ES&H Division
SLAC-R-789

Annual Site Environmental Report: 2004

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)
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Menlo Park, CA 94025

May 4, 2006

Subject: 2004 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 2004. 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 2004 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 2004
SLAC-R-789

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”, the Environment, Safety, and Health (ES&H) Division of the Stanford Linear Accelerator Center (SLAC) prepares an annual report describing its environmental programs and activities.

This *Annual Site Environmental Report: 2004* 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 provides an overview of the report.

Contributors

This report was prepared under the direction of Helen Nuckolls, 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
BSD	Business Services Division
BTP	Batch Treatment Facility
BTU	British thermal unit
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
ISO	International Organization for Standardization
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 2004 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 2004, 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. There were no reportable releases to the environment from SLAC operations during 2004.

In addition, many improvements were continued during 2004, in waste minimization, recycling, decreasing air emission rates, stormwater drain system, groundwater restoration, and planning for a chemical management system to manage chemical use better. Program-specific details are discussed below.

Air Quality

SLAC operates its air quality management program in compliance with its established permit conditions: 2004 was the seventh consecutive year the air quality management program operated without receiving any notices of violation (NOVs) from regulators.

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 no facility inspections of SLAC during 2004.

Stormwater and Industrial Wastewater

SLAC operates its industrial and sanitary wastewater management program in compliance with established permit conditions: 2004 was the eighth consecutive year the program operated without receiving any NOVs from program regulators. During 2004 the last 32 unauthorized discharge connections to the stormwater system were eliminated.

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

In 2004, 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

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 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 (revised June 2003).[1]

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.

1 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

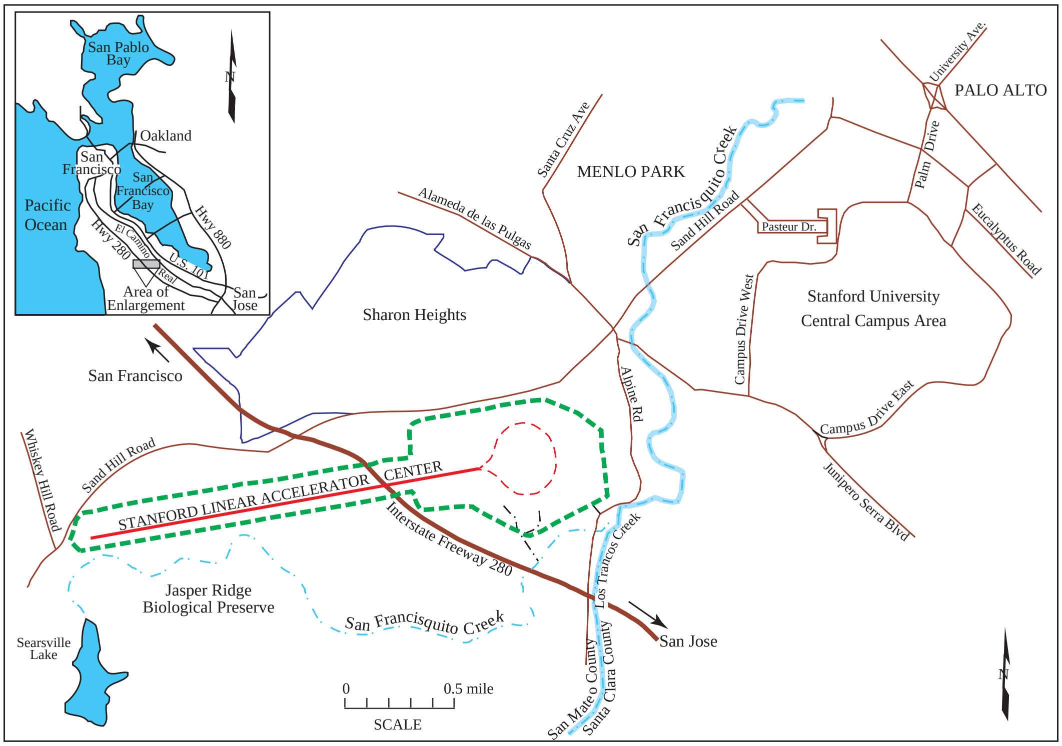

Figure 1-1 SLAC Site Location

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.[2]

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

2 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

SLAC 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 145 to 374 feet above sea level. The alluvial plain to the east around the bay lies less than 151 feet above sea level; the mountains to the west rise abruptly to over 2000 feet (see Figure 1-2).

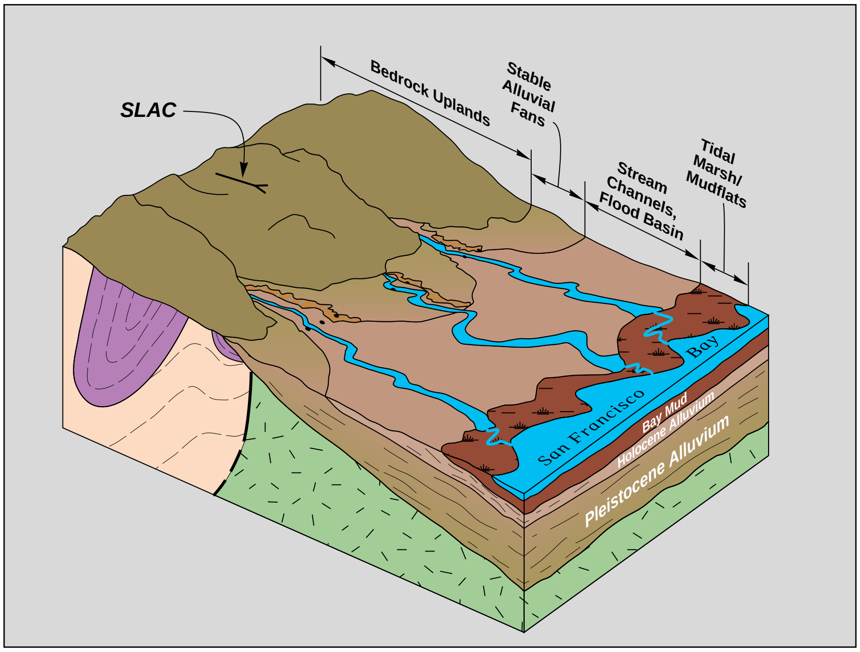

Figure 1-2 Site Area General Geographic and Geologic Setting

The site occupies 426 acres of land owned by Stanford University. The property was leased in 1962 for purposes of research into the basic properties of matter. The DOE now owns the original 50-year lease to the Atomic Energy Commission (AEC). 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 2.75 miles long, running in an east-west direction. The parcel widens to about 0.65 mile 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 channel of its kind between San Jose and San Francisco still in its natural state.

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 Sandstone (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 0.3 to 5 feet 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, 3 miles east of SLAC. The SLAC site is 197 to 394 feet higher than the station and is free of the moderating influences of the city; temperatures therefore average about two degrees lower than those in Palo Alto. Daily mean temperatures are seldom below 32 degrees Fahrenheit or above 86 degrees Fahrenheit.

Rainfall averages about 22 inches 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 that produce heavy precipitation for periods of five to 15 minutes with lulls in between bursts.

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 a “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 Sharon Heights development (to the north), including the Stanford 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 268,391-cubic-feet reservoir in Atherton north of Sand Hill Road, approximately 1.5 miles from central SLAC.

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

Drinking and process water are both transported throughout SLAC 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 1500 feet 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 in 2004 was 37,261 cubic feet per day, or 13,600,400 cubic feet total.

1.7 Demographics

SLAC's primary customers are the approximately 3000 students, postdoctoral students, and scientists from around the world who make use of its accelerator-based instrumentation and techniques for their research. SLAC has a working population of about 1,500, of which about 240 are PhD physicists. Approximately 730 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 mainly surrounded 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. Table 1-1 provides a summary of populations in the communities around SLAC.

Within one mile of SLAC's perimeter 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			124,980

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 compliance with those regulations for 2004.

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	SLAC complies with hazardous waste management and waste minimization 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 4.2	SLAC has both non-radiological and radiological air quality protection programs Per Title V, submitted Annual Emissions Report
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 2004 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 modified and improved 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
Environmental Management System	DOE Order 450.1	Meets requirements	Section 3.4	SLAC continued development of EMS
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	No eligible NHPA sites at SLAC
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")

Major Statute/Executive Order	Governing Document	Status*	ASER Location	Pertinent Documents, Programs, Activities, and Accomplishments
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
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. Participated in voluntary disclosure program at USEPA request
Safe Drinking Water Act	42 USC 300f and following	SLAC is not a water supplier	Not applicable	SLAC is not a water supplier
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	No ORPS were submitted
Radioactive Waste Management	DOE Order 435.1	Meets requirements	Section 5.10	Radioactive waste management requirements were met
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 2004 are shown in Table 2-2.

Table 2-2 General Permits Held by SLAC

Issuing Agency	Permit Type	Description	Number
Bay Area Air Quality Management District	Air quality	33 permitted sources and 17 exempt sources for operation of various types of equipment	50
		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 1A – Building 025, permit by rule (PBR) for cyanide treatment tanks	1
		Unit 1B – Building 038, permit by rule (PBR) for metal finishing pretreatment facility	1
		Unit 1C – Building 038, permit by rule (PBR) for batch hazardous waste treatment tank	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	0
		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

2.4.1 Non-radiological Incidents

There were no incidents in which regulatory permit limits or local, state, or federal reporting requirements were exceeded.

2.4.2 Radiological Incidents

In 2004, 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 2004.

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 2004 are reported here.

2.5.1 Assessments

2.5.1.1 External

External assessments are conducted on varying basis, but two assessments related to the radiological program occur regularly:

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.

In 2004, the DOE Independent Review Team reviewed the proposed technical scope of work for environmental restoration activities for SLAC and developed findings and recommendations where appropriate.

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) program. It is used to identify opportunities for ES&H improvement, and 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 develop site-wide corrective action plans. A structured walk-through inspection and a clean-up opportunity are also provided.

2.5.1.3 Independent Assessments

In 2004, URS Corporation performed an independent assessment of ES&H activities at SLAC. The 2004 assessment covered a wide variety of safety and health issues, including the following topics relevant to environmental concerns:

- General health and safety
- Industrial hygiene
- Electrical safety
- Asbestos management
- Radioactive waste
- Laser
- Toxic Substances Control Act/PCBs
- Medical services

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 2-3 lists the inspections conducted in 2004 by these agencies. No notices of violation were issued to SLAC by any regulatory agency.

Table 2-3 Environmental Audits and Inspections

Regulatory Agency	Inspection Title	Date	Violations
South Bayside System Authority	Annual Wastewater Discharge Inspection	March 2	0
Bay Area Air Quality Management District	Various activities with emissions to air	Multiple inspections	0

2.5.3 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 implementing the ten criteria from the DOE order.[3]

The Chemical and General Safety Department (previously the Safety, Health and Assurance 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.

2.5.3.1 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.

2.5.3.2 Environmental Radiological Program

In 2004, SLAC participated in the Mixed Analyte Performance Evaluation Program (MAPEP) held by DOE Idaho National Laboratory (INEL). Under this program, the INL provided the SLAC Radioanalysis

3 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

Laboratory with samples that contained unknown gamma- and beta-emitting radionuclides. The lab used these samples to test and improve its gamma counting and liquid scintillation counting capabilities.

2.6 Environmental Performance Measures

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

Performance measure results are reported in a fiscal year structure; the SLAC fiscal year 2004 (FY04) covered October 1, 2003 through September 30, 2004. The performance measure results for FY04 indicated a rating of "outstanding" on environmental measures.[5]

4 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, "ES&H ISMS: Performance Measures" (FY 2004), http://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm

5 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Final Draft, Annual Environment, Safety, and Health Report* (November 2004)

3 Management Systems

3.1 Introduction

This chapter provides an overview (as of 2004) 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. The results for the various measures and reviews discussed below are contained in Chapter 2, "Environmental Compliance".

3.2 ES&H Division Organization

In 2004, the ES&H Division consisted of six departments (see below) and a division office. The division office was tasked with overall strategic planning and management. The shared goal was to ensure SLAC operated in compliance with federal, state, and local regulations, as well as Department of Energy (DOE) requirements.

3.2.1 Environmental Protection

The Environmental Protection (EP) Department oversaw most of the SLAC environmental programs, including environmental restoration, air quality, stormwater and industrial wastewater, toxic substance control, and groundwater protection. The Waste Management (WM) Group in EP developed and implemented waste minimization and pollution prevention plans, and coordinated the disposal of regulated waste.

3.2.2 Fire Department

During 2004, the Fire Department, staffed by fire personnel from the Palo Alto Fire Department, was reassigned from SHA to report to the ES&H division office. Fire protection services were provided to the site on a 24 hour-a-day, seven days-a-week basis.

3.2.3 Radiation Protection

The Radiation Physics Group provided expertise in shielding design for new experiments and facilities, and provided oversight for safe operation of beam lines to protect workers and members of the general public. The Field Operations Group oversaw radiological monitoring, the Dosimetry and Radiological Environmental Group oversaw dosimetry, and the Radioactive Waste and Material Accountability Group oversaw radioactive waste management at SLAC.

3.2.4 Safety, Health, and Assurance (Chemical and General Safety)

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. After a serious accident at SLAC on October 11, 2004, SHA was reorganized into the new Chemical and General Safety Department (CGS).

3.2.5 Medical Department

During 2004, the Medical Department, staffed by contract professional medical personnel, was reassigned from SHA to report to the ES&H division office. The Medical Department provided a full range of occupational medicine services.

3.2.6 Knowledge Management

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

3.3 Integrated Safety Management System

The ES&H program has been designed to ensure 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

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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-R001.2, October 2004), http://www-group.slac.stanford.edu/esh/general/isems/docs/sms.pdf

4. Balanced priorities
5. Identification of safety standards
6. Hazard controls tailored to work being performed
7. Operations authorization

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 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 environment, 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 those who work at SLAC.[8] Because of the serious accident at SLAC on October 11, 2004, the FY04 WSS Set review was not finalized and the FY03 WSS Set continued in force by agreement with the DOE Stanford Site Office.

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]

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

9 The measures for fiscal years 1997 through 2004 can be found on line athttp://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm.

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

3.4 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 future generations in mind, thus ensuring proper stewardship and the eventual return of the land to unrestricted use. This stewardship goal is embodied in the safety management system described above, which 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.

DOE guidance on requirements for an EMS system was received in January of 2003. Activities at SLAC during 2004 addressed the general issues associated with the order, DOE O 450.1 "Environmental Protection Program".[11] SLAC continued to follow the path to "self declare" an EMS in place by utilizing the framework provided by the safety management system rather than seeking third-party certification, as described under the International Organization for Standardization (ISO) section 14001.

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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/

11 http://www.directives.doe.gov/pdfs/doe/doetext/neworder/450/o4501c1.html

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 as large quantities of electricity and cooling water are used in the operation of the accelerator. 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. Finally, SLAC has environmental management issues relevant for any employer with more than 1,500 full-time staff, 3,000 scientific users, 200 vehicles, hundreds of buildings, and over 400 acres of land located in an environmentally sensitive location.

SLAC expends considerable effort to minimize waste and emissions. If possible, SLAC avoids creating waste and emissions in the first place. If waste or emission generation is unavoidable, SLAC minimizes the amount it does produce, and then carefully manages the impacts that may occur as a result of waste generation.

