ES&H Division
SLAC-R-787

Annual Site Environmental Report: 2002

April 2006

Prepared for the Department of Energy under contract number DE-AC02-76-SF00515

Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94309

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Stanford Site Office (SSO)
Stanford Linear Accelerator Center (SLAC)
2575 Sand Hill Road, MS-8A
Menlo Park, CA 94025

May 4, 2006

Subject: 2002 Annual Site Environmental Report (ASER) for the Stanford Linear Accelerator Center (SLAC)

This report, prepared by SLAC for the U.S. Department of Energy, Stanford Site Office (SSO), provides a comprehensive summary of the environmental program activities at SLAC for calendar year 2002. Annual Site Environmental Reports (ASERs) are prepared for all DOE sites with significant environmental activities, and distributed to relevant external regulatory agencies and other interested organizations or individuals.

To the best of my knowledge, this report accurately summarizes the results of the 2002 environmental monitoring, compliance, and restoration programs at SLAC. This assurance can be made based on SSO and SLAC review of the ASER, and quality assurance protocols applied to monitoring and data analyses at SLAC.

Any questions or comments regarding this report may be directed to Dave Osugi of the SSO at (650) 926-3305, or by mail to the address above.

Sincerely,

Nancy N. Sanchez
Site Manager
Stanford Site Office

Certification of Accuracy

Annual Site Environmental Report
January - December 2002
SLAC-R-787

Stanford Linear Accelerator Center

I certify that the information submitted herein is current for the reporting period, accurate, and complete, based on my familiarity with the information and my inquiry of those individuals immediately responsible for obtaining the information.

______________________________ Date April 14, 2006

Sayed Rokni
Acting Associate Director
Environment, Safety, and Health Division

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Preface

To satisfy the requirements of the United States Department of Energy Order 231.1, “Environment, Safety and Health Reporting”, every year the Environment, Safety, and Health (ES&H) Division of the Stanford Linear Accelerator Center (SLAC) prepares a report describing its environmental programs and activities.

This *Annual Site Environmental Report: 2002* summarizes SLAC’s compliance with standards and requirements, describes the management and monitoring systems in place, and highlights significant accomplishments for the year.

Organization

The report is published in a single volume, organized into the following chapters:

- Chapter 1, “Site Overview”, describes the environmental setting of the Stanford Linear Accelerator Center (SLAC) and the activities conducted at the site
- Chapter 2, “Environmental Compliance”, gives an account of the regulatory framework and results concerning the site’s environmental programs
- Chapter 3, “Management Systems”, outlines the organizational structure, methods, and responsibilities relevant to environmental programs
- Chapters 4, 5, and 6, respectively “Environmental Non-radiological Programs”, “Environmental Radiological Programs”, and “Groundwater Protection and Environmental Restoration”, give more detailed accounts of the programs and their results for the year

An executive summary gives an overview of the report, and appendices present pertinent details on methodology and data.

Contributors

This report was prepared under the direction of Helen Nuckolls, head, ES&H Division, Environmental Protection Department (EP).

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Editing and Publishing

ES&H Division Publishing edited and published this report; SLAC Technical Publications provided electronic publishing and printing support.

Acronyms

AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ASER	annual site environmental report
AST	aboveground storage tank
BAAQMD	Bay Area Air Quality Management District
BaBar	SLAC B Factory detector
bhp	brake horsepower
BMP	best management practice
BTP	Batch Treatment Facility
CAA	Clean Air Act
CalARP	California Accidental Release Prevention Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHS	California Health and Safety
Ci	curie
CMS	chemical management system
CUPA	certified unified program agency
CWA	Clean Water Act
CX	categorical exclusion
CY	calendar year
DCH	drift chamber
DHS	San Mateo County Department of Health Services
DOE	United States Department of Energy
DTSC	California Department of Toxic Substances Control
EA	environmental assessment
EIS	environmental impact statement
EML	Environmental Measurements Laboratory
EMS	environmental management system
EPCRA	Emergency Planning and Community-Right-to-Know Act
EPR	environmental protection and restoration

ERP	environmental restoration program
ES&H	environment, safety, and health
ESA	Endangered Species Act
FFTB	Final Focus Test Beam
FHWSA	Former Hazardous Waste Storage Area
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMS	flow metering station
FSUST	Former Solvent Underground Storage Tank
FY	fiscal year
GDF	gasoline dispensing facility
GeV	giga-electron volt
GHG	greenhouse gas
gpd	gallons per day
gpm	gallons per minute
GSA	United States General Services Administration
HAP	hazardous air pollutant
HHRA	human health risk assessment
HMBP	hazardous materials business plan
HVAC	heating, ventilation, and air conditioning
IFR	instrumented flux return
IR	interaction region
ISMS	integrated safety management system
kg	kilogram
KM	knowledge management
L	liter
linac	linear accelerator
LLRW	low-level radioactive waste
LRDP	long-range development plan
m	meter
M&O	management and operating
MEI	maximally exposed individual
MFD	Mechanical Fabrication Department
MFPF	Metal Finishing Pre-treatment Facility
mg	milligram

MGE	Main Gate East Channel
MIBK	methyl isobutyl ketone
MPMWD	Menlo Park Municipal Water Department
mrem	millirem
NAE	North Adit East Channel
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIH	National Institutes of Health
NLC	Next Linear Collider
NLCTA	Next Linear Collider Test Accelerator
NOV	notice of violation
NTC	notice to comply
NZE	near-zero emission
ODS	ozone-depleting substance
OES	California Office of Emergency Services
OHP	operational health physics
PBR	permit by rule
PBV	parameter benchmark value
PCB	polychlorinated biphenyl
pCi	picocurie
PE	professional engineer
PEP	Positron-Electron Project
POTW	publicly owned treatment work
ppm	parts per million
PSA	preliminary site assessment
PVTC	Portola Valley Training Center
QA	quality assurance
QC	quality control
RACM	regulated asbestos-containing material
RCRA	Resource Conservation and Recovery Act
REP	radiological environmental protection
RL	reporting limit

RMP	risk management plan
RMPP	Risk Management and Prevention Program
RP	radiation physics
RWQCB	regional water quality control board
SARA	Superfund Amendments and Reauthorization Act
SBSA	South Bayside System Authority
SEM	site engineering and maintenance
SHA	safety, health, and assurance
SLAC	Stanford Linear Accelerator Center
SMCHD	San Mateo County Health Department
SMOP	synthetic minor operating permit
SMP	solvent management plan
SPCC	spill prevention control and countermeasures
SPEAR	Stanford Positron-Electron Asymmetric Ring
SSO	Stanford Site Office
SSRL	Stanford Synchrotron Radiation Laboratory
SVOC	semi-volatile organic compound
SWMP	stormwater monitoring program
SWPPP	stormwater pollution prevention plan
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TRI	toxics release inventory
TSCA	Toxic Substances Control Act
TTO	total toxic organics
TWC	talk, walk, clean
UFC	Uniform Fire Code
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
WBSD	West Bay Sanitary District
WM	waste management
WSS	work smart standard
WTS	waste tracking system

Executive Summary

This report provides information about environmental programs during 2002 at the Stanford Linear Accelerator Center (SLAC). Seasonal activities that span calendar years are also included.

Production of an annual site environmental report (ASER) is a requirement established by the United States Department of Energy (DOE) for all management and operating (M&O) contractors throughout the DOE complex. SLAC is a federally-funded, research and development center with Stanford University as the M&O contractor.

The most noteworthy information in this report is summarized in this section. This summary demonstrates the effective application of SLAC environmental management in meeting the site's integrated safety management system (ISMS) goals. For normal daily activities, all SLAC managers and supervisors are responsible for ensuring that proper procedures are followed so that

- Worker safety and health are protected
- The environment is protected
- Compliance is ensured

Throughout 2002, SLAC focused on these activities through the SLAC management systems (described in Chapter 3). These systems were also the way SLAC approached implementing "greening of the government" initiatives such as Executive Order 13148. The management systems at SLAC are effective, supporting compliance with all relevant statutory and regulatory requirements. SLAC did not receive any notices of violation during 2002.

In addition, many improvements were continued during 2002, in decreasing air emission rates, the storm drain system, groundwater restoration, and planning for a chemical management system to manage chemical use better. Program-specific details are discussed below.

Environmental Compliance

Chapter 2 contains detailed environmental compliance and assessment information. The following are highlights:

Air Quality

No notices of violation (NOVs) or notices to comply (NTCs) were received from the Bay Area Air Quality Management District (BAAQMD) during 2002.

Industrial Wastewater

No wastewater discharge permit violations occurred during 2002.

Stormwater

One sewage release entered the storm drain system, resulting in notification to the regional water quality control board (RWQCB) and the San Mateo County Health Department (SMCHD). No actions were taken by these regulatory agencies.

Environmental Non-radiological Program

Chapter 4 contains the bulk of the environmental non-radiological information.

Air Quality

SLAC operates its air quality management program in compliance with its established permit conditions: 2002 was the fifth consecutive year the air quality management program operated without receiving any notices of violation (NOVs) from cognizant regulators. Nevertheless, SLAC has an active program to improve its environmental performance in the air quality arena. Recent years have witnessed the following accomplishments:

- Decrease of more than 90 percent in halogenated solvent emissions from SLAC's Plating Shop
- Replacement of three pre-1984, Class 1 ozone-depleting substance (ODS) using chillers
- Decrease in the average age of SLAC's vehicle fleet from nine years to seven
- Successful negotiations to obtain a Title V synthetic minor operating permit (SMOP), which implements caps on facility-wide hazardous air pollutant (HAP) emissions

Future plans include the phasing out of all Class 1 ODSs, performance of a baseline greenhouse gas (GHG) survey for the facility, installation of new natural gas metering and instrumentation control systems at its main boilers, development and implementation of a new air emissions data management system, and further transition to a younger, more alternatively-fueled vehicle fleet.

Hazardous Waste

The Environmental Health Division of the San Mateo County Health Services Agency is the California certified unified permitting agency (CUPA) responsible for overseeing hazardous materials and waste management at SLAC. The CUPA made facility enforcement inspections of SLAC on January 8 through January 11 and on February 21, 2002. These inspections covered SLAC's hazardous materials and waste management, business plan, CalARP, and tiered permitting/permit-by-rule programs. No notices of violation were issued as a result of either inspection.

Stormwater and Industrial Wastewater

SLAC operates its industrial and sanitary wastewater management program in compliance with established permit conditions: 2002 was the sixth consecutive year the program operated without receiving any NOVs from program regulators. SLAC actively pursues projects that reduce flow to the wastewater system, and through a variety of measures has managed to keep its facility-wide wastewater discharge constant during a period in which many new connections were made to the system. SLAC continues to make progress on its transition to a new facility-wide flow-monitoring scheme (and substantially completed the project during 2003).

SLAC discharges stormwater that has the potential to come into contact with industrial activities. SLAC has an extensive monitoring program in place at the eight discharge locations where past sampling results indicate the greatest potential exists. During the 2002–2003 wet season, SLAC met all the requirements of its monitoring plan, except for consistently collecting samples within the first hour of discharge.[1]

For the tenth consecutive year, in 2002 the surface water program operated without receiving any NOVs from the program regulators. After the expenditure of more than $1 million, SLAC was nearing the completion of its Unauthorized Stormwater Connection Project at year-end; only 32 connections (less than 10 percent of the original total) remained to be remediated. SLAC actively pursued several other BMP-related performance improvements during the year.

Hazardous Materials Program

Although SLAC has been successful in meeting the regulatory requirements for managing hazardous materials, it has decided to pursue a more active strategy in reducing its use of such materials. The cornerstone of this effort is the implementation of a chemical management system (CMS).

Environmental Radiological Program

Chapter 5 provides detailed information on the SLAC environmental radiological program.

In 2002, no radiological incidents occurred that increased radiation levels or released radioactivity to the environment. In addition to managing its radioactive wastes safely and responsibly, SLAC worked to reduce the amount of waste generated. As detailed in Chapter 5, SLAC has implemented programs and systems to ensure compliance with all radiological requirements related to the environment.

Groundwater Protection and Environmental Restoration

Chapter 6 contains the bulk of the information about the groundwater protection and environmental restoration program. In general, environmental concerns at SLAC are limited in number, small in scale and are actively being managed or eliminated. The Environmental Restoration Program continued work on site characterization and evaluation of remedial alternatives at four sites with volatile organic compounds (VOCs) in groundwater and several areas with polychlorinated biphenyls (PCBs) and lead in soil.

1 Missed sampling times were because of equipment malfunctions, primarily battery failure. Samples were collected as soon as the malfunction was identified, generally within two hours of the start of discharge. Steps taken to minimize missed sampling times include using alternative power sources wherever possible, changing batteries weekly, and only collecting from storm events that occur during regular work hours, in accordance with the permit.

1 Site Overview

This chapter describes the environmental setting of the Stanford Linear Accelerator Center (SLAC) and the activities conducted at the site.

For an overview of site environmental planning, including descriptions of environmental resources, see the long-range development plan prepared in 2002.[2]

1.1 Introduction

SLAC is a national research laboratory operated by Stanford University under contract to the Department of Energy (DOE). SLAC is located on the San Francisco Peninsula, about halfway between San Francisco and San Jose, California (see Figure 1-1). Current research and scientific user facilities are in areas of photon science and particle astrophysics. Five scientists have been awarded the Nobel Prize for work carried out at SLAC and there are 10 members of its faculty in the National Academies.

The majority of SLAC funding comes from DOE Office of Science, with smaller contributions from NASA, NIH, and other federal and non-federal sources.

2 Stanford University Architect/Planning Office, *Stanford Linear Accelerator Center Long Range Development Plan* (December 2002, revised June 2003), http://www-group.slac.stanford.edu/bsd/SLAC_LRDP_final.pdf

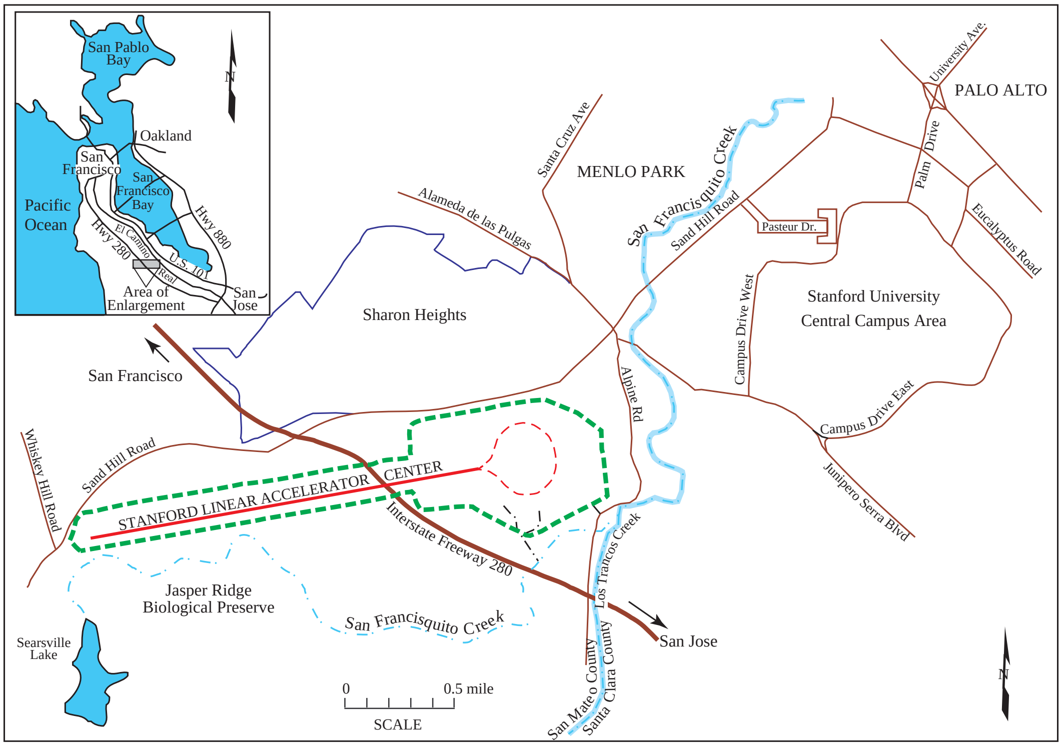

Figure 1-1 SLAC Site Location

1.1.1 SLAC Mission

SLAC's mission is to (a) discover new scientific frontiers within the physical and life sciences by probing the ultrasmall and ultrafast world of materials, molecules and atoms with high brightness x-rays, and (b) understand the fundamental physics of the birth and evolution of the universe by conducting theoretical studies and experiments in the interrelated disciplines of particle and particle astrophysics.

1.1.2 Research Program

The research program at SLAC centers on experimental and theoretical research in elementary particle physics, using accelerated electron beams; a broad program of research in atomic and solid-state physics, chemistry, and biology, using synchrotron radiation; and a growing research effort in particle astrophysics. There is also an active program in the development of new sources of high-energy particles and synchrotron radiation sources and of related instruments and techniques. Scientists from all parts of the United States and from throughout the world participate in the experimental programs at SLAC.[3]

SLAC has three major research areas. The first, in photon science, is to develop and support innovative, synchrotron-based methods and instrumentation to x-ray based studies of matter on length scales down to the nano- to atomic-level and on time scales from milli- down to femto-seconds. Photon science research

3 For more information on SLAC, its research program, and mission, see the public web page: Stanford Linear Accelerator Center, "Stanford Linear Accelerator Center", http://www.slac.stanford.edu/

includes complex, correlated and magnetic materials science, molecular environmental science, and structural biology; there is a rapidly developing new area of excellence in ultrafast x-ray science.

A second research area is the use of particle accelerators and observatories in space and on the ground to understand what our Universe is made of at its most basic and fundamental level. The principal areas of particle physics at the electron energy frontier using a linear collider, theoretical investigations of the quantum universe, and, at the Kavli Institute for Particle Astrophysics and Cosmology, non-accelerator tests of the Standard Cosmology Model through investigations of Dark Matter and Dark Energy.

Continuing over the next four years, a third research drive at SLAC is the construction of the Linac Coherent Light Source (LCLS), the world’s first x-ray free electron laser. SLAC is committed to the on-time and on-budget construction and rapid commissioning of this major new facility that will open revolutionary frontiers for photon science in the coming decades.

The main instrument of research is the 2-mile linear accelerator (linac), which generates high intensity beams of electrons and positrons up to 50 giga-electron volts (GeV). The linac is also used for injecting electrons and positrons into colliding-beam storage rings for particle physics research.

The Positron-Electron Project (PEP) storage ring is about 875 yards in diameter. While the original PEP program was completed in 1990, the storage ring has since been upgraded to serve as an asymmetric B factory (known as PEP-II) to study the B meson. PEP-II continued its program with the BaBar detector throughout 2004.

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

SLAC also hosts the Next Linear Collider (NLC) test facilities, including the Final Focus Test Beam (FFTB) and the Next Linear Collider Test Accelerator (NLCTA).

1.2 Location

The site is located in a belt of low, rolling foothills between the alluvial plain bordering San Francisco Bay to the east and the Santa Cruz Mountains to the west. The site varies in elevation from 53 to 114 meters above sea level. 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 over 610 meters (see Figure 1-2).

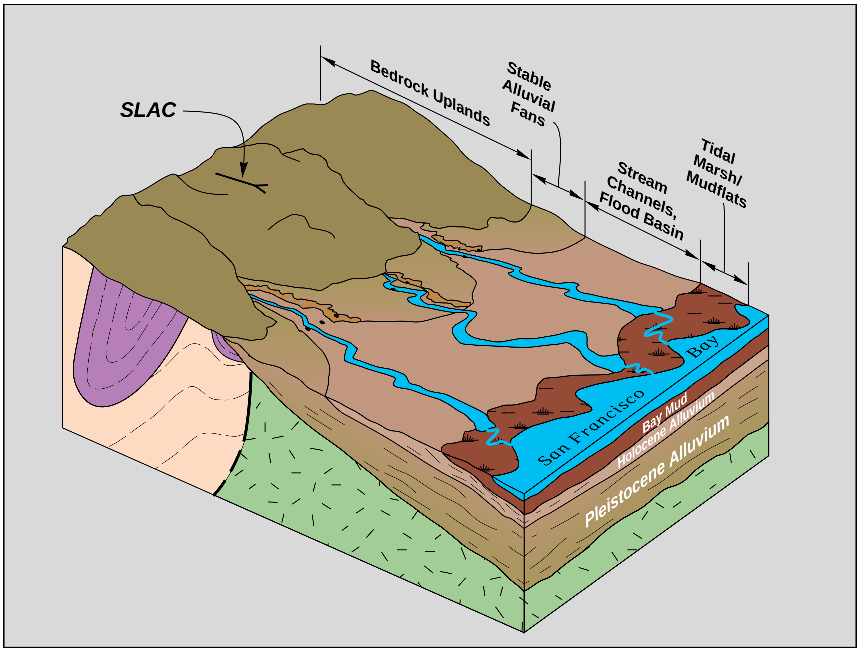

Figure 1-2 Geographic Site Area

The site occupies 170 hectares of land owned by Stanford University. The property was leased in 1962 for purposes of research in the basic properties of matter. The original lease to the Atomic Energy Commission (AEC), now DOE, was for 50 years. The land is part of Stanford's academic reserve, and is located west of the university and the city of Palo Alto in an unincorporated portion of San Mateo County.

The site lies between Sand Hill Road and Alpine Road, bisected by Highway 280, on an elongated parcel roughly 3.2 kilometers long, running in an east-west direction. The parcel widens to about 910 meters at the target (east) end to allow space for buildings and experimental facilities. Much of the western end of the parcel is bordered by Stanford University's Jasper Ridge Biological Preserve, which includes part of the San Francisquito Creek riparian channel, the last in its natural state between San Jose and San Francisco.

1.3 Geology

The SLAC site is underlain by sandstone, with some basalt at the far eastern end. In general, the bedrock on which the western half of the SLAC linac rests is the Whiskey Hill Formation (Eocene age), and the bedrock under the eastern half is the Ladera Formation (Miocene age). On top of this bedrock at various places along the accelerator alignment is the Santa Clara Formation (Pleistocene age), where alluvial deposits of sand and gravel are found. At the surface is a soil overburden of non-consolidated earth material averaging from 0.1 to 1.5 meters in depth.

1.4 Climate

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

Rainfall averages about 56 centimeters per year. The distribution of precipitation is highly seasonal. About 75 percent of the precipitation, including most of the major storms, occurs during the four-month period from December through March. Most winter storm periods are from two days to 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 substantial fluctuations in intensity, which can best be characterized as a series of storm cells following one another so as to produce heavy precipitation for periods of five to 15 minutes with lulls in between.

1.5 Land Use

The SLAC site is in an unincorporated portion of San Mateo County and is zoned in the San Mateo County General Plan as “residential estate”. Approximately 34 percent of the property is developed with buildings and pavement, mostly in the core campus area.

Land use to the immediate west is commercial, and farther west is agricultural and reserved open space. Land use to the north is mostly commercial, residential, and recreational (a golf course), with a school and convalescent hospital north of the central campus. Land use to the east is residential, recreational (another golf course), and educational (the Stanford campus). Land use to the south is agricultural (including a horse boarding and training facility), reserved open space, and residential.

1.6 Water Supply

SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPMWD), the source of which is the City of San Francisco-operated Hetch Hetchy aqueduct system, fed from reservoirs in the Sierra Nevada. SLAC and the neighboring (to the north) Sharon Heights development, including the shopping center, receive water service from an independent system (called “Zone 3”) within the MPMWD. This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7,600-cubic-meter reservoir in Atherton north of Sand Hill Road, approximately 2.4 kilometers from central SLAC.

The Zone 3 system was constructed in 1962 under special agreements between the City of Menlo Park, the developer of Sharon Heights, Stanford University, and the DOE. Since the cost of construction, including reservoir, pump station, and transmission lines, was shared among the various parties, each party has a vested interest and is entitled to certain capacity rights in accordance with these agreements.

Drinking and process water both are transported throughout the facility by a distribution system protected by backflow prevention devices. SLAC has no drinking-water supply wells. The drinking-water supply well nearest to SLAC is 460 meters from the SLAC boundary.

Use of water at SLAC is about equally divided between water used to cool equipment (such as the linac) and domestic uses (such as landscape irrigation and drinking water). The average water consumption by SLAC was 1150 cubic meters per day, or 407,000 cubic meters total, for 2002.

1.7 Demographics

SLAC has a population of about 1,500, of which about 220 are PhD physicists. Approximately 1,000 staff members are professional, including physicists, engineers, programmers, and other scientific-related personnel. The balance of the staff comprises support personnel, including technicians, crafts personnel, laboratory assistants, and administrative assistants. In addition to the regular population, at any given time SLAC hosts between 900 and 1,000 visiting scientists.

The populated area around SLAC is a mix of offices, schools, single-family housing, apartments, condominiums, and Stanford University. Approximately 3,500 people live within a one-mile radius of central SLAC. SLAC is surrounded mainly by five communities: the city of Menlo Park; the towns of Atherton, Portola Valley, and Woodside; and the unincorporated community of Stanford University, which is in Santa Clara County. Nearby unincorporated communities in San Mateo County include Ladera and two neighborhoods in western Menlo Park.

Within one mile of the perimeter of the SLAC property, there are two public and two private schools with elementary and/or middle school students.

Table 1-1 Populations of Communities near SLAC

Type	Community	County	Population
Incorporated town or city	Atherton	San Mateo	7,194
	Menlo Park	San Mateo	30,785
	Palo Alto	Santa Clara	58,598
	Portola Valley	San Mateo	4,462
	Woodside	San Mateo	5,352
Unincorporated community	Ladera	San Mateo	1,492
	Stanford	Santa Clara	13,200
	West Menlo Park	San Mateo	3,629
	Weekend Acres	San Mateo	268
Total			125,292

Sources:

1 Census 2000 data from the San Mateo County web site and from US Census Bureau site

2 Stanford population from Stanford University Planning Department estimates

Note: Population in unincorporated areas outside the defined communities is not included

2 Environmental Compliance

2.1 Introduction

This chapter provides a summary of the regulatory framework within which the environmental programs of SLAC operate, and our compliance for 2002.

2.2 Regulatory Framework

Table 2-1 lists the major laws and regulations, executive orders, and other requirements that govern activities at SLAC. For each requirement it gives the compliance status, section in this report where the requirement is discussed in detail, and any relevant comments.

Table 2-1 Regulatory Compliance

Major Statute/Executive Order	Governing Document	Status*	ASER Location	Pertinent Documents, Programs, Activities, and Accomplishments
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA/SARA)	42 USC 11022 (Tier II) 40 CFR 372 *California Health and Safety (CHS) Code*, Chapter 6.95; Article 80, Uniform Fire Code San Mateo County ordinance	Meets requirements	Section 4.5	The Hazardous Materials Business Plan and Hazardous Material Annual Inventory SLAC filed its required Form R reports as part of the Toxics Release Inventory
Resource Conservation and Recovery Act (RCRA)	40 CFR 261 Title 22 *California Code of Regulations*	Meets requirements	Section 4.6	Hazardous materials and hazardous waste management requirements
National Environmental Policy Act (NEPA)	42 USC 4321-4347 40 CFR 1500-1508	Meets requirements	Section 4.7	12 categorical exclusions
Clean Air Act (CAA)	40 CFR 60 40 CFR 61 40 CFR 63 40 CFR 82 40 CFR 89 BAAQMD rules and regulations	Meets requirements	Section 4.1	SLAC has both non-radiological and radiological air quality protection programs Per Title V, synthetic minor operating permit (SMOP) approved July 2002
Federal Water Pollution Control Act (Clean Water Act, CWA) – Groundwater	33 USC 1344 40 CFR 400 et seq	Meets requirements	Sections 4.3 and 4.4 and Chapter 6	New wells were installed in 2002 to evaluate specific locations for certain potential constituents near SLAC facilities

Major Statute/Executive Order	Governing Document	Status*	ASER Location	Pertinent Documents, Programs, Activities, and Accomplishments
Federal Water Pollution Control Act (Clean Water Act, CWA) – Surface Water	Stormwater Pollution Prevention Plan (SWPPP)	Meets requirements	Section 4.4	SLAC expanded its stormwater monitoring program to ensure continued compliance with the requirements of the general permit
Federal Water Pollution Control Act (Clean Water Act, CWA) – Industrial Wastewater	Regulations of South Bayside System Authority SBSA) *Code of General Regulations* of the West Bay Sanitary District (WBSD) Three mandatory wastewater discharge permits	Meets requirements	Section 4.3	SLAC remained in compliance with requirements of its 3 wastewater discharge permits; annual inspection by SBSA was routine and generated no enforcement actions or violations
Greening the Government	Executive Order 13148 Executive Order 13101 DOE Notice 450.4 DOE Notice 450.9	Meets requirements	Sections 3.5, 4.2, and 4.5	SLAC was in compliance with those portions of the orders for which DOE has issued guidance
Toxic Substances Control Act (TSCA)	40 CFR 761	Meets requirements	Section 4.5	SLAC's PCB Annual Log remains up to date
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	7 USC 136 and following 3 CCR 6	Level and types of pesticide use at SLAC do not subject our applicators to the FIFRA requirements	Not applicable	SLAC complies with pesticide worker safety regulations per 3 CCR 6
Endangered Species Act (ESA)	16 USC 1531 and following Pre-construction notice, US Army Corps of Engineers	Meets requirements	Section 4.7	SLAC's Long Range Development Plan (LRDP) includes endangered species and other local biota (see LDRP "Biotic Communities")
National Historic Preservation Act (NHPA)	16 USC 470	No eligible NHPA sites at SLAC	Not Applicable	Not applicable
Executive Order 11988, "Floodplain Management"	Executive Order 11988 10 CFR 1022	Meets requirements	Section 4.7	LRDP includes floodplain management (see LDRP "Flooding and Wetlands")
Executive Order 11990, "Protection of Wetlands"	Executive Order 11990	Meets requirements	Section 4.7	LRDP includes wetlands protection (see LDRP "Flooding and Wetlands")
Tank Management Aboveground Petroleum Storage Act	*California Health and Safety (CHS) Code*, Section 25270	Meets requirements	Section 4.5	SLAC's Spill Prevention, Control, and Countermeasures Plan remains up to date

Major Statute/Executive Order	Governing Document	Status*	ASER Location	Pertinent Documents, Programs, Activities, and Accomplishments
Federal Facilities Compliance Act	Public Law 102-386			
NESHAPs Subpart H: National Emission Standards for Emissions of Radionuclides Other than Radon, from Department of Energy Facilities	40 CFR 61.90–61.97	Meets requirements	Section 5.4	Submitted reports as required under program
NESHAPs Subpart T: National Emissions Standards for Halogenated Solvent Cleaning	40 CFR Part 63 Subpart T BAAQMD Regulation 8, Rule 16: Solvent Cleaning Operations	Meets requirements	Section 4.2	Submitted annual emissions report and semi-annual exceedance reports as required under program
Safe Drinking Water Act	42 USC 300f and following	SLAC is not a water supplier	Not applicable	Not applicable
Migratory Bird Treaty Act	16 USC 703–712 Executive Order 13186	Meets requirements	Section 4.7	LRDP includes bird populations (see LDRP "Biotic Communities") No migratory birds were taken during the conduct of any program at SLAC
Environment, Safety, and Health Reporting	DOE Order 231.1	Meets requirements	Chapter 3	This order covers many areas of ES&H and for compliance various quarterly, semi-annual, and annual reports were submitted to DOE
Occurrence Reporting and Processing of Operations Information	DOE Order 232.1	Meets requirements	Chapter 3	ORPS reports were submitted for off-normal discharges
Radioactive Waste Management	DOE Order 435.1	Meets requirements	Section 5.10	Radioactive waste management requirements
General Environmental Protection Program	DOE Order 5400.1	Meets requirements	Chapters 3 and 4	Submitted reports as required under program
Radiation Protection of the Public and the Environment	DOE Order 5400.5 DOE-STD-1153-2002	Meets requirements	Section 5.4	Demonstrated compliance with standards and requirements that apply to radiation protection of the public and environment

* "Meets requirements" means that SLAC has implemented systems and programs designed to ensure compliance with applicable requirements.

