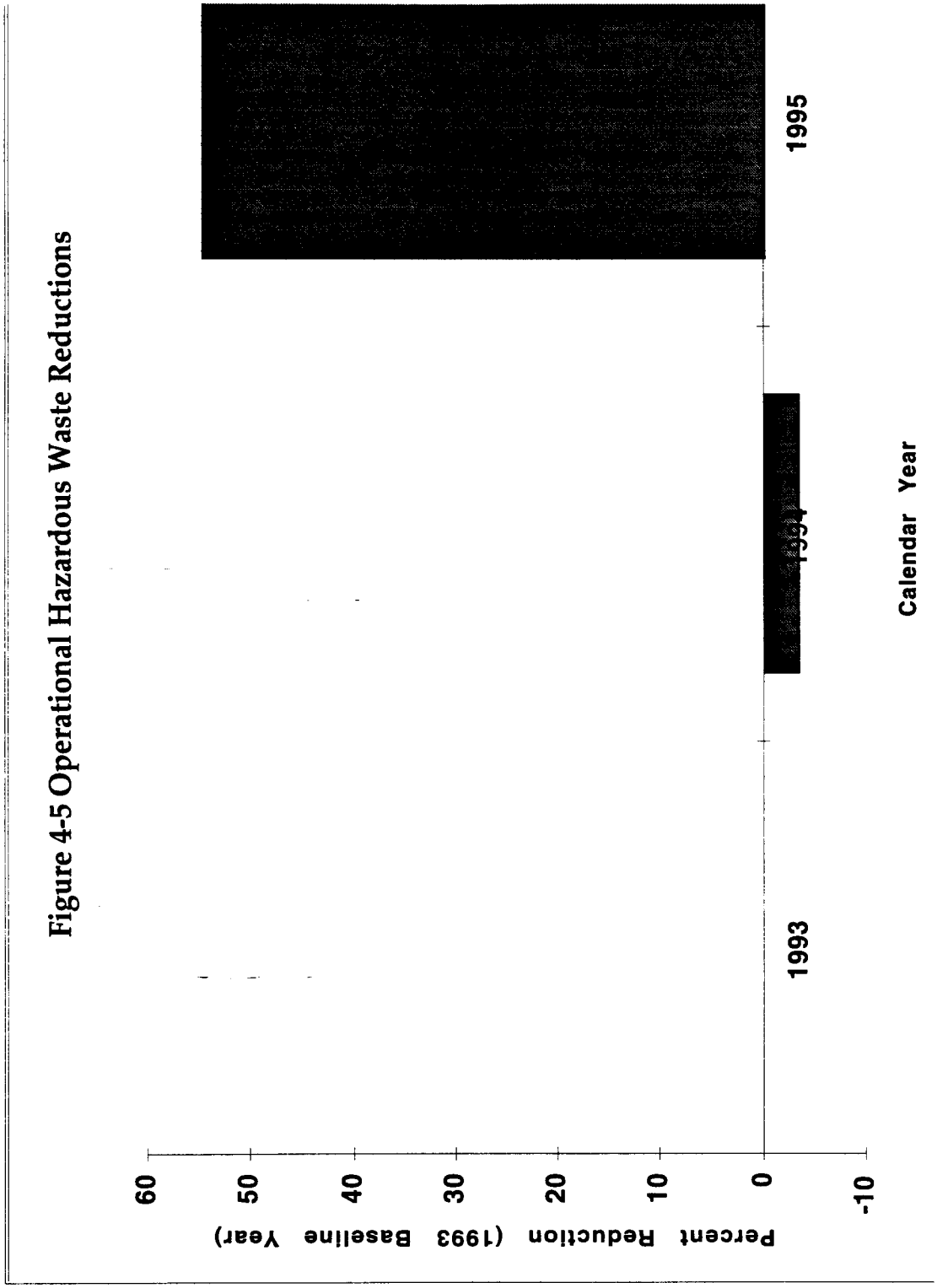

Figure 4-5 Operational Hazardous Waste Reductions Using 1993 as a Baseline

[This page intentionally left blank.]

5 Environmental Radiological Program Information

5.1 Airborne Monitoring

Airborne radionuclides are produced in the air volume surrounding major electron beam absorbers such as beam dumps, collimators, and targets. The degree of activation is dependent upon the beam power absorbed and the composition of the parent elements. The composition of air is well known, consisting of nitrogen, oxygen, and trace quantities of carbon dioxide and argon. Induced radioactivity produced at high energies is composed of short-lived radionuclides, such as oxygen-15 and carbon-11, with half-lives of 2 minutes and 20 minutes, respectively. Nitrogen-13, with a half-life of 10 minutes, is also produced, but in much lower concentrations. As a consequence of water cooling and concrete shielding, both containing large quantities of hydrogen, the thermal neutron reaction with stable argon produces argon-41, which has a half-life of 1.8 hours.

There was no uncontrolled venting of the accelerator housing while the accelerator was operating in calendar year 1995 (CY95). This was accelerator operations policy due to the desire to maintain thermal stability. There was one beam loss area at the Stanford Linear Accelerator Center (SLAC) that was not enclosed, so emissions due to diffusion occurred. This situation was accounted for in Appendix B.

The accelerator, the Positron-Electron Project (PEP), Stanford Positron Electron Asymmetric Ring (SPEAR), and experimental areas were designed to transport (not absorb) high energy electrons and positrons. Radioactive gas concentrations were therefore not produced in measurable quantities. The Beam Switchyard (BSY), Positron Source (PS), Beam Dump East (BDE), and electron/positron (e-/e+) beam dumps in the Final Focus System (FFS) represent the only portions of SLAC designed to absorb high energy particles and are the only sources of detectable gaseous radioactive emissions. These areas are not vented continuously. They can be vented in emergencies and at the end of each experimental cycle.

The Derived Concentration Guides (DCGs) for airborne radioactivity appear in Department of Energy (DOE) Order 5400.5, *"Requirements for Radiation Protection for the Public"*. They were derived from dose standards which require that no individual in the general population be exposed to greater than 100 mrem (1.0 mSv) in one year. For this report, the term dose equivalent, in units of rem or Sievert (Sv), will simply be called dose.

Airborne radioactivity produced as the result of SLAC operations in CY95 was short-lived, that is, the half-lives ranged from 2.1 minutes to 1.8 hours and was in gaseous (not particulate) form. The chief radionuclides in SLAC produced airborne radioactivity are listed in Table 5-1.

Table 5-1 Radioactive Gases Released to Atmosphere

Radionuclide	Half-Life	DCG [$\mu Ci/cm^3$][a,b]
^{15}O	2.1 minutes	1.7×10^{-9}
^{13}N	9.9 minutes	1.7×10^{-9}
^{11}C	20.5 minutes	1.7×10^{-9}
^{41}Ar	1.8 hours	1.7×10^{-9}

[a] $\mu Ci = 3.7 \times 10^4$ Bq.
[b] Calculated from DOE Order 5400.5, assuming total submersion by dividing the averaged DCG by 10. See Appendix A.

Since SLAC did not routinely release airborne radioactivity while the beam was on and required a waiting period before turning on the fans (if at all); typically the only significant radionuclide released was argon-41 due to its longer half-life. This would not be the case for a facility such as BDE which has a direct pathway to the atmosphere. By far the greater proportion of exposure an individual may receive under any circumstances from the radionuclides listed in Table 5-1 is from whole-body immersion.

The Environmental Protection Agency (EPA) requires compliance with National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40CFR61) as documented in an annual radionuclide air emissions report. SLAC's report, see Appendix B, for CY95 provided calculations and modeling of air emissions. Emissions were derived by calculating the saturation activity for oxygen-15, carbon-11, nitrogen-13, and argon-41, and then releasing the radionuclides while applying an appropriate decay period.

It was conservatively assumed that these releases occurred at the end of each experimental cycle, that is, whenever the machine was shut down for repair or maintenance, whether or not any venting was performed. For the single facility that was not totally enclosed, a diffusion mechanism was conservatively estimated to determine releases that occurred continuously during beam operations.

The compliance report was generated using the required computer program, EPA, CAP88-PC, Version 1.0. The results (9.12×10^{-4} mrem or 9.12×10^{-6} mSv) show that the annual effective dose equivalent (EDE) was less than 1% of the NESHAPs standard, that is, 1.0 mrem (0.01 mSv) in CY95. Note that the NESHAPs standard, 10.0 mrem (0.1 mSv), is 10% of the DOE DCG's effective dose equivalent to a member of the public, which is 100 mrem (1.0 mSv).

5.2 Wastewater Monitoring

Wastewater containing small quantities of radioactivity within regulatory limits was periodically discharged to the sanitary sewers from the site. The only possible sources of liquid radioactive effluents were from low conductivity water (LCW) cooling systems in the BSY and certain other areas of the accelerator housing. In the event of leaks from these systems, water was collected in stainless steel lined sumps sized to contain the entire water volume. Along the Klystron Gallery there are a series of poly tanks which are used to collect LCW from the alcoves of the gallery.

The greatest source of induced radioactivity was where the electron/positron beam was absorbed. Since water is composed of hydrogen and oxygen, the only radionuclides produced were the short-lived oxygen-15 and carbon-11, beryllium-7 (half-life of 54 d), and longer-lived tritium (half-life of 12.3 y). Other radionuclides which could potentially be in the water systems would come from activated corrosion products.

The corrosion products were typically gamma emitters. Oxygen-15 and carbon-11 are too short-lived to present an environmental problem in water. Beryllium-7 and the corrosion products were removed from the LCW by the resin beds required to maintain the electrical conductivity of the water at a low level. Therefore, tritium was the most significant radioactive element present in the water that was of environmental importance in CY95. Tritium emits a soft beta and is detected primarily through liquid scintillation analysis.

All water potentially containing radioactivity was collected into several holding tanks at various points along the accelerator in order to control and keep track of tritium quantities prior to release to the sanitary sewer. Water in these holding tanks was discharged into the sanitary sewer only after radioanalysis had been completed. Radioanalysis records of the wastewater discharged for each quarter of CY95 are given in Table 5-2.

Table 5-2 Radioanalysis Results for Wastewater Discharged During CY95

Date Released	Quantity [gal[a]]	Radioactivity [mCi[b]]
First Quarter	125,130	9.79
Second Quarter	70,025	0.04
Third Quarter	60,541	0.55
Fourth Quarter	52,191	0.42
Total:	307,887	10.80[c]

[a] 1 gal = 3.8 liter
[b] 1 mCi = 3.7×10^7 Bq.
[c] This total is 0.22% of the yearly limit

The concentration of radioactivity released was less than the DCG specified by DOE Order 5400.5, *"Requirements for Radiation Protection for the Public"*.

SLAC is also bound by the provisions in a contract for service with the West Bay Sanitary District (WBSD) (Permit No. WB860915-FNS) and State regulations (California Code of Regulations, Title 17, Section 30287) which limited SLAC to a maximum of 5,000 mCi (that is, 5 Ci, or 1.85×10^{11} Bq) of tritium and 1,000 mCi (1 Ci or 3.7×10^{10} Bq) of all other radionuclides to be discharged to the sanitary sewer each calendar year.

5.3 Peripheral Monitoring Stations (PMSs)

Seven PMSs designed to provide continuously recorded data from radiation detectors located near SLAC's boundaries have been installed as direct radiation monitors. Their positions are shown in Appendix D, Figure D-1.

During CY95, every station was actively operated for large parts of the year. In CY95, 325 operating days of data were accumulated. All PMS data herein reflects activity on those operating days.

The response of each station is recorded in the VAX history buffer located in the Main Control Center (MCC). Each calendar quarter, a plot of the average dose rate for each 24 hour period was generated together with the maximum dose rates from neutron and high-energy photon radiation for that quarter. Each station recorded both accelerator and natural background radiation sources. The natural background radiation levels were known since we had been measuring this source for more than twenty years.

Historically, the measured annual dose to the general population coming from accelerator operations was almost entirely from fast neutrons and was characterized as skyshine from SLAC's research area. During CY95, there were some small neutron and photon (gamma and/or x-ray) peaks recorded by these PMSs. Estimates of accumulated neutron and photon doses associated with the peaks seen from these PMSs (325 operating days) were less than 3 mrem (0.03 mSv), on the average.

Radiation information was obtained using GM tubes for the high energy photon component and polyethylene moderated BF_3 neutron detectors for the particle component. The resultant sensitivities were such that a cobalt-60 source yielding a gamma dose equivalent rate of 1 mrem/h (0.01 mSv/h) would be recorded as 10^4 counts per minute (CPM) on the GM tube channel and a neutron source yielding a neutron dose equivalent rate of 1 mrem/h (0.01 mSv/h) would be recorded as 10^5 CPM on the BF_3 channel. All signals are fed into CAMAC inputs for signal acquisition and buffering by the MCC VAX computer system. Since August 1990, all data has been retained in a permanent history record.

Based on a qualitative and quantitative assessment of operating periods for the PMSs during CY95, the work being performed for the experimental program, and thermoluminescent dosimeter (TLD) results, it was estimated that the actual exposure to the closest member of the general public was about 2.2 mrem (0.022 mSv) for CY95. See Appendix A for the analytical model used for evaluating potential dose to the closest member of the general public. Tables 5-3 and 5-4 provide the measured dose equivalents and the summary effective dose equivalents for CY95.

The data from the PMSs were used for a qualitative check on the TLD radiation monitoring stations. Quantitatively, the data was not used to determine the dose to the general public, but only as an order of magnitude check against the TLDs. During CY95, issues regarding the locations of the stations and the design of the housings of the PMSs raised questions about the validity of the data. Redesign of the PMSs was completed during CY95. Data from the PMSs are now believed to be more valid with regards to the known sources of direct radiation and may be used more extensively in the future.

Table 5-3 CY95 Annual Penetrating Radiation Dose Measured by PMSs[a]

PMS No.	Net Photon Dose (mrem[b])	Net Neutron Dose (mrem[b])
1	2.55	0.133
2	2.18	0.108
3	2.73	0.168
4	1.78	0.076
5	2.10	0.001
6	2.51	0.256
7	Not Available[c]	Not Available [c]

[a] Data for 278 operating days only
[b] 1 rem = 0.01 Sv.
[c] Source code not yet developed for PMS 7.

Table 5-4 Summary of Annual Effective Dose Equivalents Due to 1995 Laboratory Operations

	Maximum Dose to General Public[a, b] (direct radiation only)	Maximum Dose to General Public[a, b] (airborne radiation)	Maximum Dose to General Public[a, b] (airborne + direct radiation)	Collective Dose to Population within 80 km of SLAC[b]
Dose	2.2 mrem	0.0009 mrem	2.2 mrem	4.26 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	—
Percentage of Radiation Protection Standard	2.2%	<1%	2.2%	—
Background	100 mrem	200 mrem	300 mrem	1.47×10^6 person-rem
Percentage of Background	2.2%	<1%	0.7%	Negligible

[a] This is the dose to the maximally exposed member of the general public. It assumes that the hypothetical individual is at the closest location to the facility continuously, 24 hours/day, 365 days/year.
[b] 100 mrem = 1μSv and 1 person-rem = 0.01 person-Sv.

5.4 Passive Thermoluminescent Dosimeter (TLD) Monitoring Program

To supplement the PMSs for photon and neutron external dose monitoring, SLAC has developed an environmental TLD monitoring program. Landauer, a National Voluntary Laboratory Accreditation Program (NVLAP) certified dosimetry service, was contracted to provide SLAC with quarterly TLDs. The LDR-X9 aluminum oxide TLD was designed to measure low-level photon radiation with a minimum detection level of 0.1 mrem (0.001 mSv). The LDR-I9 TLD is used for monitoring neutron radiation with a minimum detection level of 10 mrem (0.1 mSv). Both of these TLD systems were in use throughout CY95.

The environmental measurements using TLDs are summarized in Appendix D. The results show that there was fairly good agreement between the PMSs and TLDs. TLD results indicated that one site boundary location with the highest accumulated dose-equivalent in CY95 reported 23 mrem (0.23 mSv).

The CY94 TLD data showed the need for additional shielding of potential radiation sources from the klystron gallery. New shielding installations were completed in CY95 during the extended accelerator maintenance down period. Survey results of the effectiveness of the new shielding showed photon dose reduction factors ranging from 2 to 4.

The TLD data for CY95 were used to evaluate the radiation dose from direct radiation to the maximally exposed member of the general public and the collective dose to the general public within 80 km of SLAC. See Appendix D for data.

5.5 Radiological Media Sampling Program

Media sampling was limited to water (the major pathway for radionuclide release to the environment). The low source terms proportionate to DOE's DCGs have identified only this route as a likely pathway for any potential off-site population exposure. Limited soil sampling in past years has not revealed detectable levels of human-made radionuclides. In future years, a planned characterization of the site through media analysis will be done to establish the naturally occurring radionuclides on site and the background levels seen at different areas to serve as baseline values for future reference. Verification of no significant levels of human-made radionuclides by laboratory radioanalytical methods will be done at the same time. Future monitoring will be part of the radiological Environmental Surveillance Program which is being developed under SLAC's Radiological Environmental Monitoring Plan.

6 Groundwater Protection

The Stanford Linear Accelerator Center's (SLAC's) Groundwater Protection Management Program (GPMP) was developed in accordance with Department of Energy (DOE) Order 5400.1. The GPMP provides comprehensive guidance to the groundwater program including planning, integration, and coordination of all supporting activities. Documents such as the *Remedial Investigation/Feasibility Study (RI/FS) Workplan*, a *Sampling and Analysis Plan* and associated *Standard Operating Procedures*, and a *Quality Assurance Project Plan* support monitoring and investigation activities.

The RI/FS work for groundwater is part of the Environmental Restoration Program (ERP) for investigation and remediation of contaminated soil and groundwater at SLAC and is discussed below and earlier in this report (see Section 4.5.1, "Environmental Restoration").

The *Annual Well Inspection and Maintenance Manual* guides inspection of wells to protect the integrity of the monitoring wells. In calendar year 1995 (CY95), groundwater monitoring data was collected in February, March, and July. Agreement was reached with the Regional Water Quality Control Board (RWQCB) to begin monitoring for selected wells on a semester basis beginning in July of 1995.