As noted in Chapter 2, for fiscal year 2004, 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
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

Year	Organization	Award/Recognition Program	Description
2003	USEPA	Champion of Green Government Award	Reuse and reclamation of hazardous materials, and reduction of hazardous waste generation
2004	DOE	Pollution Prevention Award	Development of a site-wide chemical management system
2004	USEPA	Champion of Green Government Award	By upgrading lighting in Klystron Gallery will save $236,000 annually

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).

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 2004, and relevant performance trends. The radiological environmental program is discussed in Chapter 5, and programs covering the monitoring and remediation of groundwater, soil, and sediment are discussed in Chapter 6.

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 2004.

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). As a result of this implementation, SLAC became subject to the Title V permitting program and applied for a Synthetic Minor Operating Permit (SMOP). SLAC's Title V SMOP application was submitted on June 1, 2000, and the permit 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

1. Annual enforcement inspections
2. New source permit evaluations

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

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

- 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
- 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 two inspections in 2004: an annual facility-wide inspection on June 16, 2004 that included visits to 18 of SLAC's permitted sources of air emissions, and an inspection of the Gasoline Dispensing Facility (GDF) on August 3, 2004. No notices of violations (NOVs) were issued from either inspection.

4.2.2.2 New Source Permits

During 2004, SLAC submitted permit-to-operate application to BAAQMD for a new source (BAAQMD Source S-79) supporting the BaBar detector by testing components known as Limited Streamer Tubes (LSTs). After testing, these plastic components were installed in the Resistive Plate Chamber (RPC) of the BaBar detector, replacing metal plates. A gas mixture containing isobutane was run through the LSTs during the test phase, thereby requiring a new source permit.

The oil-water separator (S-76) installed in 2003 began operating in February 2004. In addition, the soil vapor extraction system (S-77) continued in operation. In November 2004 the system was approved for unabated operation, because after initial high concentrations and rapid decreases, VOC levels were consistently low and within the permitted limits. Finally, the plasma-arc cutting torch (S-78) in the Heavy Fabrication Building was exempted from permitting requirement in March of 2004.

Of the older sources onsite, one of the permitted diesel generators (S-69) was taken out of service and removed offsite in March 2004. Meanwhile, the inactive boiler next to the Plating Shop (formerly S-6) was refurbished and placed back in service as a backup unit for the main boilers. However, since its heating capacity is less than 10 million British thermal units (BTUs) per hour and it is fired solely by natural gas, this unit is permit-exempt in accordance with BAAQMD regulations.

In 2003, a source of air emissions was a plasma-arc cutting torch (BAAQMD Source S-78) in the southeast corner of the Heavy Fabrication Building (Bldg. 26). Because this unit was procured to cut stainless steel, the primary emittant of concern was hexavalent chromium (Cr+6). As part of an extensive permit application process, ESH researched the emissions from similar cutting machines and provided operational data to BAAQMD, such that this unit was exempted from permitting requirements in March of 2004.

In light of these changes, at the end of 2004 SLAC had a total of 54 sources of air emissions listed in its facility-wide *permit to operate*, comprising 33 permitted and 17 exempt sources. Information regarding these sources is presented in Table 4-2.

Table 4-2 BAAQMD Permitted/Exempt Sources (at end of CY2004)

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 (in mix)
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, natural gas
S-58	6	Cryogenics/SSRL	TCE "chili pot" solvent tank	TCE
S-59	31	Building wide	Solvent cleaning operations	EtOH; Acetone, TCA
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

BAAQMD Source Number	SLAC Building Number	Location	Source	Chemical(s) Emitted / Data Quantity Tracked
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
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)
S-79	750	Collider Experimental Hall	LST testing for BaBar	Isobutane
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	Cr+6 emissions, et al.

BAAQMD Source Number	SLAC Building Number	Location	Source	Chemical(s) Emitted / Data Quantity Tracked
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

Legend

TCA, Trichloroethane; H2SO4, Sulfuric Acid; EtOH, Ethanol (Ethyl Alcohol); IPA, Isopropyl Alcohol; MeOH, Methanol (Methyl Alcohol); NZE, Near-Zero Emissions; DCH, Drift Chamber; IFR, Instrumented Flux Return; H134a, Halocarbon 134a (a type of freon); MFPF, Metal Finishing Pretreatment Facility; RWTP, Rinse Water Treatment Plant; Cr, Chromium; Cr+6, Hexavalent Chromium; Ni, Nickel; CN, Cyanide; TCE, Trichloroethylene; SSRL, Stanford Synchrotron Radiation Laboratory; MeCl, Methylene Chloride; FW, Facility-Wide; CEH, Collider Experimental Hall; MCC, Main Control Center; IR[-#], Interaction Region [number]; VOC, Volatile Organic Compound; HVAC, High-Volume Air Conditioning; AG, Above-Ground; KLY, Klystron [Department]; SLD, SLAC Linear Detector

4.2.2.3 Annual Title V SMOP Emissions Report

SLAC submitted the annual emissions report on time in July 2004, covering the 12-month period from July 1, 2003 through June 30, 2004.

4.2.2.4 Annual Permit-to-Operate Update

SLAC submitted its annual update to BAAQMD on April 13, 2004. 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 2003 covered the period of July 1, 2003 through June 30, 2004. Following this submittal, SLAC received the renewal of its permit-to-operate on June 24, 2004, effective through July 1, 2005.

Currently, the largest source of air emissions at SLAC is its BaBar Detector (BAAQMD Sources S-55 and S-56, representing two separate subsystems). SLAC has operated the detector within permit conditions at all times since its startup in 1999. However, due to steadily increasing flow rates of isobutane through the detector subsystems, a second change-of-condition application may be required in the future. Due to the current permit’s emissions cap of 3,600 pounds per year, however, another increase would exceed the regional POC emissions limit of 10 pounds per day. As such, the change-of-condition request could result in more intensive review and greater scrutiny, and could require an abatement device. Due to the extremely low operating pressure of the detector, any form of abatement would be likely to render the detector useless. ESH and their air quality contractor met with BaBar personnel to discuss the situation and develop a compliance strategy. In order to manage the detector components more effectively, SLAC elected to prepare individual permit applications for the three discrete subsystems of the BaBar detector.

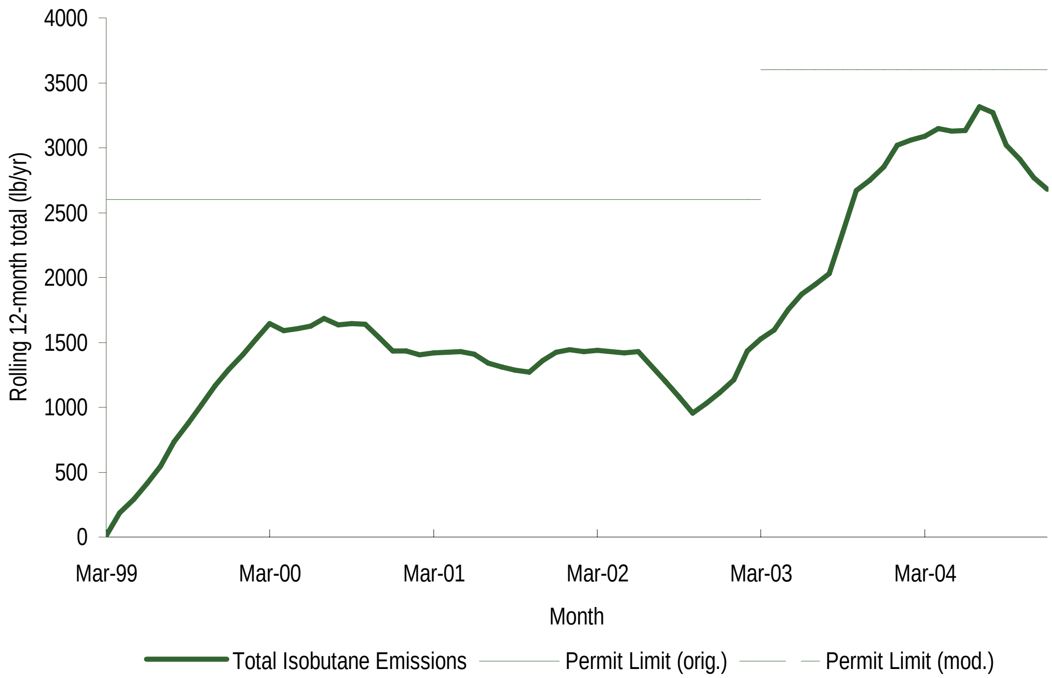


Figure 4-1 POC Emissions from BaBar (DCH-IFR/Sources S-55 and S-56)

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 more of a listed chemical 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 May 31, 2005, covering the 2004 reporting year. Air toxics emitted from permitted sources included the following:

1. H-134a, a Freon compound used in one of the components of the BaBar Detector: 14,543 pounds
2. 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: 60 gallons (about 840 pounds)
3. R-11 and R-22, used in SLAC heating, ventilation, and air conditioning (HVAC) equipment: 120 and 347 pounds, respectively
4. Sulfur hexafluoride, a potent greenhouse gas used in both experimental equipment and electrical substations: 1,260 pounds

Regarding air toxics emitted from the rest of the facility, a total of 34 air toxics were reported as being used in quantities greater than the corresponding "degree of accuracy". Usage quantities of these 34 chemicals ranged from a low of 0.18 pounds per year (for crystalline silica) to a high of 36,855 pounds per year for sulfuric acid (H_2SO_4). The silica is a component of an acrylic primer used at SLAC, while sulfuric acid is used for pH adjustment in SLAC operations. 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 April 13, 2005 (covering the 2004 reporting year) and reported using a total of 59 adhesives. Twenty-six of these materials were used in research applications (satellite assembly, magnet assembly, and cosmic ray telescope assembly) and the remaining 33 were used in equipment and building maintenance applications. The research adhesive used in the greatest quantities was seven gallons of Nusil Adhesive (#CV-1142), while the maintenance adhesive used in the greatest quantity was 18 gallons of DAP-Weldwood Contact Cement.

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 2004, evaluations of approximately 39 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 eight of the 39 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. Reporting comprises an annual performance report and two semi-annual exceedance reports.

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

In July 2004, SLAC received a letter from USEPA requesting our participation in voluntary disclosure program involving the use of Hazardous Air Pollutants (HAPs). To ensure that SLAC was in compliance with NESHAPs statutes, SLAC commissioned an audit from its air contractor to evaluate all uses of HAPs onsite. Nearly all use occurs in the SLAC Plating Shop, due largely to the use of cleaning and degreasing solvents in plating processes. The audit revealed that recordkeeping and reporting requirements were not being met at all locations and in all areas. However, no serious violations were discovered. SLAC presented the audit findings to USEPA in a letter dated September 24, 2004. Due to the nature of the findings and in light of SLAC’s full cooperation in the program, no penalties or fines were imposed by USEPA. A compliance agreement was signed by SLAC’s director, Jonathan Dorfan, in October 2004 and submitted to USEPA.

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 successful protection project resulted in SLAC receiving an environmental quality award from the city of Menlo Park for exceptional resource conservation.

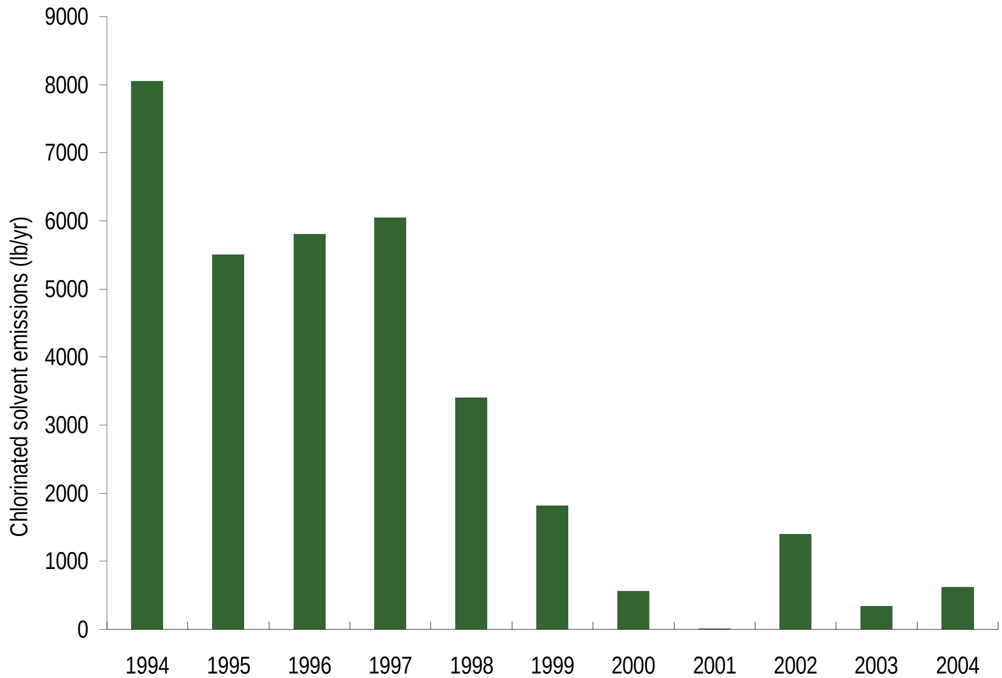


Figure 4-2 Air Emissions from Chlorinated Solvents: SLAC Plating Shop, 1994–2004

4.2.2.9 Protection of Stratospheric Ozone

No releases of stratospheric ozone-depleting substances (ODSs) occurred during 2004 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:

- 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

- 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. Limited progress was made on these items in 2004, due to limited funding and modified priorities:

- SSRL Building 118 Chiller Replacement
- Halon Fire Systems Replacement (two systems)
- Miscellaneous Heating, Ventilation, Air Conditioning (HVAC) Equipment Replacement (approximately six small systems)
- 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. This facility replaced both the tanker operation and the moped fueling station.

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. The source test was performed by a contractor in September 2004 and all results were positive. The results are transmitted automatically to both SLAC and BAAQMD by the contractor.

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.

The GDF provides both gasoline and diesel for SLAC vehicles. Only 1,826 gallons of gasoline and 2,355 gallons of diesel were dispensed in 2004. Use of both fuels was substantially reduced from 2003, continuing steady declines for the third year in a row.

SLAC continued its efforts to replace and upgrade 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. In 2004, the SLAC GSA fleet of electrical vehicles increased to 45.

Table 4-4 Vehicle Fleet Summary

Indicator	CY04	CY03
Total number of vehicles on site	224	225
Total number of GSA vehicles	213	212
Total number of DOE vehicles	11	13
Average GSA vehicle age in years	3	3
Average DOE vehicle age in years	17	17
Average year vehicle manufactured	2000	1999

At the beginning of the year SLAC operated only 13 DOE-owned vehicles. The average age of these vehicles was 17 years, and they represented the worst-polluting vehicles of SLAC's vehicle fleet. By the end of the year, SLAC had disposed of two of these aging vehicles, leaving only 11 DOE trucks onsite.

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

4.2.2.11 Greenhouse Gas Inventory and Baseline

SLAC retained the Rocky Mountain Institute for a second year to build on the greenhouse gas (GHG) inventory and baseline compiled in 2003. Possible next steps considered include registration and certification in the California Climate Air Registry (CCAR), which would help to establish a definitive baseline for tracking programs.