2.3 Environmental Permits and Notifications

The permits held by SLAC in 2002 are shown in Table 2-2. In addition to these permits, four notifications for halogenated solvent cleaning units were made, under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) program, to the US Environmental Protection Agency.

Table 2-2 General Permits Held by SLAC

Issuing Agency	Permit Type	Description	Number
Bay Area Air Quality Management District	Air quality	30 permitted sources and eight exempt sources for operation of various types of equipment	38
		Gasoline dispensing facility permit to operate	1
		Synthetic minor operating permit (SMOP), issued per Title V of the Clean Air Act	1
California Department of Toxic Substance Control	Hazardous waste treatment	Unit 1 – Building 038, permit by rule (PBR) for metals finishing pre-treatment facility	1
		Unit 2 – Building 038, PBR sludge dryer	1
		Unit 3 – Building 460, conditional authorization permit for batch treatment plant, facility shut down May 2002	1
		Unit 4 – Building 035, conditional authorization permit for groundwater treatment system	1
South Bayside System Authority and West Bay Sanitary District	Wastewater discharge	Flow meter station at Sand Hill Road	1
		Metal finishing pre-treatment facility	1
		Treated groundwater discharge at Building 035	1
Regional Water Quality Control Board	Stormwater	Industrial activities stormwater general permit	1
US Environmental Protection Agency	Hazardous waste	Hazardous waste generator permit	1

2.4 Environmental Incidents

Table 2-3 summarizes incidents in which regulatory permit limits or local, state, or federal reporting requirements were exceeded.

Table 2-3 Environmental Incidents Summary

Date	Description	Amount	Location	Cause	Corrective Action
August 2, 2002	Discharge of sewage unauthorized under the general industrial stormwater permit	5,000 gallons	SLAC Guest House	Line blocked by debris	The pipe was immediately cleaned

2.4.1 Non-radiological Incidents

As summarized above in Table 2-3, one release exceeded regulatory limits.

On August 2, 2002, at an area adjacent to the SLAC Guest House, an accumulation of rocks, rebar, and cloth rags blocked flow in an eight-inch sanitary sewer line. This caused the line to back up and release sewage water onto the unpaved ground and ultimately flow into a storm drain. Approximately 5,000 gallons of sewage water entered the storm drain system. The line was immediately cleared, and the Regional Water Quality Control Board (RWQCB) and the San Mateo County Health Department notified.

To address potential sewage discharges, SLAC directed its release prevention efforts at improving utility systems, including relining sanitary sewer lines and completing the elimination of connections to the storm sewer systems. Planning began in 2002 and in 2003 SLAC relined over 2,000 feet of sanitary sewer lines and completed a multi-year, $1.1 million dollar project to enhance stormwater connections. In addition, SLAC requested SLI funds from the DOE to further repair and upgrade SLAC utility systems by installing alarms at the four discharge locations of the industrial and sanitary sewer system. The high- and low-level alarms will alert site personnel of blocked sanitary sewer lines. This request for funds was approved and work began in 2004.

2.4.2 Radiological Incidents

In 2002, no radiological incidents occurred that increased radiation levels or released radioactivity to the environment. As detailed in Chapter 5, “Environmental Radiological Programs”, SLAC was in compliance with all radiological requirements related to the environment throughout 2002.

2.5 Assessments, Inspections, and Quality Assurance

As described in Chapter 3, “Management Systems”, the environmental programs at SLAC are subject to a number of assessments, inspections, and quality assurance measures. The results for 2002 are reported here.

2.5.1 Assessments

2.5.1.1 External

External assessments conducted vary year to year; the following occurred in 2002:

1. Quarterly operational awareness reviews of the SLAC radiological environmental protection (REP) by the DOE
2. Quarterly monitoring of SLAC perimeter radiation by the California Department of Health Services

No radiological or regulatory problems were found in either of the above evaluations.

2.5.1.2 Self-assessment Program

A major part of the SLAC self-assessment program is the annual site-wide Talk, Walk, Clean (TWC), in which every employee is invited to spend a day checking his or her area and work for potential improvements in environment, safety, and health (ES&H) measures.

2.5.1.3 Independent Assessments

In 2002, URS Corporation performed an independent assessment of ES&H activities at SLAC. The 2002 assessment covered a wide variety of safety and health issues, including the following topics relevant to environmental concerns:

- Hazardous waste programs/waste accumulation areas
- Lead
- Asbestos
- Radiation protection
- Hazardous materials (storage, packaging, and transportation)
- Stormwater/surface water
- Hazardous chemical storage
- Compressed gas storage

Findings related to environmental issues from the assessments are prioritized for funding and completion.

2.5.2 Inspections

Periodic inspections of the environmental programs are performed at SLAC by environmental regulatory agencies. Table 2-4 lists the inspections conducted in 2002 by these agencies. No notices of violation were issued to SLAC by any of the regulatory agencies.

Table 2-4 Environmental Audits and Inspections

Regulatory Agency	Inspection Title	Date	Violations
San Mateo County Department of Health Services	Hazardous Waste Management	January 8–15	0
San Mateo County Department of Health Services	Stormwater and Spill Prevention Programs	January 29	0
San Mateo County Department. of Health Services	Tiered Permit Program (Permit-by-Rule)	February 21	0
South Bayside System Authority	Annual Wastewater Discharge Inspection	March 15	0
US Nuclear Regulatory Commission	External Regulation Orientation Visit	April 3–4	0
Bay Area Air Quality Management District	Various activities with emissions to air	Multiple inspections	0

2.5.3 Quality Assurance

2.5.3.1 Environmental Non-radiological Program

For monitoring its environmental programs, ES&H follows quality assurance plans and conducts sampling following standard protocols, including the use of doubles to test compliance and equipment. During 2002 sampling efforts satisfied quality assurance criteria.

2.5.3.2 Environmental Radiological Program

The SLAC Radioanalysis Laboratory correctly identified all radionuclides present in DOE Environmental Measurements Laboratory samples.

2.6 Environmental Performance Measures

At the institutional level a program of performance measures (including environmental ones) has been established. Review of performance to these measures by senior management is part of the overall planned program assessment activities.[4]

Performance measure results are reported in a fiscal year structure; the SLAC fiscal year 2002 (FY02) covered October 1, 2001 through September 30, 2002. The performance measure results for FY02 indicated a rating of “outstanding” on environmental measures.[5]

4 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, “ES&H ISMS: Performance Measures”, http://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm

5 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Quarterly Report on Environment, Safety, and Health Fiscal Year 2003, October–December* (no date), https://www-internal.slac.stanford.edu/esh/divisional/divreports/fy03QRq1.pdf

3 Management Systems

3.1 Introduction

This chapter provides an overview of the Environment, Safety, and Health (ES&H) Division's management systems, including organizational structure, management approach, quality assurance, and environmental management system (EMS) implementation, as of 2002. The results for the various measures and reviews discussed below are contained in Chapter 2, "Environmental Compliance".

3.2 ES&H Division Organization

In 2002 the ES&H Division consisted of the following six departments and a division office. The division office is tasked with overall strategic planning and management. The shared goal is to ensure that SLAC operates in compliance with federal, state, and local regulations, as well as Department of Energy (DOE) orders.

3.2.1 Environmental Protection and Restoration

The Environmental Protection and Restoration (EPR) Department oversaw most of the SLAC environmental programs, including environmental restoration, air quality, stormwater and industrial wastewater, toxic substance control, and groundwater protection.

3.2.2 Operational Health Physics

The Operational Health Physics (OHP) Department oversaw radiological monitoring, dosimetry, and radioactive waste management at SLAC. (It has since been merged with Radiation Physics.)

3.2.3 Radiation Physics

The Radiation Physics (RP) Department provided expertise in shielding design for new experiments and facilities and oversight for safe operation of beam lines to protect workers and members of the general public.

3.2.4 Safety, Health, and Assurance

The Safety, Health, and Assurance (SHA) Department managed the overall safety, health, and quality assurance programs and supervised quality assurance audits for ES&H activities.

3.2.5 Waste Management

The Waste Management (WM) Department developed and implemented waste minimization and pollution prevention plans and coordinated the disposal of regulated waste. (It has since been merged with Environmental Protection.)

3.2.6 Knowledge Management

The Knowledge Management (KM) Department provided training, publishing, and web services and also managed the division budget.

3.3 Integrated Safety Management System

The ES&H program has been designed to ensure that SLAC operates in a safe, environmentally responsible manner and complies with applicable laws, regulations, and standards. The program is based on integrating these concerns into the mission and everyday operations of the site, and as such embodied the "integrated safety management system" (ISMS) approach even before this was made a DOE requirement and incorporated into the operating contract of the site.

3.3.1 Safety Management System

The "plan, do, check, and improve" approach of ISMS[6] has been formally adopted by SLAC, and is the foundation of the site's safety management system[7] and the ES&H program. The approach consists of the following five core functions:

1. Define the scope of work
2. Analyze the hazards
3. Develop and implement hazard controls
4. Perform work within controls
5. Provide feedback and continuous improvement

These core functions are implemented by following seven guiding principles:

1. Line management responsibility for safety
2. Roles and responsibilities
3. Competence commensurate with responsibilities
4. Balanced priorities
5. Identification of safety standards
6. Hazard controls tailored to work being performed
7. Operations authorization

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6 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, "Integrated Safety and Environmental Management Systems", http://www-group.slac.stanford.edu/esh/general/isems/

7 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *SLAC Safety Management System* (SLAC-I-720-0A00B-001, October 2000), http://www-group.slac.stanford.edu/esh/general/isems/sms.pdf

3.3.2 Roles and Responsibilities

ES&H roles and responsibilities follow guiding principles 1 and 2, “Line Management Responsibility for Safety” and “Roles and Responsibilities”:

- The director has ultimate responsibility for the laboratory’s ES&H program and for delegating the responsibility and authority necessary to implement ES&H policies
- The associate directors manage divisions of the laboratory and are responsible for ensuring that ES&H policy is implemented within their own divisions
- Managers and supervisors direct operations and functions of a division, a scientific or a support department, or a research group or program. They are responsible for implementing ES&H policies with the personnel under their supervision

3.3.3 Work Smart Standards

To ensure the goals of Guiding Principle 5, “Identification of Safety Standards”, are met, the laws and regulations that specify the environmental, safety, and health requirements of the laboratory have been identified and incorporated into the SLAC management and operating contract. These requirements, known as the SLAC Work Smart Standards (WSS), are reviewed annually and are based on and respond to potential hazards and environmental impacts identified by the people who work at SLAC.[8]

3.3.4 Environmental Performance Measures

In addition to adopting work smart standards, SLAC evaluates its activities against performance measures. The environmentally relevant measures are

- Environmental violations and releases
- Environmental restoration goals
- Waste minimization/pollution prevention goals
- Hazardous and radioactive waste

Specific performance measures are adopted and reported in a fiscal-year structure.[9]

3.3.5 Training

To ensure every employee is both aware and capable of fulfilling his or her responsibilities, the ES&H Division operates an extensive program of classroom- and computer-based training. For example, personnel who handle hazardous chemicals and waste are instructed in chemical and waste management, waste minimization, pollution prevention, stormwater protection, on-site transportation of hazardous

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8 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, “Work Smart Standards”, http://www-group.slac.stanford.edu/esh/general/isems/wss/default.htm

9 The measures for fiscal year 2002 (FY02, October 1, 2001 through September 30, 2002) can be found on line: http://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm

chemicals and waste, and spill and emergency response. Details on the ES&H training program are available on line.[10]

3.4 Assessments, Inspections, and Quality Assurance

The "check" part of the ISM approach is implemented at SLAC through a series of assessments (internal and external), inspections, and quality assurance programs.

3.4.1 Assessments

External assessments conducted vary from year to year, but two assessments occur regularly concerning the radiological program:

1. Quarterly operational awareness reviews of the SLAC radiological environmental protection (REP) by the DOE
2. Quarterly monitoring of SLAC perimeter radiation by the California Department of Health Services

3.4.1.1 Independent Assessments

A major multi-year program of independent assessments related to environment, safety, and health topics is in place at SLAC. These assessments are conducted each year by independent consulting firms utilizing highly qualified ES&H professionals. Assessments are planned every year on a rotating three-year audit cycle.

3.4.1.2 Self-assessment Program

In addition to independent assessments, SLAC conducts self-assessments. One such is an annual Talk, Walk, Clean (TWC) program used to identify opportunities for ES&H improvement. This program includes the opportunity for all laboratory employees, in small discussion groups, to reflect on the most important ES&H issues and suggest solutions. Divisions may take action on this information directly, or they may develop site-wide corrective action plans. A structured walk-through inspection and a clean-up opportunity are also provided.

3.4.2 Inspections

Periodic inspections of the environmental programs are performed at SLAC by environmental regulatory agencies. The inspections conducted in 2002 are listed in Table 2-4.

3.4.3 Quality Assurance

The SLAC site-wide Quality Assurance (QA) Program has been influenced by the requirements of DOE Order 414.1 and has roles, responsibilities, and authorities for implementation the ten criteria from the order.[11]

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10 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, "ES&H Training", http://www-group.slac.stanford.edu/esh/training/

The SHA Department is responsible for

- Auditing quality assurance for line work as well as ES&H programs
- Maintaining the SLAC Institutional Quality Assurance Program Plan
- Providing direction for implementation of the ten criteria from DOE Order 414.1

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

3.4.3.1 Environmental Non-radiological Program

The Environmental Restoration Program uses the *Quality Assurance Project Plan for the Remedial Investigation and Feasibility Study* (SLAC-I-750-2A17M-003) for soil and groundwater contamination investigations. This document has most components required of quality assurance project plans according to the EPA; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund); and DOE guidance documents. The components include defining required laboratory and field QA/QC procedures and corrective actions, and data validation and reporting.

3.4.3.2 Environmental Radiological Program

SLAC participates in the DOE Environmental Measurements Laboratory's (EML) Quality Assessment Program. Under this program, the EML provides the SLAC Radioanalysis Laboratory with samples that contain unknown gamma- and beta-emitting radionuclides. The lab uses these samples to test and improve its gamma counting and liquid scintillation counting capabilities.

3.5 Environmental Management System

Stanford University provides the land for the SLAC site to the DOE at no cost, charging no rent and exacting no fee. SLAC, as a department of the university, manages the land with an eye to the future and to future generations, thus ensuring proper stewardship and achieving the Stanford University goal of returning the land to unrestricted use. This stewardship goal is embodied in the safety management system described above, which accordingly already incorporates many of the characteristics and requirements of an "environmental management system" (EMS) as defined in Executive Order 13148, "Greening the Government", including the roles and responsibilities for an EMS.

Although DOE guidance on what the requirements for an EMS system would be was not received in 2002, activities at SLAC during 2002 continued to address the general issues associated with the order. In addition, in September of 2001, SLAC submitted a completed questionnaire to DOE indicating that it intended to "self declare" an EMS in place by utilizing the framework provided by the safety management system rather than by seeking third-party certification, such as that under the International Organization for Standardization (ISO) 14001.

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11 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *SLAC Institutional Quality Assurance Program Plan* (SLAC-I-770-0A17M-001-R002, September 2000), http://www-group.slac.stanford.edu/esh/divisional/qa.htm

4 Environmental Non-radiological Programs

4.1 Introduction

SLAC's mission statement includes the phrase "the scientific and educational mission will be achieved while maintaining excellence in matters of environmental concern and providing for the safety and health of the SLAC staff, users, and the general public".[12]

SLAC has the potential to impact the environment because, first and foremost, large quantities of electricity and cooling water are used in the operation of the accelerator itself. Second, during the course of "providing accelerators, detectors, instrumentation, and support for national and international research programs", SLAC manufactures and maintains one-of-a-kind research equipment, which requires the use and management of industrial chemicals, gases, and metals. Third, SLAC has environmental management issues commensurate with any employer that has more than 1,100 full-time staff, 2,000 scientific users, 200 vehicles, hundreds of buildings, and 400 acres of land located in an environmentally sensitive location.

SLAC expends considerable effort towards minimizing waste and emissions. If possible, SLAC tries to avoid creating waste and emissions, and if not, SLAC tries to minimize the amount it does produce and then carefully manage the impacts that result.

As noted in Chapter 2, for fiscal year 2002 the DOE recognized SLAC's environmental performance as "outstanding" (the highest possible rating) for each of the four environmental performance measures included in Stanford University's contract with DOE to manage the facility. Other recent recognition of SLAC's environmental performance accomplishments is provided in Table 4-1.

Table 4-1 Recent Environmental Awards

Year	Organization	Award/Recognition Program	Description
2000	City of Menlo Park	Environmental Quality Award	Exceptional Resource Conservation – Protection of Air Quality
2001	White House	Closing the Circle Award	Reuse of potential hazardous wastes
2001	Santa Clara County	Letter of recognition	Silicon Valley Chemical Management Services Pilot Project participant
2001	DOE	Pollution Prevention Award	Implementing alternatives to ozone-depleting solvents
2001	DOE	Pollution Prevention Award	Reducing/eliminating hazardous waste generation
2002	USEPA	Champion of Green Government Award	Identifying/developing alternatives to ozone depleting solvents

12 Stanford Linear Accelerator Center, "Stanford Linear Accelerator Center Mission Statement", http://home.slac.stanford.edu/welcome/mission.html

Additionally, SLAC continually strives to increase its environmental performance, per the objectives of Executive Order 13148, “Greening the Government through Leadership in Environmental Management”, and its own environmental management system (EMS) (see Chapter 3).

The remainder of this chapter provides an overview of the non-radiological environmental programs SLAC has implemented to protect air and water quality, to manage hazardous materials safely, and to minimize the generation of hazardous, non-hazardous, and solid waste. The chapter sections are organized by protection program and, for each, describe the regulatory framework, program status for 2002, and relevant performance trends.

4.2 Air Quality Management Programs

SLAC operates sources of air pollution such as boilers, solvent degreasers, a paint shop, a plating shop, several machine shops, a magnet shop, and a vehicle fueling station In addition, high-energy physics experiments can emit volatile organics due to the nature of the gas atmospheres required for use in particle detectors. This section describes the regulatory framework to which SLAC is subject for the purpose of air quality protection, and then presents the status of SLAC’s air quality protection programs in 2002.

4.2.1 Regulatory Framework

In the San Francisco Bay Area, most federal and state air regulatory programs are implemented through the rules and regulations of the Bay Area Air Quality Management District (BAAQMD). Included in the BAAQMD roles and responsibilities are implementation of Title V of the Clean Air Act (CAA).

During 1999, BAAQMD revised its regulations implementing Title V. As a result, SLAC became subject to the Title V permitting program and was required to take one of the following actions by October 20, 2000:

- Apply for a major facility review permit
- Apply for a synthetic minor operating permit (SMOP)
- Demonstrate that the SLAC “potential to emit” is below the major facility thresholds defined in BAAQMD Regulation 2-6-312

SLAC’s Title V SMOP application was submitted on June 1, 2000, and following a lengthy review was issued to SLAC by the BAAQMD on July 26, 2002.

The Title V SMOP fundamentally changed SLAC’s air quality protection program. Previous to receiving its Title V SMOP, SLAC was required to comply with source-specific permit conditions, which limited emissions for particular sources. The Title V SMOP placed a cap on facility-wide emissions of criteria pollutants, and – more relevant to SLAC’s operations – placed caps on facility-wide emissions of volatile organic compounds (VOCs), total hazardous air pollutants (HAPs), and individual HAPs. SLAC’s first annual emissions report under the Title V SMOP was submitted to BAAQMD on time in July 2003.

Other mechanisms by which BAAQMD regulates SLAC’s air emissions include

- Annual enforcement inspections
- New source permit evaluations

- Annual information updates for emissions of air toxics as identified by the California Air Resources Board in its toxic substances checklist
- Annual information updates for adhesives usage as specified in BAAQMD Regulation 8-51-1502.2C
- Asbestos and demolition project notification requirements

SLAC is also subject to the following two air quality programs for which the USEPA retained (that is, did not delegate to BAAQMD) its regulatory authority:

1. The National Emission Standards for Halogenated Solvent Cleaning, under Title 40, Code of Federal Regulations (CFR), Part 63.460, administered through the Air Division of Region 9 of USEPA
2. The Protection of Stratospheric Ozone, under 40 CFR 82, likewise administered through the Air Division of USEPA Region 9

4.2.2 Program Status

4.2.2.1 Annual Facility Enforcement Inspection

BAAQMD conducted an annual inspection of SLAC on October 10 to 11, 2002. No notices of violations (NOVs) were issued.

But because the two main boilers in SLAC's Central Utilities building (BAAQMD source numbers S-52 and S-53) had not had source tests performed since their construction in 1995–1996, the inspector required BAAQMD's Source Test Division to make enforcement source tests on both boilers. The enforcement source test was performed on the first boiler (BAAQMD source S 52) on December 11, 2002, and the boiler passed. The second of two enforcement source tests on the second boiler (BAAQMD source S 53) was performed on January 28, 2003, and the boiler passed.

4.2.2.2 New Source Permits

During 2002, SLAC received from BAAQMD permits to operate 11 diesel-fuel emergency standby generators.

The need to permit these units was an outgrowth of California's energy crisis during 2001. Historically, diesel-fueled emergency generators had been exempt from permitting under BAAQMD regulations. During California's energy crisis, however, BAAQMD realized that this historic exemption meant the agency had no way of knowing how many generators existed regionally, and thus had no tool to manage their oversight during the crisis. Therefore, BAAQMD removed the exemption from permitting from their regulations, and all existing diesel-fired generators with a brake horsepower rating (bhp) of 50 or greater were required to go through the permitting process.

The permit conditions SLAC received for these units limit their operating time to 100 hours or less per calendar year under non-emergency conditions; use under emergency conditions, as defined in the new regulations, is unlimited.

Following receipt of the "permits to operate" the 11 generators, at year-end SLAC had a total of 38 "current" sources listed in its facility-wide permit to operate, comprising 30 permitted and eight exempt sources. Information regarding these sources is presented in Table 4-2.

Table 4-2 BAAQMD Permitted/Exempt Sources (July 2004)

BAAQMD Source Number	SLAC Building Number	Location	Source	Chemical(s) Emitted / Data Quantity Tracked
Permitted sources				
S-4	25	Plating Shop	TCA degreaser	TCA
S-5	35	Paint Shop	Paint booth	Coatings, solvents
S-21	25	Plating Shop	Sulfuric acid bath (incl. scrubber)	H2SO4
S-26	26	Machine Maintenance Area	Cold cleaner	DeGreez 500
S-34	40	Machine Shop	Cold cleaner	DeGreez 500
S-36	var.	Facility wide	3 EtOH gatekeepers + other sources	EtOH, IPA, MeOH, others
S-37	25	Plating Shop	IPA cleaner	IPA
S-52	23	Central Utilities	B23 main boiler (B201 - west side)	Natural gas
S-53	23	Central Utilities	B23 main boiler (B200 - east side)	Natural gas
S-54	25	Plating Shop	NZE degreaser	PCE
S-55	626	Gas Shack	BaBar drift chamber (DCH)	Isobutane
S-56	626	Gas Shack	BaBar instrumented flux return (IFR)	Isobutane, H134a, fluorinert
S-57	38	MFPF (old RWTP)	RWTP sludge dryer (incl. scrubber)	Cr, Ni, Cr+6, CN, nat'l gas
S-58	6	Cryogenics/SSRL	TCE "chili pot" solvent tank	TCE
S-59	31	Building wide	Solvent cleaning operations	TCA, EtOH, Acetone
S-60	25	Plating Shop	Ultrasonic cleaner	IPA, MeOH, EtOH, Acetone
S-61	25	Plating Shop	Dynasolve degreaser	MeCl
S-62	var.	Facility wide	FW paints/coatings	Paints, coatings
S-63	var.	Facility wide	FW epoxies/adhesives	Epoxies, adhesives
S-64	81	Transportation	Gas Dispensing Facility (GDF)	1500 gasoline, 500 diesel
S-65	18	North side	Generator “Big Green Monster”	Diesel
S-66	756	North of CEH	Generator	Diesel
S-67	505	Research Yard (east of 104)	Generator (to be relocated)	Diesel
S-68	7	MCC	Generator	Diesel
S-69	626	IR-2 BaBar	Generator (gone as of March 1, 2004)	Diesel
S-70	686	IR-8 Mech Pad	Generator	Diesel
S-71	23	Old pad	Generator	Diesel

BAAQMD Source Number	SLAC Building Number	Location	Source	Chemical(s) Emitted / Data Quantity Tracked
S-72	23	New pad	Generator	Diesel
S-73	18	(from old IR Pad)	Generator	Diesel
S-74	706	IR-10 (west of SSRL)	Generator	Diesel
S-75	18	(from old IR Pad)	Generator	Diesel
S-76	81	Transportation	Oil/water separator	Wastewater throughflow
S-77	15	Power Conversion	Soil vapor extraction system	VOCs (various)
32100	var.	HVAC systems	Fugitive freons	R-11, R-12, R-22, et al.
Exempt sources				
S-10	35	Carpenter Shop	Woodworking operations/abatement device	Particulates
S-11	29	Metal Stores Saw	Metalworking operations/abatement device	Particulates
S-13	25	Grinding Room	Metalworking operations/abatement device	Particulates
S-14	123	Klystron Shop	Sandblasting/abatement device	Particulates
S-16	123	Klystron Shop	Sandblasting/abatement device	Particulates
S-17	24	Controls Department	Metal grinding operations/abatement device	Particulates
S-40	37	Boiler (old S-6)	AG diesel fuel tank (3,700 gal)	Diesel
S-41	23	Central Utilities	AG diesel fuel tank (10,000 gal)	Diesel
S-42	7	MCC	AG diesel fuel tank (500 gal)	Diesel
S-43	505	B505A	AG diesel fuel tank (500 gal)	Diesel
S-44	82	Fire Station	AG diesel fuel tank (500 gal)	Diesel
S-45	112	Master Substation	AG diesel fuel tank (2,000 gal)	Diesel
S-46	44	Klystron Test Lab	Benchtop spray painting	Aerosol paints
S-49	25	Cyanide Room	Wet scrubber for Cyanide Room	Cyanide
S-50	120	SSRL	Sandblast booth at Machine Shop	Particulates
S-51	25	B25	Small parts blast cab (PC17285)	Particulates
S-78	26	Welding Shop	Plasma-arc cutting torch with DCS	Cr+6 emissions, et al.
Pending	750	SLD/North of CEH	250 gal AG diesel – to generator (S-66)	Diesel
Pending	750	SLD/NE of CEH	55 gal AG diesel – to compressor	Diesel
Pending	var.	Facility wide	250 gal AG diesel – mobile refueling	Diesel
Pending	var.	Facility wide	250 gal AG diesel – mobile refueling	Diesel

4.2.2.3 Annual Title V SMOP Emissions Report

SLAC's first annual emissions report under its new Title V SMOP was submitted on time in July 2003, and covered the 12-month period from July 1, 2002 through June 30, 2003.

