Environmental Monitoring Plan

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1.0 SUMMARY

The Lawrence Berkeley National Laboratory (Berkeley Lab) environmental monitoring program is part of Berkeley Lab's effort to ensure that its activities are conducted in a manner that will protect and maintain environmental quality. The program is an important step in demonstrating compliance with requirements imposed by federal, state, and local agencies; confirms adherence to Department of Energy (DOE) environmental protection policies; and supports environmental management decisions.

Environmental monitoring consists of four major activities:

1. **Effluent Monitoring:** The collection and analysis of samples, or measurements of liquid and gaseous effluents for the purpose of characterizing and quantifying contaminants, assessing radiation exposures of members of the public, providing a means to control effluents at or near the point of discharge, and demonstrating compliance with applicable standards and permit requirements.
2. **Environmental Surveillance:** The collection and analysis of samples, or direct measurements, of air, water, soil, foodstuff, biota, and other media from the Berkeley Lab site and its environs for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public and assessing the effects, if any, on the local environment.
3. **Meteorological Monitoring:** The collection of representative meteorological data (e.g., wind speed and direction, precipitation, temperature, humidity, atmospheric pressure) to characterize atmospheric transport and diffusion conditions in the vicinity of the Berkeley Lab and to represent conditions which are important to environmental surveillance activities, such as air quality monitoring.
4. **Pre-operational Monitoring:** An environmental study conducted prior to the startup of a new facility or process for the purpose of establishing a baseline for environmental conditions.

Each of these activities will be covered in separate chapters of this *Environmental Monitoring Plan* (EMP).

1.1 ENVIRONMENTAL MONITORING PROGRAM OVERSIGHT

LBNL's Environmental Services Group (ESG) prepares, implements, and maintains the Environmental Monitoring Plan. The Environmental Services Group is one of several program groups within the Berkeley Lab Environment, Health and Safety (EH&S) Division (see Figure 1-1).

The ESG Group Leader is responsible for the EMP. The Group Leader is supported by a team of technical professionals, each responsible for specific disciplines. Berkeley Lab field technicians provide the support needed by these professionals to conduct the sampling needed by each environmental discipline. Laboratory analyses are performed by certified commercial vendors for both radiological and non radiological parameters. Throughout this document, reference to the phrase *certified analytical laboratory* means that it is certified under the California Department of Health Service's (DHS) Environmental Laboratory Accreditation Program (State of California 2005b). The Berkeley Lab onsite analytical chemistry laboratory is also available for radiochemical laboratory services.

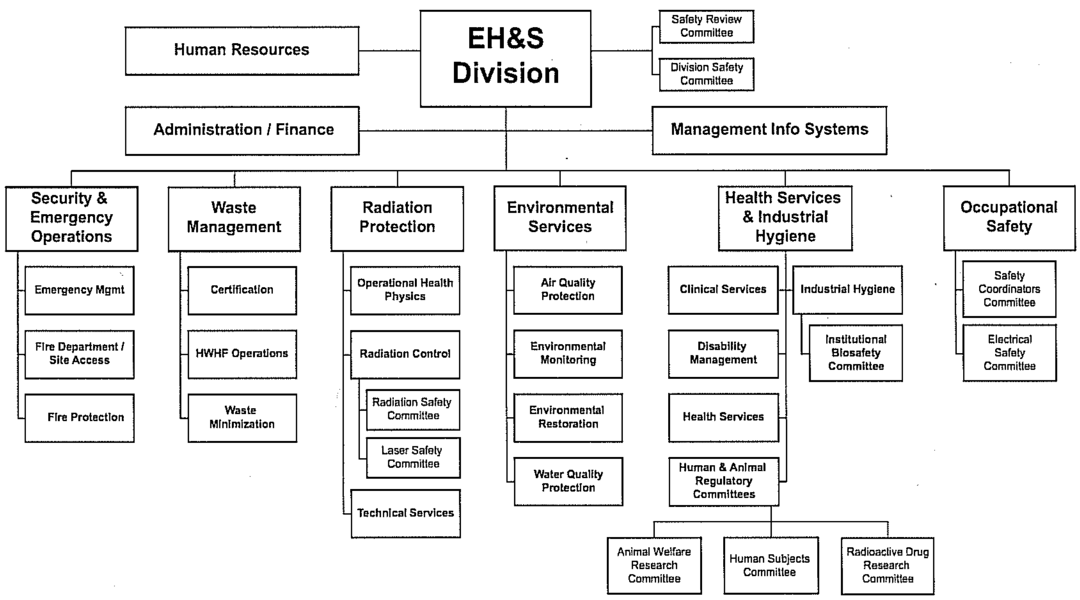

Figure 1-1. EH&S Organization Chart

Regulatory oversight is performed by the DOE, United States Environmental Protection Agency (US/EPA), State of California Department of Toxic Substances Control, California Department of Health Services, Regional Water Quality Control Board (RWQCB), East Bay Municipal Utility District (EBMUD), Bay Area Air Quality Management District (BAAQMD), and City of Berkeley. The cities of Berkeley and Oakland have a Memorandum of Understanding that grants the City of Berkeley authority for applicable regulatory oversight.

Investigations of areas of potential environmental contamination, including soil, surface water, and groundwater, are conducted under the Environmental Restoration Program, which is a subgroup of the Environmental Services Group. These activities comply with the Resource Conservation and Recovery Act's Corrective Action Process, including the preparation of planning documents. Environmental Restoration Program documents are available on the web at http://www.lbl.gov/ehs/erp.

2.0 INTRODUCTION

2.1 HISTORY

Lawrence Berkeley National Laboratory was founded by Ernest Orlando Lawrence in 1931. Lawrence received the 1939 Nobel Prize in physics for his invention of a particle accelerator called the cyclotron. He is also generally credited with the modern concept of interdisciplinary science in which scientists, engineers, and technicians from different fields work together on complex scientific projects. Lawrence's pioneering work established a great tradition of scientific inquiry and discovery at the Laboratory, leading to the awarding of Nobel Prizes to numerous Berkeley Lab scientists.

The Laboratory supports cutting edge research in such diverse fields as genomics, physical biosciences, life sciences, fundamental physics, accelerator physics and engineering, energy conservation technology, and materials science. Through its fundamental research, Berkeley Lab has achieved international recognition for its leadership and made numerous contributions to national programs. Its research embraces the following concepts to align with the Department of Energy's mission:

- Explore the complexity of energy and matter
- Advance the science needed to attain abundant clean energy
- Understand energy impacts on our living planet
- Provide extraordinary tools for multidisciplinary research

Since its beginning, Berkeley Lab has been managed by the University of California (UC) Office of the President. Many Berkeley Lab scientists are faculty members on the campuses of either UC Berkeley or UC San Francisco. Students, from high school through graduate school, as well as teachers, participate in many Berkeley Lab programs designed to enhance science education.

2.2 LABORATORY

The following sections describe the physical location, population, space distribution, and water supply at Berkeley Lab.

2.2.1 Location

Berkeley Lab is located about 5 kilometers (km) (3 miles [mi]) east of San Francisco Bay (see Figure 2-1) on land owned by the University of California. The Laboratory's main site is situated on approximately 82 hectares (203 acres) of land. University of California provides long-term land leases to the DOE for the buildings at the Laboratory.

The main site lies in the hills above the UC Berkeley campus on the ridges and draws of Blackberry Canyon, which forms the western part of the site, and adjacent Strawberry Canyon, which forms the eastern part of the site. Elevations range from 135 to 350 meters (m) (450 to 1,150 feet [ft]) above sea level, going from west to east. The western portion of the site is in Berkeley, with the eastern portion in Oakland (see Figure 2-2). The population of Berkeley is approximately 103,000, and that of Oakland at over 370,000 (ABAG 2003).

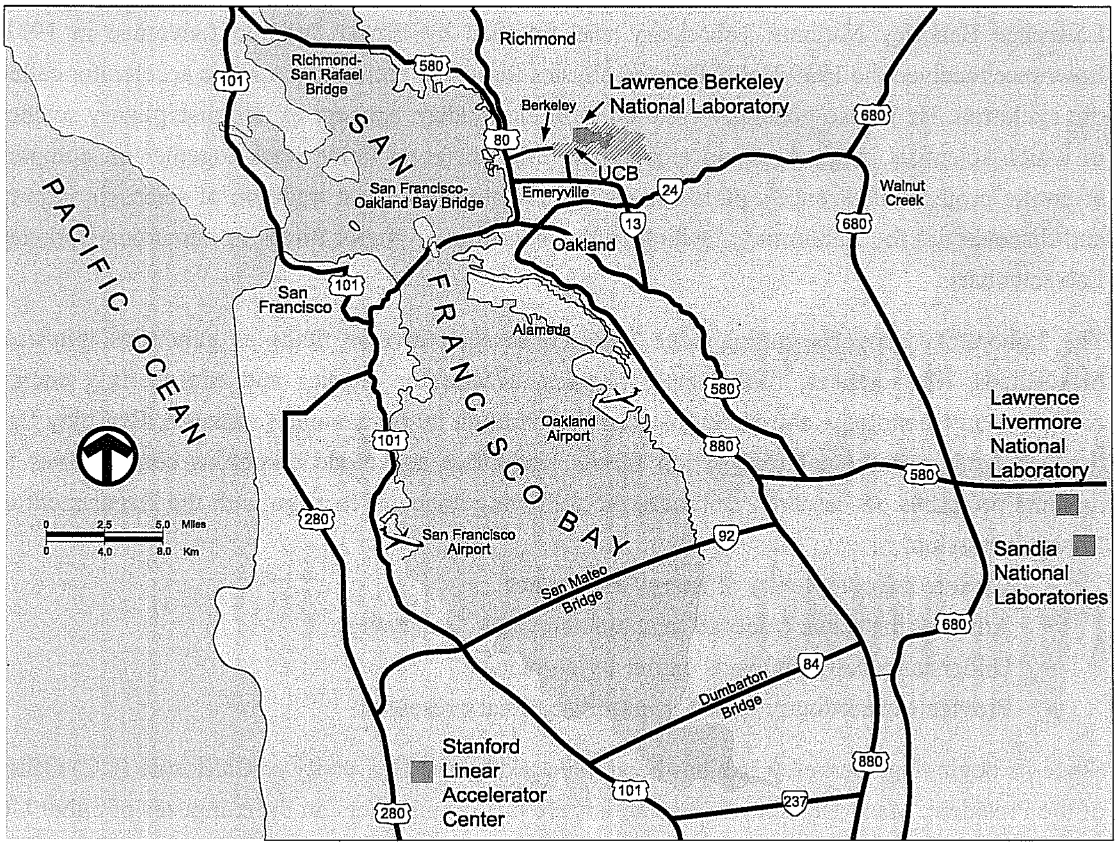

Figure 2-1 San Francisco Bay Area Map

Adjacent land use consists of residential, institutional, and recreation areas (see Figure 2-3). The area to the south and east of the Laboratory, which is University land, is maintained largely in a natural state. It includes UC Berkeley's Strawberry Canyon Recreational Area and Botanical Garden. Northeast of the Laboratory are the University's Lawrence Hall of Science, Space Sciences Laboratory, and Mathematical Sciences Research Institute. Berkeley Lab is bordered on the north by single-family homes and on the west by the UC Berkeley campus, as well as by multiunit dwellings, student residence halls, and private homes. The area to the west of Berkeley Lab is highly urbanized.

2.2.2 Population and Space Distribution

Approximately 3,900 scientists and support personnel work at Berkeley Lab, including about 600 students. In addition, the Laboratory hosts 2,000 participating guests each year, who use its unique scientific facilities for varying lengths of time. Berkeley Lab also supports 300 scientists and staff at off-site locations, including Walnut Creek, Oakland, Berkeley, and Washington, D.C. Approximately 300 of the Laboratory's scientists serve as faculty members at UC Berkeley and UC San Francisco (Berkeley Lab 2002a).

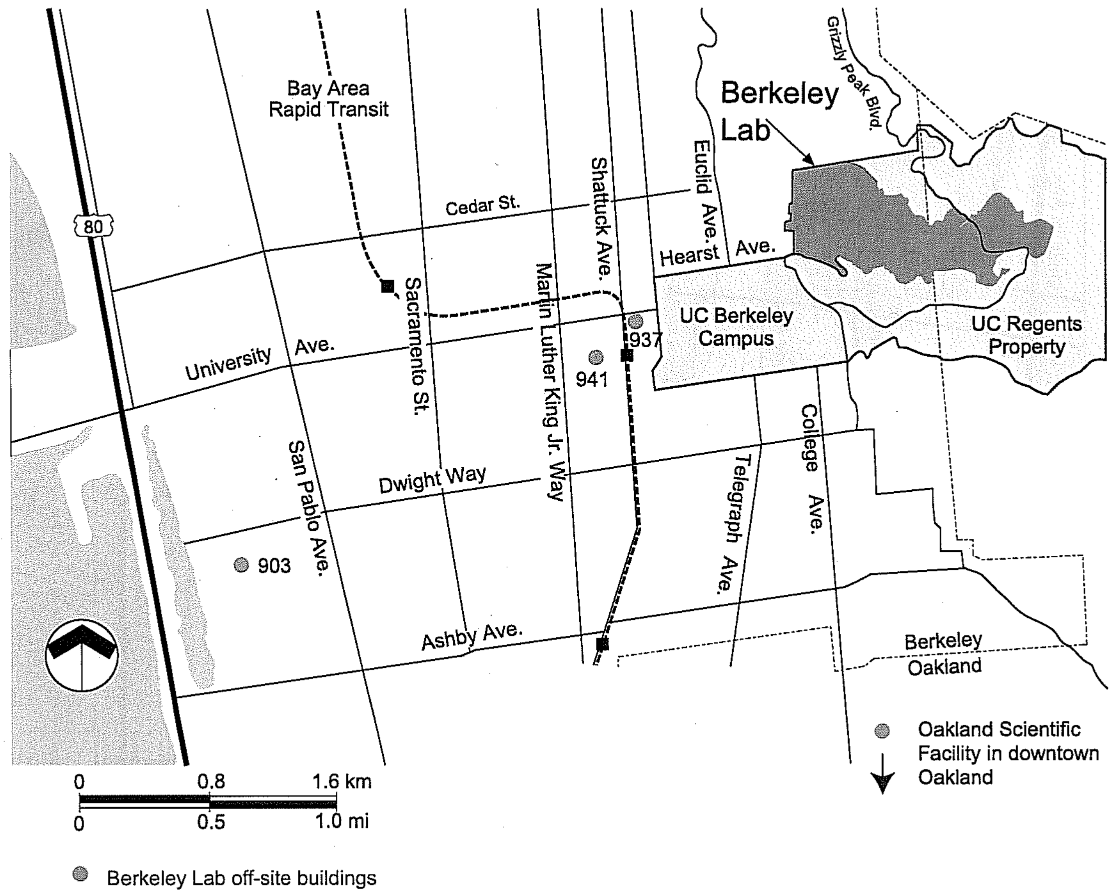

Figure 2-2 Vicinity Map

Berkeley Lab research and support activities are conducted in structures having a total area of 202,000 gross square meters (2.18 million gross square feet). About 81% of the total space is at the main site, 3% is on the UC Berkeley campus (i.e., Donner and Calvin Laboratories), and the remaining 16% is located in various other off-site leased buildings in Berkeley, Oakland, and Walnut Creek. Figure 2-4 shows the Berkeley Lab space distribution.

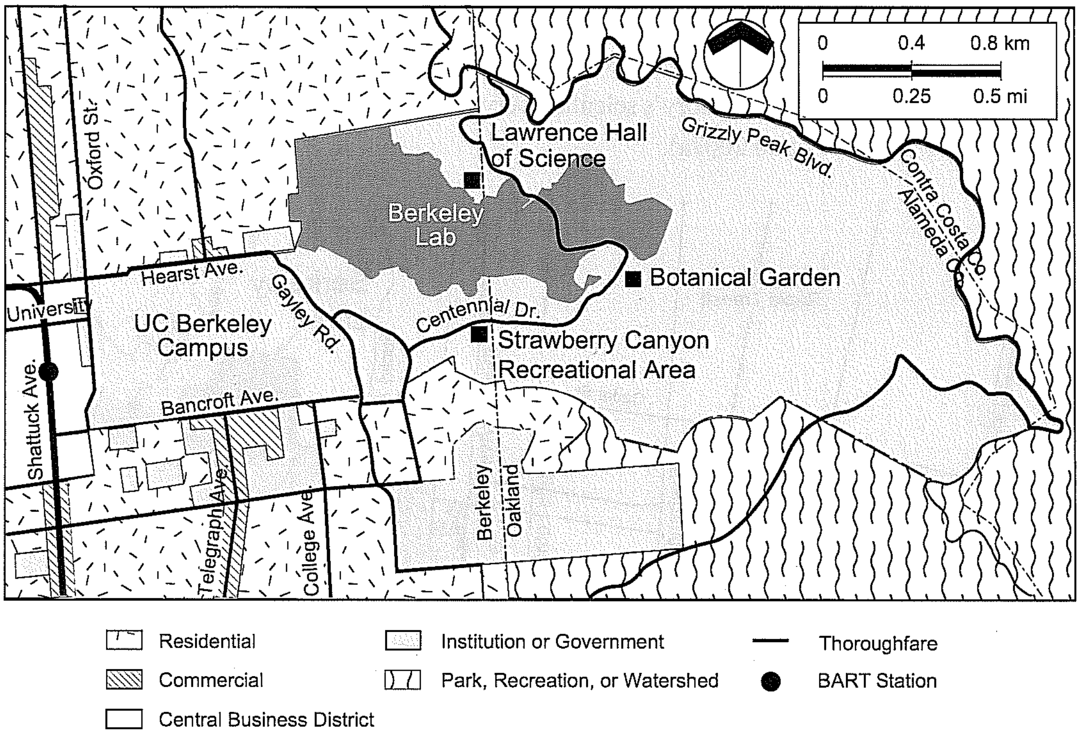

Figure 2-3 Adjacent Land Use

2.2.3 Water Supply

All domestic water for the Laboratory's main site is supplied by the East Bay Municipal Utility District. The site has no drinking-water wells.

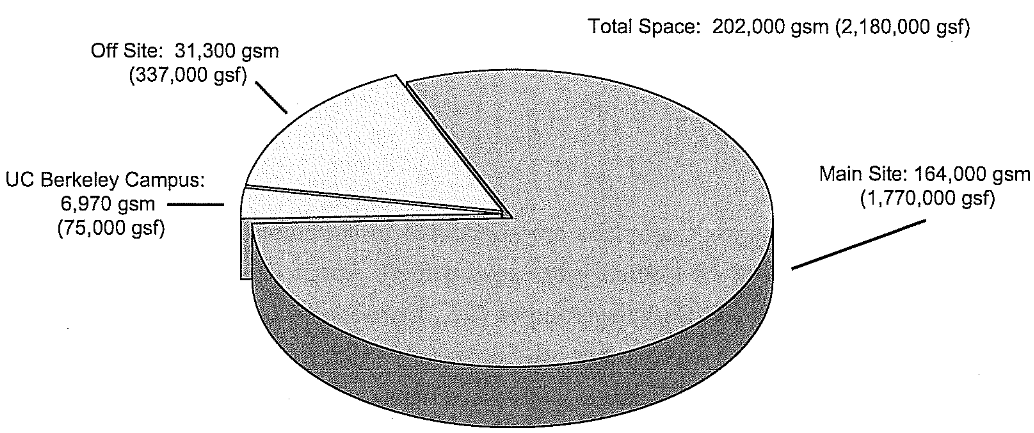

Figure 2-4 Space Distribution

Domestic water originates in Sierra Nevada watershed lands and is transported to the Bay Area and ultimately to Berkeley Lab through a system of lakes, aqueducts, treatment plants, and pumping stations. EBMUD tests for contaminants and meets disinfection standards required by the Safe Drinking Water Act.

2.3 ENVIRONMENTAL SETTING

The following sections describe the meteorology, vegetation, wildlife, geology, and hydrogeology at Berkeley Lab.

2.3.1 Meteorology

The climate of the site is influenced greatly by the moderating effects of nearby San Francisco Bay and the Pacific Ocean to the west, and on the east by the East Bay hills paralleling the eastern shore of this same bay. Combined with large-scale weather patterns, these physical barriers contribute significantly to the relatively warm, wet winters and cool, dry summers of the site. Figure 2-5 compares recent monthly temperature average and extremes against long-term meteorological statistics, recorded at the on-site weather station.

On-site wind patterns change little from one year to the next. The most prevalent wind pattern occurs during fair weather, with daytime westerly winds blowing off the bay, followed by lighter nighttime southeasterly winds originating in the East Bay hills. The other predominant wind pattern is associated with storm systems passing through the region, which usually occur during the winter months. South-to-southeast winds in advance of each storm are followed by a shift to west or northwest winds after passage of the system. Figure 2-6, a graphical summary of the historical wind patterns, called a wind rose, illustrates the frequency of these two predominant wind patterns.

Precipitation data are provided in Figure 2-7, which compares recent monthly precipitation totals to the average since 1974.

2.3.2 Vegetation

Vegetation on the Laboratory site is a mixture of native plants, naturalized exotics, and ornamental species. The main site was intensively grazed and farmed for approximately 150 years before the development of the Laboratory in the 1930s. The Laboratory manages on-site vegetation so that it is coordinated with the local natural succession of native plant communities. Berkeley Lab also works to maintain a wooded and savanna character in the areas surrounding buildings and roads. Ornamental species are generally restricted to public spaces and courtyards, plus areas adjacent to buildings. The site does not have any rare, threatened, or endangered species of plants present. Figure 2-8 shows the vegetation types and locations on-site.

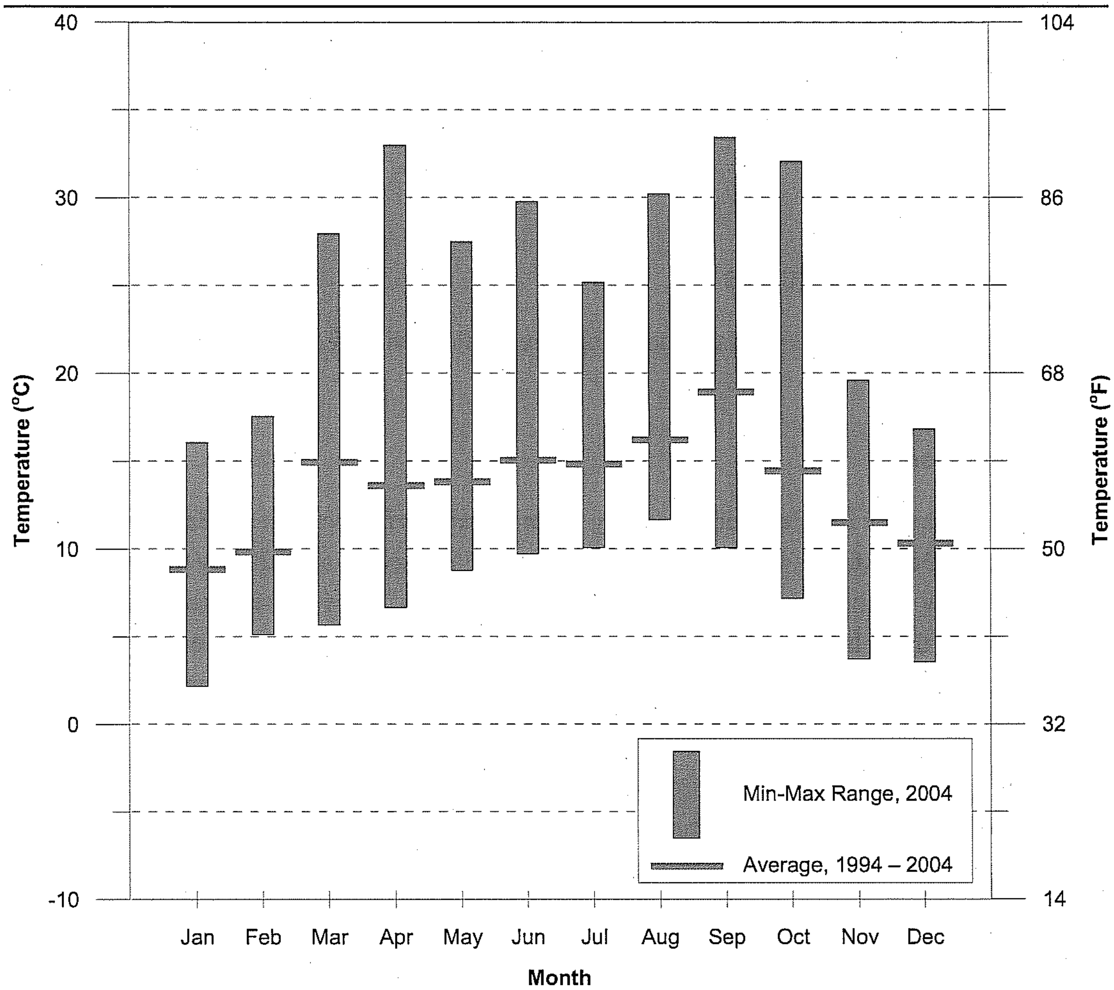

Figure 2-5 Temperature Summaries by Month

The Lab's main site is managed to minimize wildland fire damage to structures. The vegetation management program is designed to reduce the potential flame heights of ground cover vegetation to no more than 3 feet (1 meter).

