ANNUAL SITE ENVIRONMENTAL REPORT

JANUARY - DECEMBER 1992

ENVIRONMENT, SAFETY AND HEALTH DIVISION
STANFORD LINEAR ACCELERATOR CENTER
STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94309

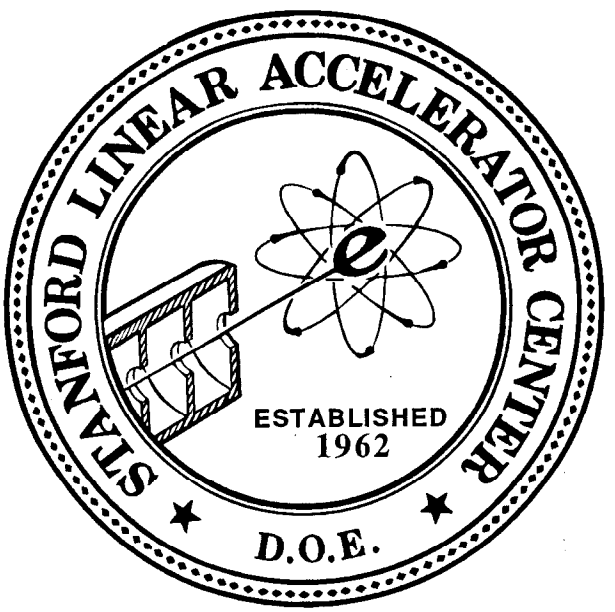

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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1.0 Executive Summary

This report describes the environmental status of the Stanford Linear Accelerator Center (SLAC) for calendar year 1992 (CY92). It covers the status of compliance with applicable environmental laws and regulations, and the plans and activities related to environmental surveillance, monitoring, and protection programs at SLAC in CY92.

1.1 Compliance

SLAC strives to operate in compliance with Department of Energy (DOE) Orders and other federal, state, and local environmental laws and regulations, and SLAC's environmental programs are designed to achieve compliance with these requirements. In CY92, no known releases of airborne or waterborne radioactive material in excess of DOE or regulatory limits occurred. In CY92, no Reportable Quantity (RQ) releases of hazardous materials to the environment occurred.

1.2 Environmental Radiological Program Information

1.2.1 Airborne Emissions

For CY92, 22 Ci of radioactivity are estimated to have been released from the vent stacks or other openings in the six identified beam loss areas. A maximum dose equivalent at the SLAC boundary of 6.8×10^{-2} mrem was attributed to these emissions for CY92. To comply with National Emission Standards for Hazardous Air Pollutants, SLAC issued a report on radionuclide releases to the air, which showed that there were no instances of noncompliant emissions at SLAC in CY92.

1.2.2 Penetrating Radiation

During CY92, the Peripheral Monitoring Stations (PMSs) measured no neutron or high energy photon fields of environmental significance at the SLAC boundary. Past experience indicates a potential effective dose equivalent ceiling of 2 mrem/year at the SLAC boundary. The passive Thermoluminescent Dosimeter (TLD) Monitoring program, however, recently indicated a potential effective dose equivalent of 20 mrem/year at some SLAC boundary locations. These results are currently being

investigated. Within a few feet of stored radioactive material, radiation levels were generally about 5 μrem/hour.

1.2.3 Surface Water Discharges

In CY92, no releases to the storm drain system of radioactivity above background concentrations were detected.

For a summary of radioactivity monitoring results for groundwater in CY92, see section 1.4, "Groundwater Protection."

1.3 Environmental Program Information

1.3.1 Clean Air Act

No permit limitations were exceeded in CY92. SLAC has 30 air pollution sources listed with the Bay Area Air Quality Management District (BAAQMD) (19 permitted, 11 exempt). In October 1992, SLAC was inspected by the BAAQMD for compliance with air pollution control requirements, and no Notices of Violations were issued.
A site survey of ozone-depleting substances (ODS) was conducted in CY92. A group at SLAC was assembled to identify and test suitable alternatives to ODSs in preparation for the 1995 phase out of ODSs required by the Montreal Protocol.

1.3.2 Clean Water Act

SLAC filed a Notice of Intent (NOI) in March 1992 with the Regional Water Quality Control Board to comply with the California General Industrial Stormwater Permit. As required by this permit, SLAC has developed a Storm Water Pollution Prevention Plan (SWPPP) and a Monitoring Program. All compliance reports related to industrial wastewater were submitted on time and no industrial wastewater discharge limits were exceeded in CY92.

For a summary of activities related to groundwater protection in CY92, see section 1.4, "Groundwater Protection."

1.3.3 Resource Conservation and Recovery Act

In CY92, SLAC continued to improve its computerized hazardous waste tracking system. In CY92, SLAC formalized the roles, responsibilities, and requirements for proper management of Waste Accumulation Areas (WAAs). SLAC finalized and began to implement its waste minimization program in January 1992. All hazardous waste minimization certifications required under the Resource Conservation and Recovery Act (RCRA) for disposal of hazardous waste were made. The Environmental Protection Agency (EPA) 1992 Hazardous Waste Biennial Report on waste generation at SLAC, and the Annual Waste Reduction Report for CY91 were completed. In an inspection of SLAC in December 1992, the San Mateo County Department of Health Services (SMCDHS) found three violations, all of which were subsequently corrected.

1.3.4 Toxic Substances Control Act

In an ongoing effort to reduce the sitewide inventory of polychlorinated biphenyls (PCBs), SLAC removed and disposed of two PCB transformers and four PCB-contaminated transformers in CY92. Several transformers containing various levels of PCBs were drained, refilled, and are pending reclassification. SLAC is currently developing a PCB Transformer Inspection procedure.

1.3.5 Comprehensive Environmental Response, Compensation, and Liability Act

In CY92, SLAC continued to develop an environmental restoration program that meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Preliminary assessments of areas with suspected or known contamination were performed to identify areas for inclusion in a sitewide Remedial Investigation (RI). The results were documented in three major reports. In CY92, SLAC drafted a Community Relations Plan (CRP), which describes how SLAC will involve the public in the environmental restoration program.

In CY92, SLAC began compiling data in order to prepare a sitewide Preliminary Assessment (PA) of soil and groundwater contamination. The Superfund Amendments and Reauthorization Act (SARA) Title III and State equivalent community Right-to-Know annual reports were submitted to the SMCDHS.

1.3.6 National Environmental Policy Act

In CY92, SLAC formalized a National Environmental Policy Act (NEPA) program, which includes a system to determine those projects for which NEPA documentation is required, and a system to track such projects. In CY92, SLAC submitted 62 Categorical Exclusions (CXs) to the Department of Energy (DOE) and initiated an Environmental Assessment (EA) of the PEP-II project.

1.3.7 Groundwater Protection

In CY92, SLAC substantially revised the Groundwater Protection Management Program (GPMP), which was prepared in accordance with DOE Order 5400.1, *General Environmental Protection Program.* The GPMP provides a comprehensive framework for groundwater protection at SLAC that includes planning, integration, and coordination of all supporting activities. Several major draft reports were written in CY92 to support the GPMP.

Quarterly groundwater monitoring data were collected from two groundwater monitoring networks in CY92. The results from the sitewide groundwater monitoring network indicate that water in some wells contains levels of heavy metals and/or chlorinated solvents at or above state and federal limits. The results from the groundwater monitoring network for a former leaking underground storage tank indicate that the water in some wells contains levels of VOCs in excess of state limits for drinking water. In CY92, groundwater samples were analyzed for radioactivity and results suggest that a sampling or analysis error is occurring. Corrective action is underway.

1.3.8 Assessments

In response to the Tiger Team assessment, SLAC developed a Corrective Action Plan (CAP), which was approved by the DOE in November 1992. SLAC has implemented a Corrective Action Management System to track the progress and completion of corrective actions. In response to an environmental functional appraisal conducted by the DOE San Francisco Field office (DOE-SF) in August 1992, SLAC has submitted a supplemental Corrective Action Plan to the DOE. The DOE-SF's Summary Appraisal Report for FY92 stated that environmental management was "good" and environmental

restoration/waste management was "excellent", a clear improvement from the results of the DOE-SF's appraisal for FY91.

SLAC completed its Self Assessment Program Plan in March 1992.

1.4 Quality Assurance

In CY92, SLAC continued to develop and implement its Quality Assurance (QA) program, which was designed to meet the requirements of DOE Order 5700.6C, *Quality Assurance.* As part of this program, the Quality Assurance and Compliance Department (QACD) at SLAC conducted 11 audits of subcontractors and analytical laboratories used by SLAC, and SLAC projects. The SLAC Institutional Quality Assurance Manual was revised during CY92 and approved in October. In CY92, plans for completing a radiological monitoring Quality Implementation Plan (QIP) and a non-radiological monitoring QIP by March 1994 were developed.

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2.0 Introduction

2.1 General

The Stanford Linear Accelerator Center (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. 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 for fifty years in 1962 to the DOE (then AEC) for purposes of research in the basic properties of matter. The lands are part of Stanford's "academic reserve", and are located west of the University and the City of Palo Alto. 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 the San Francisquito Creek. The accelerator is sited on a roughly 300 meter wide parcel, 3.2 kilometers (km) long, running in an east-west direction. The width of the parcel extends to about 910 m at the target (east) end to allow space for buildings and experimental facilities. See Figure 2-3.

The SLAC staff currently numbers roughly 1,450 employees; there are about 1,100 full-time people, 200 part-time and 150 visiting scientists. Approximately one-quarter of the staff is professional, composed of physicists, engineers, programmers and other scientific-related personnel. The balance of the staff composition is support personnel including technicians, crafts personnel, laboratory assistants, clerical and administrative employees.

2.2 Accelerators in Perspective

Accelerators are simply tools of research enabling physicists to explore and understand the fundamental behavior of the subatomic environment. Some accelerators are linear, as is SLAC's; others are circular in geometry as are cyclotrons, synchrocyclotrons, betatrons and synchrotrons. All conventional accelerators accelerate subatomic particles (electrons, protons, positrons, alpha particles) to a high energy and bombard a target nucleus. Physicists then study the effects of the collisions in an attempt to understand precisely what happens and

thereby understand the nature of the atomic nucleus. Because of the very strong forces which bind the nucleus and its constituents together, physicists need greater and greater energies in order to delve constantly deeper into the structure of the atom. Consequently, accelerators have grown in size and complexity.

One of the important components of the U.S. High Energy Physics Program is the 3.2 km long electron accelerator at SLAC. This machine is now capable of accelerating electrons to 50 billion electron volts (50 GeV), and positrons have achieved very nearly the same energy. These particle beams are utilized by an array of experimental fixed target installations, one colliding beam storage ring and the Stanford Linear Collider (SLC).

The Positron Electron Project (PEP) storage ring is a special extension of the SLAC accelerator and poses no greater environmental problems than does the existing linear accelerator (linac). The center-of-mass energy achieved by colliding beam particles together is vastly more efficient than having a single beam strike a stationary target. In a colliding-beam storage machine, the beam particles are truly "recycled", i.e., the same bunches of beam particles are brought into collision over and over again, rather than striking a target only once. For this reason, colliding-beam devices (in a fundamental way) produce very much less radiation and residual radioactivity than do conventional accelerators.

The PEP facility, completed in 1980, is a large storage ring housed in an underground tunnel at depths varying from 6-30 m, in which beams of electrons and their antimatter equivalent (positrons) circulate in opposite directions at energies up to 15 GeV. The underground ring has a diameter of about 700 m and is located at the eastern extremity of the SLAC site. SLAC is currently proposing to upgrade this 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.

When particles of matter and antimatter meet head-on at high velocity, both are completely converted into energy. According to the formulations of Albert Einstein, energy can be transformed into matter and vice versa. In the electron-positron collisions some of the resulting energy is immediately transformed back into matter, producing a variety of particles of immense interest to physicists. Many of the design details of the PEP facility are based on the design and experience of a small existing storage ring at SLAC called the Stanford Positron Electron Asymmetric Ring (SPEAR). The SPEAR facility came into operation and began

performing colliding-beam experiments in 1972. The SPEAR machine is about one-eighth the size and capable of about one-quarter the energy of the PEP facility. Although the high energy physics usefulness of SPEAR had been fully exploited in the 1980's, its success has established the feasibility and served as a prototype for PEP.

SPEAR now serves as a strong source of synchrotron light for the Stanford Synchrotron Radiation Laboratory (SSRL) and has its own linac injector and booster ring that operate independently of the 3.2 km SLAC linac.

In addition to the aforementioned facilities, SLAC has built a new machine, the SLC. The SLC project was proposed in 1980 and finished in 1987. Fully operational, SLC provides electron-positron collisions at 100 GeV center-of-mass energy. [1] It is housed in a 3 km underground tunnel having a single interaction region at the eastern end of the site. Associated with SLC is the SLC Large Detector (SLD), a nearly five story high detector assembly located in the SLC Collider Hall. SLD completed commissioning runs in CY91 and has been actively recording events from the Interaction Point (IP) into CY92. This SLC/SLD project has not had any significant additional environmental impact to date.

2.3 Local Climate

The climate in the SLAC area is Mediterranean. Winters are warm and moist, and summers are mostly cool 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, 4.8 km to the east. 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 of 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 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 be best 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 SLAC's boundary. In general, the bedrock on which the western half of the accelerator 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 unconsolidated earth materials 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 2.7×10^5 gallons per day (1.02×10^6 liters per day).

Since half of the water is necessary for machine cooling, the daily consumption of this component 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 five cooling water towers comprising a total cooling capacity of 79 megawatts (MW) to dissipate the heat generated by the linear accelerator and other experimental apparatus.

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. The LCW from the closed system is sampled and analyzed, including for tritium, prior to discharge. 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.

The SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPWD) whose source is the City of San Francisco operated Hetch Hetchy aqueduct system from reservoirs in the Sierra Nevada. SLAC and its neighboring Sharon Heights development, including the shopping center, receive water service from a separate independent system (called "Zone 3") within the MPWD. This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7600 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. 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.

During current operations, roughly 68% of the water consumed by the laboratory is evaporated from the five cooling towers. The remaining 32% is disposed of as follows:

- 8% is cooling tower blowdown water to the sanitary sewers
- 16% is waste domestic and process water discharged via the sanitary sewers, and
- 8% is absorbed into the ground from irrigation.

2.6 Land Use

San Mateo County has the ultimate planning responsibility with respect to University lands which 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 which might (directly or indirectly) adversely affect environmental quality.

The Board of Trustees of Stanford University has the responsibility of 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 of the University. Certainly 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 recent 1990 census of these five communities are shown in Table II-1.

Table II-1. Demographic Data

GEOGRAPHIC AREA	POPULATION [persons]	POP. DENSITY [per sq mile]	HOUSING [unit]	LAND AREA [sq mile]
Atherton town	7,163	1463.32	2,518	4.895
West Menlo Park	3,959	7086.19	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	6569.14	4,770	2.755
Total:	38,448	NA	12,556	29.105

A population estimate within 6 km of SLAC was determined as part of the required input to the CAP88-PC computer code. Population data from the 1990 census of San Mateo county and Santa Clara county were used in this study. The area was divided into 7 concentric circles and 16 compass sectors. The population distribution is summarized in Table II-2.

Table II-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	TOTAL
0	0	1217	2825	14108	31678	42834	92663

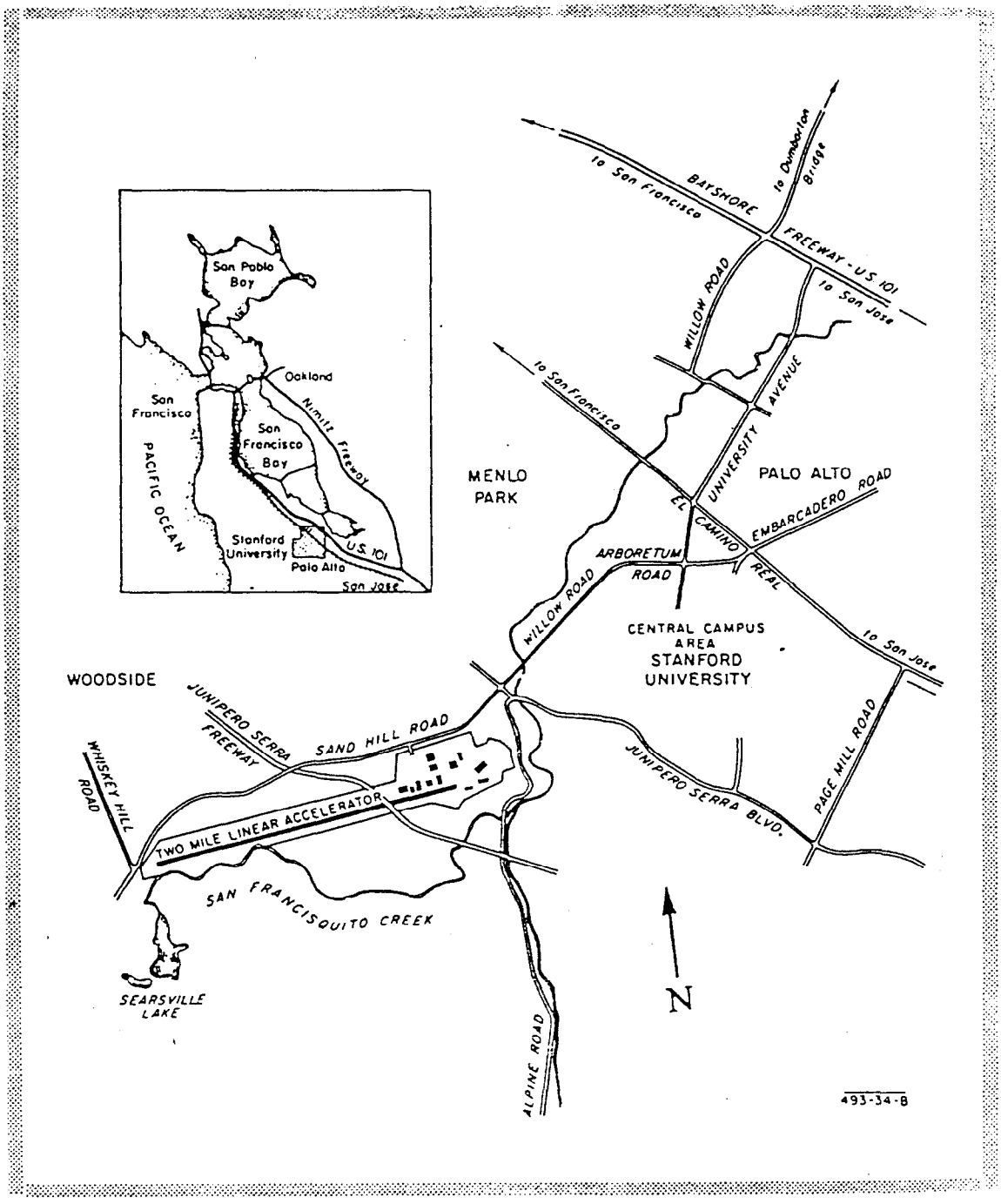

Figure 2-1. SLAC site location.

3.0 Compliance Summary

This section of the SLAC CY92 Annual Site Environmental Report provides a summary of the site's compliance with environmental laws and regulations. Specific instances of noncompliance are discussed and a description of corrective actions included. More detailed descriptions of environmental programs are presented in the Environmental Program information sections (see Sections 4, 5 and 6).

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

3.1.1 Environmental Restoration

In CY92, SLAC continued development of a formal environmental restoration program incorporating CERCLA requirements. A Community Relations Plan was drafted, and several investigations and preliminary assessments were performed to compile a list of areas with suspected or known contamination in order to perform a sitewide Remedial Investigation (RI). A repository for the Administrative Record was established, and the Administrative Record is being compiled and will be placed in the repository during the RI phase of the restoration program. Sitewide program documents such as an Environmental Restoration Implementation Plan, a Quality Assurance/Quality Control Plan (QA/QC Plan), and a Safety & Health plan are being developed and are scheduled for completion in CY93.

SLAC is on the EPA Hazardous Waste Compliance Docket because of soil and groundwater contamination associated with a former leaking underground tank which was used to store waste organic solvents. All facilities on the Docket are required to submit a sitewide Preliminary Assessment (PA) to the EPA by July 15, 1993, so that they may score the facilities and determine if they should be on the Superfund National Priority List (NPL). In CY92, SLAC began compiling information to prepare the PA.

A preliminary RI was performed on an area of drainage ditch located near Interaction Region 8. PCB contamination was found in portions of the ditch originating on SLAC property and extending approximately 350 feet offsite onto adjacent property which is owned by Stanford but leased to a private party. SLAC constructed a fence around this areas of the ditch to prevent control access to the contaminated area. Sampling and analysis of San Francisquito

Creek located downstream of the drainage ditch indicated the contamination had not migrated to that area. However, examination of the upstream onsite drainage system found PCB contamination. Further characterization of this contamination will be performed during the sitewide RI.

3.1.2 Superfund Amendments and Reauthorization Act (SARA)

The Superfund Amendments Reauthorization Act (SARA) Title III report and the State equivalent community Right-to-Know report was submitted March 4, 1992, to the San Mateo County Department of Health Services.

3.2 Resource Conservation and Recovery Act (RCRA)

SLAC is a Generator of hazardous waste, and 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 inspected by the County in December, 1992. Three minor violations were noted in the final inspection report. All deficiencies were corrected and a certification of such corrections sent to the County on January 8, 1993.

SLAC finalized and began implementing its waste minimization program in January, 1992. An employee training program covering general hazardous chemical and waste management, including waste minimization and pollution prevention, was developed and provided to over 400 employees. An annual "refresher" course for this training was developed and provided as required.

The EPA Biennial Report was completed in May, 1992 to report on CY90 and CY91 waste generation. The 1991 Annual Waste Reduction Report was also completed on April 30, 1992. All hazardous waste minimization certifications required under RCRA for disposal of hazardous waste were made.

3.3 National Environmental Policy Act (NEPA)

SLAC formalized a NEPA program in CY92. All 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 CY92, SLAC submitted 62 Categorical Exclusions (CX's) to DOE. An Environmental Assessment of the PEP-II (B Factory) project was initiated and will be coordinated for DOE approval.

3.4 Clean Air Act (CAA)

The BAAQMD implements the Clean Air Act through a set of Rules and Regulations for operations or equipment which may cause air pollution. SLAC had a total of 30 air pollution sources listed with the BAAQMD (19 permitted, 11 exempt), and permits pending for two additional sources at the end of CY92 . Two solvent cleaning sources and two sandblasting units were removed from service, and their permits canceled during the year. No permit limitations were exceeded in CY92. The annual emissions inventory (CY91), including information required for the Toxic Hot Spots (AB2588) inventory, was submitted to the BAAQMD on April 16, 1992.

In October, 1992, SLAC was inspected by the BAAQMD. No Notices of Violations were issued.

A site survey of ozone-depleting substances (ODS) such as 1,1,1-Trichloroethane (TCA) and Freon solvents was conducted in CY92. As required by the Montreal Protocol and a Presidential decision, the manufacture of ODS will be phased out by the end of 1995. Because SLAC currently relies on these solvents for cleaning operations, a group has been assembled to identify and test suitable alternatives for replacement of the ODS. Refrigeration units will also be impacted by the phase-out of ODS. Recycling of refrigerant commenced in CY92.

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 EPA. In accordance with this requirement, SLAC issued the CY91 report in June, 1992. There were no instances of noncompliant emissions reported.

3.5 Clean Water Act (CWA)

3.5.1 Groundwater Monitoring Program

The Draft Groundwater Protection Management Program (GPMP) was substantially updated and revised in CY92 to provide comprehensive guidance to the groundwater program including planning, integration and coordination of all supporting activities. Draft reports written in CY92 to support the program include: the Hydrogeologic Review Report, a Sampling and Analysis Plan and associated Standard Operating Procedures, a Soil Gas Survey, a Beneficial Use Assessment, a Fate and Transport study and an Identification and Summary of Potentially Contaminated Sites.

In CY92, as in CY91, quarterly groundwater monitoring data were collected from two distinct groundwater monitoring networks at the facility. Beginning in July, 1993 this data collection and analysis will be carried out under the guidance of the GPMP.

3.5.1.1 Sitewide Monitoring Network

SLAC has a groundwater monitoring network where wells were constructed in areas of the facility which historically and/or currently store, handle, or use chemicals which may pose a threat to groundwater quality. In CY92, samples were collected from the wells on a quarterly basis and analyzed for a wide range of chemical constituents. As reported in the CY91 Annual Report, results of the analyses indicate that water in several of the wells contained levels of heavy metals and/or chlorinated solvents at or above the State of California Maximum Contaminant Levels (MCLs) for Drinking Water or EPA National Ambient Water Quality Criteria based on health effects. 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 sitewide RI that will be performed as part of the comprehensive environmental

restoration program at the site. In the interim, the wells will continue to be monitored.

3.5.1.2 Former Leaking Underground Storage Tank Monitoring Network

The California RWQCB has oversight of a Waste Discharge Order (No. 85-88) for contaminated groundwater near a former leaking UST which contained organic compounds. Eight groundwater monitoring wells surrounding the tank area are sampled and analyzed quarterly. Several of the down-gradient wells contain VOCs in excess of the State of California MCLs for drinking water. A comparison of the data indicates that at the source, levels of VOC's are declining. However, VOC concentrations increasing in down gradient wells, indicating the contaminant plume is migrating from the source to these wells.

3.5.1.3 Radiological Monitoring of Groundwater

In CY92, SLAC analyzed groundwater samples for radioactivity. The analytical data showed large inconsistencies for alpha, beta and tritium, suggesting sampling or analytical laboratory error is occurring. Corrective action is currently being performed in order to determine the source of the error and to correct it so that consistent and comparable results are achieved in future sampling events.

3.5.2 Surface Water

Prior to December 1991, SLAC discharged cooling tower blowdown water to surface drainage under an NPDES Permit (Permit CA0028398, Order 90-098) issued by the California RWQCB, San Francisco Bay Region. On December 1, 1991, SLAC ceased discharging the cooling tower blowdown water to the stormdrain system, and began discharging to the sanitary sewer under SLAC's facility Wastewater Discharge Permit (No. WB 920415-F). Because of the change in receiving water from surface drainage to the sanitary sewer, no self monitoring was required to comply with the existing NPDES permit. SLAC does not intend to renew the NPDES permit at the next renewal period.

On March 27, 1992, SLAC filed a Notice Of Intent (NOI) with the Regional Water Quality Control Board (San Francisco Bay Region) to comply with the California General Industrial Stormwater Permit on March 27, 1992, and has developed both a Storm Water Pollution Prevention Plan (SWPPP) and a Monitoring Program as required by the permit. As part of the SWPPP, the stormwater system at the facility was inspected to identify potential "illicit" cross-connections, and SLAC is in the process of tracing suspect connections. The RWQCB was notified of these activities.

3.5.3 Industrial Wastewater

New wastewater discharge permits were issued to SLAC on April 15, 1992. Two separate discharge permits, No. WB 920415-F and No. WB 920415-P, were issued. The permits are automatically renewed for successive 1-year periods (for up to five years) if no renewal action is taken by the South Bayside Systems Authority. SBSA periodically monitors the SLAC's discharge to determine compliance with Federal and local standards. No discharge limits were exceeded in CY92.

The new wastewater permit issued to SLAC for the total facility discharge specifically allows the discharge of radioactive wastewater in compliance with federal and state discharge limitations. The permit calls for certified quarterly wastewater discharge reports comparing radioactivity discharged to regulatory limitations. All compliance reports were submitted on time, and no discharge limitations were exceeded.

3.6 Safe Drinking Water Act (SDWA)

Drinking water and process water is 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 which is protected by backflow prevention devices. In CY92, SLAC surveyed the potable water system to insure that each process water connection to the site distribution system included a backflow prevention device. These devices are inspected annually.

There are no drinking water wells at SLAC.

3.7 Toxic Substances Control Act (TSCA)

SLAC has equipment filled with oil or other dielectric fluids containing polychlorinated biphenyls (PCBs). PCBs, their use and disposal, are regulated by the Toxic Substances Control Act (TSCA - 40 CFR761). TSCA provides for regulation of raw materials as well as the control or banning of already existing chemicals that pose a risk to health or the environment. The Environmental Protection Agency (EPA) is responsible for assuring facilities are in compliance with TSCA. The EPA did not conduct a TSCA inspection in CY92.

In CY92, SLAC removed and disposed of two PCB Transformers (concentrations greater than 500 ppm PCBs) and four PCB-Contaminated transformers (concentrations greater than 50 but less than 500 ppm PCBs). Additionally, one PCB Transformer, ten PCB-Contaminated transformers and two transformers with a concentration of less than 50 ppm PCBs were drained, refilled and are pending reclassification. At the end of CY92, SLAC had 10 PCB Transformers and 30 PCB-Contaminated transformers. In on ongoing effort to reduce the sitewide inventory of PCBs, SLAC is planning to remove or retrofill and reclassify many of the remaining PCB Transformers and PCB Contaminated transformers over the next few years.

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 CY92, SLAC developed pesticide and herbicide handling and storage procedures. These procedures were incorporated into the subcontracts for landscape maintenance and pest control. These procedures 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 instead 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) should be formally designated as wetlands, which are specifically protected under Section 404 of the Clean Water Act. The field survey and evaluation were performed using established Federal Guidance. According to the survey, the drainage system at IR-8 showed characteristics of wetlands, but a definitive evaluation of the vegetation was not possible because of continuing drought conditions and because the study was performed in the fall when reproductive structures were generally absent. The report concluded that the natural hydrology of the area would probably not be capable of supporting the wetlands community because of its periodic drought. The IR-8 drainage channel, which contains the 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 Corps of Engineers in practice use ten acres as their functional cutoff for "significant" wetlands.

3.13 Releases to the Environment

3.13.1 Radiological

There were no known releases of airborne or waterborne radioactive material to the environment that exceeded the DOE or regulatory limits during CY92.

3.13.2 Non-Radiological

There were no Reportable Quantity (RQ) releases of hazardous materials to the environment during CY92.

3.14 Assessments

A Tiger Team Assessment was conducted at SLAC from October 7 through November 5, 1991. The objective of the environmental portion of the Tiger Team Assessment was to assess the site's current environmental compliance status with regard to Federal, State, and local regulations; DOE Orders; agreements; and applicable permits. The environmental assessment examined site performance against best or accepted industry practices, and evaluated the adequacy of DOE and contractor environmental program management and resources. The Environmental Subteam identified fifty-three findings in the assessment of SLAC (this included radiological as well as nonradiological findings). Of these findings, 20 percent related to compliance with Federal, State and local requirements and the remainder related to compliance with DOE Orders and best management practices.

In response to the Tiger Team Assessment, SLAC developed a Corrective Action Plan which provides timelines for correcting the findings of the assessment as well as budgetary impacts. The CAP was approved by DOE in November, 1992. A CAP Management System was established to track milestones and for validating completed corrective actions. This system was developed in a manner that allows incorporation and tracking of corrective actions in response to other assessments, audits, and appraisals as well.

An Institutional Self Assessment Program is being developed so that the status of compliance at SLAC can be continuously monitored, issues quickly identified, and corrective action taken.

An environmental functional appraisal was conducted by the DOE San Francisco Operations Office August 17-21, 1992. The purpose of the audit was to evaluate the compliance status of operations in environmental disciplines. The report identified that some deficiencies still exist at the facility, but those are being addressed in a Corrective Action Plan approved by DOE Headquarters. In addition, a few new findings were made. SLAC has prepared a Corrective Action Plan to address the new findings. Only three deficiencies identified during the appraisal required immediate action or correction:

1) Waste Accumulations areas do not fully comply with hazardous waste regulations
2) The storage statement for aboveground storage tanks was filed late and the wrong fee schedule was used to calculate fee due.
3) Documentation on what is being done to verify that there are no "illicit" discharges to the storm drain was not complete.

3.15 Current Issues and Actions for the Period of January 1, 1993-April 30, 1993

3.15.1 Low-Level Radioactive Waste Activities

In February, 1993, DOE approved SLAC's procedure for Certification of Hazardous Waste from Radioactive Material Management Areas (RMMAs), thereby lifting the moratorium that prevented the shipment of hazardous waste originating in RMMAs.

3.15.2 National Environmental Policy Act (NEPA)

A NEPA training class to provide an overview of the DOE NEPA Compliance program and NEPA compliance planning and review was held at SLAC in February, 1993. A total of 114 people representing all areas at SLAC completed the class.