4.2.2.4 Annual Permit-to-Operate Update

SLAC submitted its annual update to BAAQMD on April 26, 2002. The annual update is prepared in response to the BAAQMD "information update" request for permitted sources, and covers the previous calendar year. Thus, the annual update SLAC submitted in 2002 covered the reporting year 2001. Following these submittals, SLAC received the renewal of its permit to operate on June 28, 2002, effective through July 1, 2003.

Currently, the largest source of air emissions at SLAC is its BaBar Detector (BAAQMD Sources S-55 and S-56). SLAC has operated this source within permit conditions at all times since its startup in 1999. Precursor organic compound (POC, also known as "smog-forming") emissions are the primary concern for the BaBar Detector. BaBar POC emissions in 2002 are graphed against the source's permit conditions in Figure 4-1.

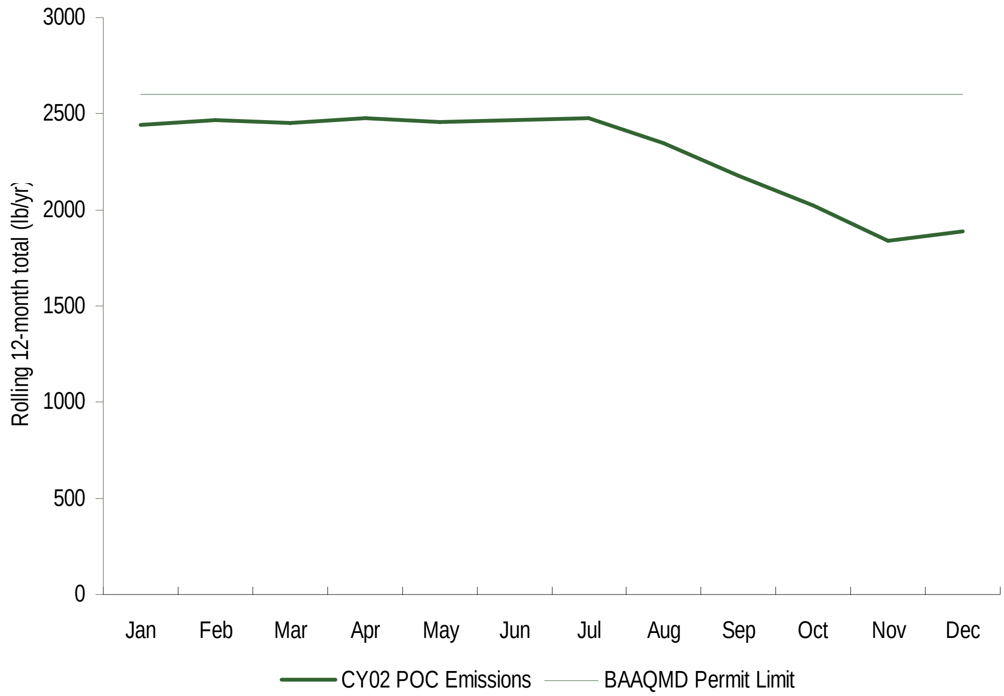


Figure 4-1 2002 POC Emissions from BaBar (Sources S-55 and S-56)

4.2.2.5 Annual Air Toxics Report

Concurrent with BAAQMD's annual information request, facilities are also required to review the toxic substances checklist promulgated by BAAQMD to support the California Air Resources Board's Air Toxics program. If facilities emit listed chemicals in quantities greater than the "applicable degree of accuracy" threshold, regardless of whether the emissions originate from a permitted source, facilities have an obligation to report air toxics usage at the same time of their annual update.

SLAC submitted its annual air toxics information to BAAQMD in 2002 (covering the 2001 reporting year) in two parts. The first part covered air toxics emitted from permitted units and was submitted with the annual update on April 26, 2002. It described the following emissions:

- H-134a, a Freon compound used in one of the components of the BaBar Detector: 9,442 pounds
- 3M FC-77 Fluorinert-brand Electronic Liquid (a mixture of perfluorinated compounds), used in heat exchangers for one of the components of the BaBar Detector: 85 gallons (about 1,300 pounds)
- R-12, R-22, R-404a, Suva 134a, and Freon 14, used in SLAC heating, ventilation, and air conditioning (HVAC) equipment: three, 213, 51, one, and 45 pounds, respectively

The second part covered air toxics emitted from the rest of the facility and was submitted on July 31. A total of eight air toxics were reported as being used in quantities greater than the air toxics "degrees of accuracy". Usage quantities of these eight air toxics ranged from a low of 0.16 pounds per year, for lead chromate, to a high of 45 pounds per year for methyl isobutyl ketone (MIBK). Lead chromate is present in paint lacquers used at SLAC and MIBK is present in aerosol paints used at SLAC. These quantities are used only to calculate annual permit fees paid to the BAAQMD.

4.2.2.6 Annual Adhesives Usage Report

SLAC submits an annual adhesives usage report to BAAQMD to satisfy Regulation 8 51 502.2c, which states "the annual total usage of each adhesive and sealant product shall be reported at the time the facility's permit to operate is renewed". SLAC submitted its annual adhesives usage report to BAAQMD on May 2, 2002 (covering the 2001 reporting year) and reported using a total of 28 adhesives. Eight were used in research applications (satellite assembly, magnet assembly, and cosmic ray telescope assembly) and the remaining 20 were used in equipment and building maintenance applications. The research adhesive used in the greatest quantities was five gallons of Epoxy Resins Casting Resin (#R-1055), while the maintenance adhesive used in the greatest quantities was 40 pounds of GE Silicones Adhesive Silicon Sealant.

4.2.2.7 Asbestos and Demolition Project Notification Program

For projects that involve the demolition of existing structures or the management of "regulated asbestos-containing material" (RACM), SLAC is required to provide 10 working days' advance notice to BAAQMD per Regulation 11, Hazardous Pollutants, Rule 2, Asbestos Demolition, Renovation, and Manufacturing. During 2002, evaluations of approximately 26 construction projects were performed for the purpose of air quality protection. Based on the project scopes and the results of pre-work asbestos surveys conducted by SLAC industrial hygienists, asbestos/demolition notifications were determined to be necessary for six of the 26 construction projects and were formally submitted to BAAQMD.

4.2.2.8 National Emission Standards for Hazardous Air Pollutants

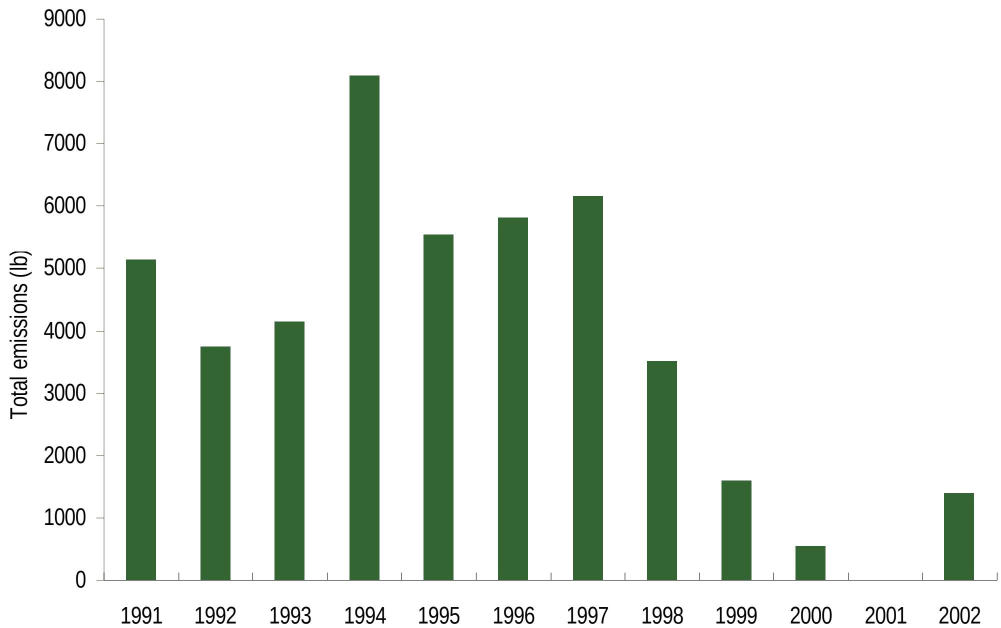
SLAC operates four sources that are subject to 40 CFR 63, Subpart T, National Emission Standards for Halogenated Solvent Cleaning, part of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) regulations, as shown in Table 4-3.

No exceedances occurred during the covered reporting periods. The four NESHAPs units were operated in accordance with their NESHAPs emissions limits during the covered reporting periods.

Table 4-3 Halogenated Solvent Cleaning Sources Subject to NESHAPs

Source	Source Description	Location	Halogenated Solvent Used
S-4	Batch vapor degreaser	Plating Shop	1,1,1-trichloroethane
S-54	Near-zero emission (NZE) degreaser	Plating Shop	tetrachloroethylene
S-58	Batch cleaning tank	Electron Gun Testing/Maintenance	1,1,1-trichloroethane
S-61	Batch cleaning tank	Plating Shop	methylene chloride

With the successful installation of Source S-54, the Near Zero Emission (NZE) Vapor Degreaser, in 1999, SLAC realized a dramatic decrease in its emissions of chlorinated solvents from its Plating Shop, thus greatly improving its environmental performance and enhancing worker health and safety. The ten-year emissions history of chlorinated solvents from the Plating Shop is shown in Figure 4-2. This very successful protection project resulted in SLAC receiving an Environmental Quality Award from the City of Menlo Park for exceptional resource conservation.



Note: NZE degreaser placed into regular operating service in June 1999

Figure 4-2 Halogenated Solvent Air Emissions: SLAC Plating Shop, 1991–2002

4.2.2.9 Protection of Stratospheric Ozone

No releases of stratospheric ozone-depleting substances (ODSs) occurred during 2002 that were subject to the release reporting and corrective action requirements in the ODS regulations (40 CFR 82).

Per Executive Order 13148, "Greening the Government through Leadership in Environmental Management", SLAC is subject to two DOE-mandated ODS management objectives:

1. By 2005, retrofit or replace 100 percent of chillers that have greater than 150 tons of cooling capacity, were manufactured before 1984, and that use Class 1 ODS
2. By 2010, eliminate the procurement of all Class 1 ODS

SLAC completed the activities to attain the first objective in 2002, three years ahead of schedule. Specifically, the final three pre-1984, Class 1 ODS-using chillers at SLAC, located in the Central Utilities Building (B23), were the subject of a successful replacement project completed in the summer of 2002. These three chillers had a combined total Class 1 ODS charge of 1,700 pounds. They were replaced with non-Class 1 ODS equipment, and the new B23 chillers have yet to experience any releases.

SLAC has identified the following five projects that will be necessary to achieve the second objective:

1. SSRL Building 117 Chiller Replacement
2. Halon Fire Systems Replacement (two systems)
3. Miscellaneous Heating, Ventilation, Air Conditioning (HVAC) Equipment Replacement (approximately six small systems)
4. TCA Replacement Project, Mechanical Fabrication Department (MFD)
5. TCA Replacement Project, Site Engineering and Maintenance Department (SEM)

4.2.2.10 Vehicle Fleet Management

SLAC operates and maintains a fleet of more than 230 cars, trucks, and specialized pieces of heavy equipment to support its daily operations. Vehicles are provided by one of two federal agencies: the DOE or the General Services Administration (GSA). While the latter can be driven off site without restrictions, the DOE fleet, mostly aging pickup trucks, cannot leave SLAC for insurance purposes, and so must be refueled on site. In the past this was accomplished by a tanker truck, which was staged in a parking lot and dispensed gasoline (and diesel, in some cases) to vehicles waiting in line. A range of problems associated with this operation led SLAC to construct a gasoline dispensing facility (GDF) that began operating in October 2001, so 2002 was the first full year of GDF operations. This facility replaced both the tanker operation and the moped fueling station.

The GDF provides both gasoline and diesel to SLAC vehicles. Nearly 10,500 gallons of gasoline and over 7,200 gallons of diesel were dispensed in 2002. The GDF is operated and managed by the Transportation Department, which is part of SEM, and is regulated as a permitted emissions source by the BAAQMD. Records of deliveries of both gasoline and diesel are tracked and reported annually to BAAQMD. Under the conditions of SLAC's site-wide air permit, the gasoline dispensing system obtained an annual source test to ensure proper functioning.

In addition to SLAC-owned passenger cars and trucks, portable diesel dispensing tanks are filled at the GDF and then transported throughout SLAC to refuel heavy equipment and stationary engines, such as emergency back-up generators.

SLAC is in the process of replacing and upgrading its vehicle fleet for a number of reasons: vehicles approaching or past their normal service lives, increased maintenance and repair costs, availability of parts, and so on. Repairs per vehicle (both in number and cost) decreased somewhat for both types of vehicles in 2002. But the SLAC Transportation Department has initiated efforts to determine the full scope of recommended maintenance and expected repairs for the diversity of vehicles in the current fleet. This is almost certain to increase the repairs performed in both categories, but especially for the older DOE vehicles.

In 2002, 42 GSA vehicles were added to the SLAC fleet, while 39 aging DOE vehicles were removed. SLAC's efforts to improve fleet management generated the statistics summarized in Table 4-4.

Table 4-4 Vehicle Fleet Summary

Indicator	CY02	CY01
Total number of vehicles on site	234	237
Total number of GSA vehicles	178	136
Total number of DOE vehicles	59	98
Average GSA vehicle age in years	3	3
Average DOE vehicle age in years	19	19
Average year vehicle manufactured	1995	1991

At the beginning of the year SLAC operated 98 DOE-owned vehicles. The average age of these vehicles was 19 years, and they clearly represented the worst-polluting vehicles of SLAC's vehicle fleet. By the end of the year, SLAC had reduced the number of these aging, polluting vehicles by 40 percent.

Further reductions in the average age of SLAC's vehicle fleet are anticipated. Each reduction brings about corresponding decreases in the associated air emissions.

SLAC has begun to investigate vendors of alternative vehicles, including alternative-fueled vehicles and, in particular, electric vehicles. Industrial electric carts have always been used on site (in the klystron gallery, for example), but on a relatively small scale. The first shipment of more advanced electric vehicles was received in 2003, and as of September 2004 the fleet numbers 42, with a waiting list for more.

4.2.3 Summary and Future Plans

SLAC emits pollutants to the atmosphere from its operation of one-of-a-kind research and manufacturing equipment, as well as from more conventional sources such as building maintenance and vehicle fleet operation. SLAC operates its air quality management program in compliance with its established permit conditions; 2002 was the fifth consecutive year the air quality management program operated without receiving any notices of violation (NOVs) from cognizant regulators. Nevertheless, SLAC has an active program to improve its environmental performance in the air quality arena. Recent years have witnessed the following accomplishments:

- Decrease of more than 90 percent in halogenated solvent emissions from SLAC's Plating Shop
- Replacement of three pre-1984, Class 1 ozone-depleting substance (ODS) using chillers
- Decrease in the average age of SLAC's vehicle fleet from nine years to seven
- Successful negotiations to obtain a Title V synthetic minor operating permit (SMOP), which implements caps on facility-wide hazardous air pollutant (HAP) emissions

Future plans include the phasing out of all Class 1 ODSs, performance of a baseline greenhouse gas (GHG) survey for the facility, installation of new natural gas metering and instrumentation control systems at its main boilers, development and implementation of a new air emissions data management system, and further transition to a younger, more alternatively-fueled vehicle transportation fleet.

4.3 Industrial and Sanitary Wastewater Management Program

SLAC discharges industrial pollutants and sanitary sewage to the sewage collection system operated by the West Bay Sanitary District (WBSD); the sewage is conveyed via the WBSD's collection system to the wastewater treatment plant operated by the South Bayside System Authority (SBSA). Much of SLAC's industrial pollutants are pre-treated prior to discharge, at such facilities as the Metal Finishing Pre-treatment Facility (MFPF, formerly called the Rinse Water Treatment Plant), the Batch Treatment Plant, and the Mobile Treatment unit. This section describes the regulatory framework to which SLAC is subject for the purpose of water quality protection, and then presents the status of SLAC's water quality protection programs in 2002.

4.3.1 Regulatory Framework

The Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), was enacted in 1972 to halt the degradation of our nation's waters. The CWA established the National Pollutant Discharge Elimination System, which regulates discharges of wastewater from point sources such as a publicly owned treatment work (POTW) and categorically regulated industrial facilities such as electroplating shops. In 1987, the CWA was amended to include non-point source discharges such as stormwater run-off from industrial, municipal, and construction activities. The CWA is the primary driver behind the SLAC water quality protection programs.

At the beginning of 2002, SLAC operated its industrial and sanitary wastewater programs under three mandatory wastewater discharge permits, which are negotiated jointly with the WBSD and SBSA. These three permits were renewed on April 1, 2002 and will expire on December 15, 2006. These three permits specify monitoring programs and pollutant discharge limits. Additionally, SLAC has a contractual relationship with the WBSD which specifies the total industrial and sanitary flow allowed to be discharged. A summary of these requirements is presented in Table 4-5.

Table 4-5 Industrial and Sanitary Wastewater Monitoring Requirements

Sampling Location	WBSD Permit Number	Sampling Frequency	Monitoring Parameters
Sand Hill Road Station	WB 020401-F	Quarterly (by SBSA)	Cd, Cr, Cu, Pb, Ni, Ag, Zn, pH, Flow
Metal Finishing Pre-treatment Facility	WB 020401-P	Semiannually (by SLAC), annually (by SBSA)	Cd, Cr, Cu, Pb, Ni, Ag, Zn, pH, cyanide
Batch Treatment Facility	WB 020401-HX	Every 2,000-4,000 gallon batch (by SLAC)	Cd, Cr, Cu, Pb, Ni, Ag, Zn, pH
Sand Hill Road and three Alpine Road stations	Contractual discharge arrangement	Flow data collected on real-time basis	Flow

Per the terms of the permits, SLAC is also required to submit a semi-annual self-monitoring report on the results of its monitoring of the MFPF and a semi-annual certification that a solvent management plan (SMP) for approximately 100 solvents selected by the SBSA is being adhered to.[13]

SLAC's industrial and sanitary monitoring locations are shown in Figure 4-3. SLAC's Sand Hill Road flow metering station (FMS) is located immediately upstream of where SLAC's sewer system connects to WBSD's Sand Hill Road trunk line, just to the north of the SLAC main gate. During 2002, SLAC was in the process of constructing three flow monitoring stations on the south side of the facility which, when finished, will collectively monitor the flow SLAC discharges to the WBSD's Alpine Road trunk line.

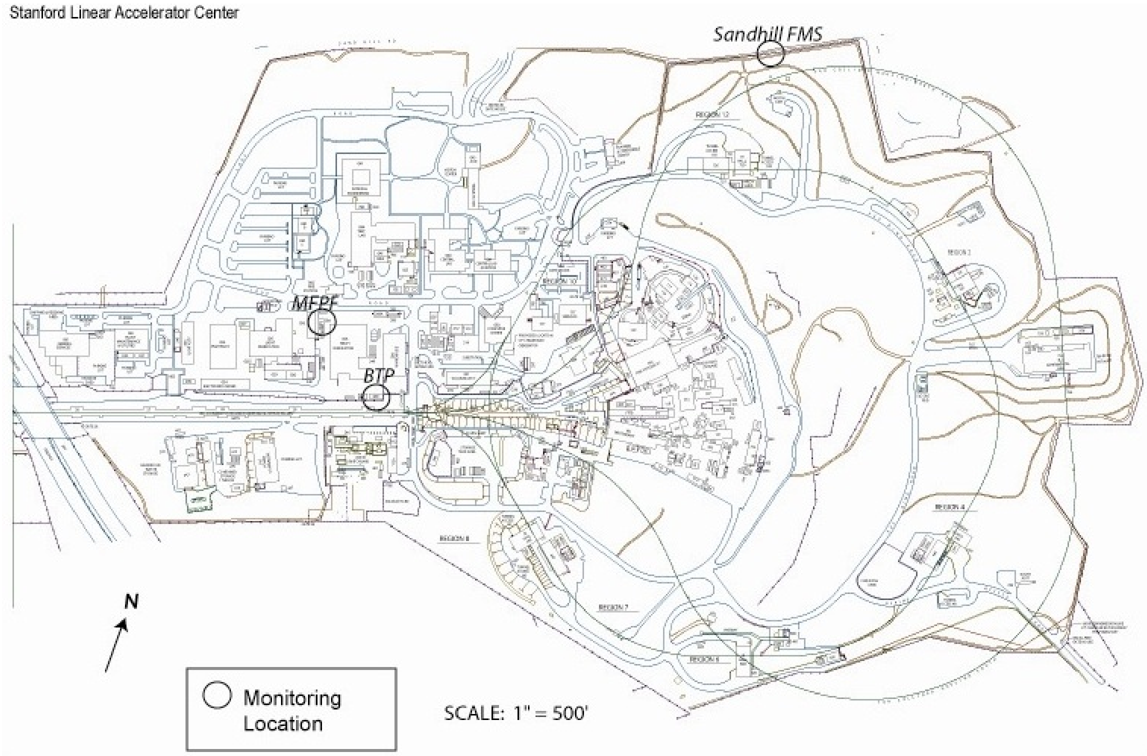


Figure 4-3 Industrial and Sanitary Wastewater Monitoring Locations

4.3.2 Program Status

4.3.2.1 Annual Facility Enforcement Inspection

The SBSA conducted an annual inspection of SLAC on March 15. No notices of violation (NOVs) were issued.

13 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *Semiannual Self-Monitoring Report, Mandatory Wastewater Discharge Permit WB 970401-P and WB 970401-HX* (EPR 0201-02, 4 January 2002, submitted to Chris Smith, Source Control, SBSA)

———, *Semiannual Self-Monitoring Report, Mandatory Wastewater Discharge Permit WB 020401-P and WB 020401-HX* (EPR 0206-08, 27 June 2002, submitted to Chris Smith, Source Control, SBSA)

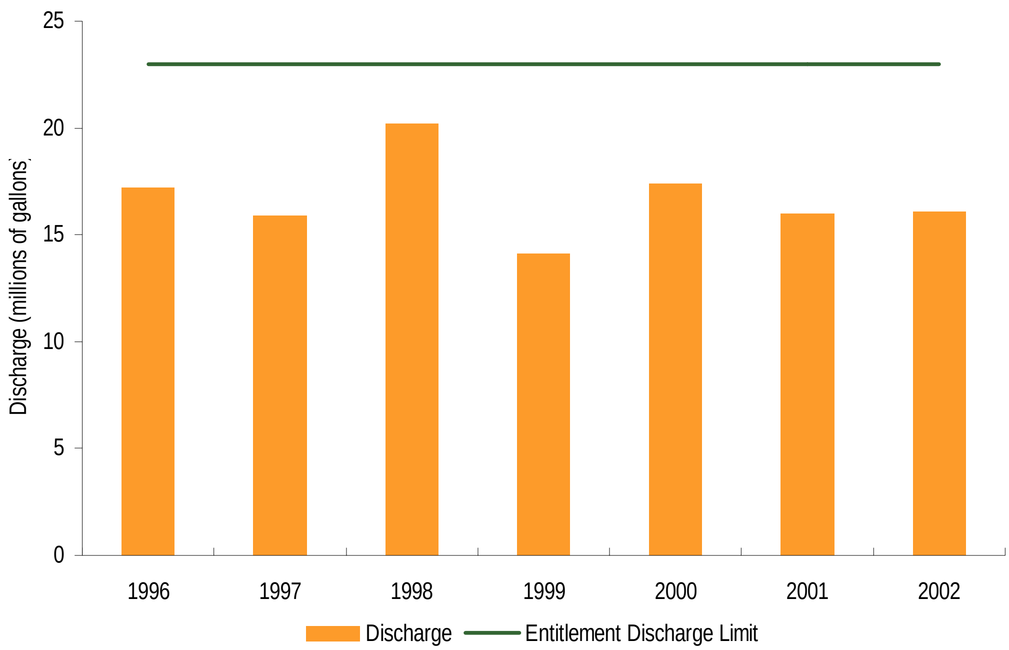
4.3.2.2 Flow Monitoring Results

Total industrial and sanitary wastewater discharge to the WBSD's regional collection system was approximately 17 million gallons, which equates to a daily average of approximately 47,000 gallons per day (gpd). The flow discharge limit for SLAC is approximately 23 million gallons, or 64,000 gpd. Thus, SLAC was approximately 25 percent under its facility-wide flow discharge limit in 2002.

SLAC's 2002 facility-wide discharge is compared to past years in Figure 4-4. The total quantity of wastewater discharged has been essentially flat over the last six to seven years. This flat trend actually reflects an improving program, because during this same time period:

- The new Research Office Building was connected to the system
- Progress on a connection project (see Section 4.4.2) continued, resulting in the elimination of unauthorized connections to the stormwater system by re-plumbing connections to the sanitary system
- A project to "slip-line" many of the old on-site sewer trunk lines was initiated, which results in decreased losses from the sewer lines to subsurface soils (less exfiltration) and increased flow within the system itself

In summary, SLAC has managed to keep its overall facility-wide discharge constant during a time period when many new sources of industrial and sanitary wastewater have been added to the collection system.



Sources: ASER, 1996–2001; Sand Hill Road Flow Meter

Figure 4-4 Industrial and Sanitary Wastewater Flow Discharged to WBSD Sewer System

4.3.2.3 Water Quality Monitoring Results

The complete set of water quality results for samples collected at the Sand Hill Road station during 2002 are presented in Appendix C. A summary of the water quality results for the Sand Hill Road station is presented in Table 4-6, along with the discharge limits set forth in SLAC's permits.

Table 4-6 Water Quality at the Sand Hill Road Station

	Monitoring Results (mg/L)		Calculated Results (lb/day)		Monitoring Results (mg/L)		Calculated Results (lb/day)		Wastewater Discharge Limit (lb/day)
Parameter	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	
	January 23, 2002				April 15, 2002				
Cadmium	<0.001	<0.01	<0.0004	<0.004	0.0031	<0.01	0.0012	<0.004	0.036
Chromium	0.0092	<0.07	0.0039	<0.03	0.0025	<0.07	0.0009	<0.03	0.18
Copper	0.084	0.13	0.035	0.055	0.11	0.20	0.042	0.076	0.13
Lead	0.0084	<0.08	0.0035	<0.03	0.0075	<0.08	0.0028	<0.03	0.33
Nickel	0.018	<0.04	0.0076	<0.02	0.011	<0.04	0.0042	<0.02	0.042
Silver	0.0029	0.013	0.0012	0.0055	<0.001	<0.008	<0.0004	<0.003	0.036
Zinc	0.17	0.20	0.072	0.084	0.18	0.19	0.068	0.073	0.45
pH (unitless)	8.5	8.8	NA	NA	7.8	8.1	NA	NA	6.0–12.5
Flow (gpd)	NA	50,453	NA	NA	NA	45,525	NA	NA	62,175
	July 3, 2002				October 22, 2002				
Cadmium	<0.005	<0.01	<0.0019	<0.004	<0.001	<0.01	<0.0004	<0.004	0.036
Chromium	<0.005	<0.07	<0.0019	<0.03	0.006	<0.07	0.0024	<0.03	0.18
Copper	0.19	0.25	0.070	0.093	0.16	0.27	0.061	0.10	0.13
Lead	<0.01	<0.08	<0.0037	<0.03	0.0083	<0.08	0.0031	<0.03	0.33
Nickel	0.088	<0.04	0.033	<0.01	0.021	<0.04	0.0079	<0.02	0.042
Silver	<0.005	0.010	<0.0019	0.004	<0.001	<0.008	<0.0004	<0.003	0.036
Zinc	0.18	0.183	0.067	0.068	0.14	0.17	0.053	0.064	0.45
pH (unitless)	7.6	7.8	NA	NA	7.9	8.4	NA	NA	6.0–12.5
Flow (gpd)	NA	44,417	NA	NA	NA	45,391	NA	NA	62,175

Notes:

1 Calculated results are derived for each sampling day using the following formula: (mg/L pollutant) (gpd) (8.34 lb/gal) (10E-6 L/mg)

2 Wastewater discharge limits for metals apply to the average of last four quarterly results and for pH to each quarter's

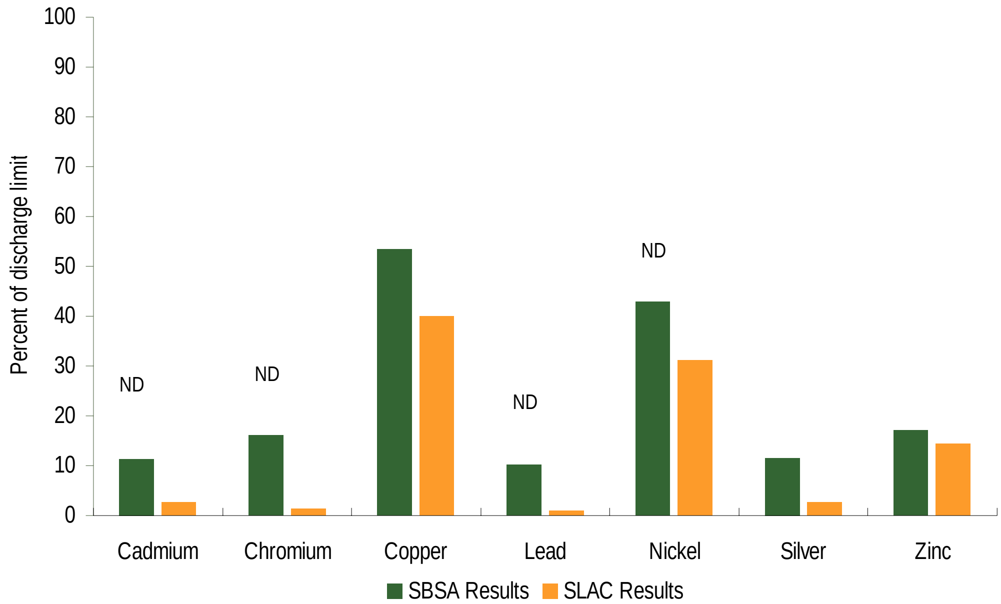
3 The detection limits for SLAC's July monitoring results were elevated due to matrix interferences

"<" precedes reporting limit (RL); for non-detectable analytes, RL used in calculations

Re SBSA calculated results: January and April are quarterly averages, while July and October are 12-month rolling averages

Most SBSA analyses have consistently higher reporting limits (RLs) than SLAC analyses; primary difference is two different labs performing two different analyses (EPA vs. APHA) -- latter specifies more aggressive extraction matrix

SLAC was in compliance with all seven heavy metal limits on all four sampling dates. In fact, on an annual basis, SLAC discharged only 10 percent (for lead) to 52 percent (for copper) of its permitted discharge limits, as shown in Figure 4-5.