6.1 Groundwater Characterization Monitoring Network

6.1.1 CY95 Summary of Results and Issues

Overall, of the limited number of wells sampled in CY95, the results of SLAC monitoring for organic contaminants in groundwater in CY95 were very similar to the results from CY94. Work has begun in CY96 on putting in more wells around the areas of known contamination to define the lateral and vertical extent of contamination. Thus, except for selected wells around the Former Underground Storage Tank (FUST) area, the existing wells were not sampled in CY95.

The wells in areas with no contamination will be sampled on a 12 to 18 month basis unless contaminants are discovered. If this happens, samples will be taken more frequently to determine whether an investigation is appropriate.

6.1.2 Background

DOE Order 5400.1 requires that facilities characterize the groundwater at their site in order to determine and document the effects that the facilities have had on groundwater quality. The groundwater monitoring network includes 21 wells which provide environmental surveillance of groundwater conditions as required. The wells define general groundwater conditions at the SLAC facility. SLAC's groundwater monitoring network also checks groundwater at four distinct sites with known groundwater contamination.

Three of the wells were constructed at SLAC during initial construction and are still in use (wells EXW-2, EXW-3, and EXW-4). Well EXW-4 is also referred to as Well 24 which should be distinguished from MW-24.

SLAC began a characterization program in 1990 and installed ten groundwater monitoring wells (MW-21 through MW-30). The wells are in the major areas of the facility that historically or presently store, handle, or use chemicals which may pose a threat to groundwater quality. They are used to monitor general groundwater quality. Eight groundwater monitoring wells were installed for characterization studies at the site of the FUST.

Figure 6-1 shows the SLAC setting, including the boundaries, topography, and San Francisquito Creek, which runs parallel to the south and east end of the site before it turns towards San Francisco Bay. Locations of the twenty-one wells are at the eastern end of the facility as shown on Figure 6-2.

The wells are on the sampling schedule described in the *Quarterly Sampling and Analysis Plan*. Samples may be analyzed for one or more of the following: volatile organics, total petroleum hydrocarbons (TPHs), metals, polychlorinated biphenyls (PCBs), total dissolved solids (TDS), and general minerals. Volatile organics have been detected at levels of concern at SLAC.

Appendix E lists positive results of analyses for volatile organics performed since 1991. The samples collected from EXW-4 and MW-30 have been historically analyzed for gross beta particle activity and for tritium. Those results are also provided in Appendix E. Wells MW-21 through MW-30 and EXW-2, 3, and 4 were not scheduled to be sampled in CY95 but will be sampled in CY96 along with the new wells that will be installed to define the extent of volatile organic contaminants in groundwater as described below.

Table 6-1 summarizes the twenty-one wells in the monitoring network by the number of wells, area of the facility, and the purpose of the well. The purpose of the well may be either contaminant plume monitoring or environmental surveillance including general background monitoring. No wells were installed or abandoned at SLAC in CY95. As noted in Table 6-1, the four areas with groundwater contamination were:

- The Former Hazardous Waste Storage Yard (FHWSY).
- The Former Underground Storage Tank (FUST).
- The area of MW-24.
- The Plating Shop.

Table 6-1 Purpose and Location of Monitoring Wells

	Number of Active Wells	
Area of Site	Groundwater Contaminated Plume Monitoring	Environmental Surveillance
FUST[a]	8 wells	
FHWSY[b]	1 well	
MW-24	1 well	
Plating Shop	3 wells	
Research Yard		3 wells
End Station A		1 well
Master Substation 8; Salvage Yard		1 well
HWSY[c]		1 well
End Station B		1 well
Other (remote area)		1 well

[a] Former Underground Storage Tank
[b] Former Hazardous Waste Storage Yard
[c] Hazardous Waste Storage Yard

The locations with groundwater contamination are shown in Figure 6-2. The main organic contaminant in all of these areas is trichloroethene (TCE) and its breakdown products. TCE was historically used at SLAC as a cleaning solvent. TCE is no longer in general use at SLAC. It is used in very small quantities in a few research laboratories. The four contaminated groundwater sites are discussed in detail in the next section.

6.2 Groundwater Site Descriptions and Results

6.2.1 Former Underground Storage Tank (FUST)

6.2.1.1 Background

A groundwater monitoring network consisting of eight wells is located in proximity to SLAC's Plant Maintenance building in the northwestern portion of the facility (see Figure 6-3). The wells (MW-1 through MW-7 and EW-1) are being used to monitor the migration of chemical constituents associated with a FUST, which contained organic solvents during the period of 1967 to 1978. A pressure test performed on the FUST in 1983 indicated a leak and the tank and accessible contaminated soil was removed in December 1983.

The California RWQCB requires that SLAC monitor selected wells at the FUST site on a quarterly basis (RWQCB Waste Discharge Order 85-88). In CY95 SLAC reached agreement with the RWQCB to begin monitoring selected wells on a semester basis beginning in July 1995. Since 1987, the samples have been analyzed for volatile organics (EPA

Methods 8010/8020) by an analytical laboratory certified by the California Department of Health Services. A summary of the organic chemical analyses since installation of the wells is presented in Appendix E.

6.2.1.2 CY95 Results and Issues

As indicated in the July 1995 groundwater elevation contour maps (Figure 6-5), the groundwater flow direction was generally to the east. This area is near a groundwater saddle where gradients have generally been to the northeast and southeast over the last few years.

From CY91 to CY92, concentrations of volatile organic compounds (VOCs) decreased at the source (well EW-1) and increased in wells MW-5 through MW-7. These changes indicated that the contaminant plume was migrating away from the source and towards these wells. In CY92, although the contaminants spread concentrically from the FUST, the greatest increase in concentration occurred in well MW-5.

This suggested that, during CY92, the plume primarily migrated towards the east. This coincided with the dominant groundwater flow direction. In CY93, the concentrations of organic contaminants were similar to CY92 levels. The upward trend in contaminant concentrations at the outer part of the plume and the downward trend in contaminant concentrations at the source did not continue. In CY94, the concentrations of organic contaminants were similar to CY93 levels, except for a slight increase in concentrations in Wells MW-6 and 7, located near the source. In CY95 the concentrations of organic contaminants were similar to CY94 levels.

No organic compounds were consistently detected in the outer wells MW-1 through MW-3, nor in well MW-4, which tests groundwater generally deeper than groundwater being tested in the other wells.

6.2.2 Former Hazardous Waste Storage Yard (FHWSY)

6.2.2.1 Background

The FHWSY was in use from approximately 1965 to 1982. During closure of the yard, PCBs were found in shallow soils. As a result, several inches of topsoil were removed. Monitoring well MW-25, shown in Figure 6-4, was installed in this area in 1990. A soil-gas survey was conducted in 1992 at the site to delineate the source-area and extent of groundwater contamination. However, the survey was terminated early because the substrate had low permeability, which severely restricted air-flow through the probe. The source of VOCs in groundwater has not been defined, but may not be limited to the FHWSY.

6.2.2.2 CY95 Results and Issues

Groundwater flow as measured in July, 1995 was to the east, as shown on Figure 6-4. Groundwater from this well was not sampled in CY95. Constituents of concern at the FHWSY were detected in groundwater at levels as high as 100 parts per billion (ppb) of 1,1-dichloroethane (DCA), 50 ppb of 1,1-dichloroethene (DCE), and 2.4 ppb of Trichloroethene (TCE) in CY94, as shown on the tables in Appendix E. Concentrations of these constituents have remained in a

generally similar range since monitoring began. The source and extent of this plume have not been defined. Thus, this site will be further investigated and, if necessary, remediated. RI/FS work will begin in CY96.

6.2.3 Plating Shop

6.2.3.1 Background

In 1990, three monitoring wells, MW-21, MW-22, and MW-23, were installed downgradient of the Plating Shop, as shown in Figure 6-5. Results of a soil-gas survey were of limited value because of the low permeability of the sediments. However, the results did suggest that the plume did not originate upgradient of the Plating Shop.

6.2.3.2 CY95 Results and Issues

Groundwater flow has been consistently to the southeast, as shown in Figure 6-5. Groundwater from these wells was not sampled in CY95. Contaminants at the Plating Shop have been detected at levels as high as 1,200 ppb of TCE and 350 ppb of 1,1-DCE as shown on the tables in Appendix E. Concentrations of contaminants have generally remained in a constant range since monitoring began. The extent of this plume has not been defined. This site will be further investigated under RI/FS work that will begin in CY96.

6.2.4 Monitoring Well 24 (MW-24)

6.2.4.1 Background

MW-24 was installed in 1990 at the site of a former leaking diesel pump. Contaminated soil was removed and the well was installed to monitor for the possible presence of diesel fuel. However, diesel fuel has never been detected in this well.

6.2.4.2 CY95 Results and Issues

The location of MW-24 and groundwater flow direction are shown in Figure 6-5, which also shows the location of the wells around the Plating Shop area. Groundwater consistently flows to the southeast. The concentration of TCE and 1,1 DCE have risen from a few ppb in January 1993 to around a hundred ppb in subsequent quarterly samples. SLAC has made the decision to include this site in the RI/FS work that will begin in CY96.

6.3 Quality Assurance

As discussed in the *1992 Annual Site Environmental Report*, a quality assurance (QA) review of sampling and analysis procedures identified laboratory and sampling errors in metals and gross alpha and beta results. During CY93, SLAC wrote and implemented procedures which resulted in consistent results for analyzed constituents. These reports were updated in CY95. As described in the *Quality Assurance Project Plan* and the *Standard Operating Procedures*, SLAC conducts a quality data validation review for all data collected.

Due to previous sampling and laboratory analysis inconsistencies, results shown in Appendix E for metals and gross alpha and beta for all of the wells prior to March 1993 are suspect.

6.4 Groundwater Protection Management Program

The GPMP, as required by DOE Order 5400.1, provides the overall framework for SLAC's groundwater program. Major documents to support the program include:

1. *Remedial Investigation/Feasibility Study (RI/FS) Workplan.*
2. *Sampling and Analysis Plan.*
3. *Standard Operating Procedures.*
4. *Quality Assurance Project Plan.*
5. *Field Sampling Plan.*
6. *Annual Well Inspection and Maintenance Manual.*

The components of the GPMP include the following:

6.4.1 Documentation of the Groundwater Regime with Respect to Quantity and Quality

The groundwater regime at the SLAC site and nearby off-site areas has been comprehensively documented in the *SLAC Hydrogeologic Review* completed in CY94. This report compiled data and summarized results of the numerous geologic, hydrogeologic, and hydrogeochemical investigations that have taken place at or near SLAC for various reasons:

- Water resources studies.
- Research.
- Geotechnical studies used to site the structures being built at SLAC.
- Environmental and monitoring purposes.

The report developed a conceptual model of the groundwater regime at SLAC. Of particular interest to studies of contaminant transport was the fact that the major bedrock unit underlying SLAC conveyed groundwater primarily by fracture flow. Based on numerous tests in exploratory borings and wells, the hydraulic conductivity of this bedrock was much less than the range of hydraulic conductivity generally accepted as representing natural aquifer material.

6.4.2 Design and Implementation of a Groundwater Monitoring Program to Support Resource Management and Regulatory Compliance

This part of the GPMP identifies all DOE requirements and regulations applicable to groundwater protection and provides the framework for the groundwater monitoring program to:

- Demonstrate compliance.
- Provide data and reporting requirements for the early detection of groundwater contamination.
- Provide data for decisions concerning groundwater resource management.

Two documents, the *Quality Assurance Project Plan* and *Standard Operating Procedures*, provide guidance for the quarterly groundwater monitoring program and ensure that data collected is of acceptable and comparable quality. These plans follow the applicable Environmental Protection Agency (EPA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and DOE guidance documents referenced in the specific plans.

6.4.3 Management Program for Groundwater Protection and Remediation, as Related to SDWA, RCRA, and CERCLA Requirements

The components of the management program for groundwater protection and remediation include:

1. SLAC personnel-management responsibilities.
2. Prioritization of site groundwater investigation studies.
3. Management of known groundwater contamination sites.
4. Guidelines for management of investigation of potential or known sources of groundwater contamination.

Several documents were prepared in 1993 under the guidance of this section of the GPMP and are discussed further in Section 6.4.6. *A Beneficial Use Assessment,* which included a well survey of the area around SLAC, provided information on possible beneficial uses of groundwater at SLAC, as outlined in the *California Regional Water Quality Control Board Basin Plan.* This report concluded that groundwater at SLAC has a very high TDS content and a very low rate of flow, and is not suitable for most potential beneficial uses.

Figure 6-8 shows the SLAC facility with respect to the location of the nearest downgradient drinking water wells which are shown as wells 46 and 26. Each of these wells supports one residence. Wells 11 and 12 provide drinking water to Stanford University. The groundwater at SLAC has a distinctly different signature than the groundwater in these wells. SLAC's groundwater generally exceeds TDS concentrations of 3,000 milligrams per liter and has been measured as high as 10,000 milligrams per liter.

6.4.4 Summary and Identification of Potentially Contaminated Areas

SLAC's 1992 report entitled *Identification and Summary of Potentially Contaminated Sites* provides a summary of areas that may be contaminated by hazardous substances. Information for the report was collected from a variety of sources including spill reports, aerial photographs, operations records, reports on previous investigations, and interviews with SLAC personnel throughout the facility.

6.4.5 Strategies for Controlling Sources of Contaminants

Strategies for contaminant source control involve measures to control known soil or groundwater contamination, and procedures to address practices that may contribute to groundwater contamination. In addition, the Storm Water Pollution Prevention Plan (SWPPP) and the Spill Prevention, Control, and Countermeasure Plan (SPCCP) discuss best management practices (BMPs) for preventing contamination at the SLAC facility. Environment, Safety, and Health (ES&H) Manual chapters on Secondary Containment and Oil-filled Equipment Management Program will address practices for preventing contamination from reaching soil or groundwater when completed in CY96.

To reduce the threat of groundwater contamination further, SLAC has established a Waste Minimization Program and a Pollution Prevention Awareness Program as required under DOE Orders 5400.1 and 5820.2A. These programs have promoted source control through the reduction of hazardous material usage and hazardous waste generation. This was accomplished by encouraging environmentally-conscious engineering and by increasing employee awareness.

6.4.6 CERCLA and DOE Required Remedial Action Program

An RI/FS Workplan addressed soil and groundwater contamination at SLAC. This was part of a CERCLA program required by DOE Order 5400.4. Associated documents included a *Sampling and Analysis Plan* and associated *Standard Operating Procedures, Quality Assurance Project Plan,* and *Field Sampling Plan.* These documents provided overall guidance for the remedial action program.

6.5 EXW-4 Tritium Results

Results for tritium analyses for CY94 groundwater monitoring in Well EXW-4 were similar to previous years' results as shown in Table E-19. Quarterly results with concentrations of less than 10,000 pCi/l are one half to one third of the California state drinking water maximum concentration level (MCL) of 20,000 pCi/l. However, this water is not usable as drinking water due to a very high TDS content, and is not used for any purpose at SLAC. Concentrations have varied about this concentration amount since the 1960s.

Well EXW-4 is located in the area of Beam Dump East ('BDE). The most probable source of tritium in the groundwater is low-level activation due to beam particle penetration in the area. The lack of tritium in other cross-gradient to down-gradient monitoring wells suggests that this groundwater does not commingle with other groundwater.

Since the concentrations have consistently been between 6,000 and 10,000 pCi/l since January 1993, no samples were analyzed in CY95. However, EXW-4 will be monitored in CY96, and will continue to be monitored on a 12 to 18 month schedule thereafter in order to determine any long-term trends in tritium concentration. If a trend of increasing tritium concentration is noted, then an investigation will ensue.