The Laboratory's vegetation management efforts not only increase the likelihood of its buildings surviving any future fire storm, but the lower-intensity fire conditions at the Laboratory would allow regional fire fighters to suppress the flame front before it proceeds to the west of the Laboratory.

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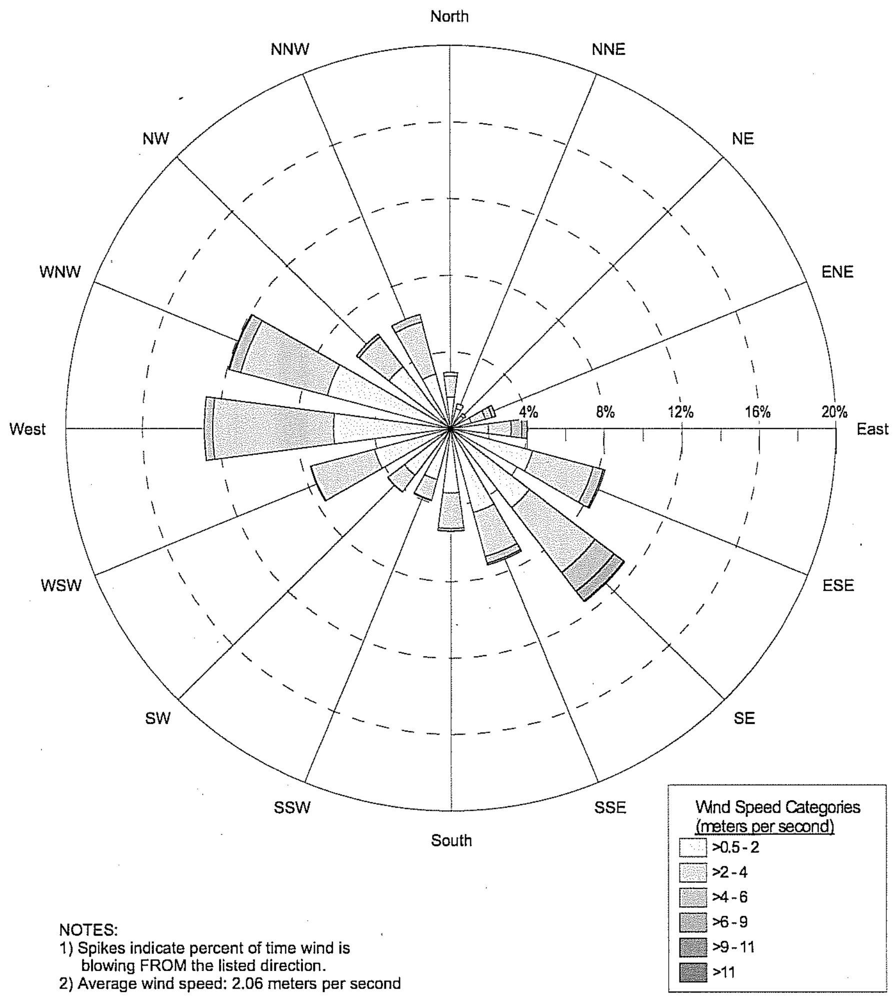

Figure 2-6 Historical Wind Patterns

Berkeley Lab also works with the Hills Emergency Forum (comprised of representatives from the neighboring cities of Berkeley and Oakland, the East Bay Regional Park District, EBMUD, and UC Berkeley) to improve vegetation management of the urban-wildland interface in the larger area.

2.3.3 Wildlife

Wildlife is abundant in the area surrounding Berkeley Lab because the site is adjacent to open spaces managed by the East Bay Regional Park District and the University of California. Wildlife that frequents the Laboratory site is typical of wildlife in previously grazed areas that have a Mediterranean climate and are located in mid-latitude California. More than 120 species of birds, mammals, and reptiles/amphibians are thought to exist on the site. The most abundant large mammal is the Columbian black-tailed deer.

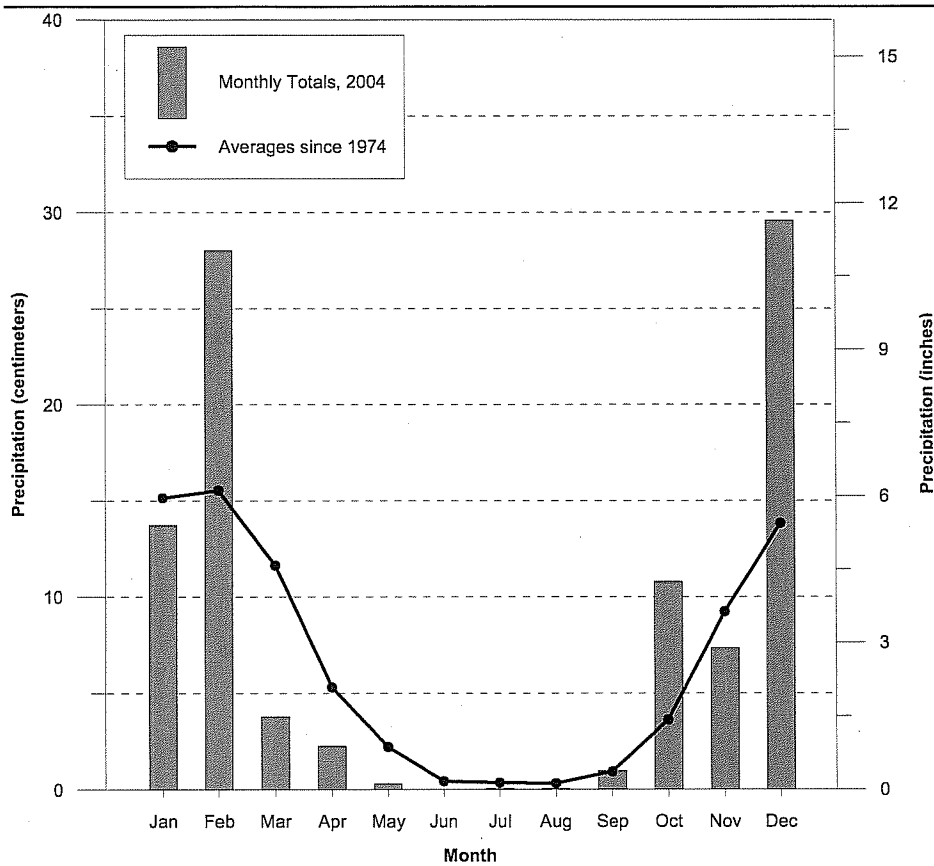

Figure 2-7 Precipitation Summary by Month

2.3.4 Geology and Hydrogeology

Three geologic formations underlie the majority of the site:

- The western and southern parts of Berkeley Lab are underlain by marine siltstones and shales of the Great Valley Group.
- River-deposited sediments of the Orinda Formation overlie the Great Valley Group and underlie most of the developed area of the site. The Orinda Formation consists primarily of fine-grained sediments (claystones, siltstones, and sandstones), with coarser-grained sandstone and conglomerate present in some areas.
- Ancient landslide deposits underlie most of the higher elevations of Berkeley Lab, as well as much of the central developed area ("Old Town"). These deposits consist primarily of basalt and andesite, agglomerates, and pyroclastic tuffs derived from the volcanic Moraga Formation.

The Claremont Formation and San Pablo Group underlie the easternmost area of the site. The Claremont Formation consists of chert and shale. The San Pablo Group consists of marine sandstones.

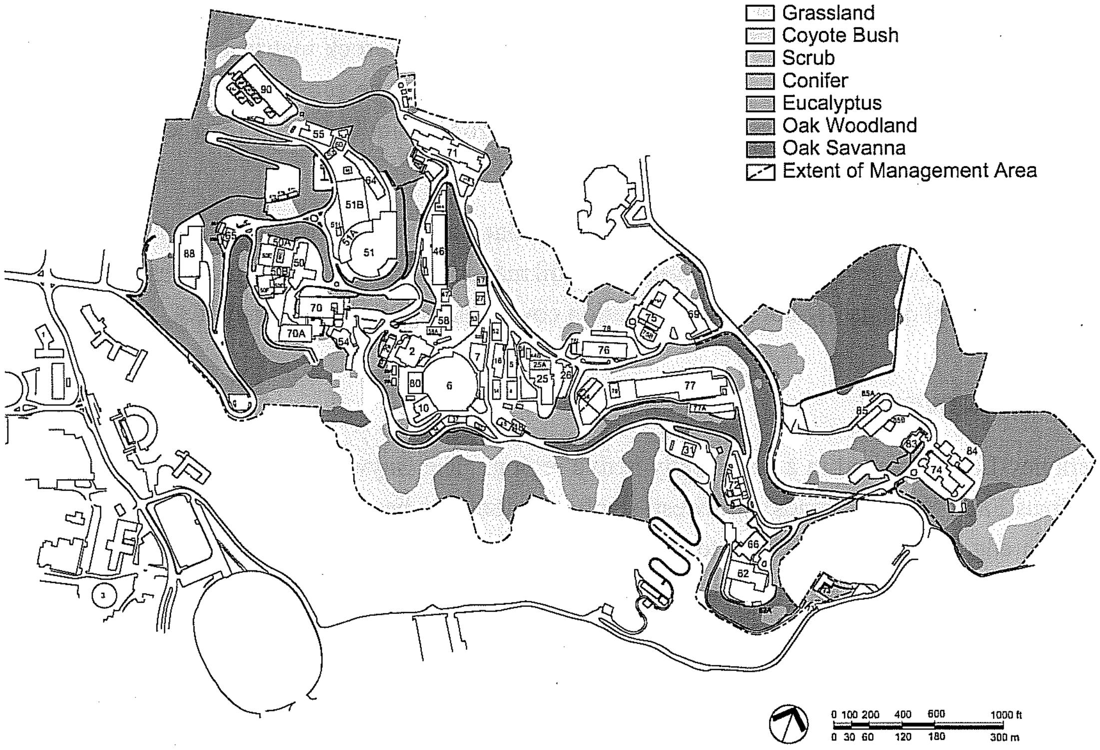

Figure 2-8 Vegetation Types (Map Revised 1999)

The surficial geology consists primarily of colluvium and fill. Weathered detritus from the bedrock units has accumulated as soil deposits, generally from one to several meters thick. Because of the hilly terrain, up to tens of meters of cuts and fills have been necessary to provide suitable building sites.

The active Hayward Fault, a branch of the San Andreas Fault System, trends northwest to southeast along the base of the hills at Berkeley Lab's western edge. The inactive Wildcat Fault traverses the site north to south along the canyon at the Laboratory's eastern edge. In addition to the faulting, landsliding and tilting of the rock units underlying the site have helped to develop a complex geological structure.

Groundwater is a concern at the Laboratory because of its potential effect on slope stability and on the underground movement of contaminants. The water table depths vary from approximately 0 to 30 m (98 ft) below the surface across the site. The hydrogeologic properties of the three primary geologic formations at the Laboratory are described below.

- The Great Valley Group consists primarily of low-permeability rock with moderately spaced open fractures that allow for groundwater movement.
- The Orinda Formation consists primarily of low-permeability rock with closed fractures that inhibit groundwater movement.

- The ancient landslide deposits of the Moraga Formation constitute the main water-bearing unit at Berkeley Lab. Although the permeability of the rock matrix is low, groundwater flows readily through the numerous open fractures. The presence of low-permeability interbeds of fine-grained sediments, as well as zones with little fracturing, creates perched water conditions at many locations.

During the past 20 years, the Laboratory has carried out a successful program of slope stabilization to reduce the risk of property damage caused by soil movement. This program includes construction of subhorizontal drains (hydraugers), vegetation cover, and soil retention structures.

2.3.6 SEISMOLOGY

Berkeley Lab is located in a seismically active region. The Hayward Fault, a branch of the San Andreas Fault System, trends northwest–southeast along the base of the hills at the Laboratory's western edge. It has the potential to produce an earthquake of approximately 7.5 on the Richter scale. Traces of the Wildcat Fault, also part of the San Andreas system, traverse the site on the east, but analysis indicates no evidence that the fault is active in this area. Shorter, apparently inactive, subsidiary faults also transect the Laboratory.

The San Andreas Fault zone, which has potential for a magnitude 8.3 earthquake, lies about 32 kilometers (20 miles) west of Berkeley Lab, offshore beyond the Golden Gate. The Calaveras Fault, another branch of the San Andreas, lies about 24 kilometers (15 miles) east of the site. For an earthquake of any given magnitude, the Hayward Fault would produce the most intense groundshaking at Berkeley Lab because of its proximity. No Laboratory buildings or building additions are sited across the fault.

To reduce the potential for damage from seismic activity, the Laboratory has carried out a comprehensive earthquake safety program since 1971. All new facilities have been designed and constructed to resist the maximum credible earthquake estimated for the site. All existing buildings have been reviewed, and many have been strengthened to meet current risk criteria.

3.0 ENVIRONMENTAL MONITORING REGULATORY REQUIREMENTS

Numerous regulatory requirements dictate the shape and extent of the Berkeley Lab environmental monitoring program. These requirements include policies issued by the DOE to govern its operations and those of its contractors, environmental regulations promulgated by federal agencies, State of California requirements, and the requirements of local and municipal authorities.

3.1 DOE ORDERS AND GUIDANCE

Environmental monitoring requirements are specified in DOE Order 5400.5 *Radiation Protection of the Public and the Environment* (DOE 1993).

Relevant sections from Chapter 2 of this order include the following paragraphs:

- 1: *Public Dose Limits* (excluding subsections 1.a.3.c and 1.c)
- 2: *The ALARA* (As Low As Reasonably Achievable) *Process*
- 5: *Release of Property Having Residual Radioactive Material*
- 6: *Demonstration of Compliance with the Dose Limits* (excluding subsection 6.a)
- 7: *Reporting Requirements*
- 8.a: *Records – Content*

All of Chapter 4, *Residual Radioactive Material,* of this order is also relevant to Berkeley Lab.

Many additional monitoring requirements previously referenced by DOE Order 5400.1 *General Environmental Protection Program*, were not included when that directive was replaced with DOE Order 450.1 *Environmental Protection Program* (DOE 2005). Order 450.1 indirectly specifies environmental monitoring through development of a site-specific environmental management program that implements "sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by Department of Energy operations."

Applicable sections of Orders 450.1 and 5400.5 are incorporated into the contract between the University of California and DOE (Berkeley Lab 2005a).

DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), provides guidance on radiological effluent monitoring and environmental surveillance program elements that DOE considers acceptable to meet DOE orders. It also provides specific monitoring guidance at a level of detail that is lacking in the directives. This guidance document describes suggested *non mandatory* approaches, which should not be construed as requirements.

3.2 FEDERAL REGULATIONS

Title 40 of the *Code of Federal Regulations* (40 CFR) (EPA 2005a) contains rules promulgated by the US/EPA implementing federal legislation such as the *Clean Air Act*, the *Federal Water Pollution Control Act,* and the *Clean Water Act.*

The *National Primary and Secondary Ambient Air Quality Standards* codified in 40 CFR 50 are designed to protect the public health with an adequate margin of safety, and to protect the public from adverse effects of certain air pollutants. These air pollutants include carbon monoxide, hydrogen sulfide, lead, nitrogen dioxide, ozone, particulate matter, sulfates, sulfur dioxide, and vinyl chloride. The ambient air standards associated with these pollutants apply to the region, rather than a single facility or any of its operations. The Bay Area Air Quality Management District, as the local administering agency, has regulatory authority under *40 CFR 58* to require either emissions monitoring or ambient air quality surveillance to verify compliance with these federal standards, as well as any additional state or local standards.

40 CFR 60 prescribes the standards of performance for emission of air pollutants from new or modified stationary sources. The basic framework for each standard is a definition of scope, establishment of an emission standard for one or more pollutants, setting of monitoring and testing methods, and identification of reporting requirements. BAAQMD has incorporated the federal new source performance standards into their regulations, which are then taken into consideration during a permit application review.

40 CFR 61 places restrictions on substances identified as hazardous air pollutants. These emission restrictions cover such substances as asbestos, benzene, beryllium, mercury, vinyl chloride, arsenic, radionuclides, and radon. Together, these regulations are called the National Emission Standards for Hazardous Air Pollutants or NESHAP.

Radionuclides are the only NESHAP substances that require routine sampling at Berkeley Lab. Regulations for these substances are detailed in 40 CFR 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities* (EPA 2005b). US/EPA retains enforcement authority for this type of air emission at Berkeley Lab.

40 CFR 63 regulates numerous categories of air emission sources that give off one or more hazardous air pollutants not covered by 40 CFR 61. Many of these source categories target production facilities, not research facilities. Only a few source categories, such as halogenated solvent cleaning, apply to operations at Berkeley Lab, though no environmental monitoring is required of Berkeley Lab under this regulation.

40 CFR 82 establishes regulations to protect the earth's stratospheric ozone layer. Berkeley Lab has only small amounts of ozone-depleting substances contained in various types of equipment, including air conditioning, refrigeration, and fire suppressant systems. Berkeley Lab is not required to conduct environmental monitoring under this regulation, although it has installed several monitoring and alarm systems in certain mechanical rooms around the site to aid in detecting leaks in cooling systems that serve critical Laboratory buildings.

40 CFR 122-125 implements the *National Pollutant Discharge Elimination System* (NPDES) under Sections 318, 402, and 405 of the Clean Water Act. US/EPA has delegated permitting authority for this program to various agencies in the state of California. The regulations define permit program

requirements and establish permit criteria and treatment standards that must be met by effluent dischargers. Permits are required for sanitary sewer discharges to publicly-owned treatment works (POTW) as well as for specific surface water discharges.

40 CFR Part 403 establishes responsibilities of government and industry to prevent the discharge of any waste that is incompatible with, or passes through, a POTW with the effect of reducing treatment efficiency or inhibiting the disposal, reuse, or recycling of treated wastewaters or sludges. In addition to these general pretreatment requirements, categorical limitations are imposed on specific process discharges. 40 CFR Part 433 places restrictions on the discharge of toxic organics, certain metals, cyanide, and excessive pH from metal finishing processes, and establishes the need for investigations of excursions.

3.3 CALIFORNIA AND LOCAL REGULATIONS

The State of California administers environmental regulatory programs authorized by statute and agreements with the US/EPA and Nuclear Regulatory Commission. The programs impacted at Berkeley Lab are predominantly limited to air and water quality.

Many air quality oversight functions, with the exception of radiological emissions from federal facilities, are delegated by US/EPA to the California Air Resources Board, which in turn delegates many of these responsibilities to the BAAQMD, as well as many requirements derived from the state's own Clean Air Act.

BAAQMD has enacted numerous regulations in many different categories (e.g., stationary internal combustion engines, surface coating) to enforce their regulatory responsibilities. The rules cover emissions of hazardous and nonhazardous air pollutants included in the National Primary and Secondary Ambient Air Quality Standards, non radiological hazardous air pollutants included in NESHAP regulations, and air toxics.

Berkeley Lab has operating permits issued by the BAAQMD for certain operations and activities. Berkeley Lab has many other sources of air emissions that are exempt from permitting requirements because emissions remain below threshold quantities for these sources. BAAQMD seldom requires emissions monitoring for the type of activities found at the Laboratory. None of the monitoring requirements are administered by ESG's environmental monitoring program.

EBMUD is authorized by the state and the Regional Water Quality Control Board to implement and enforce state and federal regulations for sanitary sewer discharge monitoring. Through its wastewater discharge permitting process, EBMUD administers and enforces permit conditions and monitoring requirements for specific fixed treatment units and site-wide discharges based on RWQCB standards and local Wastewater Control Ordinance 311A.

10 CFR 20, Subpart K, Section 20.2003 (NRC 2004), as referenced in Title 17, Section 30253 of the California Code of Regulations, is the chosen radiation protection standard for radionuclides in

sewer discharge, and contains maximum permissible annual discharge limits. DOE and EBMUD each require that Berkeley Lab monitor radionuclide discharges to the sewer to demonstrate compliance with these limits.

Berkeley Lab's storm water discharges are governed by the California General Permit for Discharges of Storm Water Associated with Industrial Activities (California SWRCB 1997). This permit requires pollutant monitoring during storm water runoff, observation of wet season discharges, dry season observation of non-storm water discharges, creation and implementation of specific plans and documents, and annual reporting of results to the San Francisco Bay RWQCB and the City of Berkeley.

The Berkeley Lab Underground Storage Tank (UST) program is managed in compliance with 40 CFR 280, California Health & Safety Code 25280-25299, and 23 California Code of Regulations (CCR) 2610-2729. These requirements include permits for UST removal and installation, monitoring plans, and potential unauthorized release reports. The City of Berkeley Toxics Management Division has been given authority to implement and enforce state rules and issue permits for USTs.

Title 23 of the CCR, Sections 2550 and 2610, defines standards for leak detection, unsaturated zone, and groundwater monitoring activities associated with waste management units and underground storage tanks. These regulations are intended to protect state waters from discharges of hazardous or toxic substances. The state board has delegated responsibility for enforcement of these regulations and the provisions of the Porter-Cologne Water Quality Control Act to the Regional Water Quality Control Board.

Title 17 of the California Code of Regulations (State of California 2005a) also places limits on dose levels from direct radiation sources in uncontrolled areas. These levels must be less than those which could result in whole body dose equivalent to any individual that exceeds either 2 mrem (0.02 mSv) in any one hour, 100 mrem (1 mSv) in any 7 consecutive days, or 0.5 rem (0.005 Sv) in any one year.

A summary of key environmental monitoring and surveillance regulatory requirements is presented in Table 3-1.

Table 3-1 Summary of Environmental Monitoring Regulatory Requirement and Guidance

Regulations, Requirements, Guidelines	Topic	Oversight Agency
DOE Order 450.1	Environmental Protection Program	DOE
DOE Order 5400.5	Radiation Protection of the Public and the Environment	DOE
DOE/EH-0173T	Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance	DOE
40 CFR Part 61	National Emission Standards for Hazardous Air Pollutants	US/EPA
40 CFR Part 136	Guidelines Establishing Test Procedures for the Analysis of Pollutants (under the Clean Water Act)	US/EPA
40 CFR Part 122-125	National Pollutant Discharge Elimination System Regulations, including Storm water Discharge (Clean Water Act)	SWRCB, RWQCB
40 CFR Subchapter N	Effluent Guidelines and Standards (Clean Water Act)	EBMUD
40 CFR Part 50	National Primary and Secondary Ambient Air Standards	US/EPA
40 CFR Part 58	Ambient Air Quality Surveillance	US/EPA
SW-846	Test Methods for Evaluating Solid Waste	US/EPA
40 CFR Part 60	Standards of Performance for New and Modified Stationary Sources	BAAQMD
40 CFR Part 280	Standards and corrective actions for owners and operators of USTs	City of Berkeley
40 CFR Part 403	Responsibilities of government and industry to prevent the discharge of harmful pollutants to POTWs	EBMUD
17 CCR 30253	Radiation protection standards of radionuclides in sewer discharge, air and water	EBMUD, DHS
California Health and Safety Code 25280-25299	USTs	City of Berkeley
23 CCR 2610-2727	USTs	City of Berkeley
23 CCR 2550 and 2610	USTs	RWQCB
22 CCR,64443	Domestic Water Quality Maximum Contaminant Level for radioactivity	RWQCB

4.0 EFFLUENT MONITORING

Effluent monitoring is defined as the collection and analysis of samples or measurements of liquid and gaseous effluents to determine and quantify contaminants and process-stream characteristics, assess any chemical or radiological exposures to members of the public, and demonstrate compliance with applicable standards.

Berkeley Lab's monitoring objectives for radiological and non radiological effluents are:

- Verify compliance with emission discharge and effluent control limits as stated in applicable federal, state, and local effluent regulations and operating permits.
- Determine compliance with commitments made in environmental and other official documents.
- Evaluate the effectiveness of effluent treatment and control as well as efforts toward achieving levels of radioactivity which are *As Low As Reasonably Achievable.*
- Identify potential environmental problems and evaluate the need for remedial actions or mitigation measures.
- Support permit applications and revision.
- Detect, characterize, and report unplanned releases.

To accomplish these objectives, the Laboratory implements the following elements:

- Representatively measure quantities and concentrations of pollutants in liquid discharges, airborne releases, solid wastes, and waste treatment and disposal system effluent and influent, as required by statute, permit, and other written commitments.
- Establish alarm and action levels when necessary for radiological and non radiological monitoring systems.
- Collect and analyze samples in a manner and frequency sufficient to characterize the effluent streams from its facilities and activities, as required by statute, permit, other written commitments, and this EMP.
- Collect samples in accordance with standard operating procedures to ensure reliable results.
- Maintain auditable records.

Effluent monitoring is conducted by a variety of approaches: (1) continuous real-time monitoring, (2) continuous sampling with off-line analysis, (3) periodic sampling with off-line analysis, and (4) administrative controls.

Specific standards for sewer, storm water, and airborne effluent monitoring are discussed in their respective subsections, which are organized to address the following topics for each effluent type:

- Monitoring rationale and design criteria
- Monitoring parameters
- Laboratory analysis procedures
- Quality assurance requirements

- Program implementation procedures
- Preparation and disposition of reports.