Notes: ND = not detected. Chart column is of the detection limit of the metal
Annual average = calculated average percent of discharge limit from quarterly sampling events

Figure 4-5 Water Quality at the Sand Hill Road Station

The analytical results for water quality samples collected at the MFPF are presented in Table 4-7, along with the discharge limits set forth in SLAC's permits. SLAC was in compliance with all seven heavy metal limits and the cyanide limit on all three sampling dates.

Table 4-7 Water Quality at the Metal Finishing Pre-treatment Facility

			SBSA-Initiated Annual Sampling		SLAC-Initiated Semi-Annual Sampling	
			January 23		June 11	October 23
Analytical Parameter	Federal Daily Maximum (mg/L)	Federal Monthly Average (mg/L)	SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)
Metals						
Cadmium	0.69	0.26	<0.005	<0.01	<0.001	<0.001
Chromium	2.77	1.71	0.015	<0.07	0.0026	0.0099
Copper	3.38	2.07	0.15	0.22	0.55	0.098

			SBSA-Initiated Annual Sampling		SLAC-Initiated Semi-Annual Sampling	
			January 23		June 11	October 23
Analytical Parameter	Federal Daily Maximum (mg/L)	Federal Monthly Average (mg/L)	SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)
Lead	0.69	0.43	0.013	<0.08	0.019	0.0034
Nickel	3.98	2.38	0.065	0.08	0.096	0.087
Silver	0.43	0.24	<0.005	0.01	0.022	0.0016
Zinc	2.61	1.48	<0.02	0.024	<0.02	<0.02
Non-metals						
Cyanide	1.20	0.65	<0.005	0.003	<0.005	<0.005

Notes:

1 All monitoring results, except for pH, are expressed in units of milligrams per liter (mg/L)

2 Former total toxic organics (TTO) monitoring requirements was superseded by implementation of the SLAC Solvent Management Plan, which was submitted to the SBSA on July 31, 2001

4.3.3 Summary and Future Plans

SLAC discharges industrial and sanitary wastewater to the WBSD regional sewer collection system. These discharges originate from manufacturing locations such as SLAC's Plating Shop, from heat exchange systems such as SLAC's five major cooling tower installations, and from employee toilets and sinks across the facility.

SLAC operates its industrial and sanitary wastewater management program in compliance with established permit conditions: 2002 was the sixth consecutive year the program operated without receiving any NOVs from the program regulators. SLAC actively pursues projects that reduce flow to the wastewater system, and through a variety of measures has managed to keep its facility-wide wastewater discharge constant during a period in which many new connections were made to the system. SLAC continues to make progress on its transition to a new facility-wide flow monitoring scheme and substantially completed the project during 2003.

4.4 Surface Water Management Program

Stormwater that falls on the approximately 430-acre SLAC site discharges as surface water in 24 locations. In certain portions of the site, the stormwater has the potential to come into contact with industrial activities before it discharges. Such activities include metal working and metal storage, cooling towers, electrical equipment operation, and secondary containments.

Eleven of the 24 surface water discharge locations drain land still in its natural state, where there is no potential for stormwater to contact the industrial activities occurring at the site. An additional five locations drain developed land or areas where there is potential for stormwater to contact industrial activities, but the characteristics of the drainage is similar to that of locations that are monitored. Therefore, the focus of SLAC's surface water management program is on the remaining eight locations, shown in Figure 4-6 and listed below.

1. IR-8 Channel (IR-8)
2. IR-6 Channel (IR-6)
3. North Adit East Channel (NAE)
4. Main Gate East Channel (MGE)
5. IR-2 North Channel (IR-2)
6. Building 81 North Channel (B81)
7. Building 15 South Channel (B15)
8. Building 18 South Channel (B18)

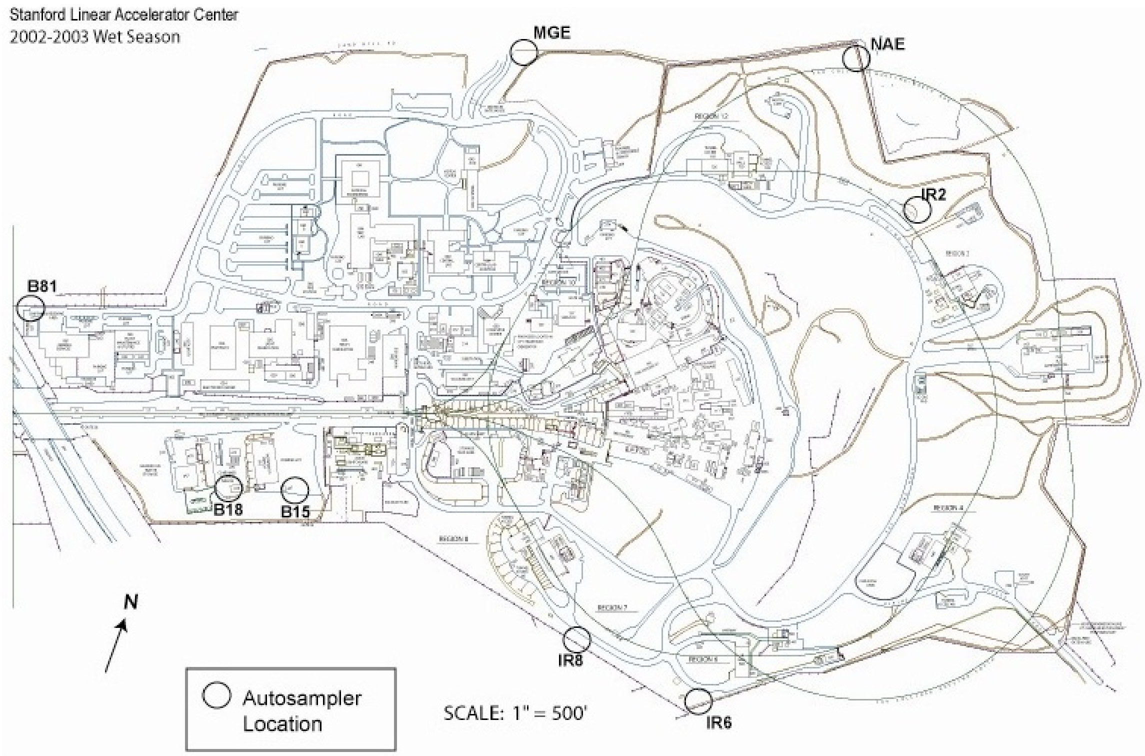


Figure 4-6 Surface Water Monitoring Locations

4.4.1 Regulatory Framework

Federal regulations allow authorized states to issue general permits to regulate industrial stormwater or non-point source discharges. California is an authorized state and, in 1991, the State Water Resources Control Board adopted the industrial activities stormwater general permit. SLAC filed a notice of intent to comply with the general permit, the goal of which is to reduce pollution in the waters of the state by regulating stormwater discharges associated with industrial activities.

California's general permit was re-issued in 1997. SLAC adheres to the requirements of the general permit, and specifies how it adheres to them in its site-specific stormwater pollution prevention plan (SWPPP).[14] The SWPPP has two main components: a stormwater monitoring program (SWMP) and a "best management practices" (BMPs) program.[15] The SWMP presents the rationale for sampling, lists the sampling locations, and specifies the analyses to be performed. The BMPs present a list of 13 generic and site-specific practices that should serve to prevent stormwater from coming into contact with SLAC's industrial activities (see Section 4.4.2.4).

4.4.2 Program Status

4.4.2.1 Annual Facility Enforcement Inspection

The Environmental Health Division of the San Mateo County Health Services Agency (the county) conducted an inspection of SLAC's surface water protection program on January 29, 2002. The inspection included a site tour of aboveground storage tanks, cooling towers, and surface water discharge locations. Additionally, the inspector reviewed SLAC's SWPPP. No notices of violation (NOVs) were issued. The inspector did request that the SWPPP map of discharge locations be updated. This requested action was completed within 30 days.

The California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) did not conduct an on-site inspection during the year. RWQCB staff, however, did review and approve a revised schedule for completion of the Unauthorized Stormwater Connection Project (for more information please refer to Section 4.4.2.4).

4.4.2.2 Flow Monitoring Results

During the year SLAC continued a flow monitoring program at the IR-6 and IR-8 channels. These are the two discharge locations with the most potential for stormwater to come into contact with industrial activities. The purpose is to measure flow at these locations; previously, flow had to be calculated from rainfall, drainage acreage, and assumed runoff coefficients.

4.4.2.3 Water Quality Monitoring Results

SLAC's SWMP incorporates all general permit sampling and analysis requirements, such as frequency (samples to be collected from first storm of season and one additional storm), locations (samples to be collected from locations where stormwater comes into contact with industrial activities), analytes (SLAC analyzes for 12 metal and nine non-metal analytes), and methodologies.

The general permit's definition of "wet season" runs from October 1 through May 30. This reflects California's (and SLAC's) climatological conditions, where rain rarely, if ever, falls during June through September. Therefore, SLAC has adopted the convention of reporting its water quality monitoring results

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14 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection Department, *Stormwater Pollution Prevention Plan* (SLAC-I-750-0A16M-002-R002, December 2001)

15 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, "Stormwater", http://www-group.slac.stanford.edu/esh/departments_groups/environmental_protection/water/stormwater/index.html

for the October 2002 through May 2003 "wet season" in its 2002 ASER. This is the same convention SLAC has adopted for TRI reporting (see Section 4.5.4).

The general permit requires submission of an annual report on stormwater activities by July 1, following the May 30 close of the wet season.[16] SLAC transmitted its annual report, which included all the water quality monitoring results, to the RWQCB to fulfill this requirement. No regulatory concerns were raised by the RWQCB regarding the annual report.

The first major storm of the wet season meeting the requirements of the general permit occurred on November 7, 2002. The second storm event sampled was on February 12, 2003.

SLAC met all the sampling and analysis requirements in its SWMP, with one exception: five of the 16 samples collected were not collected within the first hour of discharge. Missed sampling times were because of equipment malfunctions, primarily battery failure. Samples were collected as soon as the malfunction was identified, generally within two hours of the start of discharge. Steps taken to minimize missed sampling times include using alternative power sources wherever possible, changing batteries weekly, and only collecting from storm events that occur during regular work hours, in accordance with the permit.

The complete set of water quality results from the 2002–2003 wet season is presented in Appendix C. A summary of the water quality results for metals, polychlorinated biphenyls (PCBs), and tritium is presented in Table 4-8. Note that these results are derived from unfiltered samples; the results derived from filtered samples are included in the tables in Appendix C.

In Table 4-8 the number of results greater than the corresponding parameter benchmark values (PBVs, also referred to as the "reduction certification values") are shown. The PBVs are available from the State Water Resources Control Board.[17] Note that PBVs represent a threshold at which BMPs should be re-evaluated for effectiveness. They are not numerical discharge limits.

If a facility's stormwater monitoring results are entirely below the PBVs, then by law the facility operator is entitled to petition the RWQCB for a reduction in stormwater monitoring frequency. Thus, a comparison of SLAC's observed stormwater monitoring results against the PBVs is useful in assessing the overall effectiveness of SLAC's stormwater management program.

Eleven of the parameters for which SLAC monitors surface water quality have had PBVs established by the SWRCB. The total number of samples analyzed for these parameters during the 2002–2003 wet season was 149. A total of 21 percent of the analytical results were found to be above the PBVs. This was primarily because of the results for aluminum, iron, and zinc, which comprised 28 of the 32 instances of PBV exceedance.

Since neither aluminum nor iron is a priority pollutant, SLAC believes this is a good indication that efforts to manage priority pollutants in surface water are on the right track. Nevertheless, SLAC has an on-going effort to review its sampling protocols and improve its BMPs, as discussed below.

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16 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *2001–2002 Annual Stormwater Report* (EPR 0206-02, 30 June 2002, submitted to Rico Duazo, San Francisco Bay RWQCB)

17 State of California, State Water Resources Control Board, *Sampling and Analysis Reduction Certification* (no date), http://www.swrcb.ca.gov/stormwtr/docs/smanlrdc.doc

Table 4-8 Water Quality Results and Comparison to Parameter Benchmark Values

Analyte	Number of Results	Number of Defects	Maximum Concentration Detected[1]	SWRCB PBV[2]	Number of Results > PBV	Percent of Results > PBV
Metals						
Aluminum	16	16	9.4	0.75	9	56
Arsenic	16	4	0.090	0.16854	0	0
Cadmium	8	4	0.017	0.0159	0	0
Chromium	10	10	0.026	NA	NA	NA
Copper	16	16	0.40	0.0636	6	38
Iron	16	16	13	1.0	10	63
Lead	16	16	0.21	0.0816	2	13
Manganese	13	13	2.2	1.0	0	0
Molybdenum	8	1	0.018	NA	NA	NA
Nickel	8	5	0.058	1.417	0	0
Silver	8	0	ND[3]	0.0318	0	0
Zinc	16	16	6.6	0.117	11	69
Non-metals						
PCBs	16	2	0.015	0.1	0	0
Tritium (in pCi/L)	16	0	ND[3]	NA	NA	NA
Total	183	119			38	29[4]

Notes:

1 The maximum concentration of the analyte detected. Concentrations are in milligrams per liter (mg/L)

2 SWRCB PBVs are in mg/L and should be adjusted for hardness. PBVs shown are on a total metal basis; the PBV shown for PCBs is for Aroclor-1254. PBVs have not been set for chromium, molybdenum or tritium

3 The analyte was not detected in any of the samples for which it was analyzed

4 Determined by the total number of results > PBVs for those analytes for which PBVs are available

4.4.2.4 Best Management Practice Implementation Results

Best management practices (BMPs) are implemented at SLAC to reduce the potential for stormwater to come into contact with industrial activities. One way to gauge the effectiveness of BMP implementation is to compare the water quality monitoring results to the PBVs set forth by the SWRCB.

Over the last several years an important component of SLAC’s surface water management program has been the Unauthorized Stormwater Connection Project. In 1995 and 1996, a site-wide assessment was performed that eventually resulted in the identification of more than 300 unauthorized connections to SLAC’s surface water system. By “unauthorized”, we mean that these connections could have potentially allowed non-stormwater (process water, tunnel water, blowdown, et cetera, depending on the connection) to enter the surface water drainage system. A multi-year remediation plan was developed and funded. By the close of 2002, SLAC had expended more than $1 million on the remediation efforts. Only 32 connections remained to be remediated. The RWQCB has been kept apprised of the project status and reviewed and approved a revised schedule in June 2002.

Other BMP-related accomplishments during 2002 included

- Installing alarms at the four discharge locations of the industrial and sanitary sewer system. The high- and low-level alarms will alert site personnel of blocked sanitary sewer lines
- Installing a gutter drain at the entrance to Salvage (Building 28). The drain, in addition to the existing asphalt curbing around the perimeter of the yard, diverts a large amount of surface runoff around the Salvage yard, thereby greatly reducing the amount of metal particulates picked up by the runoff
- Removing 10 abandoned vehicles from SLAC. Releases of oil and antifreeze from abandoned cars represents a potential risk to stormwater
- Purchasing 10 two-yard hoppers to be used to contain excavated material requiring sampling and testing
- Improved the secondary containment at Building 750 consistent with SLAC policy and SLAC's spill prevention control and countermeasures program

4.4.3 Summary and Future Plans

SLAC discharges stormwater that has the potential to come into contact with industrial activities. SLAC has an extensive monitoring program in place at the eight discharge locations where past sampling results indicate the greatest potential exists. During the 2002–2003 wet season, SLAC met all the requirements of its monitoring plan, except for consistently collecting samples within the first hour of discharge.

2002 was tenth consecutive year the surface water program operated without receiving any NOVs from the program regulators. After the expenditure of more than $1 million, SLAC was nearing the completion of its Unauthorized Stormwater Connection Project at year-end; only 32 connections (less than 10 percent of the original total) remained to be remediated. SLAC actively pursued several other BMP-related performance improvements during the year.

When the analytical results from the 2002–2003 wet season were compared to the SWRCB's PBVs, 79 percent of the 149 results were below the benchmarks. SLAC believes this is a good indication that its implementation of surface water BMPs is on the right track. SLAC plans to continue to enhance its surface water monitoring program and the data analysis techniques for interpreting the results.

4.5 Hazardous Materials Management

SLAC uses hazardous materials as part of its experimental programs in high-energy physics and synchrotron radiation. For instance, isobutane and the refrigerant H-134a are used to create detector atmospheres with the appropriate physical and chemical properties to aid in detecting subatomic particles. In addition, SLAC uses hazardous materials in the manufacturing and maintenance of accelerator devices. Examples of hazardous materials managed at SLAC include

- Cryogens
- Flammable gases
- Compressed gases

- Acids and bases
- Solvents
- Adhesives
- Paints and epoxies
- Metals

4.5.1 Regulatory Framework

The regulatory framework for hazardous materials regulations, especially in California, has historically been a complex and overlapping web of statutes and regulations. Some of the most important regulatory drivers at the federal level include the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also commonly referred to as Superfund), its successor, the Superfund Amendments and Reauthorization Act (SARA), and the Toxic Substances Control Act (TSCA).

Important drivers at the state level generally date back to the mid-1980s and include hazardous materials business plans (often called AB 2185/2187 plans, after the state assembly bill numbers that initiated the program), the California Accidental Release Prevention Program, (CalARP, the successor of the original Risk Management and Prevention Program [RMPP] program), the underground and aboveground storage tank programs, and the waste minimization and pollution prevention program (often called SB 14, after the state senate bill number).

In general, the implementing agency for hazardous materials regulation in California is the local certified unified program agency (CUPA). The CUPA tasked with overseeing SLAC's hazardous materials management programs is the San Mateo County Health Services Agency, Environmental Health Division. CUPAs have broad enforcement responsibilities in the following six hazardous material subject areas:

1. Aboveground storage tanks/spill prevention control and countermeasures (AST/SPCC programs)
2. Hazardous materials business plans
3. California Accidental Release Prevention (CalARP)
4. Uniform Fire Code (UFC) hazardous materials issues
5. Underground storage tanks (USTs)
6. Pollution prevention and waste minimization

4.5.2 Program Status

Discussed in the following sections are the status of SLAC's current programs related to hazardous materials management, including its hazardous materials business plan, toxics release inventory (TRI), and CalARP programs. Also discussed are SLAC's aboveground storage tank program and its polychlorinated biphenyl (PCB) management program under the TSCA.

4.5.2.1 Annual Facility Enforcement Inspection

The Environmental Health Division of the San Mateo County Health Services Agency is the California certified unified permitting agency (CUPA) responsible for overseeing hazardous materials and waste management at SLAC. The CUPA made facility enforcement inspections of SLAC on January 8 through

January 11 and on February 21, 2002. These inspections covered SLAC's hazardous materials and waste management, business plan, CalARP, and tiered permitting/permit-by-rule programs. No notices of violation were issued as a result of either inspection.

4.5.3 Hazardous Materials Business Plan Program

The Emergency Planning and Community-Right-to-Know Act (EPCRA) was passed in 1986 as Title III of the Superfund Amendments and Reauthorization Act (SARA). SARA established requirements for emergency planning, notification, and reporting. In California, the requirements of SARA Title III are incorporated into the state's Hazardous Materials Release Response Plan and Inventory Law, more commonly referred to as the Hazardous Materials Business Plan (HMBP) program.

For the 2001 reporting year, SLAC updated its HMBP and submitted it to the CUPA on March 1, 2002 as scheduled. The HMBP includes a list of all hazardous materials present at SLAC in amounts exceeding the state's aggregate threshold quantities (55 gallons for liquids, 500 pounds for solids, and 200 cubic feet for compressed gases) on a building-by-building basis. The plan also includes building floor plans and summaries of emergency plans, procedures, and training. SLAC's HMBP was reviewed by CUPA staff during the annual enforcement inspection and found to be in order.

4.5.4 Toxics Release Inventory Program

Under Executive Order 13148, "Greening the Government through Leadership in Environmental Management", the DOE requires its facilities to comply with the Toxic Chemical Release Reporting and Community Right-to-Know requirements (40 CFR 312), more commonly referred to as the Toxics Release Inventory (TRI) program. SLAC annually provides the appropriate information to meet these program requirements to the DOE. Submittals go to the DOE SLAC Site Office (SSO), which provides the information to DOE headquarters. The information from all DOE facilities is then rolled up and reported to the USEPA.

TRI reporting consists of two steps: first, determination whether the facility's usage of more than 400 listed TRI chemicals exceeds certain threshold criteria, and if so, two, preparation of release inventory forms, commonly known as "Form Rs", for each chemical for which the usage threshold was exceeded.

For the 2001 reporting year, SLAC calculated that it used lead and copper in quantities greater than the corresponding threshold criteria. Therefore, SLAC prepared Form Rs for the two metals and submitted them to the DOE site office on June 13, 2002, in advance of the July 1, 2002 deadline. Note that SLAC had begun reporting on its releases of lead and copper beginning with the 2000 reporting year, which was also the year the usage amount threshold criterion for lead was lowered from 10,000 pounds per year to only 10 pounds per year.

SLAC's reported TRI releases, as taken from Section 8.1 of the TRI forms, from the 1993 reporting year through the 2001 reporting year, are shown in Figure 4-7. It can be seen from the figure that SLAC has reduced its reported TRI releases by more than 90 percent over this time.

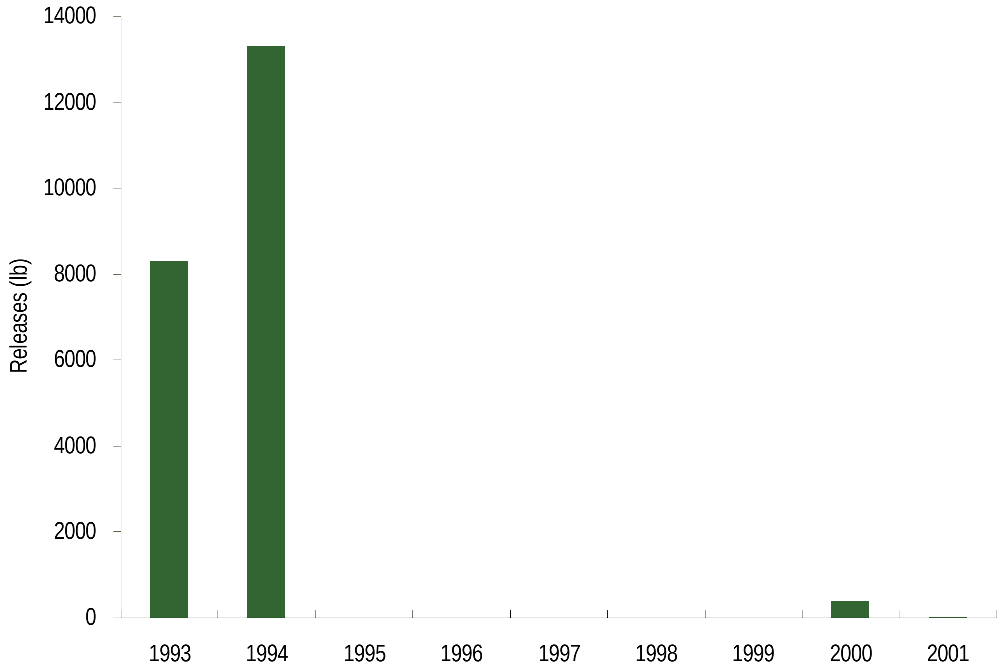

Figure 4-7 TRI Releases

A report prepared by DOE headquarters staff comparing TRI releases from 17 DOE facilities from the 1993 through the 2001 reporting years showed that, on a percentage reduction basis, SLAC achieved the third largest reduction in TRI releases of the 17 facilities. (TRI data is made available by the USEPA on its TRI Explorer web site.[18])

4.5.5 California Accidental Release Prevention Program

SLAC submitted its CalARP registration information to its CUPA on March 3, 1998. The original registration information was amended on May 15, 1998. The net result was that SLAC registered under the CalARP program for the "CalARP Table 3" substances nitric acid and potassium cyanide.

Information received during 1999 from the California Office of Emergency Services (OES) appeared to indicate that SLAC had an excellent case for "de-registering" its use of nitric acid. Additionally, a case can be made for de-registering potassium cyanide based on the way SLAC manages and processes the chemical.

CalARP program regulations for Table 3 substances state that the county is required to make a determination whether a risk management plan (RMP) is required of SLAC for the CalARP-regulated substances SLAC is managing. As of 2002 year-end, the county had not yet made its determination.

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18 United States Environmental Protection Agency, "EPA TRI Explorer: Chemical Report", http://www.epa.gov/triexplorer/

If the county determines that a RMP is necessary, it is required to give SLAC a minimum of 12 months, and a maximum of 36, to submit one. In an RMP, SLAC would need to prepare off-site consequence analyses of worst-case and alternative release scenarios for its registered CalARP chemicals, along with accident histories for the registered chemicals, and general descriptions of its accident prevention programs.

4.5.6 Aboveground Storage Tank Program

Aboveground storage tanks (ASTs) are regulated under the authority of the federal Clean Water Act (CWA) and California's Aboveground Petroleum Storage Act. A listing of the petroleum containing ASTs in operation at SLAC during 2002 is presented in Table 4.9. At SLAC, all petroleum tanks are constructed of steel. Each tank is either double-walled or has a cinder-block or poured-concrete containment basin surrounding the tank base.

Table 4-9 Aboveground Petroleum Tanks

Petroleum Product	Property Control Number	Location	Capacity (gallons)
Diesel	20501	B023 Central Utility	10,000
Diesel	20502	B037 Old Boiler Building	3,700
Diesel	19683	B112 Master Substation	2,000
Gas/Diesel	21443	B035 Vehicle Refueling Station	1,500/500
*Mineral Oil	19659	Mobile Transformer Oil Tank	1,000
*Castrol Oil	19596	B020 North Damping Ring	516
Diesel	NA	B082 Fire Station	500
Diesel	Unmarked	B505A Generator Fueling	500
Diesel	Unmarked	B007 MCC Generator Fueling	500
*Mineral Oil	Unmarked	B062 NLC "8-pack"	440
*Mineral Oil	19595	B021 South Damping Ring	260
*Mineral Oil	18902	B044 Klystron Test Lab	250
Diesel	Unmarked	B756 SLD Generator Fueling	250
Diesel	21544	Mobile Equipment Refueling	250

* These tanks are used only for short-term storage

A spill prevention, control, and countermeasures (SPCC) plan is required by 40 CFR 112 for all petroleum-containing ASTs greater than 660 gallons in size. The SLAC SPCC Plan is available on line.[19]

During 2002, changes to the SPCC regulations were promulgated. The revised regulations impacted SLAC's existing plan in the following three areas:

1. In addition to visual inspections, integrity testing was now required

19 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection Department, *Spill Prevention, Control, and Countermeasures Plan* (SLAC-I-750-0A16M-001-R001, November 2001), https://www-internal.slac.stanford.edu/esh/documents_internal/SPCC.pdf

2. A more rigorous review of the SPCC was required for certification as a professional engineer (PE)
3. The SPCC plan review cycle was increased from three to five years

A draft revision of SLAC's SPCC plan was completed in order to address the regulatory changes.

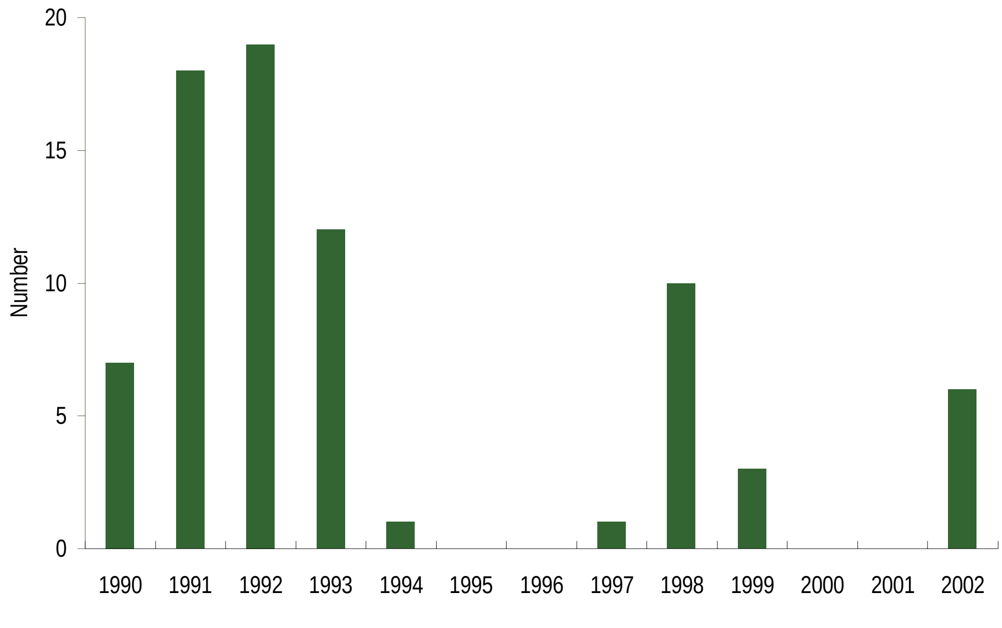
SLAC did not have any underground storage tanks (USTs) in operation during 2002. All USTs previously in operation have been removed.