Figure 6-1 Site Topographic Setting

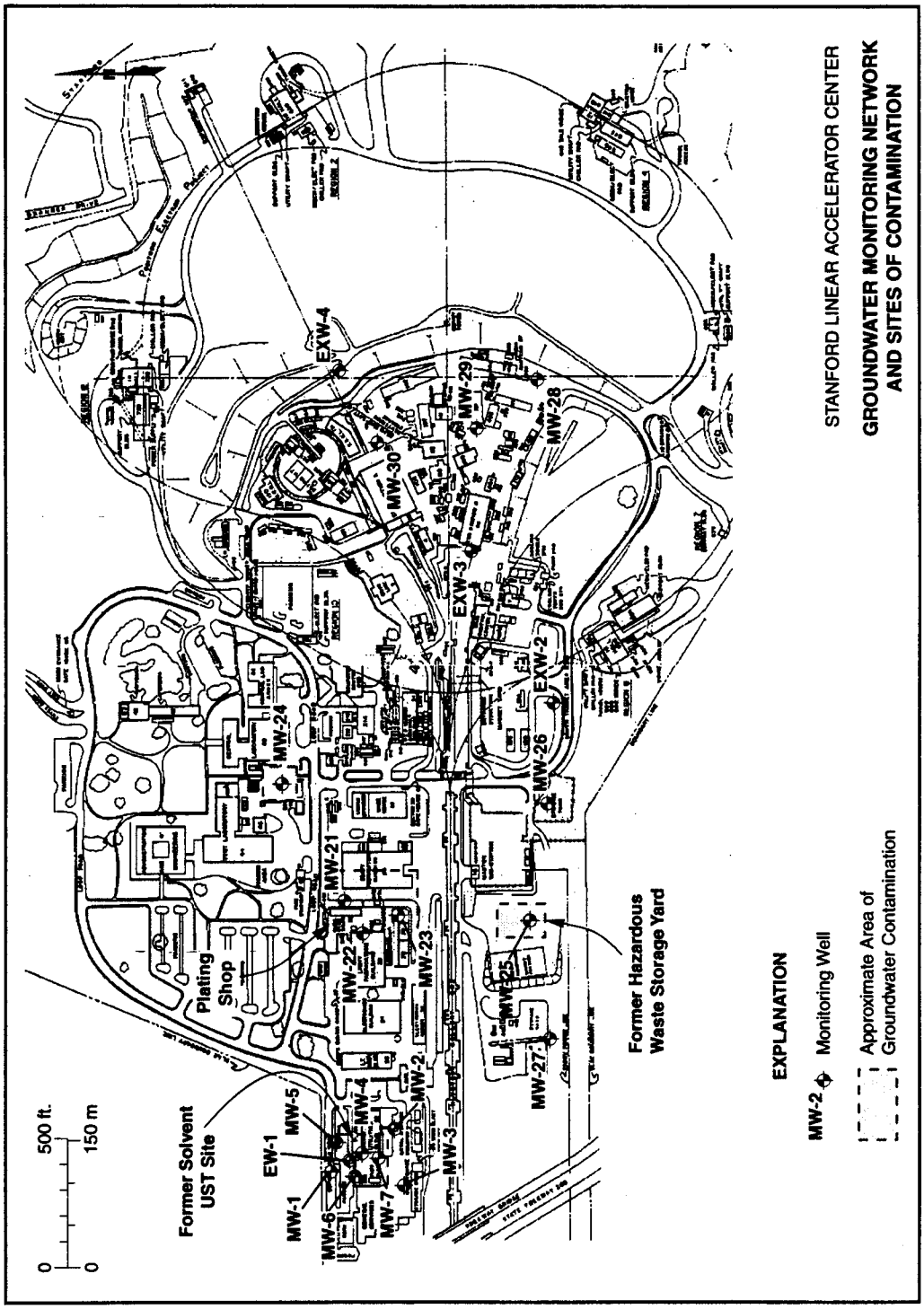

Figure 6-2 Location of Groundwater Monitoring Well Network and Areas with Groundwater Contamination

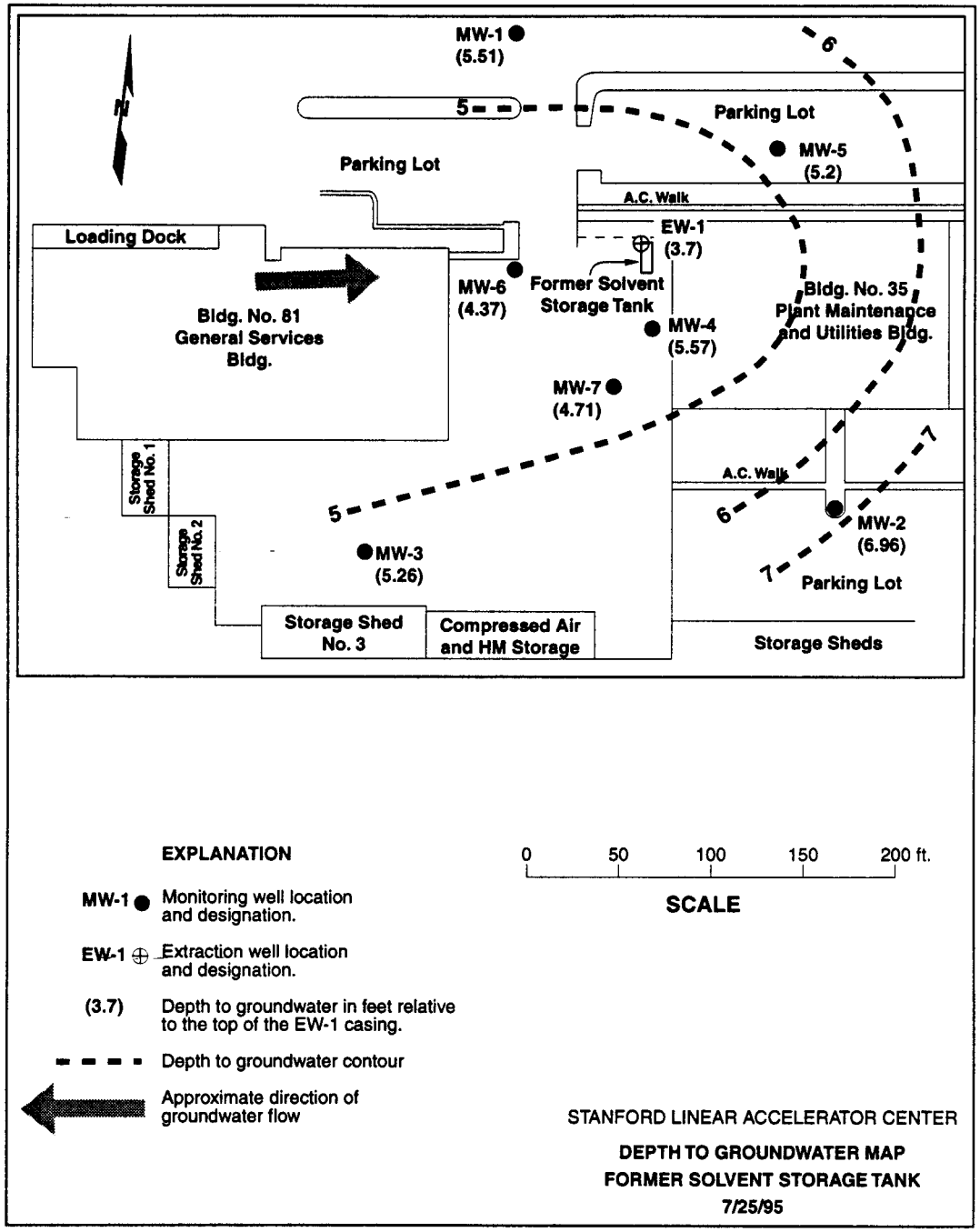

Figure 6-3 Location and Groundwater Contour Map in the Area of the Former Solvent Storage Tank, July 1995

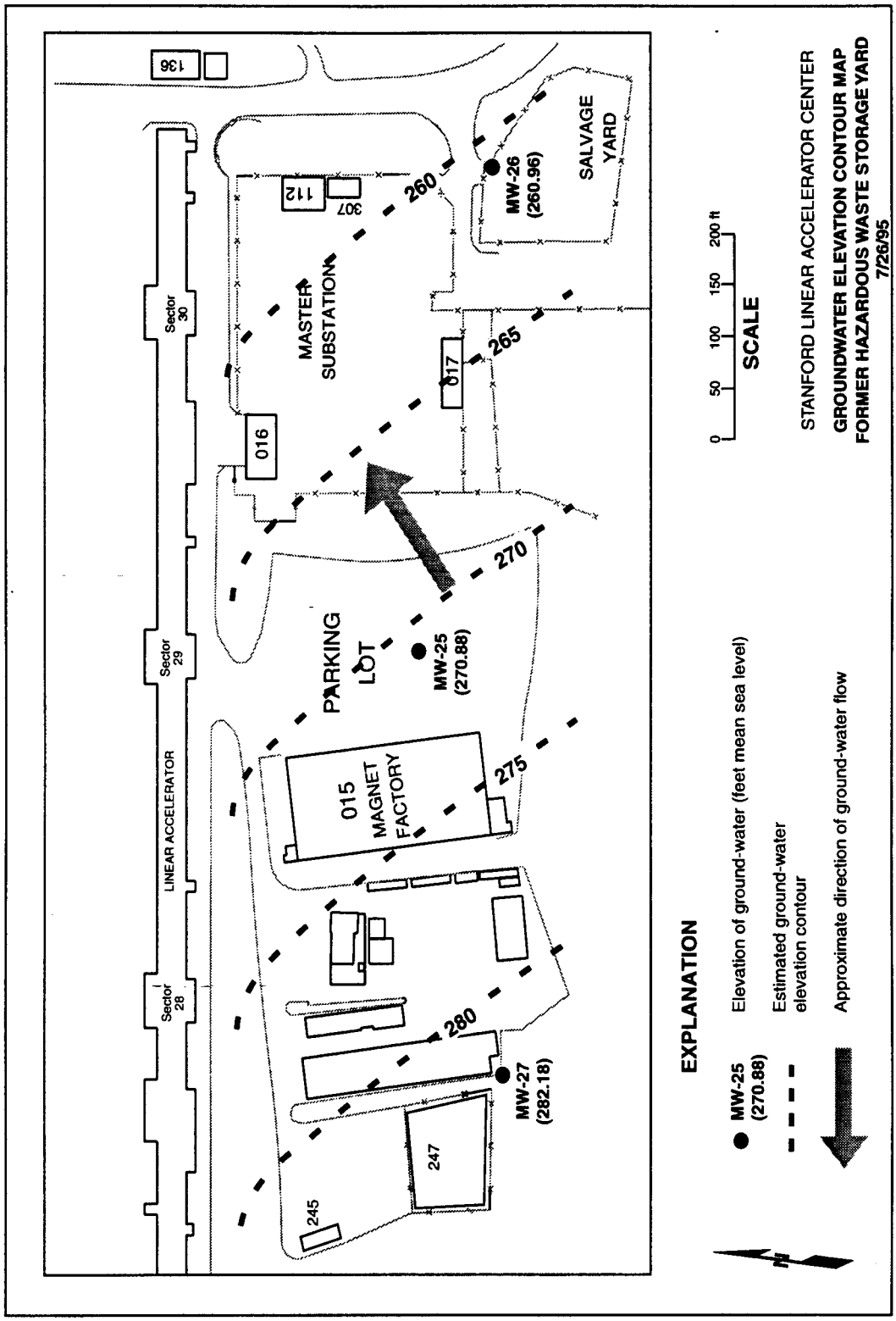

Figure 6-4 Location and Groundwater Elevation Contour Map of the Former Hazardous Waste Storage Yard, July 1995

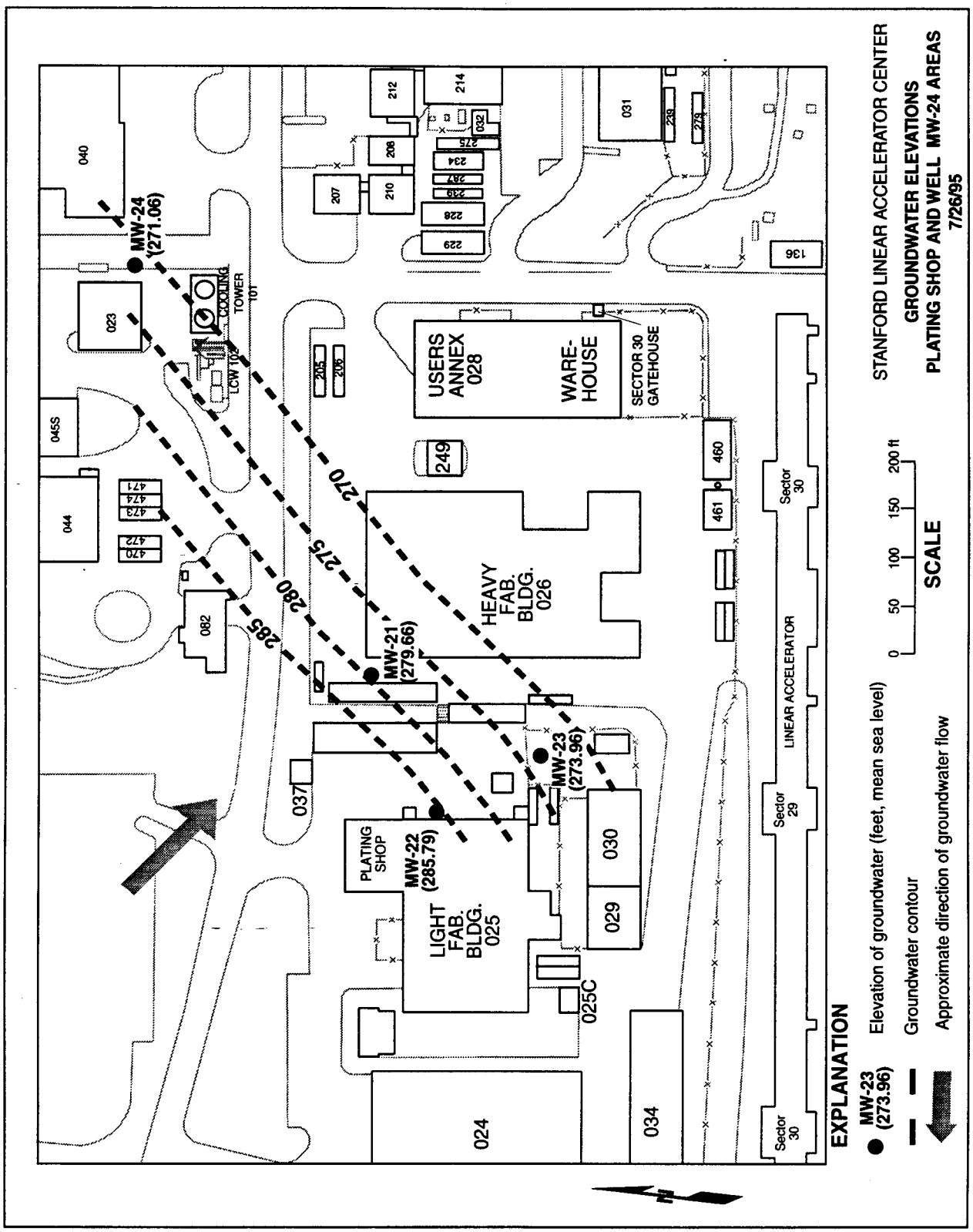

Figure 6-5 Location and Groundwater Elevation Contour Map of the Former Hazardous Waste Storage Yard, July 1995

[This page left intentionally blank.]

7 Quality Assurance

The Stanford Linear Accelerator Center's (SLAC's) site-wide Quality Assurance (QA) Program has been crafted to meet the requirements of Department of Energy (DOE) Order 5700.6C. The QA Program is described in the *SLAC Institutional Quality Assurance Program Plan* (SLAC-I-770-0A17M-001). This document was approved by the DOE in May 1993. The plan defines the roles, responsibilities, and authorities for implementation of the ten criteria from DOE Order 5700.6C.

The Safety, Health, and Assurance (SHA) Department is involved in the qualification process for environmentally sensitive services, including off-site analytical laboratories. SHA is responsible for auditing the line QA and environment, safety, and health (ES&H) programs; maintaining the *SLAC Institutional Quality Assurance Program Plan*; and providing direction for implementation of the ten criteria from 5700.6C.

The QA Program includes qualification of laboratories that provide analytical services, verification of certification to perform analytical work, and review of Environmental Protection Agency (EPA) performance test results. Also included in this review is adequacy of the internal quality control (QC) practices, record keeping, chain of custody, and the analytical laboratory QA program as a whole.

Laboratory performance testing is performed as outlined in the latest revision of the *Environmental Laboratory Performance Program* (SLAC-I-770-2A17C-008).

The following procedures and policies that support the QA Program for environmental monitoring activities have been developed:

Document #	Title
QC-030-004-00-R0	*Radioactive Water Sampling/Analysis Audit Procedure*
SLAC-I-770-0A19C-001	*Oversight Procedure*
SLAC-I-770-2A19C-004	*Non-Radiological Sampling Audit Procedure*
SLAC-I-770-0A16Z-001	*Establishing Data Quality Objectives*

The Environmental Restoration Program (ERP) will use the *Quality Assurance Project Plan* for the *Remedial Investigation and Feasibility Study* for soil and groundwater contamination investigations. The *Quality Assurance Project Plan* for the groundwater monitoring program and the associated *Data Management Plan* are used for the quarterly groundwater monitoring program. These documents have all the components required of *Quality Assurance Project Plans* according to EPA, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and DOE guidance documents. This includes defining required laboratory and field QA/QC procedures and corrective actions, as well as data validation and reporting.

[This page left intentionally blank.]

A Model for Potential Dose Assessment

According to Department of Energy (DOE) Orders, an assessment of whole-body dose equivalent (in person-rem) to the general population near SLAC is required where appropriate. For this report, the term dose equivalent simply will be called dose. SLAC's dose to the maximally exposed member of the general public due to accelerator operations was conservatively estimated to be 2.2 mrem (0.022 mSv) in CY95 from penetrating radiation. The 2.2 mrem (0.022 mSv) value is approximately 0.7% of the total natural background dose and is 2.2% of the dose limit for members of the general population, that is, 100 mrem (1 mSv) per year (DOE Order 5400.5).

There are three major pathways leading to human exposure from human-made ionizing radiation:

- Airborne Radioactivity.
- Food Chain Radioactivity.
- Direct Exposure to Penetrating Radiation.

Of these three major pathways, only direct exposure to penetrating radiation is of any measurable significance from SLAC operations. The sources of this exposure are from neutrons resulting from the absorption of high-energy electrons, from photons from klystron operations, and/or from the experimental areas where energetic particles are created, some of which may escape from the heavily shielded enclosures.

In order to make an accurate and realistic assessment of radiation exposure to the public at low doses, it is necessary that exposure from the natural radiological environment be known, that is, background radiation. This is true because the instruments used respond to natural radiation sources as well as human-made sources, and the portion due to natural radiation must be subtracted from the total measurement. The population exposure assessments appearing in this report are in all cases overstatements, due to the conservative modeling assumptions used compared to the likely actual impact; hence, the resulting values are representative of an upper limit of the possible range.

While the annual radiation dose from accelerator operations at the site boundary has generally been measurable, it has always amounted to less than 10% of the total annual individual dose from natural background radiation. According to an Environmental Protection Agency (EPA) report, the average dose from cosmic, terrestrial, and internal radiation (not including radon) in California is 125 mrem (1.25 mSv). For purposes of comparison, we have rounded this number down to 100 mrem (1 mSv).

Another quantity of interest is the population dose in units of person-rem (person-cSv). This is simply the product of average individual dose and the total population exposed. For example, if

1,000 people are exposed to an average annual background dose of 0.1 rem (1 mSv), then the population dose is 0.1 x 1,000 or 100 person-rem (1 person-Sievert) from natural background radiation. The annual variation of exposure to natural background radiation may be ± 20%, largely caused by differences in naturally occurring uranium, thorium, and potassium present in the ground and in building material where people live and work.

Most of the high energy accelerator laboratories have made measurements to determine the characteristic attenuation of radiation fields from their facilities. These measurements are unique to each facility because of design differences, types of machines, and surrounding topography. We have chosen a conservative formula for calculating the dose at distances other than the point of measurement. Lindenbaum gave a method for evaluating skyshine which was later verified by Ladu using Monte Carlo techniques. Lindenbaum approximated the falloff by $(e^{-R/\lambda})/R$ where R is distance in meters from the source and $\lambda = 250$ m. This equation fits the SLAC data fairly well, and is the one used to predict doses beyond our measuring stations (see Figure A-1). It is likely that the methods used and reported in this document could overestimate the true population dose by at least an additional factor of two.