4.1 SEWER EFFLUENT

Sewer effluent monitoring assesses two types of Berkeley Lab sewer discharges for compliance with regulations and permits: 1) controlled sanitary sewer discharges monitored for specific pollutants at point-of-release, and 2) monitoring of strategic points in the sewer system to determine total site discharges of major pollutants of concern.

4.1.1 Monitoring Rationale and Design Criteria

Berkeley Lab monitors sewer effluent at the Buildings 25 and 77 wastewater treatment units, groundwater treatment discharge near Buildings 6, 7, 46, 51, and 51L, and at the Strawberry and Hearst site outfalls. These locations, as well as specific parameters, are monitored to comply with release limits stated in the East Bay Municipal Utility District wastewater discharge permits, and, in some cases, state and federal radionuclide release limits in *Title 17 of the California Code of Regulations, Section 30253* (State of California 2005a).

There are a number of hazardous materials in use at Berkeley Lab which have the potential to enter the sanitary sewer through either accidental or routine discharge. Identified uses include the following:

- Many laboratories use small quantities of acids and bases. Acid and basic wastes are stored and disposed of as hazardous wastes or treated by neutralization in Fixed Treatment Units before disposal to the sanitary sewer.
- Solutions of metals are used in various processes, such as metal finishing operations.
- Chlorinated hydrocarbons and other volatile organic compounds (VOCs) are used in research and facility processes. Major uses of VOCs at the site are wipe cleaning, painting, and laboratory research. Additionally, near Buildings 6, 7, 46, and 51, groundwater is treated to remove VOC contamination prior to discharge to the sanitary sewer under a specific EBMUD permit. Spent solvent VOCs are recycled or handled as hazardous waste.
- Total toxic organics refers to a specific list of organic compounds defined in *40 CFR 433.11*, and modified by the EBMUD permit, for any given permit category. At Buildings 25 and 77, Berkeley Lab no longer monitors for those toxic organics defined by EBMUD as required for their category, but certifies to EBMUD biannually that an appropriate solvent management plan is in place and that there is no discharge of toxic organics to wastewater.
- With approval through EH&S' Radiological Work Authorization (RWA) program, small amounts of radioactive materials may be discharged to the sanitary sewer within the limits set in the EBMUD permit by reference to *CCR Title 17*, *Section 30253*, which further references 10 CFR 20.

Requirements and guidance for design of sampling and analytical methods are drawn from *Standard Methods for Analysis of Water and Wastewater* (ASTM 1995), *40 CFR 136* (EPA 2005), *SW-846* (EPA 1998), and monitoring criteria specified in wastewater discharge permits. The Environmental Services Group and the Facilities Division oversee design and construction of sewer monitoring systems for the site.

4.1.2 Monitoring Parameters

Figure 4-1 illustrates the location of Berkeley Lab's separate point-of-discharge monitoring points and two site sewer outfall monitoring stations. Table 4-1 presents a summary of the sampling activities at each point. EBMUD mandates that Berkeley Lab perform self-monitoring for specific substances in its discharges at certain prescribed intervals. EBMUD also performs on-site monitoring to verify Berkeley Lab's self-monitoring methods and results.

4.1.2.1 Site Sewer Outfall Points

The sanitary sewer system is based on gravity flow. There are two monitoring locations for this

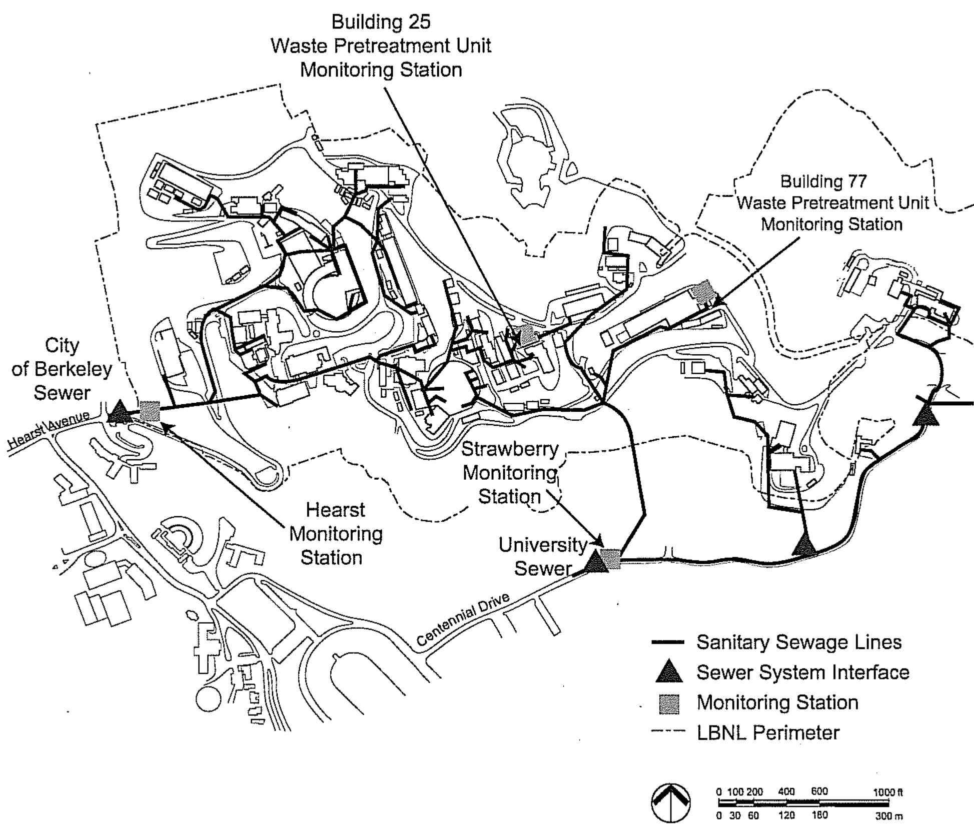

Figure 4-1 Monitoring Locations for Effluent to the Sanitary Sewer

type of effluent at site boundaries. Both are located in vaults in separate drainage areas. The Hearst vault is located in Blackberry Canyon east of Hearst Avenue, and receives wastewater from the western portion of the site. It connects to the City of Berkeley sewer main at Hearst Avenue. The Strawberry Sewer, south of Berkeley Lab's border on Centennial Drive, receives discharges from the buildings on the eastern portion of the site and from some UC Berkeley locations. This outfall connects to University-owned piping at Centennial Drive and then to the City of Berkeley system on Rim Road.

Effluent from both of the sewers is directed to the EBMUD treatment plant, where it undergoes treatment prior to discharge into the San Francisco Bay. Effluent flows at both the Hearst and Strawberry monitoring stations are continuously recorded in order to calculate total radiological discharges. The flow meters are inspected weekly and calibrated quarterly.

Table 4-1 Sampling Methods for Non Radiological Permitted Discharge Monitoring

Sampling Location	Sampling Point	Sampling Frequency	Sampling Method
Building 25 Fixed Treatment Unit (FTU)	FTU effluent discharge pipe	Two representative batches during designated weeks in the permit year.	Grab obtained and preserved per 40 CFR 136 and SW-846.
Building 77 FTU	FTU effluent discharge pipe	One representative operating day each during three designated weeks in the permit year.	24-hour composite sample and grab obtained and preserved per 40 CFR 136 and SW-846.
Hearst Sewer Outfall	Vault at Hearst St... and Highland Pl. (Side Sewer #1)	One representative operating day each during two designated weeks in the permit year.	24-hour composite sample and grab obtained and preserved per 40 CFR 136 and SW-846.
Strawberry Sewer Outfall	Vault on Centennial Drive near UC swimming pools (Side Sewer #2)	One representative operating day each during two designated weeks in the permit year.	24-hour composite sample and grab obtained and preserved per 40 CFR 136 and SW-846.
Groundwater discharge points near Buildings 6, 7, 46, 51, and 51L	Carbon drum effluent	Monthly	Grab sample obtained and preserved per 40 CFR 136 and SW-846.

Pretreated and untreated wastewaters from the site are sampled at the Hearst and Strawberry outfalls. The *EBMUD Wastewater Discharge Permit* states the sampling frequency. Currently, that frequency is two sampling events per permit year at each sewer outfall monitoring point. Time composite samples are also automatically collected every month for laboratory radiochemistry analysis. The samples are analyzed for gross alpha and beta, iodine-125, phosphorus-32, carbon-14, sulfur-35, and tritium. For details of this analysis, see Section 4.1.3, Laboratory Analysis Procedures.

4.1.2.2 Building 25

Building 25 houses the Photo Fabrication Facility, which uses plating solutions, acids (sulfuric, hydrochloric), etchers, conditioners, activators, developers, and associated rinse water. Spent solutions which are hazardous waste are drummed and shipped to an approved off-site hazardous waste facility for proper disposal.

Rinse water and releases to all floor drains flow to a 250-gal carbon steel epoxy-lined sump, which leads to the wastewater treatment unit. The wastewater treatment unit operates on a batch basis. Wastewaters are treated by neutralization, precipitation of metals, flocculation, clarification, and filtration using a filter press. The dry filter cake is collected in a drum and shipped to an approved off-site hazardous waste facility for proper disposal.

Two samples are taken from the Building 25 treatment unit batch discharge during the EBMUD permit year. EBMUD notifies Berkeley Lab of sampling dates by letter approximately one month prior to sampling. Samples are analyzed for metals and pH. Instead of sampling for organics, twice per year Berkeley Lab submits a Total Toxic Organics Compliance Report certifying that no toxic organics are being released to the sanitary sewer and that appropriate solvent management plans are in place.

Periodically, EBMUD provides Berkeley Lab notice of their intent to collect their own samples. In this manner, EBMUD can arrange for its inspector to be present when a batch is discharged.

4.1.2.3 Building 77

The Ultra High Vacuum Cleaning Facility in Building 77 cleans metal parts as needed to support Berkeley Lab activities. Coating activities added in 2005 include plating parts with electro less nickel, applying a chromate coating (Iridite 14-2) to aluminum parts, and anodizing aluminum parts along with sealers and, if desired, dyes. The facility includes an ultrasonic cleaner using nontoxic aqueous detergents, cleaner tanks using a caustic detergent, rinse tanks, and acid tanks. Spent solutions are drummed and shipped to an approved, off-site hazardous waste disposal facility. The primary rinse tank solutions and sumps are directed to the wastewater treatment unit. The secondary and tertiary rinse water is recycled through a de-ionizing filter system.

Primary rinse tank solutions are treated by hexavalent chromium reduction, neutralization, precipitation of metals, flocculation, clarification, and filtration using a sand filter and a filter press. The dry filter cake is collected and dried further in a drying oven before disposal as hazardous waste.

Effluent from the treatment process discharges to the sanitary sewer on a continuous basis during the hours of operation. As specified by EBMUD permit, wastewater samples are taken from the sampling port downstream of this treatment unit, but before this effluent combines with other wastewaters. The effluent is sampled by ESG personnel at a frequency that is designated in the permit. Samples are analyzed for metals and pH. The samples are representative composites of a 24-hour average discharge. As with the Building 25 treatment unit, Berkeley Lab submits a Total Toxic Organics Compliance Report twice each year certifying that no toxic organics are being released to the sanitary sewer and that appropriate solvent management plans are in place.

EBMUD also periodically performs monitoring as specified in the permit to verify Berkeley Lab's self-monitoring results.

4.1.2.4 Groundwater Discharge Near Buildings 6, 7, 46, 51, and 51L

In a separate permit, EBMUD allows Berkeley Lab to discharge groundwater to the sanitary sewer following treatment to remove VOC contamination pursuant to Environmental Restoration Program activities. The treatment process consists of passing the contaminated groundwater through a double-filtered carbon adsorption system. Samples are taken monthly from the effluent of each system to verify that breakthrough has not occurred. Presently, this treatment and discharge occurs at several systems near Buildings 6, 7, 46, 51, and 51L.

Due to on-site use of treated water, only part of the effluent from these systems is actually discharged to the sanitary sewer. A description of monitoring, maintenance, and sampling is documented in one of the Environmental Restoration Program's standard operating procedures. In addition, EBMUD conducts semi-annual sampling from treatment systems to verify LBNL's monitoring results.

4.1.2.5 Direct Sources

Most other operations discharge directly to the sanitary sewer, commingle with site sewer effluent, and are monitored at the site sewer outfall points. EBMUD has determined that these small discharge sources do not merit individual permits. Some individual source monitoring for specific parameters of concern (e.g., pH, radioactivity) is conducted for selected sources. The following direct sources are regulated under conditional authorization permits from the California Department of Toxic Substances Control (State of California, 2005c):

- Building 2 Acid Neutralization System
- Building 70A Acid Neutralization System
- Building 76 Oil/Water Separator

The wastewater treatment units at Buildings 25 and 77, discussed earlier in this section, fall under this agency's permit-by-rule tier of these same regulations.

Liquid wastes that are not individually permitted are characterized by the discharger to determine whether discharge to the sanitary sewer is appropriate. For radioactive sources, this characterization includes an RWA and working procedures that are subject to an internal *As Low As Reasonably Achievable* review to account for direct sewer discharge of radionuclides under *17 CCR 30253* (State of California 2005a).

All onsite and offsite waste generators at Berkeley Lab are responsible for appropriate disposal practices to the sanitary sewer in their respective work areas. The RWA program requires waste generators to maintain disposal logs and report radionuclide discharges to the program.

Offsite Buildings 1 and 3 on the University of California-Berkeley campus are two sites that fall under these conditions. Confirmatory sewer monitoring is not necessary at these buildings due to the small amounts authorized for disposal and the level of administrative controls applied. Administrative controls include use of disposal logs and analyses of records, both prepared by the discharger, plus a periodic review by ESG. The quarterly inventory report from the RWA program's database is reviewed to ensure that only authorized amounts of specified isotopes are released to the sanitary sewer.

At the other offsite buildings (i.e., 903, 937, 941, 943, 977 [Berkeley West Biocenter on Potter Street] and the Joint Genome Institute in Walnut Creek), no sewer discharge of radionuclides is currently authorized. Additionally, EBMUD has determined that no discharge permit is necessary at Building 977, and the permit from the Central Contra Costa Sanitary District for the Joint Genome Institute does not require effluent monitoring. Therefore, EH&S does not perform confirmatory sewer monitoring at these sites.

4.1.3 Laboratory Analysis Procedures

Laboratory analysis of samples is undertaken pursuant to the self-monitoring provisions of the EBMUD permit or, for radionuclide effluent discharges, to meet the requirements of DOE orders. Table 4-2 presents the parameters analyzed and methods used.

Radiological procedures are based on DOE guidance and US/EPA methods. Analyses are performed at an offsite commercial laboratory. Gross alpha measurements by proportional counter are used as a screening mechanism. If the gross alpha measurement indicates alpha activity above the state Maximum Contaminant Level (MCL) for drinking water of 15 pCi/L, then the analytical laboratory performs a gamma spectroscopy analysis to determine the specific radionuclides contributing to the alpha activity. Gross beta measurements by proportional counter are also used as a screening mechanism for beta emitters. If the gross beta measurement indicates beta activity above the state MCL for drinking water of 50 pCi/L, then the laboratory performs a gamma spectroscopy analysis to determine the specific radionuclides contributing to the beta activity.

Tritium samples are analyzed by a liquid scintillation counting technique (US/EPA Method 906). The collected water is distilled, mixed with a counting cocktail, and placed in a counter. As required in the contract with any pre-qualified commercial radiological laboratories, the minimum detectable activity (MDA) for tritium is 7 Bq/L (200 pCi/L).

The value of performing a periodic gamma spectroscopy analysis on sewer samples was reviewed by ESG in 2003 using data from the previous five years. Provided the overall values remain well within the range of the natural isotopic abundances identified by this technical assessment, there is no need to perform routine gamma spectroscopy.

Water samples are prepared for gross alpha and beta analysis by acidification (HNO_3) and evaporation into 5-centimeter (2-inch) diameter stainless steel planchettes. Organic residues not wet-ashed by the nitric acid treatment are oxidized by flaming the planchettes. The minimum detectable activity for gross alpha is 0.2 Bq/L (5 pCi/L), depending on the amount of dissolved solids in the sample. The MDA for gross beta is 0.15 Bq/L (4 pCi/L)

Table 4-2 Analytical Methods for Permitted Sewer Discharge Monitoring

Parameter	Sample Type	Method	Location
pH	Grab	EPA 150.1	25, 77, Outfalls
PCBs	Grab	EPA 608	51 Basement
Total Identifiable Chlorinated Hydrocarbons	Grab	EPA 624	Outfalls
Cadmium	Composite	EPA 200.7	25, 77, Outfalls
Chromium	Composite	EPA 200.7	25, 77, Outfalls
Copper	Composite	EPA 200.7	25, 77, Outfalls
Lead	Composite	EPA 200.7	25, 77, Outfalls
Nickel	Composite	EPA 200.7	25, 77, Outfalls
Silver	Composite	EPA 200.7	25, 77, Outfalls
Zinc	Composite	EPA 200.7	25, 77, Outfalls
Chemical Oxygen Demand	Composite	Standard Methods (18) 5220D	Outfalls
Total Suspended Solids	Composite	EPA 160.2	Outfalls
Gross Alpha Activity	Composite	EPA 900	Outfalls
Gross Beta Activity	Composite	EPA 900	Outfalls
S-35	Composite	Liquid Scintillation Counting	Outfalls
Tritium	Composite	EPA 906	Outfalls
I-125	Composite	Liquid Scintillation Counting	Outfalls
C-14	Composite	Liquid Scintillation Counting	Outfalls
P-32	Composite	Gas Proportional Counting	Outfalls
Volatile Organic Compounds	Grab	EPA 8260	Treated Groundwater

4.1.4 Quality Assurance Requirements

All wastewater samples are collected using containers, collection methods, and preservation techniques as specified in 40 CFR 136. Sampling methods include chain-of-custody, duplicate samples, field blanks, and sample tracking information for data management.Holding times and analytical methods are as set forth in 40 CFR 136, the most recent version of *Standard Methods for the Analysis of Water and Wastewater* (EPA 1999), or as specified in the wastewater discharge permit. On-line sewer monitoring instrumentation (e.g., flow meters) is also subject to Berkeley Lab QA requirements. Each flow meter is calibrated at several different flow levels to assure linearity.

Discharges of water from secondary containment or any questionable liquid effluent are reviewed by Facilities Division staff to ensure environmental compliance and reduce the potential for excursions. Facilities' rainwater disposal procedures for aboveground storage tanks specify that water accumulation in aboveground storage tank secondary containments will not be directly discharged until appropriately evaluated.

Goals for the accuracy and precision of sewer monitoring data are established in ESG procedures. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

4.1.5 Monitoring Operating Procedures

A list of procedures used by the sewer effluent monitoring program is presented in Appendix C.

Operating procedures and operator training are provided by ESG personnel for permitted wastewater treatment units. Operating procedures may include the following, if appropriate for the unit:

- instructions for calibration of monitoring instrumentation, determination of the accuracy of the pH meter, and other parameters
- regular inspection of equipment
- approved methods of cleaning, maintenance, and calibration/operation logs.

4.1.6 Reporting

Sewer effluent self-monitoring results are reported to EBMUD within 30 days of sampling and within 24 hours if there is an exceedance of the permitted limit. The reports include certifying signatures, analytical results, chain-of-custody forms, process description, field notes, and volumes discharged. Radiological results for wastewater form the basis for an annual certification to EBMUD that Berkeley Lab is operating within regulatory limits.

Monitoring results are also presented in the annual *Site Environmental Report* (Berkeley Lab 2005c), which is distributed to many federal, state, and local regulatory agencies, made available to the public, and posted on the ESG web site at http://www.lbl.gov/ehs/esg.

4.2 STORM WATER EFFLUENT

Berkeley Lab monitors storm water discharges as stated in its Storm Water Monitoring Program (SWMP) (Berkeley Lab 2001a). The SWMP is required by the NPDES General Permit for Storm Water Discharges Associated With Industrial Activities, administered by the Regional Water Quality Control Board (California State 1997) and the City of Berkeley. Storm water monitoring results are reported annually to the RWQCB and the City of Berkeley. The SWMP has been prepared as a stand-alone document and is included in Appendix A of this Plan.

4.3 AIRBORNE EMISSIONS

Berkeley Lab measures airborne radionuclides emitted from building exhaust systems through stacks or other vents to ensure compliance with 40 CFR 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities* (EPA 2005b). Measurements are made in one of two ways; sampling or monitoring. Sampling consists of extracting airborne radionuclides from the effluent stream using a filter collection device, while monitoring consists of making continuous real-time measurements.

Berkeley Lab also measures nonradioactive airborne emissions, but this activity is limited to periodic testing for organic compounds at several BAAQMD-permitted soil vapor extraction projects operated by the Environmental Restoration Program. This testing is performed using direct-reading instrumentation such as hand-held photoionization detectors. Monitoring frequency and location is dictated by permit conditions and will not be further discussed in this document since this activity is not administered by the ESG environmental monitoring program.

4.3.1 Sampling/Monitoring Rationale and Design Criteria

The radionuclide NESHAP requirements require Berkeley Lab to calculate the potential dose (i.e., exposure over time) that could result from each source of radionuclide emissions. When determining this potential dose, ESG personnel consider the radionuclide quantities that are authorized for use in each laboratory, but do not consider emissions controls, such as filters.

Based on the calculated potential dose, the radionuclide NESHAP regulation categorizes sources of radionuclide emissions into one of two groups:

- those with a potential dose that could equal or exceed 1.0×10^{-3} mSv/yr (0.1 mrem/yr); and
- those with a potential dose of less than 1.0×10^{-3} mSv/yr (0.1 mrem/yr).

None of Berkeley Lab's stacks fall into the category where the potential dose could reach 1.0×10^{-3} mSv/yr (0.1 mrem/yr) or more. For sources in the second category, Berkeley Lab performs periodic confirmatory measurements. The NESHAP regulation does not provide details on such measurements. Berkeley Lab has obtained DOE and US/EPA approval to perform periodic confirmatory measurements using a graded approach.

This approach is shown in Table 4-3. This approach, which both agencies approved in early 2005, increases the threshold for stack measurements from 1.0×10^{-5} mSv/yr (0.001 mrem/yr) to 1.0×10^{-4} mSv/yr (0.01 mrem/yr). The higher measurement threshold is based on more than 10 years of data showing that airborne radionuclide emissions from the vast majority of Berkeley Lab release points have negligible dose impacts and allows Berkeley Lab to focus its resources on those release points that have the greatest potential impact on public health.

The measurement requirements in Table 4-3 are minimum requirements. Berkeley Lab may choose to sample or monitor more frequently if the situation warrants. For example, the potential dose

Table 4-3 Radionuclide NESHAP Graded Measurement Approach

Category	Potential dose (mSv/yr)[a]	Requirements
1	1.0×10^{-1} > dose ≥ 1.0×10^{-2}	Continuous sampling with weekly collection and analysis AND Real-time monitoring with alarming telemetry for short-lived (t 1/2 <100 h) radionuclides resulting in >10% of potential dose to the maximally exposed individual
2	1.0×10^{-2} > dose ≥ 1.0×10^{-3}	Continuous sampling with monthly collection and analysis OR Real-time monitoring for short-lived (t 1/2 <100 h) radionuclides resulting in >10% of potential dose to the maximally exposed individual
3	1.0×10^{-3} > dose ≥ 1.0×10^{-4}	Periodic sampling 25% of the year
4	Dose ≤ 1.0×10^{-4}	Potential dose evaluation before project starts and when annual radionuclide use limits are revised; no sampling or monitoring required

[a] 1 mSv/yr = 100 mrem/yr

from radionuclides released to the atmosphere from the Building 56 and Building 88 accelerators, is very low. Yet since the expected emissions are short-lived (fluorine-18 has a 110-min half-life and carbon-11 has a 20-min half-life, respectively), the best way to measure these emissions is by real-time monitoring rather than by quarterly sampling.

All sampled stacks have turbulent flow (Reynolds number >2100), where probe position and size are not critical. Nonetheless, for particulate sampling, the location at each stack where particulate radioactive effluent is withdrawn is generally selected in accordance with the guidance of ANSI N13.1 (ANSI 1969) and the requirements of 40 CFR 61, Appendix A, Methods 1 and 1A. Probes are placed at positions of average flow in the effluent stream and the stream is drawn through the probes at near-isokinetic flow rates, which means that the sample flows through the probe at a velocity that is within about 20% of the average annual stack flow rate (Berkeley Lab 2005).

For gases and vapors that are well-mixed, measurement design criteria can be less rigorous than for particulates (Berkeley Lab 2005d). Sampling probes that withdraw gaseous species, air activation products from Berkeley Lab accelerators, and tritium are not selected in accordance with the ANSI N13.1 criteria as these species are essentially uniformly distributed in the effluent streams and do not exhibit particulate behavior.

Locations of sampled and monitored stacks are shown in Figure 4-2. These locations are discussed below.

- **Building 85 stacks:** Stacks from hoods and glove boxes in the Hazardous Waste Handling Facility (Building 85) are equipped with high-efficiency particulate air (HEPA) filters upstream of the sampling probes. Therefore, the average particle size collected by these systems is expected to be less than 0.3 μm in diameter. Any nonisokinetic flow variation has little affect on these small particles. Sampling of these particulate emission stacks is expected to be representative within the limits provided by adherence to the ANSI N13.1 standard (ANSI 1969). These stacks are also sampled for gaseous carbon and tritium vapor.