3.15.3 Resource, Conservation and Recovery Act (RCRA)

A training program for Hazardous Materials & Waste Coordinators at SLAC was finalized and presented to the coordinators in March, 1993. Quarterly topic discussion meetings are scheduled for CY93.

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

The Superfund Amendments Reauthorization Act (SARA) Title III report and the State equivalent community Right-to-Know report was submitted April 22, 1993, to the San Mateo County Department of Health Services.

SLAC, in accordance with DOE guidance, will begin reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313 for CY93, with

reports due July 1, 1994. SLAC is already working toward that goal by dedicating resources to the planning and information gathering process necessary to submit complete and timely Toxic Release Inventory (TRI) reports.

3.15.5 Clean Air Act

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) report for CY92 was submitted to DOE on April 30, 1993 (see Appendix B).

3.15.6 Clean Water Act

As required by the General Stormwater Permit, SLAC began implementing a stormwater monitoring program on January 1, 1993.

3.15.7 Agreement in Principle (AIP)

An Agreement in Principle (AIP) was entered into between the DOE and the State of California in CY90. The State's designated lead agency for the AIP is the California Department of Health Services (DHS). The AIP is intended to provide technical and financial support to the State for environmental oversight and independent monitoring to ensure compliance with applicable Federal, State, and local laws at SLAC and other DOE facilities in California. The first of planned quarterly meetings was held between SLAC, DOE, and representatives of the AIP program in February, 1993.

3.16 Summary of Permits

SLAC has one (1) NPDES permit, two (2) wastewater discharge permits, 30 air pollution permits/ listed sources, two (2) air permits pending, and two (2) California Extremely Hazardous Waste Disposal Permits. A more detailed description of these permits is provided in Section 5.8.

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4.0 Environmental Radiological Program Information

4.1 Airborne Monitoring

Airborne radionuclides are produced in the air volume surrounding major electron beam absorbers such as beam dumps, collimators, and targets (see Appendix B for more detail descriptions). 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, chlorine-38, and chlorine-39 are 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.

We have not detected any other radionuclides, including particulates, in the airborne effluent exhausted from SLAC.

The accelerator, PEP, SPEAR, and experimental areas are designed to transport (not absorb) high energy electrons and positrons. Radioactive gas concentrations are therefore not produced in measurable quantities. The Beam Switch Yard (BSY), Positron Source (PS), 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 are vented only for emergencies and occasionally at the end of each experimental cycle for brief periods of one hour or less.

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

Table IV-1. Radioactive Gases Potentially Released to Atmosphere

Radionuclide	Half-Life
^{15}O	2.1 minutes
^{13}N	9.9 minutes
^{11}C	20.5 minutes
^{41}Ar	1.8 hours
^{38}Cl	37.2 minutes
^{39}Cl	55.6 minutes

Since we do not routinely release airborne radioactivity while the beam is on and require a waiting period before turning on the exhausters, the only radionuclide released is argon-41. By far the greater proportion of exposure an individual may receive under any circumstances from the radionuclides listed in Table IV-1 is from whole body immersion.

The BSY areas are vented by a total of five fans. The discharge point is just slightly above roof elevation. The total exhaust rate for the accelerator is 60 m^3/min, and for the BSY it is 40 m^3/min.

Each BSY ventilation fan is provided with a radioactive gas detector. A Geiger-Mueller (GM) detector, power supply, rate meter, input to VAX computer system, and air pump are interlocked with the ventilation fan so that they operate only when the machine is vented. These components are found in every Air Monitoring Station (AMS) system at SLAC.

The gas monitors for the BSY collect particulate samples during venting and have yielded no detectable activity above background nor above the detection limits of SLAC's counting instrument. During the CY92 monitoring period, particulate radioactivity above background was not detected.

The effluent gases from the PS and FFS areas are also monitored continuously while the exhausters are running. The same type of air monitoring is used as described above for the BSY.

There were no measurable releases of radioactive gases from the BSY, PS, or FFS during CY92. In compliance with the 10CFR-61, a NESHAPs compliance report for the CY92 was prepared and submitted to the DOE in April 1993. The NESHAPs report and the results of CAP-88 calculational models appear in Appendix B. They were derived by calculating the saturation activity for oxygen-15, carbon-11, nitrogen-13, and argon-41, and then releasing the radionuclides without applying decay factors. We also conservatively assumed that these releases occurred at the end of each experimental cycle, i.e., whenever the machine was shut down for repair or maintenance, whether or not any venting was done.

The compliance report was generated using the required computer program, EPA, CAP88-PC, Version 1.0. The results (6.8×10^{-2} mrem or 6.8×10^{-4} mSv) show that the annual effective dose equivalent (EDE) was less than 0.7% of the NESHAPs standard, i.e., 10.0 mrem (0.1 mSv) per year.

4.2 Wastewater Monitoring

Wastewater containing small quantities of radioactivity within regulatory limits is periodically discharged to the sanitary sewers from the site. The only possible sources of liquid radioactive effluents are from LCW cooling systems in the BSY and certain other areas of the accelerator housing. See Appendix D for CY92 water analysis data. In the event of leaks from these systems, water is collected in stainless steel lined sumps sized to contain the entire water volume.

The greatest source of induced radioactivity is where the electron/positron beam is absorbed. Since water is composed of hydrogen and oxygen, the only radionuclides produced are 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). Oxygen-15 and carbon-11 are too short-lived to present an environmental problem in water, and the beryllium-7 is removed by the resin beds required to maintain the electrical conductivity of the water at a low level; therefore, tritium is the major radioactive element present in the water that is of environmental importance. See Appendix D for the detailed wastewater tritium analysis results for CY92. Gross beta/gamma analysis results are also shown in Appendix D.

In October 1991, SLAC started to collect all water potentially containing tritium in a 20,000 gallon holding tank at Sector 30 in order to control and keep track of tritium quantities prior to

release to the sanitary sewer. Water in this holding tank is discharged into the sanitary sewer only after analysis has been completed. Radioanalysis records (tritium) of the wastewater discharged for each quarter of CY92 are given in Table IV-2.

Table IV-2. Radioanalysis Results (Tritium) for Wastewater Discharged during CY92

Date Released	Quantity [gal]	Tritium Activity* [mCi]
First Quarter	39,300	38.4
Second Quarter	17,900	1.5
Third Quarter	30,000	0.6
Fourth Quarter	35,800	0.1
Total:	123,000	40.6

*1 Ci = 3.7×10^{10} Bq.

As seen in Appendix D, the derived concentration of tritium released is less than the Concentration Guides specified by DOE Order 5400.5, "Requirements for Radiation Protection for the Public". In addition, SLAC is also bound by the provisions in a contract for service with the WBSD (Permit No. WB860915-FNS) and State regulations (California Code of Regulations, Title 17, Section 30287) which limit SLAC to a maximum of 1,000 mCi (i.e., 1 Ci) of total radioactive material discharged to the sanitary sewer each calendar year. Cumulative radioactivity discharge from SLAC to the sanitary sewer during CY92 was well below these regulatory limits.

4.3 Ground and Surface Water Monitoring

There were no radioactivity above normal background released to the storm drain systems during CY92 (see Appendix D). Ground water monitoring is fully discussed in Section 6.

4.4 Peripheral Monitoring Stations

Six Peripheral Monitoring Stations (PMSs) designed to provide continuously recorded data from radiation monitors located near SLAC's boundaries have been installed as direct radiation

monitors. Their positions are shown in Figure 2-3. During CY92, every station was actively operated for large parts of the year. A large scale re-calibration and replacement/repair of active direct reading radiation monitors has been carried out since the first half of CY92. The electronics of all six PMS stations have now been completely replaced with state-of-the-art NIM modules which are more reliable and can be quickly repaired and calibrated. Among these PMS stations, PMS-1 is located in the most sensitive position. Historically (since 1966), it has measured the highest annual dose and it is the closest location to SLAC's off-site population.

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 will be generated together with the maximum dose rates from neutron and high energy photon radiation for that quarter. Each station will record both accelerator and natural background radiation sources. The natural background radiation levels are known since we have been measuring this source for the past twenty-six years. No significant increases above prevailing background levels for each instrument were identified that were due to radiation. Spikes were observed and were diagnosed as computer/CAMAC signal processing errors in each case.

The measured annual dose to the general population coming from accelerator operations is almost entirely from fast neutrons and is characterized as skyshine from SLAC's research area. During CY92, there were some small neutron and photon (gamma and/or x-rays) peaks recorded by these PMS stations. Estimates of accumulated neutron and photon doses associated with the peaks seen from these PMS stations for CY92 are less than 2 mrem (0.02 mSv). A shift in the experimental program to low intensity experiments (including storage ring experiments) is the primary reason for the decrease in PMS measurements to background or near background levels in recent years.

Radiation information is obtained with a GM tube for the high energy photon component and a polyethylene moderated BF_3 neutron detector for the particle component. The resultant sensitivities are such that a gamma exposure of 1 mR from a cobalt-60 source would be recorded as 10^4 counts per minute on the GM tube channel and a neutron dose equivalent of 1 mrem (0.01 mSv) would be recorded as 10^5 counts per minute on the BF_3 channel. All signals are fed into CAMAC inputs for signal acquisition and buffering by the MCC VAX computer system. All data has been retained in a permanent history record since August 1990.

To improve the continuous tracking of direct reading radiation monitoring equipment, a real time display capability was delivered to the Radiation Physics Department during the first half of CY92.

Based on a qualitative and quantitative assessment of operating periods for the PMSs during CY92, the work being performed for the experimental program, and the previous and following operating years, it is estimated the actual exposure at the site boundary would lie between 1 and 2 mrem (0.01 and 0.02 mSv) for CY92. The value 2 mrem (0.02 mSv) was used for summary data as an upper bound estimate for CY92. See Appendix A for the historical analysis model for evaluating PMS data and calculated exposure potentials to members of the off-site population. Tables IV-3 and IV-4 provide measured dose equivalents and the summary effective dose equivalents for CY92.

Table IV-3. CY92 Annual Penetrating Radiation Dose Measured by PMS Stations

PMS No.	Net Photon Dose* (mrem)	Net Neutron Dose* (mrem)
1	< 1	< 1
2	< 1	< 1
3	< 1	< 1
4	< 1	< 1
5	< 1	< 1
6	< 1	< 1

*1 rem = 0.01 Sv.

Table IV-4. Summary of Annual Effective Dose Equivalents Due to 1992 Laboratory Operations

	Maximum Dose to Laboratory Boundary[a]*	Maximum Dose to an Individual[b]*	Collective Dose to Population within 1.6 km of Laboratory[c]*
Dose	< 2 mrem	< 2 mrem	< 18 person-rem
DOE Radiation Protection Standard	–	100 mrem	–
Percentage of Radiation Protection Standard	–	< 2%	–
Background	100 mrem	100 mrem	880 person-rem
Percentage of Background	< 2%	< 2%	< 2%

[a] Maximum boundary dose is the dose to a hypothetical individual at the Laboratory boundary where the highest dose rate occurs, with no correction for shielding. It assumes that the hypothetical individual is at the Laboratory boundary continuously, 24 hours/day, 365 days/year.
[b] Maximum individual dose is to an individual at or outside the Laboratory where the highest dose rate occurs and where there is a person, but where calculations take into account occupancy (the fraction of time a person is actually at that location).
(c) Population dose is conservatively estimated for this 1.6 km radius range. The population dose for the 80 km range should be in the same order of magnitude when exponential dose attenuation is taken into account.
*1 rem = 0.01 Sv.

4.5 Passive Thermoluminescent (TLD) Dosimeter Monitoring Program

To supplement the PMSs for external photon and neutron dose monitoring, SLAC had initiated an environmental TLD monitoring program near the end of the third quarter of CY91. Radiation Detection Company, a NVLAP certified dosimetry service, was contracted to provide SLAC with quarterly TLD dosimeters. The supplied TLDs consist of two polyethylene capsules, each containing 30 mg of ^{7}LiF powder along with a $CaSO_4$:Dy dosimeter, which are heat sealed in an aluminized paper packet. Reproducibility levels (uncertainty values) of these environmental TLDs are within +/- 2 mR and +/- 10 mR for $CaSO_4$:Dy and ^{7}LiF, respectively.

During the second quarter of CY92, SLAC expanded the TLD environmental monitoring program by adding two additional TLD dosimeters (i.e., the models LDR-X9 and LDR-I9) from Landauer Company. The LDR-X9 aluminum oxide TLD is designed to measure low

level photon radiation with a minimum detection level of 0.1 mrem (0.001 mSv). The LDR-I9 is used for monitoring neutron dose with a minimum detection level of 10 mrem (0.1 mSv).

The environmental measurements using TLDs are summarized in Appendix E. The preliminary results show that there are some conflicts between the PMS and TLD measurements. CY92 TLD results indicated that there might have been up to 20 mrem (0.2 mSv) of low energy photon doses at some site boundary locations during CY92. Even though this TLD data indicates levels that are still significantly below the required dose limits, SLAC is continuing to investigate these differences. However, at this time, the TLD environmental monitoring program is still considered to be in the evaluation phase until sufficient data have been accumulated to validate the results based on test exposures, TL element characteristics, and additional background variation data for different locations on site.

4.6 Radiological Media Sampling Program

Routine sampling was limited to water (the major pathway for radionuclide release to the environment) and air (direct reading AMSs for radioactive gases). The low source terms proportionate to DOE's DCGs have identified only these routes as likely pathways for any potential off-site population exposure. Limited soil sampling in past years and during CY92 has not revealed detectable levels of human-made radionuclides (see Appendix G). 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 as the 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.

5.0 Environmental Program Information

This section of the Annual Site Environmental Report provides an overview of the site's environmental activities performed in order to comply with laws and regulations, to enhance environmental quality, and/or 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.

5.1 Clean Air Act (CAA)

Federal air pollution regulations require the states to carry out certain activities and institute specific controls. Because many of the issues of air pollution are regional or local, the states delegate portions of their power and authority to local or regional agencies. Each of these agencies is required to 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 VOCs from solvent cleaning operations, oxides of nitrogen (NO_x) from industrial boilers, and particulates (PM_{10}*) from metal and wood-working activities in the various shops. SLAC currently has 30 air pollution sources listed with the BAAQMD, and two permits pending. These sources and their 1992 annual emissions are identified in Table V-1. The breakdown of listed sources is as follows: 19 are permitted sources; four are sources that are exempt from permits 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 pieces. The two new sources that have permits pending are a solvent distillation unit which will be used to recycle solvent from cleaning operations; and a scrubber for a cyanide plating room in the plating shop.

In CY92, two solvent cleaning tanks and two sandblasting units were removed from service and their permits canceled. Removal of these sources will reduce emissions and waste generated by the facility.

* PM_{10}=Particulate matter less than 10 microns

Table V-1. BAAQMD Permits and Emissions

Annual Average (lbs/day)[a]

S#	Source Description	Particulates	Organics	NO_x	SO_2	CO
1	Boiler	-	-	6	-	1
2	Boiler	-	-	14	-	3
3	Degreaser	-	7	-	-	-
4	Degreaser	-	14	-	-	-
5	Spray-booth	-	1	-	-	-
6	Boiler	-	-	4	-	1
9	Degreaser	-	8	-	-	-
10	Woodworking operations (exempt) [b]	<1	-	-	-	-
11	Metal cutting operations (exempt)[b]	<1	-	-	-	-
13	Metal grinding operations (exempt)[b]	<1	-	-	-	-
14	Sandblast booth	<1	-	-	-	-
16	Sandblast booth	<1	-	-	-	-
17	Metal and epoxy glass grinding (exempt)[b]	<1	-	-	-	-
18	Degreaser	-	2	-	-	-
21	Anodizing, picking and bright dip operations	-	-	-	-	-
22	Degreaser	-	1	-	-	-
26	Cold cleaner	-	-	-	-	-
30	Sludge dryer	-	-	0.07	-	-
32	Cold cleaner	-	-	-	-	-
34	Cold cleaner	-	-	-	-	-
36	Wipe cleaning	-	11	-	-	-
37	Cold cleaner	-	2	-	-	-
38	Solvent distillation unit	-	-	-	-	-
39	Solvent distillation unit (permit pending)	-	-	-	-	-
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 (permit pending)	-	-	-	-	-

(a) NO_x = Nitrogen oxides; SO_2 = Sulfur dioxide; CO = Carbon monoxide

(b) (exempt) = These sources are exempt from a permit but are listed with the BAAQMD

As required by the BAAQMD, SLAC maintains solvent usage records for permitted solvent sources. Permit conditions may limit the amount of solvent which can be used at an individual source on a daily and/or annual basis. Records for individual sources are compared to permit limits to assure that limits have not been exceeded. No permit limits were exceeded in CY92.

In October CY92, SLAC was inspected by the BAAQMD. No Notices of Violations (NOVs) were issued.

A site survey of ozone-depleting substances (ODS) such as 1,1,1-Trichloroethane (TCA) and Freon solvents was conducted in CY92. As required by the Montreal Protocol and a Presidential decision, the manufacture of ODS will be phased out by the end of 1995. Because SLAC currently relies on these solvents for cleaning operations, a group has been assembled to identify and test suitable alternatives for replacement of the ODS. Refrigeration / air conditioning units will also be impacted by the phase-out of ODS. Recycling of refrigerant commenced in CY92.

A new regulation adopted by the BAAQMD in CY92, Regulation 9, Rule 7, limits the emissions of nitrogen oxides and carbon monoxide from boilers. Emissions from the three boilers at SLAC were measured and two boilers were found to have emissions that will not meet the new regulations. Therefore, SLAC is investigating the replacement or retrofitting of the two units by the January 1, 1996 compliance deadline.

5.2 Clean Water Act (CWA)

The ultimate goal of the CWA is the achievement of the "chemical, physical, and biological integrity of the nation's waters." A more immediate goal is to reach a level of water quality which provides for fishable and swimmable waters. In this effort, national water standards have been set for Publicly Owned Treatment Works (POTW) and industrial facilities. To accomplish the goals of the Act, EPA established mandatory effluent limitation guidelines that must be followed by all dischargers through the NPDES permit program. One set of effluent limitations applies to POTWs, and another set applies to industrial dischargers. There are also National Pre-treatment Standards for industries which discharge wastewater to POTWs.

Conveyance of domestic and industrial wastewater from SLAC to the POTW is via the sanitary sewer system. Surface runoff is conveyed separately through the storm drain system to San Francisquito Creek. The ultimate receiving water for the San Francisquito Creek, and hence SLAC's surface runoff, is San Francisco Bay.

5.2.1 Surface Water

Prior to December 1991, SLAC discharged cooling tower blowdown water to surface drainage under an NPDES Permit (Permit CA0028398, Order 90-098) issued by the California RWQCB, San Francisco Bay Region. On December 1, 1991, the cooling towers ceased discharging blowdown water to the stormdrain system, and began

discharging to the sanitary sewer as per SLAC's POTW Wastewater Discharge Permit. Because of the change in receiving water from surface drainage to the sanitary sewer, self monitoring was no longer required to comply with the existing NPDES permit. SLAC does not intend to renew the NPDES permit at the next renewal period.

SLAC filed a Notice Of Intent (NOI) with the Regional Water Quality Control Board (San Francisco Bay Region) to comply with the California General Industrial Stormwater Permit on March 27, 1992. As required by the permit, SLAC has developed both a Storm Water Pollution Prevention Plan and a Monitoring Program. For the Monitoring Program, representative sampling locations and appropriate analytical parameters were selected in cooperation with the RWQCB. SLAC's Monitoring Program will be implemented on January 1, 1993.

5.2.2 Industrial Wastewater

New wastewater discharge permits were issued to SLAC on April 15, 1992. Two separate discharge permits were issued. The permits are automatically renewed for successive 1-year periods (for up to five years) if no renewal action is taken by the South Bayside Systems Authority. A discussion of the permits and the operations they cover is provided below.

Pretreatment Facility (Permit No. WB 920415-P)

Metal finishing operations are conducted in an on-site plating shop. Non-hazardous rinsewaters from the plating shop are processed through a pretreatment facility prior to being discharged to the sanitary sewer. Effluent from the pre-treatment facility must meet the Federal Metal Finishing Pre-treatment Standards, which are specified in the permit which was issued exclusively for the pre-treatment facility. As required by the Federal standards, SBSA periodically monitors the metal finishing discharge and SLAC obtains "split" samples to provide a quality control check. The sampling location is shown in Figure 5-1. Discharge limitations and sampling frequencies are presented in Table V-2. SBSA's analytical results for CY92 are presented in Table V-3. No discharge limits were exceeded in CY92.

Total Facility Discharge (Permit No. WM 920415-F)

In addition to the pre-treatment facility permit, the POTW issued a Wastewater Discharge Permit for SLAC's total[1] contribution to the sanitary sewer. This permit applies to the combined flow from the pre-treatment facility and all other industrial and domestic wastewater discharges at SLAC. This permit differed from previously issued permits in that discharge limitations are now mass based (pounds per day) rather then concentration based. For most parameters, the mass limits were based on historical discharge concentrations and the daily discharge volume from the facility. The sampling location is shown in Figure 5-1. SBSA periodically monitored the discharge to assure compliance with discharge limitations. SLAC collects "split" samples during these monitoring events to provide a quality control check. The discharge limits and the monitoring frequency for this location are provided in Table V-4. SBSA's analytical results from samples collected in CY92 are presented in Table V-5. No discharge limitations were exceeded in CY92.

The new wastewater permit issued to SLAC for the total facility discharge specifically allows the discharge of radioactive wastewater in compliance with federal and state discharge limitations. The permit calls for a certified quarterly wastewater discharge report comparing radioactivity discharged to regulatory limitations. Data for radioactive wastewater discharges to the sanitary sewer are provided in Section 4.2 of this report.

5.3 Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) of 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.

SLAC is a Generator of hazardous waste, and is not permitted to treat hazardous waste or store it for longer than 90 days. Some hazardous wastes disposed off-site require Extremely Hazardous Waste Disposal Permits (EH Permits) which are issued by the State of California. The EH permits for CY92 are listed in section 5.8.

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

The San Mateo County Department of Health Services is the agency responsible for inspecting generators of hazardous waste for compliance with Federal, State, and local hazardous waste laws and regulations. SLAC was inspected by the County in December, 1992. Three violations were noted in the final inspection report. The findings were as follows; Land Disposal Restriction Notifications were missing for California Regulated Waste (non-RCRA waste) sent out of state for disposal; a container of waste blueprint developer was not properly labeled as waste, and; a bucket used to collect tramp oil from a piece of machinery was not closed while not in use. All of these deficiencies were corrected and a certification of such corrections sent to the County on January 8, 1993.

A computerized hazardous waste drum tracking system was developed in CY91, and continued to be improved in CY92. Hazardous waste drums are tracked from the time of being issued to the generator to eventual disposal offsite. Improvements to the system in CY92 included enhancing data entry features to automate tedious and repetitious tasks, addition of new fields such as source codes and form codes to automate creation of the biennial hazardous waste report and waste minimization reports, inclusion of an archive system to assure records are maintained for the statutory required time period, and abilities to accept the new DOT HM181 nomenclature.

Hazardous waste generated from operations throughout the site is accumulated in established Waste Accumulation Areas (WAAs). In CY92, SLAC formalized the roles, responsibilities, and requirements for proper management of these areas. Each WAA is managed by a Hazardous Materials and Waste Coordinator (HWMCs) who is provided training and written guidelines on proper management of WAA's.

The EPA 1991 Hazardous Waste Biennial Report was completed in May 1992 to report on CY90 and CY91 waste generation.

Table V-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	100 mg/l[a]	Quarterly	Grab
pH (minimum-maximum)	6.0-12.5[b]	Quarterly	Grab
Cadmium	0.69 mg/l	Quarterly[c]	Composite
Chromium (total)	2.77 mg/l	Quarterly[c]	Composite
Copper	3.38 mg/l	Quarterly[c]	Composite
Lead	0.69 mg/l	Quarterly[c]	Composite
Nickel	3.98 mg/l	Quarterly[c]	Composite
Silver	0.43 mg/l	Quarterly[c]	Composite
Zinc	2.61 mg/l	Quarterly[c]	Composite
Cyanide (total)	1.2 mg/l[d]	Quarterly[c]	Grab
Toxic organics	2.13 mg/l[e]	Semi-annual[c]	(none specified)

(a) Oil and grease of mineral or petroleum origin.
(b) pH of pre-treatment effluent continuously monitored by industrial discharger.
(c) Sampling and analysis by SBSA and SLAC.
(d) Cyanide samples were collected at the plating shop pre-treatment tank uncombined with other waste streams.
(e) Compliance with toxic organics limit is based on all compounds detected by EPA Analytical Methods 601/602.

Table V-3. 1992 Analytical Results of Metal Finishing Effluent

	12-Feb	30-Apr	8-May	12-Aug	14-Aug	28-Oct	9-Nov	13-Nov	Limit
Cyanide (mg/l)	<0.01	<0.01	n/a	n/a	<0.010	n/a	n/a	<0.01	1.2
pH (pH units)	8.3	n/a	n/a	7.3	9.2	8.9	n/a	n/a	6.0-12.5
Cadmium (mg/l)	<0.005	n/a	n/a	0.01	0.008	<0.005	n/a	n/a	0.69
Chromium (mg/l)	<0.05	n/a	n/a	<0.05	<0.05	0.13	n/a	n/a	2.77
Copper(mg/l)	0.2	n/a	n/a	0.17	<0.02	0.02	n/a	n/a	3.38
Lead (mg/l)	<0.05	n/a	n/a	<0.05	<0.05	<0.05	n/a	n/a	0.69
Nickel (mg/l)	0.05	n/a	n/a	<0.04	0.06	0.11	n/a	n/a	3.98
Silver (mg/l)	<0.01	n/a	n/a	<0.01	<0.01	0.05	n/a	n/a	0.43
Zinc (mg/l)	0.312	n/a	n/a	0.146	0.026	0.007	n/a	n/a	2.61
Toxic Organics (mg/l)	n/a	n/a	2.13	n/a	n/a	n/a	0.0624	n/a	2.13
Flow (gal/day)	n/a	n/a	n/a	n/a	n/a	5330	n/a	n/a	none

n/a = Not analyzed for that parameter
Note: Split samples were collected by SLAC and SBSA. The above results are from SBSA's samples

Table V-4. Sanitary Sewer Standards[a]

Wastewater Discharge Permit No. WB 920415-F
Monitoring Location: Flowmeter station adjacent to Sand Hill Road

Constituent	Limitation	Units	Monitoring Frequency	Sample Type
Oil and grease [b]	100 mg/l[b]	mg/l	Quarterly	Grab
pH (Minimum-Maximum)	6.0-12.5	pH	Quarterly	Grab
Arsenic	0.058	lbs/day	none	n/a
Cadmium	0.020	lbs/day	Quarterly[c]	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	n/a
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	n/a
Polycyclic Aromatic Hydrocarbons	0.12	lbs/day	none	n/a
Methylene Chloride	0.041	lbs/day	none	n/a
Chloroform	0.017	lbs/day	none	n/a
Perchloroethylene	0.017	lbs/day	none	n/a
Benzene	0.0012	lbs/day	none	n/a
Carbon Tetrachloride	0.00058	lbs/day	none	n/a
Carbon Disulfide	0.0046	lbs/day	none	n/a
Phenols	1.5	mg/l	none	n/a

[a] See Appendix E for radiological standards
[b] Oil and grease of mineral or petroleum origin
n/a = not analyzed for that parameter

Table V-5. Analytical Results of Sanitary Sewer Discharges Sand Hill Road Flowmeter Station

Date	Feb-12		Apr-29		Aug-12		Oct-28		
Flow (gallons/day)	5,340		128,320		143,660		35,924		
pH (pH units)	8.8		7.7		7.3		8.5		
	Result mg/l	Quantity lbs/day	Result mg/l	Quantity lbs/day	Result mg/l	Quantity lbs/day	Result mg/l	Quantity lbs/day	Limit lbs/day
Cadmium	<0.005	<0.0002	<0.005	<0.005	0.01	0.01	<0.005	<0.001	0.02
Chromium	0.06	0.003	<0.05	<0.05	<0.05	<0.06	<0.05	<0.01	0.10
Copper	0.04	0.002	0.43	0.46	0.17	0.20	0.23	0.069	0.79
Lead	0.07	0.003	0.06	0.06	<0.05	<0.06	<0.05	<0.01	0.12
Nickel	0.06	0.003	<0.04	<0.04	<0.04	<0.05	<0.04	<0.01	0.37
Silver	<0.01	<0.0004	0.04	0.04	<0.01	<0.01	0.01	0.003	0.07
Zinc	0.017	0.0008	0.32	0.34	0.146	0.17	0.227	0.068	0.68

Split samples were collected by SLAC and SBSA. The above results are from SBSA's samples

5.3.1 Waste Minimization

SLAC finalized and began implementing its waste minimization program in January, 1992. Two waste minimization plans were developed. One was prepared to comply with the waste minimization and pollution prevention requirements of DOE and the other to comply with California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill-14).

Training programs were developed and are being used to instruct employees and to increase their awareness in the importance of the Waste Minimization and Pollution Prevention Program. The following has been accomplished:

- Distributed SLAC's Hazardous Materials Management Handbook and provided a $2^{1/2}$-hour class, "Introduction to Hazardous Waste and Materials Management," to those employees who handle hazardous waste as part of their job. A program and schedule was developed to provide this training to new employees. To date, 405 employees have received this introductory training class.
- Developed a training curriculum for the annual review (refresher training) of the above mentioned course. This training was provided to those employees who were scheduled for refresher training as required by RCRA.
- Developed an advanced training curriculum for Hazardous Waste and Materials Coordinators (HWMC).
- Established a quarterly seminar/workshop for HWMCs to discuss common problems and concerns and to provide training on specific topics selected by the Coordinators.

HWMCs and employees in key operations had additional training in waste minimization and pollution prevention . They attended off-site training classes including:

- DOE Pollution Prevention Workshop (December 1991)
- Waste Minimization in Metal Finishing (March 1992)
- Alternatives to Ozone-Depleting Substances (April 1992)

Three articles on waste minimization and pollution prevention were published in SLAC's site-wide employee newsletter, "The Interaction Point," to further increase

employee awareness of hazardous and non-hazardous waste generation. The articles were titled:

- "When Less Is Best - Waste Minimization" (March 1992)
- "Successful Waste Minimization Strategies" (May 1992)
- "Less Is Better - Implementing Waste Minimization" (June 1992)

Additional efforts to increase employee awareness have included an on-site "trade show" to promote the purchase of office products made from recycled materials. The show was held in October 1992.

SLACs Waste Minimization Coordinator attends bimonthly meetings on waste minimization and pollution prevention with representatives from DOE and with Waste Minimization Coordinators of other DOE facilities under the control of the San Francisco Operations Office. The Waste Minimization Coordinators have been working with representatives of DOE Headquarters and the San Francisco Operations Offices (Office of Energy Research and 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 the Secretary of Energy Notice (SEN) 37-92. Results of these efforts have included:

- Presenting SLAC's waste minimization activities on process waste assessments at a workshop sponsored by DOE and Lawrence Berkeley Laboratory (September 1992)
- Preparing presentations on (a) the accomplishments, lessons learned, and challenges in SLAC's Waste Minimization and Pollution Prevention program and (b) process waste assessment activities in metal finishing operations, for presentation at a DOE-sponsored workshop held in Chicago (October 1992)

Process waste assessments were performed during 1992 to investigate waste reduction opportunities and follow-up on SLAC's earlier reviews of its metal finishing operations. The major assessments performed were:

- Technical and economic feasibility of recycling laser printer toner cartridges (November 1991)
- Reduction of heavy metal sludge from the rinsewater treatment facility for SLAC's metal finishing operations (January 1992)

- Reuse of spent alkaline cleaners from metal finishing operations (February 1992)
- Reuse of spent chlorofluorocarbon solvents by distillation (February 1992)

A pilot program was initiated to test the performance of recycled laser printer toner cartridges. The program has been effective in increasing employee awareness to recycle spent cartridges with our supplier rather than disposing of them as waste. Reduction of heavy metal sludges, reuse of spent alkaline cleaners, and reuse of spent solvents are still under consideration. Reuse of spent chlorofluorocarbon solvents by distillation is not a long-term alternative since these solvents are being phased out by 1995 due to their ozone-depleting potential. As a result, this assessment has been paralleled with a program to evaluate alternative solvents.