In CY95, the doses to the public were dominated by photon radiation from either the klystrons or the accelerator with neutron doses being insignificant. The model used for evaluating the dose to the general public was as follows:

A. Maximally Exposed Member of the General Public:

1. Determined the closest locations of the general public to the facility.
2. Evaluated the Thermoluminescent Dosimeter (TLD) data closest to these locations.
3. Determined the source of the radiation as seen by the TLD station.
4. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
5. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
6. Evaluated TLD data to determine the highest dose locations.
7. Determined the location of the general public closest to these TLD locations.
8. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
9. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
10. Reported the highest dose to any member of the general public as the maximally exposed individual.

B. Collective Dose to the General Public:

1. Established a population grid out to 80 km from the facility.
2. Determined the highest site boundary TLD dose.
3. Applied this dose conservatively to the whole facility.

4. Applied this dose to the population grid using a line source geometry (1/R relationship) out to 500 meters of the facility and a point source geometry ($1/R^2$ relationship) from 501 meters to 80,000 meters.

5. Extrapolated the neutron dose using the Lindenbaum approximation.
6. Summed all the population doses from the grid.

The population demographics in the vicinity of SLAC, that is, within an 80 km radius, include a mixture of commercial and residential dwellings. Based on the data from the 1990 census, the population estimate in this area is about 4,917,443 residents. Based on the TLD results, the maximum dose at the SLAC site boundary was about 23 mrem in CY95. Using this maximum dose value, it was estimated that the collective dose to the population within 80 km of SLAC was about 4.26 person-rem (0.0426 person-Sv).

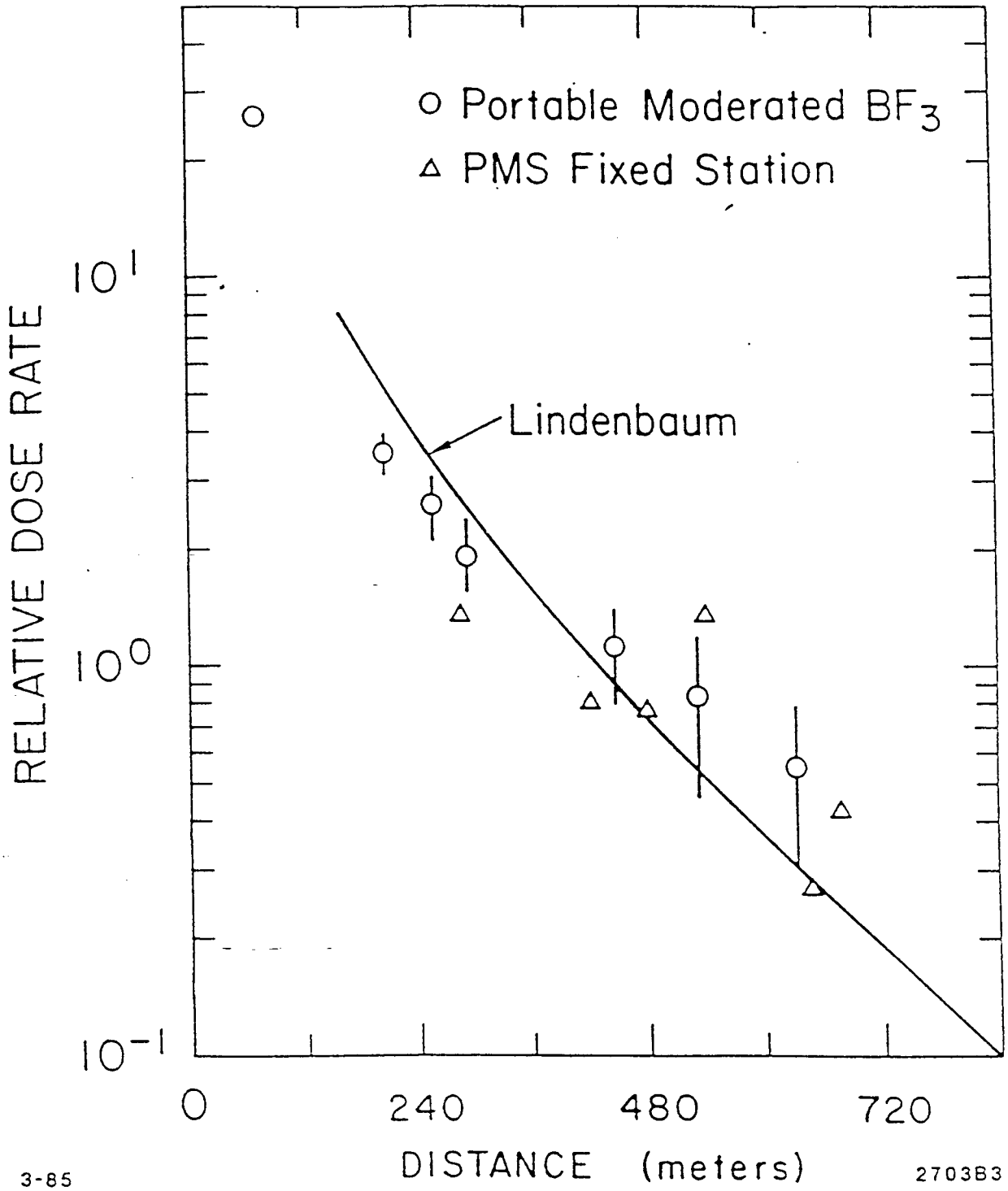

Figure A-1. Measurements made along a line between End Station A and the site boundary.

B Radionuclide Air Emissions Annual Report

B.1 Facility Information

Stanford Linear Accelerator Center (SLAC) was in full compliance in calendar year 1995 (CY95) with the requirements set forth in 40 CFR Part 61 Subpart H.

B.1.1 Site Description

SLAC is a national facility operated by Stanford University under contract with the U.S. Department of Energy (DOE). It is located on the San Francisco peninsula, about halfway between San Francisco and San Jose, California. The site area is a belt of low, rolling foothills, lying between the alluvial plain bordering the San Francisco Bay on the east and the Santa Cruz Mountains on the west.

The whole accelerator site varies in elevation from 53 to 114 meters (175 to 375 feet) above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 meters (150 feet) above sea level. The mountains to the west rise abruptly to 610 meters (2,000 feet). The SLAC site occupies 170 hectares (420 acres) of land. The site is located in an unincorporated portion of San Mateo County. It is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek.

The SLAC staff is roughly 1,400 employees, temporary staff, and visiting scientists. The climate in the SLAC area is Mediterranean. Winters are cool (sometimes it rains) and summers are mostly warm and dry.

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single family housing, and pasture. SLAC is mainly surrounded by 5 communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population distribution and housing data from the 1990 census for these five communities are shown in Table B-1 below:

Table B-1 Demographic Data

Geographic Area	Population [persons]	Pop. Density [persons/sq. mile]	Housing [units]	Land Area [sq. mile]
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6,569.14	4,770	2.755
Total:	38,448	NA	12,556	29.106

SLAC is a component of the U.S. high energy physics program. The laboratory uses a 3.2 km (2 mile) long electron accelerator to produce and accelerate both electrons and positrons for basic particle physics research.

The facilities at SLAC are used to maintain the accelerator, to design and construct new detector systems, and to support research in accelerator technology.

B.1.2 Source Description

Radioactive material is inevitably produced by the operation of the accelerator. During the acceleration process some electrons strike accelerator components and induce radioactivity in the material. In addition, some high-energy particles interact with air molecules producing relatively short-lived radionuclides such as ^{15}O, ^{13}N, ^{11}C, and ^{41}Ar. These radioactive gases are normally produced in areas where the beam strikes beam line components (beam loss). There were eight potential beam loss areas identified at SLAC for CY95 where the saturation radioactivity is produced:

- Accelerator Housing (LINAC).
- Positron Source.
- Stanford Linear Collider (SLC) Beam Dumps.
- Beam Switchyard (BSY).
- SLC Damping Rings.
- Stanford Synchrotron Radiation Laboratory (SSRL) Booster Injector.
- Final Focus Test Beam (FFTB).
- End Station A (ESA).

The saturation radioactivity is defined to be the equilibrium radioactivity level inside these areas when the accelerator is running. Calculations of saturation activity in each of these eight beam loss areas are conservatively based on the specific beam power loss and the area geometry (that is, air path length, air volume, and other factors).

Potential release points from these areas are either from the access openings (that is, entrance doors, manways) or from the forced air ventilation ducts. All the access openings are closed and administratively secured during beam operation; therefore, potential releases occur only after turning off the beam.

For As Low As Reasonably Achievable (ALARA) considerations, SLAC's radiological control policies recommend that the time between turning the beam off and venting (or making entry) should be at least one hour during normal operations. This one hour venting/entry delay is long enough for the dominant radionuclide (^{15}O) to decay through several half-lives. In CY95, the typical entry delays varied for the different beam loss areas.

The calculated source terms in each area for CY95 were conservatively based on the number of times that the machine was shut down for repair or maintenance in CY95, and were independent of whether or not venting was carried out. These calculated source terms are presented in Tables B-2 through B-9. In addition, the "number of releases/year" was conservatively estimated for many systems. The decay time for the produced radioactive gases prior to release varied for the different beam loss areas. Detailed descriptions of the beam loss areas and their associated radionuclide concentrations are discussed below.

B.1.2.1 Accelerator Housing

The accelerator, or LINear ACcelerator (LINAC), is enclosed in a 3.2 km (2 mile) long housing. The housing is located 7.6 meters (25 feet) below ground. Access to the housing is through 76.2 cm (30 inch) diameter shafts every 100.5 meters (330 feet). These shafts (release points) are also used as intake and exhaust shafts for the accelerator housing.

Before machine operation, the housing is searched and locked. There is a solid cover across each manway shaft which is interlocked with the accelerator. The cover must be in place for machine operation; consequently, the housing is not vented when the accelerator is in operation. There are no releases from these points when the machine is on. After the machine is turned off, that is, no beams are being produced, the housing can be vented.

The radioactive gas concentration is very low in the accelerator housing because there is very little beam loss, as determined by the level of activation in the accelerator structure. It is conservatively assumed that the saturation activities in this area are similar to those in one of the SLC Beam Dump areas.

Table B-2 Accelerator Housing Activity

Radionuclide	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.0E-01	25	60	3.18E-09	0.00%
N-13	2.0E-02	25	60	7.69E-03	6.60%
C-11	3.0E-02	25	60	9.67E-02	82.95%
Ar-41	1.5E-03	25	60	1.22E-02	10.45%
Total:	1.5E-01			1.17E-01	100.00%

* 1 Ci = 3.7×10^{10} Bq

- After the electron beam leaves the accelerator, it is guided to an area where it may interact with a stationary target or be directed to collide with a beam of positrons. The distance from this facility to the nearest receptor (receptor defined as a member of the general public) is about 305 meters (1,000 feet).

B.1.2.2 Positron Source

The positron source is located in an area separated from the accelerator housing by a thick concrete shield. The beam is deflected out of the accelerator into the positron target. The electron beam produces electron/positron pairs in the target. The positrons are separated and transported back to the beginning of the accelerator. The air activation associated with the operation of the positron target has been evaluated with respect to the saturation activities. The saturation activities of potential radioactive gases in this area are listed in Table B-3.

Table B-3 Positron Source Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.4E+00	8	240	2.93E-35	0.00%
N-13	3.0E-01	8	240	1.34E-07	0.01%
C-11	3.0E-01	8	240	6.64E-04	27.09%
Ar-41	2.0E-02	8	240	1.79E-03	72.90%
Total:	2.0E+00			2.45E-03	100.00%

* 1 Ci = 3.7×10^{10} Bq

The positron source has a separate exhaust fan (release point). The positron source is not vented during machine operation. The distance to the nearest receptor is about 640 meters (2,100 feet).

B.1.2.3 Beam Dumps

SLAC is operating a machine called the SLAC Linear Collider (SLC). The SLC is the upgraded linear accelerator which produces 50 GeV positrons and electrons. These beams are deflected into transport systems which guide them to an interaction point. After the interaction collision point, any electrons and positrons remaining in the beams are deflected into beam dumps. There are two beam dumps located in shielded rooms in the SLC arcs. The saturation activities for both of these beam dumps are listed in Table B-4.

Table B-4 SLC Beam Dumps Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	2.0E-01	20	60	5.09E-09	0.00%
N-13	4.0E-02	20	60	1.23E-02	6.60%
C-11	6.0E-02	20	60	1.55E-01	82.95%
Ar-41	3.0E-03	20	60	1.95E-02	10.45%
Total:	3.0E-01			1.87E-01	100.00%

* 1 Ci = 3.7×10^{10} Bq

The SLC arc and dump areas are not vented (release points) during beam operation. The distance from the north arc SLC vent to the nearest receptor is 274 m (900 feet).

B.1.2.4 Beam Switchyard

There are four vents (release points) at BSY. The vents at BSY and Beam Dump East (BDE) have covers. The covers are closed during beam operation. Use of the saturation activity produced in the accelerator housing as the release from these four vents will give a conservative estimate of the effective dose equivalent. The distance from this facility to the nearest receptor is about 457 meters (1,500 feet).

Table B-5 Beam Switchyard Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.0E-01	12	120	1.94E-18	0.00%
N-13	2.0E-02	12	120	5.68E-05	0.71%
C-11	3.0E-02	12	120	5.99E-03	75.35%
Ar-41	1.5E-03	12	120	1.90E-03	23.94%
Total:	.5E-01			7.95E-03	100.00%

* 1 Ci = 3.7×10^{10} Bq

B.1.2.5 Damping Rings

There are two damping rings associated with the SLC. The rings are located on the north and south sides of the accelerator at the end of Sector 1. The distance from these two rings to the nearest receptor is about 274 meters (900 feet). Each ring has a forced air ventilation system (release point). No ventilation is carried out during beam operation. The saturation activity produced in each ring has been calculated. The radionuclides produced and their saturation activities are listed in Table B-6.

Table B-6 Damping Rings Activity

Isotope	Saturation Aetivity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.8E-02	20	60	4.58E-10	0.00%
N-13	3.2E-03	20	60	9.84E-04	24.93%
C-11	6.0E-04	20	60	1.55E-03	39.19%
Ar-41	2.2E-04	20	60	1.42E-03	35.89%
Total:	2.2E-02			3.95E-03	100.00%

* 1 Ci = 3.7×10^{10} Bq

B.1.2.6 SSRL Booster Injector

SSRL has a 3 GeV booster ring and linac (injector) that produce very low concentrations of radioactive gases. The radionuclides and their saturation activities are listed in Table B-7.

Table B-7 SSRL Booster/Injector Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	3.7E-04	14	120	8.38E-21	0.00%
N-13	7.0E-04	14	120	2.32E-06	6.11%
C-11	8.0E-05	14	120	1.86E-05	49.07%
Ar-41	1.2E-05	14	120	1.70E-05	44.82%
Total:	1.2E-03			3.80E-05	100.00%

* 1 Ci = 3.7×10^{10} Bq

The booster ring does not have forced air ventilation, thus the entrance door is the only potential release point. The distance from this facility to the nearest receptor is about 427 meters (1,400 feet).

B.1.2.7 Final Focus Test Beam

The FFTB is an extension of the old C-line from the BSY and extends out into the research yard. This facility tests technology that is used to reduce electron beam pulse sizes and increase collision probabilities for the next generation linear accelerators. The radionuclides produced and their saturation activities are listed in Table B-8.

Table B-8 Final Focus Test Beam Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.7E-04	2	60	4.32E-13	0.00%
N-13	3.1E-04	2	60	9.54E-06	49.79%
C-11	3.3E-05	2	60	8.51E-06	44.44%
Ar-41	1.7E-06	2	60	1.11E-06	5.77%
Total:	5.1E-04			1.92E-05	100.00%

* 1 Ci = 3.7×10^{10} Bq

The FFTB does not have forced air ventilation, thus the entrance door is the only potential release point. The distance from this facility to the nearest receptor is about 487 meters (1,550 feet).

B.1.2.8 End Station A

The ESA facility is used for fixed target experiments utilizing up to 50 GeV electrons from the A-line of the BSY. The majority of the beam loss occurs at BDE, which is a 400 gallon water dump at the end of the line from ESA. The radionuclides produced and their saturation activities are listed in Table B-9.

Table B-9 End Station A Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	2.0E-03	9	0	1.78E-02	21.81%
N-13	3.7E-03	9	0	3.33E-02	40.76%
C-11	4.0E-04	9	0	3.57E-03	4.37%
Ar-41	3.0E-03	9	0	2.70E-02	33.05%
Total:	9.1E-03			8.17E-02	100.00%

* 1 Ci = 3.7×10^{10} Bq

The ESA beam loss area is located at BDE. BDE does not have forced air ventilation, thus the entrance door to BDE is the only potential release point. This entrance door is a gate and does not constitute an area isolated from the environs. Continuous air diffusion to the environs is assumed at a rate of one tunnel volume per week. For this reason, the typical decay time of 0 minutes is used.

The radionuclide activities used for assessing compliance are listed in Table B-10. These activities were calculated using internal reports and memoranda to file.