- **Buildings 70 and 70A stacks:** Stacks that exhaust the Building 70 Pit Room (a radionuclide storage facility) and Building 70A Heavy Elements Research Laboratory (HERL) fume hoods and glove boxes are continuously sampled for particulates with analytical laboratory alpha or beta analyses. Emissions from the HERL glove box stack are also measured for alpha emitters in real time using a continuous air monitoring system that sends data by telemetry to HERL and ESG staff. As at Building 85, HEPA filters are upstream of the Buildings 70 and 70A sampling probes and the small particles that pass through the filters are largely unaffected by any nonisokinetic flow variations.
- **Buildings 56 and 88 accelerator stacks:** The probes for the real-time monitors at Buildings 56 and 88 sample gaseous emissions and were designed to provide representative, but not isokinetic, samples from these stacks.

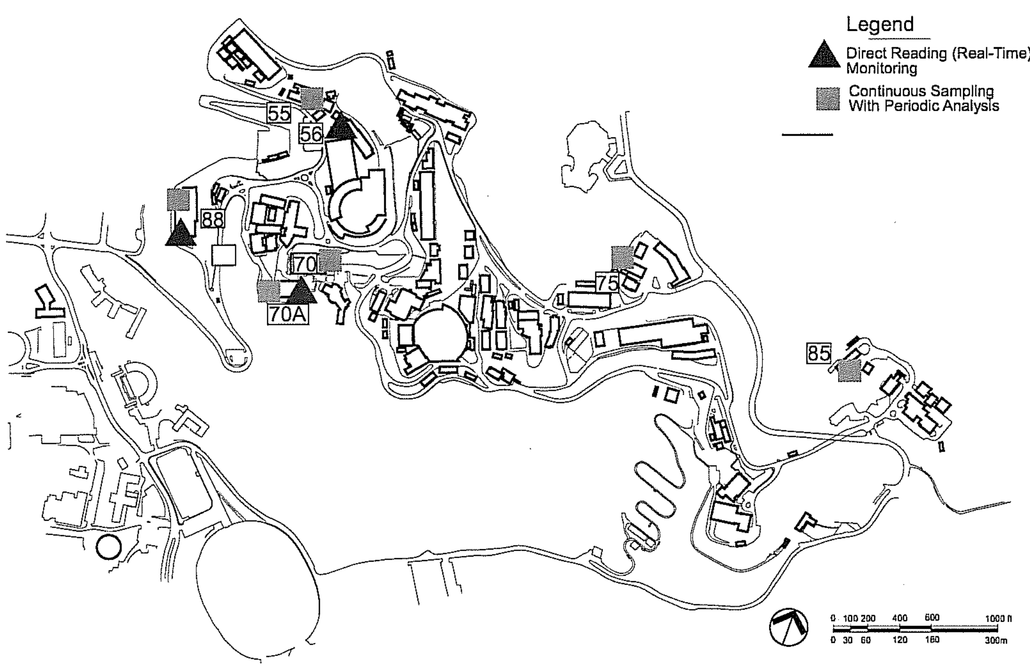

Figure 4-2 Stack Sampling and Monitoring Sites

- **Other stacks:** The sampling probes for the remainder of the sampled stacks were designed to provide near-isokinetic sampling at a point of average flow across the stack cross-section and at the medium flow rate expected from the stack. The effluent flow rate from many of these stacks varies depending on how frequently the hood is used and how high the hood sash is opened. The probes were designed to sample at a fixed rate at the point of the average anticipated flow rate. These stacks are also equipped with HEPA filters upstream of the sampling site, which reduces the average size of particulate species these systems collect and minimizes the impact of any nonisokinetic flow variations. For a summary of sampling and monitoring locations, see Table 4-4.

4.3.2 Sampling/Monitoring Parameters

Berkeley Lab uses a wide variety of radionuclides in its research programs. These radionuclides are described in detail in the Laboratory's annual radionuclide air emission report (Berkeley Lab 2005b). Emissions of radionuclides are accounted for annually by measuring stack emissions of alpha-emitting radionuclides, beta-emitting radionuclides, carbon-14, iodine-125, tritium, and positron-emitting radionuclides, and by inventorying radionuclides used or received for use throughout the year. At some sites, samples are collected continuously and the filter paper is changed monthly. At other sites, samples are collected for one month once every quarter. Table 4-4 provides details of sampling and monitoring frequency and analyses.

Specific radionuclides are sampled or monitored as follows.

- **Alpha- and beta-emitting radionuclides:** Samplers collect particulates on 47-mm (2-in.) diameter filter paper. The filter paper is sent to a certified analytical laboratory for analysis by gas proportional counting. For real-time monitoring of alpha-emitting radionuclides, the filter paper is in close contact with a passivated planar silicon detector. The detector records the alpha activity of the stack air in near real-time and sends the results to a database accessible through the Berkeley Lab web site.
- **Carbon-14:** Each sample is collected by passing air through a sodium hydroxide solution. The solution is sent to a certified analytical laboratory for liquid scintillation analysis.
- **Iodine-125:** This radionuclide is collected by passing air through a canister of charcoal. The charcoal is sent to a certified analytical laboratory for analysis by gamma spectroscopy.
- **Tritium:** Sampling systems collect tritium by passing stack air through a glass column containing color-indicating silica gel. The silica gel is blended and sent to a certified analytical laboratory for tritium analysis by liquid scintillation.
- **Positron-emitting radionuclides:** Positron-emitting radionuclides are measured at accelerators when a continuous stream of stack air is passed into a gas proportional radiation detector. The detector records the activity of the air in near real-time, sending the results by telemetry to a database accessible through the Berkeley Lab web site.

Table 4-4 Stack Sampling and Monitoring Locations

Building #	Radionuclides	Frequency
55	Alpha emitters, beta emitters, ^{125}I	Continuous sampling with monthly analysis
56	Positron emitters	Real-time, continuous monitoring
70	Alpha emitters, beta emitters	Continuous sampling with monthly analysis
70A	• Alpha emitters • Alpha emitters, beta emitters	• Real-time, continuous monitoring • Continuous sampling with monthly analysis
75	Alpha emitters, beta emitters	Continuous sampling for one month each quarter
85	Alpha emitters, beta emitters, tritium, ^{14}C, ^{125}I	Continous sampling for one month each quarter
88	• Positron emitters • Alpha emitters, beta emitters	• Real-time, continuous monitoring • Continuous sampling for one month each quarter

4.3.3 Laboratory Analysis Procedures

All sampled stack emissions are analyzed using procedures conforming to 40 CFR 61, Appendix B, Method 114. Procedures for each measured parameter are summarized below.

- **Alpha- and beta-emitting radionuclides:** Before air particulate filters are analyzed, they are set aside for five days to allow short-lived radon and thoron daughters, which are naturally occurring radionuclides, to decay. Samples of particulate emissions are then screened by gas proportional counting for any significant radioactivity. Based on conservative, predetermined action levels, any significant particulate samples are further quantified by gamma spectroscopy and characterized in accordance with the approved US/EPA Method 114 (EPA 2001b), Table 1. Action levels for alpha-emitting radionuclides are set at 0.0037 Bq/m3 (0.1 pCi/m3), while action levels for beta-emitting radionuclides are set at 0.0074 Bq/m3 (0.2 pCi/m3). By contract, the analytical laboratory must be able to detect 0.074 Bq (2 pCi) per sample or less of alpha-emitting radionuclides and 0.15 Bq (4 pCi) per sample or less of beta-emitting radionuclides.
- **Carbon-14:** Sodium hydroxide solution is analyzed for carbon-14 by mixing the solution with a counting cocktail and measuring the radioactivity by liquid scintillation counting. By contract, the analytical laboratory must be able to detect carbon-14 activity of 1.9 Bq (50 pCi) per sample or less.

- **Iodine-125:** Charcoal canisters are analyzed for iodine-125 by gamma spectroscopy. By contract, the analytical laboratory must be able to detect iodine-125 activity of 0.15 Bq (4 pCi) per sample or less.
- **Tritium:** Silica gel is analyzed for tritium by extracting the water using azeotropic distillation, mixing the water with a counting cocktail, and measuring the radioactivity by liquid scintillation counting. By contract, the analytical laboratory must be able to detect tritium activity of 0.37 Bq (10 pCi) per sample or less.

Laboratory analytical procedures are described in the Technical Services Group Analytical Procedures Manual (Berkeley Lab 2001) or provided by offsite commercial laboratories. Sources for radioanalytical procedures include US/EPA methods, ASTM standard methods, the *EML (Environmental Monitoring Laboratory) Procedures Manual* (HASL-300) (DOE 1997), and the *Radiological and Environmental Sciences Laboratory Procedures Manual* (DOE 1982).

4.3.4 Quality Assurance Requirements

The *Quality Assurance Program Plan for NESHAP Compliance* (Berkeley Lab 2005d) describes the radioanalytical quality control (QC) program for airborne radionuclide emissions, as required by 40 CFR 61, Appendix B, Method 114, paragraph 4.5.

All stack sampling and monitoring activities that affect quality are documented and implemented by ESG procedures. Field and laboratory quality control samples are prepared and analyzed to monitor data quality. Quality control sample results are compared to preset limits to evaluate data acceptance. For additional details on quality assurance procedures, see Section 8, Quality Assurance and Data Review.

4.3.5 Sampling/Monitoring Procedures

The airborne radionuclide emissions program is implemented by established procedures listed in Appendix C. The procedures include stack sample collection, equipment calibration, effluent flow rate measurements, results reporting, and data quality.

Berkeley Lab may employ trained manufacturer personnel or vendors to implement system calibration, maintenance, or repair activities where vendor expertise is deemed critical. Berkeley Lab will assure that all vendor procedures and services conform to 40 CFR 61, Subpart H. The Technical Services Group calibrates and maintains the stack real-time monitoring detector systems per their standard procedures.

4.3.6 Reporting

Two annual reports summarize the stack emission sampling and monitoring data for the calendar year. Both reports are posted on the Environmental Services Group website, which is found at http://www.lbl.gov/ehs/esg.

- TheRadionuclide Air Emission Report (Berkeley Lab 2005b), which documents dose received by the public based on stack sampling and monitoring program data, is submitted to US/EPA and DOE by June 30 each year.
- The Site Environmental Report (Berkeley Lab 2005c) summarizes laboratory environmental compliance issues and presents radiological and non radiological environmental monitoring methods and results (including stack air emission data and dose assessments).

5.0 ENVIRONMENTAL SURVEILLANCE

Environmental surveillance is conducted for the purpose of characterizing impacts of site activities upon the onsite and offsite air, land, and water environs and natural resources. Surveillance is carried out by the sampling and analysis of environmental media, or by direct measurement of environmental conditions. Surveillance can be used to verify effluent measurements, dispersion modeling, and dose assessment results.

Through surveillance activities, the following objectives are achieved:

- Characterization of the environment, including definition of spatial and temporal trends in measured quantities.
- Establishment of baseline values for environmental quality indices so that long-term changes can be detected.
- Assessment of pollution protection programs by evaluation of environmental quality measurements.
- Identification of new or unmonitored effluents or emissions.
- Verification of compliance with applicable environmental laws and regulations.
- Verification of environmental commitments made in official documents.

Each of the surveillance sections is organized to address the following topics:

- Surveillance rationale and design criteria
- Surveillance parameters
- Laboratory analysis procedures
- Quality assurance requirements
- Program implementation procedures
- Preparation and disposition of reports.

5.1 AIR

5.1.1 Surveillance Rationale and Design Criteria

Air surveillance design criteria incorporate the technical guidance from DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991). State and local air quality regulatory agency requirements currently do not have any impact on the design of Berkeley Lab's air quality surveillance program.

5.1.2 Air Surveillance Parameters and Locations

Berkeley Lab uses a wide variety of radionuclides in its research programs. These radionuclides are described in detail in the annual Site Environmental Report (Berkeley Lab 2005c) and the annual radionuclide air emission report (Berkeley Lab 2005b). The inventory of radioactive material received for use at Berkeley Lab establishes an upper range for the radioactive material at risk for airborne release and is used to estimate emissions where direct emissions measurements are not available. Atmospheric releases as vapors or gases are the most common form. Measurable releases of particulate matter are rare because of high-efficiency filtering controls on the largest potential emission sources around the site.

The complex terrain and building layouts at Berkeley Lab add challenges to siting representative ambient air monitoring stations. Specifically, finding a site that both allows placing a sample inlet at a height of two meters above ground and is free from unusual localized effects or other conditions is very difficult. The inlet height is specified by DOE guidance (DOE 1991) and is intended to represent the typical breathing zone height for an individual.

Berkeley Lab has selected the present monitoring locations by considering the distribution and proximity of population around the site, the presence of utility services and security, current and historical sources of stack emissions, the potential for accidental releases from these sources and prevailing local wind patterns across the site. For some of the monitoring locations, these factors mean that the best available site has an inlet height at building rooftop level rather than at two meters above ground level.

Berkeley Lab's ambient air particulate sampling network has consisted of four stations since 1995. Three of these locations are found onsite. Adjustments to these locations took place at the end of 2005 in an effort ot satisfy the above criteria and account for operational changes at the Laboratory. The sole offsite station serves as a background site. Figure 5-1 shows these locations.

In April of 2005, Berkeley Lab discontinued monitoring for tritium at its network of five remaining ambient air monitoring stations. Prior to this shutdown, Berkeley Lab received DOE approval based on recent trends in ambient air results and the lack of potentially-significant tritium sources across the site. Since the former National Tritium Labeling Facility and the Laboratory's historically predominant source of airborne tritium ceased research activities at the end of 2002, detectable tritium throughout the entire network was seldom observed. Only two out of 212 samples collected during this period indicated any detectable tritium. And even then the levels were only slightly over detection limits.

The particulate samplers use a 4.7-centimeter (1.9-inch) diameter glass fiber filter paper to collect atmospheric matter for radioanalysis. Samplers draw air through the filter paper at a rate of 50 liters per minute (1.9 cubic feet per minute) that is maintained by a mass flow controller. Samplers were upgraded at the beginning of 2006. Previous samplers operated under the same principle, using a 10-centimeter (4-inch) diameter fiberglass-polyester filter paper and drawing air through the filter paper at a rate of 60 liters per minute (2.1 cubic feet per minute).

Samplers operate continuously and filter media are changed monthly. Media are analyzed by one of the Laboratory's contract analytical laboratories.

5.1.3 Laboratory Analysis Procedures

Air particulate filter samples are analyzed for gross alpha and gross beta radiation. Before filters are counted for this type of activity, they are set aside for five days to allow short-lived radon and thoron daughters (naturally occurring radionuclides) to decay.

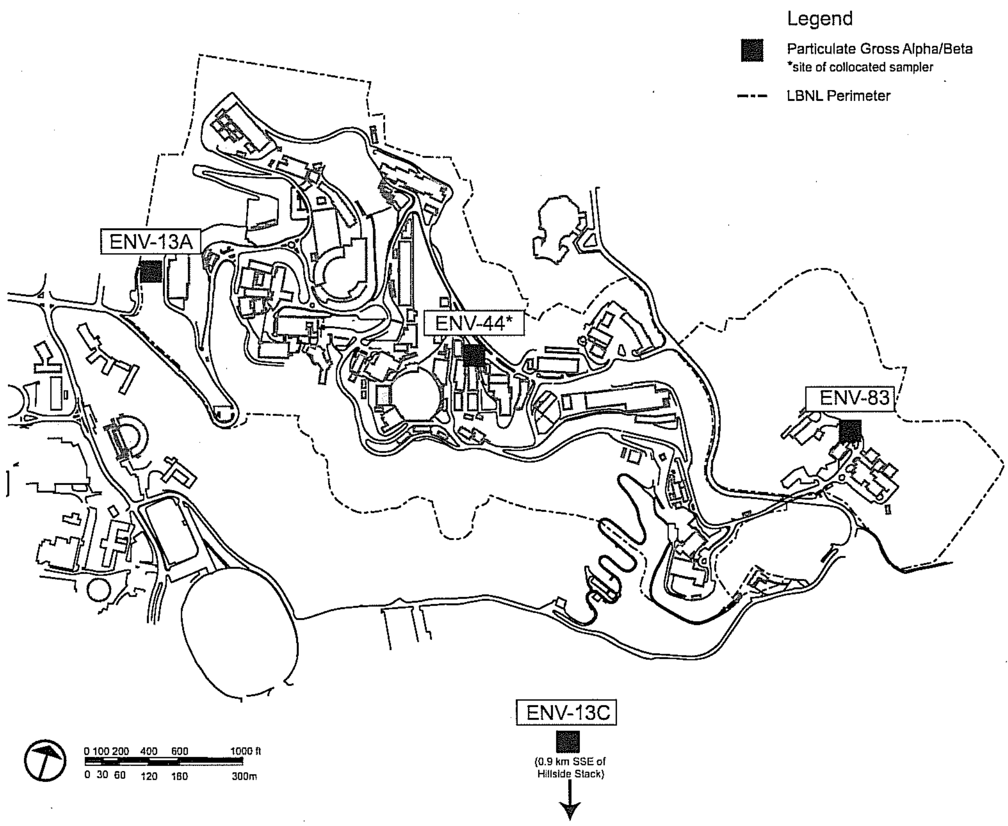

Figure 5-1. Map of Airborne Particulate (Gross Alpha and Gross Beta) Sampling Stations

If the gross alpha or gross beta result is above the most restrictive Derived Concentration Guide (as defined in DOE Order 5400.5) of the radionuclides used at Berkeley Lab, radiochemical analyses such as gamma spectroscopy to determine the specific radionuclide contributing to the activity may be performed. For its NESHAP reporting, Berkeley Lab has identified the most restrictive radionuclides authorized for use in research as Thorium-232 for gross alpha and Strontium-90 for gross beta. The Derived Concentration Guides for each are equivalent to approximately 0.00026 Bq/m^3 (0.007 pCi/m^3) and 1.3 Bq/m^3 (9.0 pCi/m^3), respectively. Reportable detection limits for the standards analytical methods are equivalent to approximately 0.00015 Bq/m^3 (0.004 pCi/m^3) for gross alpha and 0.0003 Bq/m^3 (0.008 pCi/m^3) for gross beta.

5.1.4 Quality Assurance Requirements

All air surveillance activities that affect quality are documented and implemented by ESG procedures (see Appendix C). Field and laboratory quality control samples are prepared and analyzed to monitor data quality. A minimum of 10% of each month's collected samples are reanalyzed as duplicate samples. ENV-44 currently serves as the site for this duplicate, also called collocated, sample. Travel and lot blank filters are included with each collection. The lot blank is intended to allow the analytical laboratory to subtract any pre-existing contamination from individual sample results. Quality control sample results are compared to preset limits to determine data acceptance. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

5.1.5 Surveillance Procedures

The air surveillance program is conducted in accordance with the established ESG procedures listed in Appendix C. The procedures include ambient air sampling, analysis and reporting, control and calibration of test equipment and data quality.

5.1.6 Reporting

Results from the air surveillance program are reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c). In addition, results relevant to the NESHAP compliance standards are reported in the Radionuclide Air Emission Annual Report (Berkeley Lab 2005b). Both of these documents are available on the ESG web site.

5.2 Water

5.2.1 Surveillance Rationale and Design Criteria

At Berkeley Lab, no intentional discharges other than storm water and certain other minor discharges, which are listed in the Storm Water Pollution Prevention Plan (Berkeley Lab 2002b), are made to the storm drain system. However, accidental releases or releases from onsite sewer and drain line breaks, and releases from locations above the site may enter the storm drain or sanitary sewer systems. To assess these potential discharges, Berkeley Lab performs monitoring of both these systems (see sections 4.1 and 4.2). A stand-alone Storm Water Monitoring Program (Berkeley Lab 2005e) was developed to satisfy state and local requirements and is included as Appendix A of this document.

Even though Berkeley Lab has no direct discharges to any freshwater bodies, other than surface water runoff to Strawberry Creek, nearby bodies of water such as lakes and reservoirs may receive pollutants through direct exchange, dry deposition, and rain out of contaminants released to the air. Potential human exposure pathways from these bodies of water include consumption of fish, consumption of foodstuff irrigated with the water, and external exposure and accidental ingestion from recreational activities.

The western portions of the Berkeley Lab site are drained by the North Fork of Strawberry Creek, while the eastern portions of the site are drained by Strawberry Creek. These perennial streams are fed by springs at their headwaters, and also receive storm water runoff from the site through man-made storm sewers or through ephemeral tributaries. Neither Strawberry Creek, nor any of its tributaries, is known to be used as a source of public drinking or irrigation water. The streams converge at the west end of the UC Berkeley campus, where they are diverted underground, and eventually discharge into the San Francisco Bay. Other creeks exist in the vicinity of Berkeley Lab, but do not drain portions of the site.

San Francisco Bay lies 5 km west of the Berkeley Lab site. The bay is the ultimate receptor for all POTW, sub-surface, and surface runoff discharges from Berkeley Lab, as it is from all surrounding San Francisco Bay Area communities and businesses.

Groundwater in the vicinity of the Berkeley Lab site is also not known to be used for drinking purposes. Hydraugers have been installed at several areas of the site to drain groundwater from slopes and improve slope stability. Surveillance of groundwater is performed by periodically analyzing groundwater sampled from monitoring wells and hydrauger discharges. Groundwater that reaches the surface flows into the storm sewer system. From the storm sewer, it eventually enters Strawberry Creek, and eventually, San Francisco Bay, as described earlier.

Studies of contamination of the groundwater in some areas from past releases at Berkeley Lab are being conducted. These studies indicate that some historical activities have released chlorinated hydrocarbons, fuel hydrocarbons, and tritium to the groundwater in certain areas on the site (see Figure 5-2). Groundwater in the vicinity of Buildings 51, 51L, and 64, known to be contaminated with chlorinated solvents, is first treated with activated carbon before discharge to the sanitary sewer under a separate Wastewater Discharge Permit granted to Berkeley Lab (see Section 4.1.2.4).

Radioactive materials discharged to the air have the potential for contributing contaminants to storm water runoff and surface bodies of water through dry deposition or rain out. Berkeley Lab monitors the following radionuclides: gross alpha radiation, gross beta radiation, and tritium. Airborne emissions do not have the same deposition affect on effluent to the sanitary sewer system, which was discussed earlier in Section 4.1.2.1.

5.2.2 Water Surveillance Parameters

In August of 2003, monitoring of two off-site creeks (Claremont and Wildcat) was eliminated due to the closure of the National Tritium Labeling Facility. Water samples are now obtained quarterly from three creek sampling points indicated in Figure 5-3 (i.e., Strawberry Creek, North Fork of Strawberry Creek, and Chicken Creek).

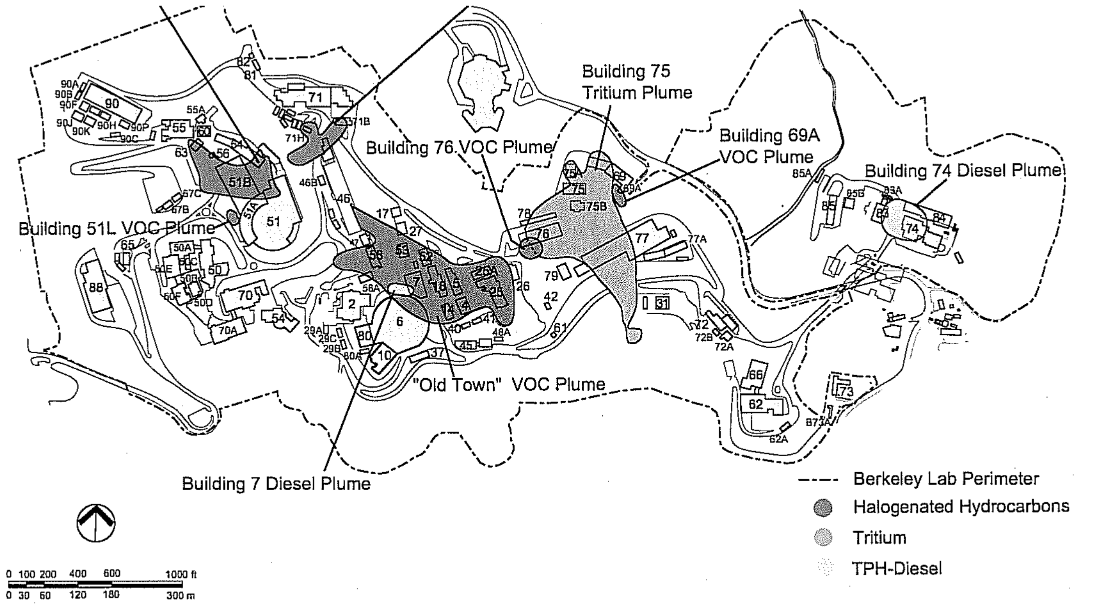

Figure 5-2 Principal Groundwater Contamination Plumes

Water samples (creek and rain) are analyzed for tritium, and gross alpha and gross beta activity. Samples with higher than normal alpha or beta radioactivity are subsequently analyzed for gamma-emitting isotopes. Creek samples are also analyzed for mercury, consistent with process knowledge of historical operations.