Assessments of other major waste streams, spent oils and empty containers, are planned for CY93.

SLAC also completed various waste reporting activities. The EPA 1991 Hazardous Waste Biennial Report was completed in May 1992 to report on CY90 and CY91 waste generation. The 1991 Annual Waste Reduction Report was also completed in May 1992. A summary of hazardous and non-hazardous waste generation information is provided in Figures 5-2 and 5-3. The quantities reported in the figures increase in accuracy with more recent years. Hazardous and non-hazardous waste generation was highest in 1991 due to activities associated with preparing the site for the October 1991 Tiger Team audit and the removal and disposal of four underground storage tanks. Hazardous waste generation during CY92 was lower than CY91 and some of the previous years. The variability in SLAC fabrication and research activities oscillate widely. Thus, a direct relationship between programmatic waste reduction and the waste minimization program is difficult to demonstrate.

5.4 Toxic Substances Control Act (TSCA)

SLAC has equipment filled with oil or other dielectric fluids containing polychlorinated biphenyls (PCBs). PCBs, their use and disposal, are regulated by the Toxic Substances Control Act (TSCA). TSCA provides for regulation of raw materials as well as the control or banning of already existing chemicals that pose a risk to health or the environment. The

Environmental Protection Agency (EPA) is responsible for assuring facilities are in compliance with TSCA. The EPA did not conduct a TSCA inspection of SLAC in CY92.

In CY92, SLAC removed and disposed of four PCB Transformers (concentrations greater than 500 ppm PCBs) and four PCB-Contaminated transformers (concentrations greater than 50 but less than 500 ppm PCBs). Additionally, one PCB Transformer, ten PCB-Contaminated transformers and two transformers with a concentration of less than 50 ppm PCBs were drained, refilled, and are pending reclassification. At the end of CY92, SLAC had 10 PCB Transformers and 30 PCB-Contaminated transformers . There are also three additional transformers which due to operational constraints have not yet been sampled and analyzed to determine the PCB concentration of the dielectric fluid. Until results are obtained, these transformers must be classified as PCB-Contaminated.

In an ongoing effort to reduce the sitewide inventory of PCB, SLAC is planning to remove or retrofill and reclassify many of the remaining PCB Transformers and PCB-Contaminated transformers over the next few years. Additionally, a formal PCB Transformer Inspection procedure is under development. A sitewide inventory of oil-filled equipment is planned for CY93 and is expected to provide a more comprehensive view of PCBs at SLAC.

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

5.5.1 Environmental Restoration

As stated in DOE Order 5400.1, 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 Contingency Plan (NCP) and Executive Order 12580. This includes both removal and/or remedial actions to reduce adverse impacts on public health and the environment from releases, regardless of whether the facility is listed on the National Priorities List.

In CY91, SLAC began developing a comprehensive environmental restoration program. When complete, the program will delineate how SLAC will address environmental contamination problems from discovery through remediation and post remedial monitoring. SLAC's restoration approach is to 1) identify sites with actual or potential contamination (soil, groundwater, and sediments); 2) perform a single

Remedial Investigation (RI) that encompasses all of these areas; 3) prioritize contaminated sites based on risk, and; 4) perform remedial actions according to risk priority. SLAC is in the process of developing the infrastructure for these restoration activities.

Program Development

Several program documents are required to establish the infrastructure for how SLAC will carry out its environmental restoration program. The backbone document will be an Environmental Restoration Implementation Plan, which will describe how SLAC will conduct its remedial activities in compliance with applicable CERCLA requirements This plan is expected to be completed in late 1993 or early 1994. CERCLA sets a very strict path for performing investigations and remedial activities and calls for public involvement during the entire process (see Figure 5-4). Therefore, in CY92, SLAC drafted a Community Relations Plan which describes how SLAC will involve the public in the remedial process. Development of the Community Relations Plan involved interviewing members of the public to identify their concerns and solicit ideas on how best to keep the public abreast of remedial activities at the site. The Plan will be completed and submitted to DOE and regulatory agencies for comments in CY93.

Another requirement of CERCLA is the establishment of an Administrative Record to provide the public with access to all documents and information utilized in making decisions throughout the CERCLA process. Therefore, in CY92, SLAC made arrangements to have an Administrative Record established at Stanford University's Jonsson Library of Government Documents. The Administrative Record is being compiled, and will be placed in this repository during the RI phase.

Other site-wide program documents required for the environmental restoration program will be a Quality Assurance Plan and a Safety & Health Plan. Preparation of these documents began in CY92, and completion is scheduled for CY93.

Site Identification

In CY92, SLAC began identifying areas for inclusion in the site-wide RI by conducting several investigations:

Preliminary assessments were conducted at 22 areas to evaluate potential contamination where environmental releases were suspected. The preliminary

assessments were not intended to fully characterize the type(s) or extent of contamination, but rather to provide preliminary data to be used in establishing priorities and developing schedules to address potential threats to soil and groundwater quality. Results of the Preliminary Assessments were provided in a report entitled *Preliminary Site Assessment of PCBs and Other Contaminants for Selected Sites at the Stanford Linear Accelerator Center, June 1992.*

To identify additional actual or potentially contaminated sites an investigation was conducted which involved interviewing SLAC personnel to identify past activities or processes which may have resulted in contamination and will require further investigation and inclusion into the RI. Results of the investigation were documented in the draft report entitled, *Identification and Summary of Potentially Contaminated Sites September 1992.*

Another assessment was performed in CY92 in which environmental samples were collected throughout the facility and analyzed to determine 1) background levels of various chemical constituents in asphalt and soil, and, 2) indications of bioaccumulation of contaminants in marshland vegetation. Results of these analyses are presented in the draft report entitled, *Facility Background Sampling and Vegetation Uptake Assessment, April 1992.*

IR-6/IR-8 PCB Contamination

In CY91, SLAC confirmed the presence of PCB contamination in a stormdrain culvert in an area of the facility know as IR-6. Because of the possibility that contamination had migrated off-site, a Remedial Investigation (RI) 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 extending horizontally over approximately 200 feet of drainage ditch, with detectable levels down to a depth of five feet. A section of the contaminated ditch extended beyond SLAC's site boundary to an adjacent area, also owned by Stanford University, but leased to a private party. To prevent unauthorized access to the contamination, a fence was erected to enclose the area.

Since contamination was confirmed in the storm drain system, SLAC has performed two additional studies to determine whether contamination existed further "upstream" in

the storm drain system, and if it had migrated further "downstream" to San Francisquito Creek. 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). The same area had lead concentrations that are generally comparable to background levels. Results of this investigation were presented in a draft report entitled, *Preliminary Assessment of San Francisquito Creek, November 1992*. Sampling and analysis of the storm drain catch basins upstream of the contaminated areas, however, revealed PCB and lead contamination in many catch basins sediments. Therefore, additional study of the storm drain system is required.

Further investigation of the storm drain system will be performed as part of the site-wide RI. The system will be prioritized for remediation along will other identified areas of contamination.

EPA Preliminary Assessment

SLAC is not on the National Priorities List as a Superfund site. However, in 1986, SLAC was placed on the EPA Hazardous Waste Compliance Docket (a list of potential Superfund sites) after solvents from a leaking underground solvent tank on-site contaminated surrounding soils and groundwater. Each facility placed on the Docket is required to submit a sitewide Preliminary Assessment (PA) to the EPA for evaluation using the EPA Hazard Ranking System (HRS) to determine which sites should be placed on the National Priorities List. Under a 1991 U.S. District Court judgment, the EPA must complete its scoring of all unranked facilities on the Docket by July 15, 1993. In CY92, SLAC began compiling data for preparing a sitewide PA, which is due to the EPA by June, 1993. The PA is intended to provide:

- An evaluation of the net impact of SLAC activities on the surrounding environment;
- Identification of all sites with actual or potential contamination that may require further attention and possible remediation;
- A baseline for all subsequent changes in site structures and operations.

5.5.2 The Superfund Amendments and Reauthorization Act (SARA)

The Superfund Amendments and Reauthorization Act of 1986 (SARA), includes a free-standing title known as the Emergency Planning and Community Right-to-Know Act, otherwise known as Title III. It is intended to encourage and support emergency planning efforts at the State and local levels. Annually, SLAC submits applicable information required by SARA Title III as well as the State's equivalent report to the San Mateo County Department of Health Services.

DOE has committed to voluntarily complying with the Toxic Chemical Release Inventory (TRI) reporting requirements under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). DOE is also waiving the criteria that only facilities in Standard Industrial Classification (SIC) codes 20-39 report, and is modifying the "laboratory exemption" described at 40 CFR 372.23. SLAC, in accordance with DOE guidance, will begin reporting under EPCRA Section 313 for CY93, with reports due July 1, 1994. SLAC is already working toward that goal by dedicating resources to the planning and information gathering process necessary to submit complete and timely TRI reports.

5.6 National Environmental Policy Act (NEPA)

NEPA serves to provide a mechanism to assure that all environmental impacts and options to a project are considered before it is carried out. The following are some of the areas which must be considered when preparing documentation for a proposed project: archeological sites, wetlands, floodplains, and sensitive habitats. Options for the proposed project and the impacts of those options must be evaluated.

SLAC formalized a NEPA program in CY92. All project or action descriptions 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 NEPA document is reviewed by specified SLAC staff for concurrence, and is forwarded to the DOE-site office for DOE review and approval. To further enhance the program, formal NEPA training has been scheduled for early CY93 for appropriate SLAC staff.

In CY92, SLAC submitted 62 Categorical Exclusions (CX's) for General Plant Projects (GPPs), Accelerator Improvement Projects, and Capital Equipment Projects. An

Environmental Assessment was initiated in CY92 for PEP-II (B-Factory) and will be submitted to DOE in early CY93.

5.7 Assessments

Tiger Team Assessment

A Tiger Team Assessment was conducted at SLAC from October 7 through November 5, 1991. The objective of the environmental portion of the Tiger Team Assessment was to assess the site's current environmental compliance status with regard to Federal, State, and local regulations; DOE Orders; agreements; and applicable permits. The environmental assessment examined site performance against best or accepted industry practices, and evaluated the adequacy of DOE and contractor environmental program management and resources. The Environmental Subteam identified fifty-three findings in the assessment of SLAC (this included radiological as well as nonradiological findings). Of these findings, 20 percent related to compliance with Federal, State and local requirements and the remaining 80% of the findings related to compliance with DOE Orders and best management practices.

In response to the Tiger Team Assessment, SLAC developed a Corrective Action Plan (CAP) which provides budgets and schedules for correcting the assessment findings. The CAP was approved by DOE in November, 1992. SLAC has implemented a Corrective Action Management System to track the progress and completion of corrective actions. This system was developed in a manner that allows incorporation and tracking of corrective actions in response to other assessments, audits, and appraisals as well.

Self Assessment

SLAC's Self Assessment Program Plan, dated March 1992, describes the laboratory's plan for implementing DOE requirements for performance of ongoing self assessments. Implementation of this program will begin in CY93, and will include ongoing line self assessments, internal independent appraisals, and management appraisals.

DOE-SF Functional Appraisal

An environmental functional appraisal was conducted by the DOE San Francisco Field office August 17-21, 1992. The purpose of the audit was to evaluate the compliance status of operations in environmental disciplines. The report identified that deficiencies still exist at the facility, although most are being addressed in the Tiger Team Corrective Action Plan approved

by DOE Headquarters. SLAC has submitted a supplemental Corrective Action Plan to address new findings.

Summary Appraisal Report for FY92

DOE-SF prepared a Summary Appraisal Report for the Stanford Linear Accelerator Center for FY92. The purpose of the report was to provide a comprehensive assessment of the performance of the facility by recognizing significant accomplishments, providing constructive feedback, and identifying opportunities for enhanced performance. While the FY91 Appraisal found SLAC's performance in Environmental Management, Environmental Restoration/Waste Management "marginal", the FY92 appraisal indicated that Environmental Management had improved to a level of "good" and the Environmental Restoration /Waste Management improved to a level of "excellent".

5.8 Permits

The following permits pertain to SLAC;

- SLAC has filed a Notice Of Intent to comply with the following permit:
  California General Industrial Stormwater Permit
  (as amended on September 17, 1992)
  California Regional Water Quality Control Board
  San Francisco Bay Region
  SLAC Permit Identification Number: 2 41 S 002417
  Expiration date: November 19, 1996

- California Regional Water Quality Control Board
  San Francisco Bay Region

  NPDES Permit CA0028398, Order 90-098
  Expiration date: July 18, 1995

  Waste Discharge Order 85-88 (for groundwater contamination around former leaking underground storage tank)

- 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, 1993

- Bay Area Air Quality Management District (BAAQMD)
  Plant No. 556, 30 listed sources, two permit applications pending

- Environmental Protection Agency
  Hazardous Waste Generator EPA ID No. CA8890016126

- California Extremely Hazardous Waste Disposal Permits
  EH-2-16013
  EH-2-17487

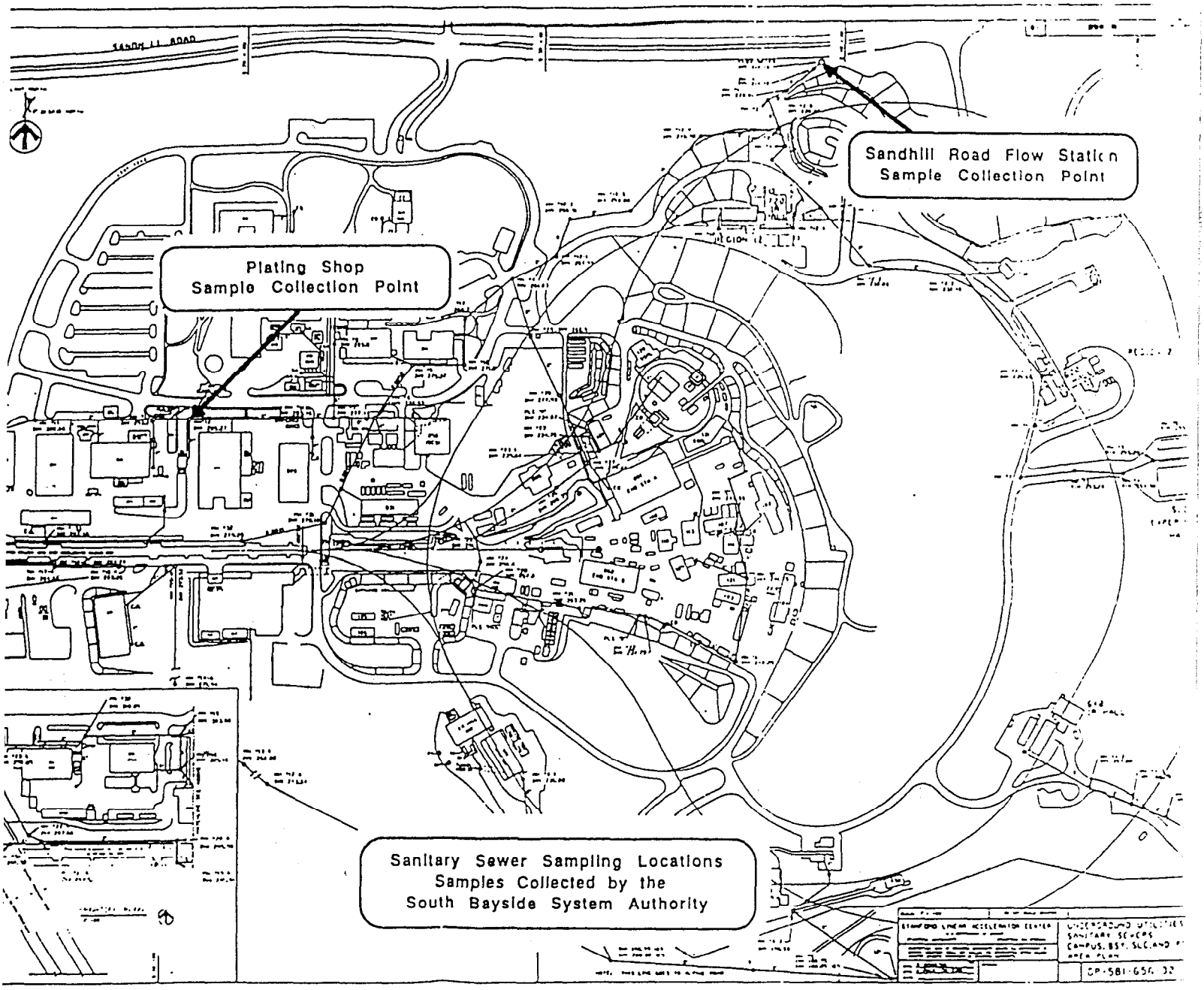

Figure 5-1. Sanitary sewer sampling locations.

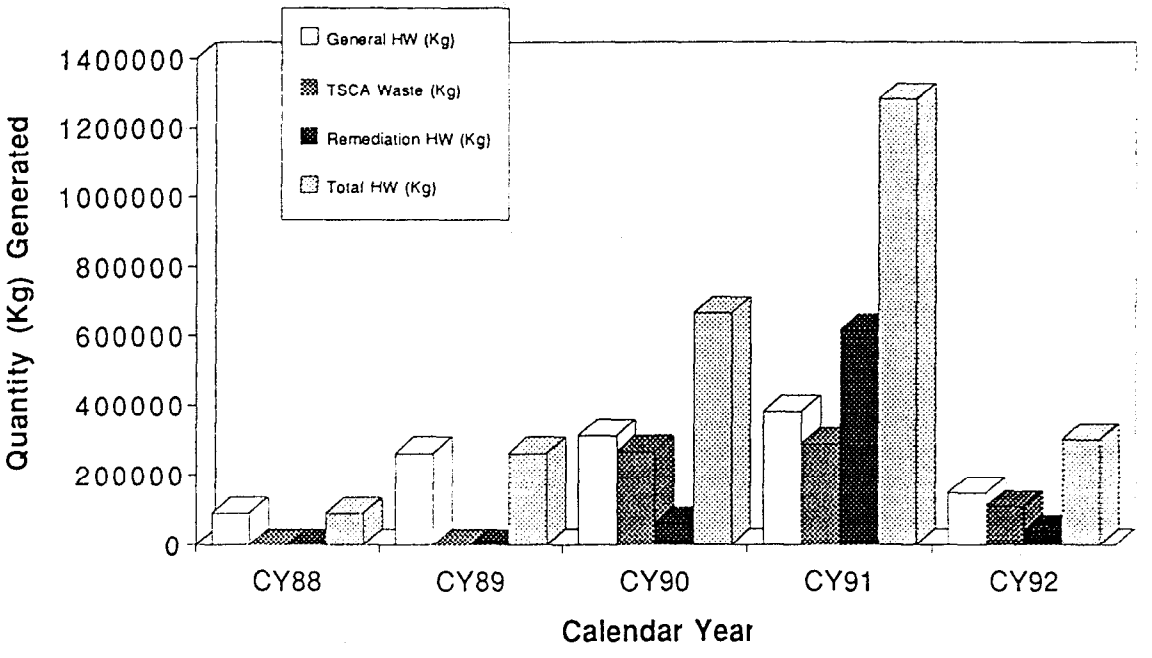

Figure 5-2. Summary of Hazardous Waste Generation Trends.

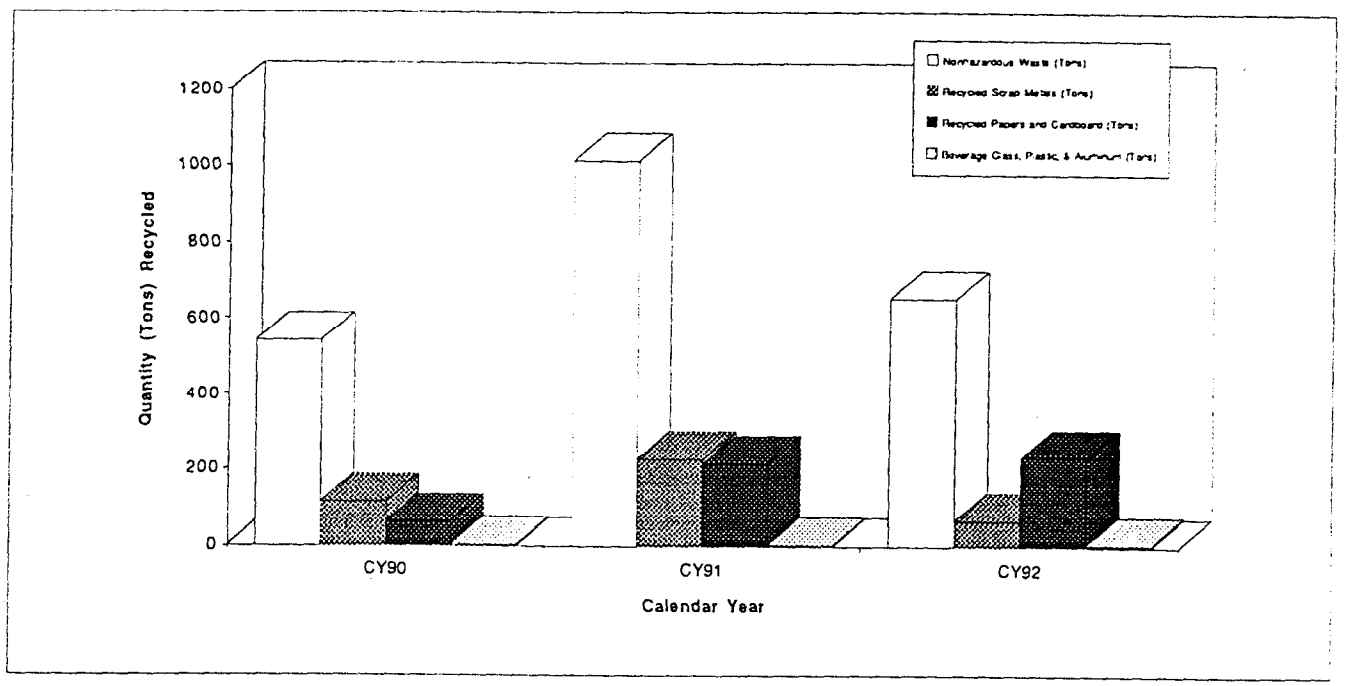

Figure 5-3. Summary of Non-hazardous Waste Generation Tends.

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

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Procedural Flowchart

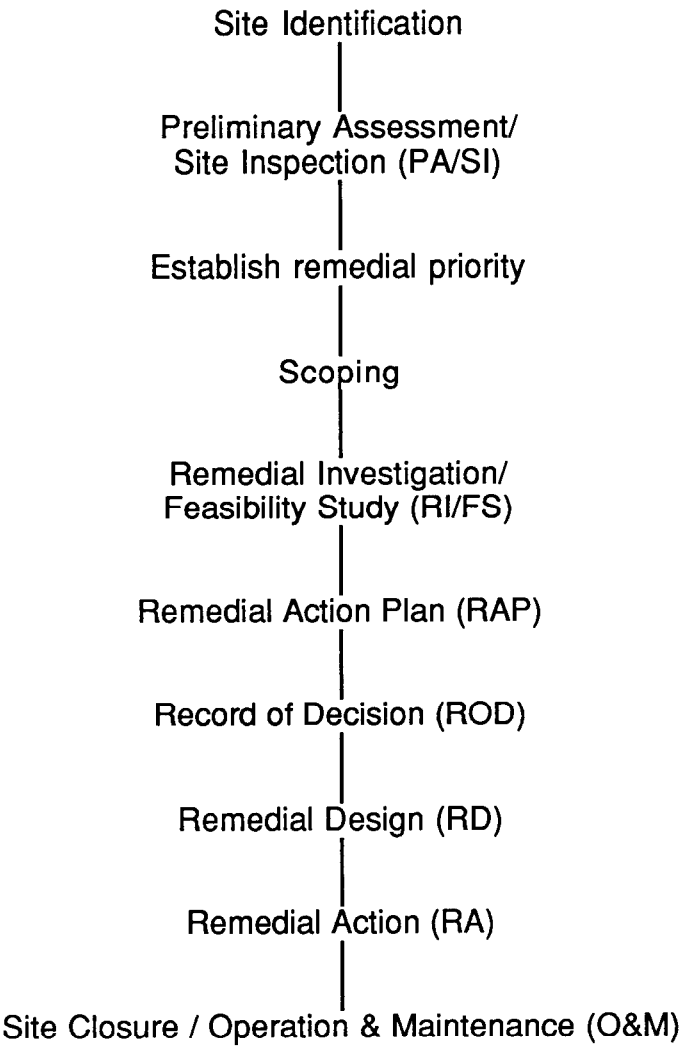

Figure 5-4. Overview of CERCLA Process.

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6.0 Groundwater Protection

In CY 92, SLAC substantially updated and revised the Groundwater Protection Management Program (GPMP) which was prepared in accordance with DOE Order 5400.1. The GPMP was prepared to provide comprehensive guidance to the groundwater program including planning, integration and coordination of all supporting activities. Draft reports written in CY92 to support the program include: the Hydrogeologic Review Report, a Sampling and Analysis Plan and associated Standard Operating Procedures, a Soil Gas Survey, a Beneficial Use Assessment, a Fate and Transport study and an Identification and Summary of Potentially Contaminated Sites. In CY92, as in CY91, quarterly groundwater monitoring data were collected from two distinct groundwater monitoring networks at the facility. Beginning in July, 1993 this data collection and analysis will be carried out under the guidance of the GPMP.

SLAC has two distinct groundwater monitoring networks. This section of the SLAC CY92 Annual Site Environmental Report presents data from each groundwater monitoring well network and then discusses the major components of the GPMP including a brief description of the draft reports prepared in CY92.

6.1 Groundwater Characterization Monitoring Network

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. Three wells constructed at SLAC during initial construction are still in place (wells EXW-2, EXW-3, and EXW-4, also referred to as Well 24). Additionally, SLAC began a characterization program in 1990 by installing ten new groundwater monitoring wells (MW-21 through MW-30) in the major areas of the facility that historically and/or presently store, handle, or use chemicals which may pose a threat to groundwater quality. Locations of these ten wells in addition to the three old wells are shown in Figure 6-1.

The ten groundwater monitoring wells were installed in late 1990. Samples collected from the wells at the approximate time of installation were analyzed for a wide range of potential chemical constituents and general groundwater quality parameters including heavy metals, volatile and semi-volatile organics, polychlorinated biphenyl's (PCBs), total petroleum

hydrocarbons as diesel (TPH), cyanide, and total dissolved solids (TDS). General groundwater quality, as measured by TDS values, ranged from 1,100 ppm (parts per million) to 11,000 ppm, and can be characterized as "brackish". Water containing more than 2,000-3,000 ppm TDS is generally too salty to drink. No PCBs, TPH, or cyanide were detected in any of the wells. Nickel, selenium, thallium, and chlorinated solvents were detected in several of the wells at or above the then current State of California Maximum Contaminant Levels (MCLs) for drinking water or EPA National Ambient Water Quality Criteria based on health effects. This information was submitted to the California Regional Water Quality Control Board (RWQCB) and the San Mateo County Department of Health Services on January 31, 1991.

In CY91, the wells were placed on a quarterly sampling schedule, which has continued through CY92. Samples collected have been analyzed for volatile organics (EPA Methods 8010/8020) and the 17 California Administrative Code Title 22 (CAC Title 22) metals and results of analyses performed since installation of the wells are provided in Appendix G. In addition, samples collected have been analyzed since July, 1991 for gross alpha and beta particle activity and for tritium. These results are also provided in Appendix G. Review of the data in 1991 indicated that the elevated levels of heavy metals and/or chlorinated solvents, reported in the CY90 environmental report, still occurred in several of the wells. The main organic contaminants were and still are trichloroethene (TCE) and its breakdown products. TCE was historically used at the site as a cleaning solvent, but is no longer in use with the exception of very small quantities in research laboratories. Tritium (analysis by EPA Method 906.0) and gross alpha and beta particle activity (analysis by EPA Method 900.0) were also found at levels above the MCLs in samples collected from some of the wells in CY91.

CY92 Results and Issues

The concentrations of organic contaminants in groundwater collected from the ten wells during CY92 were in a generally similar range to CY91. First-time detected levels of chloromethane and/or 1,2-dichloroethane occurred during the October 1992 or January 1993 analysis in groundwater from monitoring wells MW-26 through MW-30. Continued monitoring of these constituents will take place in CY93 in order to determine if the results can be attributed to laboratory or sampling error or if a trend is developing.

As previously mentioned, several heavy metals have been detected at above MCLs in groundwater collected from monitoring wells MW-21 through MW-30. No clear trends in any

of the metals concentrations have developed in the quarterly groundwater analysis of any of the wells. Rather, the concentrations are highly variable. An analysis of these results suggests that in part, this may be due to sampling biases dependent on whether or not the sample was filtered before analysis. A filtered sample analyzed for dissolved metals concentrations commonly produces significantly lower concentrations than an unfiltered (total metal) sample when the sample is very turbid as is common of SLAC's groundwater. The higher total metal concentrations do not necessarily represent the introduction of contaminants into the groundwater. Instead, they may reflect the natural concentrations within the soil at the SLAC site. During and before CY92, when groundwater was collected from the wells, it was not consistently filtered or left unfiltered. Consequently, reliable comparisons of the results with previous years and other wells can often not be made. All samples will be field filtered and acidified according to standard protocol starting with the April 1993 sampling event allowing evaluation of background metals concentrations in filtered samples. Analyses of available data of dissolved (filtered) metals concentrations from wells MW-21 through MW-30 suggest that the natural background levels of barium, molybdenum, nickel, zinc, and possibly selenium in the groundwater at SLAC are above the detection limit and for selenium may be above MCLs.

The results of radiological activity of groundwater collected from wells MW-21 through MW-30 and EXW-2 through EXW-4 during CY92 show significant variability between sampling events as well as between wells (Appendix F). The gross alpha and gross beta concentrations in wells MW-21 through MW-24, which should represent background levels because they are located upgradient and outside of any possible source areas, and well MW-27, were commonly above MCLs. However, their concentrations may vary by an order of magnitude from one analysis to the next. Likewise, the samples collected in October 1992 were analyzed three times and for some wells each analysis produced a significantly different result. Tritium results were also variable in some of the wells. Tritium levels were highest in well EXW-4, where levels ranged from 8,357 to 16,749 pCi/l during CY92 which is below the MCL of 20,000 pCi/l. A probable cause for tritium's occurrence in this well's water is activation of groundwater by particles from accelerator beams. Tritium has not been detected in groundwater from any of the other wells except for the samples collected in July and October, 1992. The analytical results from the July 1992 sampling event indicated that wells EXW-2 and EXW-3 had tritium concentrations of 921 and 692 pCi/l, respectively. The October 1992 water quality analyses produced detectable levels of tritium in seven of the wells; however, re-analysis of the original groundwater samples resulted in tritium concentrations below the detection limit in all the wells' water, except well EXW-4. The inconsistent radioactivity results for alpha, beta and tritium clearly suggests that a sampling or analytical laboratory error

is occurring. Corrective action performed in FY92 to address variable detected tritium concentrations in EXW-4 is discussed in Section 6.4, EXW-4 Tritium Results. SLAC is currently evaluating the sampling and analysis process for gross alpha and beta to determine the source of the error and to correct it so that consistent and comparable results are achieved in future sampling events.

6.2 Groundwater Monitoring Network Around Former Solvent Storage Tank

Background

A groundwater monitoring network consisting of eight shallow wells is located in the vicinity of SLAC's Plant Maintenance building in the northwestern portion of the facility (see Figure 6-2). The wells (MW-1 through MW-7 and EW-1) are being used to monitor the migration of chemical constituents associated with a former Underground Storage Tank (UST) which contained organic solvents during the period of 1967 to 1978. A pressure test performed on the UST in 1983 indicated a leak and the tank was removed in December, 1983.

The California RWQCB requires that SLAC monitor the wells at the former UST site on a quarterly basis (RWQCB Waste Discharge Order 85-88). 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 G.