Table B-10 Summary Activity by Location for CY95

Isotope	Accelerator Housing [Ci*]	Positron Source [Ci*]	SLC Beam Dump [Ci*]	Beam Switchyard [Ci*]	SLC Damping Rings [Ci*]	SSRL Booster/ Injector [Ci*]	FFTB [Ci*]	END Station A [Ci*]	All Site Total (Ci)	Percent of Contribution
O-15	3.2E-09	2.9E-35	5.1E-09	1.9E-18	4.6E-10	8.4E-21	4.3E-13	1.8E-02	1.8E-02	4.46%
N-13	7.7E-03	1.3E-07	1.2E-02	5.7E-05	9.8E-04	2.3E-06	9.5E-06	3.3E-02	5.4E-02	13.61%
C-11	9.7E-02	6.6E-04	1.5E-01	6.0E-03	1.5E-03	1.9E-05	8.5E-06	3.6E-03	2.6E-01	65.94%
Ar-41	1.2E-02	1.8E-03	2.0E-02	1.9E-03	1.4E-03	1.7E-05	1.1E-06	2.7E-02	6.4E-02	15.98%
Total:	1.2E-01	2.4E-03	1.9E-01	7.9E-03	3.9E-03	3.8E-05	1.9E-05	8.2E-02	4.0E-01	
Percent of Contribution	29.20%	0.61%	46.73%	1.99%	0.99%	0.01%	0.00%	20.46%		100.00%

* 1 Ci = 3.7×10^{10} Bq

B.2 Air Emissions Data

Nearest Point Source	Type Control*	Efficiency*	Distance to Receptor
Positron Source	Not vented during beam operation	100%	640m (NNE)
Damping Ring	Not vented during beam operation	100%	274m (WNW)
SLC Beam Dump	Not vented during beam operation	100%	274m (NE)
Accelerator Housing	Not vented during beam operation	100%	305m (N)
Beam Switchyard	Not vented during beam operation	100%	457m (NNW)
SSRL Booster/Injector	Not vented during beam operation	100%	427m (N)
FFTB	Not vented during beam operation	100%	487m (N)
End Station A	Not vented during beam operation; however since this is not a closed facility, emission occurs by diffusion.	100%	457m (N)

* There are no controls during venting, so efficiency is not applicable.

Non-Point Source	Annual Quantity (Ci)
None Identified	0.0

Table B-11 Total Radioactive Gases Potentially Released in CY95 (Decay/Venting Delay Corrected)

Isotope	All Site Total (Ci)	Percent of Contribution
O-15	1.8E-02	4.46%
N-13	5.4E-02	13.61%
C-11	2.6E-01	65.94%
Ar-41	6.4E-02	15.98%
Total (Ci)	4.0E-01	100.00%

* 1 Ci = 3.7×10^{10} Bq

B.3 Dose Assessments

B.3.1 Description of the Dose Model

The EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC Version 1.0, was used to calculate the average radiation dose to individuals at specified distances and directions from the facility and to individuals within each population segment around the facility. Collective population dose is calculated as the average radiation dose to an individual in a specified area, multiplied by the number of individuals in that area.

The CY95 radioactivity air emissions were conservatively derived and are shown in Table 11 in Section 2. The "number of releases/year" was estimated for each release point. This parameter was purely based on the number of times that the machine was shut down for repair or maintenance in CY95, and was independent of whether or not venting was carried out. The typical period of time after the accelerator was shut down till the opening of the housing for entries in CY95 varied for each of the beam loss areas. These beam loss area-specific decay times were used to calculate the remaining inventory of radioactive gases prior to release.

Each release point was conservatively modeled as a single point source with a stack height of 0.0 meter and a diameter of 0.0 meter. The distances in meters (feet) from each single release point to the respective nearest receptors were specifically noted. The dose assessment model consisted of two parts:

1. Individual source term releases, which took into account the closest receptor and contributions from all other sources to that receptor in order to find the appropriate or "real" Maximally Exposed Individual (MEI).
2. A collective source term release, which was used to determine a collective Effective Dose Equivalent (EDE) to the surrounding population, out to 80 km.

Part 1 of the assessment model included determining where the closest and highest exposed individual resides for each source term and adding the dose contributions from all the other source terms to that individual. This calculation was carried out for each of the eight source terms separately since a point source model of release from the collective sources at SLAC was inappropriate for the nearest receptors. The MEI from each source term (with the appropriate contributions from the other source terms) was compared and the highest of these was considered the MEI for SLAC.

Included as attachments are the Dose and Risk Equivalent Summaries generated by CAP88-PC for each of the source terms: accelerator housing (LIN95), BSY (BSY95), Positron Source Vault (PV95), damping rings (DR95), SSRL (SSRL95), beam dumps (DUMP95), FFTB (FFTB95), and ESA (ESA95).

Determination of the MEI resulted in locating that individual at the Addison Wesley Publishers Building on the north side of the SLAC facility. Details of this evaluation can be found in Table B-12.

Part 2 of the assessment model utilized the radial population grid (shown in Table B-13) to calculate the collective dose in person-rem to the surrounding population out to 80 km. In this case, the source term was modeled as the eight sources taken as a point source to the

population. The point source model was appropriate for the collective EDE calculations at distances out to 80 km.

An estimate of the population residing within 80 km of SLAC was made using 1990 census data. An area defined by a circle of 80 km radius around the center of SLAC (Sector 30) was further divided into 16 equal sectors, with segments formed by the intersection of the sectors and a total of 13 radial distances of 0.1, 0.3, 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 30.0, 40.0, 60.0, and 80.0 km. The population within each segment was derived by multiplying the segment area by the population density of the appropriate city/cities. Unpopulated areas, that is, mountains and pastures were also taken into account in this population study.

Since SLAC does not have a qualified weather station, meteorological input data for CY95 were based on the averaged data provided for San Francisco Airport (SFO) which most closely represented the local conditions at SLAC. In addition, previous parametric studies have shown that meteorological data did not significantly affect the final results and the use of SFO meteorological data in CAP88-PC yielded reasonably conservative results for both the MEI and the collective EDE.

Included in this report are the following attachments for this population assessment case (SLAC95): General Data, Dose and Risk Equivalent Summaries, Weather Data, and the Dose and Risk Conversion Factors.

Table B-12 Determination of Maximally Exposed Individual

Source		Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
1	Beam Dumps		274m	NE	7.14E-04	
		SSRL	792m	ENE	2.7E-08	
		BSY	1097m	NE	1.7E-06	
		LINAC	1372m	ENE	1.7E-05	
		Positron Source Vault	2195m	E	5.7E-07	
		Damping Rings	3962m	E	4.5E-07	
		FFTB	852m	ENE	7.9E-09	
		ESA	822m	ENE	4.1E-05	
						7.71E-04
2	SSRL		427m	N	1.7E-07	
		Dumps	731m	NW	8.9E-05	
		BSY	640m	NNE	5.7E-06	
		LINAC	792m	NE	4.4E-05	
		Positron Source Vault	1554m	NE	4.6E-07	
		Damping Rings	3353m	ENE	3.1E-07	
		FFTB	487m	N	5.0E-08	
		ESA	457m	N	2.3E-04	
						3.70E-04
3	BSY		457m	NNW	1.3E-05	
		SSRL	640m	NW	3.4E-08	
		Dumps	1280m	WNW	1.7E-05	
		LINAC	366m	NNW	2.8E-04	
		Positron Source Vault	640m	NE	2.5E-06	
		Damping Rings	2743m	ENE	4.6E-07	
		FFTB	700m	NW	1.1E-08	
		ESA	670m	NW	5.2E-05	
						3.65E-04
4	LINAC		305m	N	8.5E-04	
		BSY	457m	NW	1.2E-05	
		SSRL	640m	WNW	2.0E-08	
		Dumps	1280m	WNW	1.7E-05	
		Positron Source Vault	792m	NE	1.6E-06	
		Damping Rings	2438m	ENE	5.8E-07	
		FFTB	700m	WNW	6.7E-09	
		ESA	670m	WNW	3.1E-05	
						9.12E-04

Table B-12 Determination of Maximally Exposed Individual

Source		Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
5	Positron Source Vault		640m	NNE	2.5E-06	
		LINAC	731m	NNW	6.1E-05	
		BSY	914m	NW	2.8E-06	
		SSRL	1097m	NW	1.1E-08	
		Dumps	1676m	NW	1.4E-05	
		Damping Rings	2195m	NE	5.3E-07	
		FFTB	1157m	NW	3.0E-09	
		ESA	1127m	NW	1.7E-05	
						9.78E-05
6	Damping Rings		274m	WNW	1.9E-05	
		Positron Source Vault	2195m	W	1.0E-07	
		LINAC	2743m	W	1.4E-06	
		BSY	3048m	W	9.8E-08	
		SSRL	3353m	W	5.2E-10	
		Dumps	3962m	W	9.6E-07	
		FFTB	3353m	W	1.0E-10	
		ESA	3353m	W	7.5E-07	
						2.23E-05
7	FFTB		487m	N	5.0E-08	
		Damping Rings	3353m	ENE	3.1E-07	
		Positron Source Vault	1554m	NE	4.6E-07	
		LINAC	792m	NE	4.4E-05	
		BSY	640m	NNE	5.7E-06	
		SSRL	427m	N	1.7E-07	
		Dumps	731m	NW	8.9E-05	
		ESA	457m	N	2.3E-04	
						3.70E-04
8	ESA		457m	N	2.3E-04	
		Damping Rings	3353m	ENE	3.1E-07	
		Positron Source Vault	1554m	NE	4.6E-07	
		LINAC	792m	NE	4.4E-05	
		BSY	640m	NNE	5.7E-06	
		SSRL	427m	N	1.7E-07	
		Dumps	731m	NW	8.9E-05	
		FFTB	487m	N	5.0E-08	
						3.70E-04

*Location is defined as the distance and direction from the source to the closest and highest dose individual.

B.3.2 POPULATION DATA

Table B-13 Radial Population Data for CAP88-PC

Direction	0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	8.0 km	10.0 km	30.0 km	40.0 km	60 km	80.0 km	Total
N	0	0	125	403	1100	1331	4103	23994	18447	28176	0	330284	321492	729455
NNW	0	0	126	403	1292	1696	4956	21485	19690	127166	96225	816270	184076	1273385
NW	0	0	127	403	1292	1231	1803	2671	2617	25645	18835	0	0	54624
WNW	0	0	127	403	1289	910	650	503	503	13312	3002	0	0	20699
W	0	0	125	379	149	793	650	0	0	100	0	0	0	2196
WSW	0	0	12	0	0	715	520	503	0	120	0	0	0	1870
SW	0	0	12	0	0	242	668	210	0	420	0	0	0	1552
SSW	0	0	12	0	0	417	690	0	420	0	0	0	0	1539
S	0	0	12	0	1195	1529	913	1118	5590	0	6725	37754	24520	79356
SSE	0	0	12	0	1195	1529	3579	1878	3006	28061	27357	24520	58692	149829
SE	0	0	12	0	896	1195	2020	1878	10521	1003808	270722	10171	25641	423436
ESE	0	0	12	0	896	598	4855	17926	25498	130550	391124	234674	0	806133
E	0	0	125	0	1195	5976	4855	22360	11180	50686	156449	0	0	252826
ENE	0	0	125	40	1322	5976	5174	15870	4690	107196	69336	78923	28370	317022
NE	0	0	125	391	869	4944	3773	8669	5608	53762	22300	23229	0	123670
NNE	0	0	125	403	1416	2597	3623	12564	6607	0	170278	160746	321492	679851
TOTAL:	0	0	1214	2825	14106	31679	42832	131629	114377	665574	1232353	1716571	964283	4917443

*SEE ATTACHMENTS FOR OTHER INPUT PARAMETERS

B.3.3 Compliance Assessment

This assessment of the potential radioactivity released is based on calculations of the activity produced and other conservative assumptions as stated in Section 3.1, Description of the Dose Model. This compliance assessment used the computer code CAP-88 PC Version 1.0 to calculate the dose for CY95.

Maximally Exposed Individual Effective Dose Equivalent:	9.12E-04 mrem (9.12E-06 mSv)
Location of Maximally Exposed Individual:	305 meters North (Addison Wesley)

B.3.4 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 U.S.C. 1001.)

Kenneth R. Kase

SLAC Facility Manager

Signature 6/7/96 Date

John S. Muhlestein

DOE Stanford Site Office Director

for Signature 6/12/96 Date

B.4 Additional Information

- SLAC did not have any new/completed construction projects nor modifications during CY95. SLAC is currently upgrading the existing Positron Electron Project (PEP) collider to an Asymmetric B Factory (PEP-II) for high energy physics research. The purpose of the proposed PEP-II project is to collide beams of electrons and positrons of different energy to produce abundant pairs of subatomic particles known as B mesons. The production of radioactive gases during the operation of the proposed PEP-II have been estimated and found to be insignificant. Prior EPA approval for facility construction/modification associated with the PEP-II project will not be necessary since all radioactive gas source terms at SLAC still contribute less than 1.0% of the 10 mrem/year (0.1 mSv/year) NESHAP's limit.
- There were no unplanned releases of radionuclides to the atmosphere during CY95.
- There were no known diffuse emissions at SLAC.

B.4.1 Supplemental Information:

- During CY95, the collective effective dose equivalent for the population within 80 km from SLAC's site boundary (4,917,443 persons) was estimated to be 3.83 x 10^{-3} person-rem (3.83 x 10^{-5} person-Sv).
- The reported source terms in the NESHAP's report for CY95 included all unmonitored sources that were identified at SLAC.
- Compliance with Subparts Q and T of 40 CFR Part 61 was not applicable at SLAC.
- Information on Rn-220 emissions from sources containing U-232 and Th-232 where emissions potentially could exceed 0.1 mrem in one year to the public or 10% of the non-radon dose to the public was not applicable at SLAC.
- Information on non-disposal/non-storage sources of Rn-222 emissions where emissions potentially could exceed 0.1 mrem in one year to the public or 10% of the non-radon dose to the public was not applicable at SLAC.
- SLAC did not have any emission points that contributed to more than 1% of the 10 mrem in one year (0.1 mSv in one year) NESHAP's limit. Thus, continuous monitoring of these emission points was not required.

C Calibration and Quality Assurance Procedures

The recording of natural background radiation provides continuous verification that SLAC's monitoring equipment is connected and functioning properly. Also, backgrounds collected during accelerator downtimes and any interrupted operations provide additional information for establishing the calibration baseline.

C.1 Direct Radiation Monitoring Equipment

A regular calibration procedure was performed on the PMSs in CY95. Radiation sources were placed at a measured distance from the detector to produce a known dose equivalent rate, for example, 1 mrem/h (0.01 mSv/h).

The equipment is kept in normal operation during these checks. The data printout is marked so that the calibration data is not confused with actual measurements of machine-produced radiation. This procedure will be carried out at least once each year, and following any equipment repair or maintenance actions.

An appropriate response to natural background radiation provides evidence that the instruments are operating properly. The calibration procedure was not performed in CY95. An improved calibration program is under development.

C.2 Liquid Radiological Effluents

Water samples are analyzed in-house with a liquid scintillation counter (LSC) and a hyper-pure germanium (HPGe) detector as necessary. Both pieces of equipment are calibrated with appropriate National Institute of Standards and Technology (NIST) traceable sources.

[This page intentionally left blank.]

D Environmental TLD Measurements for CY95

The following appendix contains data on environmental TLD measurements for CY95. It includes:

- Summary of net photon and neutron doses for CY95.
- Environmental TLD Monitoring Stations (Table D-1).

Notes:

TLD Type	Nominal Minimum Detectable Levels	Type of Radiation Detected
Al_2O_3:C (LDR-X9 Landauer Company)	0.1 mrem	Gamma
NeutrakER (LDR-I9 Landauer Company)	10 mrem	Neutron

D-1 Net Anual Doses for CY95

TLD Location	TLD #	Net Photon Dose (mrem)			Net Neutron Dose (mrem)
Transport Control	—	4.1	+/-	5.5	M[a]
Deployment Control	—	8.6	+/-	5.6	M[a]
SB at Region 6	1	-1.0	+/-	6.5	M[a]
SB at Injector	2	-0.8	+/-	5.8	M[a]
Computer Center SE Corner	3	0.6	+/-	5.9	M[a]
SB at Region 4	4	-0.4	+/-	5.8	M[a]
SB at North Damping Ring	5	13.2	+/-	5.9	M[a]
I-280 Overpass South	6	2.9	+/-	5.6	M[a]
SB at Sector 10 south	7	1.5	+/-	5.8	M[a]
SB across from B of A	8	3.5	+/-	5.6	M[a]
Alpine Gatehouse	9	-0.7	+/-	5.8	M[a]
Meteorological Tower	10	0.3	+/-	5.7	M[a]
SB at SLD	11	6.8	+/-	6.1	M[a]
SB at Region 12	12	-1.9	+/-	6.3	M[a]
SB at Region 2	13	-5.8	+/-	5.7	M[a]
SLAC Entrance Gatehouse	14	0.5	+/-	6.0	M[a]
SLAC Cafeteria	15	2.1	+/-	6.1	M[a]
SB at Region 8	16	-1.8	+/-	5.9	M[a]
SB at Addison Wesley Building	17	0.6	+/-	5.7	M[a]
SB at Positron Vault	18	0.8	+/-	5.8	M[a]
Control	19	8.7	+/-	5.6	M[a]
SB at Sector 20 south	20	3.7	+/-	5.9	M[a]
SB at South Damping Ring	21	-0.8	+/-	6.1	M[a]
I-280 Overpass North	22	18.9	+/-	5.8	M[a]
SB at Sector 21 south	23	6.3	+/-	5.7	M[a]
OHP Department Head Office	24	9.4	+/-	5.9	M[a]
PMS 1	26	2.2	+/-	5.8	M[a]
PMS 2	27	3.1	+/-	6.0	M[a]
PMS 3	28	4.4	+/-	5.6	M[a]
PMS 4	29	2.0	+/-	6.0	M[a]
PMS 5	30	1.5	+/-	5.8	M[a]
PMS 6	31	4.2	+/-	5.8	M[a]
PMS 7	32	5.4	+/-	5.7	M[a]
SB at Sector 24 north	33	10.1	+/-	5.6	M[a]
SB at Sector 17 north	34	4.9	+/-	5.7	M[a]
SB at Sector 5 north	35	23.0	+/-	5.9	M[a]

[a] Below the minimum detection limit.