In August of 2002, rainwater sampling was for tritium also eliminated at two off-site stations, south of the Laboratory on Panoramic Hill and northwest of the Lawrence Hall of Science, again in response to the closure of the National Tritium Labeling Facility. One rain collection station is now monitored at Berkeley Lab. It is in the area of Building 75, which historically was the source of the largest release of airborne tritium on the site. This is also shown on Figure 5-3. Samples are collected by funneling rainwater, as it falls, into a carboy. Samples are collected and analyzed monthly during the wet season (generally October to April).

5.2.3 Laboratory Analysis Procedures

Radiological procedures are based on DOE guidance and US/EPA methods. Gross alpha measurements by proportional counter are used as a screening mechanism. If the gross alpha measurement indicates alpha activity above the state MCL for drinking water of 15 pCi/L, then the analytical laboratory performs gamma spectroscopy to determine the specific radionuclides contributing to the alpha activity.

Gross beta measurements are used as a screening mechanism for beta emitters. If the gross beta measurement indicates beta activity above the state MCL for drinking water of 50 pCi/L,

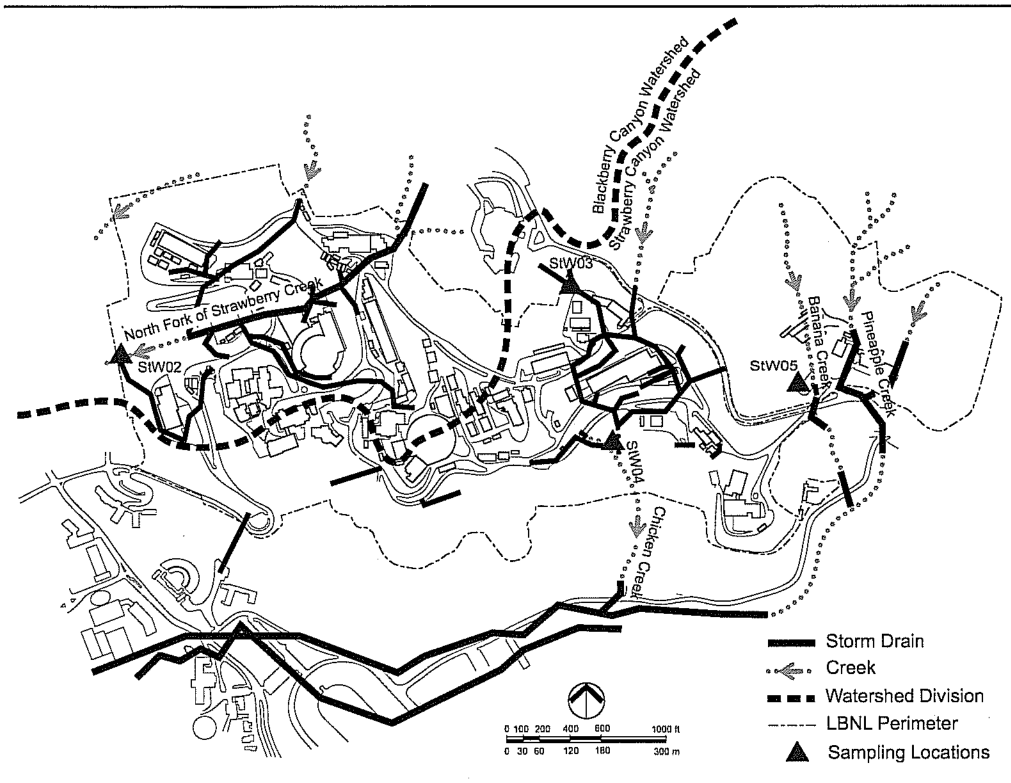

Figure 5-3 Creek and Rainwater Sampling Locations

a gamma spectroscopy analysis is also performed to determine the specific radionuclides contributing to the beta activity.

Tritium analysis of water samples is accomplished by a liquid scintillation counting technique (US/EPA Method 906). The collected water is distilled, mixed with a counting cocktail, and placed in a counter. According to the analytical contract, the minimum detectable activity for tritium that the commercial radiological laboratory must achieve is 7 Bq/L (200 pCi/L).

Water samples are prepared for gross alpha and beta analysis by acidification (HNO_3) and evaporation into 5-centimeter (2-inch) diameter stainless steel planchettes. Organic residues not wet-ashed by the nitric acid treatment are oxidized by flaming the planchettes. The minimum detectable activity for gross alpha analysis is approximately 0.2 Bq/L (5 pCi/L), depending on the amount of dissolved solids in the sample. The MDA for gross beta analysis is approximately 0.13 Bq/L (3.5 pCi/L) for rainwater and 0.14 Bq/L (3.8 pCi/L) for creek water.

All the analyses described above are performed by a California-state certified commercial laboratory.

5.2.4 Quality Assurance Requirements

All water surveillance activities that affect quality are documented and implemented by ESG procedures (see Appendix C). Field and laboratory quality control samples are prepared and analyzed in order to monitor data quality. Quality control sample results are compared to preset limits in order to perform data acceptance. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

5.2.5 Surveillance Procedures

The water surveillance program is conducted in accordance with the established ESG procedures listed in Appendix C. The procedures include sampling of storm and surface water, wastewater, and rainwater.

5.2.6 Reporting

Results from the water surveillance program are reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c). This report is available on the ESG web site (http://www.lbl.gov/ehs/esg). Storm water results are also submitted to the RWQCB and City of Berkeley in an annual report as mandated in the storm water permit.

5.3 SOIL AND SEDIMENT

5.3.1 Surveillance Rationale and Design Criteria

Soil provides an integrating medium that can account for contaminants released to the atmosphere or liquid effluents. Soil sampling can be used to evaluate long-term accumulation trends and to estimate environmental radionuclide inventories. Sediment can provide an indication of the accumulation of contaminants in the aquatic environment. For such contaminants, sediment sampling can be a more sensitive indicator than water sampling. Storm water runoff through creeks and storm drains at and around the Lab ultimately discharges to San Francisco Bay. Accordingly, sediment is sampled from significant creeks at locations downstream from the Laboratory.

5.3.2 Surveillance Parameters

Soil and sediment samples are collected and analyzed annually. When possible, soil sampling locations and analyses are selected to coincide with ambient air sampling locations and analyses, respectively. There are four soil sampling locations (see Figure 5-4); three on-site locations and one off-site.

Sediment sampling locations and analyses are selected to coincide with surface water sampling sites and analyses, respectively. There are four sediment sampling locations (see Figure 5-4); two at the north fork of Strawberry Creek and two at Chicken Creek.

5.3.3 Laboratory Analysis Procedures

Soil and sediment sample analyses procedures are summarized in Table 5-1. All analyses are performed at offsite certified commercial laboratories.

5.3.4 Quality Assurance Requirements

All soil/sediment surveillance activities that affect quality are documented and implemented by ESG procedures (see Appendix C). Field and laboratory quality control samples are prepared and analyzed in order to monitor data quality. Quality control sample results are compared to preset limits in order to perform data acceptance. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

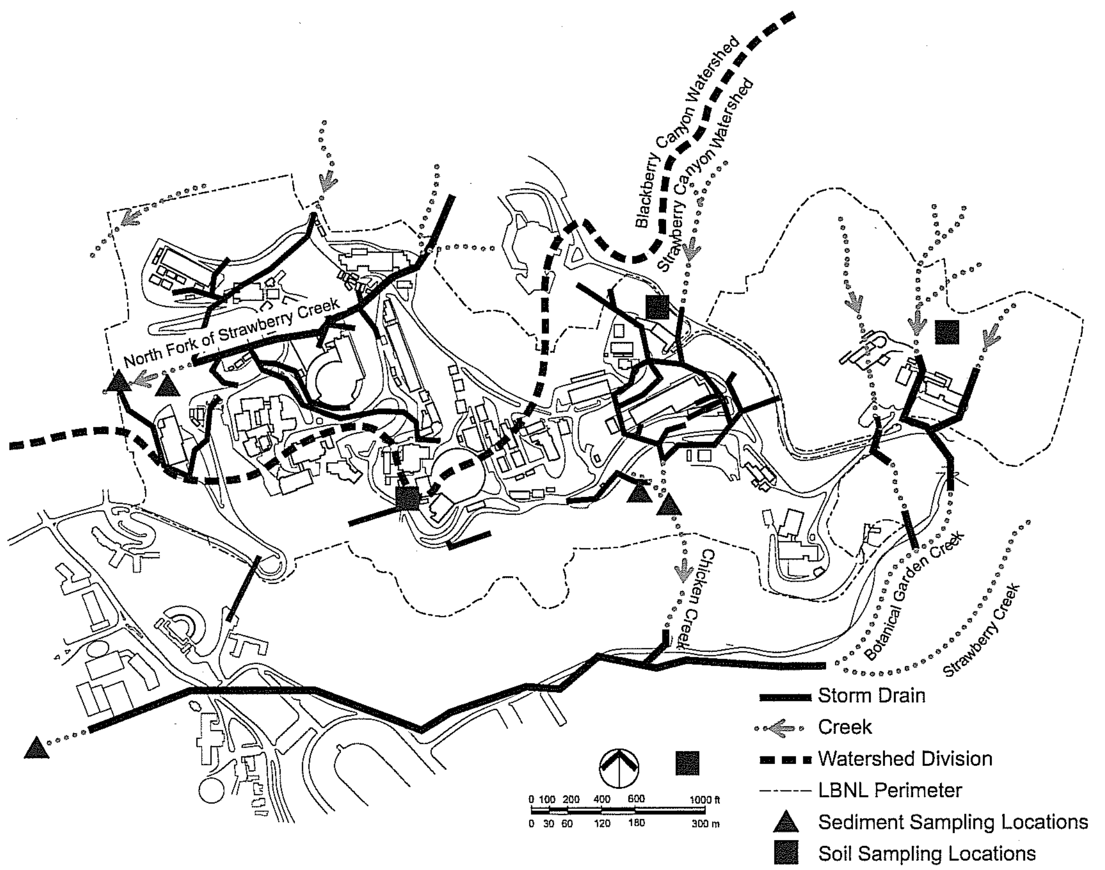

Figure 5-4 Soil and Sediment Sampling Sites

5.3.5 Surveillance Procedures

The soil/sediment surveillance program is conducted in accordance with the established ESG procedures listed in Appendix C.

Table 5-1 Soil and Sediment Analysis Procedures

Analysis	Soil Analysis Method	Sediment Analysis Method
Diesel	Not Done	EPA 8015 modified
Gross Alpha and Gross Beta	Direct count with gas proportional detector	Direct count with gas proportional detector
Gamma Emitters	Direct count with high-resolution germanium detector	Direct count with high-resolution germanium detector
Metals	EPA 6010 EPA 7471	EPA 6010 EPA 7471
Oil and Grease	Not Done	EPA 413.1
PCBs	Not Done	EPA 8082
pH	EPA 9045	EPA 9045
Tritiated Water	Azeotropic distillation/liquid scintillation counting	Azeotropic distillation/liquid scintillation counting

5.3.6 Reporting

Results from the soil and sediment surveillance program are reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c).

5.4 VEGETATION AND FOOD STUFFS

There are no state or local regulations requiring the sampling of foodstuff or vegetation for pollutants. Berkeley Lab performs periodic sampling and analysis of indicator materials, such as vegetation, to determine if there is a long-term buildup of radionuclides in the terrestrial environment. This approach is consistent with DOE guidance (DOE 1991).

5.4.1 Surveillance Rationale and Design Criteria

Ingestion of radionuclides could occur via the following pathways:

liquid effluent → aquatic species → human
airborne effluent → vegetable crop → human
airborne effluent → forage crop meat → meat/milk animal → human
airborne effluent → surface water → aquatic species → human
airborne effluent → surface or ground water → vegetable crop → human

Historically, tritium accounted for most of Berkeley Lab's airborne radionuclide emissions. Tritium was released from Berkeley Lab primarily in the form of tritiated water vapor. As such it is susceptible to washout by rain or fog, and to vapor exchange with leaf surfaces and bodies of water. Tritiated water vapor behaves chemically and biologically in a manner very similar to normal water, and follows the same pathways in the food chain, becoming easily incorporated into plant and animal tissues.

In the vicinity of Berkeley Lab, there are no farms where vegetables or fruit are grown, and the nearest area where cattle are grazed is Wildcat Canyon Regional Park, 3.2 km (2 miles) northwest of the Laboratory's boundary. Vegetation in the area consists of primarily trees and grasses. As part of an ongoing vegetation management program at Berkeley Lab, eucalyptus and pine trees are strategically removed to establish more native trees that produc healthier stands and reduce the fire danger.

5.4.2 Surveillance Parameters

Routine vegetation samples are collected and analyzed for tritium. Sampling locations are chosen to best represent air emissions from the former National Tritium Labeling Facility, which operated for nearly 30 years until its closure in 2002. Routine vegetation monitoring is conducted at least every five years.

Nonroutine vegetation samples are collected in cooperation with the ongoing vegetation management program at Berkeley Lab (see Section 2.3.2). Before on-site trees are removed, trees in the area are sampled and analyzed for free-water and organically bound tritium. The results of these analyses are used to better understand the distribution of tritium at Berkeley Lab and to make decisions about the disposal of vegetation containing tritium, affected by past activities at the Laboratory.

5.4.3 Laboratory Analysis Procedures

Vegetation samples are typically analyzed for free-water and organically bound tritium only. These samples are shipped offsite to a certified commercial laboratory.

Free-water tritium is analyzed in vegetation samples by liquid scintillation counting. Water is extracted from samples using an azeotropic distillation method and mixed with a counting cocktail, and tritium radioactivity is measured with a liquid scintillation counter. By contract, the analytical laboratory must be able to detect free-water tritium concentrations of 0.0185 Bq/g (0.5 pCi/gram of plant material) or less.

Organically bound tritium in samples is analyzed by combustion followed by liquid scintillation counting. The vegetation samples are thoroughly mixed, dried, and combusted. The water from the oxidation process is collected, mixed with a counting cocktail, and measured with a liquid scintillation counter. By contract, the analytical laboratory must detect free-water tritium concentrations of 0.185 Bq/g (5 pCi/gram of plant material) or less.

5.4.4 Quality Assurance Requirements

All vegetation surveillance activities that affect quality are documented and implemented by ESG procedures (see Appendix C). Field and laboratory quality control samples are prepared and analyzed in order to monitor data quality. Quality control results are compared to preset limits as part of data acceptance. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

5.4.5 Surveillance Procedures

The vegetation surveillance program is conducted in accordance with the established ESG procedures listed in Appendix C.

5.4.6 Reporting

Results from the vegetation surveillance program are reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c).

5.5 DIRECT RADIATION MEASUREMENTS

5.5.1 Surveillance Rationale and Design Criteria

DOE Order 5400.5 requires that facilities perform environmental radiological monitoring to assess the potential radiation dose to members of the public, which could result from site operations.

Exposures to members of the public from such routine DOE-related activities are limited to an effective dose equivalent of 100 mrem (1 mSv) in a year (DOE 1990). The comparable dose equivalent to this limit is the sum of the effective dose equivalent from exposures to radiation sources external to the body plus the committed effective dose equivalent from radionuclides taken into the body during the year.

DOE also requires that doses to members of the public in the vicinity of site activities be evaluated and documented to demonstrate compliance with dose limits and to assess exposures to the public from unplanned events. The order also requires that DOE facilities implement a program to maintain the maximum dose to members of the public and the collective dose to the population *As Low As Reasonably Achievable* or as far below the limits as practicable. Thus, although the specific public dose equivalent limit of DOE 5400.5 is 100 mrem (1 mSv), the ALARA program requires that public exposures be maintained as far below the limit as practicable.

In addition, the California Code of Regulations, Title 17 (State of California 2005a), limits the radiation levels in uncontrolled areas to less than those which could cause any individual to receive a dose equivalent to the whole body in excess of 2 mrem (0.02 mSv) in any one hour, or 100 mrem (1 mSv) in any 7 consecutive days, or 0.5 rem (0.005 Sv) in any one year.

Berkeley Lab measures direct radiation (neutron and gamma emissions) from its accelerators and gamma emissions from stored radioactive materials. These measurements are taken with real-time neutron and gamma detectors, in conjunction with thermoluminescent dosimeter (TLD) stations that are used for gamma measurements only.

The potential sources of external exposure to members of the public by direct radiation from Berkeley Lab activities include the operating accelerator facilities of the 88" Cyclotron, the Advanced Light Source, and the Biomedical Isotope Facility accelerator, plus facilities in which radioactive materials are stored in sufficient quantity and type to present a potential external exposure hazard. These latter facilities include an irradiator in Building 74 and radiological waste storage area in Building 85.

5.5.2 Direct Radiation Measurement Parameters

Berkeley Lab's site-wide environmental TLD monitoring program includes 8 sites. Seven TLDs are located near the site boundary and one is located 1 km from the Lab perimeter. TLDs measure only gamma radiation; they are not sufficiently sensitive to detect environmental levels of neutron radiation. Additionally, because they cannot exclude background gamma radiation from their results, they provide time-averaged dose results that must be determined by a laboratory analytical method rather than by real-time instrumentation. Figure 5-5 shows the locations of TLD sites near the main facility.

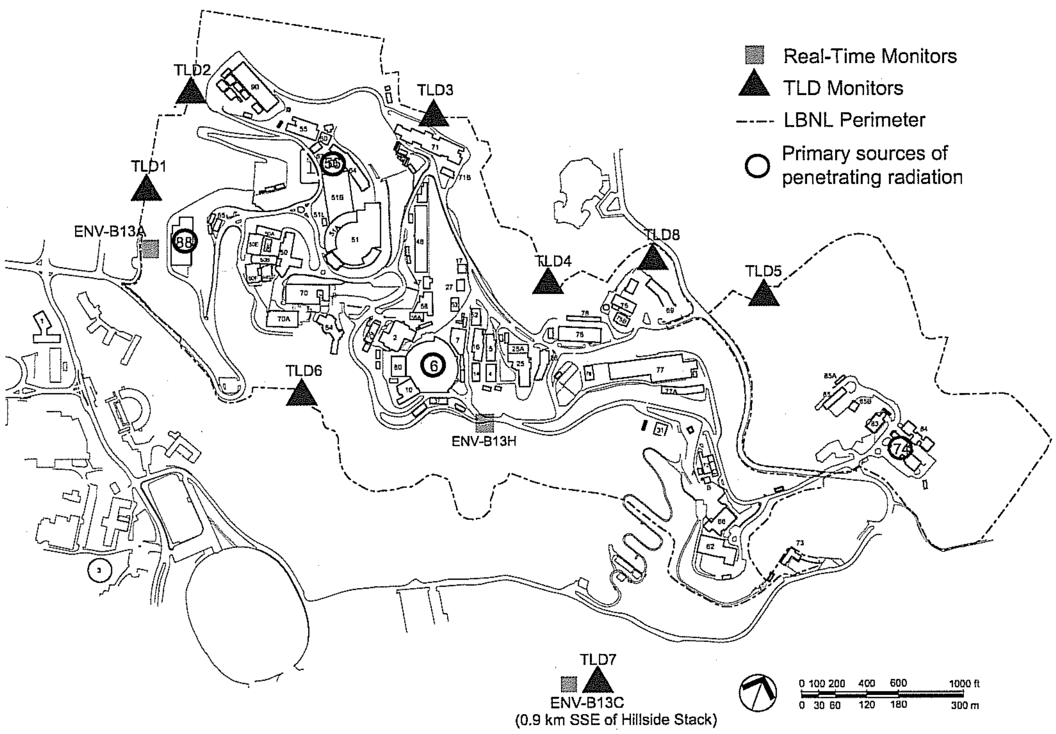

Figure 5-5 Environmental Penetrating Radiation Monitoring Stations

The TLD network's objective is to confirm the estimated exposures from external penetrating radiation based on the real-time monitoring data (discussed below), and to ensure that public radiation exposure is kept well below allowable regulatory limits.

Berkeley Lab uses aluminum oxide with carbon (Al_2O_3:C) as the primary TLD material. Aluminum oxide with carbon has a sensitivity in the 0.01 mrem (0.001 mSv) range. Other materials considered have sensitivities in the range of 0.1 to 1 mrem (.001 to .01 mSv), with error ranges of ±25%.

Other important considerations that affected the selection of sensor used in the Berkeley Lab TLD program include:

- type and energy of radiation to be measured
- expected environmental levels and corresponding background levels
- exposure period

TLDs are placed in the field for a period of three months, at which time they are removed and processed by a vendor to determine the integrated dose. Calibrations are also performed by the processing vendor. Four quarterly samples are collected for each station each year.

In addition to the TLD program, Berkeley Lab maintains three real-time gamma and neutron monitoring stations:

- South of the Advanced Light Source housed in Building 6 (ENV-B13H).
- Offsite on Panoramic Way approximately 2 kilometers south of Berkeley Lab, which is used as a background station (ENV-B13C).
- Near the site boundary, between Building 88 and the nearest residence (ENV-B13A).

The real-time monitoring stations continuously detect and record direct gamma and neutron radiation. Each station contains sensitive pulse counters for each radiation type. The neutron detector is a modified Anderson Braun-type consisting of an LND model 252139 detector (helium-3) with dimensions of 2.5 cm x 8,8 cm and an effective volume of 24 cm3. This gas-proportional counter is housed in a 20 cm x 25 cm thick polyethylene and boron plastic moderator. The neutron energy range is from 60 to 3,000 MeV. The gamma detector is an energy-compensated Geiger-Muller chamber (LND model 7807) with dimensions of 27.0 cm x 2.6 cm. Detector specifications are listed in Table 5-2.

Table 5-2 Real-Time Monitor Specifications

Detector Characteristic	Gamma	Neutron
Energy Response	80 – 1,600 keV	up to >100 MeV
Sensitivity (nominal counts/ mrem)	650,000 counts/mrem	30,000 counts/mrem (insensitive to 500 rem/ hr gamma)
Fill Gas	Neon & Halogen	Helium-3
Dose Range	0.001 - 100 mrem/hr	0.001 – 2000 mrem/hr

The calibrated output pulses from these detectors are transferred electronically via a link between the data source and a local computer attached to the Berkeley Lab computer network. Data is transmitted over the network to a Unix server that hosts an Oracle database. There the data are integrated and analyzed. This computer is dedicated to hosting multiple Berkeley Lab database applications and is maintained by the Berkeley Lab Information Systems and Services Department.

Calibrations of the detectors are performed annually using NIST-traceable standards. Detectors are rotated out of service during the bench-top calibration. Each detector is given a unique calibration factor to convert its output from counts to millirem.

5.5.3 Laboratory Analysis Procedures

The exposed TLDs are analyzed by the organization that provides the TLDs (either an onsite group or an off-site vendor). Reduction of dose data from the real-time monitoring systems is performed by the Environmental Services Group.

5.5.4 Quality Assurance Requirements

All direct radiation measurement activities that affect quality are documented and implemented by TSG and ESG procedures (see Appendix C). For addition details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

5.5.5 Surveillance Procedures

The direct radiation measurement program is conducted in accordance with the established ESG and TSG procedures. ESG procedures are listed in Appendix C. TSG procedures are included in the TSG Analytical Procedures Manual (Berkeley Lab 2001). The procedures include penetrating radiation monitoring, analysis, reporting, and data quality.

5.5.6 Reporting

Results from the direct radiation measurement program are reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c). A link to this report is found at the Environmental Services Group's web site; http://www.lbl.gov/ehs/esg.

5.6 Dose to animals and plants

The Department of Energy requires that aquatic organisms be protected by limiting their radiation doses to 0.01 gray/day (1 rad/day). In addition, international recommendations suggest that doses to terrestrial animals should be limited to less than 0.001 gray/day (0.1 rad/day) and doses to terrestrial plants should not exceed 0.01 gray/day (1 rad/day).

To assist sites in demonstrating compliance with these limits, DOE approved a technical standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota, (DOE 2002) in July 2002. Berkeley Lab applies the standard to evaluate aquatic and terrestrial plants and animals across the Laboratory's site.

As required by the DOE technical standard, Berkeley Lab summarizes the results of the biota dose assessment annually in its Site Environmental Report (Berkeley Lab 2005c), which is distributed to all interested federal, state, and local regulatory agencies, as well as being available to the public. Berkeley Lab documents details of the assessment in an annual report retained on file.

6.0 METEOROLOGICAL MONITORING

6.1 SURVEILLANCE RATIONALE AND DESIGN CRITERIA

Onsite meteorological data help assess the environmental impact of Berkeley Lab's airborne emissions for regulatory compliance requirements, such as the radiological NESHAP regulations. Other applications for the meteorological data include risk assessments, obtaining environmental operating permits from regulatory agencies, or use in responding to emergency situations such as spills, gas releases, or fires. On site researchers periodically request data to include in their research projects.

6.2 METEOROLOGICAL MONITORING PARAMETERS

The meteorological monitoring network consists of a 20-meter tower located onsite near Building 44 (see Figure 6-1). The tower serves as the source of representative onsite meteorological data because of its central location and relatively unobstructed surroundings. The tower is instrumented at the 20-meter level with wind speed, wind direction, and solar radiation sensors. It is instrumented at the 2-meter level for temperature, dew point, precipitation, and barometric pressure.