Sulfur hexafluoride (SF_6), the most potent greenhouse gas known, is used at SLAC in both electrical equipment and experimental apparatus. ESH consulted various work groups to determine why SF_6 was used in those applications, and whether any comparable substitutes existed for specific uses. It became clear that SF_6 is the post appropriate for its application, and that research into acceptable substitutes has barely begun. Nevertheless, subsequent research proposals have considered substitutes and incorporated justification for using SF_6, even in minute quantities.

In December 2004, ESH personnel attended an international conference that focused on the environmental impacts of SF_6. Particle accelerators constitute a distinct category of SF_6 use, and there are nearly 20 to 25 units currently operating in the United States. However, this category represents only a tiny fraction of total SF_6 use, which is dominated by the utility industry.

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; 2003 was the sixth consecutive year the air quality management program operated without receiving any NOVs from cognizant regulators. Nevertheless, SLAC maintains 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, continued work on the greenhouse gas (GHG) baseline/inventory 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 then 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 pretreated prior to discharge at such facilities as the Metal Finishing Pre-treatment Facility (MFPF) and the Contained Water Treatment System at Cooling Tower 1701. This section describes the regulatory framework under which SLAC operates for the purpose of water quality protection, and then presents the status of SLAC's water quality protection programs in 2004.

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.

SLAC operates its industrial and sanitary wastewater programs under two mandatory wastewater discharge permits, which are negotiated jointly with the WBSD and SBSA. These permits were renewed on April 1, 2002 and will expire on December 15, 2006, and specify monitoring programs and pollutant discharge limits. SLAC also has two discretionary groundwater discharge permits. One is for the existing groundwater treatment system at the Former Solvent Underground Storage Tank (FSUST), which will expire August 21, 2006. The other permit is for the proposed dual phase extraction and treatment system at the Former Hazardous Waste Storage Area (FHWSA), which became effective October 15, 2004 and expires October 14, 2009. The FHWSA is working in an interim mode until its final design and construction, which is planned for CY 2005. SLAC also 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, Flow
FSUST	GW WB082201	Quarterly (determined by carbon depletion pattern)	Specified organics[13], Flow
FHWSA	GW WB041015	Quarterly	As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, Specified organics, CS2, Flow
Sand Hill Road and three Alpine Road stations (MSub, Alpine, IR08)	Contractual discharge arrangement	Flow data collected on real-time basis	Flow

Per the permit terms, SLAC is required to submit a semi-annual self-monitoring report[14] on the results of its monitoring of the MFPF, a semi-annual certification of a solvent management plan (SMP) for approximately 100 solvents selected by the SBSA, and quarterly reports for discharges of treated groundwater[15] and radioactivity in industrial wastewater (see Section 5.5.1).

SLAC's industrial and sanitary monitoring locations are shown in Figure 4-3. SLAC's Sand Hill Road flow metering station (Sandhill FMS) is located immediately upstream of SLAC's sewer system connection to WBSD's Sand Hill Road trunk line, just to the north of the SLAC main gate. SLAC also has three flow monitoring stations (MSub, Alpine, and IR08) on the south side of the facility, which collectively monitors the flow SLAC discharges to the WBSD's Alpine Road trunk line.

13 Total petroleum hydrocarbon (gasoline), benzene, chloroform, methylene chloride, carbon tetrachloride, perchloroethylene

14 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *Semiannual Self-Monitoring Report, Mandatory Wastewater Discharge Permit WB 020401-P (*EPR 0306-04, 20 July 2004, submitted to Norman Domingo, Technical Services Supervisor, SBSA)

———, *Semiannual Self-Monitoring Report, Mandatory Wastewater Discharge Permit WB 020401-P* (EPR 0401-01, 31 January 2005, submitted to Norman Domingo, Technical Services Supervisor, SBSA)

15 Erler & Kalinowski, Inc, *Groundwater Discharge Self Monitoring Report, 1st Quarter 2004, Discretionary Groundwater Discharge Permit No. GW WB 082201* (April 15, 2004, submitted to SBSA).

______, *Groundwater Discharge Self Monitoring Report, 2nd Quarter 2004, Discretionary Groundwater Discharge Permit No. GW WB 082201* (July 15, 2004, submitted to SBSA).

______, *Groundwater Discharge Self Monitoring Report, 3rd Quarter 2004, Discretionary Groundwater Discharge Permit No. GW WB 082201* (September 15, 2004, submitted to SBSA).

______, *Groundwater Discharge Self Monitoring Report, 4th Quarter 2004, Discretionary Groundwater Discharge Permit No. GW WB 082201* (January 12, 2005, submitted to SBSA).

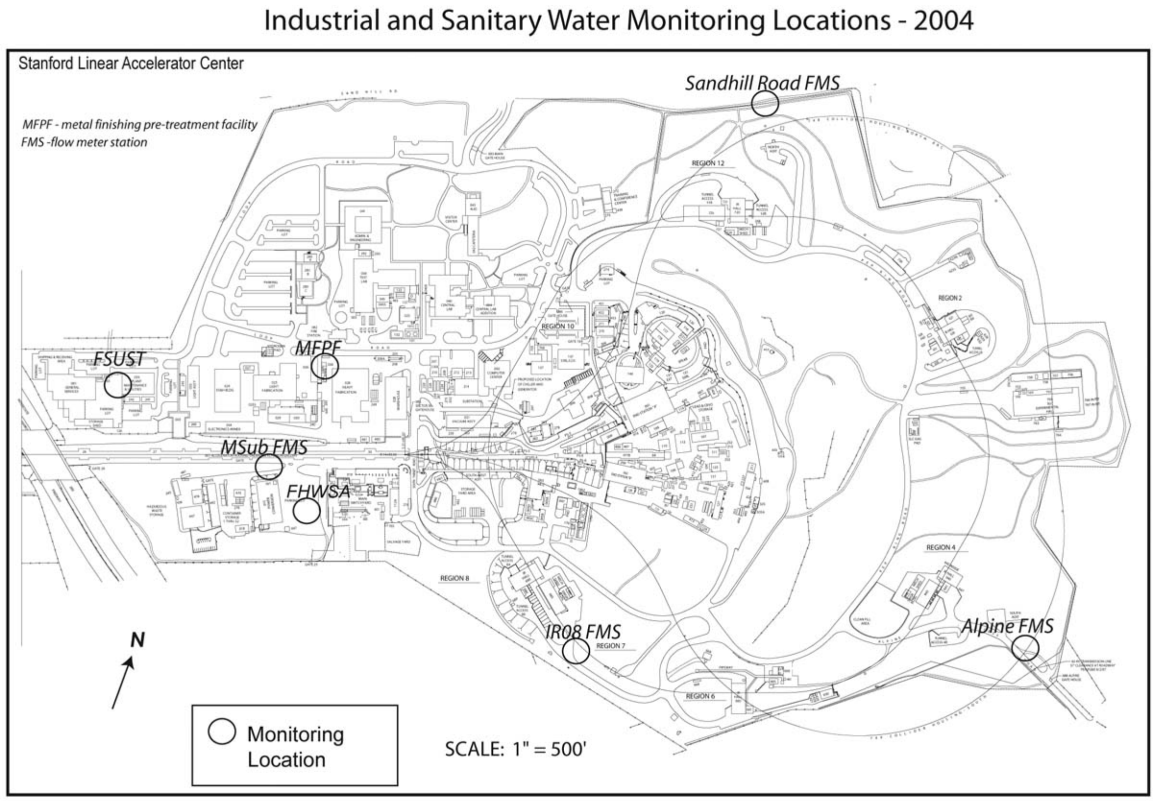


Figure 4-3 Industrial and Sanitary Wastewater Monitoring Locations

4.3.2 Program Status

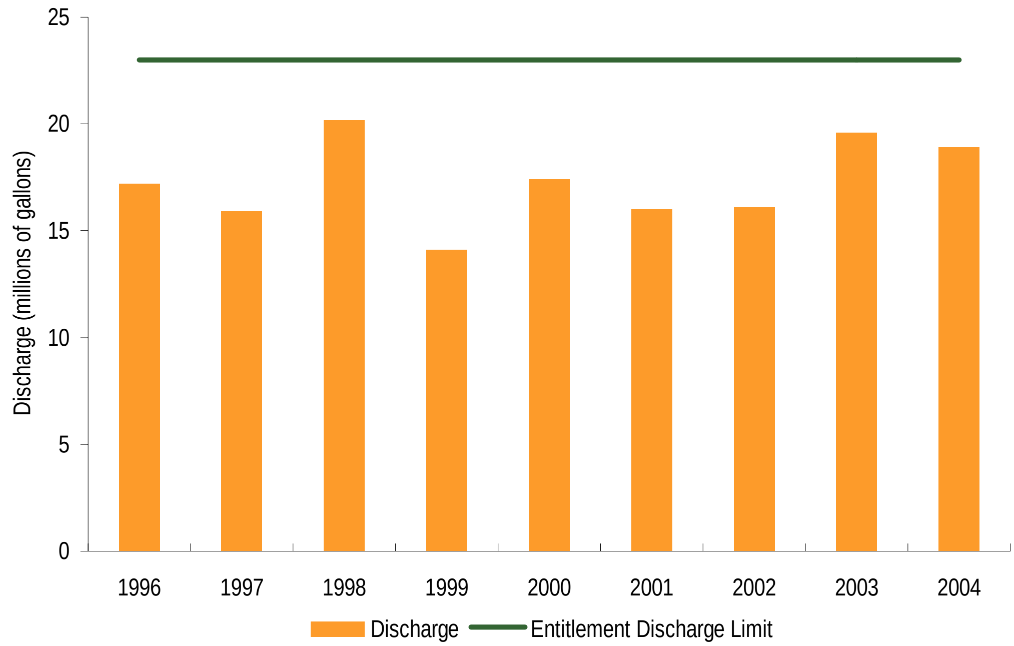
4.3.2.1 Annual Facility Enforcement Inspection

The SBSA conducted an annual inspection of SLAC on March 2, 2004. There was a site tour of the new Cooling Tower 404 in the Research Yard, of the groundwater extraction treatment plant at Building 35 (Former Solvent Underground Storage Tank), and the proposed location of a new dual phase groundwater extraction treatment plant at Building 15 (Former Hazardous Waste Storage Area). Discussion topics during the inspection included the new oil/water separator at Building 81 (Discharge # 14), and the proposed modifications to the sanitary sewer discharge location as a result of the Safety and Operational Reliability Improvements Project. No notices of violation (NOVs) were issued.

4.3.2.2 Flow Monitoring Results

Total industrial and sanitary wastewater discharge to the WBSD's regional collection system was approximately 19 million gallons, which equates to a daily average of approximately 52,000 gallons per day (gpd). The flow discharge limit for SLAC is approximately 23 million gallons, or 64,000 gpd. Thus, SLAC was approximately 19 percent under its facility-wide flow discharge limit in 2004, slightly lower than 2003.

SLAC's 2004 facility-wide discharge is compared with past years in Figure 4-4. Missing from these totals are flows from two restrooms from unoccupied buildings (B-650, B-665), a SLAC Linear Collider (SLC) underdrain, and gutter water discharging from the South Adit to the sanitary sewer near IR-6.



Sources: ASER, 1996–2001; Sand Hill Road Flow Meter, 2002; Total Flow Meter Records, 2003–2004

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

4.3.2.3 Water Quality Monitoring Results

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

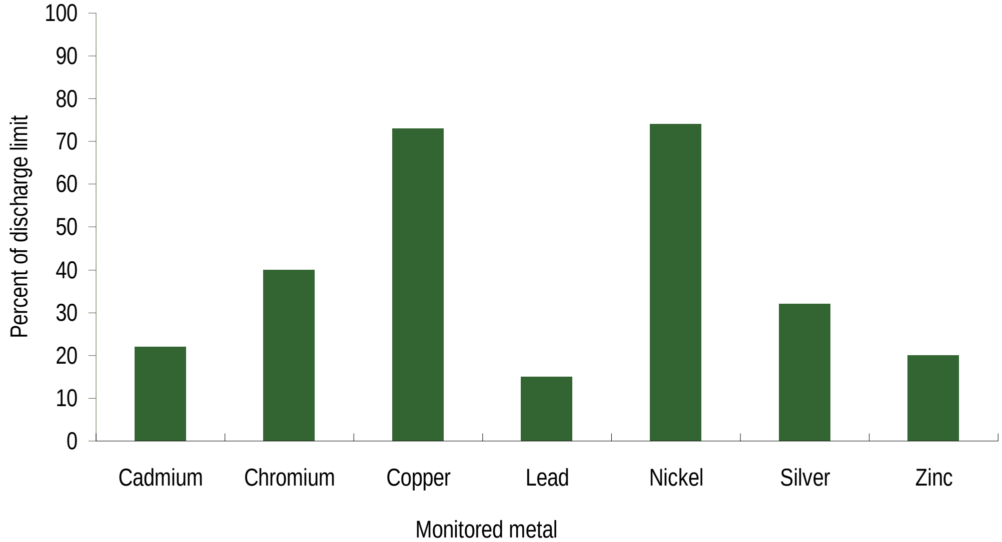
Parameter	February 11, 2004		May 5, 2004		Wastewater Discharge Limits (ppd)
	SBSA Monitoring Results (mg/L)	SBSA Calculated Results (ppd)	SBSA Monitoring Results (mg/L)	SBSA Calculated Results (ppd)	
Flow (gpd)	59,923	NA	71,067	NA	62,175
Cadmium	<0.02	<0.4998	<0.02	<0.5927	0.036
Chromium	<0.21	<0.4998	<0.21	<0.5927	0.18
Copper	0.1300	0.0650	0.1800	0.1067	0.13
Lead	<0.14	0.4998	<0.14	<0.5927	0.33
Nickel	<0.14	<0.4998	<0.07	<0.5927	0.042
Silver	<0.032	<0.4998	<0.032	<0.5927	0.036
Zinc	0.1720	0.0860	0.2940	0.1743	0.45
pH	8.60	NA	8.50	NA	6.0 - 12.5
Parameter	July 29, 2004		October 28, 2004		
Flow (gpd)	72,952	NA	36,024	NA	62,175
Cadmium	<0.02	<0.6084	<0.001	<0.3004	0.036
Chromium	<0.21	<0.6084	<0.005	<0.3004	0.18
Copper	0.1900	0.1156	0.0880	0.0264	0.13
Lead	<0.14	<0.6084	0.0090	0.0027	0.33
Nickel	0.1000	0.0608	0.0150	0.0045	0.042
Silver	<0.032	<0.6084	<0.003	<0.3004	0.036
Zinc	0.1380	0.0840	0.1800	0.0541	0.45
pH	8.50	NA	8.20	NA	6.0 - 12.5

NA = not appllicable

ppd = pounds per day

gpd = gallons per day

SLAC was in compliance with all seven heavy metal limits on all four sampling dates. On an annual basis, SLAC discharged from 15 percent (for lead) to 74 percent (for nickel) of its permitted discharge limits, as shown in Figure 4-5.



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	
	Discharge Limits		February 11	April 28	January 05
Analytical Parameter	Federal Daily Maximum (mg/L)	Federal Monthly Average (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)	SLAC Monitoring Results (mg/L)
Metals					
Cadmium	0.69	0.26	<0.02	<0.0010	<0.010
Chromium	2.77	1.71	<0.21	0.0059	<0.040
Copper	3.38	2.07	0.270	0.1800	0.0840
Lead	0.69	0.43	<0.14	0.0038	<0.040
Nickel	3.98	2.38	0.410	0.1200	0.0450
Silver	0.43	0.24	0.086	0.0047	<0.010
Zinc	2.61	1.48	0.042	0.0110	<0.030
Non-metals					
Cyanide	1.20	0.65	<0.003	<0.0050	<0.0050
pH (unitless)	6.0 - 12.5	NA	10.00	9.40	9.84

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 requirement was superceded by implementation of SLAC's Solvent Management Plan, which was originally submitted to SBSA on July 31, 2001.