CY92 Results and Issues

As indicated in the quarterly 1992 groundwater elevation contour maps (Figures 6-3 and 6-4) the groundwater flow direction was generally to the northeast in April 1992, but in October 1992, a groundwater ridge appears to have formed to the west of the monitoring wells, adding an eastern and southeastern component to the flow direction. These changes are quite striking especially when compared to water levels during April 1991 when the groundwater flow direction was to the north-northwest. From these maps, it is apparent that the water levels in this area have been fluctuating through time and will probably continue to do so and these fluctuations are not uniform throughout the monitoring field. The extensive accelerator construction and excavation that has occurred in this area has probably produced an

unequilibrated groundwater flow regime which will take an unknown period of time to stabilize.

The January 1992 and January 1993 concentrations of selected major volatile organic compounds (1,1-dichloroethane, 1,1-dichloroethene, trichloroethene, and 1,1,1-trichloroethane) are shown in Figures 6-5 and 6-6 for monitoring wells MW-1 through MW-7 and EW-1. A comparison of the 1992 versus 1993 concentrations indicates that at the source (well EW-1) levels of the volatile organics are declining. However, wells MW-5 through MW-7 show an increase in concentrations of these compounds from 1992 to 1993. The increasing concentrations indicate that the contaminant plume is migrating away from the source and towards these wells. Although the contaminant is spreading concentrically from the former storage tank, by far the greatest increase in concentration occurred in well MW-5 which suggests that during CY92 the plume primarily migrated towards the northeast which coincides with the dominant groundwater flow direction. No organic compounds were consistently detected in the outer wells MW-1 through MW-3, nor in well MW-4 which is screened mostly below the screened interval of the other wells.

In addition to monitoring of the wells, the RWQCB requested SLAC to monitor a potential groundwater seep to determine if Volatile Organic Compounds (VOCs) from the UST are migrating into the subdrain. The sampling point selected by the RWQCB is referred to as point E-003 and is shown in Figure 6-1. The RWQCB requested that point E-003 be sampled on a quarterly basis, analyzed for VOCs (EPA methods 8010/8020) and metals, and that annually, preferably in the winter, the analysis shall use EPA Method 8240 in lieu of 8010/8020. Though two VOCs (chloroform and methylene chloride) were detected at the surface seep (E-003), their concentrations were extremely low and at or near the detection limit, and neither compound was found in samples collected during subsequent quarterly events. Both of these compounds are common laboratory contaminants. SLAC has also been analyzing water from point E-003 for CAM Metals by EPA Method 6010/7000. All of the metals results have been below MCLs.

Results of point E-003 organics and metals analyses, listing only those constituents that have been detected, are presented in Appendix G. The RWQCB will be evaluating the need to continue monitoring point E-003 in CY93.

6.3 Groundwater Protection Management Program

In 1992 SLAC revised the Groundwater Protection Management Program (GPMP) which is required by DOE Order 5400.1. The program provides the overall framework for the groundwater program. Major documents that were prepared in 1992 to support the program include (drafts): the Hydrogeologic Review Report, a Sampling and Analysis Plan and associated Standard Operating Procedures, a Soil Gas Survey, a Beneficial Use Assessment, a Fate and Transport study and an Identification and Summary of Potentially Contaminated Sites. The components of the GPMP include the following:

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 Draft *SLAC Hydrogeologic Review* . This report compiles data and summarizes results of numerous geologic, hydrogeologic, and hydrogeochemical investigations that have taken place at or near SLAC for water resources studies, for research, for geotechnical studies used to site the facility structures, and for environmental and monitoring purposes. The report then develops a conceptual model of the groundwater regime. Plates showing groundwater contours, geology and the hydrogeochemical regimes were prepared for this report. Of particular interest to studies of contaminant transport is the fact that the major bedrock underlying SLAC conveys groundwater substantially by fracture flow and that based on numerous well tests in exploratory borings and wells, the hydraulic conductivity of this bedrock is much less than the range of hydraulic conductivity generally accepted as representing natural aquifer material.

2) Design and implementation of a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations:
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; and provide data for decisions concerning groundwater resource management.

Two documents, the Draft *Sampling and Analysis Plan* (SAP) and Draft *Standard Operating Procedures* (SOPs) were prepared in 1992 under this section of the GPMP to provide guidance to the quarterly groundwater monitoring program to ensure that data collected are of acceptable

and comparable quality. The SAP is composed of a Field Sampling Plan which refers to the SOPs, a Quality Assurance Project Plan and a Data Management Plan all of which follow applicable EPA, CERCLA, and DOE guidance documents as referenced in the specific plans. The plan will partly take effect with the April, 1993 sampling event and will be completely in effect for the July, 1993 sampling event.

3) A management program for groundwater protection and remediation, including specific SDWA, RCRA and CERCLA actions:

The components of this part of the program include: 1) SLAC personnel management responsibilities, 2) prioritization of site groundwater investigation studies, 3) management of known groundwater contamination sites, and 4) guidelines for management of investigation of potential or known sources of groundwater contamination. Several documents were prepared in 1992 under guidance of this section of the GPMP. The *Soil Gas Survey* was conducted at two sites with known groundwater contamination to try and define the extent of contamination and thus set priorities for investigation. Unfortunately, the survey only provided qualitative information because the rock was generally found not to allow the flow of soil gas vapors. 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, which will also be used to prioritize investigations, concluded that groundwater at SLAC has a very high total dissolved solids content and a very low rate of flow and thus is probably not suitable for most potential beneficial uses. The *Fate and Transport Study* describes the occurrences of and processes involved in distribution of known organic constituents in groundwater beneath the SLAC facility.

4) A summary and identification of areas that may be contaminated with hazardous substances:

The 1992 draft report entitled: *Identification and Summary of Potentially Contaminated Sites* provides a summary of areas that may be contaminated by hazardous substances. Information was collected from a variety of sources including spill reports, aerial photographs, operations records, reports on previous investigations, and primarily from interviews with SLAC personnel throughout the facility. This report is being further revised and updated while compiling information for the EPA Preliminary Assessment for the Hazard Ranking Scoring. The information will be used to set priorities for soil investigations and, if needed, groundwater investigations.

5) Strategies for controlling sources of these contaminants:
This section is being developed.

6) A remedial action program that is part of the site CERCLA program required by DOE Order 5400.4:
A sitewide Remedial Investigation / Feasibility Study is being prepared in 1993 to address soil and groundwater contamination at SLAC as part of the CERCLA program required by DOE Order 5400.4.

6.4 EXW-4 Tritium Results

Corrective action carried out during FY 92 resulted in consistent and comparable results for tritium measured in groundwater from EXW-4 (previously referred to as Well 24, not to be confused with MW-24). The results indicate that the 7/19/91 result of 23,500 pCi/l, which is above MCL's for drinking water, in EXW-4 is anomalous. Corrective action included instituting a consistent sampling protocol of purging by dewatering the well once and then allowing it to recharge for one hour before taking a sample. To test the new sampling protocol, the well was purged and groundwater samples were collected monthly from December 1991 through July 1992 as shown in Appendix F, EXW-4 Tritium Analysis History, 1991, 1992. Splits were sent to the laboratory for a few of the samples and SLAC's internal laboratory conducted independent analysis of some of the samples to further confirm consistent and comparable results. For the seven months of data collection, the reported tritium levels in the water samples stabilized at between about 11,000 and 14,000 pCi/l. The only anomaly was the March, 1992 result of <500 pCi/l. Controls for Environmental Pollution (CEP), Inc. re-tested the sample at SLAC's request, and came up with a concentration of 1363 +/- 669 pCi/l, still below the expected value of around 13,000 pCi/l. SLAC's lab detected 12,072 pCi/l for this sample, which is within a normal range for this well. Otherwise results between the two labs and between splits sent to CEP were comparable. Thus quarterly sampling rather than monthly sampling has resumed.

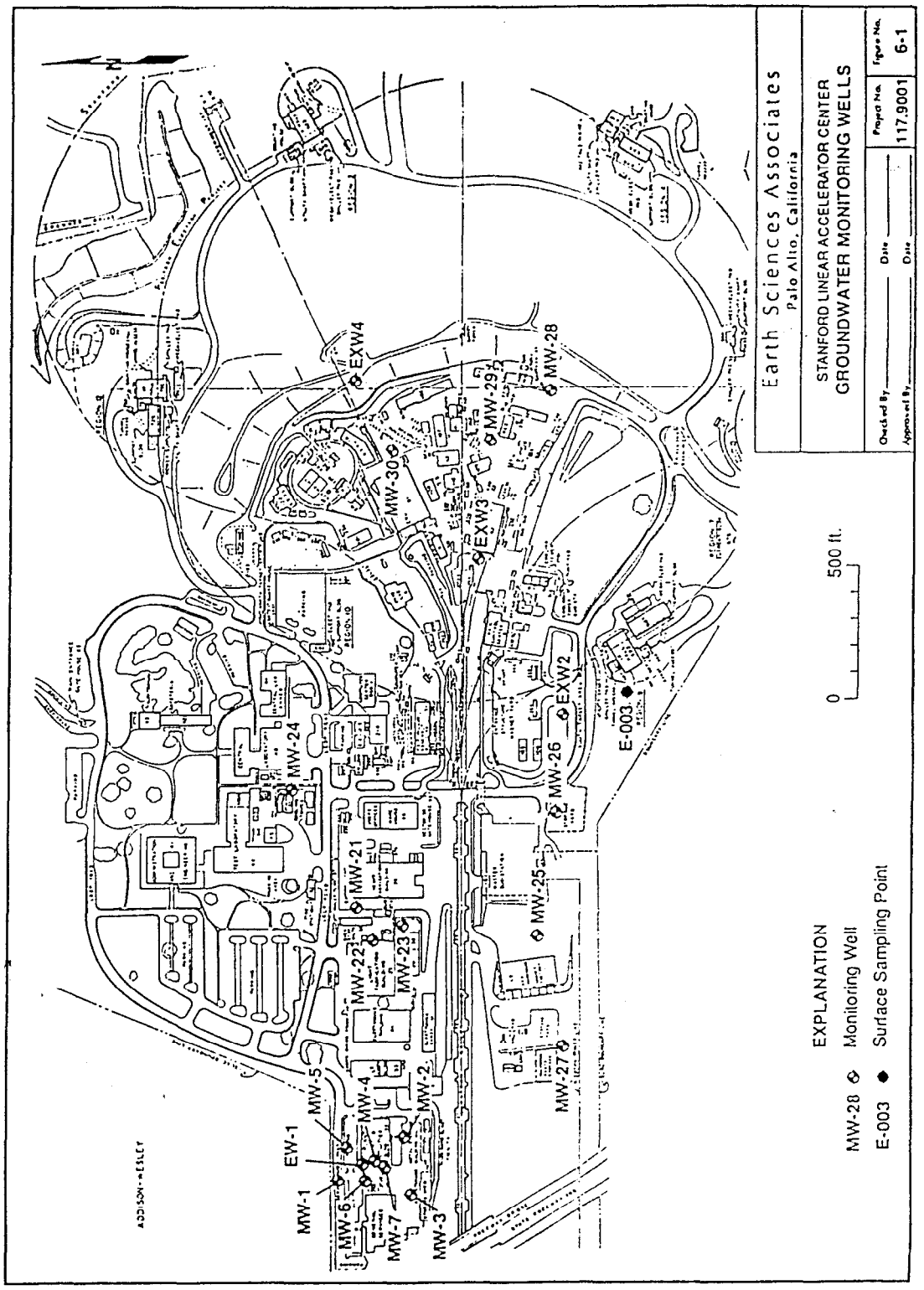

Figure 6-1. Location of groundwater monitoring wells.

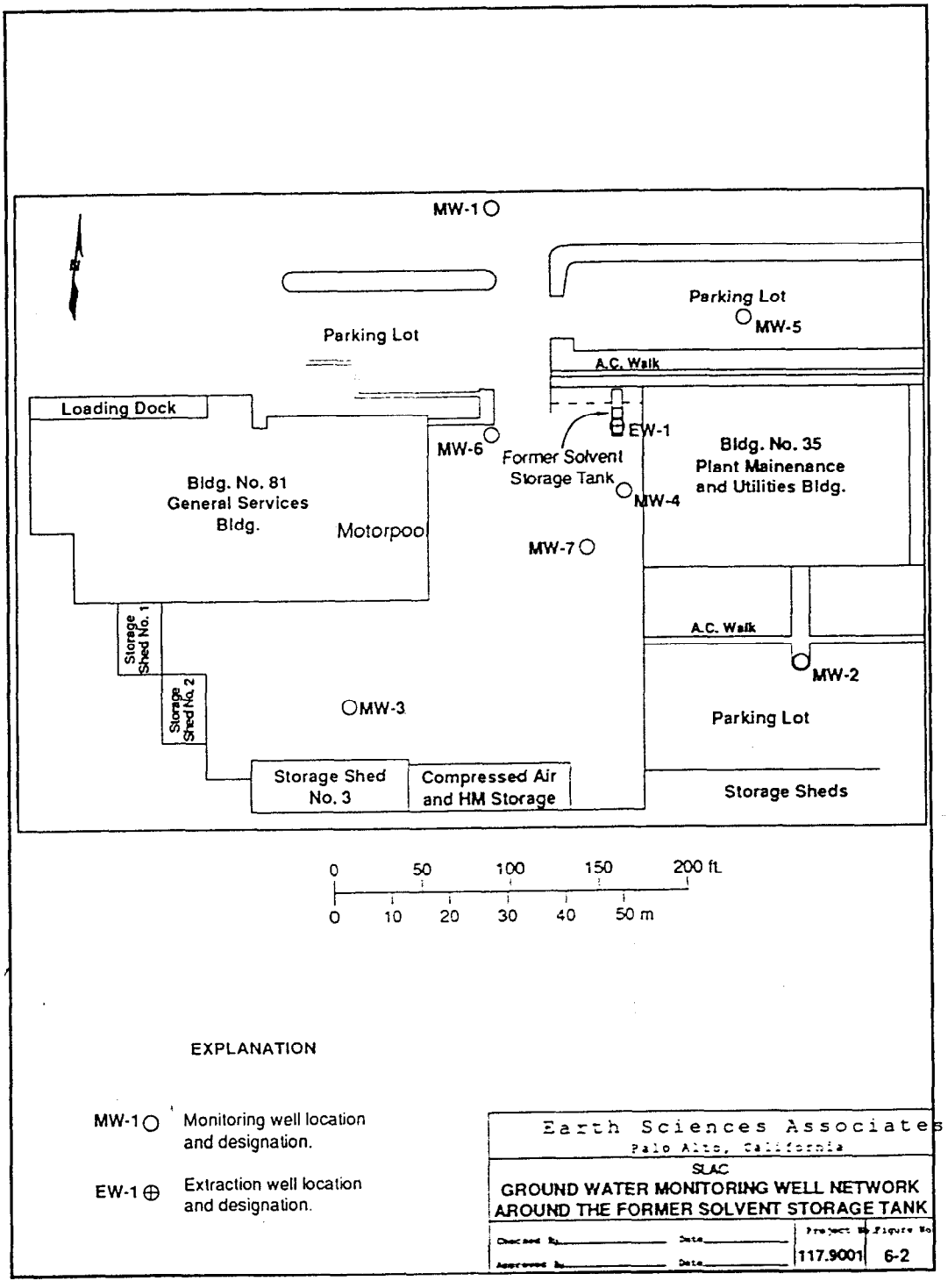

Figure 6-2. Location of groundwater monitoring wells surrounding a former solvent storage tank.

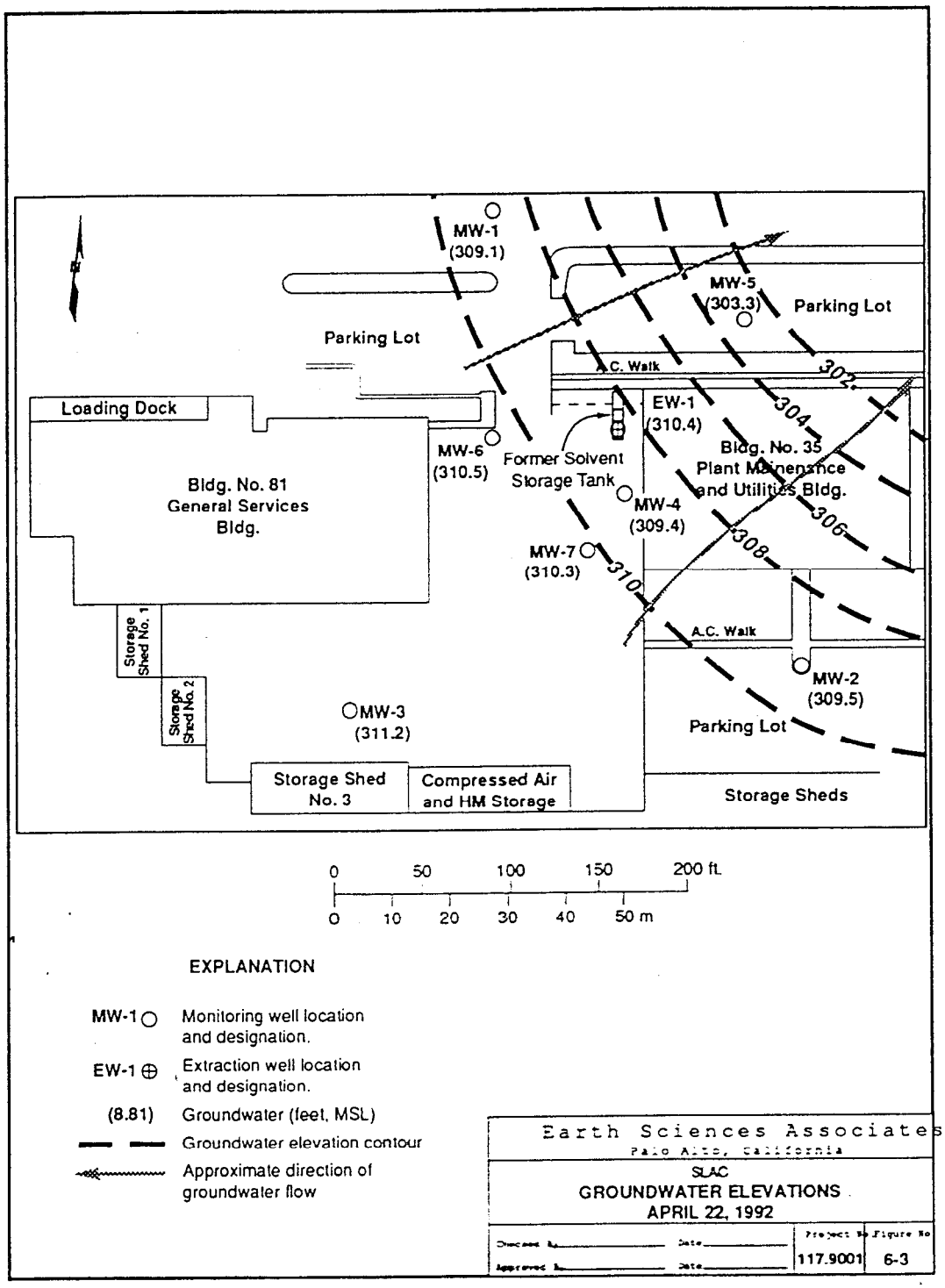

Figure 6-3. Groundwater contour map in the area of the former solvent storage tank, April 22, 1992.

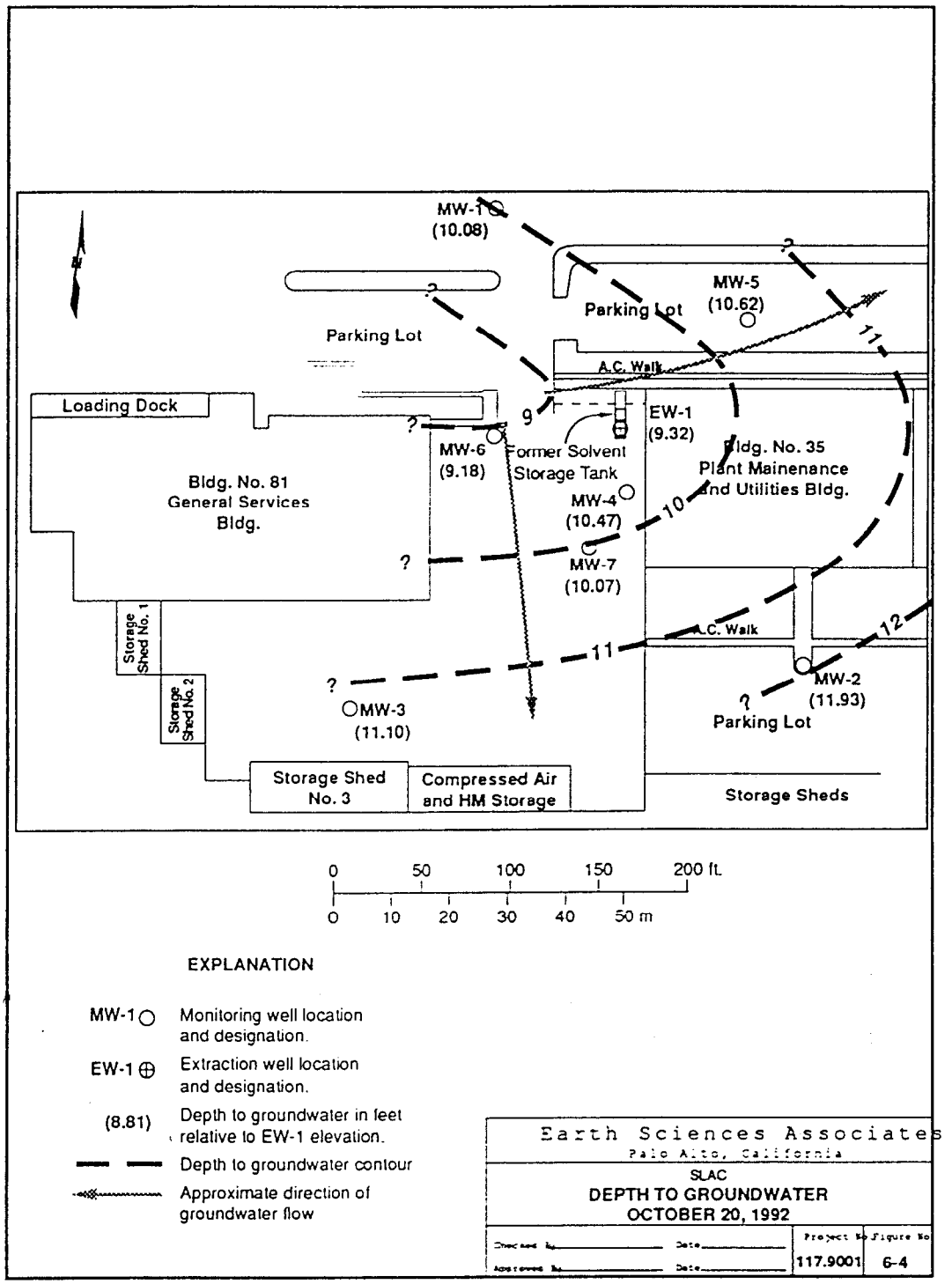

Figure 6-4. Groundwater elevation contour map in the area of the former solvent storage tank, October 20, 1992.

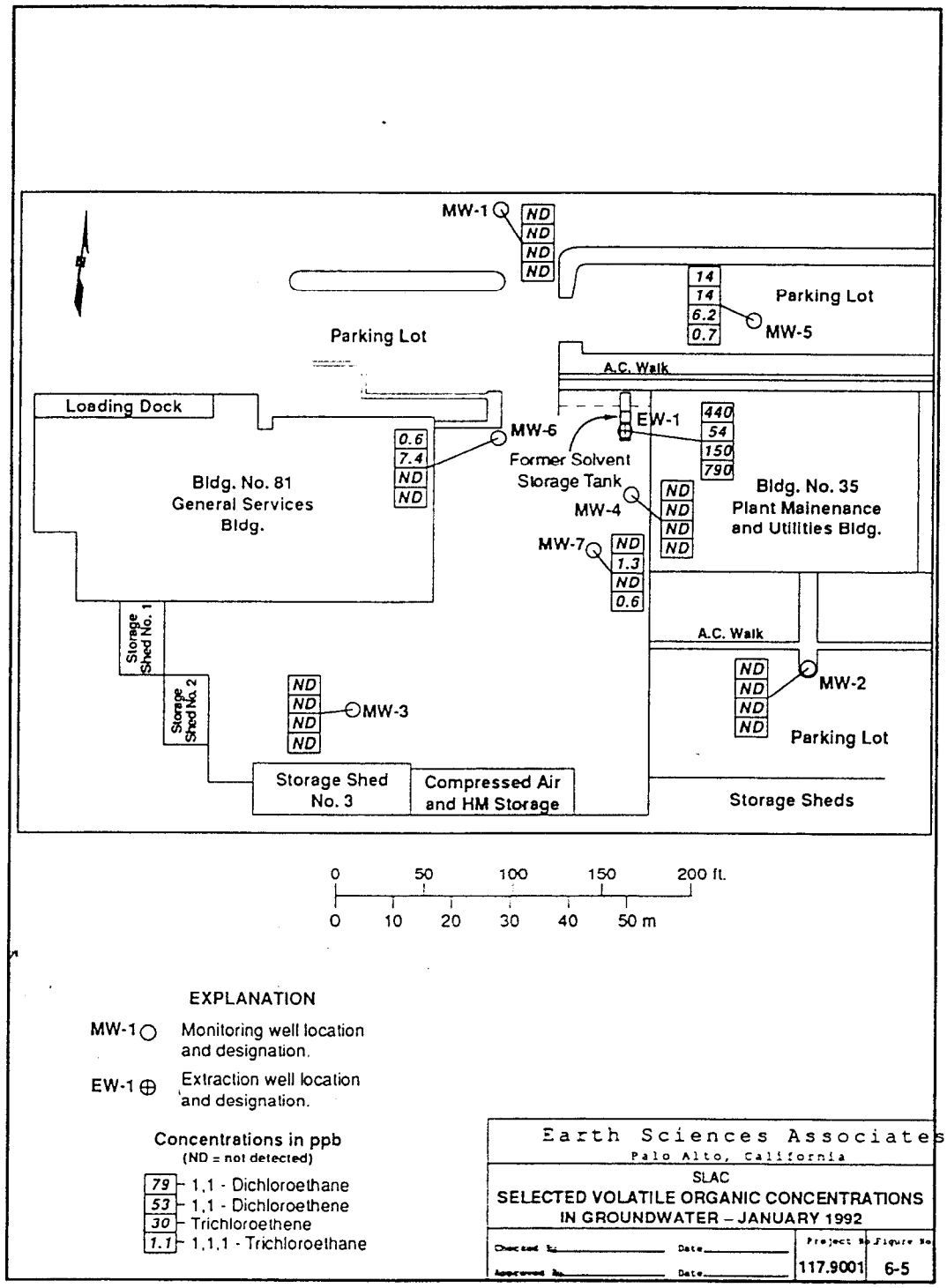

Figure 6-5. Selected volatile organic concentrations in groundwater in the area of a former solvent storage tank, January, 1992.

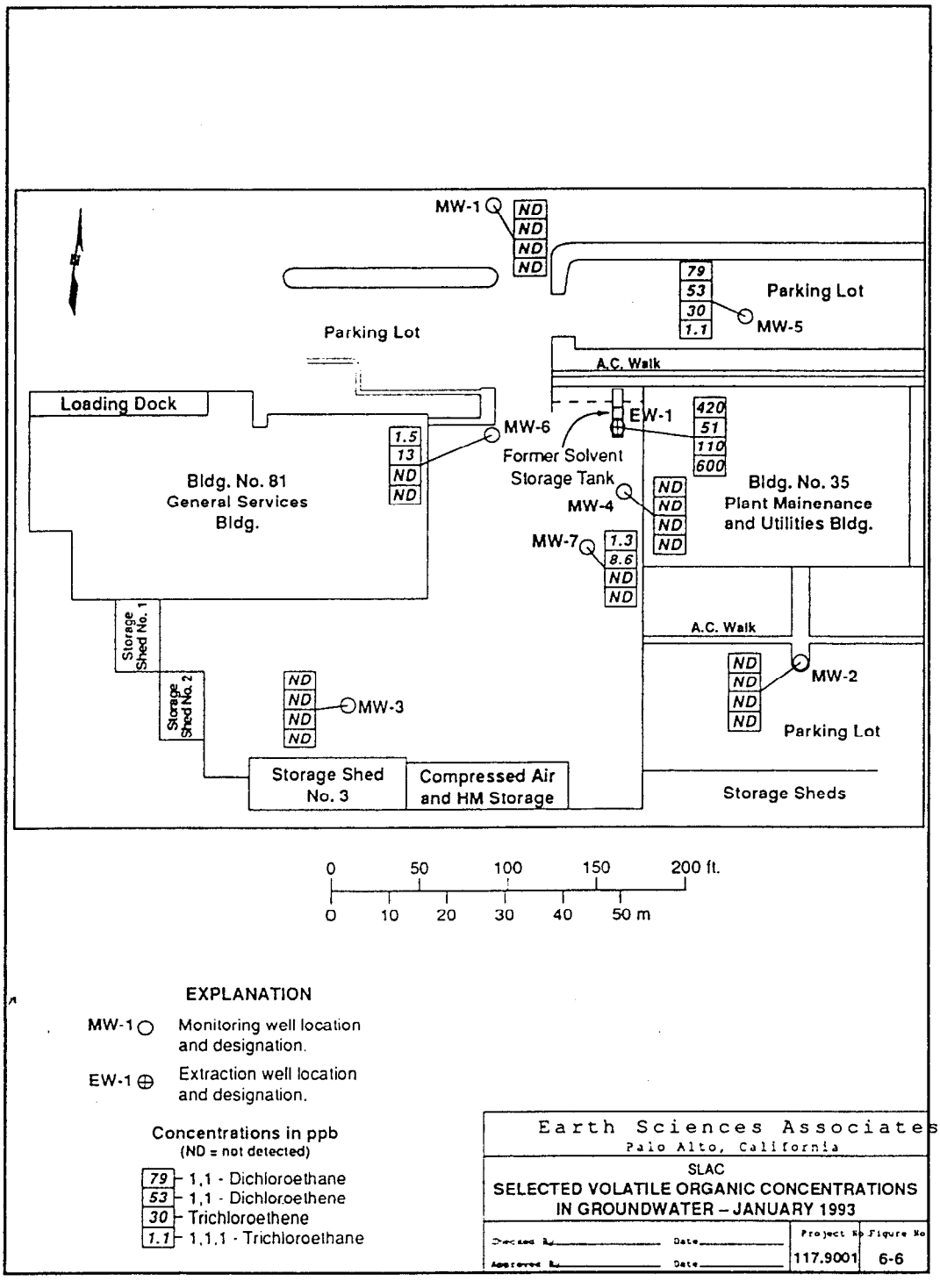

Figure 6-6. Selected volatile organic concentrations in groundwater in the area of a former solvent storage tank, January, 1993.

Table VI-1. Well 24 Tritium Analysis History

Date Sampled	Tritium [pCi/liter]
03/21/67	4,000 +/- 2,000
08/29/67	2,000 +/- 5,000
10/23/67	<3,000
12/27/67	<3,000
03/29/68	<3,000
06/25/68	<3,000
08/08/68	16,000 +/- 1,000
10/29/68	<3,000
01/02/69	<3,000
04/22/69	<3,000
06/04/69	<3,000
08/27/69	<3,000
12/02/69	<3,000
04/06/70	<3,000
06/04/70	<3,000
09/17/70	<3,000
01/18/71	<3,000
07/07/71	<3,000
01/04/72	<3,000
07/07/72	6,000 +/- 1,000
02/15/73	5,000 +/- 1,000
07/10/73	6,000 +/- 1,000
06/03/74	4,000 +/- 2,000
07/11/75	5,000 +/- 1,000
02/15/77	15,000 +/- 4,000
08/10/77	16,000 +/- 5,000
07/28/78	12,000 +/- 6,000
04/10/81	<3,000
08/01/84	10,000 +/- 1,000
11/07/84	15,000 +/- 1,000
07/19/91	23,500 +/- 1,000
12/13/91	16,982 +/- 594

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7.0 Quality Assurance

The site-wide Quality Assurance (QA) program has been crafted to meet the requirements of DOE Order 5700.6C, *Quality Assurance.*. The QA program is described in the SLAC Institutional Quality Assurance Program Plan (SLAC-I-770-0A17M-001). This document was submitted to the Department of Energy in October of 1992 for approval. This document defines the roles, responsibilities and authorities for implementation of the ten criteria from DOE Order 5700.6C.