From 1994 until 2002, the Laboratory's network also included three wind profiling systems. These systems, called miniSODARs, collected wind speed, wind direction, and turbulence data at many levels above the sampler. The systems were located at rooftop on the Building 50 complex, Building 25, and Building 62. Operation of this portion of the network ceased because the Laboratory had collected a sufficient period of data to adequately characterize the meteorological air flow patterns at the site, the componentry of each unit (i.e., electronics and enclosures) was reaching the end of its expected lifetime, and the 20-meter tower was proving sufficient for the ongoing meteorological needs of the Laboratory.

6.3 QUALITY ASSURANCE REQUIREMENTS

Sensors are audited twice each year by a qualified external party. This frequency and the acceptance criteria for each sensor adhere to BAAQMD recommended guidance for air quality applications (BAAQMD 1996).

6.4 SURVEILLANCE PROCEDURES

The meteorological monitoring program follows an established procedure that is largely based on the BAAQMD guidance. BAAQMD guidance addresses the major topical areas of a program, such as the various parameters that should be collected for air quality applications, their collection interval (e.g., 15-minute or 60-minute data periods), as well as auditing and calibration criteria. ESG procedures are listed in Appendix C.

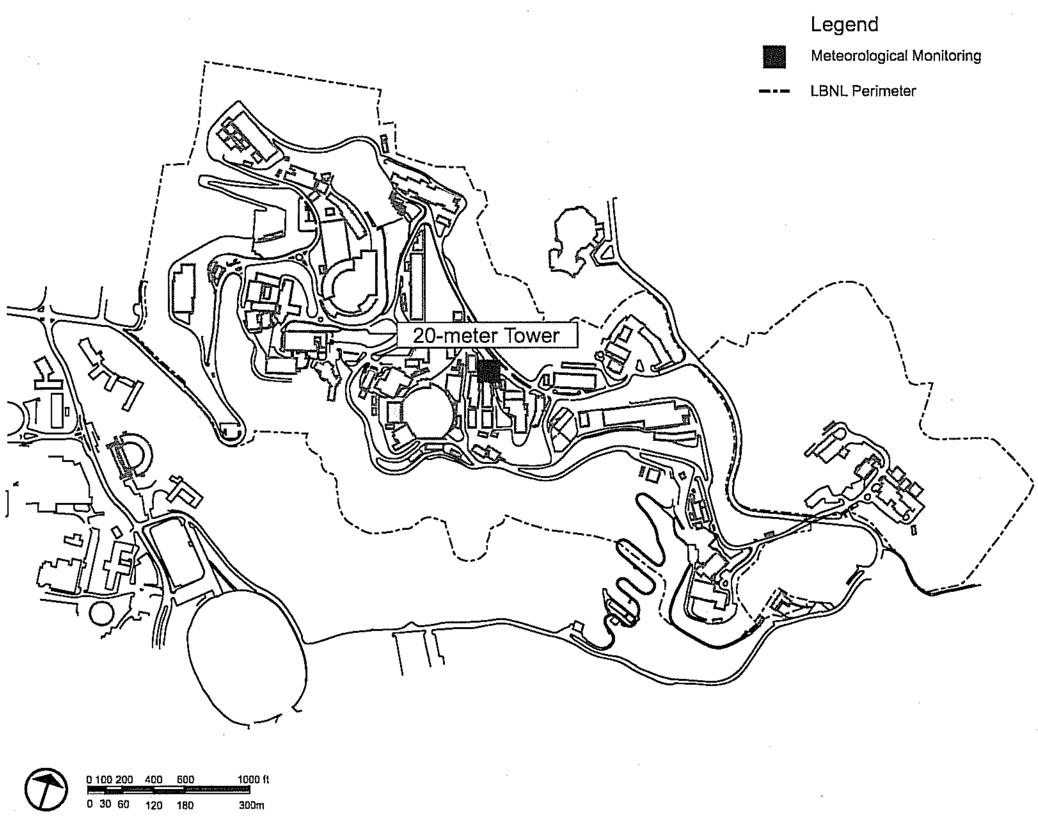

Figure 6-1 Meteorological Monitoring Network

6.5 REPORTING

Meteorological data from the sensors on the tower are collected continuously and stored into 15 minute and hourly average data sets. The data are retrieved and stored in redundant computer data acquisition systems. The data are available at the Environmental Services Group's web site, which is found at http://www.lbl.gov/ehs/esg. Summary data are also reported annually in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c), which is found at this same web address.

7.0 PRE-OPERATIONAL MONITORING

7.1 PURPOSE

Pre-operational studies serve to characterize existing physical, chemical, and biological conditions, monitor background levels of radioactive materials and chemicals in the environment, characterize environmental parameters, and examine potential pathways for environmental contamination and public exposure prior to operation of new Berkeley Lab facilities that have the potential for significant environmental impact. An example of such a facility is the Laboratory's Hazardous Waste Handling Facility.

The determination of significant adverse environmental impact and the need for a pre-operational study will be assessed prior to the start-up of new facilities or activities in coordination with *National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA)* compliance activities. The results of preoperational studies are also used to ensure that radiation exposures to the public and the environment are kept *As Low As Reasonably Achievable.*

For those facilities or activities requiring an environmental assessment, pre-operational studies may be performed if projected facility operations will require a significant change in the environmental surveillance program.

Information on the existing environment in the NEPA/CEQA evaluation may substitute for a pre-operational study if DOE 5400.5 requirements are appropriately addressed, are otherwise inapplicable (e.g., a non radiological facility), or if facility operations would not require any change in the environmental surveillance program.

7.2 SCHEDULING

Wherever possible, the pre-operational study or NEPA/CEQA evaluation will be completed prior to start-up, assessing the existing environment, potential effects on the environment, and changes to the existing monitoring program to accommodate the new activity or facility. In order to observe seasonal variations, the study should begin at least one year prior to the anticipated date of operation, with measurements concluding at the beginning of operations.

Schedules and plans for pre-operational monitoring will be based on their potential effect on the environment, as defined in their NEPA/CEQA and safety analysis documentation.

7.3 ENVIRONMENTAL AND ECOLOGICAL PARAMETERS

The description of the existing environment will be limited to information that directly relates to the scope of the proposed action and is necessary to assess or understand the impacts. Where appropriate, information may be incorporated by reference to more detailed descriptions of the affected environment.

Radiological and chemical components of interest are determined by characterizing the potential pollutant sources from new facilities and activities based on design plans, NEPA/CEQA reviews, and safety analyses. After determining significant radiological and chemical background components, the background levels are evaluated by studying current environmental monitoring program data, supplemented by a pre-operational sampling plan. Existing monitoring activities are coordinated with the supplemental pre-operational sampling activities.

The NEPA/CEQA evaluation will describe sensitive resources that may be affected by the new facility or activity (such as threatened and endangered species, and property of historic, archeological, or architectural significance). If such resources are present, the NEPA/CEQA compliance process shall satisfy requirements for pre-operational study.

7.4 PATHWAYS FOR HUMAN EXPOSURE OR ENVIRONMENTAL IMPACT

The nature and extent of potential environmental impact or human exposure will be assessed by determining potential pathways for pollutants.

The pathway analysis will estimate source terms, concentrations in relevant pathway compartments, and effects of concentrations on the public and environment. Sampling strategies are developed for those critical pathways where environmental effects or public dose are most significant. Existing data from other environmental assessments and safety analysis reports may be cited to estimate source terms and effects.

7.5 PRE-OPERATIONAL MONITORING QUALITY ASSURANCE

All pre-operational monitoring activities that affect quality are documented and implemented by ESG procedures (see Appendix C). Field and laboratory quality control samples are prepared and analyzed in order to monitor data quality. Quality control sample results are compared to preset limits in order to perform data acceptance. For additional details pertaining to quality assurance procedures, see Section 8, Quality Assurance and Data Review.

7.6 IMPLEMENTATION PROCEDURES

Pre-operational monitoring is conducted in accordance with the established ESG procedures listed in Appendix C. The procedures include evaluating air emission sources, data quality, ambient air sampling, soil/sediment sampling, surface water sampling, and vegetation sampling.

7.7 REPORTING

Results from any pre-operational monitoring studies are reported in the Berkeley Lab Site Environmental Report (Berkeley Lab 2005c).

8.0 QUALITY ASSURANCE AND DATA REVIEW

8.1 BACKGROUND

Quality assurance (QA) activities and processes ensure that environmental monitoring data meet user requirements. Quality control (QC) procedures verify that Berkeley Lab attains prescribed standards of performance for environmental monitoring. This chapter contains a summary discussion of QA and QC activities performed routinely by the environmental monitoring program.

Berkeley Lab's policy on QA is documented in the *Operating and Assurance Plan* (OAP) (Berkeley Lab 2000). The OAP consists of a set of operating principles used to support internal organizations in achieving consistent, safe, and high-quality performance in their work activities. OAP principles are applied to individual programs using a graded approach, with consideration given to factors such as the program's environmental, health, and safety consequences; its programmatic significance; and its mission.

When special QA/QC requirements are necessary for environmental monitoring a Quality Assurance Project Plan is developed and implemented. The Laboratory's NESHAP program has such a specific quality assurance plan.

8.2 SAMPLE COLLECTION

Berkeley Lab's environmental monitoring program collects samples in accordance with the specifications of this plan. Documented implementation procedures are used for performing sample collection. These procedures prescribe sampling collection methods and related requirements for obtaining representative matrix samples. The following requirements are integrated into the sample collection procedures:

- US/EPA- or internally-developed methods are used to obtain representative matrix samples;
- The environmental monitoring database generates chain of custody and field collection forms.
- Qualified and experienced field staff perform the sample collections using standard procedures and calibrated sampling instrumentation;
- All necessary field-sampling information is documented on chain-of-custody forms and other field notes;
- Samples are packaged and shipped to analytical laboratories using standard and documented handling procedures and containers that preserve sample integrity;
- When possible, field QC samples (i.e., duplicates, splits, blanks) are submitted to analytical laboratories with each batch of samples; and
- Sample disposition and status are tracked using chain-of-custody sheet information.

8.3 SAMPLE ANALYSIS

Berkeley Lab uses on-site and off-site commercial laboratories to analyze samples for the environmental monitoring program. Both types of laboratories must meet demanding QA/QC specifications and certifications that were established to define, monitor, and document laboratory performance. The QA/QC data provided by these laboratories are incorporated into the data quality-assessment processes.

The following list is a summary of QA/QC requirements that analytical laboratories supporting the environmental monitoring program must meet:

- Have a written and implemented QA/QC plan that meets Berkeley Lab requirements and specifications,
- Be certified by the California Department of Health Services Environmental Laboratory Accreditation Program,
- Participate in inter-laboratory QA programs such as the Environmental Monitoring Sampling Laboratory and the Department of Energy Environmental Measurement Laboratory (Performance evaluation committee reviews results from these programs and initiates follow-up actions when data do not fall within satisfactory limits),
- Conform to the Statement of Work for analytical services in support of Lawrence Livermore National Laboratory and Lawrence Berkeley National Laboratory,
- Participate in annual audits and assessments conducted by DOE's Consolidated Audit Program (DOECAP) (LLNL and Berkeley Lab personnel participate on the DOECAP audit teams. The DOECAP Audit team prepares a formal written report that summarizes findings and requirements for follow-up actions.), and

  When applicable, have the following documented internal QC requirements:

  1) Control limits,
  2) Method detection limit studies,
  3) Contract reporting limit,
  4) Matrix spikes, matrix spike duplicates, and laboratory control samples,
  5) Method blanks,
  6) Surrogates,
  7) Initial and ongoing calibration checks,
  8) Sample duplicates, and
  9) Tracer yields.

Deliverables from each analytical laboratory must include both hardcopy and electronic products. Hardcopy deliverables include case narratives, chain-of-custody documentation, and a summary of QC sample results. Electronic data deliverables include four specific types of files; sample, analysis, QA/QC, and a batch number reference.

8.4 DATA QUALITY ASSESSMENT

Each set of data received from the analytical laboratory is systematically evaluated and compared to established data quality objectives. Data quality is assessed for each analytical batch before the results can be authenticated and accepted into the environmental monitoring database. Categories of data quality objectives include accuracy, precision, representativeness, comparability, and completeness. When possible, quantitative criteria are used to define and assess data quality.

To perform the large number of QC checks necessary to determine whether data quality objectives have been achieved, the electronic data deliverables provided by the analytical laboratories are uploaded into the environmental monitoring database. This database is used to perform computer-automated data quality checks on the laboratory data package. Data quality discrepancies are flagged, investigated, and resolved by Berkeley Lab staff. Following the automated data validation/verification checks and any necessary discrepancy resolution, program specialists perform final data authentication by reviewing the data and QC results before they are accepted.

8.5 OVERSIGHT OF ENVIRONMENTAL MONITORING QUALITY ASSURANCE

To verify that environmental monitoring activities are adequate and effective, internal and external oversight is performed as required on specific environmental monitoring programs. Internal oversight activities consist of technical QA assessments performed by the Environmental Services Group and internal independent assessments conducted by the Berkeley Lab Office of Contract Assurance.

In addition to internal QA assessments, the ESG maintains a nonconformance and corrective action (NCAR) process documented in ESG procedure #208. The purpose of this process is to improve the quality of ESG operations by identifying nonconformances and taking corrective action to prevent their recurrence. This process also seeks to improve the quality of work received from parties outside of ESG including LBNL and non LBNL analytical laboratories, outside contractors, and vendors.

DOE's external oversight of Berkeley Lab programs is performed through the Operational Awareness Program. Operational awareness activities include participation of DOE staff in Berkeley Lab activities, such as field orientations, meetings, audits, workshops, document and information system reviews, and day-to-day communications. DOE criteria for performance evaluation include federal, state, and local regulations with general applicability to DOE facilities and applicable DOE requirements. DOE also provides external oversight through inspections performed by the Office of Environment, Safety and Health. In addition, US/EPA conducts external audits of the NESHAP monitoring program under 40 CFR 61, Subpart H.

8.6 SUMMARY

Quality assurance for environmental monitoring at Berkeley Lab is a continuous and comprehensive process designed to ensure that monitoring results meet documented requirements. All results generated and reported by the environmental monitoring program undergo a stringent data quality assessment to verify that data quality objectives are met.

Throughout the QA process, data quality checks and communication links are in place to identify, document, and correct data quality discrepancies.

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APPENDIX A

Storm Water Monitoring Program

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Storm Water Monitoring Program

November, 2005

Environmental Services Group
Lawrence Berkeley National Laboratory
Berkeley, California

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1.0 INTRODUCTION

1.1 GENERAL

The Storm Water Monitoring Program (SWMP) constitutes one component of the requirements of the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities as promulgated and administered by the California State Water Resources Control Board (SWRCB) and the San Francisco Bay Regional Water Quality Control Board (RWQCB or Regional Board). It represents the specific plan and procedures Lawrence Berkeley National Laboratory (Berkeley Lab) will implement in order to monitor its storm water discharge for hazardous constituents, and, together with the Storm Water Pollution Prevention Plan (SWPPP), demonstrates Berkeley Lab's compliance with the requirements of the state general permit. This program has been prepared in accordance with the requirements of 40 CFR 122 and the United Sates Department of Energy (DOE) Order No. 5400.1, "General Environmental Protection Program."

As a DOE facility, Berkeley Lab is subject to applicable orders issued by the United States Department of Energy and defined by the UC Contract, Appendix G, including portions of DOE 5400.1, General Environmental Protection Program, and DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance. The latter both incorporates and expands on requirements embodied in the former. To ensure that Berkeley Lab research activities are carried out in compliance with both DOE orders and regulatory requirements, Berkeley Lab maintains a complex program of monitoring of the workplace, effluents, and the environment. Among other information, the various kinds of monitoring undertaken and the results are detailed in the annual Site Environmental Report and are available on the Web at http://www.lbl.gov/ehs/esg.

DOE orders are directives rather than regulations enforceable by civil or criminal penalties. Berkeley Lab adheres to them pursuant to Contract No. DE-AC02-05CH11231, Appendix G, between DOE and the University of California, which operates Berkeley Lab for DOE.

1.1.1 Berkeley Lab Organization

Within the Environment, Health, and Safety Division at Berkeley Lab, the Environmental Services Group (ESG) has general responsibility for regulatory compliance oversight with federal, state, and local laws, regulations, and orders, and prepares necessary permits, plans, and reports documenting compliance as required. Within ESG, the Water Quality Program is charged with responding to the requirements of the General Permit, and will maintain and update the SWMP.

1.2 REGULATORY FRAMEWORK

1.2.1 Federal Requirements

The Clean Water Act, enacted by Congress in 1972 as an amendment to the Federal Water Pollution Control Act, gave the Environmental Protection Agency (EPA) authority to regulate the discharge of any pollutant from a point source to navigable waters by means of a permit system called the National Pollutant Discharge Elimination System (NPDES). Using this authority, EPA has up to now concentrated mainly on regulating discharges from municipal treatment plants and the process waters from industrial facilities. However, several nationwide studies conducted in recent years have consistently shown urban runoff to be a leading cause of water quality impairment to the nation's waterways and wetlands. Surveys indicated that such pollution from diffuse sources — including urban runoff, agricultural runoff, construction-site discharges, illegal dumping, and illicit connections to storm sewers — contained both organic and inorganic pollutants and included heavy metals, cyanides, pesticides, construction chemicals, solid wastes, and oil and grease.

Accordingly, the Water Quality Act of 1987 amended the Clean Water Act and provided the impetus for EPA to change its focus and begin regulating storm water discharges under the NPDES program. On November 16, 1990, the EPA published a final rule relating to permitting requirements for storm water discharges for three categories: (1) medium (with a population of between 100,000 and 250,000) municipal separate storm water systems, (2) large (with a population over 250,000) municipal separate storm water systems, and (3) discharges associated with industrial activity. Both "storm water discharge" and "industrial activity" are defined in the rules; see also 40 CFR 122.26 for "storm water discharges associated with industrial activity."

The EPA estimated that about 100,000 industrial facilities would be affected by the storm water regulations. The burden was on each facility to decide whether or not it needed to apply for a permit. If a facility has a Standard Industrial Classification (SIC) code that is within one of the regulated categories, or fits the description of a category, it probably is subject to storm water permitting. If a facility further has a storm water discharge from any conveyance used for collecting and conveying storm water, and that discharge goes either to U.S. waters or to a separate storm water system, it will be required to permit that discharge under the storm water regulations.

EPA devised a strategy whereby there were three types of storm water permits (general, group, and individual), and many states that have authorized NPDES programs have issued their own general permits to cover the majority of their industrial dischargers.

1.2.2 State Requirements

The State of California has an authorized NPDES program, and early on the SWRCB announced its intent to issue a general permit, which would cover the majority of the facilities engaged in industrial activity in the state. On November 19, 1991, the state did adopt such a general permit.

The first requirement for this permit was the submittal of a Notice of Intent (NOI) between January 15 and March 30, 1992. Other requirements included the elimination of non-storm water discharges to storm water systems, the development of a Storm Water Pollution Prevention Plan (SWPPP), and the development of an SWMP, all of which Berkeley Lab has completed.

On April 17, 1997, the SWRCB re-issued the General Permit. It contained many changes, several of which impacted Berkeley Lab's program. In 2003 the SWRCB issued a draft general industrial permit which was contested by various groups. It was withdrawn, and in 2005 a revised draft was issued, which has also been withdrawn for further changes and re-hearing. Berkeley Lab and other industrial dischargers are thus still operating under the 1997 permit. This revision of the SWMP has been undertaken to incorporate general updating of the program.

This SWMP is written to comply with the requirements of the existing General Permit. It is a plan which is not submitted to an agency, but rather must be kept on the site and available for inspection by an administering agency. Within the general framework of the permit requirements and provisions, each participating facility will develop site-specific plans tailored to the needs and circumstances of its own site and operations.

1.2.3 Applicability to Berkeley Lab

Several criteria exist to determine whether a facility's operations must be permitted under the storm water NPDES regulations. The General Permit refers to categories detailed at 40 CFR 122.26 (b)(14). Berkeley Lab fits into two of these categories: facilities subject to toxic pollutant effluent standards (40 CFR Subchapter N), and hazardous waste treatment, storage, or disposal facilities. Because of metal finishing operations at Buildings 25 and 77 (SIC code 3499), Berkeley Lab is subject to toxic pollutant effluent standards as noted at 40 CFR 122.26 (b)(14)(i). Additionally, the operation of a hazardous waste treatment and storage facility (SIC code 4953) also subjects Berkeley Lab to the General Permit.

A major criterion in determining whether a facility is engaged in industrial activity is its SIC code. Although Berkeley Lab's general classification is 8733, Noncommercial Research Organization, several of the secondary SIC codes under which Berkeley Lab was classified would require Berkeley Lab to be covered under the General Permit. The activities included gasoline dispensing (5541), transportation (4789), and car washing (7542). Accordingly, Berkeley Lab submitted an NOI in March of 1992 and embarked on a program of identifying and eliminating all non-storm water discharges to storm water systems. This program was successfully completed in March of 1995. A SWPPP and a SWMP have been in place since October 1, 1992. Current revisions of these plans are the guiding documents for the facility's compliance with storm water permitting regulations.

Based upon a rationale as detailed in Section 2.0 of this document, Berkeley Lab has decided upon a certain monitoring program, which it desires to implement in the interest of characterizing its own facility and responsibly managing its storm water in the spirit of the Clean Water Act. The details of this plan are given in the following sections of this SWMP. Please note that off-site locations where Berkeley Lab activities are conducted (including parts of several buildings on the UC campus and off-site leased buildings including 903, 937, 941, 943, and 977, and the Joint Genome Institute in Walnut Creek) have not been included in this plan, 1) because they are not physically contiguous to the property addressed in this plan, and 2) because they do not contain any industrial activity or have any hazardous materials exposed to storm water.

1.3 MONITORING PROGRAM OBJECTIVES

Berkeley Lab has designed this SWMP to be responsive to the objectives of the general permit for a monitoring program. These are:

- To demonstrate compliance with the permit;
- To demonstrate compliance in the implementation of the SWPPP;
- To measure the effectiveness of Best Management Practices in removing pollutants from industrial storm water discharge.

The purpose of the SWMP is thus to produce reliable, representative, defensible, and sufficient data in order to assess the quality of Berkeley Lab's storm water discharge. This will enable Berkeley Lab to demonstrate permit compliance by meeting discharge prohibitions, effluent limitations, and receiving water limitations as stated in the general permit. Discharge prohibitions include unauthorized non-storm water discharges, anything in excess of 40 CFR Subchapter N numeric effluent limitations, and discharges of storm water containing hazardous substances in excess of reportable quantities established at 40 CFR 117.3 and 40 CFR 302.4. Furthermore, storm water discharges should not adversely impact human health or the environment, or violate applicable standards contained in various state or regional water quality plans. The Regional Board has stated that any such limits are currently regarded as guidelines rather than causes for enforcement action, as long as Best Management Practices (BMPs) have been implemented that achieve best available technology economically achievable and best conventional pollutant control technology (BAT/BCT) and a report is made to the RWQCB in accordance with C.3 of the General Permit.

The SWMP will also enable Berkeley Lab to demonstrate implementation and efficacy of the SWPPP and to gauge the effectiveness of Best Management Practices instituted in accordance with the SWPPP. While the SWPPP is a separate document, the measures and practices delineated in it substantially affect the parameters of concern in the monitoring program. As the SWPPP represents at least in part the existing conditions on which the SWMP is predicated, so the SWMP is the means for determining the soundness of the SWPPP.

1.4 IMPLEMENTATION ACTIVITIES

In order to fulfill the requirements of the general permit for a SWMP, Berkeley Lab will, at a minimum, perform the following activities:

- Conduct visual observations for the presence of unauthorized and authorized non-storm water discharges quarterly. Efforts will normally consist of visual observation of flows, stains, sludges, odors, and other abnormal conditions, and will be recorded on a standard form including date of observations, locations observed, and observations, and any actions taken (see Appendix C).
- Conduct visual observations of the storm water discharge locations during the wet season (October 1 to May 31) for at least one storm event per month that produces significant storm water discharge. "Significant" storm water discharge is defined as a continuous discharge of storm water for a minimum of one hour. Observations will be recorded on a standard form (see Appendix C) and will include floating and suspended materials, oil and grease, discolorations, turbidity, odor, and source of any pollutants. Observation dates, locations observed, observations, and any actions taken to reduce or prevent pollutants in storm water discharges will be recorded. Should there not be a storm event per month which produces significant discharge, or visual observations not be performed due to adverse climatic conditions, this fact will be documented in the record as an exception report and will be made part of the annual monitoring report.
- Collect and analyze samples of storm water discharge of representative quality and quantity from at least two storm events during a wet season that produce significant storm water discharge, including, if possible, the first storm of the season. Samples will be taken and preserved in accordance with the sampling program detailed in Section 4.0 of this document. Samples will be analyzed for the following parameters: pH, total suspended solids (TSS), specific conductance, and total organic carbon (TOC) or oil and grease, plus toxic chemicals and other pollutants which have a reasonable potential to be present in storm water discharge in significant quantities. Such materials are detailed in Section 2.4 of this document, Rationale for Monitoring Program Parameters. At Berkeley Lab's option and with the approval of the RWQCB, analysis for acute toxicity may be conducted in lieu of chemical-specific analysis. Should the required samples not be collected due to adverse climatic conditions as defined in the permit, this fact will be documented in the record as an exception report and will be made part of the annual monitoring report.
- Calibrate and maintain all monitoring instruments and equipment in accordance with manufacturers' specifications to ensure accurate measurements and to ensure that QA/QC as defined in the environmental monitoring program is followed.
- Train and certify all personnel carrying out observations and/or sampling in accordance with the training program which is described in Section 6.0 of this document.
- Conduct all analyses at a laboratory certified for such analyses by the State Department of Health Services. Berkeley Lab will specify that all analyses must be conducted according

to test procedures under 40 CFR 136, unless other procedures have been specified in the general permit or by the Regional Board.