3 The second SLAC semi-annual sampling event occurred in early January due to the extended shut-down during the last quarter of 2004.

NA = not applicable

4.3.2.4 Best Management Implementation Results

The Industrial Wastewater Program started initiating best management practices in 2004 to reduce discharge of constituents of concern to the sanitary sewer. The following were accomplished as part of this effort:

- An evaluation of the Containment Water Treatment Unit was performed. This unit primarily treats rainwater that accumulates in electrical vaults and transformer containments. The treated water is then used as make-up water in Cooling Tower 1701. The evaluation confirmed the overall unit configuration and effectiveness, and gave recommendations for minor improvements that included additional filters and sampling ports. As a result of this evaluation, a quarterly sampling program for the basin water at Cooling Tower 1701 was initiated.
- A new procedure was implemented in the Positron Electron Project (PEP) II tunnel that reduces the discharge of solids to the sanitary sewer. The tunnel is now cleaned in a manner to minimize water use,

thus allowing for the bagging of solids for disposal instead of solids flowing into the tunnel gutter and discharging to the sanitary sewer. This new procedure is expected to reduce metal loading to the sanitary sewer.

- Mop water from the High Bay in Building 44 is being analyzed for metals and PCB before disposal and will be diverted from the sanitary sewer based on results.

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, heat exchange systems such as SLAC's six major cooling tower installations, and employee toilets and sinks throughout the facility.

SLAC operates its industrial and sanitary wastewater management program in compliance with established permit conditions. In 2004, SLAC operated the program for the eighth consecutive year without receiving any NOVs from program regulators. SLAC is in the process of combining the multiple permits into one site-wide permit that will include flows to both the Sand Hill and Alpine trunk lines and incorporate the groundwater treatment systems and MFPF as sub-discharges. This permit consolidation will allow SLAC to manage its industrial wastewater in a consistent manner and will better represent discharges to the sanitary sewer. In addition, SLAC plans to expand its industrial wastewater best management practices (IW-BMPs) program with a web presence, allowing for the posting of IW-BMPs to be used as guidance documents for operations.

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, stormwater has the potential to come into contact with industrial activities or facilities before discharge. Such activities or facilities include metal working and metal storage, cooling towers, electrical equipment operation, and secondary containments.

Many of the 24 surface water discharge locations drain land still in its natural state, where there is no potential for stormwater to contact industrial activities occurring at the site. Some locations drain developed land or areas where stormwater can potentially come into contact with industrial activities, but the characteristics of the drainage is similar to monitored locations. Therefore, the focus of SLAC's surface water management program is on the remaining seven locations, listed below and shown in Figure 4-6.

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 and Building 18 combined flow

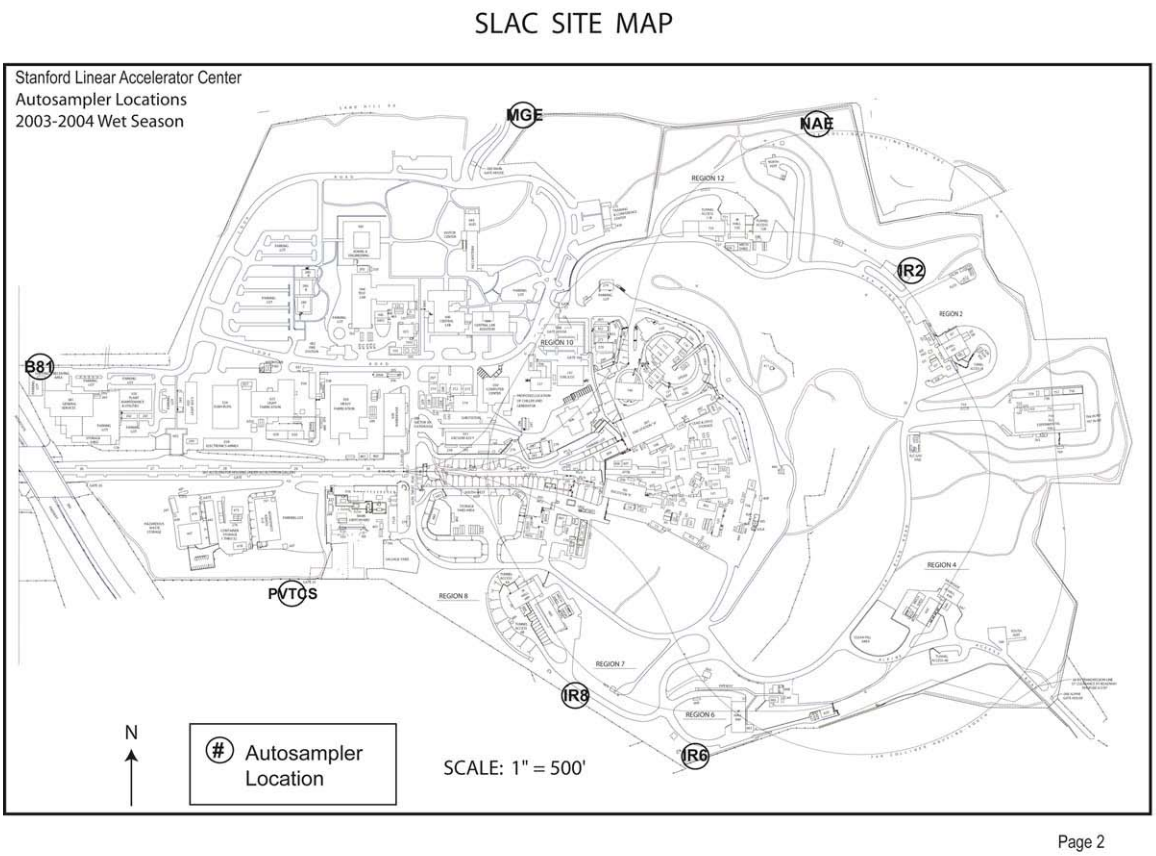


Figure 4-6 Surface Water Monitoring Locations

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, with the goal of reducing water pollution by regulating stormwater discharges associated with industrial activities. SLAC filed a notice of intent to comply with the general permit.

California's general permit was re-issued in 1997. SLAC adheres to the requirements of the general permit, and specifies how it adheres to requirements through its stormwater pollution prevention plan (SWPPP).[16] The SWPPP has two main components: a stormwater monitoring program (SWMP) and a "best management practices" (BMPs) program.[17] The SWMP presents the rationale for sampling, lists the

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

17 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

sampling locations, and specifies the analyses to be performed. The BMPs present a list of 13 generic and site-specific practices that serve to minimize the impact on stormwater from SLAC's industrial activities (see Section 4.4.2.3).

4.4.2 Program Status

4.4.2.1 Annual Facility Enforcement Inspection

Neither the Environmental Health Division of the San Mateo County Health Services Agency, nor the California Regional Water Quality Control Board San Francisco Bay Region (RWQCB) conducted an inspection of SLAC's surface water protection program this year. No notices of violation (NOVs) were issued.

4.4.2.2 Water Quality Monitoring Results

SLAC's SWMP incorporates all general permit sampling and analysis requirements, such as frequency (samples collected from first storm of season and one additional storm), locations (samples 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 SLAC's climatological conditions, as rain rarely falls during June through September. Since the general permit's definition of "wet season" runs from October 1 through May 30, the 2004 water quality monitoring results published in the ASER are for the last three months of 2004 and the first five months of 2005. 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. [18] SLAC delivered its annual report, which includes all water quality monitoring results, to the RWQCB to fulfill this requirement.[19]

Four storm events were sampled during the 2004–2005 wet season. This sample schedule was the result of automated samplers that can be triggered by rain gauges and level sensors. Though this allows for monitoring of storm events that occur during off-hours, the sensors are not always reliable, thus, two storm events that occurred during off-hours activated only some of the samplers. The remaining sample locations had to be sampled again during storm events that occurred during facility operating hours.

The first storm to be sampled occurred on December 7, 2004. Samples were retrieved from the NAE, IR-8, and the Building 15/Building 18 combined flow. The second sample storm was on January 7, 2005. Samples were retrieved from IR-8, PVTCs, and B-081. The third sample storm was on February 14, 2005. Samples were retrieved from MGE, NAE, IR-2, IR-6, and B-081. The final sampled storm was on March 18, 2005. Samples were retrieved from MGE, IR-2, and IR-6. SLAC met all sampling and analysis requirements in its SWMP.

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18 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *2004–2005 Annual Stormwater Report* (EPR 0505-02, June 30, 2005, submitted to Rico Duazo, San Francisco Bay RWQCB)

19 SLAC has adopted the convention of reporting its water quality monitoring results for the "wet season" in its ASER. The data from the 2004-2005 wet season are discussed in the 2004 ASER.

Table 4-8 lists the number of results greater than the corresponding parameter benchmark values (PBVs, also referred to as the “reduction certification values”). The PBVs are available from the State Water Resources Control Board.[20] Note that PBVs represent a threshold at which BMPs should be re-evaluated for effectiveness, not numerical discharge limits.

If a facility’s stormwater monitoring results are entirely below the PBVs, by law the facility operator is entitled to a reduction in stormwater monitoring frequency. Thus, a comparison of SLAC’s observed stormwater monitoring results against the PBVs is used to assess the overall effectiveness of SLAC’s stormwater management program.

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

Analyte	Units	Number of Results	Number of Detects	Maximum Conc. Detected	SWRCB PBV (1)	Number of Results >PBV (4)	Percent of Results >PBV
Metals							
Aluminum	mg/L	14	14	2.0	0.75	6	43
Chromium	mg/L	7	6	0.012	NA	NA	NA
Copper	mg/L	14	14	0.08	0.0636 (H)	1	7
Iron	mg/L	14	14	2.8	1.0	6	43
Lead	mg/L	12	10	0.061	0.0816(H)	0	0
Manganese	mg/L	5	5	0.12	1.0	0	0
Zinc	mg/L	12	12	0.51	0.117(H)	8	67
Non-Metals							
TSS	mg/L	14	13	460	100	5	36
TOC	mg/L	14	13	42	110	0	0
pH	SU	14	14	8.14	6-9	0	0
Turbidity	NTU	14	14	360	NA	NA	NA
SC	µs	14	14	3700	200	11	79
PCBs	mg/L	14	4	0.00056	0.000477	3	21
Radioactivity	pCi/L	14	0	ND(2)	NA	NA	NA
Total		176	147			40	22.7 (3)

Notes:

1 SWRCB Parameter Benchmark Values are available at www.swrcb.ca.gov/stormwtr/docs/smanlrdc.doc. Metal PBVs shown are on a total metal basis. (H) signifies that this is a hardness dependant benchmark The PBV shown for PCBs is for Aroclor-1260. SWRCB PBVs have not been set for chromium, molybdenum, radioactivity (tritium, gamma), or turbidity. SLAC may choose to develop benchmarks for site specific conditions.

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

3 Determined by the total number of results greater than PBVs for those analytes for which PBVs are available.

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

4 Hardness dependant metals were compared to hardness modified benchmarks specific to each location and storm event.

NA = Not applicable

ND = Not detected

Many of the parameters that SLAC monitors have PBVs established by the SWRCB. Stormwater samples were collected at seven locations and analyzed for as many as 14 parameters. The majority of the analytical results (77 percent) were below the PBVs. Analytes that exceeded the PBVs were primarily specific conductance (SC), aluminum, and iron. The SWPPP monitoring program changes over time based on evaluation of BMP effectiveness and sampling results. Arsenic, nickel, molybdenum and cadmium are no longer analyzed as the sampling results were 50 percent below the PBV for two consecutive sampling events.

Maximum concentrations of all metal parameters were lower than last year. This is the second year that these concentrations have declined. There were also fewer occurrences of all parameters exceeding PBVs, except for specific conductance and PCB Aroclor 1260. TOC never exceeded the PBV, and total suspended solids (TSS) benchmarks were exceeded in only 36 percent of the samples, much lower than the 75 percent reported last year. Overall, the results showed a continued decline in concentrations and occurrences of PBV excesses. SLAC uses this information in an on-going effort to review its sampling protocols and improve its BMPs, as discussed below.

The RWQCB contacted the City of Menlo Park and San Mateo County during the summer of 2004 to request inspection of facilities that exceed benchmarks. However, no inspections occurred in 2004. San Mateo County has 109 permitted facilities, 48 of which exceeded one or more PBVs in 2003. Table 4-9 compiles data made available to SLAC by the City of Menlo Park, and relates SLAC to other county facilities that have exceeded specific stormwater parameters.

Table 4-9 San Mateo County Permitted Facilities Exceeding PBV

Parameter	Number of Permitted Facilities Exceeding PBV	Percentage of Permitted Facilities Exceeding PBV
Al	3	2.8
Cu	4	3.7
Fe	7	6.4
O&G	6	5.5
Pb	2	1.8
pH	8	7.3
SC	35	32.1
TOC	5	4.6
TSS	20	18.4
Zn	14	12.8

Note: Those in bold include SLAC

4.4.2.3 Stormwater Management Improvements

Best management practices are implemented at SLAC to reduce the potential for stormwater to come into contact with industrial activities. The BMPs are one component of an environmental management system that includes planning, implementing, checking, and improving performance.

BMP and surface water program -related accomplishments during 2004 included the following:

- SWMP improvements. The SWMP was improved through programmatic changes that increased safety, saved money, increased reliability of data and increased documentation
- Outreach activities. Four articles were published in The Interaction Point, SLAC’s newsletter, to educate and inform SLAC personnel of stormwater protection requirements
- Training. stormwater awareness training was enhanced and the target audience was increased
- New BMPs for activated material. To date, no stormwater sample submitted for analysis has shown any detectable radioactivity above background levels
- Research Yard cleaning. Additional surface cleaning was completed in the Research Yard to remove sediment containing low levels of PCB and lead (see Chapter 6)
- Containment BMPs. New BMPs were implemented to ensure discharge from containments is sampled and documented
- Alpine Gate Channel maintenance. A storm drain pipe was installed at Alpine Road to address flooding in this area. The asphalt-lined channel was cleaned and repaired with a portion of the channel left unlined as a vegetated swale
- The last 32 unauthorized discharge connections to the stormwater system were eliminated. Since 1995, approximately 300 connections have been identified and eliminated.

4.4.3 Summary and Future Plans

SLAC discharges stormwater with the potential to come into contact with industrial activities. SLAC has an extensive monitoring program in place at the seven discharge locations where past sampling results indicate the greatest potential exists for industrial contact. During the 2004–2005 wet season, SLAC met all requirements of its monitoring plan.

In 2004, SLAC operated its surface water program for the twelfth consecutive year without receiving any NOVs from program regulators. When analytical results from the 2004–2005 wet season were compared with the PBVs, over 77 percent of all the parameter results were below the benchmarks. SLAC continued to actively pursue several BMP-related performance improvements during the year.

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 plan
3. California Accidental Release Prevention
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 CUPA responsible for overseeing hazardous materials and waste management at SLAC. The CUPA did not perform any facility-enforcement inspections in 2004.