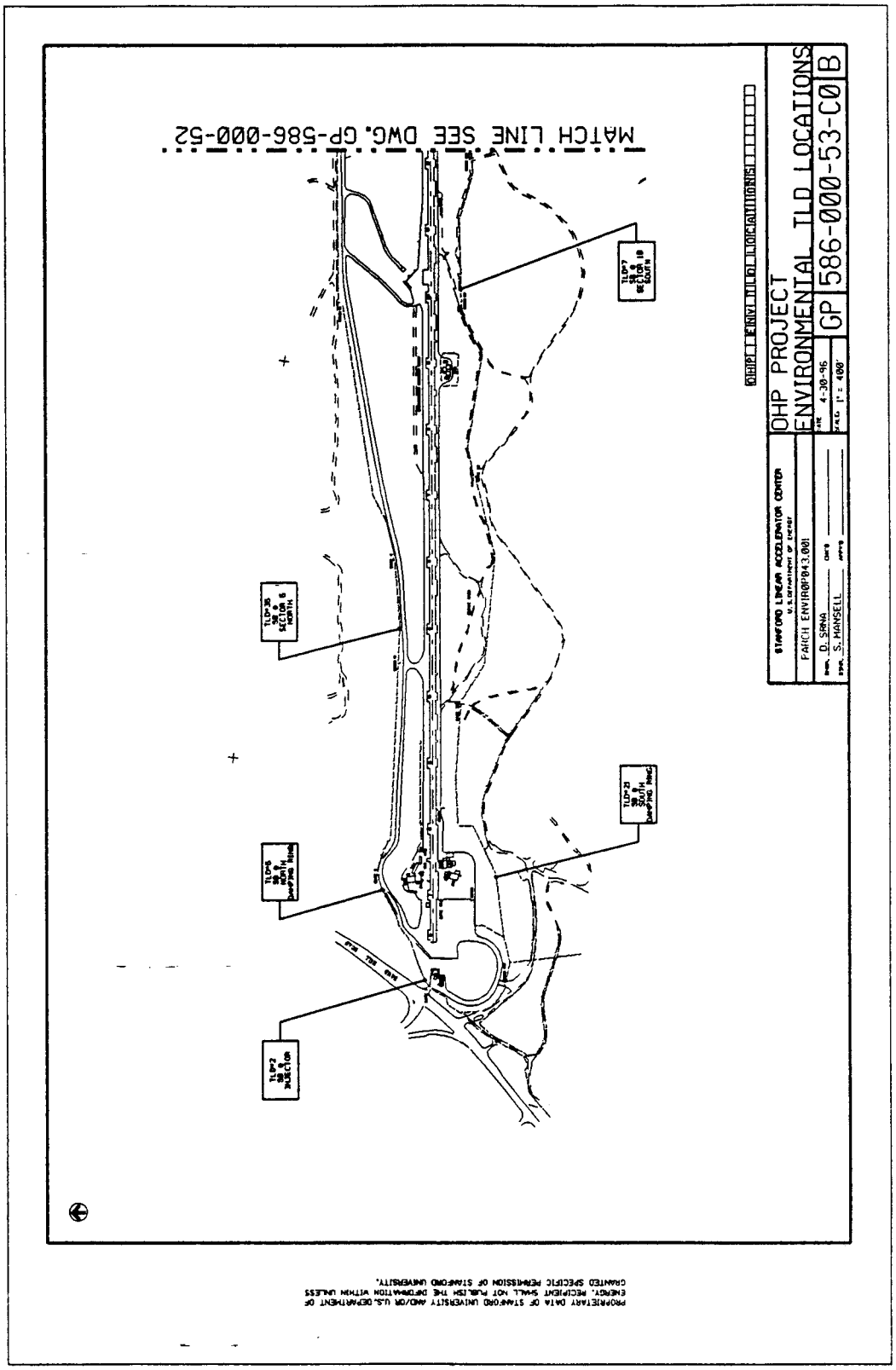

Figure D-1 Environmental TLD Monitoring Stations, Sectors 0 through 12

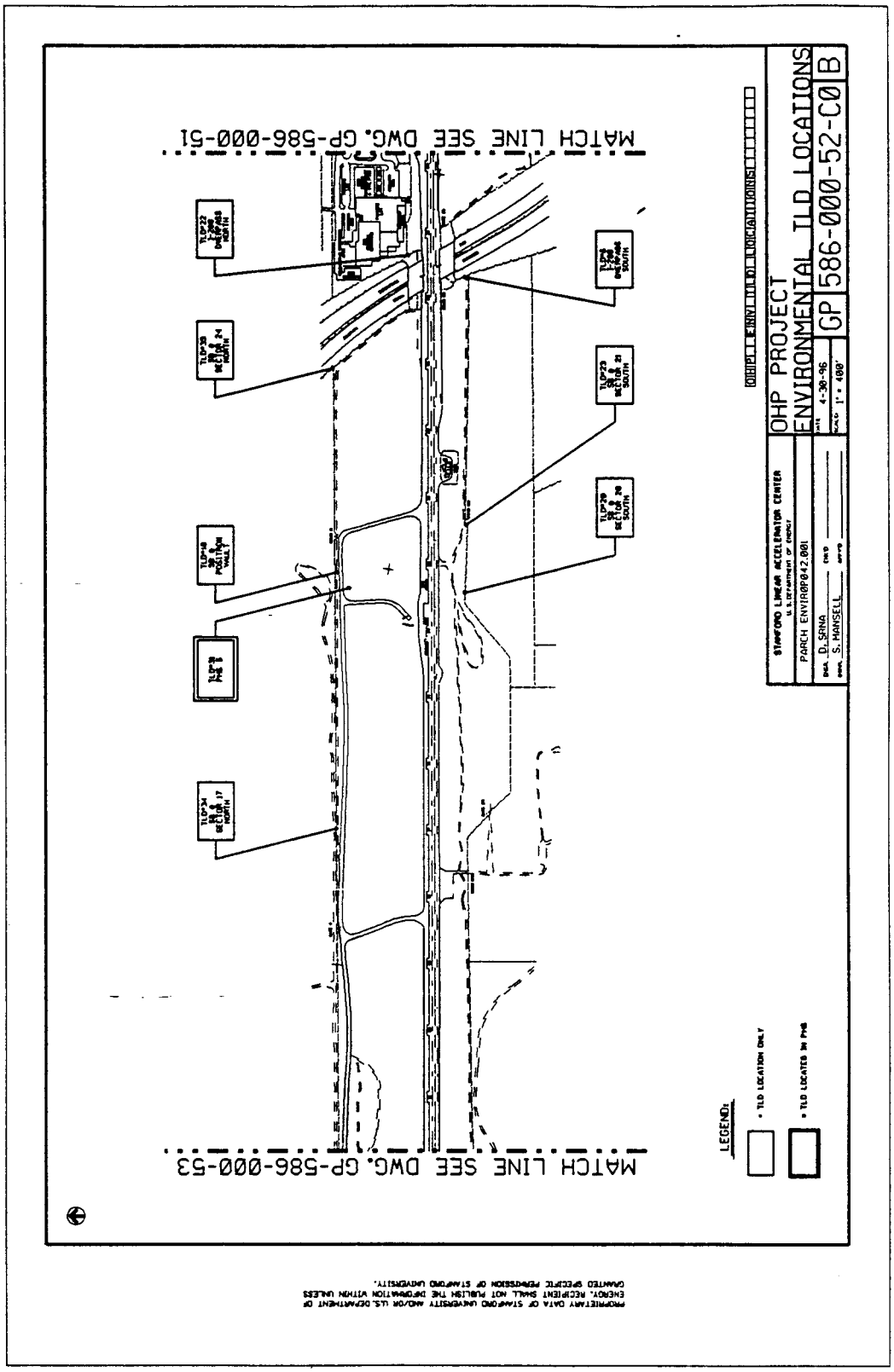

Figure D-2 Environmental TLD Monitoring Stations, Sectors 12 through 27

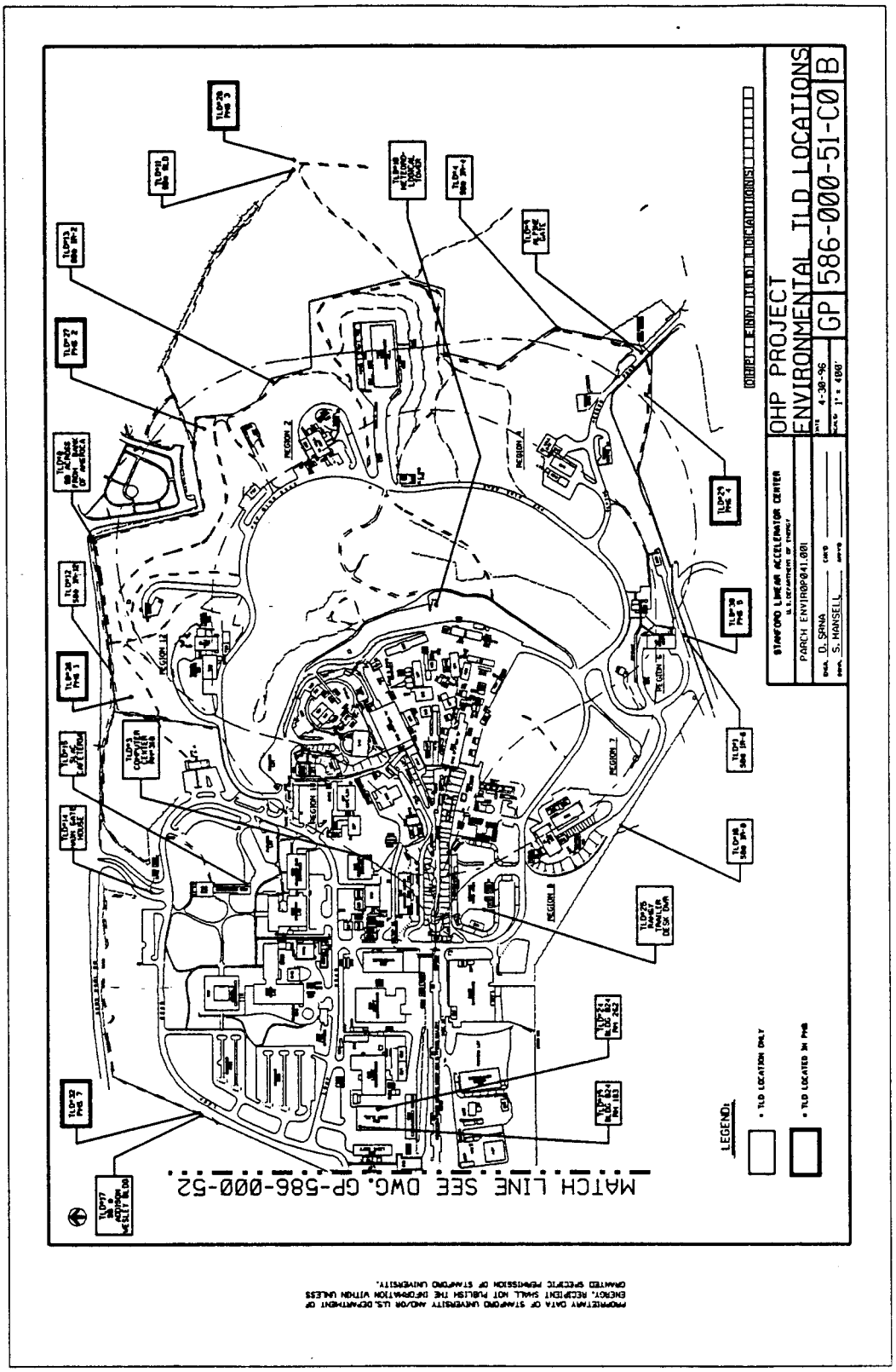

Figure D-3 Environmental TLD Monitoring Stations, Sector 27 through SLC

[This page intentionally left blank.]

E Monitoring Well Data

This appendix contains monitoring well data. It includes measurements for the following extraction and monitoring wells:

- Extraction Well EW-1
- Monitoring Well MW-1
- Monitoring Well MW-2
- Monitoring Well MW-3
- Monitoring Well MW-4
- Monitoring Well MW-5
- Monitoring Well MW-6
- Monitoring Well MW-7
- Monitoring Well MW-21
- Monitoring Well MW-22
- Monitoring Well MW-23
- Monitoring Well MW-24
- Monitoring Well MW-25
- Monitoring Well MW-26
- Monitoring Well MW-27
- Monitoring Well MW-28
- Monitoring Well MW-29
- Monitoring Well MW-30
- Monitoring Well MW-30 and EXW-4: Results of Quarterly Radioactivity Analyses, 7/91 through 11/94

Wells in areas with no contamination are sampled on a 12-18 month basis. In areas of contamination, some wells are not sampled if new wells will be installed for an investigation. Therefore, many wells were not sampled in CY95.

Table E-1 Extraction Well EW-1, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/28/94	7/13/94	11/9/94	2/1/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroethane	<10	<12	<20	<0.5	<5	<2.5	<13	<5	<10	<25	<50	<5	2[b]	1.3[b]	<0.5	na[c]	na[c]	none
1,3-Dichlorobenzene	<10	<12	<10	<0.5	<5	<2.5	<13	<5	<10	<25	<50	<5	<0.5	<0.5	2.3[b]	na[c]	na[c]	none
1,4-Dichlorobenzene	<10	<12	<10	<0.5	<5	<2.5	<13	<5	<10	<25	<50	<5	<0.5	<0.5	0.97[b]	na[c]	na[c]	5
1,1-Dichloroethane	440[b]	510[b]	740[b]	940[b]	420[b]	650[b]	680[b]	670[b]	560[b]	1300[b]	1100[b]	520[b]	590[b]	550[b]	450[b]	na[c]	na[c]	5
1,1-Dichloroethene	54[b]	42[b]	22[b]	85[b]	51[b]	48[b]	51[b]	34[b]	31[b]	85[b]	62[b]	34[b]	42[b]	34[b]	26[b]	na[c]	na[c]	6
cis-1,2-Dichloroethene	<10	18[b]	na	na	na	na	na	na	na	na	na	na	na	na	na	na[c]	na[c]	6
1,2-Dichloroethene, total	na	na	64[b]	86[b]	17[b]	93[b]	140[b]	180[b]	170[b]	290[b]	260[b]	180[b]	140[b]	110[b]	160[b]	na[c]	na[c]	16[d]
Methylene Chloride	38[b]	50[b]	<10	<0.5	110[b]	<2.5	<13	<5	13[b]	<25	<50	<5	23[b]	<0.5	<0.5	na[c]	na[c]	5
Tetrachloroethene	10[b]	<12	<10	19[b]	19[b]	3.3[b]	<13	11[b]	10[b]	<25	8.7[b]	12[b]	13[b]	13[b]	4.3[b]	na[c]	na[c]	5
1,1,1-Trichloroethane	790[b]	640[b]	530[b]	910[b]	600[b]	500[b]	300[b]	140[b]	260[b]	240[b]	180[b]	200[b]	250[b]	210[b]	97[b]	na[c]	na[c]	200
1,1,2-Trichloroethane	<10	<12	<10	2.8[b]	<5	<2.5	<13	<5	<10	<25	<50	<5	0.87[b]	0.67[b]	<0.5	na[c]	na[c]	5
Trichloroethene	150[b]	150[b]	78[b]	150[b]	110[b]	94[b]	48[b]	43[b]	43[b]	32[b]	22[b]	20[b]	32[b]	19[b]	7.6[b]	na[c]	na[c]	5
Benzene	<10	<12	0.7[b]	0.6[b]	<0.5	<0.5	<0.3	<6	<6	<15	<30	0.69[b]	0.63[b]	<0.3	0.44[b]	na[c]	na[c]	1
Toluene	<10	<12	0.8[b]	0.9[b]	49[b]	<0.3	<0.3	<3	<6	<15	<30	0.34[b]	6.4[b]	<0.3	1.9[b]	na[c]	na[c]	150
Ethylbenzene	<10	<12	0.7[b]	<0.5	3.9[b]	<0.3	<0.3	<3	<6	<15	13[b]	<0.3	0.75[b]	<0.3	6.4[b]	na[c]	na[c]	700
Total xylenes	<10	<12	8.7[b]	13[b]	15[b]	15[b]	<0.6	38[b]	<12	<30	31[b]	7.2[b]	8.2[b]	5.6[b]	14[b]	na[c]	na[c]	1750

[a] Maximum Contaminate Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-2 Monitoring Well MW-1, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/2/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	**1**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<0.5	**0.5**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.4**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**4.1**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	5
Benzene	<0.5	<0.5	<0.5	<0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**1.2**[b]	<0.3	na[c]	<0.3	1
Toluene	<0.5	<0.5	<0.5	<0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0.78**[b]	<0.3	na[c]	<0.3	150
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0.78**[b]	<0.6	na[c]	<0.3	700
Total xylenes	<0.5	<0.5	<1.0	<1.0	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	**3**[b]	<0.3	na[c]	<0.6	1750

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-3 Monitoring Well MW-2, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/2/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	**0.8**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<0.5	<0.5	**0.8**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.5**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	0.5
Tetrachloroethene	<0.5	<0.5	**0.8**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	**1**[b]	**0.6**[b]	**2.1**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	5
Benzene	<0.5	<0.5	<0.5	<0.5	<0.3	**1.2**[b]	**0.7**[b]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	na[c]	<0.3	1
Toluene	**0.8**[b]	<0.5	<0.5	<0.5	<0.3	**1.2**[b]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0.63**[b]	<0.3	na[c]	<0.3	150
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.3	**2.9**[b]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	na[c]	<0.3	700
Total xylenes	<0.5	<0.5	<1	<1	<0.6	**15**[b]	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	na[c]	<0.6	1750