- Retain records of all storm water monitoring information and copies of all required reports, inspections, and certifications for a period of at least five years. Such records are detailed in Section 5.0 of this SWMP, Records and Reports.
- Submit an annual report by July 1 of each year to the Executive Officer of the San Francisco Bay Regional Water Quality Control Board, and, if requested, to a local agency. The contents of this report are detailed in Section 5.0 of this SWMP, Records and Reports. Berkeley Lab will also include sampling results in the annual Site Environmental Report and make these results available on the Web at http://www.lbl.gov/ehs/esg.
- Maintain on the site a copy of this SWMP and make it available upon request to a representative of the Regional Board and/or local agency, which receives the storm water discharge, or DOE.
- Update and amend the SWMP upon any change of conditions as described in this document, or as necessary on the basis of the annual report and program evaluation. Upon notification by the Regional Board or local agency of any deficiencies in the SWMP, Berkeley Lab will submit a time schedule for amending the SWMP to meet requirements to the appropriate agency within 30 days. After making any required changes, Berkeley Lab will provide written certification to the appropriate agency that such changes have been made.
- Institute a quality assurance/quality control program to assure that all elements of the monitoring program are conducted and that all monitoring is conducted by trained personnel. The elements of such a program are detailed in Section 7.0 of this document, QA/QC and Program Evaluation.
- Conduct a program evaluation to ascertain the effectiveness of the monitoring program in achieving its stated objectives (see Section 1.3 above). The elements of such an evaluation are also detailed in Section 7.0 of this document and are included in the annual report.
- Notify the RWQCB of Berkeley Lab's intent to conduct composite sampling rather than grab sampling, as defined in the permit, and to substitute other representative parameters (e.g., whole effluent toxicity) for chemical-specific monitoring, as appropriate.
- Conduct annual site inspections to identify areas contributing to a storm water discharge associated with industrial activity and to evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate and properly implemented. Records of the annual site inspections will include the date, the individual who performed the inspections, and any observations, and are included in the annual report.
- Certify, based on the annual site inspections, which the facility is in compliance with the requirements of the General Permit and the SWPPP. Certification will be in accordance with requirements as detailed in Section 5.0 of this SWMP, Records and Reports.

2.0 RATIONALE FOR MONITORING EFFORTS

2.1 FACILITY DESCRIPTION

Lawrence Berkeley National Laboratory (Berkeley Lab) is a multiprogram national laboratory managed by the University of California for the U.S. Department of Energy (DOE). Berkeley Lab's major role is to conduct unclassified basic and applied science research across a wide range of scientific disciplines. Key efforts are in fundamental studies of the universe, qualitative biology, nanoscience, new energy systems and environmental solutions, and the use of integrated computing as a tool for discovery. Berkeley Lab also supports nationwide university-based research by providing national facilities, including the National Center for Electron Microscopy, the Advanced Light Source, the Energy Sciences Network, and the National Energy Research Scientific Computing Center. Support functions for these operations at Berkeley Lab include handling and storage of hazardous materials, management of hazardous wastes (pre-treatment of wastewaters, storage and/or treatment of hazardous waste in containers and tanks, and packaging and storage of low-level mixed waste), metal finishing, various fabrication and construction activities, and provision of infrastructure and utilities. Normal operating hours for the facility are 8 a.m. to 5 p.m., Monday through Friday.

2.2 SITE DESCRIPTION

2.2.1 Location

Berkeley Lab is located in Alameda County in the hills above the University of California campus, approximately three miles east of San Francisco Bay (see Figure 2-1). Most of the site is within the city limits of Berkeley, although the eastern portion (approximately one-quarter of the site) is within the City of Oakland. Berkeley Lab is situated on the generally western-facing slopes of the hills, at elevations ranging from 150 to 330 meters above sea level. The total acreage of this site is 203 acres, of which approximately 110 acres remain undeveloped, with steep slopes and vegetation which lend the area a rural character.

The site currently includes 80 permanent buildings and 108 trailers and temporary structures encompassing 1.75 million gross square feet. Approximately 50% of the site is currently either paved or covered by buildings or structures (see Figure 2-2).

On the northern boundary of the central portion of the Berkeley Lab site, and also spatially above it on the hill slopes, is the UC Berkeley Lawrence Hall of Science, with the Samuel Silver Space Sciences Laboratory, the Mathematical Sciences Research Institute, and a field station for behavioral research with animals beyond that. Also upslope and to the north and west bordering

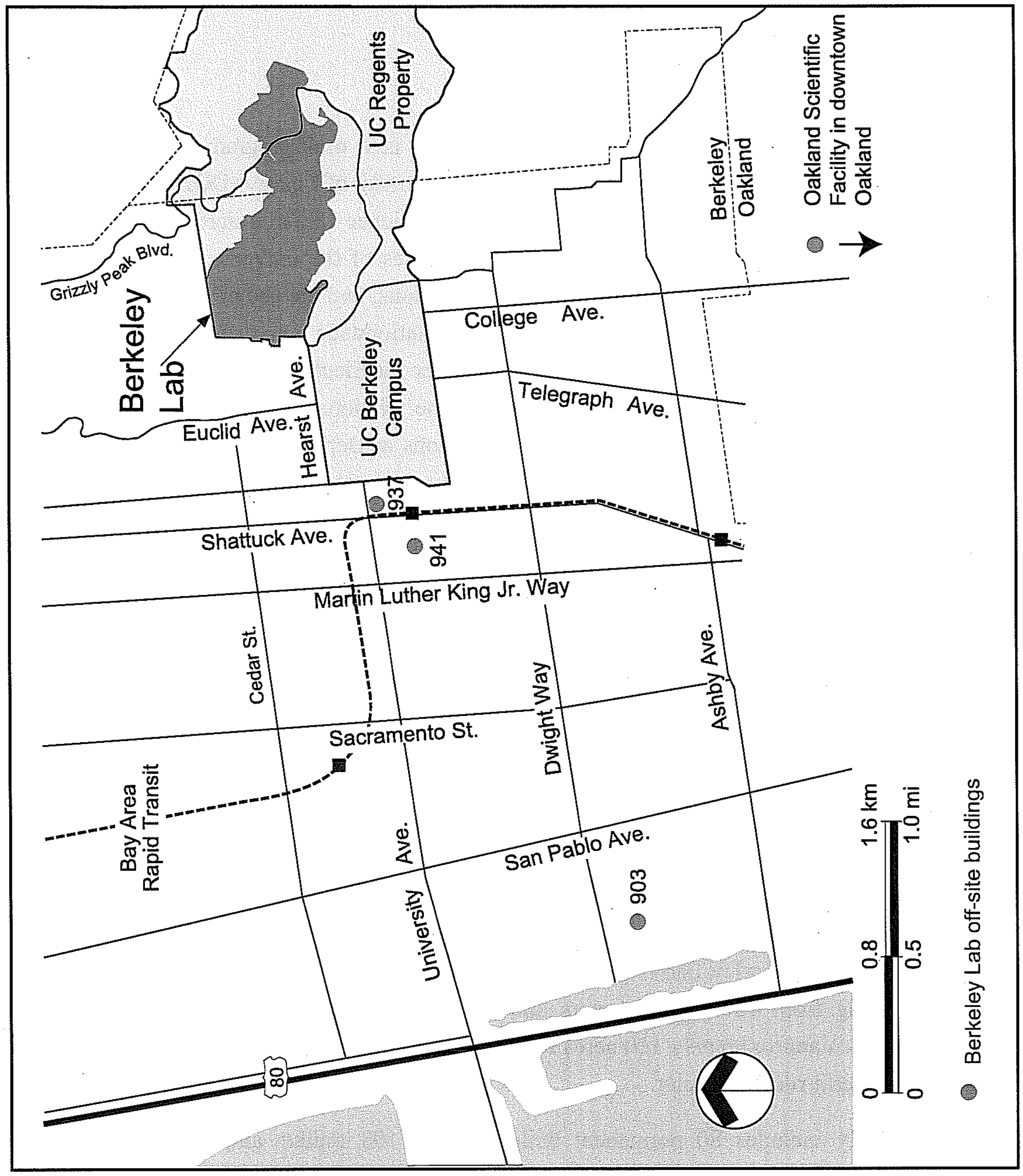

Figure 2-1 Vicinity Map

Figure 2-2 Lawrence Berkeley National Laboratory Buildings

University property is a series of single-family residences that overlook Berkeley Lab. To the east, Berkeley Lab is bounded by undeveloped lands included in the UC Berkeley ecological study area and, across Centennial Drive, the Botanical Garden. Abutting Berkeley Lab to the south and west, and downslope of it, are the University of California and several of its facilities such as student residence halls, and a residential area consisting primarily of multiple- and single-family dwellings and mid-rise apartment buildings.

Berkeley Lab's location on the eastern shore of San Francisco Bay is usually influenced by maritime air masses from the eastern Pacific Ocean which flow through the Golden Gate. During the spring through autumn months, this flow is usually generated by the temperature differences between the air over the Pacific Ocean and that of the interior valleys of California. Fog often moves on shore during summer afternoons, although rain is uncommon. The winter months are climatologically characterized by cycles of Pacific Ocean storms that bring periods of clouds, wind, and rain. About 95% of the annual average rainfall of 30 inches occurs from October through April, and intensities are seldom greater than one-half inch per hour. Thunderstorms, hail, and snow are extremely rare. Berkeley Lab enjoys a mild, Mediterranean-type climate, with drought years as well as heavy rainfall years.

2.2.2 Site Drainage

2.2.2.1 Watershed

The topography of the hilly area in which Berkeley Lab is located is characterized by three main canyons with related tributary features. The west-trending Strawberry Canyon lies along the southern border of the property; at its head, it is joined by a north-south trending canyon along the eastern border of the property. Blackberry Canyon, another west-trending feature, drains the central and northern portions of Berkeley Lab. The topography at Berkeley Lab and the surrounding area is shown on Figures 2-2 and 2-3.

Berkeley Lab lies within the Strawberry Creek Watershed, which includes other University of California property, public streets of both Oakland and Berkeley, and private property. The entire watershed is comprised of 878 acres, with approximately one-third within the City of Berkeley and two-thirds within the City of Oakland. Two main branches of Strawberry Creek drain the watershed, the north fork and the south fork. The south fork is usually referred to as Strawberry Creek, while the north fork is commonly known as the North Fork.

Strawberry Creek Watershed is divided into five sub-watersheds (see Figure 2-3). That portion called the North Fork (Blackberry Canyon), contains 170 acres comprised mostly of steep canyons and hillsides covered with brush, trees, and grass. Within this are Berkeley Lab's buildings, parking lots, pavements, and other improvements, the upslope buildings, roads, and parking lots belonging to the university, and a residential area within the City of Berkeley. Total developed area

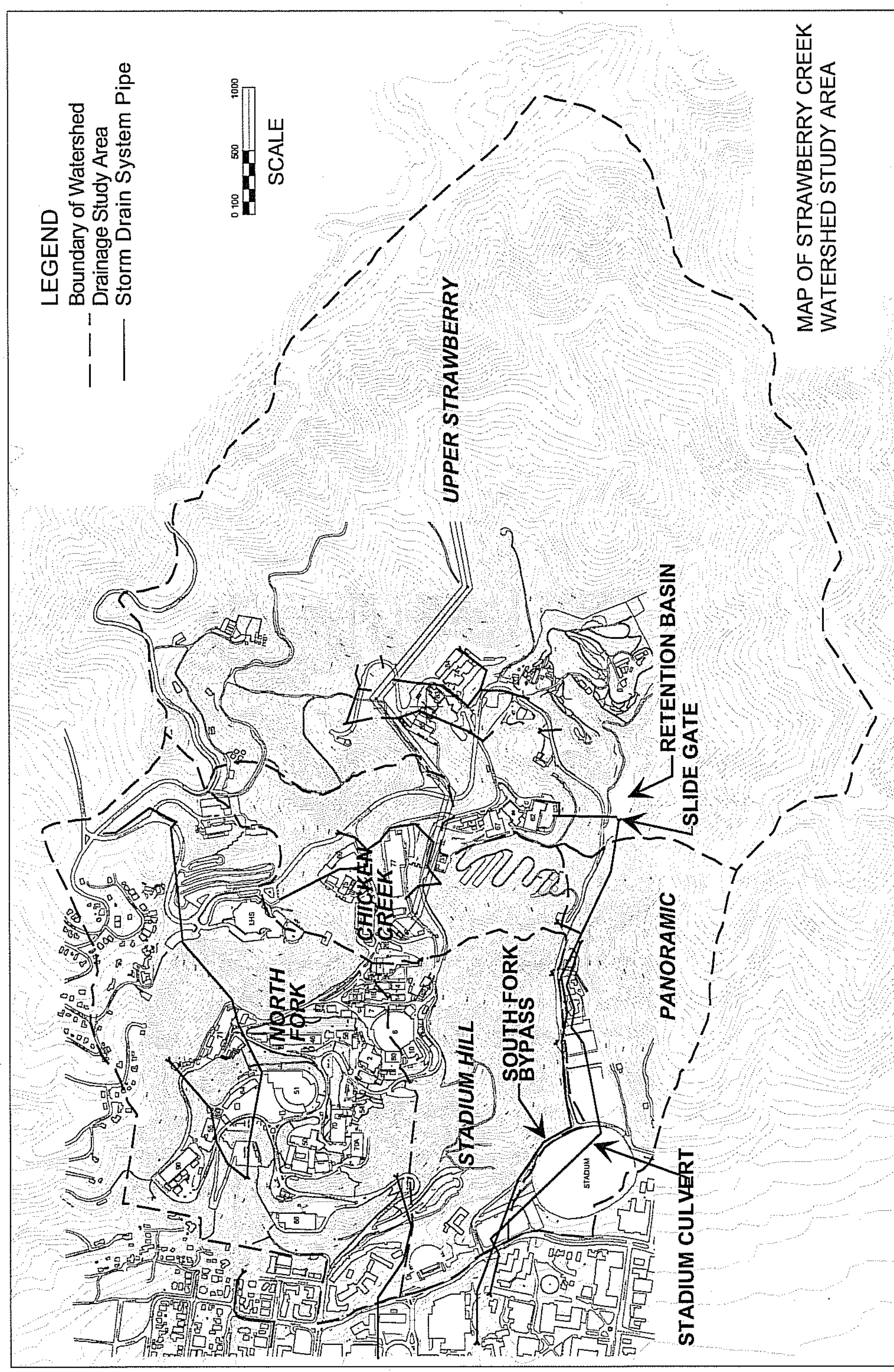

Figure 2-3 Strawberry Creek Watershed

in the North Fork sub-watershed is 53.25 acres, or about 31%. Berkeley Lab developed area is 35.11 acres, or about 20.7% of the total watershed.

The South Fork (Strawberry Canyon) watershed of Strawberry Creek, as it relates to Berkeley Lab, has a total area of about 708 acres and is further divided into four sub-watersheds as presented in Table 2-1:

Table 2-1 Area of Strawberry Canyon Watersheds (in acres and percentages)

Watershed	Total Area	Total Developed Area	Percentage of Total Area	Berkeley Lab Developed Area	Berkeley Lab Developed Area (% of Total Area)
Upper Strawberry Creek	508	12	4.4	4.0	2.1
Chicken Creek	63	17.13	27	10.0	19.8
Panoramic	70	18.54	26	—	0
Stadium Hill	67	17.55	26	7.5	12.1

The Panoramic sub-watershed does not drain any of Berkeley Lab. The other three sub-watersheds consist mostly of steep canyons and natural hillsides, but also contain Berkeley Lab's infrastructure and some of the University of California's facilities, including the Botanical Garden.

2.2.2.2 Groundwater

Highly complex groundwater conditions are present at Berkeley Lab. Water table depths vary from 0 to over 90 feet across the site. Year-round springs, annual surface seeps, and variable water levels in observation wells indicate discontinuous and localized aquifers. During the rainy season, groundwater levels increase and cause an increase in hydrostatic pressure and a decrease in slope stability. Consequently, Berkeley Lab has installed an elaborate groundwater detection and drainage system. The drainage system uses both pumped vertical and free-flowing horizontal wells called hydraugers. Discharge from the hydraugers is routinely routed to the storm drainage system, except for the discharge at Buildings 6, 7, 46 and the discharge from some hydraugers to the north and east of Building 51, which have been found to contain low levels of solvents (chlorinated hydrocarbons) from a plume of contamination present in a narrow aquifer formed along the bed of the main branch of the original North Fork of Strawberry Creek. Discharge from these hydraugers is collected and treated by granular activated carbon systems and is subsequently discharged to the sanitary sewer under a permit from the East Bay Municipal Utility District (EBMUD).

2.2.2.3 Surface Water

Surface water is in part composed of the above-mentioned seeps and springs; one permanent spring is located in the northeastern portion of the site and contributes to the North Fork of Strawberry Creek. Other features of surface water are the stream flows, which vary from nearly dry conditions in the summer, particularly during drought years, to powerful runoff flows during intense winter rains. The north and south forks of Strawberry Creek are perennial and are believed to be fed by urban runoff and the hydraugers during the summer; most of their tributaries on-site are either ephemeral or intermittent, and any flow is generally limited to storm water runoff, with some augmentation by urban runoff and subsurface hydrauger flows. Berkeley Lab is not located within a 100-year flood plain.

2.2.2.4 Storm Drain System

Extensive cut and fill operations and grading of the natural steep slopes have occurred over the history of Berkeley Lab as development of the site has progressed and structures, multi-story buildings, roads, parking lots, and storage areas have been constructed. Natural drainage patterns have been altered, and extensive paving and building have increased runoff during storms, which in turn increased erosion and added to the ever-present danger of landslides.

As a consequence, a storm drain system was designed and installed in the 1960s. It provided capacity for runoff intensities expected from the 25-year storm (see Figure 2-4). There is some evidence that portions of this system are now of questionable integrity and may, through infiltration, allow discharge of contaminants to surface waters. Any current upgrades or additions to the system are designed and constructed to handle runoff from the 100-year storm. On the north, draining the North Fork of Strawberry Creek watershed portion of Berkeley Lab and the upper parts of the watershed beyond Berkeley Lab, the system discharges into a 60-inch concrete culvert at the head of Le Conte Avenue in Berkeley. Southerly and easterly portions of Berkeley Lab drain into Chicken Creek, Ten-Inch Creek, Ravine Creek, and Cafeteria Creek, to list the named tributaries, and then into Strawberry Creek. The East Canyon portion of the site drains to Botanical Garden Creek and then into Strawberry Creek.

Downstream from the Botanical Garden, Strawberry Creek is diverted underground through a culvert and later emerges as a surface stream near the eastern end of the UC campus. The north and south forks of Strawberry Creek later combine at the western end of the campus, approximately 400 feet east of the City of Berkeley's Oxford and Center streets culvert. Runoff from the entire watershed, including the lower campus, is delivered to the entrance of this culvert. The runoff flows through the City of Berkeley's storm drainage system and empties into San Francisco Bay.

2.3 RATIONALE FOR MONITORING LOCATIONS

Having examined site drainage and conditions as described above, and having monitored under this program since the 1992/93 wet season, Berkeley Lab now concentrates its monitoring efforts on

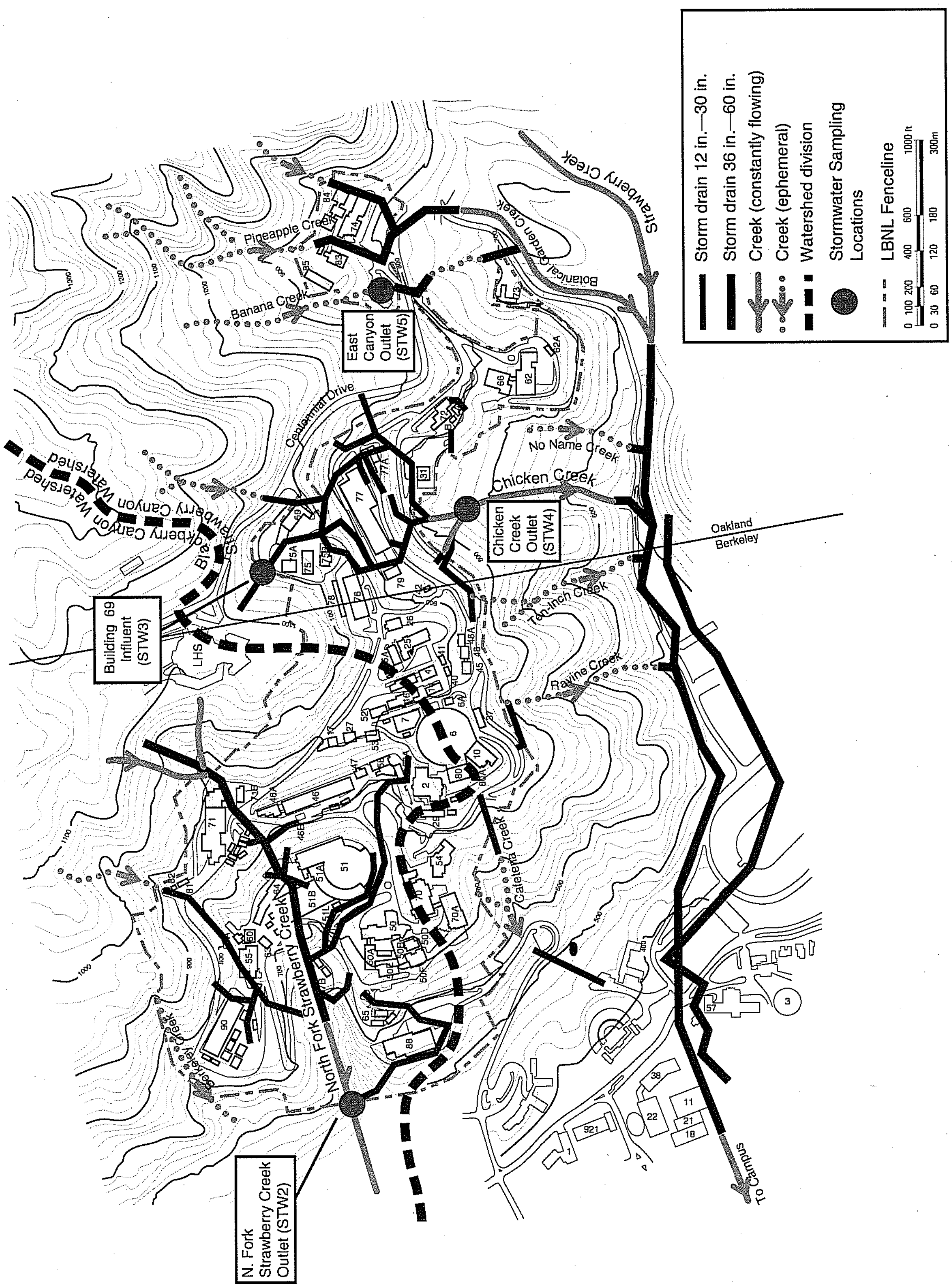

Figure 2-4 Site Storm Drainage and Monitoring Locations
Note: StW1 was located at Building 71. It was eliminated from the program for safety reasons.

four sampling locations: one influent and three effluent. Figure 2-4 shows all monitoring locations, including the influent locations. Since Berkeley Lab clearly receives runoff from facilities and residences above it in the watershed, it is felt that sampling of the influent location is an important component of the monitoring program and will aid in establishing off-site sources of any contaminants which may be identified. All monitoring locations are further described below.

For the northern and central portion of the site, drained by the North Fork of Strawberry Creek, there is clearly a major influent point and a major effluent point. The previous influent sampling location has been abandoned due to safety considerations, and a replacement location remains to be determined.

The effluent sampling location is shown as StW2 on Figure 2-4. The sampling equipment is installed downstream of the fence (just off the property) in order to incorporate the discharge from an 18" pipe which enters the stream just beyond the property line. This pipe receives storm runoff from the areas of Buildings 88, 65, 50A, 50B, 50C, 50 D, 50E, and 50F. The North Fork of Strawberry Creek itself at that point receives storm water runoff from the entire rest of the site within its watershed, namely Buildings 90 and attendant trailers, 55, 55A, 60, 63, 56, 64, 51, 71, 46, 46A, 47, 17, 27, 53, 52, 16, 7, 6, 80, 2, 58, 58A, and portions of 70 and 70A.

The influent sampling point for the Strawberry Canyon watershed will be the large manhole north of Building 69 (StW3 on Figure 2-4). This manhole receives storm water from the Lawrence Hall of Science, from the hillside above Berkeley Lab, and from off-site road drainage. Although there are minor influent streams in the areas of Building 69 and Buildings 83, 84, 85, and 74, the drainage area on the hillside above them is undeveloped. In the past these points have not been sampled, since there was no reason to believe that they were a significant source of pollution.

With increasing construction predicted in the future, Berkeley Lab is considering further monitoring points below buildings 74 and 62. Flow will be observed during the next storm water season, and logistics, resources, and construction considerations will be evaluated before a decision is made as to whether to add these new monitoring sites.