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 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 2003 reporting year, SLAC updated its HMBP and submitted it to the CUPA on March 31, 2004 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 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, second, preparation of release inventory forms, commonly known as "Form Rs", for each chemical for which the usage threshold was exceeded. As discussed in Section 4.3.2.2, SLAC monitors stormwater runoff during the regulatory "wet season", which extends from October 1 through May 31. To maintain comparability of the data and minimize confusion, the stormwater data entered on each Form R represent the last three months of 2003 and the first five months of 2005.

SLAC prepared Form Rs for lead and copper and submitted them to the DOE site office on June 28, 2004, in advance of the July 1, 2004 deadline. In calendar year 2003, as in previous years, copper and lead were the only materials reportable under TRI that were used in excess of their respective regulatory threshold criteria. 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 2004 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.

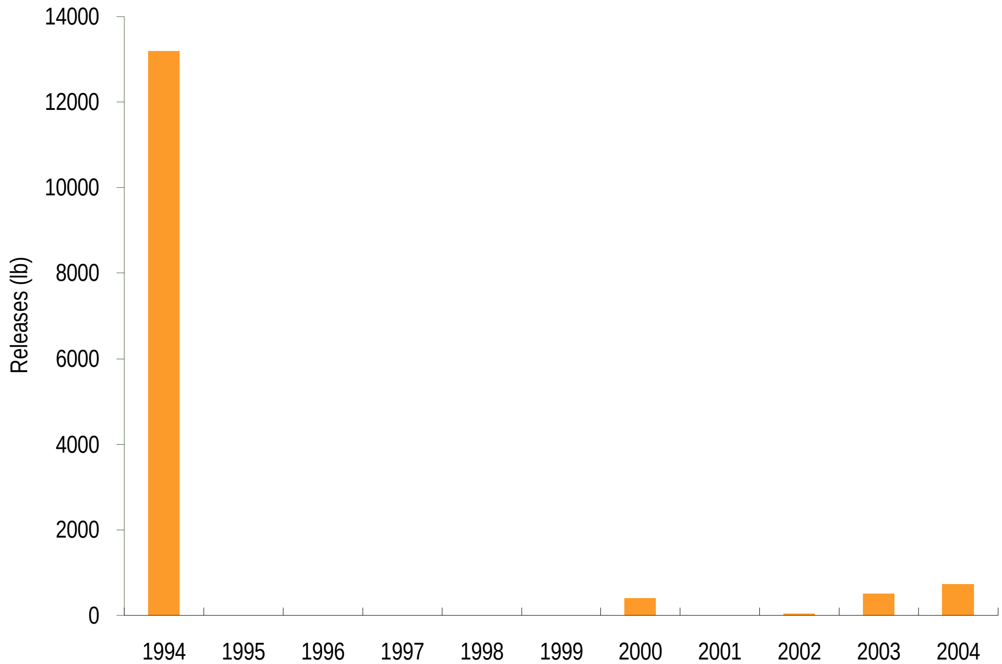

Figure 4-7 TRI Releases

A report prepared by DOE headquarters staff comparing TRI releases from 17 DOE facilities from the 1993 through the 2003 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.[21])

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. In August 2004, seven years after SLAC's original data was submitted, SLAC received a letter from the CUPA representative for the San Mateo Department of Health Services,

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

instructing SLAC to update its chemical inventory information to determine whether SLAC had any regulated chemicals in excess of the CalARP thresholds. SLAC responded by explaining that the advent of the chemical management system would generate a highly accurate inventory by mid-2005 to update the required information.

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 CWA and California's Aboveground Petroleum Storage Act. A listing of ASTs containing petroleum at SLAC during 2004 is presented in Table 4-10. All petroleum tanks at SLAC 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 4-10 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 remains up to date and is available on line.[22]

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

SLAC did not have any underground storage tanks (USTs) in operation during 2004. 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 by the manufacturing, processing, and commercial distribution sectors. One portion of TSCA regulates equipment 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 2004.

At the end of 2004, 99 transformers were in service at SLAC. Transformers with concentration ranges of greater than 50 parts per million (ppm) but less than 500 ppm are defined by TSCA as “PCB-contaminated transformers”; SLAC has 12 of these units in service, with no immediate plans to remove them. SLAC has no PCB transformers (transformers with concentrations of PCB greater than 500 ppm).

The total quantity of PCBs contained in the 99 transformers currently in service is 24 pounds. A new, non-PCB transformer was acquired during 2004. 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,[23] 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 one of the first academic and government facilities to pursue implementation of the CMS model, SLAC has generated much interest in its experience among both the CMS vendor and academic/government customer communities.

In 2004, SLAC officially selected Haas TCM as its CMS contractor. Contract negotiations lasted throughout most of the year, with only a few issues being left unresolved at the end of the calendar year. In the summer of 2004, SLAC began Information Technology systems integration and completed a site-wide baseline chemical inventory. From this inventory SLAC began working with individual groups at SLAC on building chemical catalogs for use with the new CMS. In November 2004, four pilot work groups were chosen to begin using the CMS. The four pilot work groups that were on line by the end of the year were

- Paint Shop
- Plating Shop
- Cooling Tower Operations

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

- SSRL wet chemistry laboratories

4.6 Waste Minimization and Management

During the course of its research operations, SLAC generates a variety of waste streams, including hazardous waste, non-hazardous industrial waste, municipal solid waste, and 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:[24]

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

4.6.1 Waste Minimization Accomplishments

SLAC has achieved both of its waste minimization goals since the year 2000.

SLAC continues to make progress in reducing hazardous waste generated from routine operations, as shown in Figure 4-8. For 2004, SLAC reduced generation of hazardous waste from routine operations by 69 percent from the 1993 baseline. The goal for FY2004 was to achieve a 64 percent reduction in routine hazardous waste relative to the 1993 baseline.

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24 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, "ES&H ISMS: Performance Measures" (July 2004), http://www-group.slac.stanford.edu/esh/general/isems/perfmeas.htm

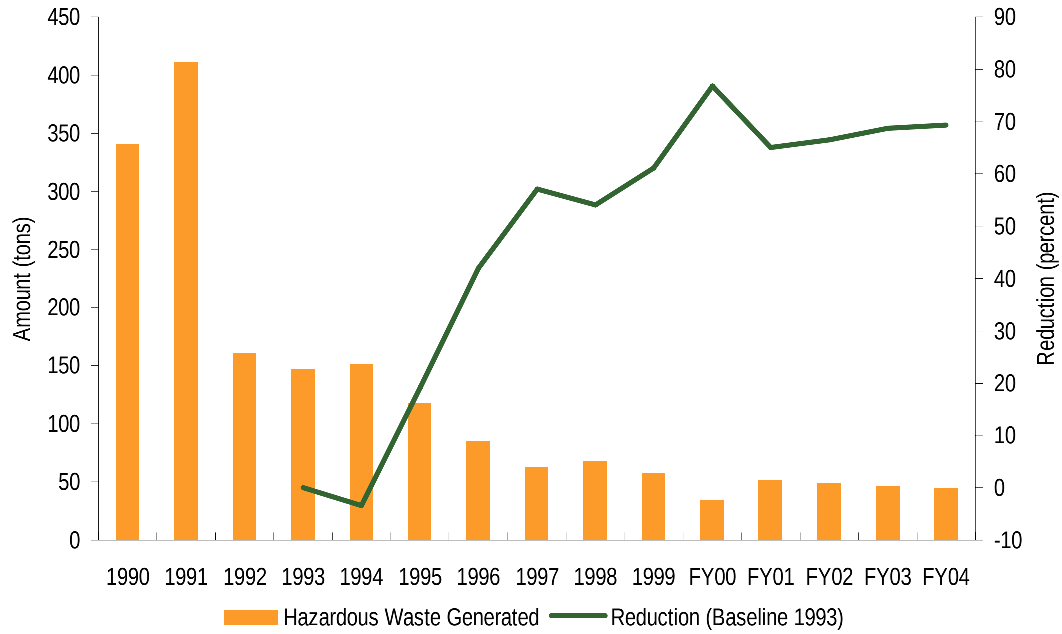

Figure 4-8 Hazardous Waste Generation

SLAC's progress in recycling its municipal solid waste is shown in Figure 4-9. For 2004, SLAC recycled exactly 51 percent of its municipal solid waste. The goal for FY2004 was to achieve 47 percent recycling.

The term "municipal solid waste" refers to the following waste streams generated at SLAC:

- Beverage containers (glass, aluminum, plastic)
- Paper (white paper, mixed paper)
- Cardboard
- Wood
- Scrap metal
- Garden/landscaping waste
- Construction debris (asphalt, concrete, and soils)
- Trash not otherwise sorted at the source and placed into dumpsters

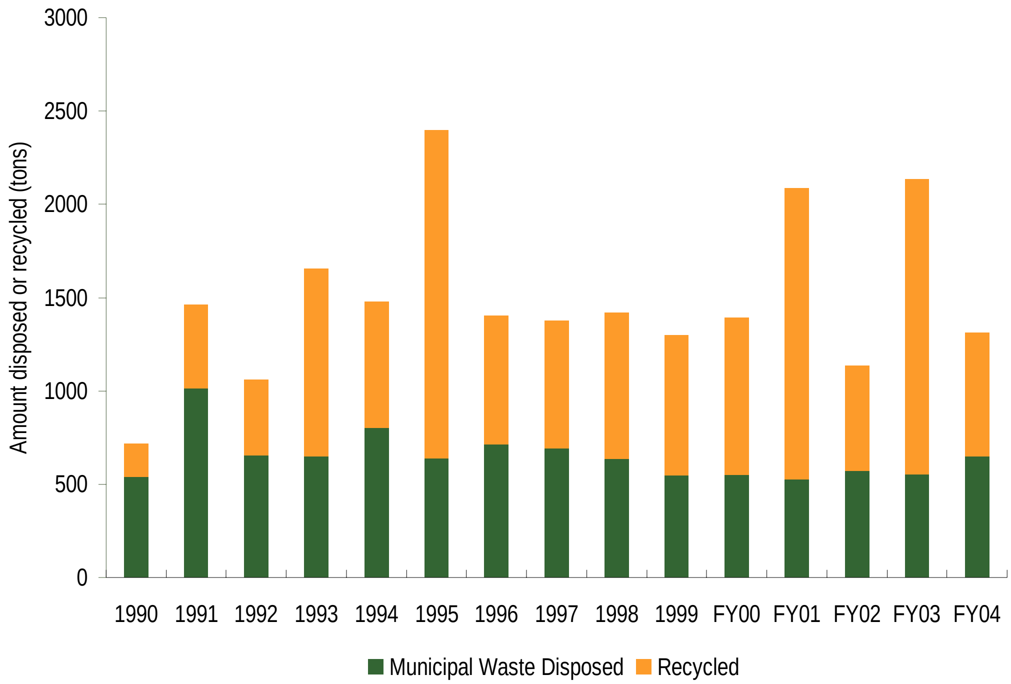

Figure 4-9 Municipal Solid Waste Recycling

In April 2004, SLAC received the following awards for efforts in waste minimization and pollution prevention:

- April 2004, DOE Office of Science Pollution Prevention and Environmental Stewardship Accomplishment awarded SLAC recognition of outstanding commitment to pollution prevention and environmental stewardship through education outreach for development of a site-wide chemical management system.
- April 2004, the USEPA Federal Facilities Compliance Program awarded SLAC the Champions of Green Government Award. SLAC implemented a project to upgrade the two-mile Klystron Gallery Lighting at SLAC. New lighting fixtures were installed to reduce the electrical load and provide comparable light levels. The new lighting resulted in a total annual electrical energy saving of 4,456 Megawatt-hours (MWH). Based on the latest projected electrical cost of $0.053/Kilowatt-hours (KWh), it is estimated that the project will save SLAC $236,000 per year

Other waste minimization and pollution prevention projects initiated and/or continuing during 2004 are listed in Table 4-11.

Table 4-11 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	Ongoing	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	Ongoing	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	Ongoing	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	Ongoing	Better handling and prevention of spills
7	Scrap copper reused in metal finishing operations as plating bath anodes	1996	Ongoing	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	Ongoing	See graph on 1,1,1-trichloroethane reduction

Number	Name/Description	Year Initiated	Status/ Project Length	Waste Reduction/Pollution Prevention Result
9	Increased reuse of stock metal through electric discharge machining operations	1996	Ongoing	Improved fabrication technique reduces scrap metal – no quantitative results tracked due to variations in production
10	Reducing Hazardous Waste through better waste management – using reuse and on-and off-site recycling measures	1995	Ongoing	Approximately 205 tons of waste disposal avoided from 1997 to 2004
11	Processing Unit to Reduce Stormwater Waste Handling by removing polychlorinated biphenyl (PCB) contamination	1999	Ongoing	Approximately 60,000 gallons of stormwater reused in cooling towers annually
12	PEP II waste reduction promoted through reuse of materials and equipment at SLAC or at off-site facilities	1998		Approximately 1,000 tons of concrete blocks reused at an off-site location
13	Implementation of a site-wide recycling program for paper, cardboard, and beverage cans/bottles	1999	Ongoing	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	Ongoing	As of 2004, SLAC reduced generation of hazardous waste (filter cake) by an average of 49 percent over a three year period relative to 1998 and per gallon of rinse water treated
15	Employee Awareness in Waste Minimization and Pollution Prevention	1991	Ongoing	Prepared over 45 articles on waste minimization and pollution prevention to increase employee awareness
16	Off-Site Recycling Program for Laser Printer and Ink Jet Cartridges	2002	Ongoing	Program for off-site recycling of spent laser printer and ink jet cartridges – recycled 342 cartridges in FY04 and vendor contributed $1 per recycled cartridge to charity

Number	Name/Description	Year Initiated	Status/ Project Length	Waste Reduction/Pollution Prevention Result
17	Transportation Pollution Prevention Program	2003	Ongoing	SLAC became the first DOE Office of Science (SC) facility to order and dispense only Bio-diesel 20 for all its diesel applications. SLAC continues to operate 100 percent of its diesel engine fleet on bio-based diesel fuel (80 percent diesel/20 percent bio-based oil). Also, 25 electric powered vehicles are in use at SLAC, an increase of 6 since 2003. Three old DOE-owned motor vehicles were replaced with GSA alternative fuel vehicles.
18	Reduction of Equipment Using Class I Ozone-Depleting Substances (Class I ODS)	2003		Phased out 3 chillers (pre-1984, over 150 ton cooling capacity each) that used Class I ODS
19	Two-Mile Klystron Gallery Lighting Upgrade	2003		SLAC completed a two phase project to reduce energy usage and pollution by replacing lower-efficiency lighting system with a high-efficiency one in the 2-mile linear accelerator saving over 4.4 million kilowatt-hours of electricity per year, reducing greenhouse gases generated from electricity generation, and reducing mercury usage (see award discussed above).

Number	Name/Description	Year Initiated	Status/ Project Length	Waste Reduction/Pollution Prevention Result
20	Chemical Management Service	2003	Ongoing	SLAC selected a vendor, began contract negotiations, developed an implementation schedule, and performed a physical inventory of all chemicals managed under the Chemical Management Services (CMS) Project. The CMS Project will help SLAC cost-effectively manage its chemicals throughout their life cycle on the site from purchasing to use. Environmental Protection initiated pilot programs at four key buildings, and developed comprehensive and detailed maps for those buildings. The first CMS order was placed and delivered late in FY04.
21	Water Conservation	2004		A pilot project is in progress to conserve water through the use of waterless urinals.