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-4 Monitoring Well MW-3, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/2/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	**0.7[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<1	<0.5	**1.8[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.5[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	0.5
Trichloroethene	<0.5	**0.5[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-5 Monitoring Well MW-4, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/1/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	**0.8[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<1	**0.9[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.6[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	0.5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-6 Monitoring Well MW-5, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/2/95	5/2/95	7/25/95	11/1/95	2/13/96	Split of 2/13/96	Drinking Water MCL[a]
Organics (µg/l)																			
Chloroform	<0.5	<0.5	<0.5	**0.6[b]**	**0.7[b]**	<2.5	**0.7[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.51[b]**	na[c]	**0.66[b]**	**0.68[b]**	100[d]
Chloromethane	<0.5	<0.5	<1	**0.5[b]**	**1.5[b]**	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	<0.5	none
1,1-Dichloroethane	**14[b]**	**18[b]**	**39[b]**	**69[b]**	**79[b]**	**68[b]**	**39[b]**	**35[b]**	**37[b]**	**79[b]**	**89[b]**	**80[b]**	**70[b]**	**83[b]**	**80[b]**	na[c]	**130[b]**	**140[b]**	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<0.5	<0.5	**1.5[b]**	**1.5[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	<0.5	0.5
1,1-Dichloroethene	**14[b]**	**12[b]**	**41[b]**	**32[b]**	**53[b]**	**35[b]**	**25[b]**	**13[b]**	**9[b]**	**27[b]**	**36[b]**	**35[b]**	**19[b]**	**28[b]**	**34[b]**	na[c]	**39[b]**	**36[b]**	6
1,2-Dichloroethene, total	na[c]	na[c]	<0.5	**0.5[b]**	**0.6[b]**	<2.5	<0.5	<0.5	<0.5	<0.5	**0.51[b]**	<0.5	<0.5	<0.5	**0.57[b]**	na[c]	**0.77[b]**	**0.74[b]**	16[e]
Tetrachloroethene	<0.5	<0.5	**0.9[b]**	<0.5	<0.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	<0.5	5
1,1,1-Trichloroethane	**0.7[b]**	**0.5[b]**	**0.7[b]**	**1[b]**	**1.1[b]**	<2.5	**0.5[b]**	<0.5	<0.5	<0.5	**0.57[b]**	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	<0.5	200
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	**<0.5[b]**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	<0.5	<0.5	
Trichloroethene	**6.2[b]**	**5.9[b]**	**12[b]**	**26[b]**	**30[b]**	**26[b]**	**15[b]**	**16[b]**	**11[b]**	**21[b]**	**25[b]**	**16[b]**	**15[b]**	**20[b]**	**25[b]**	na[c]	**38[b]**	**36[b]**	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)
[e] MCL for cis & trans-1,2-Dichloroethene = 1,2-Dichloroethene, total

Table E-7 Monitoring Well MW-6, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/2/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	1.1[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	100[d]
Chloromethane	<0.5	<0.5	<0.5	<0.5	4[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	none
1,1-Dichloroethane	0.6[b]	1[b]	1.1[b]	0.9[b]	1.5[b]	1.8[b]	2.7[b]	2.5[b]	2.1[b]	3.6[b]	3[b]	3.9[b]	3.3[b]	3.9[b]	2.8[b]	na[c]	na[c]	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	0.5
1,1-Dichloroethene	7.4[b]	13[b]	13[b]	0.6[b]	13[b]	20[b]	23[b]	14[b]	11[b]	31[b]	16	29[b]	35[b]	33[b]	23[b]	na[c]	na[c]	6
Methylene Chloride	<0.5	<0.5	<0.5	2.2[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1[b]	2.9[b]	0.8[b]	1.3[b]	1[b]	1.1[b]	1.4[b]	1.5[b]	1.1[b]	na[c]	na[c]	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-8 Monitoring Well MW-7, compounds detected in the last 4 years

Date Sampled	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93	4/20/93	7/27/93	10/27/93	2/1/94	4/27/94	7/13/94	11/9/94	2/1/95	5/2/95	7/25/95	11/1/95	2/13/96	Drinking Water MCL[a]
Organics (µg/l)																		
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	1.5[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.61[b]	<0.5	na[c]	na[c]	100[d]
Chloromethane	<0.5	<0.5	<1	1.4[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	none
1,1-Dichloroethane	<0.5	1.3[b]	2.3[b]	<0.5	1.3[b]	1.4[b]	1.5[b]	3.1[b]	8.3[b]	15[b]	17[b]	33[b]	40[b]	44[b]	34[b]	na[c]	na[c]	5
1,1-Dichloroethene	1.3[b]	6.2[b]	9.8[b]	2.9[b]	8.6[b]	8.9[b]	12[b]	17[b]	29[b]	61[b]	60[b]	130[b]	94[b]	130[b]	110[b]	na[c]	na[c]	6
Methylene Chloride	<0.5	<0.5	<0.5	2.1[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9[b]	1.6[b]	1.6[b]	4[b]	3.4[b]	5.5[b]	4.5[b]	na[c]	na[c]	5
1,1,1-Trichloroethene	0.6[b]	0.7[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6[b]	0.65[b]	1[b]	0.83[b]	1.4[b]	0.86[b]	na[c]	na[c]	200
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.9[b]	4.9[b]	8.3[b]	9.3[b]	18[b]	20[b]	29[b]	24[b]	na[c]	na[c]	5
Benzene	<0.5	<0.5	<0.5	<0.5	<0.3	<0.3	<0.3	<0.3	0.4[b]	0.6[b]	0.61[b]	0.96[b]	<0.3	<0.3	<0.3	na[c]	na[c]	1

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for this compound
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-9 Monitoring Well MW-21, detected compounds only

Date Sampled	1/22/92	Split of 1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<2.5	<2.5	<2.5	**0.7**[b]	**1.3**[b]	**3.6**[b]	<10	**3.5**[b]	<5	<10	**4.4**[b]	<1	<2.5	<2.5	100[c]
cis-1,2-Dichloroethene	<2.5	<2.5	<2.5	na[d]	na[d]	na[d]	na[d]	na[d]	na[d]	**59**[b]	na[d]	na[d]	na[d]	na[d]	6
trans-1,2-Dichloroethene	<2.5	<2.5	<2.5	na[d]	na[d]	na[d]	na[d]	na[d]	na[d]	**29**[b]	na[d]	na[d]	na[d]	na[d]	10
Chloromethane	<0.5	<0.5	<0.5	<0.5	**0.9**[b]	<0.5	<10	<10	<5	<10	<2.5	<1	<2.5	<2.5	none
1,1-Dichloroethane	<2.5	<2.5	<2.5	<0.5	<0.5	**0.6**[b]	<10	<10	**21**[b]	<10	<2.5	<1	<2.5	<2.5	5
1,1-Dichloroethene	<2.5	<2.5	<2.5	**1.3**[b]	**1.4**[b]	**5.3**[b]	<10	<10	<5	<10	**2.6**[b]	**2**[b]	**2.6**[b]	**5.1**[b]	6
1,2-Dichloroethene, total	na[d]	na[d]	na[d]	**21**[b]	**29**[b]	**5.4**[b]	**25**[b]	**120**[b]	**120**[b]	**79**[b]	**150**[b]	**370**[b]	**91**[b]	**530**[b]	16[e]
Trichloroethene	**130**[b]	**180**[b]	**160**[b]	**140**[b]	**180**[b]	**340**[b]	**260**[b]	**180**[b]	**260**[b]	**200**[b]	**33**[b]	**320**[b]	**320**[b]	**660**[b]	5
Freon 113[f]	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	<10	<2.5	<5	<5	<2.5	<1	<2.5	**3.7**[b]	1,200
Benzene	<2.5	<2.5	<2.5	<0.5	<0.5	**0.6**[b]	na[d]	<2.5	na[d]	<5	<1.5	na[d]	na[d]	<1.5	1

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)
[d] Not analyzed for that parameter
[e] MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
[f] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113

Table E-10 Monitoring Well MW-22, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)														
Chloroform	<10	<10	<50	3.3[b]	<50	<25	<25	<50	<50	<50	<50	<10	<5	100[c]
1,1-Dichloroethane	<10	<10	<50	12[b]	<50	<25	<25	<50	<50	<50	<50	<10	7.5[b]	5
1,1-Dichloroethene	240[b]	180[b]	160[b]	220[b]	350[b]	590[b]	530[b]	350[b]	320[b]	420[b]	260[b]	300[b]	320[b]	6
1,1,1-Trichloroethane	<10	<10	<50	4.8[b]	<50	<25	<25	<50	<50	<50	<50	<10	<5	200
Trichloroethene	930[b]	640[b]	760[b]	800[b]	1000[b]	900[b]	1100[b]	1200[b]	780[b]	1200[b]	840[b]	990[b]	1100[b]	5
Freon 113[d]	1000[b]	740[b]	790[b]	540[b]	1700[b]	2500[b]	2800[b]	900[b]	1100[b]	1700[b]	1100[b]	1800[b]	1300[b]	1200
Benzene	<10	<10	0.6[b]	<0.5	0.8[b]	na[e]	<50	na[e]	<5	<30	na[e]	na[e]	<1.5	1

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)
[d] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113
[e] Not analyzed for that parameter

Table E-11 Monitoring Well MW-23, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	4/22/93	7/28/93	10/27/93	Split of 10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	0.8[b]	<0.5	<0.5	0.5[b]	<0.5	<0.5	<0.5	<0.5	<0.5	100[c]
Chloromethane	<0.5	<0.5	<1	<0.5	2.9[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	none
1,1-Dichloroethane	4.3[b]	4.8[b]	2.7[b]	2.7[b]	6.7[b]	6.9[b]	7.1[b]	4.7[b]	4.5[b]	4.6[b]	3.6[b]	5.9[b]	6.2[b]	7.1[b]	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.7[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
1,1-Dichloroethene	6.1[b]	5.4[b]	4[b]	3.9[b]	8[b]	6.3[b]	8.6[b]	4.3[b]	2.7[b]	4.3[b]	4.3[b]	7[b]	6.8[b]	6[b]	6
1, 2-Dichloropropane	<0.5	<0.5	<1	<0.5	2.9[b]	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5
1,1,1-Trichloroethane	4.9[b]	4.8[b]	2.2[b]	2[b]	5.7[b]	5.5[b]	7[b]	3.4[b]	2.3[b]	3.9[b]	2.9[b]	4[b]	6.1[b]	6.1[b]	200
Trichloroethene	<0.5	0.5[b]	<0.5	<0.5	<0.5	<0.5	13[b]	0.7[b]	0.5[b]	5.4[b]	<0.5	0.72[b]	0.79[b]	2.2[b]	5
Freon 113[d]	<0.5	<0.5	<0.5	<0.5	2.3[b]	0.9[b]	3.4[b]	<0.5	<0.5	<0.5	<0.5	<0.5	1.9[b]	3.2[b]	1200

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)
[d] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113

Table E-12 Monitoring Well MW-24, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	Split of 7/28/92	10/21/92	1/27/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	0.97[b]	<0.5	100[b]
Chloromethane	<0.5	<0.5	<1	<1	0.8[b]	<0.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	none
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	0.5[b]	<0.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	0.8[b]	<0.5	<2.5	<2.5	<2.5	<0.5	0.7[b]	<0.5	0.66[b]	0.73[b]	6
1,2-Dichloroethene, total	na[c]	na[c]	1.7[b]	1.9[b]	5.3[b]	8.5[b]	120[b]	130[b]	89[b]	26[b]	55[b]	17[b]	50[b]	96[b]	16[d]
cis-1,2-Dichloroethene	1.6[b]	2.2[b]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	<0.5	na[c]	na[c]	6
1,1,1-Trichloroethane	0.5[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	200
Trichloroethene	2[b]	4.1[b]	1.7[b]	1.6[b]	4.1[b]	7.3[b]	57[b]	49[b]	130[b]	18[b]	33[b]	12	52[b]	49[b]	5
Freon 113[e]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5	<2.5	<0.5	0.8[b]	<0.5	<0.5	1.3[b]	1200
Vinyl chloride	<0.5	<0.5	<1	<1	<0.5	<0.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	0.55[b]	<0.5	0.5

[a] Maximum Contaminant Level
[b] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)
[c] Not analyzed for that parameter
[d] MCL for cis & trans-1,2-Dichloroethene = 1,2-Dichloroethene, total
[e] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113

Table E-13 Monitoring Well MW-25, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	4/22/93	7/27/93	10/27/93	2/2/94	Split of 2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloromethane	<0.5	<0.5	<1	1.1[b]	2[b]	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	none
1,1-Dichloroethane	45[b]	38[b]	68[b]	75[b]	40[b]	72[b]	61[b]	91[b]	50[b]	62[b]	70[b]	57[b]	100[b]	85[b]	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	2.2[b]	<2.5	<2.5	0.9[b]	2.2[b]	2.2[b]	0.9[b]	<0.5	1.4[b]	1.2[b]	0.5
1,1-Dichloroethene	25[b]	19[b]	46[b]	38[b]	19[b]	32[b]	57	46[b]	28[b]	34[b]	33[b]	32[b]	50[b]	38[b]	6
1,2-Dichloroethene, total	na[c]	na[c]	9.3[b]	14[b]	4.4[b]	14[b]	14[b]	21[b]	14[b]	15[b]	18[b]	17[b]	26[b]	26[b]	16
cis-1,2-Dichloroethene	4.6[b]	4.5[b]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	6
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5	<0.5	<0.5	<0.5	0.8[b]	<0.5	<0.5	<0.5	none
Trichloroethene	0.6[b]	0.5[b]	0.6[b]	1.5[b]	<0.5	<2.5	5.4[b]	4.5[b]	1.3[b]	1[b]	2.4[b]	1[b]	1.5[b]	2.2[b]	5
Trichlorofluoromethane	2.6[b]	1.9[b]	<0.5	<0.5	2.8[b]	<2.5	<2.5	4.7[b]	<0.5	<0.5	<0.5	<0.5	5.6[b]	<0.5	150
Freon 113[d]	<0.5	<0.5	<0.5	1.7[b]	<0.5	<2.5	15[b]	<0.5	0.5[b]	<0.5	<0.5	<0.5	0.9[b]	0.74[b]	1200
Vinyl chloride	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	2.7[b]	<0.5	1.1[b]	1.9[b]	<0.5	0.5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for that parameter
[d] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113

Table E-14 Monitoring Well MW-26, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	Split of 4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.7**[b]	na[c]	na[c]	<0.5	<0.5	na[c]	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<1	<0.5	**3.5**[b]	<0.5	<0.5	na[c]	na[c]	<0.5	<0.5	na[c]	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	**0.9**[b]	<0.5	<0.5	na[c]	na[c]	<0.5	<0.5	na[c]	na[c]	<0.5	0.5
Trichloroethene	<0.5	<0.5	<0.5	**12**[b]	<0.5	<0.5	<0.5	na[c]	na[c]	<0.5	<0.5	na[c]	na[c]	<0.5	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for that parameter
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-15 Monitoring Well MW-27, detected compounds only

Date Sampled	1/22/92	4/21/92	Split of 4/21/92	7/28/92	10/21/92	1/27/93	4/22/93	7/27/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.5**[b]	<0.5	na[c]	na[c]	<0.5	na[c]	na[c]	<0.5	100[d]
Chloromethane	<0.5	<0.5	<0.5	<1	**1.4**[b]	**1.1**[b]	<0.5	<0.5	na[c]	na[c]	<0.5	na[c]	na[c]	<0.5	none
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	**1.1**[b]	<0.5	<0.5	na[c]	na[c]	<0.5	na[c]	na[c]	<0.5	0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.5**[b]	<0.5	na[c]	na[c]	<0.5	na[c]	na[c]	<0.5	200
Trichloroethene	**1.3**[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na[c]	na[c]	<0.5	na[c]	na[c]	<0.5	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for that parameter
[d] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane)

Table E-16 Monitoring Well MW-28, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	Split of 10/21/92	1/28/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)															
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	100
Chloromethane	<0.5	<0.5	<1	0.9[b]	0.8[b]	2.8[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	none
1,1-Dichloroethane	0.9[b]	2.2[b]	0.6[b]	2.8[b]	2.3[b]	1.1[b]	4.6[b]	4.5[b]	4.7[b]	2.6[b]	4.1[b]	2.9[b]	0.87[b]	0.97[b]	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	1.2[b]	<0.5	<0.5	<0.5	1.8[b]	<0.5	<0.5	<0.5	<0.5	0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.3[b]	1.8[b]	0.5[b]	0.6[b]	1.2[b]	<0.5	<0.5	0.65[b]	6
Tetrachloroethene	<0.5	<0.5	1.2[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5
1,1,1 Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	200
Trichloroethene	<0.5	<0.5	<0.5	0.6[b]	0.7[b]	<0.5	<0.5	<0.5	0.6[b]	<0.5	<0.5	<0.5	0.55[b]	<0.5	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity

Table E-17 Monitoring Well MW-29, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/14/96	Drinking Water MCL[a]
Organics (µg/l)														
Chloromethane	<0.5	<0.5	<1	2.9[b]	2.1[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	none
1,1-Dichloroethane	1.2[b]	0.7[b]	1.6[b]	1.5[b]	1.1[b]	<0.5	0.7[b]	0.9[b]	0.6[b]	<0.5	0.7[b]	0.53[b]	<0.5	5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	1[b]	<0.5	<0.5	<0.5	1.8[b]	<0.5	<0.5	<0.5	<0.5	0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7[b]	<0.5	<0.5	<0.5	none
1,1,1-Trichloroethane	1.2[b]	<0.5	0.9[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	200
Trichloroethene	0.8[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4[b]	<0.5	<0.5	<0.5	<0.5	<0.5	5

[a] Maximum Contaminant Level
[b] Indicates detectable quantity

Table E-18 Monitoring Well MW-30, detected compounds only

Date Sampled	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	4/22/93	7/28/93	10/27/93	2/2/94	4/28/94	7/14/94	11/10/94	2/13/96	Drinking Water MCL[a]
Organics (µg/l)														
Chloromethane	<0.5	<0.5	<1	**3.2**[b]	<0.5	<2.5	<2.5	na[c]	na[c]	na[c]	<0.5	<0.5	<0.5	none
Dichlorodifluoromethane	<0.5	<0.5	<1	<0.5	<0.5	<2.5	<2.5	na[c]	na[c]	na[c]	**7.9**[b]	<0.5	**12**[b]	none
PCB (Aroclor 1254)	na[c]	na[c]	na[c]	na[c]	na[c]	na[c]	<0.5	na[c]	na[c]	na[c]	na[c]	na[c]	**1.1**[b]	0.5
Trichloroethene	<0.5	<0.5	<0.5	**3.7**[b]	<0.5	<2.5	<2.5	na[c]	na[c]	na[c]	<0.5	<0.5	<0.5	5
Trichlorofluoromethane	**9.2**[b]	**8.8**[b]	<0.5	<0.5	**25**[b]	<2.5	<2.5	na[c]	na[c]	na[c]	<0.5	**20**[b]	<0.5	100
Freon 113[d]	**10**[b]	**16**[b]	**20**[b]	**30**[b]	**91**[b]	**82**[b]	**57**[b]	na[c]	na[c]	na[c]	**80**[b]	**37**[b]	**140**[b]	1200