The Quality Assurance and Compliance Department (QACD) is involved in the qualification process for environmentally sensitive services, including off-site analytical laboratories; is responsible for providing auditing of the line QA and environment, safety, and health programs; maintains the Institutional QA Program Plan; develops policies for Data Quality Objectives (DQO) and Data Validation; and provides direction for implementation of the ten criteria from 5700.6C.

The contract for non-radiological analytical work was renewed this year, and the three finalists were subjected to a formalized qualification process. Verification of certification to perform analytical work, and review of EPA performance test results were part of the qualification process. Also included in the review was the adequacy of the internal quality control (QC) practices, record keeping, chain of custody, and the adequacy of the analytical laboratory QA program as a whole.

Performance testing for the in-house SLAC radiological laboratory through the DOE Environmental Measurements Laboratory (EML) is scheduled to begin by September 30, 1993. In the interim, samples that are used to support radiological monitoring are provided by the certified laboratory CEP in New Mexico.

Audits performed in 1992 through the SLAC program are as follows:

Title	Date
ES&H/QA Surveillance Program	2/92
Radioactive Water Sampling	6/92
Construction S & H Oversight	6/92
RMMA	6/92
OSHA Compliance Inspections	6/92
Dosimetry Blind Performance Audit	6/92

Contractor S & H Oversight	7/92
Environmental Sampling	8/92
Pesticide application	8/92
PCB's	9/92
Radiation Protection - Source Material Control	12/92

These audits resulted in the resolution of 163 deficiencies. The steps taken to address these deficiencies include but are not limited to improving training programs, developing procedures, modifying practices, and modifying facilities to obtain compliance with requirements.

The following procedures and policies that support the quality assurance program for environmental monitoring activities have been developed and approved this year:

Document #	Title	Date Issued
QC-030-004-00-R0	Radioactive Water Sampling/Analysis Audit Procedure	3/92
SLAC-I-770-0A19C-001	Oversight Procedure	3/92
SLAC-I-770-2A19C-004	Non-Radiological Sampling Audit Procedure	7/92
SLAC-I-770-0A16Z-001	Establishing Data Quality Objectives	8/92

Plans are currently in place to develop Quality Implementing Procedures (QIPs) for radiological and non-radiological environmental monitoring by March 30, 1994. These QIPs are required by the Institutional QA program. These documents will formalize the programs for document control, records retention, training, calibration of monitoring equipment, self-assessment and other issues identified in the ten QA criteria of DOE Order 5700.6C.

8.0 References

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6. J. A. Murray, L. M. Vaughn and R. W. McMullen, *Atmospheric Transport and Diffusion Characteristics for Selected Daytime Meteorological Regimes at* SLAC, Memorandum Report No. 326-1, Metronics Aerosol Laboratory, Palo Alto, California, 21 December 1967.

7. *Estimates of Ionizing Radiation Doses in the United States, 1960-2000,* U.S. Environmental Protection Agency Report No. ORP/CSD 72-1, 1972.

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9. M. Ladu *et al., A Contribution to the Skyshine Study,* Nucl. Inst. and Methods 62, 51 (1968).

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9.0 External Distribution

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GC	Gas Chromatograph
GM	Geiger-Mueller Tube
GPP	General Plant Project

H

HRS	Hazardous Ranking System
HW	Hazardous Waste

I

IP	Interaction Point
IR	Interaction Area

K

kWh	Kilowatt-hour

L

LCW	Low Conductivity Water
LINAC	Linear Accelerator

M

MCC	Main Control Center
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MPWD	Menlo Park Municipal Water Department
MW	Megawatt

N

NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NOV	Notice-of-Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	National Response Center
NVLAP	National Voluntary Laboratory Accreditation Program

O

ODIS	On-Site Discharge Information System

P

PA	Preliminary Assessment
PBR	Permit-by-Rule
PCB	Polychlorinated Biphenyl
PEP	Positron Electron Project
PMS	Peripheral Monitoring Stations
POTW	Public Owned Treatment Works
PS	Positron Source

Q

QA	Quality Assurance
QA&C	Quality Assurance and Compliance
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board

S

SARA	Superfund Amendments Reauthorization Act
SBSA	South Bayside Systems Authority
SDWA	Safe Drinking Water Act
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SLD	SLC Large Detector
SPEAR	Stanford Positron Electron Asymmetric Ring
SSRL	Stanford Synchrotron Radiation Laboratory

T

TCE	Trichloroethene, alternative spelling trichloroethylene
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act

U

UST	Underground Storage Tank

V

VOC	Volatile Organic Compound

W

WBSD	West Bay Sanitary District
WHC	Westinghouse Hanford Corporation

Appendix A

Model For Potential Dose Assessment

According to Department of Energy orders, an assessment of whole body person-rem dose equivalent to the general population near SLAC is required where appropriate. For this report, the term dose equivalent will simply be called dose. Our site boundary dose due to accelerator operations has generally been less than 10 mrem (0.1 mSv) per year from penetrating radiation. We have estimated the population size to include individual annual doses down to 1 mrem (0.01 mSv), which corresponds to a distance of approximately 1.6 km from a central point representative of the source of neutrons. The 1 mrem (0.01 mSv) value is approximately 1% of the total natural background dose and is 1% of the dose limit for the general population, i.e., 100 mrem (1 mSv) per year (DOE Order 5480.11).

There are three major pathways leading to human exposure from ionizing radiation: (1) airborne, (2) food chain and (3) 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 source of this exposure is from neutrons resulting from the absorption of high-energy electrons and photons in the experimental areas creating energetic particles, some of which 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. 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 document are in all cases overstatements, due to very conservative modeling assumptions, of the true impact; hence, the resulting values are representative of an upper limit of the possible range.

While the annual neutron 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 EPA report, the average dose from cosmic, terrestrial, and internal radiation in California is 125 mrem (1.25 mSv). For purposes of comparison, we have rounded this number to 100 mrem (1 mSv).[7]

Another quantity of interest is the population dose in units of person-rem (person-centi-Sievert). 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 1000 or 100 person-rem (1 person-Sievert) from natural background radiation. The annual variation of exposure to natural background radiation may vary by $\pm$ 20%, largely caused by differences in naturally occurring uranium, thorium, and potassium present in the ground and in building materials where people live and work.

Two major problems associated with this dose assessment affect overall accuracy of the measurement. First, the conversion of neutron flux to dose requires that the spectrum of neutrons at the measurement point be known, because the quality factor (QF) is a function of neutron energy. Because of the very low neutron fluence at the SLAC boundary and beyond, it is impossible to measure the energy spectrum; therefore, we have selected a QF of ten as a conservative choice. We feel that this choice leads to an overestimate of the neutron dose-equivalent by a factor of approximately two. Until a useful experiment can be performed with neutron yields of sufficient intensity, the quality factor cannot be determined with any better precision.

A second problem is the behavior of neutrons at large distances. Most of the high energy accelerator laboratories have made measurements. These measurements are unique to each facility because of design differences, types of machines, and surrounding topography. Here again we have chosen a conservative formula for calculating the dose at distances other than the point of measurement. Lindenbaum[8] gave a method for evaluating skyshine neutrons which was later verified by Ladu, et al.[9] using Monte Carlo techniques. Lindenbaum approximated the falloff by $(e^{-} R/\ )/R$ where R is distance in meters from the source and $= 250$ m. This equation fits the SLAC data fairly well, and is the one used to predict doses beyond our measuring station (see Figure A-1). We feel that the methods used and reported in this document may overestimate the true population dose by at least an additional factor of two.

The population demographics in the vicinity of SLAC, i.e., within 1.6 km radius, is a mixture of commerce and residential dwellings. This area is partially covered by West Menlo Park town, Atherton town, and the Stanford unincorporated community. Based on the population data from the 1990 census, the population estimate in this area is about 8800 residents. The same exposure assumptions were used for the CY91 report using a ceiling estimate of 2 mrem (0.02 mSv) to the site boundary. The 17.6 person-rem (0.176 person-Sievert) collective dose was estimated from this value.

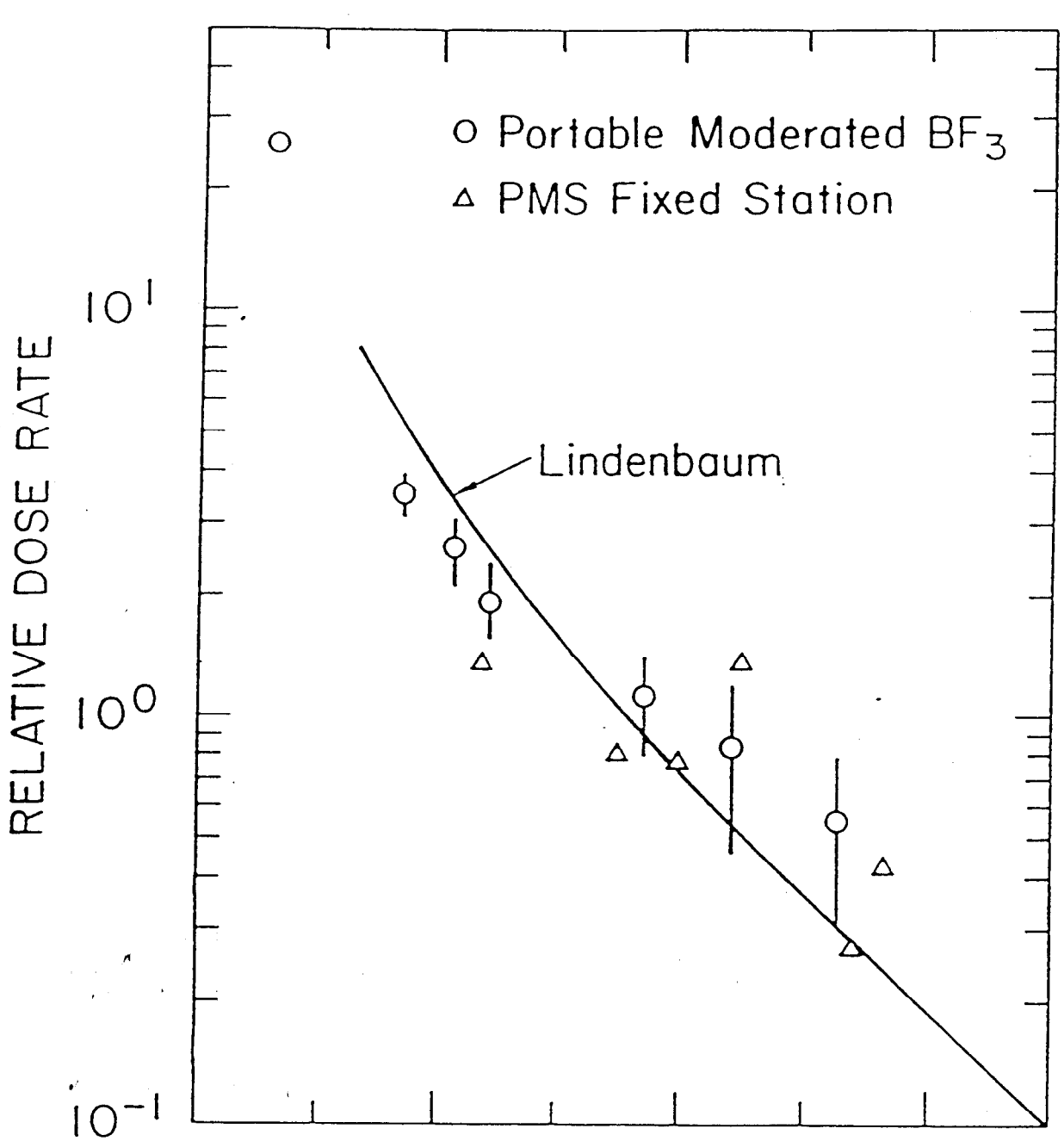
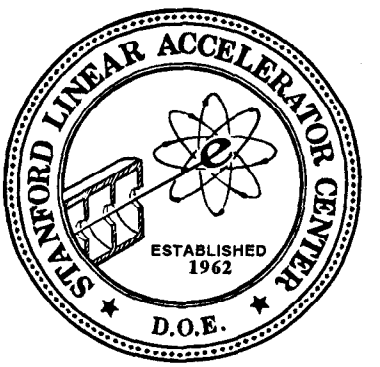


Figure A-1. Measurements made along a line between End Station A and the site boundary.

U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR 61)
Calendar Year 1992



Site Name: **Stanford Linear Accelerator Center (SLAC)**

Field Office Information

Office: Department of Energy SF

Address: 1301 Clay street, Room 700N
Oakland, CA 94612-5208

Contact: John Muhlestein Phone: (415) 926-3208

Site Information

Operator: Stanford University

Address: P.O. Box 4349
Stanford, CA 94309

Contact: Gary Warren Phone: (415) 926-3614

Section I. Facility Information

Stanford Linear Accelerator Center is fully in compliance with the required 40 CFR Part 61 Subpart H for CY92.

Site Description

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the U.S. Department of Energy. 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 above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 meters above sea level. The mountains to the west rise abruptly to 610 meters. The SLAC site occupies 170 hectares 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 1400 employees, temporary staff and visiting scientists. The climate in the SLAC area is Mediterranean. Winters are warm (sometimes it rains) and summers are mostly cool 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 recent 1990 census for these five communities are shown below:

Table 1. Demographic Data

GEOGRAPHIC AREA	POPULATION [persons]	POP. DENSITY [persons/sq mile]	HOUSING [unit]	LAND AREA [sq mile]
Atherton town	7,163	1463.32	2,518	4.895
West Menlo Park	3,959	7086.19	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	6569.14	4,770	2.755
Total:	38,448	NA	12,556	29.105

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

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

Source Description

Radioactive materials are 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 isotopes such as ^{15}O, ^{13}N, ^{11}C, ^{38}Cl, ^{39}Cl, and ^{41}Ar. These radioactive gases are normally produced in areas where the beam strikes beam line components (beam loss). There are six potential beam loss areas currently identified at SLAC: Accelerator Housing, Positron Source, SLC Beam Dump, Beam Switchyard, SLC Damping Rings, and SSRL Booster Injector. The saturation radioactivity produced in these areas has been studied by Jenkins, et al. (CN-227). The saturation activity is defined to be the equilibrium radioactivity level inside these areas when the accelerator is running. Calculations of saturation activity in each of these six beam loss areas are conservatively based on the specific beam power loss and the area geometry (i.e., air path length, air volume, etc...). Potential release points from these areas are either from the access openings (i.e. entrance doors, manways) or from the

forced air ventilation ducts. All the access openings are closed and administratively secured during the beam operation. The calculated source terms in each area for the CY92 were conservatively based on the number of times that the machine was shut down for repair or maintenance in CY92, and were independent of whether or not venting was carried out. In addition, the "number of releases/year" was overly estimated for many systems and, in many cases, was not representative of the true release. Detail descriptions of these areas and their associated radionuclide concentrations are discussed below.

- Accelerator Housing: The accelerator is housed in a 3.2 km long housing. The housing is located 25 feet (7.6 meters) below ground. Access to the housing is through 30 inch (76.2 cm) diameter shafts every 330 feet (100.5 meters). 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 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. Thus, there is no release from these points when the machine is on. After the machine is off, 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 assumed that the saturation activities in this area are similar to those in one of the SLC Beam Dump areas.

Table 2. Accelerator Housing Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	1.00E-01	8	8.00E-01	63%
N-13	2.00E-02	8	1.60E-01	13%
C-11	3.00E-02	8	2.40E-01	19%
Cl-38	4.00E-03	8	3.20E-02	3%
Cl-39	3.00E-03	8	2.40E-02	2%
Ar-41	1.50E-03	8	1.20E-02	1%
TOTAL:	1.59E-01	NA	1.27E+00	100%

* 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 is about 400 meters.

- 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. Jenkins, et al (CN 226), have reviewed the air activation associated with the operation of the positron target. The saturation activities of potential radioactive gases in this area are listed below:

Table 3. Positron Source Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	1.40E+00	7	9.80E+00	68%
N-13	3.00E-01	7	2.10E+00	15%
C-11	3.00E-01	7	2.10E+00	15%
Cl-38	5.00E-03	7	3.50E-02	0%
Cl-39	3.00E-02	7	2.10E-01	1%
Ar-41	2.00E-02	7	1.40E-01	1%
TOTAL:	2.06E+00	NA	1.44E+01	100%

* 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 400 m.

- Beam Dumps: Over the past few years, SLAC has commissioned and operated 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. The electrons and positrons remaining in the beam after the collision 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 below:

Table 4. Beam Dumps Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	2.00E-01	7	1.40E+00	63%
N-13	4.00E-02	7	2.80E-01	13%
C-11	6.00E-02	7	4.20E-01	19%
Cl-38	8.00E-03	7	5.60E-02	3%
Cl-39	6.00E-03	7	4.20E-02	2%
Ar-41	3.00E-03	7	2.10E-02	1%
TOTAL:	3.17E-01	NA	2.22E+00	100%

* 1 Ci = 3.7×10^{10} Bq

The SLC arcs and dump areas are not vented (release point) during beam operation. The distance from the north arc SLC vent to the nearest receptor is 300 m.

- Beam Switchyard: There are four vents (release point) on the beam switchyard. The vents on the beam switchyard and Beam Dump East have covers. The covers are closed during beam operation. If we use the saturation activity produced in the Accelerator Housing as the release from these four vents, this will give a conservative estimate of the effective dose equivalent. The distance from this facility to the nearest receptor is about 400 meters.

Table 5. Beam Switchyard Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	1.00E-01	25	2.50E+00	63%
N-13	2.00E-02	25	5.00E-01	13%
C-11	3.00E-02	25	7.50E-01	19%
Cl-38	4.00E-03	25	1.00E-01	3%
Cl-39	3.00E-03	25	7.50E-02	2%
Ar-41	1.50E-03	25	3.75E-02	1%
TOTAL:	1.59E-01	NA	3.96E+00	100%

* 1 Ci = 3.7×10^{10} Bq

- 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 400 meters. Each ring has a forced air ventilation system (release point). No ventilation is carried out during the beam operation. The saturation activity produced in each ring has been calculated by Jenkins, (CN 51). The isotopes produced and the saturation activity are listed in the following table:

Table 6. Damping Rings Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	1.80E-02	12	2.16E-01	81%
N-13	3.20E-03	12	3.84E-02	14%
C-11	6.00E-04	12	7.20E-03	3%
Cl-38	1.30E-06	12	1.56E-05	0%
Cl-39	8.00E-05	12	9.60E-04	0%
Ar-41	2.18E-04	12	2.62E-03	1%
TOTAL:	2.21E-02	NA	2.65E-01	100%

* 1 Ci = 3.7×10^{10} Bq

- SSRL Booster Injector: The Stanford Synchrotron Radiation Laboratory has a 3 GeV booster that produces very low concentrations of radioactive gases. The isotopes and saturation activities are listed in the following table.

Table 7. SSRL/Booster Injector Activity

Isotope	Saturation Activity [Ci*/Release]	Number of Releases per Year	Total Activity Released [Ci*/yr]	Percent of Contribution
O-15	3.70E-04	5	1.85E-03	31%
N-13	7.00E-04	5	3.50E-03	58%
C-11	8.00E-05	5	4.00E-04	7%
Cl-38	1.60E-06	5	8.00E-06	0%
Cl-39	4.00E-05	5	2.00E-04	3%
Ar-41	1.15E-05	5	5.75E-05	1%
TOTAL:	1.20E-03	NA	6.02E-03	100%

* 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 400 meters.

The activity used for assessing compliance is listed in the following tables: The activity was calculated using internal reports and memoranda to file.

Table 9. Summary Activity by Location

Isotope	Accelerator Housing [Ci*]	Positron Source [Ci*]	SLC Beam Dump [Ci*]	Beam Switchyard [Ci*]	SLC Damping Rings [Ci*]	SSRL Booster [Ci*]	All Site Total [Ci*]	Percen Contribu
O-15	8.00E-01	9.80E+00	1.40E+00	2.50E+00	2.16E-01	1.85E-03	**14.72**	67%
N-13	1.60E-01	2.10E+00	2.80E-01	5.00E-01	3.84E-02	3.50E-03	**3.08**	14%
C-11	2.40E-01	2.10E+00	4.20E-01	7.50E-01	7.20E-03	4.00E-04	**3.52**	16%
Cl-38	3.20E-02	3.50E-02	5.60E-02	1.00E-01	1.56E-05	8.00E-06	**0.22**	1%
Cl-39	2.40E-02	2.10E-01	4.20E-02	7.50E-02	9.60E-04	2.00E-04	**0.35**	2%
Ar-41	1.20E-02	1.40E-01	2.10E-02	3.75E-02	2.62E-03	5.75E-05	**0.21**	1%
TOTAL [Ci*]	**1.27**	**14.39**	**2.22**	**3.96**	**0.27**	**0.01**	**22.11**	100%
Percent of Contribution	6%	65%	10%	18%	1%	0%	100%	

* 1 Ci = 3.7×10^{10} Bq

Section II. Air Emissions Data

Point Source	Type Control*	Efficiency*	Distance to Nearest Receptor
Positron Source	Not vented during beam operation	100%	400 m
Damping Ring	Not vented during beam operation	100%	400 m
SLC Beam Dump	Not vented during beam operation	100%	300 m
Acc. Housing	Not vented during beam operation	100%	400 m
Beam Switchyard	Not vented during beam operation	100%	400 m
SSRL Booster	Not vented during beam operation	100%	400 m

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

Non-Point Source	Annual Quantity [Ci]
None Identified	0.0

Table 10. Total Radioactive Gases Potentially Released in 1992

Isotope	All Site Total [Ci*]	Percent of Contribution
O-15	14.718	67%
N-13	3.082	14%
C-11	3.518	16%
Cl-38	0.223	1%
Cl-39	0.352	2%
Ar-41	0.213	1%
TOTAL [Ci*]	**22.106**	100%

* 1 Ci = 3.7×10^{10} Bq

Section III. Dose Assessments

Description of 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 an individual within each population segment. 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.

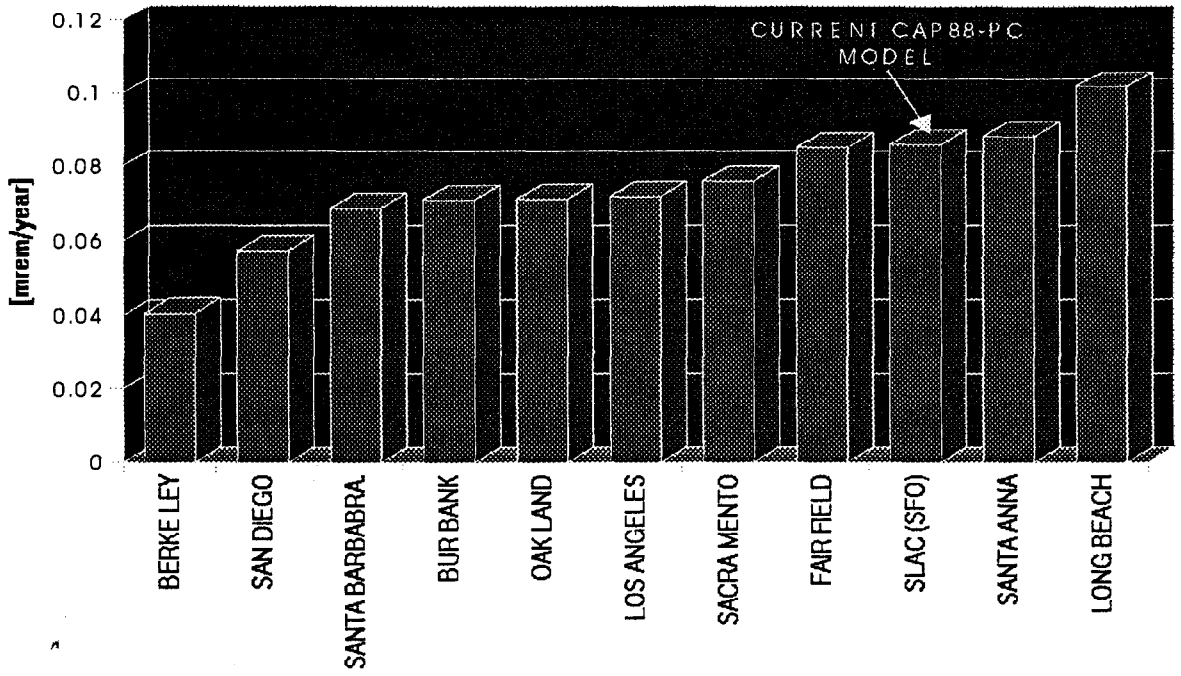
The 1992 radioactivity air emissions used as input to the CAP88-PC were conservatively derived and are shown in Table 10 in Section II. The "number of releases/year" was overly estimated for many systems and, in many cases, was not representative of the true release. This parameter was purely based on the number of times that the machine was shut down for repair or maintenance in 1992, and was independent of whether or not venting was carried out.

As mentioned previously, none of the identified areas are vented or accessed during the beam operation; therefore potential releases occur only after the shutdown of the beam. The time between turning the beam off and venting (or making entry) is normally over an hour, which is long enough for the dominant radioisotope O^{15} to decay through several half-lives. For the purpose of calculating the source terms, it is conservatively assumed that all of these facilities will be vented or accessed right after the shutdown of machine for emergency repairs or routine maintenance. Each release point will be conservatively modeled as a single point source with a stack height of 0.0 meter and 0.0 meter in diameter. The distances from these single release points to the respective nearest receptors are taken to be 300 meters.

An estimate of the population residing within 6 km of SLAC was made using 1990 census data for San Mateo and Santa Clara counties. An area defined by a circle of 6 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 7 radial distances of 0.1, 0.3, 0.5, 1.0, 2.0, 4.0, and 6.0 km. The population within each segment was derived by multiplying the segment area by the population density of the appropriate city/cities. Unpopulated areas, i.e., mountains and grazing fields, were also taken into account in this population study.

Since SLAC does not have a qualified weather station, meteorological input data for CY92 were based on the averaged data provided for San Francisco Airport which are closely best representative the local condition at SLAC. In addition, parametric studies of various meteorological data from different cities within California and the Bay Areas were previously carried out for the CY91 CAP88-PC model. The results of these parametric studies shown that meteorological data do not significantly affect the final results and the use of SFO meteorological data in CAP88-PC will yield a relatively conservative effective dose equivalent (see Figure 1).

FIGURE 1. PREVIOUS PARAMETRIC STUDY OF METEOROLOGICAL DATA FOR CY91



- SOURCE TERMS:

Table 11. Total Input Radioactivity for CAP88-PC

Isotope	All Site Total [Ci*]	Percent Contrib.
O-15	14.718	68%
N-13	3.082	14%
C-11	3.518	16%
Ar-41	0.213	1%
TOTAL [Ci*]	**21.531**	100%

* 1 Ci = 3.7×10^{10} Bq

- POPULATION DATA:

Table 12. 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	TOTAL
N	0	0	125	403	1100	1331	4103	7063
NNW	0	0	126	403	1292	1696	4956	8474
NW	0	0	127	403	1292	1231	1803	4856
WNW	0	0	127	403	1289	910	650	3380
W	0	0	125	379	149	793	650	2096
WSW	0	0	12	0	0	715	520	1247
SW	0	0	12	0	0	242	668	922
SSW	0	0	12	0	0	417	690	1119
S	0	0	12	0	1195	1529	913	3650
SSE	0	0	12	0	1195	1529	3579	6315
SE	0	0	12	0	896	1195	2020	4125
ESE	0	0	12	0	896	598	4855	6362
E	0	0	125	0	1195	5976	4855	12151
ENE	0	0	125	40	1322	5976	5174	12637
NE	0	0	125	391	869	4944	3773	10101
NNE	0	0	125	403	1416	2597	3623	8165
TOTAL:	0	0	1217	2825	14108	31678	42834	92663

- SEE ATTACHMENTS FOR OTHER INPUT PARAMETERS

Compliance Assessment

This assessment of the potential radioactivity released is based on calculations of the activity produced and the immediate release of all of the activity at one time. This is a very conservative approach since ^{15}O dominates the dose calculation. ^{15}O has a two (2) minute half-life and the time between turning the beam off and venting is long (probably in excess of an hour, which is 30 half-lives). This compliance assessment uses the computer code CAP-88 PC Version 1.0 to calculate the dose.

Effective Dose Equivalent: 6.83E-02 mrem/year (6.83E-04 mSv/year)

Location of Maximally Exposed Individual: 400 meters East Southeast

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).

SLAC's Facility Manager: Gary J. Warren

Signature: Gary J. Warren Date: 6/11/93

DOE's, Stanford Site Office Director:
~~DOE's Field Office Manager:~~ John S. Muhlestein

Signature: John S. Muhlestein Date: 6/14/93

Section IV. Additional Information

- SLAC did not have any new/completed construction projects nor modifications during CY92. SLAC is currently seeking financial supports to upgrade 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 productions of radioactive gases during the operation of the proposed PEP II have been estimated and found to be insignificant. Prior EPA approval for facility constructions/modifications associated with this PEP II project will not be necessary since all radioactive gas source terms at SLAC still contribute to less than 1.0% of the 10 mrem/year (0.1 mSv/year) of the NESHAPs limit.

- There were no unplanned releases of radionuclides to the atmosphere during CY92.

- There were no known diffuse emissions at SLAC.

Supplemental Information:

- During CY92, the collective effective dose equivalent for population within 6 km from SLAC's site boundary (92663 persons) was estimated to be 5.54E-02 person-rem/year (5.54E-04 person-Sv/year).

- The reported source terms in the NESHAP report for CY92 include both monitored and unmonitored sources that are currently identified at SLAC.

- Compliance with Subparts Q and T of 40 CFR Part 61 is not applicable at SLAC.

- Information on Rn-220 emission from sources containing U-232 and Th-232 where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the non-radon dose to the public is not applicable at SLAC.

- Information on non-disposal/non-storage sources of Rn-222 emissions where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the non-radon dose to the public is not applicable at SLAC.

- SLAC does not have any emission point that contributes to more than 1% of the 10 mrem/year (0.1 mSv/year) NESHAPs limit. Thus, continuous monitoring of these emission points are not required. However all six major emission points at SLAC are equipped with real-time continuous air monitoring system (AMSs). These AMSs will be used to implement the periodic confirmatory measurement plan that is currently developed.

SLAC Continuous Air Monitoring System (AMSs):

A radioactive gas monitor is provided at each vent from the BSY, positron source and SLC vent. The monitors consist of a detector unit at the vent and the pulse processing equipment located in the Main Control Room.

The detector unit is a GM tube mounted inside a nine liter air volume container. Gas from the vent is pulsed through the monitor air volume while the exhaust fan at the vent is on. When the exhaust fan is turned off the pump pulling gas through the air volume is turned off.

The GM tube is 11 inch (28 cm) long x 5/8 inch (1.6 cm) diameter. The wall is 50 milligrams per square centimeter. The GM tube inside the nine liter volume was calibrated using ^{85}Kr gas. The sensitivity of the equipment is 2×10^{-8} μCi/cc per count per minute.

The isotopes being monitored are beta and gamma emitters. The maximum energies of the beta spectrum and gamma peaks are as follows:

Table 8. Beta Endpoint Energies and Gamma Energies

Isotope	half-life [Minute]	Maximum Beta Energy* [Mev]	Gamma Energy [Mev]
0-15	2.03	+1.74	0.511
N-13	9.96	+1.20	0.511
C-11	20.30	+0.97	0.511
Cl-38	37.00	-4.92	1.64, 2.16
Cl-39	55.00	-1.91	1.26, 1.52
Ar-41	109.20	-1.20	1.29
Kr-85	3.38E+08	-0.70	0.514

* (+) Positron Emitter (-) Negatron Emitter

Since ^{85}Kr has the lowest energy, the detector will be more sensitive to the other isotopes. The net result is that by calibrating to ^{85}Kr, SLAC is reporting a higher concentration than is actually present.

The pulses from the detector are stored in history buffers which are read out by the VAX computer. The data is analyzed to determine a concentration and total activity for each vent.