In addition to the above projects, SLAC has been continuing to perform process waste assessments and pollution prevention projects to reduce the use of toxic materials, to conserve resources, and to prevent pollution in a technically and economically feasible manner for the future. Assessments and projects are in the following areas:

- An activity data sheet (ADS) funding request for the last major (>150 tons) chiller using Class I ozone depleting substances was prepared, submitted, and prioritized for funding
- 34 different project activities are being addressed to help SLAC improve energy and water conservation
- Sulfur hexafluoride (SF6) operations were modified in response to a presentation on greenhouse gases by an ESH contractor (Rocky Mountain Institute). Some procedures were changed immediately to reduce emissions, and longer-term changes (for example, investigation into SF6 substitutes) were initiated
- SLAC investigated the feasibility of replacing chemicals used to treat cooling tower water using an alternative technology. This technology involves a system that reduces water hardness and bacteria by electromagnetic field effects as opposed to adding chemicals to the water. With limited funding, it was deemed better to continue reliable operation of cooling towers using chemicals rather than facing the uncertainties of a new technology. Small towers piloting the new technology continue to be test cases; however, no advances have been made to use this technology on larger sized towers

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. Regulation is 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 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 treatment, storage, and disposal facility [TSD] permit) under the federal-level RCRA regulations. SLAC does have permits to treat a few RCRA-exempt and non-RCRA (that is, California-only) hazardous waste streams (refer to Section 4.6.2.3 regarding state-level tiered permit program).

In 2004, no inspections of SLAC hazardous waste generation program were conducted by the CUPA.

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 Superfund Amendment and Reauthorization Act (SARA) Title III, and TSCA PCB annual reports.

SLAC categorizes the hazardous wastes it generates into the following categories:

- 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 with a 1993 baseline) beginning in FY00, and continued to achieve that goal through FY04. During FY04, SLAC achieved a 69 percent reduction in its hazardous waste generation.

Hazardous wastes regulated by the Toxic Substance Control Act (TSCA) at SLAC result from two sources: removal of old electrical equipment containing PCBs, and construction projects containing asbestos. 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 4-10. Specifically, During FY04, SLAC achieved a 99 percent reduction in its TSCA waste generation compared with a 1990 baseline.

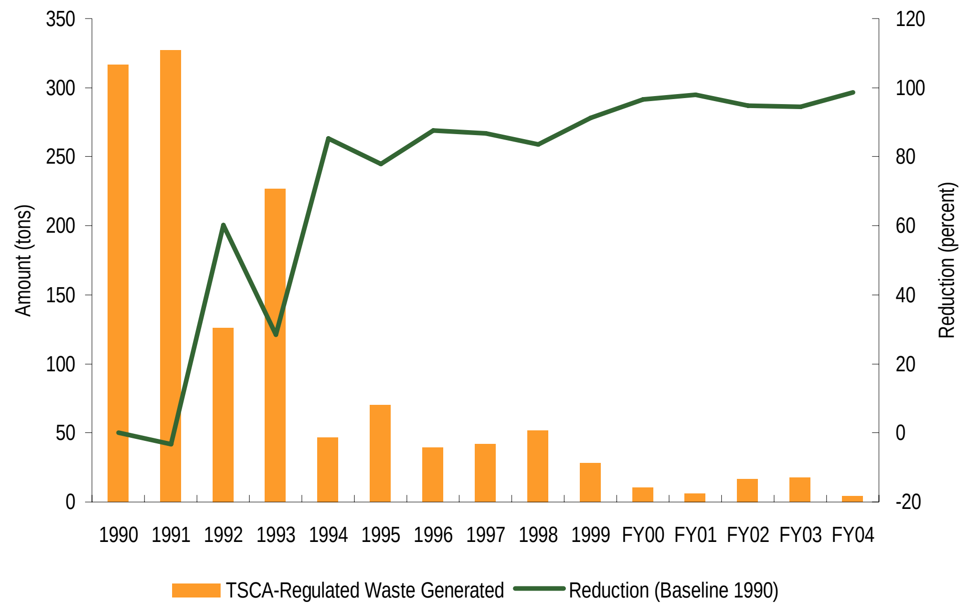

Figure 4-10 TSCA-Regulated Hazardous Waste, 1990–2004

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 annual quantities of remediation hazardous wastes are shown in Figure 4-11.

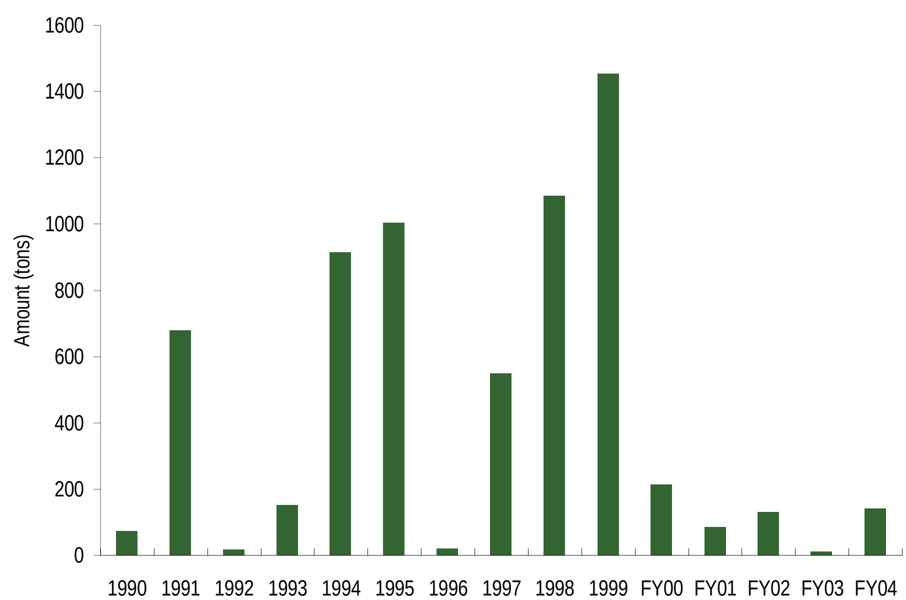

Figure 4-11 Remediation Waste (Class I Hazardous Waste), 1990–2004

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 generation of Class 2 Landfill Waste (Figure 4-12) continues to be high because of California standards requiring certain industrial wastes be restricted from Class 3 sanitary landfills.

SLAC's hazardous waste generation rates have been reduced through a combination of waste minimization and pollution prevention techniques, including the following:

- 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 reuse by other organizations

SLAC expects 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 will decrease as SLAC continues to phase out its use of PCBs, removes soils impacted with PCBs, and removes 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*. During 2004, SLAC operated the same three hazardous waste treatment units as in 2003. One of the units, the Unit 1 Metal Finishing Pretreatment Facility (MFPF), however, was split into three units, Units 1A, 1B, and 1C making the total of five operating treatment units. This unit was split to better identify the units that comprise the MFPF, the Cyanide Destruction Unit (Unit 1A), the MFPF treatment operation (Unit 1B), which treats rinse waters and processed wastes streams, and the Batch Hazardous Waste Treatment Tank (Unit 1C), which treats concentrated plating baths and other hazardous, aqueous waste streams. The various units and tiered permit level are summarized in Table 4-12.

Table 4-12 Hazardous Waste Treatment Units Subject to Tiered Permitting

Tiered Permit Level	Unit Number	Location/Description
Permit by rule	Unit 1A	Cyanide Treatment Tanks
Permit by rule	Unit 1B	Metal Finishing Pre-treatment Facility
Permit by rule	Unit 1C	Batch Hazardous Waste Treatment Tank
Permit by rule	Unit 2	Metal Finishing Pre-treatment Facility – Sludge Dryer
Conditional authorization	Unit 4	Groundwater Treatment System at Former Solvent Underground Storage Tank (FSUST)

These units were authorized to treat listed or characteristic hazardous wastes. The 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 MFPF also treated non-hazardous rinse waters and wastewater to meet industrial wastewater discharge requirements. The FSUST (Unit 4) treated groundwater contaminated with volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) to meet industrial wastewater discharge requirements.

The CUPA last inspected the tiered permitting program at SLAC in August 2003. The program was found to be in compliance, with no violations noted.

Based on correspondence with DTSC, the original MFPF (Unit 1) was not fully authorized because of the cyanide treatment operations, which SLAC had included in the original MFPF permit. As a result, SLAC split out the original MFPF into the above units (1A, 1B, and 1C) to more clearly demark the treatment operations of the MFPF. SLAC is awaiting inspection of these units by the DTSC to affirm that Tiered Permit requirements are being met for the Cyanide Treatment Tanks (Unit 1A).

4.6.3 Non-hazardous Waste Management

Non-hazardous waste can be grouped into non-hazardous industrial waste and municipal solid waste.

4.6.3.1 Non-hazardous Industrial Waste Management

In addition to its hazardous waste management program, SLAC also operates various projects that involve disposal of non-hazardous waste called here non-hazardous Industrial or regulated 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 or sanitary solid waste landfill. Examples of Industrial wastes include soils contaminated with low levels of petroleum hydrocarbons, PCBs or metals such that qualify as non-hazardous but are not acceptable to municipal landfills. In California, industrial wastes 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). The trends in SLAC's generation of non-hazardous industrial waste from 1999 through FY03 are shown in Figure 4-12. SLAC began to break out the Class 2 category waste in 1999.

4.6.3.2 Municipal Solid Waste Management

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 (construction materials e.g. concrete, clean soils, asphalt, wood) and equipment for their cash value. SLAC integrates the results of its metal salvage operations when reporting data about its municipal solid waste program.

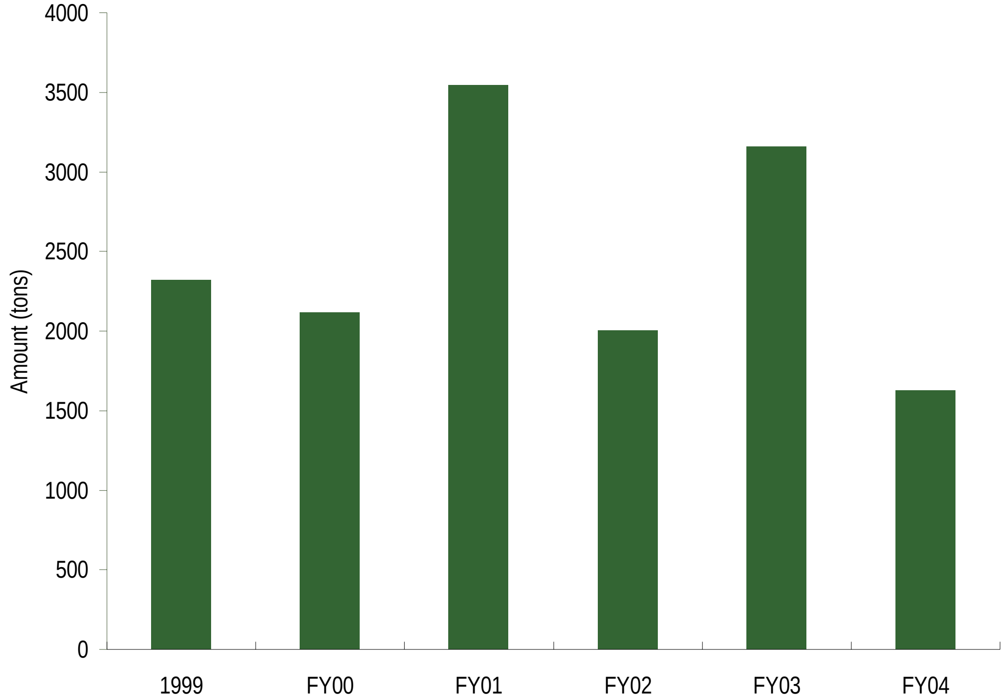

Figure 4-12 Non-hazardous Industrial Waste (Class II Landfill Waste), 1998–2004

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, as well as dumpsters for cardboard collection and specific locations for waste wood. Scrap metal is collected and construction materials from building demolition and rehabilitation projects are also recycled.

SLAC's municipal solid waste recycling rate for 2004 is 51 percent. The 51 percent figure achieved, however, was below SLAC's annual average recycling rate of 58 percent achieved over the last decade. The contributions of the various waste streams being recycled are shown in Figure 4-13.

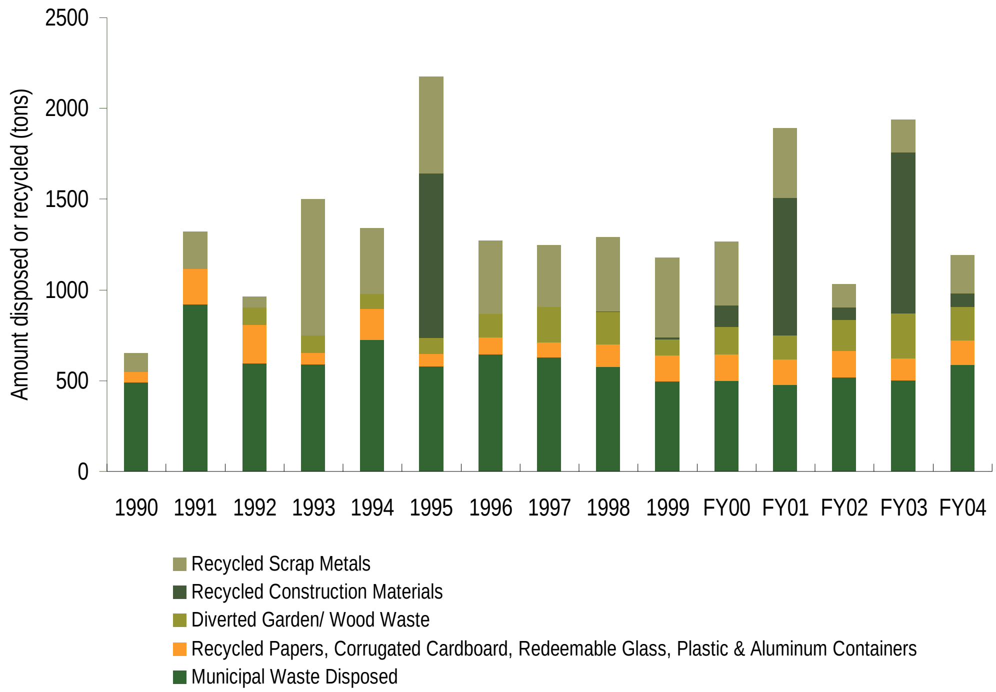

Figure 4-13 Municipal Solid Waste Recycling and Disposal, 1990–2004

SLAC's highest annual recycling rates of 73 percent (1995), 75 percent (2001), and 74 percent (2003) correspond to years when quantities of recycled construction materials spiked significantly. By 2004, the amount of recycled construction material dropped significantly due to a reduction in construction activities.

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 generated by the on-site Medical Department. In California, the state Medical Waste Management Act requires proper storage, treatment, and disposal of medical waste. The state program is administered by the California Department of Health Services.

4.7 Environmental Planning

SLAC's scientific and support facilities were constructed under a clearly conceived planning framework established in the site's original general development plan (1961) and master plan (1966). For nearly four decades, SLAC facilities expanded within this original framework, but over the years, many small support and storage buildings and more parking demands 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).[25]

4.7.1 SLAC Long Range Development Plan

In December 2002, SLAC published its new LRDP, the result of 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 was revised in June 2003.