4.5.7 Toxic Substances Control Act Program

The objective of the Toxic Substances Control Act (TSCA) is to minimize the exposure of humans and the environment to chemicals introduced into the manufacturing, processing, and commercial distribution sectors. One portion of the TSCA regulations addresses equipment that is filled with oil or other dielectric fluids that contain PCBs.

TSCA regulations are administered by the USEPA. No USEPA inspections regarding TSCA were conducted at SLAC during 2002.

By the end of 2002, SLAC had completed a decade-long project to remove from service many of its aging transformers and all 14 of its "PCB transformers". Note that a "PCB transformer" is specifically defined in 40 CFR 761 as a transformer containing more than 500 parts per million (ppm) of PCBs in its dielectric fluid. Project accomplishments are shown in figures 4.8 and 4.9. A total of 77 transformers, containing more than 46,000 pounds of PCBs, were removed from SLAC during the project.



Note: No transformers removed in 1995–6 and 2000–1

Figure 4-8 PCB Transformers Removed

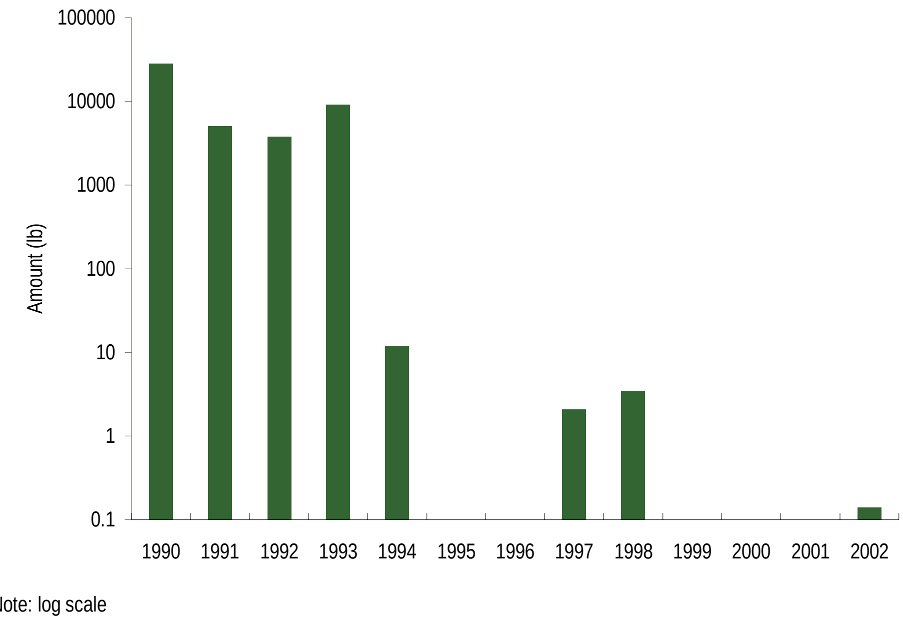


Figure 4-9 PCBs Removed

At the end of 2002, 97 transformers were in service at SLAC. Their PCB concentration ranges are shown in Figure 4-10. Transformers with concentration ranges of >50 ppm, but <500 ppm, are defined by TSCA as "PCB-contaminated transformers"; SLAC has 12 of these units remaining in service, with no immediate plans to remove them.

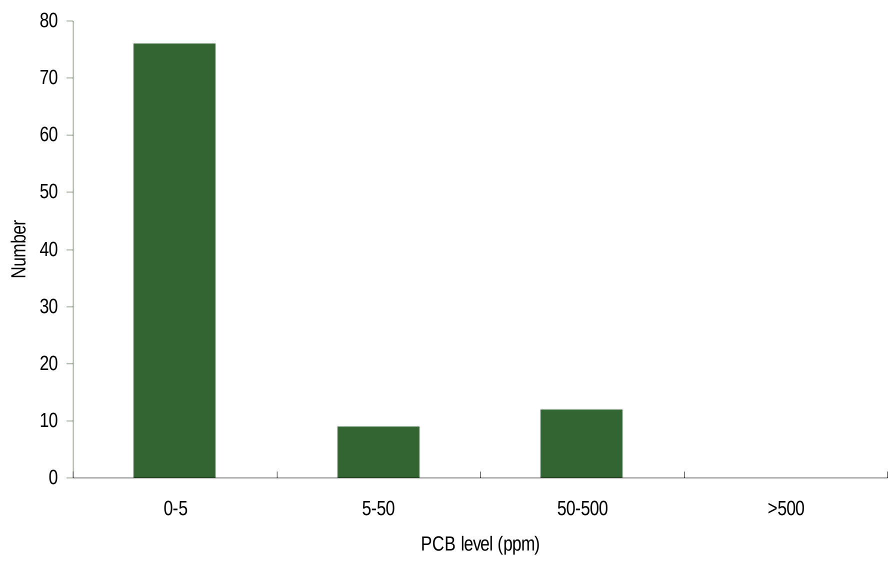


Figure 4-10 PCB Transformers Remaining

The total quantity of PCBs contained in the 97 transformers currently in service is 24 pounds. Thus, over the last decade, SLAC has removed from the site more than 99.9 percent of the total mass of PCBs contained in its transformers.

4.5.8 Chemical Management System

Although SLAC has been successful in meeting the regulatory requirements discussed above for managing hazardous materials, it has decided to pursue a more active strategy in reducing its use of such materials. The cornerstone of this effort is the implementation of a chemical management system (CMS).

Following its participation in the Silicon Valley Chemical Management Services Pilot Project,[20] SLAC finished its analysis of the various alternative approaches towards building a new hazardous materials management system. In December 2002, SLAC management decided to pursue implementation of the CMS contracting model, which has been used successfully by private industry for roughly a decade.

As of 2004, SLAC has conducted a competitive bid process and has begun implementation.

As a first-mover among academic and government facilities in pursuing implementation of the CMS model, SLAC has generated much interest in its experience among both the CMS vendor and academic/government customer communities. During 2002, SLAC made presentations at the following two workshops based on its experience:

1. Chemical Management Services in Silicon Valley: Updates from the Field (held in March 2002 in San Jose)
2. Sixth Annual Chemical Strategies Partnership Workshop: Lessons, Innovations, and Future Directions for CMS (held in October 2002 in Chicago)

4.6 Waste Minimization and Management

During the course of its research operations, SLAC generates a variety of waste streams, including hazardous, non-hazardous industrial, and municipal solid waste, in addition to scrap metal.

SLAC actively practices the pollution prevention hierarchy with respect to each of these waste streams:

- First, reduce waste and prevent pollution at the source through process changes, substitutions, and work practices
- Second, reduce waste and prevent pollution by reusing or recycling materials
- Third, reduce waste and prevent pollution by using appropriate control technologies
- Finally, after exhausting the first three approaches, exercise proper disposal

The following performance measures in the operating contract between the DOE and Stanford University reflect the importance that both parties place on waste minimization:[21]

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20 Chemical Strategies Partnership, “Pilot Programs – Silicon Valley”, http://www.chemicalstrategies.org/silicon_valley.htm

21 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, “ES&H ISMS: Performance Measures”, http://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm

- SLAC will reduce its generation of hazardous waste from routine operations by 65 percent by the year 2005, when using 1993 as the baseline year
- SLAC will recycle 50 percent of its municipal solid waste by the year 2005

4.6.1 Waste Minimization Accomplishments

SLAC has achieved both of its waste minimization goals since the year 2000 – five years early.

SLAC continues to make progress in reducing its hazardous waste from routine operations, as shown in Figure 4-11. For 2002, SLAC reduced its generation of hazardous waste from routine operations by 67 percent from the 1993 baseline.

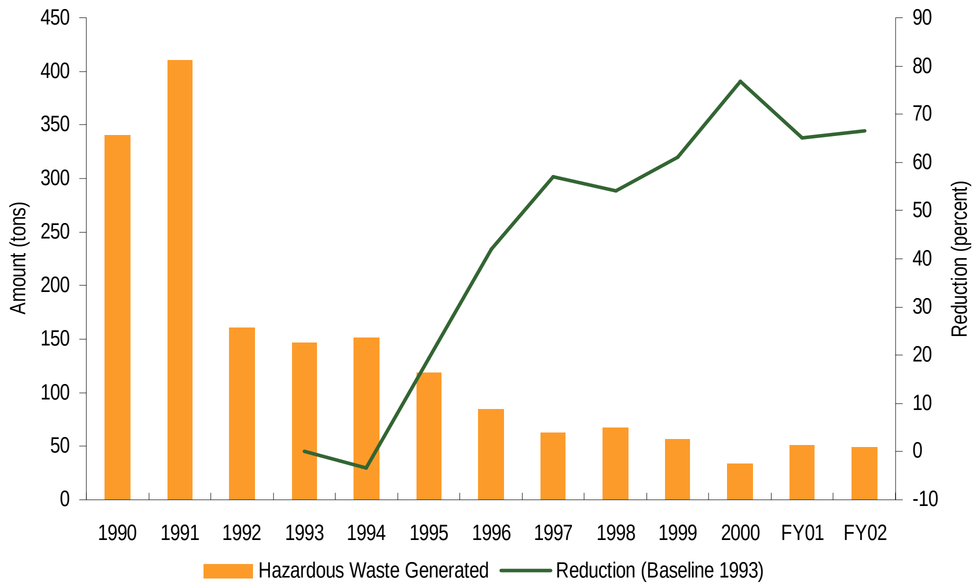


Figure 4-11 Hazardous Waste Generation

SLAC's progress in recycling 50 percent of its municipal solid waste is shown in Figure 4-12. For 2002, SLAC recycled exactly 50 percent of its municipal solid waste.

By the term "municipal solid waste", SLAC refers to the following waste streams generated at the site:

- Beverage containers (glass, aluminum, plastic)
- Paper (white paper, mixed paper)
- Cardboard
- Wood
- Scrap metal
- Garden/landscaping waste

- Construction debris
- Trash not otherwise sorted at the source and placed into dumpsters

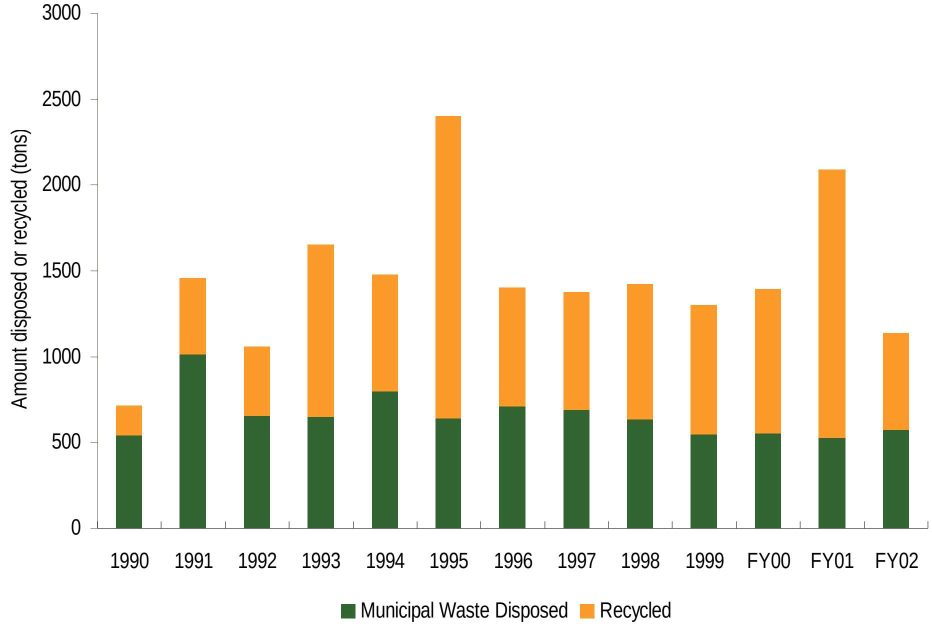


Figure 4-12 Municipal Solid Waste Recycling

In May 2002, the USEPA Federal Facilities Compliance Program awarded SLAC the Champions of Green Government Award for identifying and developing alternatives to ozone-depleting solvents. This award culminates a pollution prevention project that began in 1993 when an interdepartmental team began developing alternatives to ozone-depleting solvents to help SLAC reduce pollution. In the intervening years, the team has risen up through municipal and regional level awards for their work. The Champions of Green Government award is the first national-level recognition of their results.

SLAC's implementation of the team's recommendations achieved cleaning needs and also reduced emissions of hazardous air pollutants from these operations from an average of 5,800 pounds per year (over an 11 year period) to as little as 10 pounds in 2001. When compared to the 10-year average from 1988 to 1998, SLAC reduced emissions by more than 5,500 pounds per year, as shown in Figure 4-2.

Other waste minimization and pollution prevention projects initiated and/or continuing during 2002 are listed in Table 4-10.

Table 4-10 Waste Minimization and Pollution Prevention Projects

Number	Name/Description	Year Initiated	Status/ Project Length	Waste Reduction/Pollution Prevention Result
1	Extending plating bath life by quality control and chemical analyses using in-house atomic adsorption and ion chromatograph analyzers	1991	On going	Approx. 5,000 gallons annually
2	Reducing plating baths used for metal finishing of printed circuit boards by using outside services	1993	Continue to use outside services	1,000 gallons annually
3	Reducing wastes from spent alkali and acid baths in metal finishing operations by reuse and treatment	1996	On going	1,000 to 5,000 gallons annually
4	Reducing rinse water usage in metal finishing operations to reduce water and treatment chemical usage	1990	Two-year project	Reduced water usage by 0.9 million gallons and chemical usage (2,700 gallons of sulfuric acid, 1,800 gallons of sodium hydroxide, 1,100 gallons of ferric chloride solution and 1,100 pounds of calcium chloride)
5	Reduction of plating bath filter usage by more closely monitoring filter pressure drop and performance	1995	On going	Reduced waste by a volume by 16 55-gallon drums per year
6	Integration of spill prevention and safety measures for plating baths containing cyanides by transferring plating baths from a central plating area to a single room with more reliable containment and monitoring systems	1992	On going	Better handling and prevention of spills
7	Scrap copper reused in metal finishing operations as plating bath anodes	1996	On going	Reuse varies with production needs
8	Alternative solvent usage measures – closed system vapor degreasing, water-based cleaning, and non-chlorinated solvents – replaced ozone-depleting solvents used in metal fabrication and finishing operations	1993	On going	See graph on 1,1,1-trichloroethane reduction
9	Increased reuse of stock metal through electric discharge machining operations	1996	On going	Improved fabrication technique reduces scrap metal – no quantitative results tracked due to variations in production
10	Reducing Hazardous Waste by through better waste management -using reuse and on-and off-site recycling measures	1995	On going	Approximately 130 tons of waste disposal avoided from 1997 to 2002
11	Mobile Processing Unit to Reduce Stormwater Waste Handling by removing polychlorinated biphenyl (PCB) contamination	1999	On going	Approximately 60,000 gallons of storm reused in cooling towers annually
12	PEP II waste reduction promoted through	1998		Approximately 1,000 tons of concrete

Number	Name/Description	Year Initiated	Status/ Project Length	Waste Reduction/Pollution Prevention Result
	reuse of materials and equipment at SLAC or at off-site facilities			blocks reused at an off-site location
13	Implementation of a site-wide recycling program for paper, cardboard, and beverage cans/bottles	1999	On going	Improved paper and cardboard recycling by over 30 tons per year
14	Reduction of Ferric Chloride and Filter Cake in the Treatment of Rinse Waters from Metal Finishing Operations	2002	On going	Reduced generation of hazardous waste (filter cake) by 43 percent in 2002 relative to 1998 per gallon of rinse water treated
15	Employee Awareness in Waste Minimization and Pollution Prevention	1991	On going	Prepared over 25 articles on waste minimization and pollution prevention to increase employee awareness

4.6.2 Hazardous Waste Management

The Resource Conservation and Recovery Act (RCRA) of 1976 provided “cradle to grave” authority to regulate hazardous wastes from their generation to their ultimate disposal. This was to be accomplished through a system of record keeping, permitting, monitoring, and reporting.

The primary objective of the RCRA was to protect human health and the environment. A secondary objective of the RCRA, however, was to conserve valuable material and energy resources by promoting beneficial solid waste management, resource recovery, and resource conservation systems.

The USEPA has delegated authority to the state of California for implementing the RCRA program. In turn the state has delegated its authority for certain aspects of hazardous waste program oversight to what are called certified unified program agencies (CUPAs); the San Mateo County Health Services Agency, Environmental Health Division serves as the CUPA tasked with overseeing SLAC’s hazardous waste management.

4.6.2.1 Program Status/Annual Facility Enforcement Inspection

SLAC is considered to be a hazardous waste generator. SLAC does not have a RCRA Part B permit that would allow it to treat hazardous waste, store it on site, and/or dispose of it on site (that is, a TSD permit) under the federal-level RCRA regulations. SLAC does have permits that allow it to treat a few RCRA-exempt and non-RCRA (that is, California-only) hazardous waste streams (refer to Section 4.6.2.3 regarding the state-level tiered permitting program).

The CUPA last conducted a hazardous waste generator inspection of SLAC during January 2002. The inspection, carried out over four consecutive days, resulted in no notices of violation and in addition SLAC was commended for several good management practices.

4.6.2.2 Hazardous Waste Generation and Tracking

SLAC utilizes a self-developed, site-specific computerized hazardous waste tracking system (WTS). Hazardous waste containers are tracked from the time they are issued to the generator to eventual disposal off site. The WTS includes fields that generate information for the biennial SARA Title III and TSCA PCB annual reports.

SLAC categorizes the hazardous wastes it generates as

- Hazardous wastes from routine laboratory operations
- Hazardous wastes considered to be TSCA-regulated waste
- Hazardous wastes resulting from remediation and/or cleanup/stabilization projects

SLAC achieved its goal of reducing hazardous waste from routine laboratory operations by 65 percent by 2005 (compared to a 1993 baseline) beginning in FY00, and continued to achieve that goal through FY02. Specifically, during FY02 SLAC achieved a 67 percent reduction in its hazardous waste generation.

Hazardous wastes considered TSCA-regulated at SLAC result from two sources: removal of old electrical equipment containing PCBs and construction projects containing asbestos. The TSCA wastes result from the phasing-out of these chemicals from use at SLAC. SLAC's progress in reducing the quantities of TSCA waste from these sources is shown in Figure 4-13. Specifically, during FY02 SLAC achieved a 92 percent reduction in its TSCA waste generation compared to the 1993 baseline, and a 95 percent reduction compared to a 1990 baseline.

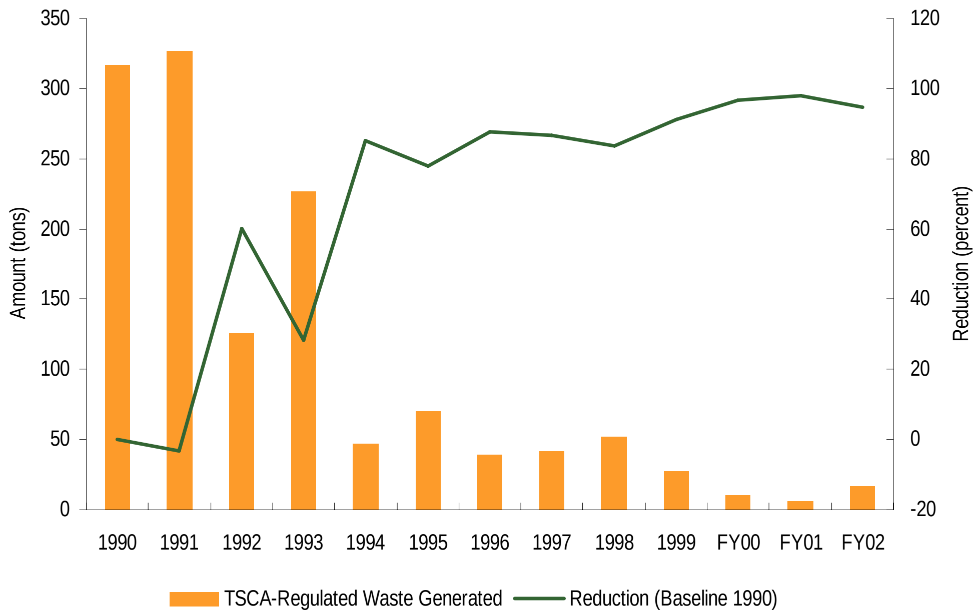


Figure 4-13 TSCA-Regulated Hazardous Waste, 1990–2002

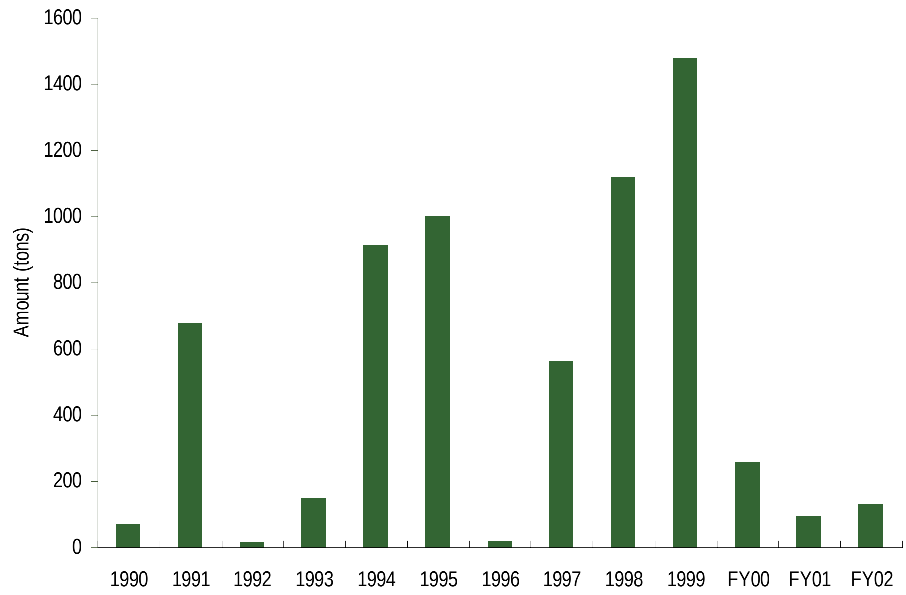
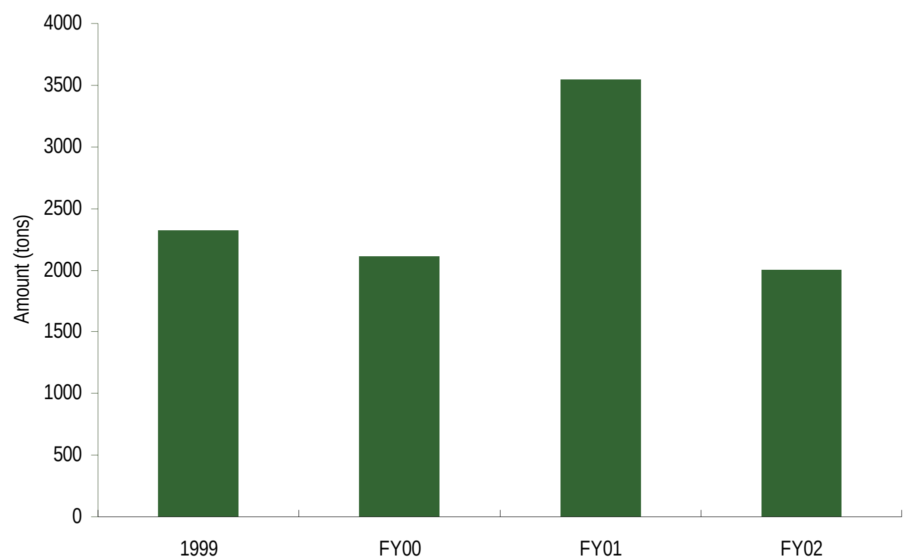


Figure 4-14 Remediation or Cleanup/Stabilization Waste (Class I), 1990–2002

Remediation wastes result from cleanup of soil and groundwater contaminated by historical management practices or accidental spills. Common remediation wastes at SLAC include metal- and PCB-contaminated soils. SLAC's progress in reducing the quantities of remediation hazardous wastes is shown in Figure 4-15.



Note: Class II waste is not hazardous (Class I) waste, however, it has sufficient contamination such that it cannot be disposed to municipal landfill

Figure 4-15 Non-hazardous Industrial Waste (Class II), 1998–2002

Spikes occur in the generation rate of remediation wastes based on cyclical remediation project activity levels. (For a discussion of SLAC's environmental restoration programs that result in the generation of remediation wastes, see Chapter 6.)

The overall reduction in SLAC's hazardous waste generation rates has been reduced through a combination of waste minimization and pollution prevention techniques, including

- Converting empty metal containers and drums to scrap metal
- Exchanging chemicals with other users
- Reclassifying waste streams to reduce hazardous waste volumes
- Reusing chemicals
- Returning unused material back to the vendor or manufacturer
- Sending electrical equipment off site for re-use by other organizations

SLAC should be able to continue to make progress in reducing the generation of hazardous waste from routine laboratory operations, although in much smaller increments than was previously the case. Additionally, the generation of TSCA and remediation wastes should decrease as SLAC continues to phase out its use of PCBs and removes its asbestos-containing materials.

4.6.2.3 Hazardous Waste Treatment: Tiered Permitting Program

The three tiers of California hazardous waste permits, presented in order of decreasing regulation, are called "permit by rule", "conditional authorization", and "conditional exemption". As shown in Table 4-11, during 2002 SLAC operated four hazardous waste treatment units that fell under these three categories.

Table 4-11 Hazardous Waste Treatment Units Subject to Tiered Permitting

Tiered Permit Level	Unit Number	Location/Description
Permit by rule	Unit 1	Metal Finishing Pre-treatment Facility – Water Treatment
Permit by rule	Unit 2	Metal Finishing Pre-treatment Facility – Sludge Dryer
Permit by rule	Unit 3	Batch Wastewater Treatment Plant (BTP)
Conditional authorization	Unit 4	Groundwater Treatment System at Former Underground Solvent Storage Tank (FSUST)

These units were authorized to treat listed or characteristic hazardous wastes. The Metal Finishing Pre-treatment Facility (MFPF) treated acidic and alkaline wastes containing heavy metals that result from the operation of SLAC's Plating Shop (Unit 1), and then dried the resulting heavy-metal containing filter cake to remove water (Unit 2). The BTP (Unit 3) treated aqueous waste containing heavy metals (typically from pipe-cleaning operations). The MFPF and BTP units also treated non-hazardous rinse waters and wastewater to meet industrial wastewater discharge requirements. The FSUST (Unit 4) treated groundwater contaminated with VOCs and SVOCs in order to meet industrial wastewater discharge requirements.

During 2002, SLAC decided that continued operation of the BTP was no longer necessary and therefore closed the unit during July 2002. A closure plan and report were provided to the CUPA.

The CUPA last inspected the tiered permitting program at SLAC in February 2002. The program was found to be in compliance, with no violations noted.

Also during 2002, SLAC received a questionnaire about its tiered permitting programs from the California Department of Toxic Substances Control (DTSC), the state-level agency that oversees the local-level CUPA. The questionnaire, dated June 26, 2002 and titled "Further Investigation Questionnaire in Connection with Phase 1 Environmental Assessment for Stanford Linear Accelerator Center", was completed and returned to DTSC. No further communication on the matter was received from DTSC during 2002.

4.6.3 Non-hazardous Waste Management

In addition to its hazardous waste management program, SLAC also operates several for non-hazardous waste. SLAC's Waste Management Department manages industrial waste resulting from SLAC's laboratory and remediation operations that, while not classified as hazardous, is not sufficiently "clean" to be disposed of in a municipal solid waste landfill. In California, these are generally termed "Class 2" wastes, since they are specifically required to be sent to what are known as Class 2 landfills (these provide an intermediate level of protection to the environment between Class 1, hazardous waste, landfills and Class 3, municipal solid waste, landfills).

SLAC's Site Engineering and Maintenance Department operates a municipal solid waste program that collects a variety of recyclable materials as well as regular dumpster refuse. SLAC's Property Control Department operates a salvage operation that sells metal and other industrial recyclables and equipment for their cash value. SLAC integrates the results of its metal salvage operations when reporting data about its municipal solid waste program.

4.6.3.1 Non-hazardous Industrial Waste Management

Non-hazardous industrial waste is a category used by SLAC to denote waste that is not classified as hazardous according to California and/or federal regulations, but because of some characteristic is not allowed to be disposed of in a regular California Class 3 (municipal solid waste) landfill. SLAC began to break out this category in 1999. The trends in SLAC's generation of non-hazardous industrial waste from 1999 through FY02 are shown in Figure 4-15.