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 400 Meters East Southeast
Lifetime Fatal Cancer Risk: 1.66E-06

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	7.89E-02	6.37E-02
BREAST	7.32E-02	5.91E-02
R MAR	6.02E-02	4.86E-02
LUNGS	6.91E-02	5.74E-02
THYROID	7.33E-02	5.93E-02
ENDOST	6.87E-02	5.54E-02
RMNDR	5.94E-02	4.83E-02
EFFEC	6.83E-02	5.54E-02

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Risk Range	Number of People	Number of People In This Risk Range Or Higher	Deaths/Year In This Risk Range	Deaths/Year In This Risk Range Or Higher
1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
1.0E-02 TO 1.0E-03	0	0	0.00E+00	0.00E+00
1.0E-03 TO 1.0E-04	0	0	0.00E+00	0.00E+00
1.0E-04 TO 1.0E-05	0	0	0.00E+00	0.00E+00
1.0E-05 TO 1.0E-06	137	137	2.38E-06	2.38E-06
LESS THAN 1.0E-06	92519	92656	1.67E-05	1.91E-05

RADIONUCLIDE EMISSIONS DURING THE YEAR 1992

Nuclide	Class	Size	Source #1 Ci/y	Source #2 Ci/y	Source #3 Ci/y	Source #4 Ci/y	Source #5 Ci/y	Source #6 Ci/y	TOTAL Ci/y
AR-41	*	0.00	1.2E-02	1.4E-01	2.1E-02	3.8E-02	2.6E-03	5.8E-05	2.1E-01
C-11	D	1.00	2.4E-01	2.1E+00	4.2E-01	7.5E-01	7.2E-03	4.0E-04	3.5E+00
N-13	D	1.00	1.6E-01	2.1E+00	2.8E-01	5.0E-01	3.8E-02	3.5E-03	3.1E+00
O-15	D	1.00	8.0E-01	9.8E+00	1.4E+00	2.5E+00	2.2E-01	1.9E-03	1.5E+01

SITE INFORMATION

Temperature: 10 degrees C
Precipitation: 100 cm/y
Mixing Height: 1000 m

SOURCE INFORMATION

Source Number:	1	2	3	4	5	6
Stack Height (m):	0.00	0.00	0.00	0.00	0.00	0.00
Diameter (m):	0.00	0.00	0.00	0.00	0.00	0.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Beef Cattle Density:	8.81E-02
Milk Cattle Density:	2.85E-02
Land Fraction Cultivated for Vegetable Crops:	1.18E-02

POPULATION DATA

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0	0	125	403	1100	1331	4103
NNW	0	0	126	403	1292	1696	4956
NW	0	0	127	403	1292	1231	1803
WNW	0	0	127	403	1289	910	650
W	0	0	125	379	149	793	650
WSW	0	0	12	0	0	715	520
SW	0	0	12	0	0	242	668
SSW	0	0	12	0	0	417	690
S	0	0	12	0	1195	1529	913
SSE	0	0	12	0	1195	1529	3579
SE	0	0	12	0	896	1195	2020
ESE	0	0	12	0	896	598	4855
E	0	0	125	0	1195	5976	4855
ENE	0	0	125	40	1322	5976	5174
NE	0	0	125	391	869	4944	3773
NNE	0	0	125	403	1416	2597	3623

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0	0	0	0	0	0
NNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
WNW	0	0	0	0	0	0
W	0	0	0	0	0	0
WSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
SSW	0	0	0	0	0	0
S	0	0	0	0	0	0
SSE	0	0	0	0	0	0
SE	0	0	0	0	0	0
ESE	0	0	0	0	0	0
E	0	0	0	0	0	0
ENE	0	0	0	0	0	0
NE	0	0	0	0	0	0
NNE	0	0	0	0	0	0

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Population Assessment
May 6, 1993 5:02 pm

Facility: STANFORD LINEAR ACCELERATOR CENTER
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1992

Comments: Henry H. Tran
Health Physicist (415) 926-3793

Dataset Name: slac92-3
Dataset Date: May 6, 1993 5:02 pm
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	7.89E-02	6.37E-02
BREAST	7.32E-02	5.91E-02
R MAR	6.02E-02	4.86E-02
LUNGS	6.91E-02	5.74E-02
THYROID	7.33E-02	5.93E-02
ENDOST	6.87E-02	5.54E-02
RMNDR	5.94E-02	4.83E-02
EFFEC	6.83E-02	5.54E-02

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)	Collective Population (person-rem/y)
INGESTION	0.00E+00	0.00E+00
INHALATION	1.58E-03	1.55E-03
AIR IMMERSION	6.58E-02	5.28E-02
GROUND SURFACE	9.49E-04	1.09E-03
INTERNAL	1.58E-03	1.55E-03
EXTERNAL	6.67E-02	5.39E-02
TOTAL	6.83E-02	5.54E-02

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclides	Selected Individual (mrem/y)	Collective Population (person-rem/y)
AR-41	1.69E-03	3.34E-03
C-11	1.85E-02	2.22E-02
N-13	1.40E-02	1.35E-02
O-15	3.41E-02	1.63E-02
TOTAL	6.83E-02	5.54E-02

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
LEUKEMIA	1.90E-07	2.18E-06
BONE	1.22E-08	1.39E-07
THYROID	3.33E-08	3.81E-07
BREAST	2.87E-07	3.27E-06
LUNG	3.39E-07	4.00E-06
STOMACH	1.85E-07	2.14E-06
BOWEL	8.73E-08	9.98E-07
LIVER	1.93E-07	2.20E-06
PANCREAS	1.16E-07	1.33E-06
URINARY	7.19E-08	8.22E-07
OTHER	1.42E-07	1.63E-06
TOTAL	1.66E-06	1.91E-05

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
INGESTION	0.00E+00	0.00E+00
INHALATION	6.21E-08	8.91E-07
AIR IMMERSION	1.57E-06	1.78E-05
GROUND SURFACE	2.27E-08	3.67E-07
INTERNAL	6.21E-08	8.91E-07
EXTERNAL	1.59E-06	1.82E-05
TOTAL	1.66E-06	1.91E-05

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
AR-41	4.09E-08	1.14E-06
C-11	4.59E-07	7.77E-06
N-13	3.40E-07	4.65E-06
O-15	8.16E-07	5.52E-06
TOTAL	1.66E-06	1.91E-05

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	3.5E-02	7.0E-03	1.2E-03	1.9E-04	5.2E-05
NNW	0.0E+00	0.0E+00	1.8E-02	3.6E-03	6.0E-04	9.7E-05	2.7E-05
NW	0.0E+00	0.0E+00	1.7E-02	3.6E-03	6.1E-04	1.0E-04	2.9E-05
WNW	0.0E+00	0.0E+00	1.1E-02	2.4E-03	4.2E-04	7.0E-05	2.0E-05
W	0.0E+00	0.0E+00	8.1E-03	1.7E-03	2.9E-04	4.8E-05	1.3E-05
WSW	0.0E+00	0.0E+00	7.3E-03	0.0E+00	0.0E+00	4.3E-05	1.2E-05
SW	0.0E+00	0.0E+00	6.7E-03	0.0E+00	0.0E+00	3.8E-05	1.0E-05
SSW	0.0E+00	0.0E+00	5.8E-03	0.0E+00	0.0E+00	3.5E-05	9.6E-06
S	0.0E+00	0.0E+00	1.1E-02	0.0E+00	3.9E-04	6.6E-05	1.9E-05
SSE	0.0E+00	0.0E+00	5.1E-03	0.0E+00	1.8E-04	2.9E-05	8.2E-06
SE	0.0E+00	0.0E+00	1.8E-02	0.0E+00	7.1E-04	1.2E-04	3.6E-05
ESE	0.0E+00	0.0E+00	6.8E-02	0.0E+00	3.0E-03	5.5E-04	1.7E-04
E	0.0E+00	0.0E+00	4.9E-02	0.0E+00	2.2E-03	4.0E-04	1.2E-04
ENE	0.0E+00	0.0E+00	2.1E-02	4.4E-03	7.6E-04	1.3E-04	3.7E-05
NE	0.0E+00	0.0E+00	1.6E-02	3.2E-03	5.3E-04	8.7E-05	2.5E-05
NNE	0.0E+00	0.0E+00	1.6E-02	3.3E-03	5.6E-04	9.3E-05	2.6E-05

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

COLLECTIVE EFFECTIVE DOSE EQUIVALENT (person rem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	4.4E-03	2.8E-03	1.3E-03	2.5E-04	2.1E-04
NNW	0.0E+00	0.0E+00	2.3E-03	1.5E-03	7.8E-04	1.7E-04	1.4E-04
NW	0.0E+00	0.0E+00	2.2E-03	1.4E-03	7.8E-04	1.2E-04	5.2E-05
WNW	0.0E+00	0.0E+00	1.4E-03	9.6E-04	5.4E-04	6.4E-05	1.3E-05
W	0.0E+00	0.0E+00	1.0E-03	6.4E-04	4.4E-05	3.8E-05	8.5E-06
WSW	0.0E+00	0.0E+00	8.7E-05	0.0E+00	0.0E+00	3.0E-05	6.0E-06
SW	0.0E+00	0.0E+00	8.0E-05	0.0E+00	0.0E+00	9.2E-06	6.8E-06
SSW	0.0E+00	0.0E+00	6.9E-05	0.0E+00	0.0E+00	1.5E-05	6.6E-06
S	0.0E+00	0.0E+00	1.3E-04	0.0E+00	4.7E-04	1.0E-04	1.7E-05
SSE	0.0E+00	0.0E+00	6.1E-05	0.0E+00	2.1E-04	4.4E-05	2.9E-05
SE	0.0E+00	0.0E+00	2.2E-04	0.0E+00	6.3E-04	1.5E-04	7.3E-05
ESE	0.0E+00	0.0E+00	8.2E-04	0.0E+00	2.7E-03	3.3E-04	8.1E-04
E	0.0E+00	0.0E+00	6.1E-03	0.0E+00	2.6E-03	2.4E-03	5.9E-04
ENE	0.0E+00	0.0E+00	2.7E-03	1.8E-04	1.0E-03	7.5E-04	1.9E-04
NE	0.0E+00	0.0E+00	2.0E-03	1.2E-03	4.6E-04	4.3E-04	9.3E-05
NNE	0.0E+00	0.0E+00	2.0E-03	1.3E-03	8.0E-04	2.4E-04	9.6E-05

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

AVERAGE COLLECTIVE GENETIC DOSE EQUIVALENT
(person rem)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	1.3E-01	8.1E-02	3.7E-02	7.1E-03	6.1E-03
NNW	0.0E+00	0.0E+00	6.6E-02	4.2E-02	2.2E-02	4.7E-03	3.9E-03
NW	0.0E+00	0.0E+00	6.3E-02	4.1E-02	2.3E-02	3.5E-03	1.5E-03
WNW	0.0E+00	0.0E+00	4.1E-02	2.8E-02	1.5E-02	1.8E-03	3.7E-04
W	0.0E+00	0.0E+00	2.9E-02	1.8E-02	1.2E-03	1.1E-03	2.4E-04
WSW	0.0E+00	0.0E+00	2.5E-03	0.0E+00	0.0E+00	8.7E-04	1.7E-04
SW	0.0E+00	0.0E+00	2.3E-03	0.0E+00	0.0E+00	2.6E-04	2.0E-04
SSW	0.0E+00	0.0E+00	2.0E-03	0.0E+00	0.0E+00	4.2E-04	1.9E-04
S	0.0E+00	0.0E+00	3.6E-03	0.0E+00	1.3E-02	2.9E-03	4.9E-04
SSE	0.0E+00	0.0E+00	1.8E-03	0.0E+00	6.1E-03	1.3E-03	8.4E-04
SE	0.0E+00	0.0E+00	6.3E-03	0.0E+00	1.8E-02	4.2E-03	2.1E-03
ESE	0.0E+00	0.0E+00	2.4E-02	0.0E+00	7.7E-02	9.4E-03	2.3E-02
E	0.0E+00	0.0E+00	1.8E-01	0.0E+00	7.5E-02	6.8E-02	1.7E-02
ENE	0.0E+00	0.0E+00	7.7E-02	5.1E-03	2.9E-02	2.2E-02	5.4E-03
NE	0.0E+00	0.0E+00	5.7E-02	3.6E-02	1.3E-02	1.2E-02	2.7E-03
NNE	0.0E+00	0.0E+00	5.9E-02	3.8E-02	2.3E-02	6.9E-03	2.7E-03

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	8.6E-07	1.7E-07	2.9E-08	4.6E-09	1.3E-09
NNW	0.0E+00	0.0E+00	4.4E-07	8.8E-08	1.5E-08	2.4E-09	6.7E-10
NW	0.0E+00	0.0E+00	4.2E-07	8.7E-08	1.5E-08	2.5E-09	7.0E-10
WNW	0.0E+00	0.0E+00	2.8E-07	5.8E-08	1.0E-08	1.7E-09	4.9E-10
W	0.0E+00	0.0E+00	2.0E-07	4.1E-08	7.1E-09	1.2E-09	3.2E-10
WSW	0.0E+00	0.0E+00	1.8E-07	0.0E+00	0.0E+00	1.0E-09	2.8E-10
SW	0.0E+00	0.0E+00	1.6E-07	0.0E+00	0.0E+00	9.3E-10	2.5E-10
SSW	0.0E+00	0.0E+00	1.4E-07	0.0E+00	0.0E+00	8.5E-10	2.4E-10
S	0.0E+00	0.0E+00	2.6E-07	0.0E+00	9.6E-09	1.6E-09	4.6E-10
SSE	0.0E+00	0.0E+00	1.2E-07	0.0E+00	4.3E-09	7.1E-10	2.0E-10
SE	0.0E+00	0.0E+00	4.4E-07	0.0E+00	1.7E-08	3.0E-09	8.9E-10
ESE	0.0E+00	0.0E+00	1.7E-06	0.0E+00	7.2E-08	1.3E-08	4.1E-09
E	0.0E+00	0.0E+00	1.2E-06	0.0E+00	5.3E-08	9.7E-09	3.0E-09
ENE	0.0E+00	0.0E+00	5.2E-07	1.1E-07	1.9E-08	3.1E-09	9.0E-10
NE	0.0E+00	0.0E+00	3.8E-07	7.7E-08	1.3E-08	2.1E-09	6.1E-10
NNE	0.0E+00	0.0E+00	4.0E-07	8.1E-08	1.4E-08	2.3E-09	6.5E-10

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

COLLECTIVE FATAL CANCER RATE (deaths/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	1.5E-06	9.8E-07	4.5E-07	8.6E-08	7.4E-08
NNW	0.0E+00	0.0E+00	7.9E-07	5.0E-07	2.7E-07	5.7E-08	4.7E-08
NW	0.0E+00	0.0E+00	7.6E-07	4.9E-07	2.7E-07	4.3E-08	1.8E-08
WNW	0.0E+00	0.0E+00	4.9E-07	3.3E-07	1.9E-07	2.2E-08	4.5E-09
W	0.0E+00	0.0E+00	3.5E-07	2.2E-07	1.5E-08	1.3E-08	3.0E-09
WSW	0.0E+00	0.0E+00	3.0E-08	0.0E+00	0.0E+00	1.1E-08	2.1E-09
SW	0.0E+00	0.0E+00	2.8E-08	0.0E+00	0.0E+00	3.2E-09	2.4E-09
SSW	0.0E+00	0.0E+00	2.4E-08	0.0E+00	0.0E+00	5.0E-09	2.3E-09
S	0.0E+00	0.0E+00	4.3E-08	0.0E+00	1.6E-07	3.5E-08	5.9E-09
SSE	0.0E+00	0.0E+00	2.1E-08	0.0E+00	7.3E-08	1.5E-08	1.0E-08
SE	0.0E+00	0.0E+00	7.5E-08	0.0E+00	2.2E-07	5.1E-08	2.5E-08
ESE	0.0E+00	0.0E+00	2.8E-07	0.0E+00	9.2E-07	1.1E-07	2.8E-07
E	0.0E+00	0.0E+00	2.1E-06	0.0E+00	8.9E-07	8.2E-07	2.0E-07
ENE	0.0E+00	0.0E+00	9.2E-07	6.1E-08	3.5E-07	2.6E-07	6.6E-08
NE	0.0E+00	0.0E+00	6.8E-07	4.3E-07	1.6E-07	1.5E-07	3.2E-08
NNE	0.0E+00	0.0E+00	7.0E-07	4.6E-07	2.8E-07	8.4E-08	3.3E-08

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K C O N V E R S I O N F A C T O R S

Non-Radon Population Assessment
May 6, 1993 5:02 pm

Facility: STANFORD LINEAR ACCELERATOR CENTER
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1992

Comments: Henry H. Tran
Health Physicist (415) 926-3793

Dataset Name: slac92-3
Dataset Date: May 6, 1993 5:02 pm
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

DOSE AND RISK FACTOR UNITS

The units for each type of dose rate conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	millirem/picoCurie
Inhalation	millirem/picoCurie
Immersion	millirem-cubic centimeter/microCurie-year
Surface	millirem-square centimeter/microCurie-year

Risks for internal exposures (inhalation and ingestion) are the lifetime risk of premature death in a birth cohort of 100,000 people for a 1 picoCurie/year intake rate, where the average lifetime is 70.7565 years. This simplified to lifetime risk per 100,000 picoCuries.

The units for each type of risk conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	lifetime risk/100,000 picoCuries
Inhalation	lifetime risk/100,000 picoCuries
Immersion	lifetime risk-cubic centimeter/100,000 picoCurie-years
Surface	lifetime risk-square centimeter/100,000 picoCurie-years

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* NUCLIDE AR-41 *
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DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
GONADS	0.000E+00	2.946E-10	7.733E+09	1.347E+06
BREAST	0.000E+00	3.236E-10	6.956E+09	1.210E+06
R MAR	0.000E+00	3.083E-10	5.957E+09	1.032E+06
LUNGS	0.000E+00	3.443E-09	5.883E+09	1.025E+06
THYROID	0.000E+00	3.465E-10	7.326E+09	1.276E+06
ENDOST	0.000E+00	2.551E-10	6.290E+09	1.095E+06
RMNDR	0.000E+00	3.532E-10	5.964E+09	1.037E+06
EFFEC	0.000E+00	6.964E-10	6.595E+09	1.147E+06

GENETIC EFFECT DOSE RATE CONVERSION FACTORS

TESTES	0.000E+00	8.837E-09	2.320E+11	4.040E+07
OVARIES	0.000E+00	7.793E-09	1.587E+11	2.764E+07
AVERAGE	0.000E+00	8.315E-09	1.954E+11	3.402E+07

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
LEUKEMIA	0.000E+00	9.766E-11	1.887E+03	3.270E-01
BONE	0.000E+00	4.515E-12	1.113E+02	1.938E-02
THYROID	0.000E+00	1.576E-11	3.332E+02	5.806E-02
BREAST	0.000E+00	1.268E-10	2.725E+03	4.739E-01
LUNG	0.000E+00	2.721E-09	2.917E+03	5.081E-01
STOMACH	0.000E+00	8.832E-11	1.768E+03	3.079E-01
BOWEL	0.000E+00	2.937E-11	8.983E+02	1.562E-01
LIVER	0.000E+00	1.208E-10	1.946E+03	3.398E-01
PANCREAS	0.000E+00	8.577E-11	1.177E+03	2.054E-01
URINARY	0.000E+00	4.233E-11	7.381E+02	1.281E-01
OTHER	0.000E+00	1.049E-10	1.439E+03	2.513E-01

GENETIC EFFECT RISK CONVERSION FACTORS

AVERAGE	0.000E+00	2.162E-15	5.080E+04	8.845E+00

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* NUCLIDE C-11 *
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DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
GONADS	7.396E-09	2.501E-09	5.957E+09	1.232E+06
BREAST	6.822E-09	4.371E-09	5.550E+09	1.140E+06
R MAR	6.226E-09	4.153E-09	4.551E+09	9.398E+05
LUNGS	7.342E-09	1.882E-07	4.440E+09	9.176E+05
THYROID	3.169E-09	3.860E-09	5.550E+09	1.140E+06
ENDOST	3.850E-09	3.150E-09	5.217E+09	1.073E+06
RMNDR	1.684E-07	1.949E-08	4.447E+09	9.161E+05
EFFEC	5.522E-08	3.042E-08	5.058E+09	1.043E+06
GENETIC EFFECT DOSE RATE CONVERSION FACTORS				
TESTES	8.421E-08	5.802E-08	1.787E+11	3.696E+07
OVARIES	2.219E-07	7.503E-08	1.199E+11	2.464E+07
AVERAGE	1.530E-07	6.653E-08	1.493E+11	3.080E+07

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
LEUKEMIA	1.972E-09	1.315E-09	1.441E+03	2.977E-01
BONE	6.814E-11	5.575E-11	9.233E+01	1.899E-02
THYROID	1.441E-10	1.756E-10	2.524E+02	5.183E-02
BREAST	2.672E-09	1.712E-09	2.174E+03	4.464E-01
LUNG	3.640E-09	9.723E-08	2.201E+03	4.549E-01
STOMACH	2.183E-07	2.121E-08	1.335E+03	2.743E-01
BOWEL	4.641E-09	6.497E-10	6.594E+02	1.357E-01
LIVER	2.981E-09	2.129E-09	1.453E+03	2.996E-01
PANCREAS	1.136E-08	2.463E-09	8.734E+02	1.801E-01
URINARY	1.536E-09	5.707E-10	5.432E+02	1.119E-01
OTHER	1.389E-08	3.012E-09	1.068E+03	2.203E-01
GENETIC EFFECT RISK CONVERSION FACTORS				
AVERAGE	3.978E-14	1.730E-14	3.882E+04	8.008E+00

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* NUCLIDE N-13 *
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DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
GONADS	2.884E-09	9.321E-10	5.994E+09	1.232E+06
BREAST	2.974E-09	2.003E-09	5.550E+09	1.140E+06
R MAR	2.594E-09	1.895E-09	4.551E+09	9.398E+05
LUNGS	3.402E-09	1.334E-07	4.440E+09	9.176E+05
THYROID	9.159E-10	1.765E-09	5.550E+09	1.140E+06
ENDOST	1.538E-09	1.476E-09	5.217E+09	1.073E+06
RMNDR	1.139E-07	9.503E-09	4.447E+09	9.161E+05
EFFEC	3.612E-08	1.972E-08	5.067E+09	1.043E+06

GENETIC EFFECT DOSE RATE CONVERSION FACTORS

TESTES	2.242E-08	2.087E-08	1.798E+11	3.696E+07
OVARIES	8.651E-08	2.796E-08	1.199E+11	2.464E+07
AVERAGE	5.447E-08	2.442E-08	1.498E+11	3.080E+07

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
LEUKEMIA	8.215E-10	6.003E-10	1.441E+03	2.977E-01
BONE	2.723E-11	2.613E-11	9.233E+01	1.899E-02
THYROID	4.166E-11	8.026E-11	2.524E+02	5.183E-02
BREAST	1.165E-09	7.845E-10	2.174E+03	4.464E-01
LUNG	1.687E-09	5.959E-08	2.201E+03	4.549E-01
STOMACH	1.559E-07	1.057E-08	1.335E+03	2.743E-01
BOWEL	2.204E-09	2.365E-10	6.596E+02	1.359E-01
LIVER	1.382E-09	1.037E-09	1.453E+03	2.996E-01
PANCREAS	6.420E-09	1.148E-09	8.734E+02	1.801E-01
URINARY	7.524E-10	2.494E-10	5.432E+02	1.119E-01
OTHER	7.852E-09	1.404E-09	1.068E+03	2.203E-01

GENETIC EFFECT RISK CONVERSION FACTORS

AVERAGE	1.416E-14	6.349E-15	3.895E+04	8.008E+00

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* NUCLIDE O-15 *
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DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
GONADS	3.156E-10	8.741E-11	5.994E+09	1.232E+06
BREAST	5.258E-10	3.509E-10	5.550E+09	1.143E+06
R MAR	4.135E-10	3.306E-10	4.551E+09	9.398E+05
LUNGS	6.663E-10	4.839E-08	4.440E+09	9.176E+05
THYROID	6.929E-11	3.141E-10	5.550E+09	1.140E+06
ENDOST	2.338E-10	2.633E-10	5.217E+09	1.073E+06
RMNDR	3.594E-08	1.270E-09	4.447E+09	9.161E+05
EFFEC	1.108E-08	6.319E-09	5.067E+09	1.044E+06
GENETIC EFFECT DOSE RATE CONVERSION FACTORS				
TESTES	8.689E-10	1.649E-09	1.798E+11	3.696E+07
OVARIES	9.467E-09	2.622E-09	1.199E+11	2.464E+07
AVERAGE	5.168E-09	2.136E-09	1.498E+11	3.080E+07

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
LEUKEMIA	1.310E-10	1.047E-10	1.441E+03	2.977E-01
BONE	4.138E-12	4.660E-12	9.233E+01	1.899E-02
THYROID	3.152E-12	1.429E-11	2.524E+02	5.183E-02
BREAST	2.060E-10	1.374E-10	2.174E+03	4.478E-01
LUNG	3.304E-10	1.770E-08	2.201E+03	4.549E-01
STOMACH	5.324E-08	1.161E-09	1.335E+03	2.743E-01
BOWEL	2.960E-10	1.884E-11	6.597E+02	1.359E-01
LIVER	2.628E-10	2.029E-10	1.453E+03	2.996E-01
PANCREAS	1.498E-09	1.878E-10	8.743E+02	1.801E-01
URINARY	1.507E-10	3.804E-11	5.432E+02	1.119E-01
OTHER	1.833E-09	2.297E-10	1.069E+03	2.203E-01
GENETIC EFFECT RISK CONVERSION FACTORS				
AVERAGE	1.344E-15	5.554E-16	3.895E+04	8.008E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Population Assessment
May 6, 1993 5:02 pm

Facility: STANFORD LINEAR ACCELERATOR CENTER
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1992

Comments: Henry H. Tran
Health Physicist (415) 926-3793

Dataset Name: slac92-3
Dataset Date: May 6, 1993 5:02 pm
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
AR-41	*	0.0	0.00E+00	0.00E+00
C-11	D	1.0	1.00E-05	1.80E-03
N-13	D	1.0	1.00E-05	1.80E-03
O-15	D	1.0	1.00E-05	1.80E-03

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
AR-41	9.10E+00	5.48E-05	0.00E+00	0.00E+00	0.00E+00
C-11	4.87E+01	5.48E-05	0.00E+00	0.00E+00	0.00E+00
N-13	1.00E+02	5.48E-05	0.00E+00	2.50E-02	7.50E-02
O-15	4.90E+02	5.48E-05	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES:
(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
AR-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-11	0.00E+00	0.00E+00	9.50E-01	9.50E-01
N-13	3.00E+01	1.28E+01	9.50E-01	9.50E-01
O-15	0.00E+00	0.00E+00	9.50E-01	9.50E-01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

NUMBER OF BEEF CATTLE

	Distance (meters)						
Direction	50	200	400	750	1500	3000	5000
N	0	0	0	1	5	21	35
NNW	0	0	0	1	5	21	35
NW	0	0	0	1	5	21	35
WNW	0	0	0	1	5	21	35
W	0	0	0	1	5	21	35
WSW	0	0	0	1	5	21	35
SW	0	0	0	1	5	21	35
SSW	0	0	0	1	5	21	35
S	0	0	0	1	5	21	35
SSE	0	0	0	1	5	21	35
SE	0	0	0	1	5	21	35
ESE	0	0	0	1	5	21	35
E	0	0	0	1	5	21	35
ENE	0	0	0	1	5	21	35
NE	0	0	0	1	5	21	35
NNE	0	0	0	1	5	21	35

	Distance (meters)					
Direction	8000	20000	35000	45000	55000	70000
N	111	1384	1211	1557	1903	4844
NNW	111	1384	1211	1557	1903	4844
NW	111	1384	1211	1557	1903	4844
WNW	111	1384	1211	1557	1903	4844
W	111	1384	1211	1557	1903	4844
WSW	111	1384	1211	1557	1903	4844
SW	111	1384	1211	1557	1903	4844
SSW	111	1384	1211	1557	1903	4844
S	111	1384	1211	1557	1903	4844
SSE	111	1384	1211	1557	1903	4844
SE	111	1384	1211	1557	1903	4844
ESE	111	1384	1211	1557	1903	4844
E	111	1384	1211	1557	1903	4844
ENE	111	1384	1211	1557	1903	4844
NE	111	1384	1211	1557	1903	4844
NNE	111	1384	1211	1557	1903	4844

NUMBER OF MILK CATTLE

Direction	Distance (meters) 50	200	400	750	1500	3000	5000
N	0	0	0	0	2	7	11
NNW	0	0	0	0	2	7	11
NW	0	0	0	0	2	7	11
WNW	0	0	0	0	2	7	11
W	0	0	0	0	2	7	11
WSW	0	0	0	0	2	7	11
SW	0	0	0	0	2	7	11
SSW	0	0	0	0	2	7	11
S	0	0	0	0	2	7	11
SSE	0	0	0	0	2	7	11
SE	0	0	0	0	2	7	11
ESE	0	0	0	0	2	7	11
E	0	0	0	0	2	7	11
ENE	0	0	0	0	2	7	11
NE	0	0	0	0	2	7	11
NNE	0	0	0	0	2	7	11

Direction	Distance (meters) 8000	20000	35000	45000	55000	70000
N	36	448	392	504	616	1567
NNW	36	448	392	504	616	1567
NW	36	448	392	504	616	1567
WNW	36	448	392	504	616	1567
W	36	448	392	504	616	1567
WSW	36	448	392	504	616	1567
SW	36	448	392	504	616	1567
SSW	36	448	392	504	616	1567
S	36	448	392	504	616	1567
SSE	36	448	392	504	616	1567
SE	36	448	392	504	616	1567
ESE	36	448	392	504	616	1567
E	36	448	392	504	616	1567
ENE	36	448	392	504	616	1567
NE	36	448	392	504	616	1567
NNE	36	448	392	504	616	1567

AREA OF VEGETABLE CROP PRODUCTION (M**2)

	Distance (meters)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
NNW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
NW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
WNW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
W	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
WSW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
SW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
SSW	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
S	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
SSE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
SE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
ESE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
E	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
ENE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
NE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04
NNE	0.0E+00	0.0E+00	0.0E+00	1.7E+03	7.0E+03	2.8E+04	4.6E+04

	Distance (meters)					
Direction	8000	20000	35000	45000	55000	70000
N	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NNW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
WNW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
W	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
WSW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SSW	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
S	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SSE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
ESE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
E	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
ENE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NNE	1.5E+05	1.9E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.60E-02
Meat	8.00E-03
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Actual fractions of food types from outside area can be greater than the minimum fractions listed below.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Population Assessment
May 6, 1993 5:02 pm

Facility: STANFORD LINEAR ACCELERATOR CENTER
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1992

Comments: Henry H. Tran
Health Physicist (415) 926-3793

Dataset Name: slac92-3
Dataset Date: May 6, 1993 5:02 pm
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Frequency
N	0.000	1.018	1.537	3.480	2.760	1.462	0.772	0.065
NNW	0.000	1.211	1.661	3.082	2.740	1.552	0.772	0.035
NW	0.000	0.973	1.784	3.481	2.931	1.531	0.772	0.041
WNW	1.304	1.259	2.375	2.546	2.860	1.498	0.772	0.032
W	1.304	1.452	1.978	2.054	2.925	1.138	0.772	0.027
WSW	0.000	1.739	2.249	2.320	3.545	1.597	0.772	0.031
SW	0.772	1.825	2.289	2.225	3.201	1.323	0.772	0.029
SSW	1.304	2.016	2.505	2.625	2.914	1.358	0.772	0.024
S	1.304	2.003	2.642	3.449	3.363	1.498	0.772	0.031
SSE	0.000	1.758	3.492	2.535	3.462	1.845	0.772	0.012
SE	0.970	1.621	4.654	5.002	3.817	1.865	0.772	0.066
ESE	0.000	1.329	5.056	5.870	4.095	2.061	0.772	0.276
E	0.000	2.216	4.811	5.822	3.912	1.916	0.772	0.213
ENE	0.000	1.546	4.780	4.203	3.525	1.647	0.772	0.054
NE	0.000	1.146	2.398	3.207	2.881	1.828	0.772	0.031
NNE	0.000	1.215	4.600	3.401	2.932	1.705	0.772	0.033

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.000	1.451	2.921	5.564	2.870	1.987	0.772
NNW	0.000	1.790	2.389	4.416	2.839	2.065	0.772
NW	0.000	1.408	2.680	4.860	3.108	2.047	0.772
WNW	1.822	2.022	3.167	3.762	3.012	2.019	0.772
W	1.822	2.146	2.747	3.144	3.099	1.599	0.772
WSW	0.000	2.404	2.759	3.414	3.773	2.101	0.772
SW	0.772	2.506	2.980	3.594	3.431	1.843	0.772
SSW	1.822	2.731	3.171	3.889	3.085	1.882	0.772
S	1.822	2.738	3.738	5.914	3.600	2.019	0.772
SSE	0.000	2.334	4.451	5.292	3.696	2.268	0.772
SE	1.297	2.731	5.986	6.565	3.999	2.280	0.772
ESE	0.000	2.233	6.470	6.971	4.198	2.381	0.772
E	0.000	3.028	6.520	6.904	4.070	2.308	0.772
ENE	0.000	2.758	5.576	5.264	3.754	2.139	0.772
NE	0.000	1.612	4.411	4.807	3.041	2.258	0.772
NNE	0.000	2.172	5.587	5.165	3.109	2.180	0.772

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.0000	0.0283	0.0451	0.5093	0.1027	0.1914	0.1231
NNW	0.0000	0.0344	0.0471	0.5116	0.1179	0.1882	0.1007
NW	0.0000	0.0245	0.0784	0.5889	0.0964	0.1340	0.0779
WNW	0.0037	0.0487	0.1597	0.5842	0.0788	0.0828	0.0422
W	0.0045	0.1573	0.2419	0.4529	0.0611	0.0552	0.0272
WSW	0.0000	0.3795	0.2293	0.2684	0.0537	0.0485	0.0205
SW	0.0042	0.4360	0.2218	0.2274	0.0451	0.0437	0.0218
SSW	0.0049	0.3246	0.2657	0.2743	0.0589	0.0544	0.0172
S	0.0039	0.1204	0.2018	0.4448	0.0781	0.0963	0.0547
SSE	0.0000	0.1400	0.2132	0.3105	0.1327	0.1191	0.0845
SE	0.0037	0.0277	0.2743	0.4434	0.1356	0.0722	0.0431
ESE	0.0000	0.0067	0.1061	0.5709	0.2022	0.0990	0.0152
E	0.0000	0.0041	0.0670	0.7438	0.1033	0.0592	0.0226
ENE	0.0000	0.0161	0.0525	0.6101	0.1258	0.1156	0.0798
NE	0.0000	0.0048	0.0696	0.5386	0.1010	0.1783	0.1077
NNE	0.0000	0.0136	0.0607	0.5300	0.0972	0.2034	0.0951
TOT	0.0008	0.0535	0.1168	0.5574	0.1273	0.1004	0.0438

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.0 degrees C
283.2 K
Precipitation: 100.0 cm/y
Lid Height: 1000 meters
Surface Roughness Length: 0.010 meters
Height Of Wind Measurements: 10.0 meters
Average Wind Speed: 4.847 m/s

Vertical Temperature Gradients:
STABILITY E 0.073 k/m
STABILITY F 0.109 k/m
STABILITY G 0.146 k/m

Appendix 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. During accelerator downtime, and any interrupted operation, background provides a calibration baseline as well.