The LRDP encourages the gradual 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 intelligently guide the location of future projects. Environmental factors considered in developing the plan include the following:

- Geology and seismicity
- Topography
- Sedimentation and erosion potential
- Hazardous materials
- Sitting 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 actions are reviewed to evaluate environmental effects of the federal undertaking including its alternatives. If so, Business Services Division (BSD) works in conjunction with DOE to determine which of the following three categories of NEPA documentation, presented in increasing order of complexity, is required:

- Categorical exclusion (CX)
- Environmental assessment (EA)
- 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 10 construction projects during 2004, listed in Table 4-13. These projects ranged from construction of a new Astrophysics Building, to projects upgrading SLAC's electrical

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25 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

infrastructure. Since all the projects were relatively minor in scope and environmental impact, all required only the CX documentation. A total of 10 CXs were prepared to cover all the projects. Completed NEPA documents are forwarded to DOE/SSO for review and approval.

Table 4-13 NEPA Documentation Prepared during 2004

Project Name	Project ID	Project Year	Document ID	Document Type	Date
T 277 Replacement trailer	3460	2004	SS-SC-0304	CX	January 28
Light Assembly Building Substation	5440	2004	SS-SC-0303	CX	January 28
Safety and Operational Improvements	4415	2004	SS-SC-0302	CX	January 28
Particle Astrophysics and Cosmology Building	Third Party	2004	SS-SC-0301	CX	January 28
E 163 Clean Room	3461	2004	SS-SC-0403	CX	April 6
UPS Expansion and Enclosure for Bldg 050	5445	2004	SS-SC-0402	CX	April 7
B. 225 Relocation	Operating	2004	SS-SC-0404	CX	April 14
IR-8 Drainage Channel Maintenance	Pending	2004	SS-SC-0401	CX	June 28
Physics and Engineering Annex Building	5425	2004	SS-SC-0405	CX	July 27
Install Temporary Trailers near Bldgs 280A and 028	LCLS	2004	SS-SC-0501	CX	October 28

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 2004, the potential radiation dose to the public and the radiation-related impacts to the environment from SLAC operations were significantly below all regulatory limits.

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.[26] In 2004, the maximum dose that could have been received by a member of the public due to direct radiation from SLAC was approximately 0.1 mrem, or 0.1% of the 100 mrem regulatory limit.

During 2004, SLAC measured direct radiation at nearly 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 Department of Energy's Laboratory Accreditation Program (DOELAP) and National Voluntary Laboratory Accreditation Program (NVLAP) 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 (50 miles) of SLAC.

Section 5.8 and Table 5-6 summarize annual doses from both direct radiation and airborne radioactivity and show how those doses compare with those from natural background radiation.

5.4 Assessment of Airborne Radioactivity

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 2004, the maximum dose that could have been received by a member of the public due to airborne radioactivity from SLAC was 0.06 mrem (6.0×10^{-4} milli Sievert), or less than one percent of the regulatory limit.

SLAC files an annual report that describes the possible sources, types, and quantities of airborne radioactivity released into the atmosphere.[27] As detailed in that report, the released airborne radioactivity was calculated, based on conservative information about accelerator operations in 2004 (Table 5-2

26 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

27 Stanford Linear Accelerator Center, Environment, Safety, and Health Division. Radiation Protection Department, *Radionuclide Air Emissions Annual Report – CY2004* (May 2005)

summarizes the released radioactivity, showing the quantities in curies [Ci]). Potential doses to members of the public due to the released radioactivity were determined using USEPA software (CAP88). 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 (50 miles) of SLAC.

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

Table 5-2 Airborne Radioactivity Released in 2004

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	0.6
Short-lived activation products ($T_{1/2}$ < 3 hr)	^{15}O	10
	^{13}N	19
	^{11}C	2.1
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
Total		32

n/a – not applicable

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 2004 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 2004, SLAC releases totaled 0.4 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 of SLAC's industrial wastewater. Thus a small fraction of SLAC's wastewater volume contains radioactivity.

Throughout the year, SLAC sampled and analyzed wastewater at about 30 discharge points. Total activity released during CY2004 is summarized in Table 5-3.

Table 5-3 Radioactivity in Wastewater Released in 2004

Category	Radioactive Element	Activity (Ci)	Annual Release Limit (Ci)
Tritium	^{3}H	2.0×10^{-2}	5
Activation products ($T_{1/2}$ > 3 hr)	^{22}Na	0	1*
	^{7}Be	0	
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

n/a – not applicable

Table 5-4 summarizes the historical results of wastewater monitoring for calendar year 1993 through 2004. 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.

Each year, the quantities and types of radioactivity in wastewater discharged depend on past accelerator operations and on details of wastewater handling. For 2004, radioactivity in wastewater discharges to the sanitary sewer totaled 0.4 percent of the permitted annual limits.

Throughout 2004, SLAC reported the results of wastewater monitoring to the South Bayside System Authority (SBSA) at the end of each calendar quarter.[28]

28 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Radiation Protection Department, *Radioactivity in Industrial Wastewater for the Period 1 January 2004 to 31 March 2004, ,for the Period 1 April 2004 to 30 June 2004, for the Period 1 July 2004 to 30 September 2004, and for the Period 1 October to 31 December 2004*

Table 5-4 Summary of Radioactivity in SLAC Wastewater, 1994–2004

Year	Radioactive Element	Activity (Ci)	Percentage of Annual Limit
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}	
2003	^{3}H	4.1×10^{-4}	0.008
2004	^{3}H	2.0×10^{-2}	0.4

* 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

** No specific limit for Be

5.5.2 Stormwater

The program for monitoring stormwater is described in Section 4.4 of this report. In 2004 (and in all previous years), no radioactivity above background was found in any stormwater sample.

In 2004, SLAC reported the results of stormwater monitoring (including checks for radioactivity) to the regional water quality control board (RWQCB).[29]

5.5.3 Groundwater

Throughout 2004, 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 four monitoring wells listed in Table 5-5 below, no radioactivity above natural background was detected in any of the groundwater samples.

The detected concentrations of tritium (^{3}H) in the water samples summarized in Table 5-5 were below 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

29 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, Environmental Protection and Restoration Department, *2003–2004 Annual Report for Stormwater Discharges Associated with Industrial Activities* (July 1, 2004, submitted to Rico Duazo, San Francisco Bay RWQCB)

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 total dissolved solids.

Table 5-5 Summary of Tritium (^3H) Concentrations Measured in Monitoring Wells in 2004

Period (Month)	Jan to March	April to June	July to Sep	Oct to Dec
Well Variable				
EXW-4				
Avg ^3H (pCi/L)	4258	4621	4810	5621
% of DWS[1]	21	23	24	28
No. of Samples	5	6	5	1
MW-30				
^3H (pCi/L)	756	< 500[3]	< 500[3]	< 500[3]
% of DWS[1]	4	n/a	n/a	n/a
No. of Samples	1	1	3	1
MW-81				
^3H (pCi/L)	538	< 500[3]	837	< 500[3]
% of DWS[1]	3	n/a	4	n/a
No. of Samples	1	1	2	1
MW-94[2]				
Avg ^3H (pCi/L)	653	685	< 500[3]	2502
% of DWS[1]	3	3	n/a	13
No. of Samples	2	2	1	1

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

2 MW-94 was installed at SLAC during 2003

3 500 pCi/L was the minimum 3H concentration that was detectable by SLAC in 2004

n/a – not available

5.6 Assessment of Radioactivity in Soil

Throughout 2004, 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 2004, 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 very small compared with 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 2004: 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 any imaginable scenario. The reported maximum dose for the maximally exposed individual (MEI), dominated by direct radiation, is based on a person being present 24 hours per day in 2004 at the location near Sand Hill Road, approximately 650 m (2,133 feet) northeast of the intersection of Sand Hill and Whiskey Hill Road.

Table 5-6 compares the 2004 dose results with regulatory limits and natural background. Like previous calculations, the 2004 calculation of the MEI dose does not include any dose reduction for hills that may lie between the locations of dose measurements and the MEI. However, since 2003, the effects of air attenuation for direct photon radiation calculations (a factor of 40) were taken into account.

Table 5-6 Summary of Potential Annual Doses due to SLAC Operations in 2004

	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 2004	0.1 mrem	0.06 mrem	0.2 mrem	1.0 (direct) +0.2 (air) = 1.2 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	n/a
SLAC 2004 Max. Dose as Percentage of DOE Standard	0.1%	0.6%	0.2%	n/a
Dose from Natural Background	100 mrem	200 mrem	300 mrem	1,667,000 person-rem
SLAC 2004 Max. Dose as Percentage of Natural Background	0.1%	0.03%	0.06%	0.0001%

n/a – not applicable

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 2004 and compares it with the average dose due to natural background radiation and radioactivity.

Table 5-7 Potential Dose (mrem) to Maximally Exposed Individual, 1995–2004

Year	SLAC Direct and Airborne Radiation	Average, Total Natural Background Radiation	Percentage of Background
1995	2.2	300	0.73
1996	4.6	300	1.53
1997	4.2	300	1.40
1998	4.6	300	1.53
1999	4.5	300	1.50
2000	5.7	300	1.90
2001	5.3	300	1.77
2002	2.1	300	0.70
2003*	0.2	300	0.07
2004	0.2	300	0.07

* Starting with the 2003 calculations, the effects of air attenuation (a factor of 40) were taken into account. Air attenuation was not part of the MEI determination in past years.

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 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 2004, SLAC monitored dose and dose rate at approximately 250 on-site locations (indoors and out) using passive radiation dosimeters posted for three to six month periods. For each period, the average dose rate among these 250 dosimeters was found to be less than 0.001 rad/day. 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 0.001 rad/day, doses to plant and animal populations at SLAC were well within the limits of the DOE standard throughout 2004.

5.9.2 Dose to Biota from Activation Products

In 2004 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 (^3H) was occasionally found in industrial wastewater in 2004, but plant and animal populations have no opportunity for access to industrial wastewater at SLAC.

In 2004, 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 2004 results of monitoring for radioactivity in groundwater. There is no possibility that plants or animals will receive dose rates that exceed the limits of the standard due to radioactive activation products at SLAC.

5.10 Low-level Radioactive Waste Management

Low-level radioactive waste (LLRW) is produced at SLAC sporadically. Prior to 2002, 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 2004, SLAC shipped 1256 cubic feet of LLRW to treatment and disposal facilities.

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 Background Conditions

The groundwater regime at SLAC and nearby off-site areas has been comprehensively documented in the *SLAC Hydrogeologic Review* completed in 1994.[30] 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 total dissolved solids). 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.[31] The request was denied, stating that a basin plan amendment would be required to exempt groundwater from some potential uses.

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

31 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 Impact from Chemicals

A SLAC 1994 report entitled *Summary and Identification of Potentially Contaminated Sites* provides a summary of areas that may have been impacted by chemicals of potential concern.[32] 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 as 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,[33] and spill prevention, control, and countermeasure[34] plans, (SWPPP and SPCC, respectively), which discuss best management practices for preventing adverse impacts from spills and operations at SLAC.

6.5 Restoration Activities

SLAC first began to develop a comprehensive Environmental Restoration Program 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 accomplish the following steps:

- 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 2004, SLAC had generally reached the third and fourth steps. Investigative and remediation 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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32 ESA Consultants, *Stanford Linear Accelerator Center, Summary and Identification of Potentially Contaminated Sites* (February 1994)

33 See note 16

34 See note 22

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.

In 2004, SLAC Environmental Protection and Restoration Department (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 2004 on installing additional wells to define the lateral and vertical groundwater conditions. Groundwater samples were collected at least once from 83 wells in 2004 and analyzed for a variety of constituents.

Figure 6-1 shows the portion of the site that contains the monitoring network.