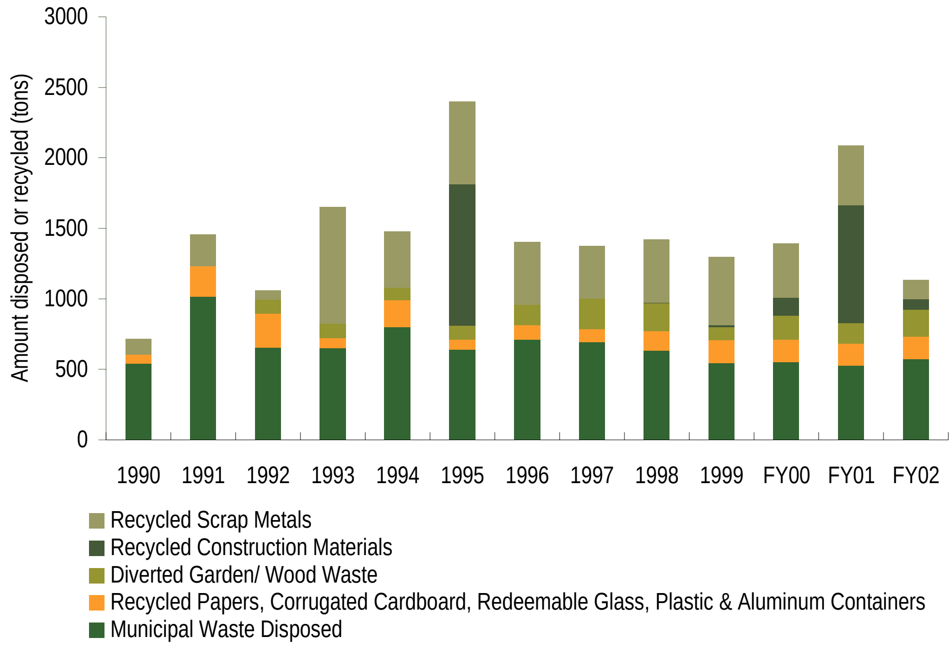
In general, the trend is flat to slightly decreasing, with the exception of a spike in volume during FY01.

4.6.3.2 Municipal Solid Waste Management

A site-wide program that recycles white paper, mixed paper, beverage containers (glass, aluminum, and plastic), cardboard, and scrap wood has been fully operational for more than 10 years. Collection stations incorporating anywhere from one to 10 green containers are strategically distributed around the site, along with dumpsters for cardboard collection and specific locations for waste wood. Scrap metal is collected. Construction materials from building demolition and rehabilitation projects are also recycled.

As is shown in Figure 4-16, SLAC's municipal solid waste recycling rate of 50 percent in 2002 marked the sixth straight year SLAC had achieved its contracted performance measure of 50 percent recycling.

The 50 percent figure achieved, however, was slightly below SLAC's annual average recycling rate of 58 percent achieved over the last decade. Two possible explanations for this result can be deduced if one looks at the contributions of the various waste streams being recycled, shown in Figure 4-16.



Note: Redeemable glass, plastic and aluminum ranges from 7 to 10 tons per year (included as paper and cardboard)

Figure 4-16 Municipal Solid Waste Recycling and Disposal, 1990–2002

First, SLAC's greatest annual recycling rates of 73 percent and 75 percent, achieved in years 1995 and 2001, respectively, correspond to years in which the quantities of construction materials being recycled spiked significantly. Second, the quantity of recycled scrap metal in 2002 was less than half of its normal annual rate. This is quite likely because of what is known as the DOE "metals moratorium", which went into effect in January 2000 for the release of volumetrically contaminated metals (activated metals) and July 2000, for metals from radiological areas, and forbids any DOE facility from sending off site for recycling any metal salvaged from inside an accelerator housing, even if the metal has been tested for radiological properties and found to be clean. The metals moratorium is not expected to be lifted until after DOE prepares an environmental impact statement (EIS) for the entire DOE complex on the issue, which could take several years. The moratorium may thus impact SLAC's ability to meet its performance measure.

4.6.4 Other Waste Management Activities

SLAC generates a small quantity of low-level radioactive waste every year; this waste stream is discussed in Chapter 5.

SLAC generates a small quantity of medical waste as a result of operating a Medical Department (in B41). In California, the state Medical Waste Management Act contains requirements designed to ensure the proper storage, treatment, and disposal of medical waste. The state program is administered by the Department of Health Services.

4.7 Environmental Planning

SLAC's scientific and support facilities were constructed with a strongly conceived planning framework established in the site's original general development plan (circa 1961) and master plan (circa 1966). For nearly four decades SLAC grew within this original framework, but over the years many small support and storage buildings and more parking demand have crowded the core research areas and obscured the original circulation plan. To meet the challenges of constructing major new projects in this constricted and environmentally sensitive location, SLAC employs two primary tools: National Environmental Policy Act (NEPA) analyses on a project-by-project basis, and conformance with SLAC's new long-range development plan (LRDP).[22]

4.7.1 SLAC Long Range Development Plan

In December 2002, SLAC published its new LRDP, the work of a group including both SLAC's LRDP Working Committee and the professional land use, environmental, and campus planners from the Stanford University Architect and Planning Office.

The LRDP will gradually encourage the replacement of small, outdated structures with more efficient and well-planned development. The plan includes a series of diagrams that overlay planned structures and circulation systems with environmental constraints to guide intelligently the siting of future projects. Environmental factors considered in developing the plan include

- Geology and seismicity
- Topography
- Sedimentation and erosion potential
- Hazardous materials
- Siting considerations relative to sensitive receptors
- Flooding and wetlands
- Habitat and species protection
- The visual character of SLAC

4.7.2 National Environmental Policy Act

SLAC developed its National Environmental Policy Act (NEPA) program in 1992. It is administered by SLAC's Business Services Division, with staff from the Environmental Protection Department providing environmental resources input and document review as requested. Under this program, proposed new construction at SLAC is reviewed to determine if NEPA documentation is required. If so, BSD determines which of the following three categories of NEPA documentation, presented in increasing order of complexity, is required:

- Categorical exclusion (CX)
- Environmental assessment (EA)

22 Stanford University Architect/Planning Office, *Stanford Linear Accelerator Center Long Range Development Plan* (December 2002, revised June 2003), http://www-group.slac.stanford.edu/bsd/SLAC_LRDP_final.pdf

- Environmental impact statement (EIS)

Aspects that must be considered when scoping and preparing NEPA documentation commonly include potential increases in air emissions or hazardous materials usage; impacts on wetlands, sensitive species, and critical habitats; and increases in water consumption and wastewater discharge.

SLAC prepared NEPA documentation for 13 construction projects during 2002, listed in Table 4-12. These projects ranged from construction of a new cooling tower in the Research Yard to projects upgrading SLAC’s electrical and computing infrastructures. Since all the projects were relatively minor in scope and environmental impact, all required only the lowest level of NEPA documentation, the CX. A total of 10 CXs were prepared, covering all 13 projects. Completed NEPA documents are forwarded to DOE/SSO for review and approval.

Table 4-12 NEPA Documentation Prepared during 2002

Project Name	Project ID	Project Year	Document ID	Document Type	Date
HVAC Upgrade SCS	5251	2002	SS-SC-0201	CX	02/19/2002
Upgrade to Substation 7	5250	2002	SS-SC-0201	CX	02/19/2002
Computer Bldg. Cooling Upgrade	5235	2002	SS-SC-0201	CX	02/19/2002
Additional Electrical Capacity Building 50	5211	2002	SS-SC-0201	CX	02/19/2002
Research Yard Cooling Tower	5236	2002	SS-SC-0202	CX	02/19/2002
Site 12kV Electrical Feeder Loop	5209	2002	SS-SC-0203	CX	02/26/2002
New Steam Cleaning Pad at Building 081	5242	2002	SS-SC-0204	CX	02/26/2002
Research Yard Storage Shed	5204	2002	SS-SC-0206	CX	06/16/2002
Research Yard Support Building	5205	2002	SS-SC-0207	CX	06/16/2002
Erosion Control Sector 6	5243	2002	SS-SC-0208	CX	06/27/2002
Buildings 215/224 Relocation	5247	2002	SS-SC-0209	CX	07/15/2002
Buildings 222/223 Relocation	5213	2002	SS-SC-0210	CX	08/15/2002

5 Environmental Radiological Program

5.1 Introduction

All members of the public receive radiation doses from natural background radiation and from an assortment of human activities. This chapter describes sources of radiation and radioactivity at SLAC, and provides an overview of how SLAC's Environmental Radiological Program assesses direct radiation and radioactivity in water, air, and soil for the purpose of determining the potential radiation dose to the public and impacts to the environment.

The dose that members of the public receive due to SLAC operations is a small fraction of the dose received from natural background radiation. As in past years, in 2002 the potential radiation dose to the public and the radiation-related impacts to the environment from SLAC operations were significantly below all regulatory limits.

Section 5.8 summarizes the maximum dose potentially received by a member of the public due to SLAC operations in 2002.

5.2 Sources of Radiation and Radioactivity

The linear accelerator at SLAC is encased in a concrete tunnel 25 feet beneath the surface of the ground. Through this underground tunnel, particles are accelerated to nearly the speed of light.

Some particles strike accelerator components during the acceleration process. When that happens, the decelerating particles may emit secondary radiation in the form of high-energy photons and neutrons. At SLAC, "direct radiation" is the radiation that is present whenever particles are accelerated, but that ceases as soon as power to the accelerator is terminated. Direct radiation is mainly due to the secondary photon and neutron radiation emitted when high-energy particles are decelerated.

Both the particles being accelerated and secondary radiation may also make the substances they strike become radioactive. Table 5-1 lists the predominant radioactive elements produced in water or air and their half-lives.

Facilities at SLAC are designed to meet all applicable safety and environmental requirements. Nearly all the direct radiation is stopped by the combined shielding on the accelerator structure and the earth that surrounds the accelerator tunnel. SLAC monitors the small fraction of photons and neutrons that pass through the accelerator components, through the surrounding earth, to reach areas outside of the accelerator. This monitoring is described in Section 5.3.

SLAC also assesses, measures, and reports on radioactivity as required by its policies and by state or federal regulations. Sections 5.4 through 5.6 and 5.9 describe SLAC's programs to assess and control radioactivity that can be released into the environment. All known releases of radioactive materials are included in the tables in those sections.

Table 5-1 Activation Products in Water or Air

Radioactive Element	Half-life	Primarily Produced In
^{15}O	123.0 seconds	Water or air
^{13}N	10.0 minutes	Air
^{11}C	20.3 minutes	Water or air
^{41}Ar	1.8 hours	Air
^{7}Be	53.6 days	Water
^{3}H	12.3 years	Water

5.3 Monitoring for Direct Radiation

DOE standards require SLAC to demonstrate that radiation and radioactivity from SLAC did not cause any member of the public to receive a radiation dose greater than 100 millirems (mrem, a unit used to quantify radiation dose to humans) during the year.[23] In 2002, the maximum dose that could have been received by a member of the public due to direct radiation from SLAC was less than two percent of that 100 mrem limit.

During 2002, SLAC measured direct radiation at about 30 locations to determine the potential radiation dose to a member of the public. Readings from dosimeters used to measure radiation were recorded each calendar quarter. Landauer Incorporated, accredited by the National Voluntary Laboratory Accreditation Program as a dosimeter supplier, provided and processed the dosimeters. Results from these dosimeters were also used to calculate the collective dose to the population that lives within 80 km of SLAC. Appendix A contains detailed information on how the 2002 dose measurements were used to determine the potential dose to a member of the public. Appendix B contains a summary of the collected data and a map of the measurement locations.

Section 5.8 and Table 5-6 summarize annual doses and show how those doses compare to those from natural background radiation.

5.4 Assessment of Airborne Radioactivity

United States Environmental Protection Agency (USEPA) regulations (40 CFR 61) enacted under the Clean Air Act and DOE Order 5400.5 require SLAC to demonstrate that airborne radioactivity released did not cause any member of the public to receive a dose greater than 10 mrem during the year. In 2002, the maximum dose that could have been received by a member of the public due to airborne radioactivity from SLAC was less than one percent of this limit.

SLAC files an annual report that describes the possible sources, types, and quantities of airborne radioactivity released into the atmosphere. As detailed in that report, the released airborne radioactivity was calculated, based on conservative information about accelerator operations in 2002 (Table 5-2 summarizes the released radioactivity, showing the quantities in curies [Ci]). Potential doses to members of the public

23 United States Department of Energy, DOE Order 5400.5, “Radiation Protection of the Public and the Environment” (revised January 1993), http://www.directives.doe.gov/pdfs/doe/doetext/oldord/5400/o54005c2.pdf

due to the released radioactivity were determined using USEPA software (CAP88).[24] In addition to providing information on maximum individual doses, SLAC also assessed and reported the collective dose to the population that lives within 80 km of SLAC.

Tables 5-2 and 5-6 and Section 5.8 provide a summary of the results as well as information on how the maximum possible doses compare to natural background radiation.

Table 5-2 Airborne Radioactivity Released in 2002

Category	Radioactive Element	Activity (Ci)
Tritium	^{3}H	n/a
Krypton-85	^{85}Kr	n/a
Noble gases ($T_{1/2}$ < 40 days)	^{41}Ar	1.3
Short-lived activation products ($T_{1/2}$ < 3 hr)	^{15}O	15
	^{13}N	27
	^{11}C	3
Other activation products ($T_{1/2}$ > 3 hr)	n/a	n/a
Total radioiodine	n/a	n/a
Total radiostrontium	n/a	n/a
Total uranium	n/a	n/a
Plutonium	n/a	n/a
Other actinides	n/a	n/a

5.5 Assessment of Radioactivity in Water

Three types of water are monitored for radioactivity at SLAC: industrial wastewater, stormwater, and groundwater. This section summarizes the 2002 monitoring and results for each water type.

5.5.1 Industrial Wastewater

Federal and state regulations (10 CFR 20.2003 and 17 CCR 30253) limit the radioactivity in industrial wastewater that SLAC releases to the sanitary sewer system. In 2002, SLAC releases totaled less than two percent of the applicable limits.

Although most of the cooling water or other water present in the accelerator does not contain radioactivity, other than what is naturally present, some of the water becomes activated by radiation from the accelerator (see Section 5.2). Routine operations require SLAC to drain accelerator cooling systems from time to time. Cooling water, as well as ground- and stormwater that enters the accelerator housing, is disposed of as part

24 Stanford Linear Accelerator Center, Environment, Safety, and Health Division. Operational Health Physics Department, *Radionuclide Air Emissions Annual Report – 2002* (June 2003)

of SLAC's industrial wastewater. Thus a small fraction of SLAC's wastewater volume contains radioactivity.

In 2002, SLAC sampled and analyzed wastewater at about 30 discharge points. Table 5-3 summarizes the results of wastewater monitoring for calendar year 1992 through 2002. The final column of the table compares the radioactivity discharged by SLAC into the sanitary sewer with the annual limit for such discharges set by federal and state regulation.

Table 5-3 Summary of Radioactivity in SLAC Wastewater, 1992–2002

Year	Radioactive Element	Activity (Ci)	Percentage of Annual Limit
1992	^{3}H	4.1×10^{-2}	0.8
1993	^{3}H	2.5×10^{-3}	0.05
1994	^{3}H	1.7×10^{-3}	0.03
1995	^{3}H	1.1×10^{-2}	0.2
1996	^{3}H	3.4×10^{-1}	6.8
1997	^{3}H	2.2×10^{-2}	0.5
1998	^{3}H	7.2×10^{-2}	1.4
1999	^{3}H	7.1×10^{-3}	0.1
2000	^{3}H	2.4×10^{-3}	0.05
2001	^{3}H	2.1×10^{-3}	0.04
2002	^{3}H	2.4×10^{-2}	0.5
	^{22}Na	5.1×10^{-5}	1.4*
	^{7}Be	1.4×10^{-2}	

* Combined. Excluding ^{3}H (for which there is a 5 Ci annual limit), there is a 1 Ci limit for the combined activity of all radioactive elements released during the calendar year

In addition to wastewater containing ^{3}H, water containing small quantities of ^{7}Be and ^{22}Na was released during 2002. Each year, the quantities and types of radioactivity in wastewater that is discharged depend on past accelerator operations and on details of wastewater handling. For 2002, radioactivity in wastewater discharges to the sanitary sewer totaled less than two percent of the permitted annual limits.

Throughout 2002, SLAC reported the results of wastewater monitoring to the South Bayside System Authority (SBSA) at the end of each calendar quarter.[25]

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25 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Operational Health Physics Department, *Radioactivity in Industrial Wastewater for the Period 1 January 2002 to 31 March 2002* (5 April 2002, submitted to SBSA)

———, *Radioactivity in Industrial Wastewater for the Period 1 April 2002 to 30 June 2002* (8 July 2002, submitted to SBSA)

Table 5-4 Radioactivity in Wastewater Released in 2002

Category	Radioactive Element	Activity (Ci)	Annual Release Limit (Ci)
Tritium	^{3}H	2.4×10^{-2}	5
Activation products ($T_{1/2}$ > 3 hr)	^{22}Na	5.1×10^{-5}	1*
	^{7}Be	1.4×10^{-2}	
Total radioiodine	n/a	0	
Total radiostrontium	n/a	0	
Total uranium	n/a	0	
Plutonium	n/a	0	
Other actinides	n/a	0	

* Combined. Excluding ^{3}H (for which there is a 5 Ci annual limit), there is a 1 Ci limit for the combined activity of all radioactive elements released during the calendar year

5.5.2 Stormwater

The program for monitoring stormwater is described in Section 4.4 of this report. In 2002 (and in all previous years), no radioactivity above background was found in any stormwater sample.

In 2002, SLAC reported the results of stormwater monitoring (including checks for radioactivity) to the regional water quality control board (RWQCB).[26]

5.5.3 Groundwater

Throughout 2002, SLAC analyzed water samples from monitoring wells for the presence of radioactivity each time the wells were sampled under the groundwater monitoring plan described in Chapter 6 of this report. With the exception of the three monitoring wells listed in Table 5-5 below, no radioactivity above natural background was detected in any of the water samples.

The detected concentrations of tritium (^{3}H) in the water samples summarized in Table 5-5 were below the federal and state limits set for tritium in drinking water (20,000 pCi/L under 22 CCR 64443 and 40 CFR 141.66). The groundwater supply is very limited at SLAC and it is not used for any purpose other than monitoring. Even if there was an adequate supply of groundwater available at SLAC, it could not be used as drinking water due to the high content of dissolved solids.

———, *Radioactivity in Industrial Wastewater for the Period 1 July 2002 to 30 September 2002* (29 October 2002, submitted to SBSA)

———, *Radioactivity in Industrial Wastewater for the Period 1 October to 31 December 2002* (30 January 2003, submitted to SBSA)

26 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *2001–2002 Annual Stormwater Report* (EPR 0206-02, 30 June 2002, submitted to Rico Duazo, San Francisco Bay RWQCB)

Table 5-5 Summary of Tritium (^3H) Concentrations Measured in Monitoring Wells in 2002

	Well								
	EXW-4			MW-30			MW-81		
Period	Avg ^3H (pCi/L)	% of DWS[1]	No. of Samples	^3H (pCi/L)	% of DWS[1]	No. of Samples	^3H (pCi/L)	% of DWS[1]	No. of Samples
Jan–Mar	5,851	29	11	n/a	n/a	0	[2]	[2]	0
April–June	4,711	24	5	n/a	n/a	0	<500[3]	<3	1
July–Sept	4,639	23	11	n/a	n/a	0	603	3	1
Oct–Dec	4,778	24	10	973	5	1	952	5	1

Notes:

1 Drinking water standard: 20,000 pCi/L for ^3H

2 MW-81 was one of 11 monitoring wells installed at SLAC during 2002. No detectable ^3H was present in any of the other new wells

3 500 pCi/L was the minimum ^3H concentration that was detectable by SLAC in 2002

5.6 Assessment of Radioactivity in Soil

Throughout 2002, SLAC sampled and analyzed soil for projects involving soil excavation on the SLAC site. No soil samples were found to contain radioactivity in excess of natural background.

5.7 Release of Property Containing Residual Radioactive Material

Throughout 2002, all property, real and personal, exposed to any process that could cause it to become radioactive was surveyed for radioactivity before it was permitted to be removed from SLAC. Property that had any detectable radioactivity was identified as "radioactive" and was either retained for appropriate reuse on site or was disposed of as radioactive waste. Therefore property releases do not add to the potential public dose. Material which did not have detectable radioactivity was not considered radioactive and was released from any further controls. (There were also controls on movement of property between locations on site, but these are not relevant to this report and are documented elsewhere.)

5.8 Potential Dose to the Public

The maximum possible dose to members of the public due to SLAC are small compared to doses from natural background radiation and are well below all regulatory limits.

Table 5-6 summarizes the dose results for the two modes that were the potential contributors to public radiation dose in 2002: direct radiation and airborne radioactivity. Releases of radioactivity in water and property were too small to result in a radiation dose to a member of the public under an imaginable scenario. The reported maximum dose due to direct radiation is based on a person being present 24 hours per day in 2002 at the location of a building on the northern side of the Sand Hill Road overpass of Interstate 280. Table 5-6 compares the 2002 dose results with regulatory limits and natural background.

Table 5-6 Summary of Potential Annual Doses due to SLAC Operations in 2002

	Maximum Dose to General Public – Direct Radiation	Maximum Dose to General Public – Airborne Radioactivity	Maximum Dose to General Public – Airborne + Direct	Collective Dose to Population within 80 km of SLAC
Dose from SLAC in 2002	2 mrem	0.08 mrem	2.08 mrem	19.2 (direct) +0.2 (air) = 19.4 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	n/a
SLAC 2002 Max. Dose as Percentage of DOE Standard	2%	0.8%	2%	n/a
Dose from Natural Background	100 mrem	200 mrem	300 mrem	1,667,000 person-rem
SLAC 2002 Max. Dose as Percentage of Natural Background	2%	0.04%	0.7%	0.001%

Table 5-7 presents the maximum dose potentially received by a member of the public from direct radiation and airborne radioactivity due to SLAC operations in 1995 through 2002 and compares it to the average dose due to natural background radiation and radioactivity.

Table 5-7 Potential Dose (mrem) to Maximally Exposed Individual, 1995–2002

Year	SLAC Direct and Airborne Radiation	Average, Total Natural Background Radiation
1995	2.2	300
1996	4.6	300
1997	4.2	300
1998	4.6	300
1999	4.5	300
2000	5.7	300
2001	5.3	300
2002	2.1	300

5.9 Biota Dose

The DOE technical standard, “A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota” (DOE-STD-1153-2002), suggests that DOE facilities protect plants and animals by assuring that the following doses rates – due to “…exposure to radiation or radioactive material releases” into the applicable environment – are not exceeded:

- Aquatic animals: should not exceed 1 rad/day
- Terrestrial plants: should not exceed 1 rad/day
- Terrestrial animals: should not exceed 0.1 rad/day

5.9.1 Dose to Biota from Direct Radiation

In 2002, SLAC monitored dose and dose rate at approximately 200 on-site locations (indoors and out) using passive radiation dosimeters posted for three to six month periods. For each period, nearly all of the over 200 dosimeters recorded average dose rates less than 0.005 rad/day. A small fraction of the more than 200 dosimeters recorded higher average dose rates, ranging from 0.005 to 0.088 rad/day. All of the points – where an average dose rate greater than 0.005 rem/day was measured – were, however, locations that were inaccessible to animal populations (for example inside accelerator buildings). Given this monitoring program and the fact that we know animal populations could not have been present except in locations with average dose rates of less than 0.005 rad/day, doses to plant and animal populations at SLAC were well within the limits of the DOE standard throughout 2002.

5.9.2 Dose to Biota from Activation Products

In 2002 SLAC tested soil and water samples for the presence of radioactivity in excess of natural background, as described in sections 5.5 and 5.6. Tritium (^{3}H) was occasionally found in industrial wastewater in 2002 and on one occasion, beryllium (^{7}Be) and sodium (^{22}Na) were also present, but plant and animal populations have no opportunity for access to industrial wastewater at SLAC.

In 2002, no groundwater was found with tritium concentrations in excess of the drinking water standards set by state and federal regulations. (Section 5.5.3 summarizes the 2002 results of monitoring for radioactivity in groundwater.) There is no possibility that populations of plants or animals will receive dose rates that exceed the limits of the standard due to radioactive activation products that result from accelerator operations at SLAC.

5.10 Low-level Radioactive Waste Management

Low-level radioactive waste (LLRW) is produced at SLAC sporadically. Wastes resulting from routine operations have not been tracked as a category separate from other operations such as one-time upgrade, equipment failure replacement, and special projects. A system is now in place to allow tracking of “routine operation wastes”.

LLRW minimization is accomplished through education and training for the waste generator, careful planning of work operations, thorough survey and characterization of materials, segregation, reuse, and volume reduction when applicable.

SLAC continues to manage its LLRW in compliance with all applicable laws and regulations. During calendar year 2002, SLAC shipped 607 cubic feet of LLRW to treatment and disposal facilities. Of this volume shipped, over 70 percent was from legacy waste. This legacy waste is the direct result of our continuing efforts to clean the site of old, no-longer-useful wastes and materials.

6 Groundwater Protection and Environmental Restoration

6.1 Introduction

This chapter describes the groundwater protection and environmental restoration programs at SLAC, in particular the processes for soil and groundwater evaluation used to achieve the Stanford University goal of unrestricted future use of the site.

6.2 Documentation

The groundwater regime at SLAC and nearby off-site areas has been comprehensively documented in the *SLAC Hydrogeologic Review* completed in 1994.[27] This report compiles data and summarizes results of the numerous geologic, hydrogeologic, and hydrogeochemical investigations that had taken place at or near SLAC for the following reasons:

- Water resources studies
- Research
- Geotechnical studies (used to site structures being built at SLAC)
- Environmental monitoring

The report developed a conceptual model of the groundwater regime at SLAC. Based on many tests in exploratory borings and wells, the hydraulic conductivity of this bedrock is much less than the range of that generally accepted as representing natural aquifer material. In other words, the groundwater at SLAC is not suitable as a drinking water source because of low flow (as well as high salt content). In 2001, a report was submitted to the California Regional Water Quality Control Board (RWQCB) requesting exemption for groundwater at SLAC as a potential municipal or domestic supply source, based on criteria specified in state and RWQCB resolutions 88-63 and 89-39, respectively.[28] The request was denied, stating that a basin plan amendment would be required to exempt groundwater from some potential uses.

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27 Stanford Linear Accelerator Center, *Hydrogeologic Review* (SLAC-I-750-2A15H-002, 1994)

28 Stanford Linear Accelerator Center, *Demonstration That Natural Groundwater Conditions at SLAC Meet Exemption Criteria for Potential Sources of Drinking Water* (SLAC-I-750-A32H-004, October 2001)

6.3 Areas with Potential Chemical Impact

A SLAC 1994 report entitled *Summary and Identification of Potentially Contaminated Sites* provides a summary of areas that might be impacted by chemicals of potential concern.[29] Information for the report was collected from a variety of sources including incident reports, aerial photographs, operations records, reports on previous investigations, and interviews with personnel throughout the facility. As other potentially impacted areas were identified, they were incorporated into a master list. These sites were evaluated and ranked based on the need for further investigation.

Based on further investigation, six groundwater sites, sediment in two stormwater channels, and a number of small soil sites are being monitored and remediated if necessary. Each of these sites is discussed below.

6.4 Strategies for Controlling Potential Sources of Chemicals

Strategies for chemical source control involve measures to control known soil or groundwater impacts as discussed in the rest of this chapter, and procedures and requirements to avoid practices that could adversely affect soil and groundwater as discussed in chapters 4 and 5. These procedures include the site's stormwater pollution prevention,[30] and spill prevention, control, and countermeasure plans, (SWPPP and SPCC, respectively), which discuss best management practices for preventing adverse impacts from spills and operations at SLAC.[31]

6.5 Restoration Activities

SLAC first began to develop a comprehensive Environmental Restoration Program (ERP) in 1991. Program activities range from discovery and characterization to remediation and long-term monitoring or maintenance where required. The restoration approach at SLAC is to

- Identify sites with actual or potential impacts (involving soil, groundwater, surface water, and/or air)
- Prioritize impacted sites based on site complexity, nature of chemical impact, associated risks, remaining data needs, and projected remedy
- Investigate sites and identify remedies that protect human health and the environment, beginning with the highest-priority sites
- Implement remedies and monitor for effectiveness

As of 2002, SLAC had generally reached the third step. Investigative work proceeded for the impacted sites discussed in this section.

SLAC follows the general Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) technical guidance in investigating and remediating soil and groundwater. SLAC was not listed in the National Priorities List as a Superfund site because United States Environmental Protection Agency (USEPA) determined that the conditions at the site did not warrant inclusion.

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29 ESA Consultants, *Stanford Linear Accelerator Center, Summary and Identification of Potentially Contaminated Sites* (February 1994)

30 See note 14

31 See note 15

The state RWQCB provides oversight and approval of restoration activities that impact surface or groundwater at SLAC. The San Mateo County Department of Health Services (DHS) oversees final confirmation sampling of environmental restoration activities involving remediation of chemically impacted soil.

SLAC EPR personnel continued investigations for site characterization and evaluation of remedial alternatives. Six groundwater sites have been identified and are monitored as described in the following section. One of these sites is monitored on a semi-annual basis under RWQCB Waste Discharge Order Number 85-88. In addition, two drainage channels and a number of soil sites have been identified and are also described in the following sections.