A regular calibration procedure was initiated in 1984 using two small radioactive sources. The sources are placed at a measured distance to produce a known dose equivalent rate. The equipment is kept in normal operation during these checks. The data printout is marked so that the calibration data is not confused with normal measurements. This procedure will be repeated twice each year, and following any equipment repair or maintenance actions. An appropriate response to natural background radiation provides proof that the instruments are operating properly.

Airborne Radioactivity Monitoring Equipment:

A dose equivalent from gaseous radioactivity reaching the site boundary (if large enough) would be detected by the PMSs, which are subjected to a set of quality assurance procedures.

The separate radioactive gas monitors, the AMSs, for each ventilation fan are inspected and calibrated at the beginning of each accelerator cycle. They are calibrated with a small radioactive source. During operation the natural background radiation response assures that they are operating properly.

Liquid Radiological Effluent:

All water samples are analyzed by certified analytical laboratories, which have their own documented quality assurance procedures. The CY92 analyses were performed by Controls for Environmental Pollution, Inc., Albuquerque, New Mexico, a State of California approved laboratory.

Environmental Thermoluminescent (TLD) Dosimeters:

All environmental TLD dosimeters are acquired through NVLAP certified dosimetry service companies. In addition to the required QA/QC processes provided by dosimeter suppliers, SLAC perform QC blind-audit TLD dosimeters from each quarterly TLD batch received. Up to date, the performances of these QC TLD's are acceptable.

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Appendix D

This appendix contains the analytical results of samples taken from SLAC's LCW and environmental monitoring wells. The information in Table IV-2 in Section 4 was reported at the same time.

The Analysis Report was received from a State of California certified laboratory, i.e., CEP, Inc. in Albuquerque, NM.

- California Drinking Water Limits (CCR Title 22, Section 64435):

Tritium	20,000 pCi/l
Gross Beta	50 pCi/l

- California Sanitary Sewer Radioactivity Discharge Limits (CCR Title 17, Section 30287)

All Isotopes	1 Curie/CY
Tritium	1×10^8 pCi/liter

- Derived Concentration Guide (DCG), DOE Order 5400.5:

Tritium (water)	2,000,000 pCi/l

As noted in this report, ground water at SLAC is not potable. The volumes of those systems requiring discharge are normally limited to the volumes of the collection sumps and or hold-up tanks. Concentrations approaching those in sumps and systems are not commonly seen due to the very large discharge volumes leaving the site. See Section 2.

The Detection Limits for tritium analysis and gross beta/gamma analysis are 500 pCi/liter and 3 pCi/liter, respectively. Note that 1 Ci = 3.7×10^{10} Bq.

Sample ID	Sampled Date	Location	Tritium [pCi/liter]			Gross Beta/Gamma [pCi/liter]			Discharge Point*
L00515	1/2/92	SPEAR MAN HOLE #31	0	±	500	0	±	3	SS
L00133	1/31/92	BAKER TANK	0	±	500	7	±	3	SS
L00049	2/12/92	FMS-4	0	±	500	14	±	3	SS
L00138	2/24/92	BAKER TANK	689192	±	13709	246	±	9	SS
L00186	2/25/92	BEAM DUMP EAST	52497	±	1282	113	±	7	SS
L00184	2/25/92	BAKER TANK	659307	±	13117	208	±	9	SS
L00157	3/18/92	BEAMDUMP EAST	38267	±	1003	141	±	8	SS
L00170	3/31/92	BAKER TANK	62058	±	1467	75	±	6	SS
L00172	4/5/92	SEWER WATER	0	±	500	15	±	4	SS
L00240	5/1/92	LCW SURGE TANK	0	±	500	0	±	3	SS
L00209	5/6/92	BAKER TANK	3669	±	560	17	±	4	SS
L00219	7/5/92	SEWER MONITOR 12	0	±	500	9	±	4	SS
L00833	12/10/92	BAKER TANK	0	±	500	9	±	4	SS
		MAXIMUM VALUES:	**689192**			**246**			

* SD = Storm Drain
SS = Sanitary Sewer

APPENDIX E

Environmental TLD Measurements for CY92

Notes:

TLD Type	Nominal Minimum Detectable Levels	Type Of Radiation Detected
$CaSO_4$:Dy (RDC Company)	2 mR	Gamma
LiF (RDC Company)	10 mR	Gamma
Al_2O_3:C (LDR-X9 Landauer Company)	0.1 mrem	Gamma
NeutrakER (LDR-I9 Landauer Company)	10 mrem	Neutron

			SECOND QUARTER							
(LDR)	Dosimeter ID (RDC)	Location	$CaSO_4$ Gross [mR]	$CaSO_4$ Net [mR]	LiF Gross [mR]	LiF Net [mR]	LDR-X9 Gross [mrem]	LDR-X9 Net [mrem]	LDR-I9 Gross [mrem]	LDR-I9 Net [mrem]
1	9901	SB At Region 6	18	2	20	0	12.7	-0.1	0	0
2	9902	SB At Injector	21	5	25	5	13.7	0.9	0	0
3	9903	Computer Center SE	19	3	25	5	13.3	0.5	0	0
4	9904	SB At Region 4	19	3	20	0	13.8	1	0	0
5	9905	SB At North Damping Ring	28	12	30	10	16.3	3.5	0	0
6	9906	I-280 Overpass Acc. South	26	10	30	10	16.1	3.3	0	0
7	9907-Gamma	Gamma Calibration	120	104	120	100	111.9	99.1	0	0
8	9908	Residence in San Francisco	17	1	20	0	11.3	-1.5	0	0
9	9909	Alpine Gatehouse	16	0	15	-5	11.7	-1.1	0	0
10	9910	Meteorological Tower	18	2	20	0	12.4	-0.4	0	0
11	9911	SB At SLD	19	3	20	0	12.1	-0.7	0	0
12	9912	SB At Region12	21	5	25	5	13.5	0.7	0	0
13	9913	SB At Region 2	18	2	20	0	12.3	-0.5	0	0
14	9914	SLAC Entrance Gatehouse	18	2	25	5	12.7	-0.1	0	0
15	9915	SLAC Cafeteria	18	2	20	0	12.5	-0.3	0	0
16	9916	SB At Region 8	19	3	20	0	13.2	0.4	0	0
17	9917	SB At Addison Wesley Blvd.	22	6	25	5	13.7	0.9	0	0
18	9918	SB At Positron Vault	25	9	30	10	16.2	3.4	0	0
19	9919-Control	Transport Control	16	0	20	0	11.9	-0.9	0	0
20	9920	SB At Sector 20 South	25	9	30	10	16.3	3.5	0	0
21	9921	SB At South Damping Ring	24	8	30	10	16.4	3.6	0	0
22	9922	I-280 Overpass Acc. North	26	10	30	10	15.6	2.8	0	0
23	9923-Neu&Gam	Gamma/Neutron Calibration	21	5	25	5	14.7	1.9	60	60
24	9924	OHP Department Office	17	1	20	0	11.9	-0.9	0	0
25	9925	RAMSY Yard	16	0	20	0	13.5	0.7	0	0
26	NA	PMS1					11.9	-0.9	0	0
27	NA	PMS2					12.2	-0.6	0	0
28	NA	PMS3					13.1	0.3	0	0
29	NA	PMS4					12.7	-0.1	0	0
30	NA	PMS5					14.8	2	0	0
31	NA	PMS6					12	-0.8	0	0
32	NA	Residence in San Bruno					11.5	-1.3	0	0
33	NA	Residence in Sunnyvale					31.4	18.6	0	0
34	NA	Spare					11.5	-1.3	0	0
35	NA	Spare					11.4	-1.4	0	0
00	NA	Control					12.7	-0.1	0	0
X9	NA	Posting Control					12.8	0	0	0

			THIRD QUARTER							
(LDR)	Dosimeter ID (RDC)	Location	$CaSO_4$ Gross [mR]	$CaSO_4$ Net [mR]	LiF Gross [mR]	LiF Net [mR]	LDR-X9 Gross [mrem]	LDR-X9 Net [mrem]	LDR-I9 Gross [mrem]	LDR-I9 Net [mrem]
1	9901	SB At Region 6	22	0	40	5	23.2	1.7	0	0
2	9902	SB At Injector	25	3	40	5	108.6	87.1*	0	0
3	9903	Computer Center SE	22	0	40	5	110.4	88.9*	0	0
4	9904	SB At Region 4	24	2	40	5	23.6	2.1	0	0
5	9905	SB At North Damping Ring	33	11	50	15	32	10.5	0	0
6	9906	I-280 Overpass Acc. South	29	7	45	10	29.5	8	0	0
7	9907-Gamma	Gamma Calibration	145	123	165	130	174.3	152.8	0	0
8	9908	Residence in San Francisco	18	-4	35	0	20.8	-0.7	0	0
9	9909	Alpine Gatehouse	19	-3	35	0	19.9	-1.6	0	0
10	9910	Meteorological Tower	21	-1	40	5	23.8	2.3	0	0
11	9911	SB At SLD	22	0	40	5	22.9	1.4	0	0
12	9912	SB At Region12	25	3	40	5	28.2	6.7	0	0
13	9913	SB At Region 2	21	-1	35	0	20.8	-0.7	0	0
14	9914	SLAC Entrance Gatehouse	22	0	40	5	23.5	2	0	0
15	9915	SLAC Cafeteria	22	0	40	5	21.4	-0.1	0	0
16	9916	SB At Region 8	22	0	40	5	23.8	2.3	0	0
17	9917	SB At Addison Wesley Blvd.	26	4	40	5	27.5	6	0	0
18	9918	SB At Positron Vault	31	9	45	10	30	8.5	0	0
19	9919-Control	Transport Control	22	0	35	0	20.3	-1.2	0	0
20	9920	SB At Sector 20 South	31	9	50	15	32.2	10.7	0	0
21	9921	SB At South Damping Ring	28	6	45	10	30.1	8.6	0	0
22	9922	I-280 Overpass Acc. North	26	4	40	5	28.2	6.7	0	0
23	9923-Neu&Gam	Gamma/Neutron Calibration	26	4	40	5	24.9	3.4	20	20
24	9924	OHP Department Office	18	-4	35	0	21.1	-0.4	0	0
25	9925	RAMSY Yard	130	108	135	100	127.8	106.3	0	0
26	NA	PMS1					27.5	6	0	0
27	NA	PMS2					21.8	0.3	0	0
28	NA	PMS3					24.9	3.4	0	0
29	NA	PMS4					23.7	2.2	0	0
30	NA	PMS5					22.2	0.7	0	0
31	NA	PMS6					26.9	5.4	0	0
32	NA	Residence in San Bruno					30.3	8.8	0	0
33	NA	Residence in Sunnyvale					22	0.5	0	0
34	NA	Spare					23	1.5	0	0
35	NA	Spare					22.4	0.9	0	0
00	NA	Control					21.1	-0.4	0	0
X9	NA	Posting Control					21.5	0	0	0

* TLD processing errors.

			FOURTH QUARTER							
(LDR)	Dosimeter ID (RDC)	Location	$CaSO_4$ Gross [mR]	$CaSO_4$ Net [mR]	LiF Gross [mR]	LiF Net [mR]	LDR-X9 Gross [mrem]	LDR-X9 Net [mrem]	LDR-I9 Gross [mrem]	LDR-I9 Net [mrem]
1	9901	SB At Region 6	29	3	65	5	19.9	2.5	0	0
2	9902	SB At Injector	31	5	65	5	20.4	3	0	0
3	9903	Computer Center SE	31	5	60	0	18.7	1.3	0	0
4	9904	SB At Region 4	30	4	65	5	19.2	1.8	0	0
5	9905	SB At North Damping Ring	36	10	70	10	24.7	7.3	0	0
6	9906	I-280 Overpass Acc. South	33	7	70	10	23.8	6.4	0	0
7	9907-Gamma	Gamma Calibration	130	104	160	100	106.1	88.7	0	0
8	9908	Residence in San Francisco	28	2	60	0	16.4	-1	0	0
9	9909	Alpine Gatehouse	26	0	60	0	17.4	0	0	0
10	9910	Meteorological Tower	30	4	60	0	18.7	1.3	0	0
11	9911	SB At SLD	29	3	60	0	18.4	1	0	0
12	9912	SB At Region12	32	6	65	5	22.2	4.8	0	0
13	9913	SB At Region 2	28	2	60	0	17.4	0	0	0
14	9914	SLAC Entrance Gatehouse	29	3	65	5	18.6	1.2	0	0
15	9915	SLAC Cafeteria	29	3	60	0	18.2	0.8	0	0
16	9916	SB At Region 8	30	4	60	0	20	2.6	0	0
17	9917	SB At Addison Wesley Blvd.	31	5	65	5	20.9	3.5	0	0
18	9918	SB At Positron Vault	35	9	70	10	25.3	7.9	0	0
19	9919-Control	Transport Control	26	0	60	0	17.6	0.2	0	0
20	9920	SB At Sector 20 South	34	8	70	10	23.4	6	0	0
21	9921	SB At South Damping Ring	36	10	70	10	23.2	5.8	0	0
22	9922	I-280 Overpass Acc. North	31	5	65	5	22.4	5	0	0
23	9923-Neu&Gam	Gamma/Neutron Calibration	32	6	65	5	22.2	4.8	70	70
24	9924	OHP Department Office	26	0	60	0	16.4	-1	0	0
25	9925	RAMSY Yard	92	66	120	60	71.8	54.4	0	0
26	NA	PMS1					20.4	3	0	0
27	NA	PMS2					16.6	-0.8	0	0
28	NA	PMS3					19.3	1.9	20	20
29	NA	PMS4					17.7	0.3	0	0
30	NA	PMS5					18.5	1.1	0	0
31	NA	PMS6					18.3	0.9	30	30
32	NA	Residence in San Bruno					17.5	0.1	0	0
33	NA	Residence in Sunnyvale					19.1	1.7	0	0
34	NA	Spare					16.8	-0.6	0	0
35	NA	Spare					17.1	-0.3	0	0
00	NA	Control					17.7	0.3	0	0
X9	NA	Posting Control					17.4	0	0	0

Appendix F. Monitoring Well Data

MONITORING WELL MW-21

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Split of 1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	30	34	59	76	120	130	180	160	140	180	340	5
1,1-Dichloroethene (DCE)	<6.5	1	<3	<1.0	<2.5	<2.5	<2.5	<2.5	1.3	1.4	5.3	6
1,1,1-Trichloroethane (TCA)	<4.3	2	<3	<1.0	<2.5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	200
Chloroform	<4.5	2	<3	<1.0	<2.5	<2.5	<2.5	<2.5	0.7	1.3	3.6	100
cis-1,2-Dichloroethene	na	<0.5	<3	<1.0	2.5	<2.5	<2.5	<2.5	na	na	na	6
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	21	29	5.4	16 c
Chloromethane	<4.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	none
1,1-Dichloroethane (DCA)	<4.4	<0.5	<3	<1.0	<2.5	<2.5	<2.5	<2.5	<0.5	<0.5	0.6	5
Metals (µg/l)												
Antimony	50	<50	142	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<10	<5.0	64.3	<5.0	<5.0	8.5	8.0	10.0	8.7	<5.0	12	50 a
Barium	30	23.3	1770	16.2	20	350	230	590	300	<50	190	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<6.0	<5.0	6.9	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	796	<10	<10	150	78	260	53	<50	82	50 a
Cobalt	<16	<10	72.4	<10	<10	17	15	26	<50	<50	<50	none
Copper	<5.0	<10	49.2	<10	15	12	15	23	<50	<50	<50	1000 b
Lead	<45	<1.0	28.8	2.3	<1.0	8.6	5.3	12	<5.0	<100	<5.0	50 a
Mercury	na	<0.2	1.4	<0.2	<0.2	<0.2	<0.2	0.38	0.9	<0.5	<0.5	2 a
Molybdenum	<20	<10	72.2	36.7	22	35	27	38	<50	58	<50	none
Nickel	<21	30.9	1120	31.4	22	250	180	350	160	<100	150	100(proposed)a
Selenuim	<5.0	88.2	104	54.6	47	51	48	75	21	27	60	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	300	<10	<10	62	37	94	<50	<50	<50	none
Zinc	<6.0	<10	387	<10	12	110	95	170	86	<50	75	5000 b
Total Dissolved Solids (mg/l)	9,900	na	na	na	na	6,700	8,200	8,700	9200	8800	7600	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-22

Organics (µg/l) **	10/16/90	1/24/91	Split of 1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	830	760	650	730	860	810	930	640	760	800	1000	5
1,1-Dichloroethene (DCE)	1000	180	150	<50	240	<10	240	180	160	220	350	6
Freon* 113	1200	600	500	1200	1300	1200	1000	740	790	540	1700	1200
cis-1,2-Dichloroethene	na	<25	<25	<50	<13	200	<10	<10	na	na	na	6
Chloroform	<0.5	<25	<25	<50	<13	<10	<10	<10	<50	3.3	<50	100
1,1-Dichloroethane (DCA)	<0.5	<25	<25	<50	<13	<10	<10	<10	<50	12	<50	5
1,1,1-Trichloroethane (TCA)	<0.5	<25	<25	<50	<13	<10	<10	<10	<50	4.8	<50	200
Metals (µg/l)												
Antimony	<60	<50	<50	71.5	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<5.0	<5.0	<5.0	44.9	<5.0	<5.0	8.6	15	18	<5.0	40	50 a
Barium	30	24.0	23.1	1230	23.6	24	1400	660	2000	<500	710	1000 a
Beryllium	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.1	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	<10	683	<10	<10	750	430	790	<50	410	50 a
Chromium Hex	na	11.0	11.0	na	na	na	na	na	na	na	na	none
Cobalt	<10	<10	<10	84.4	<10	<10	77	37	120	<50	<50	none
Copper	<10	<10	<10	49.1	<10	<10	66	36	140	<50	<50	1000 b
Lead	<100	<1.0	<1.0	30.8	<1.0	1.4	17	15	26	<100	<5.0	50 a
Mercury	na	<0.2	<0.2	1.1	<0.2	<0.2	0.26	0.38	2.2	<0.5	0.9	2 a
Molybdenum	20	<10	<10	55.2	16.3	<20	55	33	<50	<50	<50	none
Nickel	<20	<20	24.4	973	<20	<20	1100	500	1500	<100	520	100(proposed)a
Selenuim	29	18.1	18.2	38.6	45.8	36	37	42	7.3	23	15	10 a
Silver	<10	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	0.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<10	<10	<10	252	<10	<10	270	160	150	<50	150	none
Zinc	<10	<10	<10	370	12.7	14	440	220	650	<50	200	5000 b
Total Dissolved Solids (mg/l)	5,300	na	na	na	na	na	5,100	5,900	4900	4500	4600	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-23

Organics (µg/l) **	10/16/90	1/24/91	4/24/91	Split of 4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
1,1-Dichloroethene (DCE)	<5	6	10	12	7	4.4	6.1	5.4	4	3.9	8.0	6
1,1,1-Trichloroethane (TCA)	7	5	10	11	8	2.4	4.9	4.8	2.2	2	5.7	200
1,1-Dichloroethane (DCA)	<5	3	6	7	5	2.5	4.3	4.8	2.7	2.7	6.7	5
Freon* 113	1200	<0.5	<0.5	<0.5	<0.5	0.90	<0.50	<0.50	<0.5	<0.5	2.3	1200
trans-1,2-Dichloroethene	5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	na	na	na	10
Trichloroethene	<5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.50	0.50	<0.5	<0.5	<0.5	5
Chloromethane	<10	<0.5	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<1.0	<0.5	2.9	none
Metals (µg/l)												
Antimony	<60	<50	127	118	58.2	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<5.0	<5.0	49.5	37.4	<5.0	<5.0	22	26	19	<5.0	44	50 a
Barium	30	11.0	2350	1720	18.0	18	1100	1600	470	<50	1000	1000 a
Beryllium	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	8.0	6.6	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	979	718	<10	<10	410	560	170	<50	440	50 a
Cobalt	<10	<10	93.6	69.1	<10	<10	38	48	<50	<50	64	none
Copper	<10	<10	111	78.5	<10	11	51	87	77	<50	65	1000 b
Lead	<100	<1.0	47.5	33.3	<1.0	1.5	17	22	5.4	<100	9.2	50 a
Mercury	na	<0.2	7.5	4.7	<0.2	<0.20	2.8	3.6	2.5	0.8	10	2 a
Molybdenum	30	<10	70.1	56.4	35.7	21	42	47	<50	61	<50	none
Nickel	100	76.6	1250	899	106	57	610	660	370	<100	530	100(proposed)a
Selenuim	16	14.6	8.5	10.6	16.3	24	15	17	<5.0	6.5	<5.0	10 a
Silver	<10	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	300	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<10	<10	392	300	<10	<10	180	230	53	<50	200	none
Zinc	<10	<10	560	384	13.9	23	280	300	130	<50	280	5000 b
Total Dissolved Solids (mg/l)	9,700	na	na	na	na	na	8,600	8000	8100	9800	2900	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-24

Organics (µg/l) **	11/1/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	Split of 7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	<3.5	4	2	3	3.8	2.0	4.1	1.7	1.6	4.1	7.3	5
1,1-Dichloroethene (DCE)	<6.5	<0.5	<0.5	<0.5	0.50	<0.50	<0.50	<0.5	<0.5	0.8	<0.5	6
1,1,1-Trichloroethane (TCA)	<4.3	2	<0.5	<0.5	<0.50	0.50	<0.50	<0.5	<0.5	<0.5	<0.5	200
1,1-Dichloroethane (DCA)	<4.4	<0.5	<0.5	<0.5	0.50	<0.50	<0.50	<0.5	<0.5	0.5	<0.5	5
Freon* 113	na	<0.5	<0.5	<0.5	1.0	<0.50	<0.50	<0.5	<0.5	<0.5	<0.5	1200
cis-1,2-Dichloroethene	na	8	1	2	4.9	1.6	2.2	na	na	na	na	6
trans-1,2-Dichloroethene	<3.7	1	<0.5	<0.5	<0.50	<0.50	<0.50	na	na	na	na	10
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	<0.50	<1.0	<1.0	<0.5	<0.5	100
1,2-Dichloroethene, total	na	na	na	na	na	na	na	1.7	1.9	5.3	8.5	16
Chloromethane	na	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<1.0	<1.0	0.8	<0.5	none
Metals (µg/l)												
Antimony	80	<50	<50	<50	<50	84	<50	<500	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<5.0	<5.0	18.3	<5.0	<5.0	22	23	33	39	<5.0	1.10	50 a
Barium	20	13.9	821	12.8	14	1400	1900	710	1500	<50	2000	1000 a
Beryllium	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	6.2	<5.0	<10	<10	<10	<10	5 a
Chromium	<10	<10	335	<10	<10	1300	640	340	590	<50	950	50 a
Cobalt	<10	<10	31.6	<10	<10	120	55	<50	<50	<50	120	none
Copper	<10	<10	26.1	<10	<10	210	92	79	120	<50	150	1000 b
Lead	<100	<1.0	14.1	<1.0	<1.0	31	21	7.6	<5.0	<100	15	50 a
Mercury	<0.2	<0.2	1.1	<0.2	<0.20	3.2	5.3	3.1	3.8	<0.5	8.0	2 a
Molybdenum	40	<10	54.8	45.7	28	100	55	<50	<50	69	<50	none
Nickel	110	61.5	468	86.7	76	2000	810	620	850	<100	1500	100(proposed)a
Selenuim	12	17.0	23.9	21.7	17	11	24	15	12	20	<5.0	10 a
Silver	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	<50	50 a
Thallium	210	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<10	<10	140	<10	<10	450	240	79	150	<50	320	none
Zinc	20	<10	157	<10	12	750	350	280	290	<50	490	5000 b
Total Dissolved Solids (mg/l)	11,000	na	na	na	na	5,100	11,000	10,000	10,000	10,000	9,300	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-25

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	Split of 7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	<3.5	<0.5	<0.5	1	0.8	1.4	0.60	0.5	0.6	1.5	<0.5	5
1,1-Dichloroethene (DCE)	11	34	17	25	26	40	25	19	46	38	19	6
1,1-Dichloroethane (DCA)	11	33	31	55	53	68	45	38	68	75	40	5
Methylene Chloride	<10	<0.5	<0.5	0.5	<0.5	<1.0	<0.50	<0.50	<0.5	<0.5	<0.5	none
cis-1,2-Dichloroethene	na	2	2	8	8	10	4.6	4.5	na	na	na	6
Trichlorofluoromethane	na	<0.5	<0.5	<0.5	2	<1.0	2.6	1.9	<0.5	<0.5	2.8	150
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.5	<1.0	<0.50	<0.50	<1.0	<0.5	<0.5	none
1,2-Dichloroethane	<3.9	<0.5	<0.5	0.5	0.5	<1.0	<0.50	<0.50	<0.5	<0.5	2.2	0.5
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	9.3	14	4.4	16
Freon* 113	na	<0.5	<0.5	<0.5	<0.5	<1.0	<0.50	<0.50	<0.5	1.7	<0.5	1200
Chloromethane	<4.7	<0.5	<0.5	<0.5	<0.5	<1.0	<0.50	<0.50	<1.0	1.1	2.0	none
Metals (µg/l)												
Antimony	44	<50	<50	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<10	<5.0	8.9	<5.0	<5.0	<5.0	11	8.7	<5.0	9.7	17	50 a
Barium	35	23.3	1130	20.5	22.1	23	1900	1500	220	930	1400	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<6.0	<5.0	<5.0	<5.0	<5.0	<5.0	23	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	151	<10	<10	<10	270	200	<50	110	340	50 a
Cobalt	<16	<10	17.7	<10	<10	<10	37	14	<50	<50	58	none
Copper	<5.0	<10	<10	11.7	<10	<10	75	23	<50	<50	<50	1000 b
Lead	<45	<1.0	11.3	1.9	<1.0	<1.0	9.2	9.3	<5.0	<100	5.1	50 a
Mercury	na	<0.2	0.49	<0.2	<0.2	<0.20	0.93	0.38	<0.5	<0.5	1.1	2 a
Molybdenum	<20	11.9	23.9	27.6	30.7	<20	28	20	<50	<50	<50	none
Nickel	33	24.2	204	23.2	28.0	<20	400	240	<100	160	430	100(proposed)a
Selenuim	15	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.4	<5.0	<5.0	<5.0	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	64.2	<10	<10	<10	110	81	<50	<50	140	none
Zinc	<6.0	<10	85.6	15.2	<10	15	220	160	67	58	120	5000 b
Total Dissolved Solids (mg/l)	3,900	na	na	na	na	na	3,300	3,200	3,000	3,100	2,800	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-26

Organics (µg/l) **	11/1/90	1/24/91	4/24/91	7/19/91	10/24/91	Split of 10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	<3.5	<0.5	1	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	12	<0.5	5
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	200
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	<0.50	<0.50	<1.0	<0.5	<0.5	100
1,2-Dichloroethane	<3.9	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	<0.5	0.9	0.5
Chloromethane	na	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<1.0	<0.5	3.5	none
Metals (µg/l)												
Antimony	<60	<50	<50	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	50 a
Barium	30	19.6	169	17.5	18	18	440	140	130	<50	89.0	1000 a
Beryllium	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	<5.0	5.5	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	28.4	<10	<10	<10	78	17	<50	<50	<50	50 a
Cobalt	<11	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	none
Copper	<12	<10	<10	<10	<10	<10	16	13	<50	<50	<50	1000 b
Lead	<100	<1.0	3.3	<1.0	<1.0	1.1	3.3	2.5	<5.0	<100	<5.0	50 a
Mercury	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.5	<0.5	0.5	2 a
Molybdenum	<20	<10	13.5	18.2	<20	<20	<20	<20	<50	<50	<50	none
Nickel	30	<20	42.2	<20	<20	<20	100	29	<100	<100	<100	100(proposed)a
Selenuim	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	7.1	<5.0	<5.0	15.0	10 a
Silver	<10	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<200	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<10	<10	16.2	<10	<10	<10	38	16	<50	<50	<50	none
Zinc	<10	<10	16.0	<10	19	11	67	67	<50	<50	72.0	5000 b
Total Dissolved Solids (mg/l)	3,400	na	na	na	na	na	3,000	3,500	3,000	3,100	3000	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-27

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	Split of 4/21/92	7/28/92	10/21/92	1/27/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	<3.5	<0.5	<0.5	<0.5	<0.50	1.3	<0.50	<0.50	<0.5	<0.5	<0.5	5
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	200
Freon* 113	na	<0.5	<0.5	<0.5	0.80	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	1200
Benzoic Acid	12	na	na	na	na	na	na	na	na	na	na	none
Chloromethane	<4.7	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<1.0	1.4	1.1	none
1,2-Dichloroethane	<3.9	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	<0.5	1.1	0.5
Metals (µg/l)												
Antimony	<37	<50	<50	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<10	<5.0	6.7	<5.0	<5.0	5.5	<5.0	5.1	<5.0	<5.0	<5.0	50 a
Barium	100	81.7	656	80.0	76	600	680	570	380	77	94	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	36	<10	197	<10	<10	150	200	160	110	<50	56	50 a
Cobalt	<16	<10	29.7	<10	<10	33	29	25	<50	<50	<50	none
Copper	<5.0	<10	68.4	<10	<10	73	74	63	<50	<50	<50	1000 b
Lead	<45	1.4	16.6	2.0	1.4	15	14	13	6.6	<100	6.9	50 a
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	0.32	0.27	<0.5	<0.5	<0.5	2 a
Molybdenum	<20	<10	14.8	12.8	<20	<20	<20	<20	<50	<50	<50	none
Nickel	<21	<20	295	<20	<20	300	300	260	170	<100	<100	100(proposed)a
Selenuim	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	146	<10	<10	120	140	110	57	<50	<50	none
Zinc	12	<10	138	<10	10	150	170	140	120	<50	94	5000 b
Total Dissolved Solids (mg/l)	1,900	na	na	na	na	2,100	2,200	2,100	2,000	2,000	280	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-28