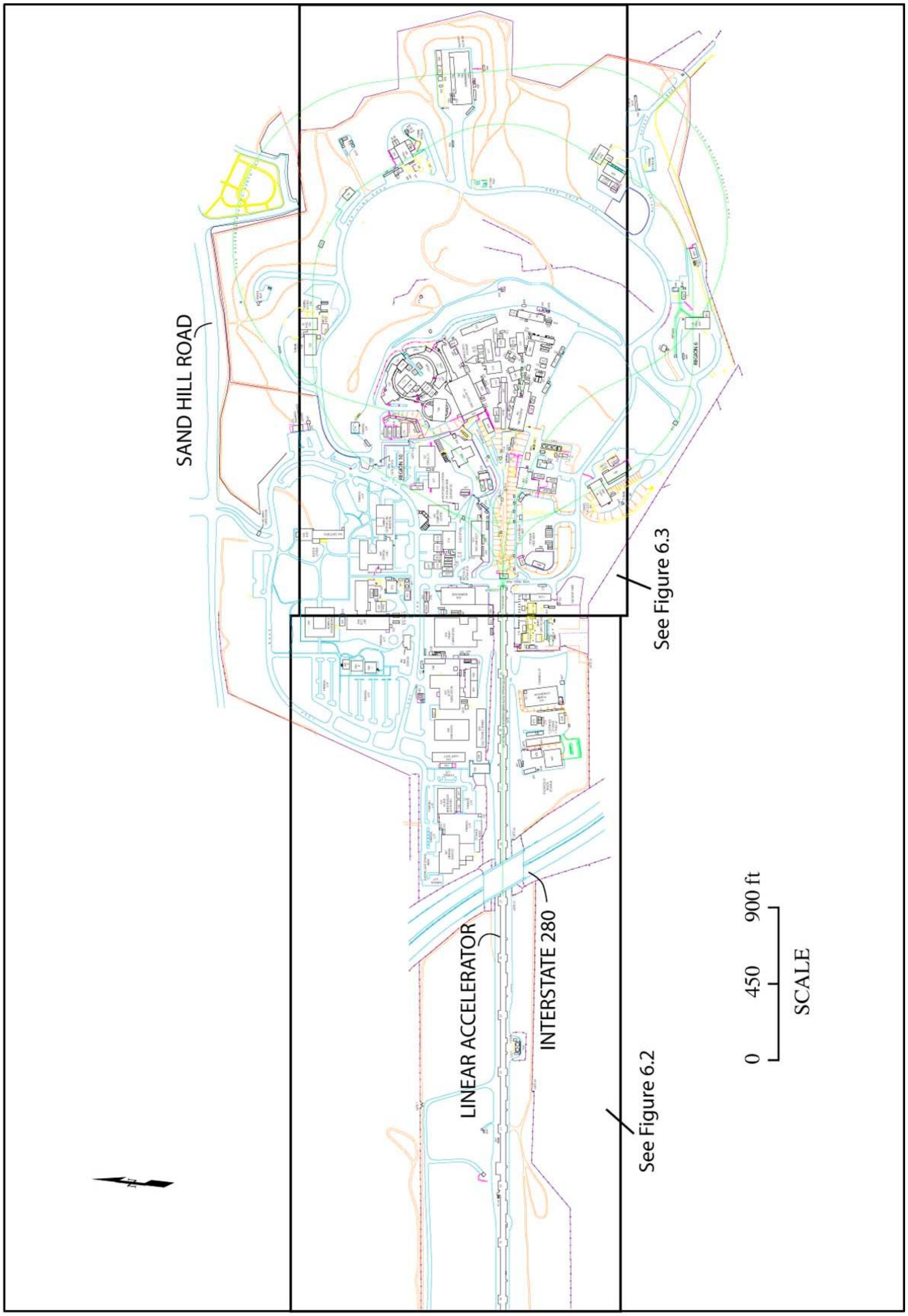

Figure 6-1 Groundwater Characterization Monitoring Network

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

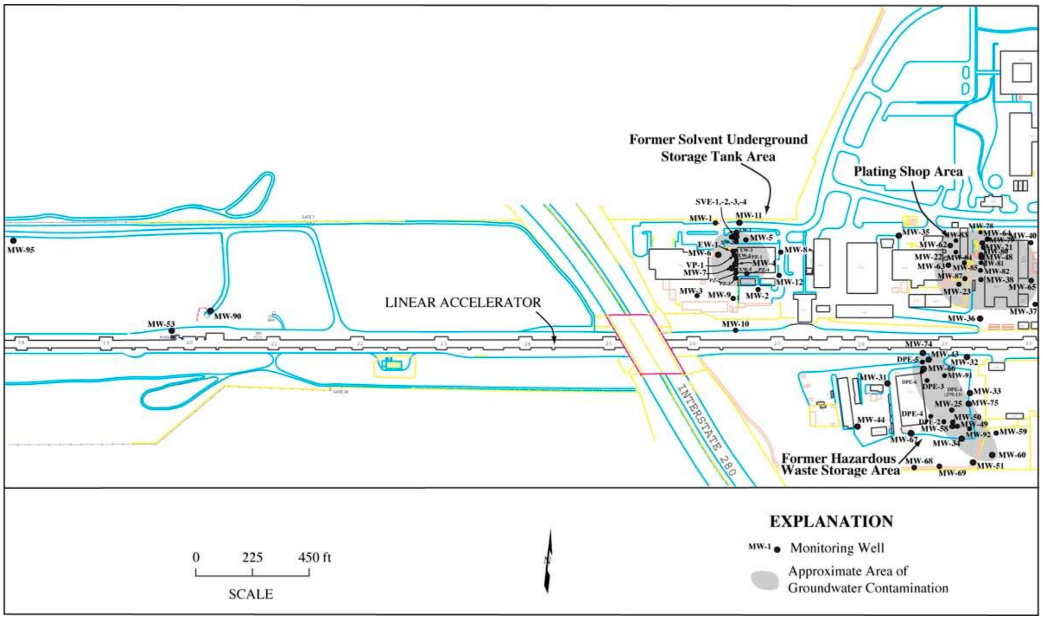

Figure 6-2 Westside Groundwater Network and Impacted Areas

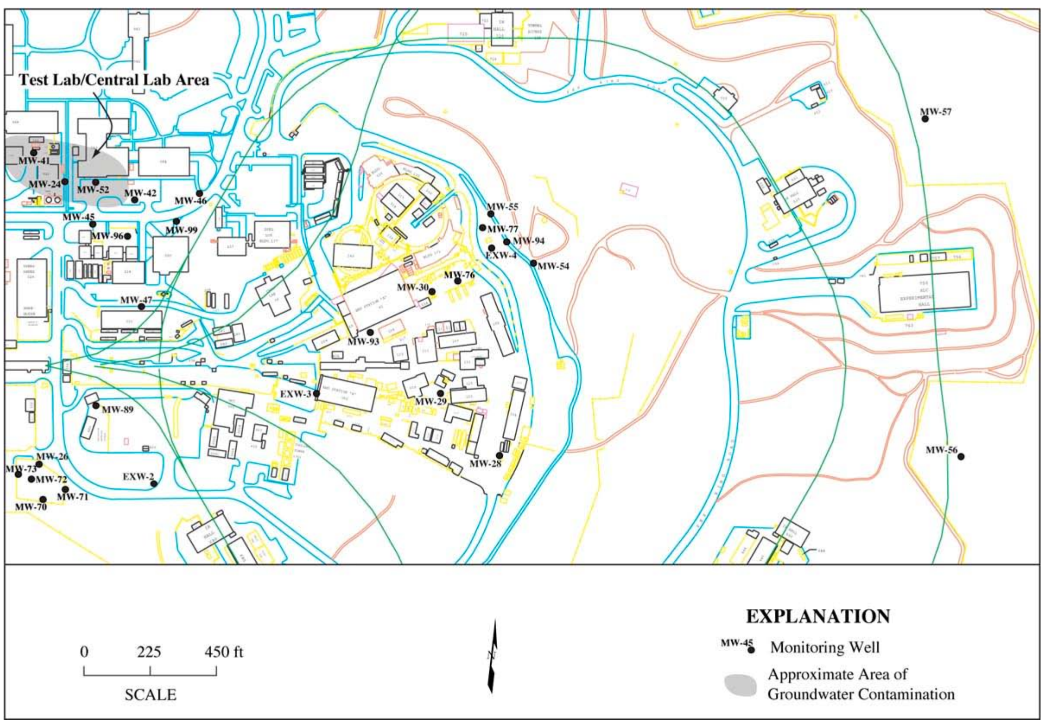

Figure 6-3 Eastside Groundwater Network and Impacted Areas

6.6.2 Background

SLAC has 106 wells across the site used for groundwater monitoring and extraction. The groundwater monitoring wells are used to monitor general groundwater quality in the major areas of the facility that historically or currently store, handle, or use chemicals. Of the 106 wells, 86 wells are used to monitor chemicals of potential concern in six plumes and seven wells are used as extraction wells for two of the six plumes. The other 13 groundwater monitoring wells are monitored for general sitewide surveillance. Table 6-1 summarizes the wells at SLAC by location, number, and purpose of the wells.

Table 6-1 Monitoring Locations and Number of Wells

Location	Number
Plume Monitoring	
Beam Dump East	6
Former Hazardous Waste Storage Area	24*
Former Solvent Underground Storage Tank	22
Lower Salvage Yard	5
Plating Shop	21
Test Lab and Central Lab	8
Sub-Total	86
Extraction	
Former Solvent Underground Storage Tank	5
Former Hazardous Waste Storage Area	2*
Sub-Total	7
Environmental surveillance	
Centralized Waste Management Area	1
End Station B	1
Magnet Yard	2
Other (remote)	5
Research Yard	3
Vacuum Assembly	1
Sub-total	13
Total	106

* Two of the monitoring wells were converted into extraction wells

The six locations where plume monitoring is taking place include the following:

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 9-month schedule. 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 quarterly sampling and analysis of wells were reported to the RWQCB in semi-annual monitoring reports.[35]

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 that protect current and future potential uses of the property are being defined.

6.7.1 Former Solvent Underground Storage Tank

A groundwater monitoring network is located in proximity to the SLAC Plant Maintenance building in the northwestern portion of the facility (see Figure 6-2). This network consists of 22 wells used to monitor the migration of chemical constituents associated with the Former Solvent Underground Storage Tank (FSUST) site. 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. Since February 2003, groundwater samples have been analyzed using US EPA method 8260.

The evaluation of remedial alternatives report for the FSUST established remedial action objectives and then evaluated 42 alternatives to determine which would meet best the objectives.[36] The selected remedial alternative for the FSUST, a groundwater extraction and treatment system, was constructed at the FSUST area during the summer of 2001 as a pilot system and has been in operation since August 27, 2001. The

35 Site Groundwater Monitoring Reports for 2004

36 Stanford Linear Accelerator Center, *Evaluation of Interim Remedial Alternatives for the Former Solvent Underground Storage Tank Area* (SLAC-I-750-3A-33H-006, 2003)

system was constructed for testing the effectiveness of a five-well extraction system for achieving hydraulic control of the small area of chemically-impacted groundwater. Chemicals of interest in groundwater in the FSUST area include VOCs and SVOCs. During the end of the dry season months in 2004, the total flow rate for the five-well extraction system stabilized at 0.10 gallons per minute (gpm) and increased to 0.25 gpm with the onset of the wet season. SLAC has submitted to the RWQCB the draft Interim Groundwater Extraction and Treatment Implementation Report and Monitoring Plan for the FSUST Area.[37]

Since the start up of the groundwater extraction system in August 2001, 253,000 gallons of water have been extracted and treated, resulting in the removal of 218 pounds of VOCs and SVOCs. Monitoring well data collected thus far indicate a capture zone encompassing the entire plume has been established and chemical data indicate that the plume appears to be shrinking in size.

6.7.2 Former Hazardous Waste Storage Area

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. Since that time, 26 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.

In 2002, a dual-phase extraction (DPE) treatability test proved promising to treat impacted soil, soil vapor, and groundwater, and was recommended as a suitable remediation technology. Two DPE wells were installed at the FHWSA in 2003. The DPE wells have been in continuous operation since January 20, 2004. Since that date, a total of 17,440 gallons of water have been treated resulting in the removal of 16.8 pounds of VOCs. The design of the full scale DPE system for the FHWSA was finalized and is anticipated to be constructed in 2005. [38]

SLAC submitted to the RWQCB the draft Site Characterization Report for the FHWSA for review and comment in November 2004.[39]

6.7.3 Plating Shop

In 1990, three monitoring wells, MW-21, MW-22, and MW-23, were installed down-gradient 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.

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37 Stanford Linear Accelerator Center, *Draft Interim Groundwater Extraction and Treatment Implementation Report and Monitoring Plan for the Former Solvent Underground Storage Tank Area* (SLAC-I-750-3A33H-016, July 2004)

38 Erler & Kalinowski, *Technical Specifications and Drawings for the Dual Phase Extraction and Treatment System at the Former Hazardous Waste Storage Area* (2004)

39 Stanford Linear Accelerator Center, *Draft Site Characterization Report for the Former Hazardous Waste Storage Area* (SLAC-I-750-3A33H-015, November 2004)

The draft site characterization report for the Plating Shop Area was submitted to the RWQCB in December 2003. No comments have been received from the RWQCB regarding the draft site characterization report.[40]

6.7.4 Test Lab and Central Lab

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 have been completed in the 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. A new perimeter well was installed in May 2004 to monitor the groundwater quality down-gradient of a well which reported the presence of VOCs for the first time in 2001.

Results of the investigative work at the Test Lab and Central Lab area were detailed in the site characterization report for the Test Lab and Central Lab area. The RWQCB approved the report in 2002.[41] An evaluation of remedial alternatives report was also prepared for the Test Lab and Central Lab Area and submitted to the RWQCB in 2002.[42] In April 2003, the RWQCB provided comments to the remedial alternatives evaluation report and SLAC responded to the comments in July 2003.

6.7.5 Beam Dump East

Beam Dump East is an area in which the high-power electron beam is terminated during experiments in End Station A. 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 2004, as in previous years, the monitoring indicates that 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” (LSY), there are minor detected petroleum hydrocarbons and VOCs in wells at this site. The LSY is discussed further below.

6.8 Soil Site Description and Results

In addition to the groundwater sites discussed above, SLAC is also looking at soil sites which have been impacted by chemicals of concern, primarily PCBs and TPH. These sites are discussed below. In one area, the IR-6 and IR-8 drainage channels, sediment in drainage channels have been impacted with chemicals of

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40 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Draft Site Characterization Report for the Plating Shop Area* (SLAC-I-750-3A33H-12, December 2003)

41 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)

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

potential concern and work continues to investigate 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 2004 to investigate low priority small soil sites.

6.8.1 Lower Salvage Yard

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 were present above cleanup levels. 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.

The five monitoring wells at the Lower Salvage Yard were sampled in 2004. 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

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 accelerator and Positron-Electron Project sub-drainage systems 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 were 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 PCB 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 off-site downstream reaches have been monitored annually since 1998. 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 the confluence 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.

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 preliminary design report was completed.[43] 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 of the engineering design for a stormwater filtration system was conducted in 2003 to test the effectiveness of the filters for removing PCB impacted sediment from stormwater. Test results indicated the storm filters had limited success in reducing PCB concentrations in the water treated. In September 2003, sediment samples collected from the downstream reaches of the IR-6 and IR-8 drainage channels contained PCBs in three of the five sediment samples at concentrations ranging from 0.0441 to 1.907 mg/kg.

A number of projects were completed based on detections of low levels of PCBs and lead found in a drainage channel located downstream of the IR-6 and IR-8 drainage channels, off of the SLAC leasehold boundary. As a result, SLAC completed an extensive field investigation study. A data package including a description of the current issues and historical data was submitted to the RWQCB. A sampling work plan for collecting data along historical channel alignments located offsite was also submitted to the RWQCB. Both of these documents were also copied for informational purposes to the San Mateo County Department of Health Services, the Department of Toxic Substances Control and the US Environmental Protection Agency. The results of the field investigation showed that PCBs and metals associated with a plastic, recycled wire groundcover used by the adjacent leasehold, contributed to the detections found in the drainage. SLAC’s contribution to the PCB detections in the channel, if any, could not be established.

6.8.3 Bone Yard

The Bone Yard is a storage area north of Sectors 12 and 13 of the linac, where concrete blocks and metal scrap used in radiation shielding applications as part of high-energy experiments are currently stored. The Bone Yard has been in use since 1964 and in use for its current storage of concrete blocks and metal scraps since 1966. Lead, in the form of lead wool, lead wire and lead shot, was historically placed between these concrete blocks as radiation shielding. Lead wire and lead shot were found interspersed in approximately 420 bundles of steel rods in the Bone Yard. In August and September 2004, lead-impacted rods were cleaned and recycled as scrap metal, except for a small portion of rods (less than one percent) found to be slightly radioactive. The radioactive rods were disposed of as radioactive waste. The lead fragments and other debris associated with the work were disposed of as hazardous waste. Following removal of the lead-impacted rods, the underlying soil/asphalt was vacuumed and/or the top one to two inches of soil were excavated to remove lead fragments that had fallen from the bundles of rods.

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

6.8.4 Surface Cleaning of the Magnet Storage Yard

The ground surface of the center of the Magnet Storage Yard was pressure washed to remove sediment containing low levels of PCBs and lead.

6.8.5 Preliminary Site Assessments

In 2003, 12 preliminary site assessments (PSA) were performed to investigate the presence of soil or groundwater impacted by chemicals of concern, generally small areas with low levels of PCBs in soil. Additional soil sampling was needed to delineate the lateral extent of chemically impacted soil was required at five of these sites and was performed in 2004. Four of these sites, along with several PSA sites that predate 2003, are scheduled to be remediated in the near future.

6.8.6 5.8 Megawatt Power Supply Substation

The project report for the former 5.8 Megawatt Power Supply Substation was completed March 2004. The report summarizes work performed as part of this project.[44]

6.8.7 Excavation Clearance Program

During 2004, the excavation clearance program continued to support SLAC-wide projects to assure proper disposal of excavated soil. Work on development of the excavation clearance program first began in 1998, but it did not become SLAC policy until 2000 in the form of an excavation permit process.. It is required that an Excavation Clearance Form must be completed for all activities that involve excavation or relocation of soil at SLAC. The form is intended to reduce worker exposure to hazards associated with excavation work at SLAC, including underground utility lines, chemical contamination, and radiological hazards and ensure proper management and disposal of excavated materials. The form requires sign-off from the following departments:

1. Site Engineering and Maintenance Department for underground utility clearance
2. Environmental Protection Department for chemical contamination clearance
3. Radiation Physics Department if the excavation is to be performed within 25 feet of a beam line or if excavating in a soil shielding berm
4. Operational Health Physics Department if the excavation is to be performed within a radiologically controlled area or radioactive materials management area

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44 Stanford Linear Accelerator Center, Environment, Safety, and Health Division, *Former 5.8 Megawatt Power Supply Site Removal Action – Final Report* (SLAC-I-750-3A32H-008, March 2004)

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