6.6 Groundwater Characterization Monitoring Network

6.6.1 Summary of Results and Issues

Work continued in 2002 on installing additional wells to define the lateral and vertical groundwater condition. Groundwater samples were collected at least once from 91 wells in 2002 and analyzed for a variety of constituents. Figure 6-1 shows the portion of the site that contains the monitoring network.

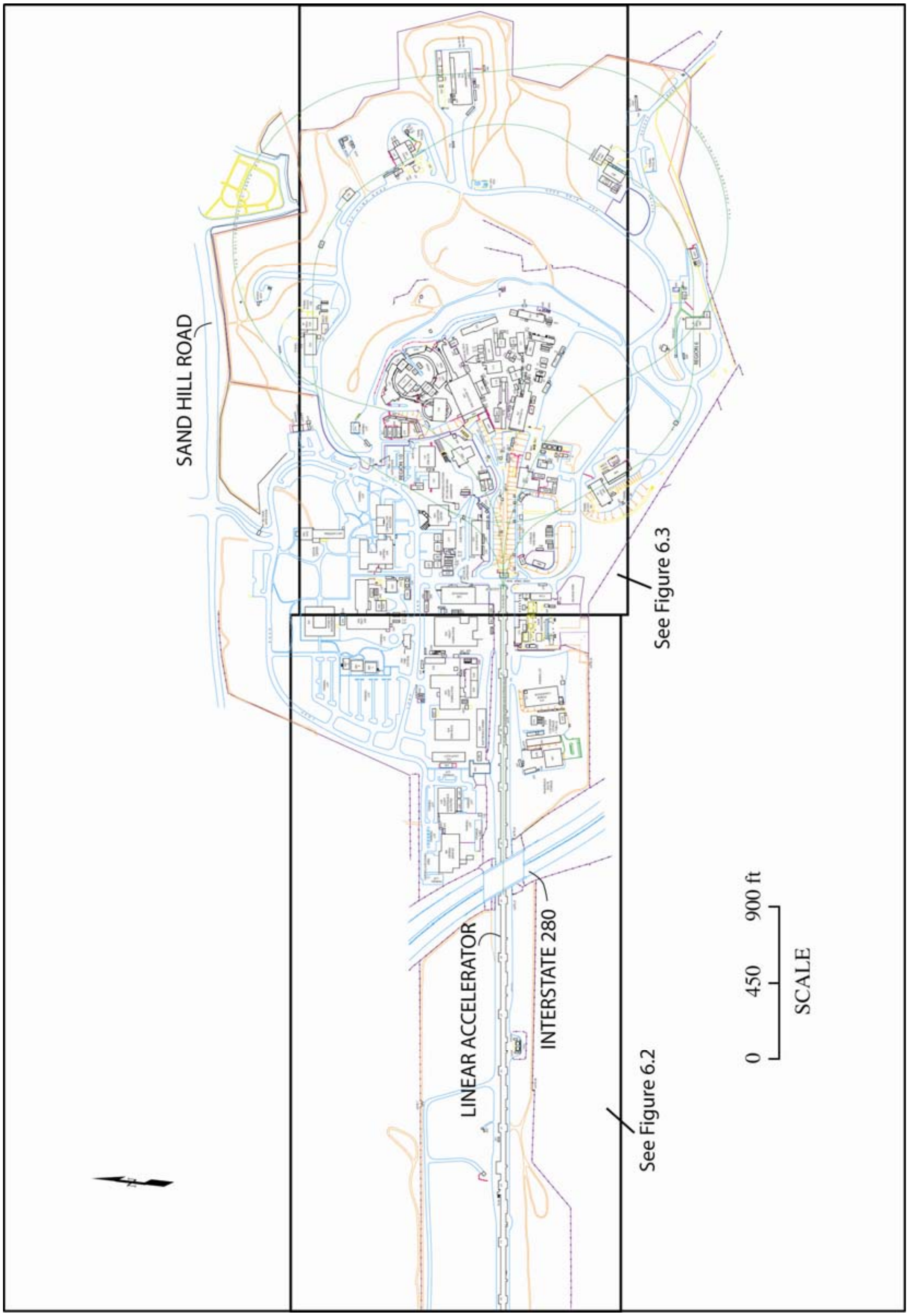

Figure 6-1 Groundwater Characterization Monitoring Network

Figure 6-2 and Figure 6-3 show the specific well locations. The groundwater analytical results were generally within each well's historic range of concentrations.

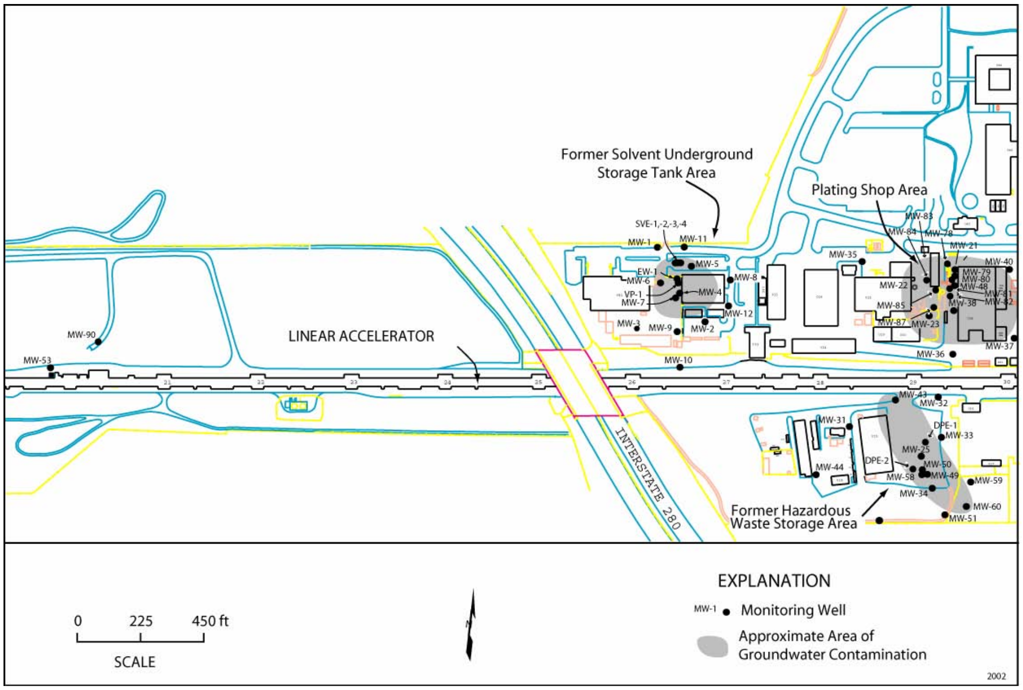

Figure 6-2 Westside Groundwater Network and Impacted Areas

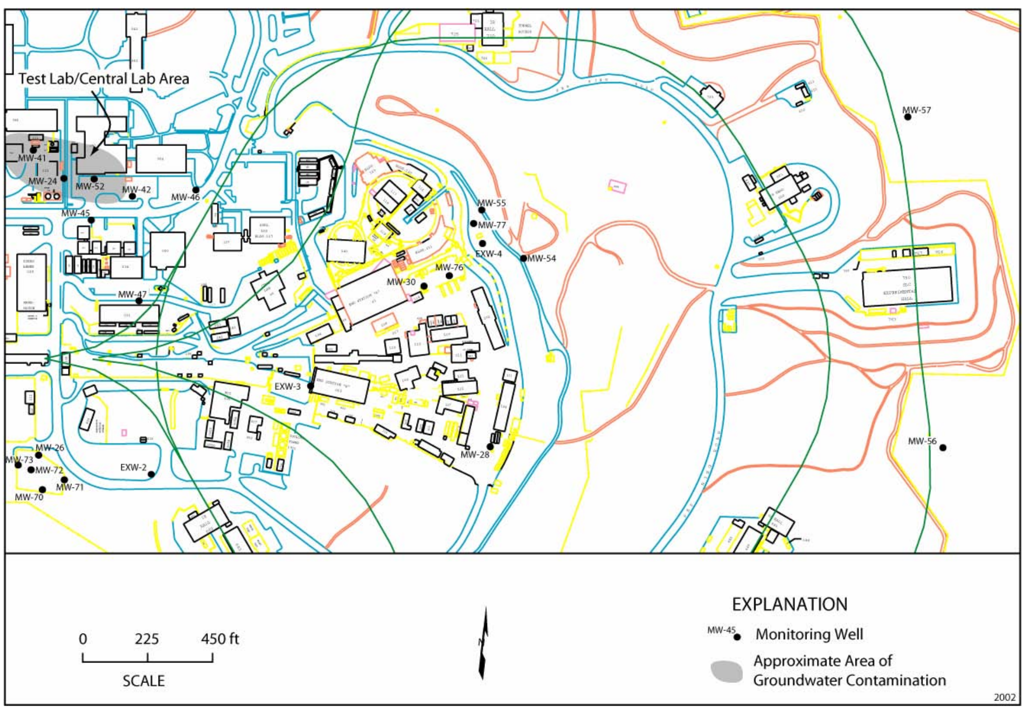

Figure 6-3 Eastside Groundwater Network and Impacted Areas

6.6.2 Background

The groundwater monitoring network included 11 wells that provided environmental surveillance of groundwater conditions. They were used to monitor general groundwater quality in the major areas of the facility that historically or currently store, handle, or use chemicals. In addition, the groundwater monitoring network included 80 wells that check groundwater, or monitor plumes, at six small sites that merit attention.

Table 6-1 summarizes the wells at SLAC by location, number, and purpose of the wells. The purpose of each well could be either plume monitoring for the six small groundwater sites or environmental surveillance, including general background monitoring.

Table 6-1 Monitoring Well Location, Number, and Purpose

Location	Number
Plume Monitoring	
Beam Dump East	5
Former Hazardous Waste Storage Area	20
Former Solvent Underground Storage Tank	22
Lower Salvage Yard	5
Plating Shop	21
Test Lab and Central Lab	7
Total	80
Environmental surveillance	
Centralized Waste Management Area	1
End Station B	1
Magnet Yard	2
Other (remote)	4
Research Yard	2
Vacuum Assembly	1
Total	11

The six locations where plume monitoring is taking place are

1. Former Hazardous Waste Storage Area (FHWSA)
2. Former Solvent Underground Storage Tank (FSUST) area
3. Test Lab and Central Lab areas
4. Plating Shop area
5. Lower Salvage Yard
6. Beam Dump East

Selected wells used for both plume monitoring and environmental surveillance were sampled and analyzed on a semi-annual basis. Samples were analyzed for one or more of the following:

- Total petroleum hydrocarbons (TPH)
- Metals
- Polychlorinated biphenyls (PCB)
- Total dissolved solids (TDS)
- General minerals
- Tritium (^3H)
- Volatile and semi-volatile organic compounds (VOCs and SVOCs)

The results of semi-annual sampling and analysis of wells were reported to the RWQCB in semi-annual monitoring reports.

The six groundwater sites warranting further attention are discussed in detail in the next section. This is followed by a discussion of mainly PCBs in sediment in stormwater drainage channels and finally PCBs in soil.

6.7 Groundwater Site Descriptions and Results

The six groundwater sites that merit further attention are described below. The sites pose no current risk to human health or the environment. Through the work described below, remediation strategies are being defined that protect current and future potential uses of the property.

6.7.1 Former Solvent Underground Storage Tank

6.7.1.1 Background

A groundwater monitoring network was located in proximity to the SLAC Plant Maintenance building in the northwestern portion of the facility (see Figure 6-2). This network consists of 18 wells that are being used to monitor the migration of chemical constituents associated with the Former Solvent Underground Storage Tank (FSUST). The FSUST was used to store organic solvents from 1967 to 1978. A pressure test performed on the FSUST in 1983 indicated a leak. The FSUST and accessible chemically impacted soil were removed in December 1983.

The RWQCB required that SLAC monitor selected wells at the FSUST site on a semi-annual basis (RWQCB Waste Discharge Order 85-88). Since 1987, the samples have been analyzed for VOCs by an analytical laboratory certified by the California Department of Health Services and following US EPA methods 8010 and 8020.

The results of investigations performed at the FSUST were provided in two draft reports, the *Site Characterization for the Former Solvent Underground Storage Tank Area,*[32] and the *Evaluation of*

32 Stanford Linear Accelerator Center, *Draft Final Site Characterization of the Former Solvent Underground Storage Tank Area* (SLAC-I-750-3A-33H-005, September 2002)

Remedial Alternatives for the Former Solvent Underground Storage Tank Area.[33] The site characterization report described the nature and extent of chemicals in the soil and groundwater at this site and evaluated potential risks posed by these chemicals. The evaluation of the potential risks was used to identify remedial goals.

The evaluation of remedial alternatives report established remedial action objectives and then evaluated 42 alternatives to determine which would meet best the objectives. Comments were received from the RWQCB. Implementation of the selected alternative began in order to control migration of the plume as described below.

The selected alternative, a groundwater extraction and treatment system, was constructed at the FSUST area during the summer of 2001. The system was constructed for testing the effectiveness of a five-well extraction system for achieving hydraulic control of a small area of chemically-impacted groundwater. Chemicals of interest in groundwater in the FSUST area include VOCs and SVOCs. The extraction system has been in operation since August 27, 2001. During the dry season months, the total flow rate for the five-well extraction system stabilized at 0.13 gallons per minute (gpm) and increased to 0.23 gpm with the onset of the wet season. As of December 31, 2001, approximately 33,000 gallons of groundwater has been treated using granular activated carbon and approximately 45 pounds of VOCs and SVOCs removed. Groundwater is collected from five extraction wells.

6.7.1.2 2002 Results and Issues

A successful groundwater extraction system installed in 2000 to control the migration of the solvent plume experienced biofouling. Slow-release chlorine tablets proved successful in inhibiting the production of hydrogen sulfide during treatment and the system treated 100,000 gallons of water resulting in the removal of 125 pounds of VOCs and SVOCs. Chemical concentrations in the nearest well located downgradient from the plume continued to show declining chemical concentrations. Monitoring well data collected thus far indicate a capture zone encompassing the entire plume has been established and chemical data indicate that the plume migration appears to be stabilized.

SLAC has submitted and the RWQCB accepted with no further comment (approved) a report characterizing the site.[34]

6.7.2 Former Hazardous Waste Storage Area

6.7.2.1 Background

The former Hazardous Waste Storage Area (FHWSA) was in use from approximately 1965 to 1982. During closure of the FHWSA, PCBs were found in shallow soils. As a result, several inches of topsoil were removed. Monitoring well 25 (MW-25) was installed in this area in 1990, and VOCs were detected in the groundwater. Eighteen wells and more than 50 soil borings have been installed at this site. Figure 6-2 defines the limited extent of VOCs in the groundwater.

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33 Stanford Linear Accelerator Center, *Draft Final Evaluation of Interim Remedial Alternatives for the Former Solvent Underground Storage Tank Area* (SLAC-I-750-3A-33H-006, September 2002)

34 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Draft Final Site Characterization for the Former Solvent Underground Storage Tank Area* (September 2002)

Most of the impacted groundwater appeared to be confined to the Santa Clara Formation, which comprised about the upper 20 feet of bedrock.

Two additional wells installed in 2001 delineated the extent of groundwater impacted with the chemicals of interest at the east and north ends of the site. In addition, a fate and transport study and a risk assessment were performed during 2001 for the chemicals of interest that were present in groundwater and soil at the site.

6.7.2.2 2002 Results and Issues

A report on evaluation of remedial alternatives for the FHWSA, drafted in 2003, considers the results of various studies, including the risk assessment and fate and transport study, and recommends a remedial strategy. In 2002, a dual-phase extraction treatability test proved promising to treat impacted soil and groundwater, and thus is recommended as a suitable remediation technology in the evaluation of remedial alternatives report.

6.7.3 Plating Shop

6.7.3.1 Background

In 1990, three monitoring wells, MW-21, MW-22, and MW-23, were installed downgradient of the Plating Shop. Constituents of interest were detected in all three wells and an investigation began as described below. A concrete steam-cleaning pad was located adjacent to the Plating Shop and work performed in 1997 identified the soil beneath it as a potential source of VOCs in the groundwater. Consequently, an interim removal action was performed in 1998, which included removing the pad and excavating approximately 200 cubic yards of chemically impacted soil for off-site disposal. A new steam-cleaning pad was built to replace it at a location to the south of the original pad. In order to construct it at the new location, well MW-22 had to be destroyed.

Four new wells were installed in 2000, and additional soil samples were collected as part of the source investigation. Figure 6-2 illustrates the limited extent of VOCs in groundwater.

6.7.3.2 2002 Results and Issues

Data analyses and plans for further characterization activities were completed in 2021. Characterization studies will continue in 2003 for final phases of the field work and preparation of an updated human health risk assessment (HHRA). A report on evaluation of remedial alternatives for the Plating Shop area, drafted in 2003, recommends remedial alternatives for the Plating Shop area.

6.7.4 Test Lab and Central Lab

6.7.4.1 Background

Monitoring Well 24 was installed between the Test Lab and Central Lab in 1990 at the site of a former, leaking, diesel pump. Chemically impacted soil was removed and the well was installed to monitor for the possible presence of diesel fuel. Diesel has never been detected in this well, but chlorinated solvents have been.

A soil gas survey and soil borings were drilled over the entire Test Lab and Central Lab area to delineate the sources of contamination. Results of the investigation indicated three possible source areas for VOCs, including one adjacent to the Test Laboratory and two adjacent to the Central Laboratory.

Results of the investigative work at the Test Lab/Central Lab area were detailed in the site characterization report for the Test Lab/Central Lab area. The report was submitted to the RWQCB for review and comment in late 1999. Comments from the regulators were received in 2000. Response to comments was completed in 2001 along with further characterization.

Based on the characterization studies and risk assessment there are no risks to human health or the environment due to the very low levels of chemicals in soil and groundwater and recommended long-term monitoring of the plume. The final reports were completed in 2002.[35, 36]

6.7.4.2 2002 Results and Issues

SLAC has submitted and the RWQCB accepted with no further comment (approved) the final report.

6.7.5 Beam Dump East

Beam Dump East is in area in which the linac high-power electron beam is terminated during experiments. Groundwater in the immediate vicinity of Beam Dump East contains tritium at levels within those acceptable for drinking water. The groundwater is monitored at least two to four times per year and in 2002, as in previous years, the tritium continues to be localized to the area immediately surrounding the beam dump.

6.7.6 Lower Salvage Yard

As discussed below in Section 6.8.1, “Lower Salvage Yard”, there are minor detected petroleum hydrocarbons in wells at this site.

6.8 Soil Site Description and Results

In addition to the groundwater sites discussed above, SLAC is also looking at soil sites mainly for impacts from PCBs. These sites are discussed below. In one area, the IR-6 and IR-8 Drainage channels, sediment in drainage channels has been impacted with chemicals of potential concern and work continues to investigate and remediate these areas. At the Lower Salvage Yard, the groundwater continues to be monitored and a second soil removal action is scheduled for 2006. Finally, preliminary site assessments (PSAs) were on-going in 2002 to investigate low-priority small soil sites, mainly for PCBs.

35 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Test Laboratory and Central Laboratory Site Characterization Report* (SLAC-I-750-3A-33H-009, July 2002)

36 Erler & Kalinowski, Inc, *Draft Evaluation of Remedial Alternatives for the Test Laboratory and Central Laboratory Area* (July 2002)

6.8.1 Lower Salvage Yard

6.8.1.1 Background

The Lower Salvage Yard has been used for storage of salvaged equipment, including oil-filled, and materials such as scrap metal, including lead. Prior to its use as a salvage yard, the first SLAC substation occupied the area.

Site characterization data indicated several chemicals of interest including PCBs and petroleum hydrocarbons. Thus a removal action was initiated in 1999.

A total of 3,114 tons of material were excavated from the yard to achieve the clean-up goal of 1 part per million PCBs, but PCBs above the clean-up goal remained in the side walls of the excavation. Accordingly, additional excavation will be required in the future.

6.8.1.2 2002 Results and Issues

Two downgradient groundwater monitoring wells were installed in 2000 to determine whether chemicals had migrated. No PCBs have been detected in these wells, but groundwater from one well has been found to contain a low level of 1,1-dichlorethane. Two additional wells were installed at the site in 2001 to better define the extent of VOCs and PCBs in groundwater. Low levels of hydraulic oil were detected but no PCBs or VOCs. Five wells were sampled for this monitoring project. Low levels of total petroleum hydrocarbons (TPH as unknown hydrocarbons) were detected in four of the wells.

6.8.2 IR-6 and IR-8 Drainage Channels

6.8.2.1 Background

Much of SLAC's stormwater runoff is conveyed by the Interaction Region (IR)-6 and IR-8 drainage channels and ultimately discharges into San Francisquito Creek. Surface water runoff from the Research Yard drains into the man-made IR-6 drainage channel located off site. IR-8, also primarily located off site, is a natural ephemeral drainage that was engineered during SLAC construction to accept groundwater from the linac sub-drainage system and surface water runoff from the campus area at SLAC. PCBs and lead were first found in the off-site portions of the IR-6 and IR-8 drainage portions in 1990.

In 1992, soil and sediment samples were taken along a 2.5-mile length of San Francisquito Creek. The samples analyzed for a variety of constituents and analysis results showed no detectable PCBs. Lead analysis showed only background levels.

Additional study of the drainage system and the removal and off-site disposal of chemically impacted sediments from the IR-6 drainage channel and its upstream stormwater catch basins occurred in 1995. The RWQCB was the lead agency and San Mateo County provided regulatory oversight of the removal action.

In 1996, it was found that sediments with PCBs were still entering the IR-6 drainage channel. Between 1996 and 2001, additional investigations and remedial work were completed to identify and remove additional potential upstream sources of PCBs and lead. Video taping of the storm drain lines indicated sediment was trapped in the lines. This sediment in the storm drain lines was the presumed main source of residual PCB. In 1997, all removable solids were removed from over one linear mile of storm drain lines and the catch basins were cleaned a second time. Between 1997 and 1999, the SLAC Master Substation was upgraded and remediation work was completed at that time to remove PCB-impacted soils.

An assessment of PCB use and impact in the Research Yard was completed in 1999. Between 1999 and 2001, two potential PCB source areas in the Research Yard were remediated (the 1.0/1.5 Megawatt Power Supply and Substation 512). In 2000 and 2001, seven acres of pavement in the Research Yard were pressure-washed to remove accumulated sediments. All materials from these remediations were disposed of off site.

Sediments in the IR-6 and IR-8 drainage channels and downstream reaches have been monitored annually since 1998. The downstream drainage sampled is located off site and is approximately 300 feet long, located on the adjacent leasehold of the Portola Valley Training Center (PVTC). This channel receives combined flow from the IR-6 and IR-8 drainage channels and the stormwater flow from the PVTC, and discharges to San Francisquito Creek.

The annual collection of sediment samples shows that despite remediation efforts, PCBs persist in sediments entering the IR-6 and IR-8 channels drainages, although at levels significantly lower than historic concentrations. Between 1998 and 2000, no PCBs were detected in the off-site drainage downstream of IR-6 and IR-8. In 2001, one sample collected at the most upstream portion of the off-site drainage downstream of the IR-6 and IR-8 drainage channels contained a low concentration of PCB at the analytical reporting limit of 0.06 milligrams per kilogram (mg/kg). Samples located downstream of this sample, including those samples nearest to San Francisquito Creek, contained no PCBs.

6.8.2.2 2002 Results and Issues

In 2002, additional studies and remedial actions were conducted. The storm drain lines were cleaned a second time and the catch basins were cleaned a third time. SLAC initiated field testing and engineering studies to assess the potential of stormwater treatment alternatives. A draft design report was completed.[37]

The report presents a preliminary engineering design for a stormwater filtration system to reduce PCBs conveyed in sediment from non-point sources through the storm drain system to the unlined IR-6 drainage channel. A small-scale pilot test was conducted in 2003 to test the effectiveness of the filters for removing PCB impacted sediment from stormwater.

In 2002, the annual sampling of the sediments in the IR-6 and IR-8 drainage channels and downstream reaches yielded similar results to those seen in 2001. Again, one sample collected at the most upstream portion of the off-site drainage downstream of the IR-6 and IR-8 drainage channels contained a low concentration of PCB at the analytical reporting limit of 0.02 mg/kg. Samples located downstream of this sample, including those samples nearest to San Francisquito Creek, contained no PCBs.

6.8.3 Preliminary Site Assessments

Preliminary site assessment (PSA) reports were completed to investigate the presence of soil or groundwater impacted by chemicals of concern, generally small areas with low levels of PCBs in soil. This work is projected to be completed in 2004 and any sites requiring remediation or soil removal will be scheduled and budgeted for 2005 and 2006.

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37 Erler & Kalinowski, Inc., *Preliminary Design Report, Interaction Region 6 Stormwater Filtration a System* (September 2002)

A Assessment of Potential Direct Radiation Dose to the Public

As described in Chapter 5, SLAC accelerator operations produce some ionizing radiation. The Department of Energy requires (DOE Order 5400.5) SLAC and similar facilities to assess and report the maximum dose that could be received by a member of the public due to SLAC operations. DOE also requires SLAC to assess and report the collective dose that could be received by the population living within 80 kilometers (km).

As in Chapter 5, this appendix uses the word “dose” in place of less-familiar, but more precise terms, such as “absorbed dose”, “dose equivalent”, and “effective dose equivalent”.

The dose assessments are summarized in Chapter 5, where Table 5-6 provides a summary of the results of those assessments. This appendix explains how the dose due to direct radiation was determined.

Direct Radiation Dose to Maximally Exposed Member of the Public

Dosimeters

Table A-1 Minimum Doses Detected by Environmental Dosimeters

Dosimeter Type	Nominal Minimum Dose Detected	Type of Radiation Detected
Landauer Luxel	1 mrem	Photons
Landauer Neutrak 144	20 mrem	Neutrons

Neutron Dose Determination

Throughout 2002, SLAC monitored quarterly neutron doses using passive neutron dosimeters (Landauer Neutrak 144). These were posted at 28 locations ringing the SLAC lease holding (see Appendix B).

None of the dosimeters recorded a neutron dose during 2002.

Photon Dose Determination

Throughout 2002, SLAC monitored quarterly photon doses using passive photon dosimeters (Landauer Luxels). These dosimeters were supplied with the previously-discussed neutron dosimeters in a combination “badge” and were thus posted at the same 28 locations ringing the SLAC lease holding (see Appendix B).

Table A-2 Definitions of Terms

Term	Definition
Background dose	At any of the approximately 28 dosimeter posting locations, the “background dose” is the dose that would be recorded by a dosimeter if no power were applied to any SLAC accelerator. SLAC estimated the background dose by using averages from data recorded by X9 dosimeters during four periods over a total of 338 days when there no power-on accelerator operations at SLAC. For 2002, X9 background doses were corrected with the applicable transit dose as described below.
Deployment dose	Dose that a dosimeter records during the deployment period. For 2002, we calculated this dose from the reading corrected using our best estimates of the transit dose and storage dose, as described below.
Deployment period	Period from when the dosimeter has been placed in its measurement location (one of approximately 28) until it has been removed from that location.
Luxel	The type of dosimeter used in CY2002 to measure direct dose at approximately 28 locations near the boundaries of the SLAC lease holding.
Reading	Dose reported by dosimeter processor (i.e. Landauer) before any correction has been made for the transit dose or for any dose that might have been accumulated while the dosimeter was at SLAC before and after the deployment period.
Receptor	Location of a home, business, school, etc. that is potentially occupied by a member of the public.
Storage dose	Dose recorded by dosimeters while at SLAC during the periods before and after the deployment period.
Transit dose	Though we refer to this quantity as “transit dose” in this appendix, this dose includes all the doses recorded by a dosimeter from when it is manufactured to when it reaches SLAC. In addition, it includes all the doses recorded by the dosimeter between the date it is shipped from SLAC and the date it is read by the processor (i.e. Landauer).
X9	The type of dosimeter used to measure the background dose at approximately 28 locations near the boundaries of the SLAC lease holding. This type of dosimeter was also used in the past for the environmental measurements that are now done using Luxels.

Estimate of Transit Dose

Since SLAC had no way of determining what portion of the reading on any individual dosimeter was due to the transit dose, we performed a special transit dose study in April and May 2003. During this period, Landauer shipped dosimeters to SLAC and we immediately (on the same day that Shipping delivered the dosimeters) returned them for read-out. We used FedEx next business day delivery as the shipping method, just as is done otherwise.

The study involved both Luxels and X9s. This was done because while we used Luxels throughout 2002, X9s were used when the background dose data were collected.

For Luxels, we averaged the readings of dosimeters in 24 separate round-trip shipments to estimate a transit dose of 5.3 + 1.3 millirem (mrem).

For X9s, we averaged the readings of dosimeters in 10 separate round trip shipments to estimate a transit dose of 3.3 + 1.3 mrem.

Note that this difference in the average X9 versus Luxel transit dose is consistent with (and predicted by) differences in Landauer's manufacturing and processing of X9s and Luxels.

Estimate of Storage Dose

We estimated the storage dose for each quarter in 2002. We made these estimates using records of dosimeter deployment, collection, and shipment dates and the measured dose rate data for Building 24 during the period. Building 24 was where the dosimeters were stored until deployed and where they were again stored in the period following the deployment period but before shipment to Landauer for processing.