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	Split of 10/21/92	1/28/93	Lowest Drinking Water MCL***
1,1-Dichloroethane (DCA)	<4.4	<0.5	1	<0.5	<0.50	0.90	2.2	0.6	2.8	2.3	1.1	5
Tetrachloroethene	<2.2	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	1.2	<0.5	<0.5	<0.5	5
Trichloroethene (TCE)	<3.5	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	0.6	0.7	<0.5	5
Chloromethane	<4.7	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<1.0	0.9	0.8	2.8	none
1,2-Dichloroethane	<3.9	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	1.2	0.5
Metals (µg/l)												
Antimony	<37	<5.0	<50	<50	<50	<50	<50	<500	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<10	<5.0	11.4	<5.0	18	<5.0	6.3	<5.0	<5.0	<5.0	<5.0	50 a
Barium	22	14.7	128	12.1	14	39	86	<50	65	50	<50	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<10	1(proposed) a
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<10	5 a
Chromium	<10	<10	413	<10	<10	99	240	65	100	72	91	50 a
Cobalt	<16	<10	27.5	<10	<10	<10	12	<50	<50	<50	<50	none
Copper	<5.0	<10	<10	10.9	<10	<10	10	52	<50	<50	<50	1000 b
Lead	<45	<1.0	8.4	<1.0	1.1	<2.0	2.9	<5.0	<100	<100	<5.0	50 a
Mercury	na	<0.2	0.49	<0.2	<0.20	<0.20	0.22	<0.5	<0.5	<0.5	<0.5	2 a
Molybdenum	<20	<10	21.6	<10	<20	<20	<20	<50	<50	51	<50	none
Nickel	<21	49.9	444	20.7	<20	130	250	<100	130	<100	100	100(proposed)a
Selenuim	<5.0	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<50	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	103	<10	<10	30	67	<50	<50	<50	<50	none
Zinc	<6.0	<10	91.2	<10	11	44	87	<50	<50	<50	<50	5000 b
Total Dissolved Solids (mg/l)	6,500	na	na	na	na	6,600	90	7400	7900	8200	3400	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-29

Organics (µg/l) **	11/21/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	Lowest Drinking Water MCL***
Trichloroethene (TCE)	<0.3	<0.5	<0.5	<0.5	<0.50	0.80	<0.50	<0.5	<0.5	<0.5	5
1,1,1-Trichloroethane (TCA)	<0.5	1	1	1	0.50	1.2	<0.50	0.9	<0.5	<0.5	200
1,1-Dichloroethane (DCA)	1.3	1	1	<0.5	1.4	1.2	0.70	1.6	1.5	1.1	5
Freon 113*	*na*	<0.5	<0.5	<0.5	0.50	<0.50	<0.50	<0.5	<0.5	<0.5	1200
Methylene Chloride	2.6	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	none
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	<0.50	<1.0	<0.5	<0.5	none
Chloromethane	<0.6	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<1.0	2.9	2.1	none
1,2-Dichloroethane	<0.2	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	<0.5	1.0	0.5
Metals (µg/l)											
Antimony	<37	<50	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	3	<5.0	9.1	<5.0	<5.0	7.6	5.4	18	8.6	7.1	50 a
Barium	15	13.2	66.8	13.0	12	29	51	190	120	60	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<6.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	180	<10	<10	58	53	630	280	160	50 a
Cobalt	<16	<10	14.7	<10	<10	<10	<10	56	<50	<50	none
Copper	<5.0	<10	<10	31.7	<10	<10	<10	69	<50	<50	1000 b
Lead	<45	<1.0	12.3	<1.0	1.0	<2.0	4.7	7.4	<100	<5.0	50 a
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	0.22	1.1	<0.5	<0.5	2 a
Molybdenum	<20	<10	10.3	15.7	<20	<20	<20	<50	<50	<50	none
Nickel	<21	<20	237	42.2	<20	92	93	930	360	210	100(proposed)a
Selenuim	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	56.5	<10	<10	22	22	140	79	51	none
Zinc	<6.0	<10	63.5	<10	10	34	66	190	78	51	5000 b
Total Dissolved Solids (mg/l)	1,100	*na*	*na*	*na*	*na*	1,100	1400	1200	1200	1100	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
= indicates detectable quantity

MONITORING WELL MW-30

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	4/21/92	7/28/92	10/21/92	1/28/93	Lowest Drinking Water MCL***
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5	200
Freon* 113	na	3	5	9	6.9	10	16	20	30	91	1200
Ethane	8	na	na	na	na	na	na	na	na	na	none
Trichlorofluoromethane	na	<0.5	<0.5	4	4.6	9.2	8.8	<0.5	<0.5	25	100
Trichloroethene (TCE)	<3.5	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.5	3.7	<0.5	5
Chloromethane	<4.7	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<1.0	3.2	<0.5	none
Metals (µg/l)											
Antimony	<37	<50	<50	<50	<50	<50	<50	<500	<500	<500	5 to 10 (proposed)a
Arsenic	<10	5.2	14.5	<5.0	<5.0	<5.0	6.1	<5.0	5.8	<5.0	50 a
Barium	33	25.3	2750	19.8	20	500	1100	390	820	200	1000 a
Beryllium	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	1(proposed) a
Cadmium	<6.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	5 a
Chromium	<10	<10	540	<10	<10	110	250	100	180	63	50 a
Cobalt	<16	<10	43.6	<10	<10	<10	13	<50	<50	<50	none
Copper	<5.0	<10	<10	<10	<10	<10	<10	<50	<50	<50	1000 b
Lead	<45	<1.0	19.5	2.8	<1.0	3.7	11	<5.0	110	<5.0	50 a
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	0.30	0.5	<0.5	<0.5	2 a
Molybdenum	<20	<10	12.9	10.4	<20	<20	<20	<50	<50	<50	none
Nickel	<21	<20	715	<20	<20	160	290	110	180	<100	100(proposed)a
Selenuim	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 a
Silver	<5.0	<10	<10	<10	<10	<10	<10	<50	<50	<50	50 a
Thallium	<51	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<500	<500	<500	1 to 2 (proposed) a
Vanadium	<11	<10	179	<10	<10	44	89	<50	79	<50	none
Zinc	<6.0	<10	174	<10	<10	54	120	81	78	<50	5000 b
Total Dissolved Solids (mg/l)	1,100	na	na	na	na	690	980	770	830	760	not applicable

* 1,1,2-Trichloro-1,2,2-trifluoroethane = Freon (Semi-quantifiable for 1990 analysis)
**For clarity, only compounds with detected values shown for organics
*** As of September, 1991 except Cadmium, Chromium, and Selenium as of July 30, 1992
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
a = Primary Maximum Contaminant Level (MCL) (State or Federal)
b = Secondary Maximum Contaminant Level (MCL) (State or Federal)
c = MCL for cis & trans 1,2-Dichloroethene = 1,2-Dichloroethene, total
[ ] = indicates detectable quantity

MONITORING WELL MW-1

Date Sampled	7/8/87	8/20/87	11/20/87	1/15/88	2/25/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/601	601/601	601/602	601/601	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloromethane	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<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	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<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	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	48	8.8	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	2.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Toluene	5.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Total xylenes	2.8	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6
Carbon Disulfide	na	na	na	na	na	na	na	<5	<5	11	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Phenol	na	na	na	na	na	na	na	28	<10	<10	na	na	na	na	na	na	na	na	na	na	na	na	na	na
2-Nitrophenol	na	na	na	na	na	na	na	24	<10	<10	na	na	na	na	na	na	na	na	na	na	na	na	na	na

= Indicates detectable quantity

MONITORING WELL MW-2

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	2/25/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<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	0.8
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<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	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	4.3	<0.5	<0.5	16	<0.5	<0.5	<0.5	73	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5
Benzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Total xylenes	<1.5	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6

= Indicates detectable quantity

MONITORING WELL MW-3

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	1.8
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<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	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	24	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	2.4	<0.5	<0.5	<0.5	<0.5	0.6	<5	<5	<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	<0.5	<0.5	<0.3
Toluene	10	<0.5	<0.5	<0.5	<0.5	0.8	<5	<5	<5	<0.5	1.6	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	1.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.3
Total xylenes	8.9	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6

= Indicates detectable quantity

MONITORING WELL MW-4

Date Sampled	7/8/87	8/20/87	11/20/87	1/15/88	2/25/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/601	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	0.9	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<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	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	<0.5	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<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	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	21.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Toluene	55.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	0.6	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	4.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Total xylenes	27.0	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6
Bis(2-ethylhexyl)phthalate	na	na	na	na	na	na	na	25	30	68	na	na	na	na	na	na	na	na	na	na	na	na	na	na

= Indicates detectable quantity

MONITORING WELL MW-5

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	duplicate	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	0.6	0.7
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	0.5	1.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	0.9	7.0	1	2	2	2	7	8.0	13	14	18	39	69	79
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<5	0.7	1.4	8	4	4	3	3	11	8.0	14	14	12	41	32	53
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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*	*na*	*na*
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	0.5	0.6
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1	<0.5	<0.5	<0.5	0.7	0.5	0.7	1	1.1
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	6	1	1	<0.5	<0.5	3	3.0	5.3	6.2	5.9	12	26	30
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	6.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.3
Toluene	7.4	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5	<0.3
Total xylenes	5.6	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6

= Indicates detectable quantity

MONITORING WELL MW-6

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<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	4
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	<0.5	0.5	<0.5	<0.5	<0.5	0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1	1.3	0.6	1	1.1	0.9	1.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1-Dichloroethene	0.5	<0.2	<0.2	<0.2	1.0	0.3	<5	<5	<5	1.6	1.4	8	3	3	3	8	12	11	7.4	13	13	0.6	13
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	15	<0.5	<0.5	<0.5	<0.5	<0.5	120	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	8.1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Toluene	23.0	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Total xylenes	15.0	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6

= Indicates detectable quantity

MONITORING WELL MW-7

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	6/7/88	7/19/89	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5	<5	<1.0	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	1.4	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Dibromomethane	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<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	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
1,1-Dichloroethane	1.8	0.8	0.5	0.6	0.6	0.8	0.5	<5	<5	<5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	1	4	<0.5	<0.5	1.3	2.3	<0.5	1.3
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
1,1-Dichloroethene	8.1	1.9	2.2	4.7	3.6	2.2	1.8	<5	6.9	<5	0.5	5.2	7	3	2	2	6	21	1.8	1.3	6.2	9.8	2.9	8.6
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
trans-1,2-Dichloroethene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<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	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.1	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	31	0.9	0.6	0.7	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	na	<0.5	<0.5	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Benzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Toluene	1.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<1.0	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<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	<0.5	<0.3
Total xylenes	1.8	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.6

[ ] = Indicates detectable quantity

MONITORING WELL EW-1

Date Sampled	7/8/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	01/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91	1/21/92	4/22/92	7/29/92	10/20/92	1/26/93
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/601	601/601	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Bromoform	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
Bromomethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
Carbon Tetrachloride	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Chlorobenzene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Chloroethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
2-Chloroethylvinyl ether	<1500	<25	<200	<20	<50	na	na	na	<25	dry	na	na	dry	dry	<250	<100	dry	<100	<120	<20	<0.5	<5.0
Chloroform	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Chloromethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
Dibromochloromethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Dibromomethane	na	na	na	na	na	na	na	na	na	dry	na	na	dry	dry	na	na	dry	na	na	<10	<0.5	<5.0
1,2-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
1,3-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
1,4-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Dichlorodifluoromethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
1,1-Dichloroethane	7000	2800	1500	1800	2100	780	970	1400	1200	dry	300	1000	dry	dry	620	790	dry	440	510	740	940	420
1,2-Dichloroethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5
1,1-Dichloroethene	<1500	150	<100	90	70	76	93	83	180	dry	200	210	dry	dry	240	94	dry	54	42	22	85	51
cis-1,2-Dichloroethene	<1500	50	<200	200	210	5.4*	11*	53*	25	dry	160	<25	dry	dry	<25	<10	dry	<10	18	na	na	na
trans-1,2-Dichloroethene	<1500	<50	<200	<50	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	na	na	na
1,2-Dichloroethene, total	na	na	na	na	na	na	na	na	na	dry	na	na	dry	dry	na	na	dry	na	na	64	86	17
1,2-Dichloropropane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
cis-1,3-Dichloropropene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	na	dry	dry	na	<10	dry	<10	<12	<10	<0.5	<5.0
trans-1,3-Dichloropropene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<50	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Methylene Chloride	180000	1400	<200	30	<50	33	<5	<5	43	dry	230**	<25	dry	dry	30	<10	dry	38	50	<10	<0.5	110
1,1,2,2-Tetrachloroethane	<1500	<50	<200	<50	<50	<5	<5	<5	<25	dry	<13	<100	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Tetrachloroethene	<1500	62	<200	60	50	30	33	38	39	dry	170	<25	dry	dry	<25	20	dry	10	<12	<10	19	19
1,1,1-Trichloroethane	11000	4600	3500	2700	1700	1500	1900	1700	1900	dry	310	1300	dry	dry	1100	1100	dry	790	640	530	910	600
1,1,2-Trichloroethane	<1500	<25	<200	<20	<50	<5	5.3	6	<25	dry	<25	<50	dry	dry	<25	<10	dry	<10	<12	<10	2.80	<5
Trichloroethene	1700	700	420	420	300	260	350	350	380	dry	240	240	dry	dry	210	240	dry	150	150	78	150	110
Trichlorofluoromethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<25	<50	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
1,1,2-Trichlorotrifluoroethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<10	<0.5	<5.0
Vinyl Chloride	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	<20	<0.5	<5.0
Benzene	<150	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	0.7	0.6	<0.5
Toluene	25000	780	<200	110	590	<5	<5	<5	32	dry	<25	<50	dry	dry	<25	<10	dry	<10	<12	0.8	0.9	49
Ethylbenzene	650	59	<200	35	110	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry	<10	<12	0.7	<0.5	3.90
Total xylenes	3600	310	<700	160	440	<5	<5	41	<70	dry	<38	<75	dry	dry	<25	<10	dry	<10	<12	8.7	13	15

= Indicates detectable quantity

Monitoring Wells MW-21 through MW-30 and EXW-2 through EXW-4:
Results of Quarterly Radioactivity Analyses

GROSS ALPHA PARTICLE ACTIVITY (MCL is 15 pCi/l)

DATE SAMPLED	DATE ANALYZED	MW-21	MW-22	MW-23	MW-24	MW-25	MW-26	MW-27	MW-28	MW-29	MW-30	EXW-2	EXW-3	EXW-4
7/19/91	9/25/91	9 ± 8	31 ± 21	56 ± 25	20 ± 15*	7 ± 6*	<2	20 ± 16	<2	5 ± 4*	4 ± 3*	7 ± 6*	<2	4 ± 3*
10/24/91	12/9/91	306 ± 98	40 ± 36*	99 ± 49	176 ± 69	7 ± 6*	6 ± 5*	107 ± 47	8 ± 6*	16 ± 10	6 ± 3	NA	NA	NA
1/22/92	2/13/92	9 ± 8*	8 ± 7*	8 ± 7*	9 ± 8	<2	<2	4 ± 3*	<2	<2	<2	<2	3 ± 2*	11 ± 5
4/21/92	5/26/92	28 ± 25*	55 ± 32	55 ± 32	27 ± 24*	13 ± 10	9 ± 8*	11 ± 10*	13 ± 11*	10 ± 8*	5 ± 4*	24 ± 7	24 ± 8	30 ± 9
7/28/92	9/9/92	13 ± 9*	20 ± 18*	27 ± 22*	3 ± 2*	<2	<2	<2	<2	2 ± 1	35 ± 18	7 ± 6*	<2	6 ± 5*
10/21/92	11/2/92	16 ± 10	43 ± 13	47 ± 22	38 ± 21	4 ± 3*	12 ± 5	102 ± 28	25 ± 7	39 ± 8	8 ± 3	<2	4 ± 3*	7 ± 6*
10/21/92	12/14/92	70 ± 42	42 ± 40	85 ± 44	33 ± 32*	<2	<2	94 ± 44	4 ± 3*	8 ± 7*	7 ± 6*	11 ± 10*	16 ± 15*	9 ± 8*
10/21/92	1/8/93	41 ± 22	NA	61 ± 24	NA	6 ± 5*	4 ± 3*	90 ± 50	NA	7 ± 6*	8 ± 6*	4 ± 3*	14 ± 10*	NA
1/27/93	2/5/93	6 ± 4*	18 ± 10*	10 ± 5	61 ± 22	5 ± 4*	13 ± 5	16 ± 5	6 ± 5*	3 ± 2*	4 ± 3*	15 ± 7	11 ± 7	6 ± 4*

GROSS BETA PARTICLE ACTIVITY (MCL is 50 pCi/l)

DATE SAMPLED	DATE ANALYZED	MW-21	MW-22	MW-23	MW-24	MW-25	MW-26	MW-27	MW-28	MW-29	MW-30	EXW-2	EXW-3	EXW-4
7/19/91	9/25/91	13 ± 7	43 ± 15	1219 ± 45	80 ± 16	12 ± 7	<3	45 ± 15	<3	12 ± 7	6 ± 4	6 ±	<3	20 ± 4
10/24/91	12/9/91	292 ± 70	160 ± 63	155 ± 62	211 ± 65	11 ± 6	<3	132 ± 61	13 ± 6	41 ± 8	9 ± 3	NA ±	NA ±	NA ±
1/22/92	2/13/92	5 ± 4	14 ± 3	14 ± 6	17 ± 6	<3	10 ± 6	13 ± 6	<3	<3	<3	<3	7 ± 3	19 ± 4
4/21/92	5/26/92	105 ± 17	114 ± 18	148 ± 19	81 ± 16	35 ± 14	6 ± 5*	23 ± 7	9 ± 7	17 ± 7	6 ± 4	38 ± 7	18 ± 4	32 ± 5
7/28/92	9/9/92	35 ± 9	199 ± 22	123 ± 19	89 ± 18	<3	<3	<3	<3	45 ± 16	67 ± 17	13 ± 6	<3	11 ± 4
10/21/92	11/2/92	90 ± 10	103 ± 10	173 ± 19	149 ± 18	7 ± 3	13 ± 3	2379 ± 58	21 ± 4	40 ± 5	15 ± 4	<3	6 ± 3	17 ± 4
10/21/92	12/14/92	86 ± 20	85 ± 20	173 ± 24	123 ± 22	<3	<3	80 ± 20	16 ± 10	16 ± 10	8 ± 6*	15 ± 10	8 ± 6*	16 ± 8
10/21/92	1/8/93	101 ± 19	NA	178 ± 22	NA	8 ± 7	7 ± 3	70 ± 17	NA	23 ± 14	9 ± 7	13 ± 10	14 ± 8	NA
1/27/93	2/5/93	11 ± 4	30 ± 13	8 ± 3	110 ± 18	<3	12 ± 4	12 ± 4	4 ± 3	7 ± 4	14 ± 4	17 ± 12	7 ± 4	16 ± 4

Note: * = High statistics due to large amount of solids.

NA = Not analyzed for that parameter

Concentration above Maximum Contaminant Level

Monitoring Wells MW-21 through MW-30 and EXW-2 through EXW-4: Results of Quarterly Radioactivity Analyses

TRITIUM CONCENTRATIONS (MCL is 20,000 pCi/l)

DATE SAMPLED	DATE ANALYZED	MW-21	MW-22	MW-23	MW-24	MW-25	MW-26	MW-27	MW-28	MW-29	MW-30	EXW-2	EXW-3	EXW-4
7/8/92	9/19/92											921 ± 509	692 ± 508	12237 ± 651
10/21/92	10/29/92-1/8/93	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	11639 ± 657
1/27/93	2/8/93	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	8357 ± 886
4/21-22/93	5/7/93-CEP	<500	<500	<500	<500	<500	865 ± 716	<500	1188 ± 742	<500	<500	1147 ± 732	<500	9833 ± 910
4/21-22/93	5?/?/93-LAS	70 ± 130	-30 ± 110	-30 ± 110	80 ± 130	-30 ± 110	30 ± 120	-60 ± 110	-30 ± 110	-10 ± 120	450 ± 170	110.0 ± 130	120 ± 130	9560 ± 610

Notes: * = High statistics due to large amount of solids.

NA = Not analyzed for that parameter

▒▒ Concentration above maximum contaminant level

CEP = Samples analyzed by Controls for Environmental Pollution, Inc.

LAS = Samples analyzed by Lockheed Analytical Services

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RADIOLOGICAL SAMPLING AND ANALYSIS OF SOILS AND SEDIMENTS AT AND AROUND SLAC AS PART OF THE ENVIRONMENTAL RESTORATION PROGRAM

The Environment, Safety and Health (ES&H) Division at SLAC is responsible for overall environmental monitoring and surveillance at and around the facility. Historically, radiological parameters have been handled by the Operational Health Physics (OHP) Department, while non-radiological parameters are handled by the Environmental Protection and Waste Management (EP&WM) Department. OHP's environmental efforts have focused on air and water as possible vehicles for radioactive materials. Radioactivity in soils and sediments has been addressed only rarely, primarily because these media are not pathways per se but rather potential receptors of contaminants conveyed through air or water.

In the wake of the DOE Tiger Team environmental audit, EP&WM has been tasked with remediation of both soil and groundwater contamination associated with the facility. Initially, polychlorinated biphenyls (PCBs), heavy metals, and volatile organic compounds (VOCs) were the primary contaminants of concern, based on the historical operations that may have led to contamination by these substances. Eventually, however, the issue of possible radioactivity in soils and sediments was raised, and radiological sampling and analysis techniques were added to the EP&WM list of parameters (PCBs, TPH, VOCs, SVOs, metals, et al.). The primary objective of radiological sampling was to determine background radionuclide levels in soils and sediments around the SLAC site and to determine whether SLAC had contributed to any increased levels of radionuclides onsite or offsite.

Throughout SLAC's existence, radiation monitoring has encompassed both radioactivity emanating from solid objects (e.g., shielding blocks) due to penetrating radiation and radionuclides present in ambient air and water. Ongoing monitoring programs at SLAC address airborne emissions, surface water discharges, process wastewater discharges, groundwater, and penetrating radiation. Results of these programs are published in the Annual Environmental Monitoring Reports required under DOE Order 5400.1.

Criteria for selecting radiological parameters involve the radionuclide(s) of interest, the type of radiation emitted, and the environmental medium or substrate, as well as whether the measurements will be in two or three dimensions--that is, per unit surface area or per unit mass or volume of material. The energy measured may be radiation emitted from a source, transmitted through a given medium, or received or absorbed as a discrete dose by a target or receptor.

Radiological analysis involves three general types of radiation: alpha particles, beta particles, and gamma rays. Since SLAC is physically incapable of producing alpha-emitting radionuclides, they do not require monitoring by EP&WM. Table A (attached) lists the SLAC-related radionuclides. While most of the radionuclides listed in Table A are beta emitters, all of them are gamma emitters (except for tritium, which is not normally associated with soils per se). Therefore, given the inherent characteristics of radioactive materials and the activation products associated with SLAC operations, the most appropriate analysis for soils is gamma spectral analysis. This scanning technique searches for all gamma emitters present in a given sample, rather than only one or a few isotopes, and compares the results to a computerized library of all known radionuclides. If results are ambiguous, specific scans can be performed to determine the exact composition of the radioactivity detected.

Two areas of prime interest in evaluating SLAC's cumulative impact on the surrounding environment are (1) the storm drain systems associated with Interaction Regions IR-6 and IR-8, and (2) San Francisquito Creek, which flows parallel to and south of the linac. Accordingly,

sampling and analysis plans for recent activities in these areas were expanded to include radiological work. Sampling locations for San Francisquito Creek are shown in Figures 1 through 3, and sampling locations for the IR6/IR8 drainage ditches are shown in Figure 4. Results of radiological analyses performed of selected samples collected from these areas are provided in Table B. A comparison of the results in Table B with the radionuclides potentially produced by SLAC operations (Table A) indicates that SLAC has had no radiological input to or impact on these areas.

Based on these results, the radioisotopes detected in the soils and sediments in and around SLAC are naturally occurring forms. In addition, drawing upon the limited information available, these natural radionuclides appear to exist in concentrations comparable to known background levels, although relevant historical data are few. As one example, values from a 1964 study at SLAC, conducted prior to startup of the facility, are presented in the table for comparison. In this study, surface and subsurface soil samples were composited from five locations at opposite ends of the linac; four of these locations surround the engineering tower east of and uphill from the Klystron gallery. At the same time, groundwater was collected from a well approximately 500 feet southeast of the east end of the linac and analyzed for comparison.

Radioactivity in SLAC's groundwater is monitored quarterly through a network of 13 groundwater wells. Tritium has been detected in monitoring well Well-24 (also designated as EXW4) in concentrations as high as 23,500 picocuries per liter (pCi/l), which exceeds the drinking water standard of 20,000 pCi/l. Tritium has not been detected in any of the other wells in the network. Possible reasons for this occurrence are being investigated; the most likely cause is activation of groundwater by non-interacting particles in the accelerator beam, since this monitoring well has the closest proximity to a beam-loss component (in this case, the beam dump from End Station A).

In summary, no SLAC activation products have been detected in soils or sediments of onsite or offsite drainages. Although the exact composition of the radionuclides have not been determined in every sample, the extremely low activities present in these samples seems to preclude the need for more definitive determination. These data support the long-standing view that no radionuclides associated with SLAC operations have produced contamination in soils or sediments on or around the facility.

Table A. Predominate Radioduclides produced by SLAC Operations

Element	Isotope	Half-life	Beta-max* (MeV)	Gamma (MeV)
Beryllium	Be-7	54 days	n/a	0.477
Cobalt	Co-56	77.3 days	β+ 1.46	0.847, 1.24
	Co-57	270 days	n/a	0.122, 0.136
	Co-58	71.3 days	β+ 0.47	0.81
	Co-60	5.27 years	β− 0.318	1.17, 1.33
Chromium	Cr-51	27.8 days	n/a	0.32
Europium	Eu-152	13.4 years	β+ 0.727	0.121, 0.344
Iron	Fe-55	2.6 years	n/a	0.005
	Fe-59	45.6 days	β− 0.273, 0.464	1.1, 1.29
Manganese	Mn-52	5.62 days	β+ 0.575	1.43, 0.94
	Mn-54	303 days	n/a	0.835
Sodium	Na-22	2.26 years	β+ 0.595	1.27
	Na-24	15 hours	β− 1.39	2.75, 1.37
Scandium	Sc-46	83.3 days	β− 0.357	0.889, 1.12
Tantalum	Ta-182	115 days	β− 0.522	0.067, 1.12
Vanadium	V-48	16 days	β+ 0.658	0.984, 1.31
Tungsten	W-181	140 days	n/a	0.06
	W-185	75 days	β− 0.433	0.125
Hydrogen	H-3**	12.3 years	β− 0.0186	n/a

* B+ annihilation gammas of 0.511 MeV.

** Tritium is produced only in liquid systems.

NOTE: All isotopes listed here are activation products.

Reference: Procedure for the Certification of Hazardous Waste from RMMA Areas (SLAC-I-720-0A86Z-001-R02)

Table B. Resutls of Radiological Analyses Performed on Selected Soil and Sediment Samples

SAN FRANCISQUITO CREEK RESULTS (sample locations shown in Figures 1, 2, and 3)

Element	Isotope	SFC-S-1	SFC-S-2	SFC-S-4	SFC-S-5	SFC-S-6	SFC-S-7	SFC-S-9	SFC-S-10	SFC-S-11	SFC-S-12	SFC-S-13	SFC-S-14	SFC-S-15	SFC-S-17
Potassium	K-40	11.2(0.5)	29.6(5.8)	8.2(0.4)	24.5(1.0)	12.6(0.7)	9.1(0.5)	9.5(0.5)	21.4(3.3)	9.8(0.4)	5.3(1.0)	19.2(3.6)	12.4(0.6)	8.4(0.4)	17.3(0.9)
Thallium	Tl-208	ND	ND	ND	0.40(0.09)	2.74(0.58)	1.53(0.41)	1.94(0.59)	0.51(0.28)	0.47(0.29)	0.55(0.37)	ND	0.32(0.9)	1.63(0.56)	ND
Lead	Pb-212 (Th)	ND	ND	ND	ND	1.49(0.31)	0.73(0.23)	0.94(0.27)	0.58(0.11)	ND	ND	ND	ND	0.50(0.26)	ND
Lead	Pb-214	ND	ND	ND	0.62(0.12)	1.37(0.66)	0.97(0.51)	0.89(0.68)	0.71(0.31)	0.50(0.37)	0.64(0.47)	ND	0.40(0.07)	0.67(0.25)	ND
Bismuth	Bi-214	ND	ND	ND	0.66(0.27)	4.80(1.77)	2.30(1.21)	2.31(0.90)	0.84(0.30)	0.50(0.40)	0.51(0.40)	ND	0.97(0.25)	0.67(0.19)	ND
Radium	Ra-226 (U)	ND	ND	ND	0.66(0.10)	2.44(0.49)	2.01(0.38)	1.46(0.53)	0.85(0.24)	0.57(0.41)	0.73(0.54)	ND	0.50(0.05)	0.66(0.44)	ND
Actinium	Ac-228	ND	ND	ND	ND	ND	2.88(0.44)	ND	ND	ND	ND	ND	ND	ND	ND

Samples were collected in September 1992 and analyzed by CEP

IR-6/IR-8 ONSITE/OFFSITE DRAINAGE SYSTEM RESULTS (sample locations shown in Figure 4)

Element	Isotope	IR6-S-1	IR6-S-2	IR6-S-3	IR6-S-4	IR6-S-8	IR6-S-10	IR6-S-12	IR6-S-13	IR8-S-1	IR8-S-4	IR8-S-5	IR8-S-6	IR6/8-S-1	IR6/8-S-2
Potassium	K-40	2.93	4.18	2.85	3.74	3.38	2.1	3.39	2.14	2.22	5.19	1.65	ND	ND	ND
Lead	Pb-212 (Th)	ND	0.178	ND	0.0608	0.185	0.203	0.138	0.0269	ND	ND	ND	0.134	ND	ND
Radium	Ra-224 (Th)	ND	ND	0.925	ND	1.05	ND	ND	1.46	ND	ND	ND	ND	ND	ND
Radium	Ra-226 (U)	ND	ND	ND	ND	ND	ND	1.06	0.848	ND	ND	1.24	ND	ND	ND
Thorium	Th-228 (Th)	ND	2.41	1.67	ND	ND	2.21	2.3	1.47	ND	2.59	4.17	2.59	ND	ND
Thorium	Th-234 (U)	ND	ND	ND	1.09	0.304	ND	0.416	ND	ND	ND	ND	ND	1.24	0.197

Samples were collected in August and December 1992 and analyzed by SLAC

COMPARATIVE DATA FROM VARIOUS FORMATIONS

Element	Isotope	Frequency/14	SLAC Range	Igneous	Sandstone	Shale	Limestone	Granite
Potassium	K-40	14	5.3 - 29.6	21.6	9.1	22.5	2.25	>29

HISTORICAL RADIOACTIVITY IN COMPOSITED ENVIRONMENTAL SAMPLES AT SLAC

Location	Medium	Sample Date	Sample Depth	K-40 (pCi/g)	Cs-137	Ra-226
Linac	Soil	Feb-64	0-2 inches	128	Present	ND
Linac	Soil	Feb-64	2-6 inches	72.7	Present	ND
Linac	Grndwater	Apr-64	10-20 feet	72.7	ND	Present

ND indicates not detected
(Th) indicates radionuclides in the thorium decay series.
(U) indicates radionuclides in the uranium decay series.
Activity expressed in picocuries per gram (pCi/g).
Standard deviation for each value is given in parentheses.