[a] Maximum Contaminant Level
[b] Indicates detectable quantity
[c] Not analyzed for that parameter
[d] 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon 113

Table E-19 Monitoring Wells MW-30 and EXW-4, Results of Quarterly Radioactivity Analyses, 7/91 through 11/94

Gross Beta Particle Activity (MCL is 50 pCi/l)			
Date Sampled	Date Analyzed	MW-30 pCi/l	EXW-4 pCi/l
7/19/91	9/25/91	6 ± 4	20 ± 4
10/24/91	12/9/91	9 ± 3	na[a]
1/22/92	2/13/92	<3	19 ± 4
4/21/92	5/26/92	6 ± 4	32 ± 5
7/28/92	9/9/92	67 ± 17	11 ± 4
10/21/92	11/2/92	15 ± 4	17 ± 4
10/21/92	12/14/92	8 ± 6[b]	16 ± 8
10/21/92	1/8/93	9 ± 7	na[a]
1/27/93	2/5/93	14 ± 4	16 ± 4
7/28/93	8/17/93	31 ± 7	43 ± 8
10/28/93	11/15/93	na[a]	14 ± 4
2/2/94	3/8/94	na[a]	15 ± 4
4/28/94	5/28/94	na[a]	3 ± 2
7/14/94	7/29/94	<3	<3
11/10/94	12/20/94	17 ± 1	45 ± 8

Tritium Concentrations (MCL is 20,000 pCi/l)			
Date Sampled	Date Analyzed	MW-30 pCi/l	EXW-4 pCi/l
7/19/91	9/25/91	<500	23505 ± 831
10/24/91	12/9/91	<500	na[a]
1/22/92	2/13/92	<500	16749 ± 746
4/21/92	5/26/92	<500	12927 ± 658
7/8/92	9/19/92	na[a]	12237 ± 651
10/21/92	10/29/92-1/8/93	<500	11639 ± 657
1/27/93	2/8/93	<500	8357 ± 886
4/21-22/93	5/7/93[c]	<500	9833 ± 910
4/21-22/93	5/93[d]	450 ± 170	9560 ± 610
7/28/93	8/9/93	930 ± 514	9658 ± 635
10/28/93	11/2/93	na[a]	9257 ± 892
2/2/94	3/9/94	na[a]	8212 ± 905
4/28/94	5/12/94	na[a]	7532 ± 943
7/14/94	7/21/94	<500	6689 ± 916
11/10/94	1/13/95	<1000	6603 ± 895

[a] Not analyzed for that parameter
[b] High statistics due to large amount of solids
[c] Samples analyzed by Controls for Environmental Pollution, Inc.
[d] Samples analyzed by Lockheed Analytical Services

F

Storm Water Sampling Data

The following appendix contains storm water sampling data. It includes:

- Main Sample Locations
- Floating Sample Locations

Table F-1 CAM Metals, TTLC (mg/l)

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Ag	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
As	0.02	<0.0020	<0.0020	0.0029	<0.0020	<0.0020	<0.0020	<0.0020	0.0094	0.0054	0.0041	0.0025	0.0034	<0.0020
Ba	N/O[a]	0.14	0.059	0.14	0.17	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	0.062	0.13
Be	N/O[a]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cd	0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.0014**	<0.0010	**0.0011**	<0.0010	<0.0010	<0.0010
Co	N/O[a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	0.011	**0.011**	0.0062	0.0020	0.0094	0.0064	0.0068	0.0034	0.0057	0.0051	0.0087	**0.017**	**0.024**	0.0068
Cu	0.02	0.013	0.0098	0.0055	0.011	**0.021**	0.018	0.0093	**0.050**	0.014	**0.040**	**0.035**	**0.026**	0.010
Hg	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Mo	N/O[a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.13	<0.050	<0.050	<0.050
Ni	0.0071	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Pb	0.0056	**0.010**	**0.0096**	<0.0020	**0.010**	**0.0074**	**0.0076**	**0.0093**	**0.0082**	0.0032	**0.0066**	**0.012**	**0.019**	0.0048
Sb	N/O[a]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Se	N/O[a]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0036	<0.0020	0.0022	<0.0020	<0.0020	<0.0020	0.0021	<0.0020
Tl	N/O[a]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
V	N/O[a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Zn	0.058	**0.098**	<0.050	**0.36**	0.051	**0.079**	**0.077**	0.056	**0.45**	**0.19**	**0.16**	**0.17**	**0.15**	**0.10**

[a] No objective in Basin Plan

Table F-2 General Minerals[a]

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Alkalinity as CaCO3	N/O[b]	120	28	210	28	65	60	60	60	46	50	28	23	42
Bicarbonate as CaCO3	N/O[b]	120	28	210	28	65	60	60	60	46	50	28	23	42
Carbonate as CaCO3	N/O[b]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide as CaCO3	N/O[b]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ca	N/O[b]	120	15	300	11	48	49	34	45	15	32	14	13	20
Chloride	N/O[b]	320	15	220	2.6	46	47	5.6	46	3.1	19	4.9	5.1	6.4
Cu	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	N/O[b]	<0.10	0.49	<0.10	0.20	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	0.30
F	N/O[b]	0.086	0.083	0.44	0.11	0.13	0.13	0.14	0.11	0.093	0.12	0.079	0.073	0.11
Hardness as CaCO3	N/O[b]	710	74	1200	42	330	340	180	360	75	170	59	57	74
K	N/O[b]	1.9	1.5	2.3	1.7	3.0	3.0	2.1	2.3	1.1	2.4	1.5	1.3	1.4
Meth. Blue Active Sub.	N/O[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Mg	N/O[b]	100	9.2	99	3.6	52	53	23	59	9.1	22	5.8	5.9	5.8
Mn	N/O[b]	0.48	<0.030	0.42	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Na	N/O[b]	150	15	160	7.5	35	36	11	25	5.3	22	7.1	7.0	13
Nitrate	N/O[b]	3.1	1.0	1.0	0.6	7.0	7.0	1.7	8.4	0.95	820	0.86	0.76	<0.50
pH[c]	6.5-8.5	7.2	6.6	7.7	6.8	7.3	7.2	7.2	7.4	7.3	7.5	7.2	7.1	7.0
Conduct[d]	N/O[b]	1700	200	2100	110	660	680	360	660	160	380	140	140	190
Sulfate	N/O[b]	530	36	920	19	250	260	110	250	35	120	28	30	45
TDS	N/O[b]	1300	180	1900	93	490	510	310	480	83	280	120	120	170
Zn	0.058	<0.050	<0.050	**0.18**	<0.050	<0.050	<0.050	<0.050	**0.13**	**0.11**	**0.066**	<0.050	<0.050	<0.050

[a] All results are in mg/l unless otherwise stated.
[b] No objective in Basin Plan.
[c] Standard pH units.
[d] umho/cm@25C

Table F-3 Halogenated Volatile Organics[a]

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
1,2-DCA	N/O[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

[a] All results are in micrograms/l unless otherwise stated.
[b] No objective in Basin Plan

Table F-4 Organochlorine Pesticides[a]

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Aldrin	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
alpha BHC	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
beta BHC	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
delta-BHC	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lindane	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlordane	N/O[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
4,4'-DDD	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
4,4'-DDE	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
4,4'-DDT	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dieldrin	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endosulfan I	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Endosulfan II	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endosulfan sulfate	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endrin	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endrin aldehyde	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Heptachlor	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Heptachlor epoxide	N/O[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Kepone	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Methoxychlor	N/O[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Mirex	N/O[b]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Toxaphene	N/O[b]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

[a] All results are in micrograms/l unless otherwise stated.
[b] No objective in Basin Plan.

Table F-5 Polychlorinated Biphenyls [a]

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Aroclor 1016	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1221	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1232	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1242	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1248	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1254	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1260	0.014	<0.50	N/R[b]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

[a] All results are in micrograms/l unless otherwise stated.
[b] Not reported.

Table F-6 Radiological Analysis (Controls for Environmental Pollution, Inc.) (pCi/l)

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Gross Alpha	N/O[a]	37 +/- 9	<2	13 +/- 10	4 +/- 2	2 +/- 1	NR	<2	9 +/- 2	<2	3 +/- 1	2 +/- 1	<2	4 +/- 2
Gross Beta	N/O[a]	44 +/- 2	<3	25 +/- 9	9 +/-2	8 +/- 1	NR	3 +/- 1	8 +/- 1	3 +/- 1	4 +/- 1	3 +/- 1	<3	9 +/- 2
Tritium	N/O[a]	<500	<500	2226+/-322	<500	<500	NR	<500	<500	<500	1490 +/- 390	<500	<500	<500

[a] No objective in Basin Plan.

Table F-7 Radiological Analysis (SLAC In-house Lab) (pCi/l)

1	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
Gross Alpha	N/O[a]	37 +/- 9	<2	13 +/- 10	4 +/- 2	2 +/- 1	NR	<2	9 +/- 2	<2	3 +/- 1	2 +/- 1	<2	4 +/- 2
Gross Beta	N/O[a]	44 +/- 2	<3	25 +/- 9	9 +/-2	8 +/- 1	NR	3 +/- 1	8 +/- 1	3 +/- 1	4 +/- 1	3 +/- 1	<3	9 +/- 2
Tritium	N/O[a]	<500	<500	2226+/-322	<500	<500	NR	<500	<500	<500	1490 +/- 390	<500	<500	<500

[a] No objective in Basin Plan.

Table F-8 Total Petroleum Hydrocarbons [a]

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
TPH as Diesel	20	0.27	<0.050	<0.050	<0.050	0.41	0.97	<0.050	0.68	<0.050	0.59	<0.050	<0.050	<0.050
TPH as Motor Oil	20	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]	N/R[b]

[a] All results are in miligrams/l unless otherwise stated.
[b] Not reported.

Table F-9 Total Suspended Solids (mg/l)

	1995 Basin Plan Obj	Main Gate 2/28/95	Main Gate 3/10/95	Sect 14-4 2/28/95	Sect 14-4 3/10/95	North Adit 2/28/95 (split)	Reg. 12 2/28/95 (split)	North Adit 3/10/95	IR-6 2/28/95	IR-6 3/10/95	IR-8 2/28/95	IR-8 3/10/95 (split)	Reg. 8 3/10/95 (split)	Sect. 10-4 3/10/95
TSS	45	62	61	14	430	27	19	26	15	9	33	65	120	52

G Acronym List

A

AIP	Agreement In Principle
ALARA	As Low As Reasonably Achievable

B

BAAQMD	Bay Area Air Quality Management District
BDE	Beam Dump East
BMP	Best Management Practice
BPO	Basin Plan Objective
BSY	Beam Switchyard

C

CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPM	Counts Per Minute
CRMP	Comprehensive Resource Management and Planning
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year

D

DCA	Dichloroethane
DCE	Dichloroethene
DCG	Derived Concentration Guide
DOE	Department of Energy
DOE/OAK	DOE Operations Office, Oakland, CA

E

EA	Environmental Assessment
EC	Electrical Conductivity
EDE	Effective Dose Equivalent

E

EECA	Engineering Evaluation and Cost Analysis
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPR	Environmental Protection and Restoration
ERP	Environmental Restoration Program
ES&H	Environment, Safety, and Health
ESA	End Station A
ESA	Endangered Species Act
ESHCC	Environment, Safety, and Health Coordinating Council

F

FEMA	Federal Emergency Management Agency
FFS	Final Focus System
FFTB	Final Focus Test Beam
FHWSY	Former Hazardous Waste Storage Yard
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMS	Flow Meter Station
FUST	Former Underground Storage Tank

G

GPMP	Groundwater Protection Management Program
GPP	General Plant Project

H

HMBP	Hazardous Materials Business Plan
HPGe	Hyper-pure Germanium
HWMC	Hazardous Waste and Material Coordinator
HWMG	Hazardous Waste Management Group

I

IR	Interaction Region
IRA	Interim Removal Action

K

kWh	kilowatt-hour

L

LA	Local Authority
LCW	Low Conductivity Water
linac	Linear Accelerator
LSC	Liquid Scintillation Counter

M

MCC	Main Control Center
MCL	Maximum Concentration Level
MCL	Maximum Contaminant Level
MEI	Maximally Exposed Individual
MFD	Mechanical Fabrication Department
MPMWD	Menlo Park Municipal Water Department
MW	mega-watt

N

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NOI	Notice of Intent
NO_X	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program

O

ODS	Ozone-Depleting Substance
OHP	Operational Health Physics

P

PCB	Polychlorinated Biphenyl
pCi/l	Pico-curies per Liter
PED	Plant Engineering Department
PEL	Physical Electronics Laboratory
PEP	Positron-Electron Project
PEP-II	Asymmetric B Factory
PMS	Peripheral Monitoring Station
POTW	Publicly Owned Treatment Work

P

PPO	Program Planning Office
PS	Positron Source

Q

QA	Quality Assurance
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RP	Radiation Physics
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board
RWTP	Rinse Water Treatment Plant

S

SARA	Superfund Amendments and Reauthorization Act
SBSA	South Bayside System Authority
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SHA	Safety, Health, and Assurance
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SPEAR	Stanford Positron Electron Asymmetric Ring
SSRL	Stanford Synchrotron Radiation Laboratory
Sv	Sievert
SWPPP	Storm Water Pollution Prevention Plan

T

TCA	Trichloroethane
TCE	Trichloroethene
TDS	Total Dissolved Solid
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility

T

TSS	Total Suspended Solids
TTO	Total Toxic Organics

V

VOC	Volatile Organic Compound

W

WAA	Waste Accumulation Area
WBSD	West Bay Sanitary District
WM	Waste Management
WTS	Waste Tracking System

[This page intentionally left blank.]

H SER Distribution List

Bill Griffing
Head,
Environment, Safety, and Health Section
Fermi National Accelerator Laboratory MS 119
P.O. Box 500
Batavia, IL 60510

District Manager
West Bay Sanitary District
500 Laurel Street
Menlo Park, CA 94025

Rebecca Failor
Environmental Monitoring Program Leader
L-629
P.O. Box 808
Lawrence Livermore National Laboratory
Livermore, CA 94550

Paul Frame
PTP/TMSD
ORISE
PO Box 117
Oak Ridge, TN 37830

Steve Hsu
State of California
Department of Health Services
Radiological Health Branch
P.O. Box 942732
Sacramento, CA 95634-7320

Ted Hull
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Bill Klokke
South Bayside System Authority
1400 Radio Road
Redwood City, CA 94065

Leslie Laudon
State Water Resources Control Board
Division of Clean Water Programs
P.O. Box 94412
Sacramento, CA 95834-2120

W. Lent
San Mateo Department of Health Services
Office of Environmental Health
County Office Building
590 Hamilton Street
Redwood City, CA 94063

Librarian
Oakridge National Laboratory
Technical Information Center
Oakridge, TN 37830

Felicia Marcus
U.S. Environmental Protection Agency
Region IX
75 Hawthorne
San Francisco, CA 94105

Bob May
TJNAL/SURA Radiation Control Group
Mail Stop 12 A 1
12000 Jefferson Avenue
Newport News, VA 23606

John Muhlestein
U.S. Department of Energy
Oakland Operations Office
Stanford Site Office
Stanford Linear Accelerator Center
P.O. Box 4349 M/S 8A
Stanford, CA 94309

John B. Murphy
Oak Ridge National Laboratory
Building 4500N, MS 6198
Oak Ridge, TN 37831

Charles NeSmith
State Water Resources Control Board
Division of Clean Water Programs
Solid Waste Assessment Test Unit
P.O. Box 944212
Sacramento, CA 94244-2120

James Nusrala
California Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, CA 94612

OSTI
U.S. Department of Energy Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37831

Steve Richie
California Regional Water Quality Control Board
San Francisco Bay Region
1111 Jackson Street
Oakland, CA 94612

Steve Richie
California Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, CA 94612

Phil Rutherford, Manager
Radiation Protection & Health Physics Services
Rocketdyne Division
Rockwell International Corporation
6633 Canoga Ave.
P. O. Box 7922 (MS T100)
Canoga Park, CA 91309-7922

[This page left intentionally blank.]

Site Environmental Report
Reader Survey

To Our Readers:

Each annual Site Environmental Report publishes the results of environmental monitoring at SLAC and documents our compliance with federal, state, and local environmental regulations. In providing this information, our goal is to give our readership—whether they be regulators, scientists, or the public—a clear accounting of the range of environmental activities we undertake, the methods we employ, the degree of accuracy of our results, the status of our program, and significant issues affecting programs.

It is important that the information we provide is easily understood, of interest, and communicates SLAC's effort to protect human health and minimize our impact on the environment. We would like to know from you whether we are successful in achieving these goals. Your comments are appreciated.

1. Is the writing ☐ too concise? ☐ too verbose? ☐ uneven? ☐ just right?
2. Is the technical content ☐ too high? ☐ too low? ☐ uneven? ☐ just right?

	YES	NO
3. Is the report comprehensive?	☐	☐
4. Do the illustrations help you understand the text better?	☐	☐
Are the figures understandable?	☐	☐
Are there enough figures?	☐	☐
Are there too few figures?	☐	☐
Are there too many figures?	☐	☐
5. Are the data tables of interest?	☐	☐
Would you prefer short summaries of data trends instead of data tables?	☐	☐
6. Is the background information sufficient?	☐	☐
7. Are the methodologies described reasonably understandable?	☐	☐
8. Is the acronym list useful?	☐	☐
9. Are the appendices useful?	☐	☐

Other comments:

This survey may be folded and stapled and returned to SLAC. Laboratory staff may send their survey forms through laboratory mail to Gene Holden, Mailstop 84.

----------FOLD HERE----------

Postage Required

Gene Holden
Mailstop 84
Stanford Linear Accelerator Center
2575 Sand Hill Road
Menlo Park, CA 94025

----------FOLD HERE----------