For 2002 dosimeters, we estimated the storage doses as follows:

- Q1: 2.5 + 0.1 mrem
- Q2: 4.1 + 0.7 mrem
- Q3: 14.3 + 2.0 mrem
- Q4: 11.1 + 1.4 mrem

Comparison of 2002 Dose Data with Background Dose Data

For each quarter of 2002, we subtracted the transit and storage doses from the readings to get the deployment doses. We converted those numbers to the dose rates that corresponded to each of the approximately 28 dosimeter locations (deployment dose divided by number of days deployed). Similarly, we corrected, averaged, and divided the background dose readings appropriately to get background dose rates for each of the same approximately 28 locations.

For each quarter in 2002, we then compared the dose rate for each of the approximately 28 locations with the corresponding background dose rate using the Paired Student's T-test. At the 95 percent confidence level, no quarter in 2002 was distinguishable from background.

Maximum Possible Dose to Individual Member of the Public

As noted, quarterly deployment dose rates paired by location with background dose rates showed the quarterly and background data sets to be statistically indistinguishable. There were, however, three dosimeter locations where deployment dose rates appear to be higher than the background dose rate during periods of linac operation in 2002. To be conservative, we considered the dose indicated by these three dosimeters.

In the case of two of the dosimeters, the recorded dose could be attributed to individual klystrons in specific locations. For this reason, we used the inverse square law to calculate the dose at the nearest receptor. For the third dosimeter, the nearest receptor was due west of the linac injector and it was again appropriate to assume a point source.

For 2002, we determined 2 mrem to be the maximum dose that could possibly have been received by a member of the public from direct radiation due to SLAC operations. This is based on a member of the public having been present 24 hours a day each day of 2002 at a location approximately 185 meters (m) north of the Sand Hill Road/Interstate 280 overpass.

Collective Dose to the Public Due to Direct Radiation

To determine the collective dose – due to direct radiation from SLAC operations – that could have been received by the population living within 80 km in 2002, SLAC used the following process:

1. In determining the maximum possible dose to a member of the public (as described above), we identified the particular sources (individual klystrons) that were the strongest during 2002. We calculated the collective dose based on these same sources
2. We used the same population information for this calculation as was used in the assessment of the dose due to airborne radioactivity (NESHAPs report)[1]. This information provides the total population in each of 12 rings that are centered on Sector 30 of the SLAC linac. The information includes population to a radius of 80 km
3. While our population information is centered on Sector 30, the sources were located in three different sectors of the linac. For each of the three source locations, we calculated the population dose in each of the 12 rings, correcting for the fact that the source was not in the center of each ring. The corrections used the inverse square law applied to the ring geometry. We did not reduce the calculated dose for air attenuation or barriers (hills, buildings) between the source and the location of members of the public
4. We summed the results over all the rings and all the sources

We determined that for 2002 the collective dose from direct radiation to the population within 80 km was 19 person-rem. For 2002, the collective dose to this same population from radiation due to natural background was 1,667,000 person-rem.

1 Stanford Linear Accelerator Center, Environment, Safety, and Health Division. Operational Health Physics Department, *Radionuclide Air Emissions Annual Report – 2002* (June 2003)

B Environmental Dosimeter Measurements

This appendix contains the following information on environmental dose measurements:

- A table listing locations and dose rates
- Figures showing dosimeter locations

Table B-1 Background and 2002 Dose Rates (mrem/day) Detected by Environmental Dosimeters

Dosimeter No.	Location Description	Background	Q1 02	Q2 02	Q3 02	Q4 02
1	fence at Region 6	0.18	0.15	0.15	0.21	0.17
2	NW fence at Injector	0.21	0.19	0.19	0.23	0.17
4	fence at Region 4	0.19	0.15	0.18	0.18	0.22
5	fence at N Damping Ring	0.23	0.24	0.29	0.24	0.29
6	SW side 280 overpass	0.19	0.18	0.22	0.19	0.22
7	fence S of Sec. 10	0.25	0.21	0.26	0.22	0.25
8	fence, B of A	0.16	0.15	0.17	0.15	0.19
9	Alpine Gate	0.16	0.13	0.14	0.16	0.16
11	fence E of SLD	0.17	missing	0.17	0.14	0.15
12	fence, Region 12	0.22	0.23	0.25	0.23	0.19
13	fence at Region 2	0.19	0.14	0.15	0.15	0.13
14	SLAC Entrance Gate	0.17	0.16	0.15	0.16	0.14
16	fence at Region 8	0.19	0.16	0.15	0.14	0.21
17	fence at AW Bldg.	0.20	0.20	0.19	0.18	0.19
18	N Access Rd. at Pos. Vault	0.24	0.21	0.26	0.25	0.22
20	fence S of Sec. 20	0.23	0.19	0.28	0.22	0.25
21	fence at S Damping Ring	0.25	0.25	0.24	0.25	0.27
22	NE side 280 overpass	0.21	0.28	0.28	0.18	0.27
23	fence S of Sec 21	0.22	0.21	0.24	0.19	0.24
26	PMS1	0.18	0.16	0.17	0.19	0.26
27	PMS2	0.16	0.17	0.15	0.14	0.15
28	PMS3	0.16	0.20	0.16	0.18	0.12
29	PMS4	0.17	0.12	0.16	0.15	0.16
30	PMS5	0.16	0.14	0.15	0.15	0.17
31	PMS6	0.19	0.22	0.21	0.19	0.23
32	PMS7	0.17	0.17	0.16	0.19	0.16
34	N Access Rd. Sec. 17	0.22	0.22	0.28	0.25	0.29
35	N. Access Rd. Sec. 5	0.22	0.27	0.52	0.21	0.44

Notes:

1 Dose rates recorded above are due to photons. All neutron doses were below the minimum detectable level.

2 Though the dosimeters are numbered from 1 to 35, some numbers are not listed. Missing numbers correspond to dosimeters not applicable to this measurement.

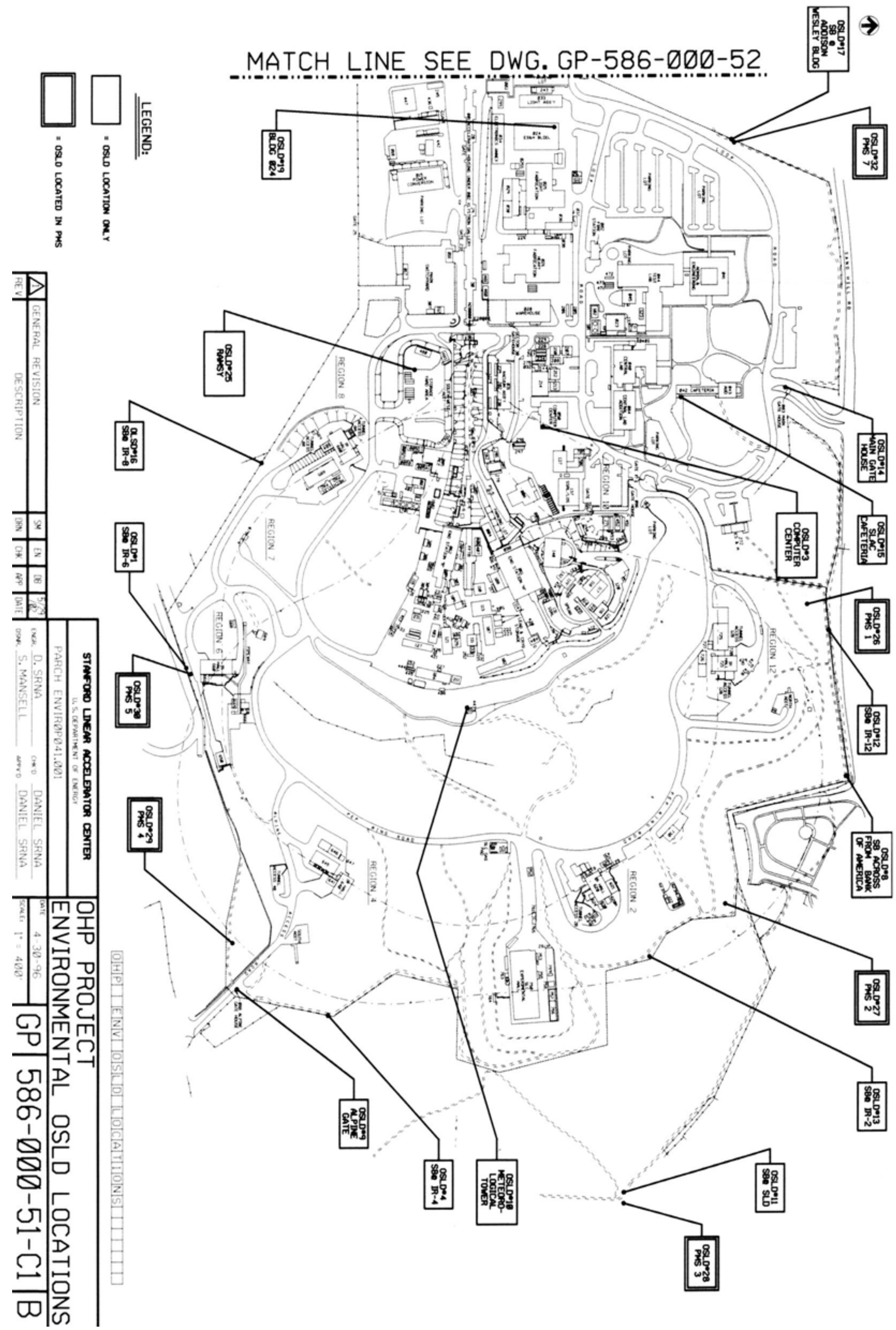

Figure B-1 Environmental Dosimeter Locations, Sectors 27 through SLC

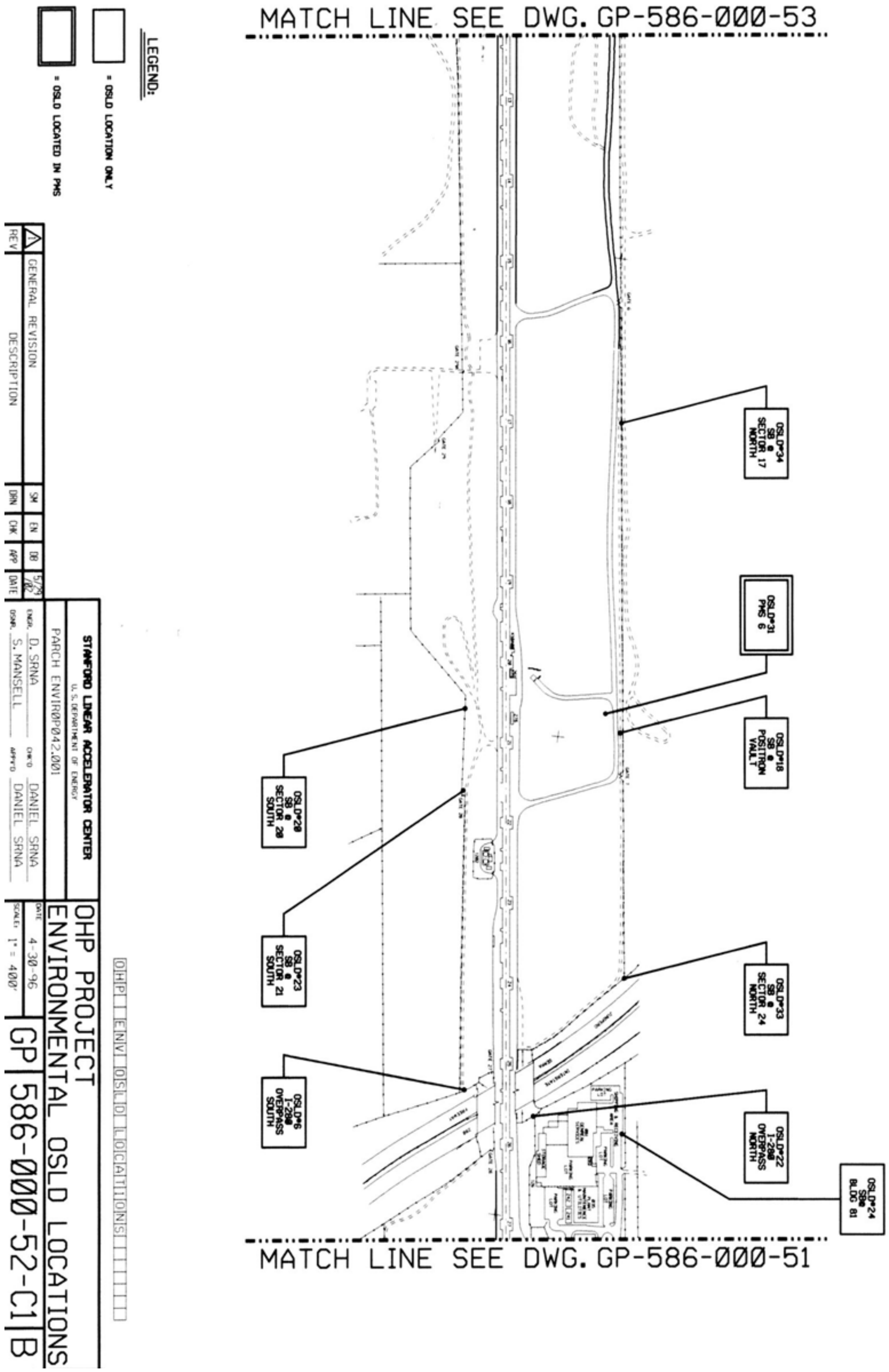

Figure B-2 Environmental Dosimeter Locations, Sectors 12 through 27

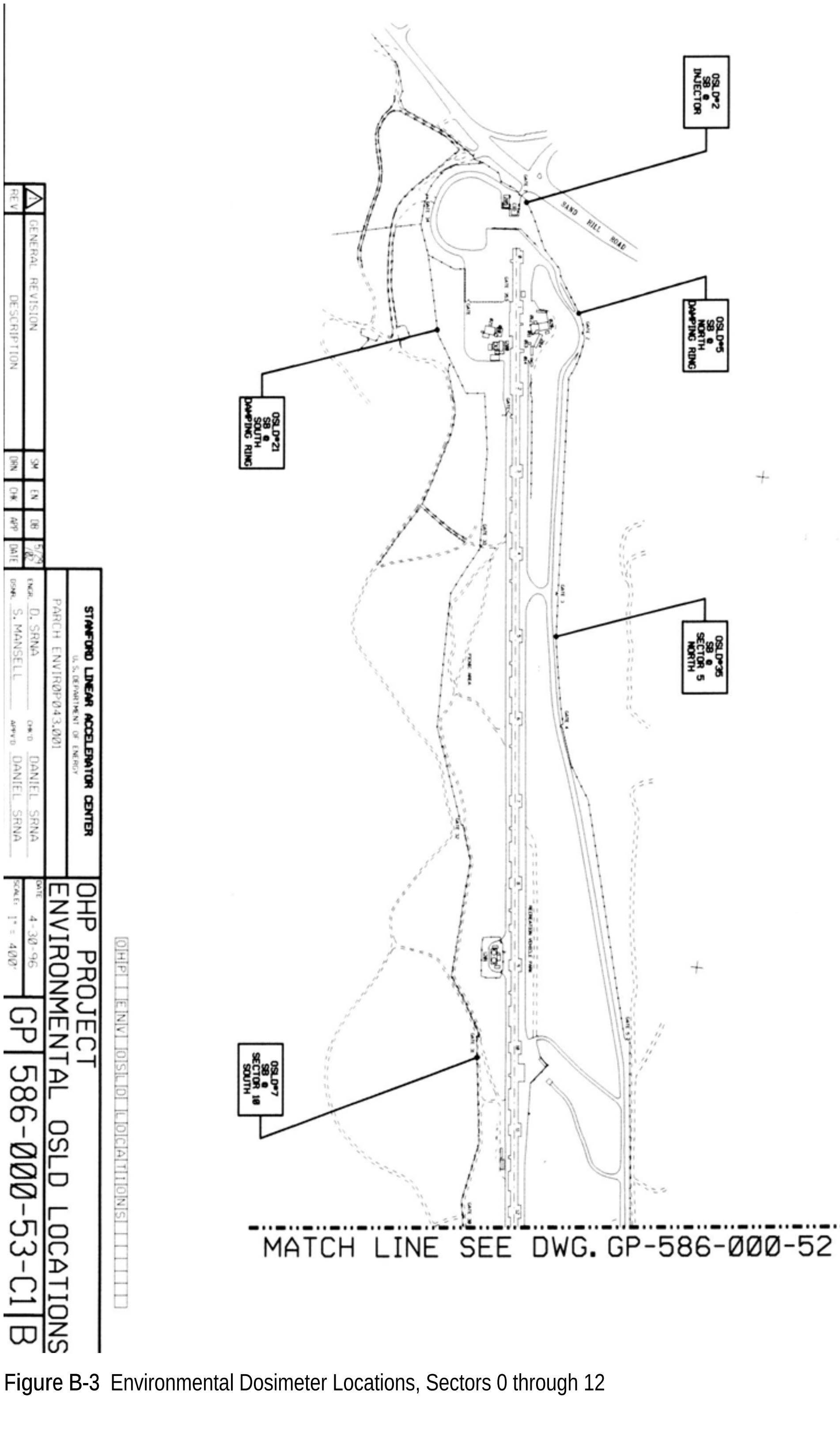

Figure B-3 Environmental Dosimeter Locations, Sectors 0 through 12

C Annual Stormwater Monitoring Report

The following table lists sampling and analysis results for stormwater monitoring during the 2002–2003 wet season (October through May).

2002-2003 Wet Season Summary	Main Gate				North Adit				IR-6			
	FIRST STORM EVENT		SECOND STORM EVENT		FIRST STORM EVENT		SECOND STORM EVENT		FIRST STORM EVENT		SECOND STORM EVENT	
Event Start Date	**7 November 2002**		**12 February 2003**		**7 November 2002**		**12 February 2003**		**7 November 2002**		**12 February 2003**	
Sampling Start	**12:52 AM**		**8:12 AM**		**12:57 AM**		**8:23 AM**		**2:13 AM**		**8:13 AM**	
Sampling End	**12:56 PM**		**8:17 AM**		**1:00 AM**		**8:32 AM**		**2:17 AM**		**8:17 AM**	
Pump Counts	**523**		**588**		**596**		**564**		**606**		**643**	
Sample Method	**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**	
Sampler ID No.	**4**				**3**				**2**			
Parameter	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**
METALS												
Aluminum	4.9	0.49	4.50	0.055	0.63	<0.050	1.30	<0.050	0.27	<0.05	2.8	0.067
Arsenic	<0.0020	<0.0020	0.090	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0061	0.0065	0.0028	<0.0020
Cadmium	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS
Chromium	0.012	0.004	0.011	0.0036	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS
Copper	0.074	0.011	0.030	0.0069	0.012	0.0084	0.029	0.020	0.20	0.17	0.080	0.023
Iron	13	0.90	6.80	0.11	1.2	0.11	2.1	<0.10	0.77	0.19	9.1	0.22
Lead	0.21	0.004	0.078	<0.0020	0.0053	<0.002	0.0051	<0.0020	0.011	0.0033	0.048	<0.0020
Manganese	NLS	NLS	NLS	NLS	0.079	0.014	NA	NA	0.15	0.13	0.24	0.034
Molybdenum	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS
Nickel	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS
Silver	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS	NLS
Zinc	0.83	0.23	0.42	0.086	0.067	0.038	0.077	0.030	0.66	0.47	2.6	0.27
NON-METALS												
pH (unitless)**	6.96	NA	7.26	NA	7.94	NA	8.04	NA	6.98	NA	7.39	NA
Polychlorinated Biphenyls (PCBs)	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0005	<0.0005	***0.004**	<0.0002	***0.015**	<0.0005
Total Organic Carbon (TOC)	24	NA	27	NA	19	NA	5.7	NA	55	NA	26	NA
Total Suspended Solids (TSS)	4,500	NA	1300	NA	120	NA	200	NA	120	NA	430	NA
Total Dissolved Solids (TDS)	690	NA	350	NA	2,200	NA	3,600	NA	280	NA	490	NA
Settleable Solids (ml/L/hr)	12	NA	1.6	NA	0.80	NA	0.8	NA	0.63	NA	1	NA
Turbidity (NTU)	44	NA	740	NA	25	NA	28	NA	6.8	NA	65	NA
Specific Conductance (umho/cm)	470	NA	500	NA	2,400	NA	4,300	NA	330	NA	680	NA
Tritium (pCi/l)	NDA	NA	NDA	NA	NDA	NA	NDA	NA	NDA	NA	NDA	NA

Tritium analysis performed in-house by SLAC health physics personnel
All other analyses performed off-site by contract lab (CLS, in Rancho Cordova, CA)
All values in milligrams per liter (mg/l) unless otherwise noted
ml/L/hr = milliliters per liter per hour
NTU = Nephelometer Turbidity Units
umho/cm = micromhos per centimeter
pCi/l = picocuries per liter
Filtered samples passed through 0.45-micron filter

"<" symbol precedes reporting limit (i.e., analyte not detected)
NLS = no longer sampled, per Sec. B(5)(c)(ii) of General Permit
NA = not analyzed
NDA = no detectable (radiological) activity above background
** = Aroclor 1254 was only PCB compound detected*
*** = pH samples exceeded hold time; analyzed within 72 hours afte*

2002-2003 Wet Season Summary	**IR-8**				**IR-2 North**				**Bldg. 15**			
	FIRST STORM EVENT		***SECOND STORM EVENT***		**FIRST STORM EVENT**		***SECOND STORM EVENT***		**FIRST STORM EVENT**		***SECOND STORM EVENT***	
Event Start Date	**7 November 2002**		**12 February 2003**		**7 November 2002**		**12 February 2003**		**7 November 2002**		**12 February 2003**	
Sampling Start	**1:55 AM**		**9:51 AM**		**1:58 AM**		**8:29 AM**		**1:39 AM**		**9:36 AM**	
Sampling End	**1:59 AM**		**9:55 AM**		**2:02 AM**		**8:33 AM**		**1:43 AM**		**9:40 AM**	
Pump Counts	**583**		**564**		**531**		**552**		**567**		**594**	
Sample Method	**ISCO / Automatic**		**ISCO / Manually**		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Manually**	
Sampler ID No.	**1**				**5**				**7**			
Parameter	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**
METALS												
Aluminum	9.4	0.33	0.36	0.15	1.6	<0.05	1.0	0.12	4.4	0.51	0.32	0.15
Arsenic	<0.010	0.0025	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	NLS	NLS	NLS	NLS	<0.0010	<0.0010	<0.0010	<0.0010	0.017	0.012	<0.0010	<0.0010
Chromium	NLS	NLS	NLS	NLS	0.0052	0.0020	0.0040	0.0011	0.011	0.005	0.0024	0.0018
Copper	0.40	0.064	0.031	0.025	0.027	0.016	0.011	0.0063	0.14	0.10	0.013	0.010
Iron	13	1.8	0.47	0.20	1.9	<0.10	1.4	0.14	3.1	0.68	0.41	0.19
Lead	0.18	0.0082	0.0032	<0.0020	0.020	<0.0020	0.0064	<0.0020	0.065	0.0048	0.0033	<0.0020
Manganese	2.2	1.2	0.059	0.028	0.17	<0.010	0.070	0.013	0.46	0.40	0.024	0.015
Molybdenum	NLS	NLS	NLS	NLS	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	NLS	NLS	NLS	NLS	0.021	0.015	0.0050	<0.0050	0.058	0.047	<0.0050	<0.010
Silver	NLS	NLS	NLS	NLS	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	4.5	0.73	0.12	0.15	0.29	0.14	0.13	0.082	6.6	5.5	0.40	0.300
NON-METALS												
pH (unitless)**	6.68	NA	6.99	NA	7.40	NA	7.46	NA	6.28	NA	**7.61	NA
Polychlorinated Biphenyls (PCBs)	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0005	<0.0005
Total Organic Carbon (TOC)	290	NA	14	NA	34	NA	15	NA	140	NA	*11.0*	NA
Total Suspended Solids (TSS)	2,000	NA	30	NA	200	NA	180	NA	480	NA	31	NA
Total Dissolved Solids (TDS)	980	NA	200	NA	900	NA	250	NA	430	NA	91	NA
Settleable Solids (ml/L/hr)	15	NA	0.20	NA	0.59	NA	0.40	NA	2.5	NA	<0.10	NA
Turbidity (NTU)	250	NA	18	NA	52	NA	46	NA	23	NA	24	NA
Specific Conductance (umho/cm)	840	NA	320	NA	1,200	NA	400	NA	440	NA	140	NA
Tritium (pCi/l)	NDA	NA	NDA	NA	NDA	NA	NDA	NA	NDA	NA	NDA	NA

Tritium analysis performed in-house by SLAC health physics personnel
All analyses performed off-site by contract laboratory (CLS, in Rancho Cordova, CA)
All values in milligrams per liter (mg/l) unless otherwise noted
ml/L/hr = milliliters per liter per hour
NTU = Nephelometer Turbidity Units
umho/cm = micromhos per centimeter
pCi/l = picocuries per liter
Filtered samples passed through 0.45-micron filter

"<" symbol precedes reporting limit (i.e., analyte not detected)
*** = sample was not analyzed within holding time for pH*
NLS = no longer sampled, per Sec. B(5)(c)(ii) of General Permit
NA = not analyzed
NDA = no detectable activity above background

2002-2003 Wet Season Summary	Bldg. 18				Bldg. 81				ANALYTICAL SPECIFICATIONS			
	FIRST STORM EVENT		*SECOND STORM EVENT*		FIRST STORM EVENT		*SECOND STORM EVENT*		FIRST STORM EVENT		*SECOND STORM EVENT*	
Event Start Date	**7 November 2002**		**12 February 2003**		**7 November 2002**		**12 February 2003**		**Reporting Limit**	**EPA Test Method**	**Reporting Limit**	**EPA Test Method**
Sampling Start	**8:26 AM**		**8:12 AM**		**1:55 AM**		**8:10 AM**					
Sampling End	**8:30 AM**		**8:16 AM**		**1:59 AM**		**8:15 AM**					
Pump Counts	**514**		**526**		**535**		**507**					
Sample Method	**ISCO / Manually *****		**ISCO / Automatic**		**ISCO / Automatic**		**ISCO / Automatic**					
Sampler ID No.	**8**				**6**							
Parameter	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**				
METALS												
Aluminum	0.69	0.13	0.22	<0.050	0.86	0.25	0.70	0.11	0.050	200.7	0.050	6010B
Arsenic	0.0030	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	200.8	0.0020	6020
Cadmium	0.011	0.007	0.0031	0.0019	0.0019	0.0014	<0.0010	<0.0010	0.0010	200.8	0.0010	6020
Chromium	0.026	0.024	0.0024	0.0022	0.0080	0.0055	0.0061	0.0024	0.0010	200.8	0.0010	6020
Copper	0.14	0.13	0.022	0.019	0.051	0.042	0.018	0.0094	0.0010	200.8	0.0010	6020
Iron	0.94	0.24	0.35	<0.10	1.2	0.31	1.0	0.16	0.10	200.7	0.10	6010B
Lead	0.024	0.0059	0.0071	<0.0020	0.033	0.010	0.028	0.0020	0.0020	200.8	0.0020	6020
Manganese	0.13	0.088	0.023	0.012	0.41	0.370	0.08	0.032	0.010	200.7	0.010	6010B
Molybdenum	0.016	0.018	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	200.7	0.010	6010B
Nickel	0.033	0.032	<0.010	0.013	0.031	0.028	<0.0050	<0.010	0.0050	200.8	0.0050	6020
Silver	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	0.0010	200.8	0.0010	6020
Zinc	0.30	0.21	0.086	0.066	0.65	0.47	0.20	0.083	0.020*	200.7	0.020	6010B
NON-METALS												
pH (unitless)**	7.10	NA	**7.16	NA	6.37	NA	7.52	NA	NA	9040	NA	150.1
Polychlorinated Biphenyls (PCBs)	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0005	<0.0005	0.0002	8082	0.0005	8082A
Total Organic Carbon (TOC)	210	NA	20	NA	130	NA	21	NA	4.0 / 10 @	9060	2.0	415.1
Total Suspended Solids (TSS)	110	NA	34	NA	190	NA	150	NA	5.0	160.2	5.0	160.2
Total Dissolved Solids (TDS)	610	NA	78	NA	630	NA	170	NA	10	160.1	10	160.1
Settleable Solids (ml/L/hr)	1.2	NA	<0.10	NA	1.7	NA	0.4	NA	0.10	160.5	0.10	160.5
Turbidity (NTU)	18	NA	22	NA	17	NA	33	NA	0.5 / 5.0 @	180.1	0.50	180.1
Specific Conductance (umho/cm)	480	NA	22	NA	640	NA	260	NA	1.0	120.1	1.0	120.1
Tritium (pCi/l)	NDA	NA	NDA	NA	NDA	NA	NDA	NA	1000	SLAC-OHP	1000	SLAC-OHP

Tritium analysis performed in-house by SLAC health physics personnel
All analyses performed off-site by contract laboratory (CLS, in Rancho Cordova, CA)
All values in milligrams per liter (mg/l) unless otherwise noted
ml/L/hr = milliliters per liter per hour
NTU = Nephelometer Turbidity Units
umho/cm = micromhos per centimeter
pCi/l = picocuries per liter
Filtered samples passed through 0.45-micron filter

SLAC-OHP = In-house procedure based on EML HASL 300
"<" symbol precedes reporting limit (i.e., analyte not detected)
NA = not analyzed
NDA = no detectable activity above background
** = Increased reporting limits reflect sample dilution*
*** = sample was not analyzed within holding time for pH*
**** Samples collected manually >1 hour after start of discharge, due to battery failure*
"@" Elevated reporting limits indicate dilution of some samples

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