The major outlet for storm water runoff from Berkeley Lab within the Strawberry Canyon watershed has been determined to be a tributary of Strawberry Creek named Chicken Creek. It drains the area which includes Buildings 31, 77, 77A, 69, 75, 75A, 75B, 76, 78, 79, 26, 61, and Grizzly Substation. Site drainage drawings indicate that storm water runoff from portions of Buildings 25, 25A, 4, 5, 40, 41, 43, 45, and 48 is also routed to this discharge. The sampling point at this location (StW4 on Figure 2-4) will be inside the fence line, but just beyond the point where the runoff from Building 31, discharged through a 12" CMP and then an aboveground channel, will enter Chicken Creek.

In the early years of the program, Berkeley Lab also monitored at various points which convey relatively minor amounts of runoff and were believed to contain little potential for contamination (Revision 0 of this document, 1992, Fig. 2-5). These sites were analyzed for whole effluent toxicity for three years, with no toxicity ever having been established. These locations were then dropped from the program after appropriate notification to the RWQCB and the City of Berkeley.

StW5 came on-line during the fourth quarter of 1996. The reason for adding this site was the construction of a new Hazardous Waste Handling Facility in the East Canyon. Pre-operational baseline monitoring for this facility was performed during 1995 and the first half of 1996; preliminary results of this surveillance were published in the 1995 Site Environmental Report, and full results were made available in a report later in 1996. Although all operations are performed indoors and it is not expected that they will contribute to contamination of Berkeley Lab's storm water discharge, Berkeley Lab monitors this facility because a facility which treats and stores hazardous waste is one of the categories which triggers the need to obtain a storm water discharge permit. The sampling point is in the southeast corner of the B83 parking lot, on the east side of Cyclotron Road, adjacent to its overcrossing by Centennial Drive, just before the channel goes into a culvert under the road.

Previous versions of this document have contained a table which listed the above discharges, the potential sources of contaminants, and the potential contaminants for each discharge. The last two columns of the table were a compilation of several past and current investigations into soil, surface water, and groundwater contamination at Berkeley Lab. These included *Preliminary Environmental Investigations at the Lawrence Berkeley National Laboratory*, conducted by Iraj Javandel in 1990, the 1992 *RCRA Facility Assessment* completed by the site Environmental Restoration Program, and the *RCRA Facility Assessment* done by DTSC in 1991. The Environmental Restoration Program has now completed considerable work, including interim corrective measures for many areas previously identified as areas of concern. In 2005 it submitted, and DTSC accepted, a draft corrective measures study report, which reported on the previous three years of corrective measure studies performed by the program. It also cites the Ecological Risk Assessment (2002) and the Human Health Risk Assessment (2003) which were performed. The result of all these studies was the recommendation of four areas of soil contamination and eleven areas of groundwater contamination for further evaluation. Two areas of soil contamination were subsequently remediated to a level that presented no further health or regulatory concern, and were deleted from the list.

In view of the fact that the Environmental Restoration Program has, over the course of nearly 15 years, so thoroughly vetted the site in regard to soil and water contamination, it is deemed appropriate to eliminate the previous table with its listing of potential sources and contaminants based on previous practices and structures. It is being replaced by a table listing the 13 areas of soil or groundwater remaining to be remediated, plus the eight areas where groundwater is currently being treated (sometimes these overlap).

Although it is unlikely that any of these areas would become sources of contamination, and all are monitored and/or inspected in accordance with regulations, these facilities represent those areas on-site with the greatest current potential for contamination of storm water.

Table 2-2 Areas with Potential for Contamination of Storm Water

Discharge Point	Building or System	Description	Potential Contaminants	Treatment System
North Fork of Strawberry	51L	Groundwater Plume Source Area	VOCs	Granulated Activated Carbon (GAC)
	51/64	Groundwater Solvent Plume	VOCs	GAC
	51L	Groundwater Solvent Plume	Vinyl Chloride	
	71B	Groundwater Solvent Plume	VOCs	
	51 Firetrail	Plume plus water from purging wells	VOCs	GAC
	46	Plume	VOCs	GAC
	7	Sump	VOCs	Trench
	7	Groundwater Solvent Plume		
	52	Groundwater Solvent Plume	VOCs	
	6	Former UST	Diesel	Bioventing
Chicken Creek	25A	Groundwater Solvent Plume	VOCs	GAC
	76	Solvents in Groundwater	—[1]	
	69	—	Vinyl Chloride	
	75/75A	—	—[1]	
	77	—		
Ravine Creek	37	Plume	VOCs	GAC

[1] Areas have been determined to have concentrations below risk-based Media Cleanup Standards, so no further action is required.

2.4 RATIONALE FOR MONITORING PROGRAM PARAMETERS

The general permit requires a discharger to monitor for certain specific substances (pH, total suspended solids (TSS), specific conductance, and total organic carbon (TOC) or oil and grease), specified parameters depending on SIC code, and also for "toxic chemicals and other pollutants that have a reasonable potential to be present in storm water discharge in significant quantities." As stated in the Storm Water Pollution Prevention Plan, the major potential source of pollution to storm water runoff at Berkeley Lab, aside from construction erosions and sedimentation, would be use of chemicals in scientific experiments and industrial support operations. Most of these operations are conducted indoors in facilities with suitable safeguards to prevent pollution to the environment.

Therefore, the most likely sources of pollution to storm water runoff would be unplanned releases from either indoor operations or outdoor facilities (including leakage from outdoor storage areas or equipment and deposition of airborne pollutants), transportation accidents, or contamination from roadway traffic and parking lots, primarily oil and grease. Pathways include contaminated soil and groundwater, due to previous practices or connections to storm drains, and the aging storm drain system itself.

Due to the nature of operations at Berkeley Lab, there are many hazardous materials present on-site at any given time, and also a large number of waste chemicals classified as hazardous under RCRA, although these are generated in relatively small quantities. Care is taken to manage and store these materials appropriately and in compliance with all applicable federal, state, and local regulations and DOE policies. As noted in 2.3 above, the site has now been thoroughly characterized, and contamination from past releases or practices has essentially been cleaned up or controlled. The original table containing a summary of contaminants of potential concern, which had been developed using data from such investigations, is no longer applicable. Additionally, as detailed below, Berkeley Lab has already monitored its storm water runoff for a number of years under the permit, and has adjusted its program according to the results of years of sampling.

Waste Accumulation Areas (WAAs) and Drum Storage Areas (DSAs) on-site are now almost all enclosed. Figure 2-5 shows the WAAs on-site; their number has been reduced to eight. It should be noted that since the contents of the WAAs vary from week to week, potential contaminants associated with the WAAs could only be given as a typical or representative inventory of the kinds of materials expected to be present. As a result of a project to consolidate bulk storage, the DSAs currently on-site are at buildings 16, 31, 58A, 62, 69, 76, and 79, and are all covered, are partially or fully enclosed, and have secondary containment. As such, their potential as a contaminant source has been greatly diminished. Current aboveground tanks are not listed for the same reason, since all are now double-walled with leak detection, and most also have secondary containment.

The reissued General Permit adopted by the SWRCB on April 17, 1997 includes other analytical parameters which are now required, depending on a facility's SIC code (Table D of the Permit). Based on Berkeley Lab's self-characterization of relevant SIC codes, the following parameters will be included in the monitoring program:

- SIC Code 4953, Hazardous Waste Treatment, Storage, or Disposal Facilities: NH_3, Mg, COD
- SIC Code 3499, Fabricated Metal Products: N+N, Fe, Al

SIC code 5093, Scrap Recycling Facilities, is no longer applicable to Berkeley Lab, since the salvage yard at building 42 was closed in 1998.

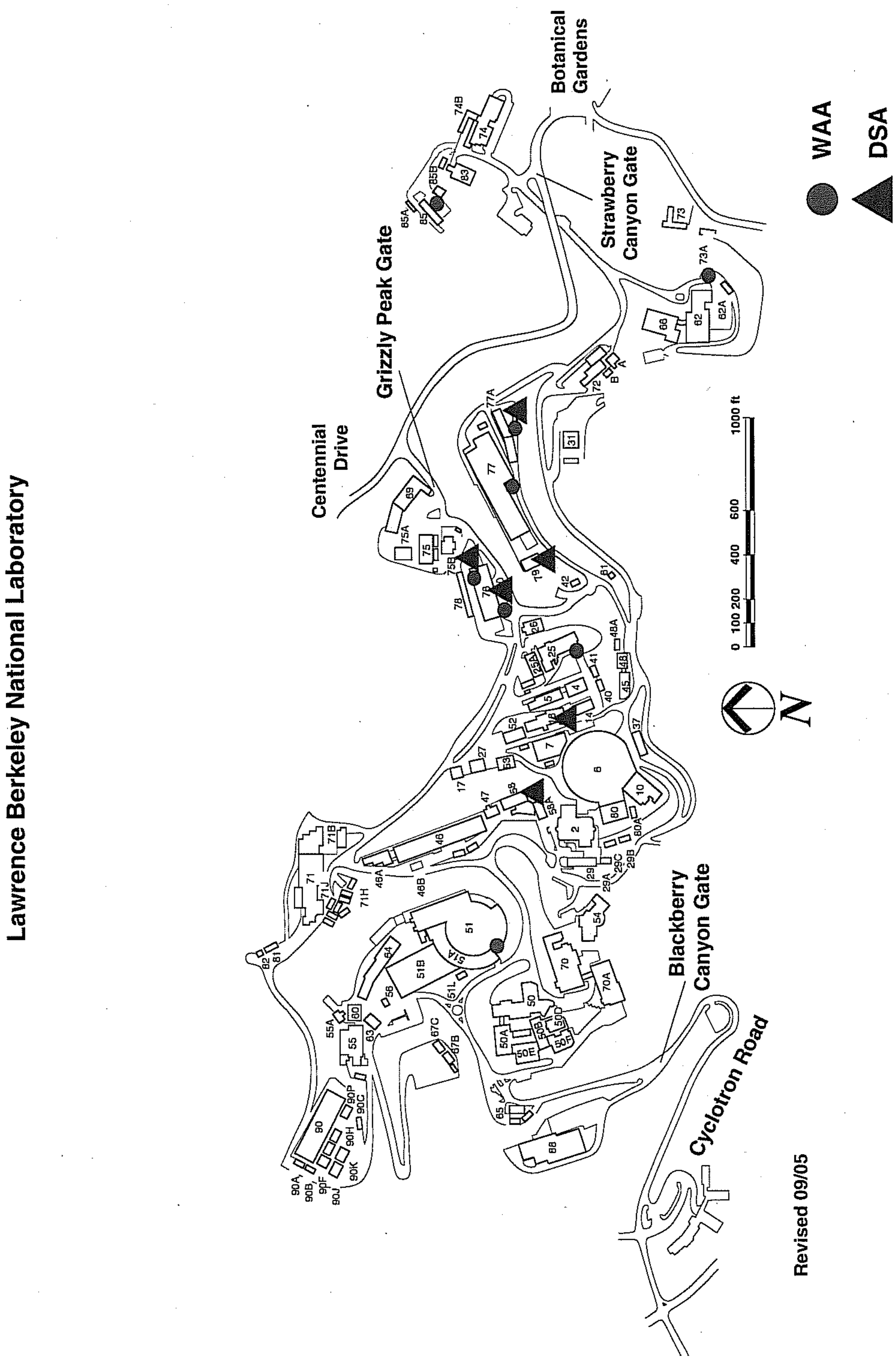

Figure 2-5 Waste Accumulation Areas and Drum Storage Areas at LBNL

Cyanide will not be monitored for at StW5 even though Table D requires it. As noted below, Berkeley Lab has previously monitored the entire site for cyanide for several years. The lack of any significant results justifies no further monitoring for this parameter in accordance with Section B, 5.c.iii of the General Permit.

Taking into consideration the results of the monitoring program over the previous years, Berkeley Lab in 1995 eliminated sampling for VOCs and cyanide, and in 1996 eliminated sampling for TPH-gasoline and PCBs. The Board was duly notified by letters of these changes in the program according to Item B.6 of the 1991 General Permit, and the reason given was that these constituents had not been detected in significant quantities during three or four years, respectively, of sampling under the storm water program. For the same reason, starting with the 2001/2002 storm water season, the list of metals analyzed was reduced to four. All others have not been detected in the last two years, or sometimes longer. Please see Table 3-1 or Appendix E for details.

In contrast, in 2005 Berkeley Lab decided to reinitiate monitoring for mercury and PCBs. This was done on the basis of a spill from 2004, consistency with other sampling programs, and a desire to confirm again that these substances are not present, even using new methods with lower detection limits. Later in 2005, it was decided to eliminate monitoring for PCBs, but monitoring for mercury will continue.

Table 2-3 shows the analyses to be performed at each monitoring location, based on the materials which are potentially present and the results of previous years' sampling. Sampling and analysis will be conducted with these parameters as targets, as detailed below and in Sections 3.0 and 4.0 of this document. Analysis for tritium is included, but note that it is performed on a voluntary basis. Tritium does not meet the definition of a "pollutant" under the Clean Water Act, since it is a material which is regulated under the Atomic Energy Act (40 CFR 122.2).

2.5 SAMPLING DESIGN

2.5.1 Sampling Approach

Taking into account the complexity of the site, the steep terrain, the equipment and number of personnel available for this program, and the unpredictability of significant storm water discharge, Berkeley Lab has designed a sampling program that makes every effort to capture representative discharge from the site. It is believed that the storm water discharged from the three current effluent monitoring locations fairly characterizes the quality and quantity of storm water discharged from the site. All current monitoring locations will be sampled twice during the storm water season for the required parameters of pH, total suspended solids (TSS), specific conductance, and total organic carbon (TOC) or oil and grease, and also for metals (including aluminum, iron, magnesium, mercury, and zinc), TPH-diesel, gross alpha and beta emitters, tritium, filtered COD, ammonia, and

Table 2-3 Analyses to be Performed for Monitoring Locations at Berkeley Lab

	Parameters of Concern[1]						
Monitoring Locations	**Metals[2] (Total)**	**TPH/ Diesel**	**Gross alpha & beta**	**Tritium**	**NH_3**	**COD**	**N+N**
StW 1	●	●	●	●		●	●
StW 2	●	●	●	●		●	●
StW 3	●	●	●	●		●	●
StW 4	●	●	●	●		●	●
StW 5	●	●	●	●	●	●	●

[1] All samples are tested for pH, Total Suspended Solids (TSS), specific conductance, and Total Organic Carbon (TOC) or oil and grease, as per permit requirements.
[2] The General Permit requires analysis for total metals. In addition, Berkeley Lab had committed to analyzing one sample per year for dissolved metals, on the request of the City of Berkeley. This was done from 1996 to 2001 with inconclusive results, and was discontinued starting with the storm water season of 2001/2002. Metals currently analyzed for are aluminum, iron, magnesium, mercury, and zinc.

Table 2-4 Monitoring Program Design

	Task[1]		
Monitoring Locations	**Observation of Authorized and Unauthorized Non-Storm Water Discharges (Quarterly)[2]**	**Visual Observation of Storm Water Discharges (once per month, wet season)**	**Sampling[3]**
North Fork of Strawberry Creek Outlet (StW2)	●	●	●
Building 69 Inlet (StW3)	●	●	●
Chicken Creek Outlet (StW4)	●	●	●
East Canyon Outlet (StW5)	●	●	●

[1] Sampling and observation of storm water discharges must be preceded by three working days of dry weather and must occur during the first hour of the discharge. At Berkeley Lab, this may not be possible during the same event at all locations.
[2] Must be performed on days when there is no storm water discharge.
[3] Consists of two storm water events per season, the first storm event of the season and one other.

nitrate and nitrite as nitrogen. Berkeley Lab will evaluate these samples at the end of the year and report the results in the Storm Water Annual Report.

It should be noted that a precise schedule of such sampling cannot be given. Details of the collection of samples, depending on the various targeted parameters, vary with each storm and with manpower resources. Sampling strategy is detailed in 2.5.2 below, while procedures for sampling can be found in Section 4.0 of this document. Specific sampling procedures are also described in ESG Procedure 263, Storm Water, Surface Water, and Rainwater Sampling.

Although most sampling is performed with automatic samplers, it may not always be possible to collect samples during the first hour at all sites for a single event. Thus it is noted that, due to logistical considerations, sampling may not necessarily be conducted for the same storm at all locations. An effort will be made to sample the inlet and outlet of the same basin during the same event to allow comparison of results.

In addition to sampling during the rainy season, Berkeley Lab will also carry out visual observations of storm water discharges once per month during the first hour of discharge at all monitoring locations. The form used to record such observations can be found in Appendix C.

As required by the General Permit, Berkeley Lab will also monitor the facility for the presence of unauthorized non-storm water discharges and visually observe the authorized non-storm water discharges. Such observations will occur quarterly, during daylight operating hours, on days with no storm water discharges. Quarters are understood to mean January-March, April-June, July-September, and October-December, and quarterly observations will be conducted within 6-18 weeks of each other. The form used to record such observations can be found in Appendix C. Table 2-4 provides an overview of the design for the entire storm water monitoring program.

2.5.2 Sampling Strategy

Automatic samplers are used at the four sites in the Strawberry Canyon and Blackberry Canyon basins described in Section 2.3 (StW2 through StW5). Samplers with liquid level actuators will be set up to initiate sampling when flow from runoff begins at the sites. Time-interval discrete samples will be collected every minute after there is flow at each site. Approximately four gallons (sixteen liters) of sample will be collected in the first hour of runoff if the runoff is continuous.

By sampling with automatic samplers at these sites it may be possible to collect runoff from storms beginning during off-duty hours. Although this is not required by the permit, it is one way in which it may be possible to fulfill the requirement of monitoring the first storm of the season. The permit also constrains sampling activities by requiring that storms to be sampled be preceded by at least three working days without storm water discharge. Berkeley Lab will make every effort to comply with all monitoring requirements as stated in the General Permit, and if unable to, will document in the Annual Report the reasons for any deviation from the required program.

3.0 ANALYTICAL METHODS

3.1 EPA METHODS

The general permit states that all analyses must be conducted according to test procedures given under 40 CFR 136, unless otherwise specified in the permit or by the RWQCB. Berkeley Lab intends to comply with this requirement of the general permit and will thus specify certain analytical methods to be used for the pollutants of concern as documented in Section 2.0. These consist of EPA-approved methods and, as appropriate, any other methods approved and required by DOE for the constituents of concern. Table 3-1 shows the parameters and the corresponding analytical methods.

Table 3-1 EPA Methods for Berkeley Lab Parameters Analyzed

Parameter	EPA Method	Reporting Limit	Bottle Type	Preservative	Hold Time
Aluminum	EPA200.7	0.05 mg/L	1L HDPE	None	6 months
Iron	EPA200.7	0.05 mg/L	1L HDPE	None	6 months
Magnesium	EPA200.7	0.05 mg/L	1L HDPE	None	6 months
Zinc	EPA200.7	0.05mg/L	1L HDPE	None	6 months
Mercury	245.1	0.0002 mg/L	1L HDPE	None	28 days
pH	EPA150.1	±1 Units	1L HDPE	None	24 hrs
TSS	EPA160.2	1 mg/L	1L HDPE	None	7 days
Conductance	EPA120.1	NA	1L HDPE	None	28 days
CODF	EPA410.4	5 mg/L	1L HDPE	None	28 Days
Nitrite / Nitrate	E300.0	0.3 mg/L	0.5L HDPE	H2SO4	28 Days
NH3	EPA350.2	0.03 mg/L	0.5L HDPE	H2SO4	28 Days
O & G	E1664	5 mg/L	1L AG	HCl	28 Days
PCBs	E8082A	0.0002 mg/L	1L AG	None	7 days
TPH (Diesel)	EPA8015	0.05 mg/L	1L AG	None	14 days
Tritium	E906EP	200 pCi/L	250ml AG	None	6 months
Alpha Emitters	EPA 900	2 pCi/L	1L HDPE	None	6 months
Beta Emitters	EPA 900	3 pCi/L	1L HDPE	None	6 months

Routine analyses and QA splits will be carried out by a laboratory certified for such analyses by the State Department of Health Services. Sample collection and preservation will be in accordance with the above methods, and are further specified in Section 4.0 of this document.

4.0 SAMPLING PROGRAM

In order to determine the contaminants that exist in the storm water runoff, it is necessary to collect representative samples of the storm water runoff for analysis. Some measurements need to be taken in situ because the parameters to be measured will change substantially immediately after samples are collected.

4.1 SAMPLING PROCEDURES

Sampling procedures will depend on the substances that are being analyzed and suspected influences that may interfere with the analyses. Samples will be collected from locations where significant storm water discharge from the site occurs. Samples must represent the quality and quantity of storm water discharged from the facility. Sample collection and preservation will be conducted in a manner which will eliminate or minimize changes in the sample which would interfere with the accurate measurement of the samples.

To this end, all sampling and sample preservation will be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment will be calibrated and maintained in accordance with the manufacturers' specifications to ensure accurate measurements. Calibration and maintenance will be documented on the appropriate form, in accordance with standard procedures. All analyses will be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified by the Regional Board. Where 40 CFR 136 does not specify test procedures for a given parameter, EPA methods from "Procedures for the Examination of Water and Wastewater" or from "Standard Methods" have been chosen.

All of the samples will be collected using a composite sampler. See Table 3-1 for the bottle type, preservation, and hold time requirements for each of the sample types collected. The composite sample container will be thoroughly mixed prior to filling each sample container. Non-radiological samples will be stored at 40C and transported to the appropriate commercial analytical laboratory on ice. Radiological samples will be stored at room temperature.

Measurements of the pH of the storm waters will be taken in situ during the sample collection. The pH will be measured electrometrically, using a pH meter which will be calibrated to the manufacturer's specifications at the beginning of each monitoring effort. The pH readings must be temperature-compensated, either manually or automatically according to manufacturer's specifications. The pH measurements will be recorded on the ESG Sample Collection Form (see Appendix C) filled out during each sample collection.

4.2 SAMPLING LOCATIONS

4.2.1 North Fork of Strawberry Creek Basin

North Fork of Strawberry Creek Outlet (Site ID: StW2)

Samples will be taken downstream of the first drop structure in the North Fork of Strawberry Creek. This site is behind Building 88, below the fence off Berkeley Lab property. A stairway for access and a sampling structure has been constructed at that point. Samples will be automatically collected using an ISCO sampler and ISCO 4210 flow-meter.

4.2.2 Strawberry Creek Basin

Chicken Creek Inlet Structure (Site ID: StW3)

The sampling location is a large manhole north of Building 69. Samples will be automatically collected using an ISCO sampler and liquid level actuator at the manhole invert after flows from the storm drains mix. Care will be taken to keep flows from the small lines on site out of the samples.

Chicken Creek Outlet (Site ID: StW4)

A sampling structure has been constructed on Chicken Creek at a point below the confluence of any site tributaries to it. Samples will be automatically collected using an ISCO sampler and ISCO 4210 flow-meter.

4.2.3 East Canyon Outlet (Site ID: StW5)

Samples will be taken at the drop structure in the south corner of the B83 Parking lot, downstream from the yards of the Hazardous Waste Handling Facility. An ISCO automatic sampler and liquid level actuator will collect the samples automatically.

4.3 SAMPLING SCHEDULES

4.3.1 Visual Observations

During the wet season, visual observations will be made at all monitoring sites during at least one storm event per month. Visual observations are recorded on ESG Field Observation forms (based on RWQCB Form 4), included in Appendix C. The visual observations will include the presence of floating and suspended materials, oil and grease, discolorations, turbidity, odor, and any observations which might indicate the source of any pollutants. In accordance with Section B.8 of the permit, if observations cannot be made because of adverse weather conditions, including lack of rain, a description of why the observations could not be made will be recorded and an explanation will be given in the Annual Report.

4.3.2 Collection and Analysis of Storm Water

Storm water will be collected and analyzed at the sample locations described in Section 4.2 for two storms each wet season, including, if possible, the first storm event. The storms must be preceded by at least three working days of dry weather. Samples will be collected during the first hour of runoff from a storm event, to the extent possible. Samples are picked up, processed, and sent to analytical laboratories by sampling technicians on the next working day after sample collection.

4.3.3 Dry Season Observations

Observation of authorized and unauthorized non-storm water discharges will be conducted quarterly for all drainage areas of the facility. Observation will include documentation of flows, discolorations, stains, sludges, odors, floating materials, and other abnormal conditions, as well as the source of any discharge. Dye tests, TV surveys, sampling and analysis, and validation of accurate piping schematics may be necessary to identify the source of any discharges. Observations will be recorded on ESG Field Observation forms (based on RWQCB forms 2 and 3), included in Appendix C. If non-storm water discharges are observed, an investigation will be conducted, and the SWPPP will be revised in accordance with Section A of the General Permit.

4.4 SAMPLING EQUIPMENT

ISCO 3700 samplers will be set up at the four sampling sites (StW2 through StW5) described in Section 4.2. The samplers will be equipped with plastic containers and liquid level sample actuator/4210 flow-meter switches, and are connected to an AC power source. The samplers will be checked prior to forecasted or anticipated storms to make sure that they are operating properly and are ready to sample. Sample volume will be checked upon installation to assure that a proper volume will be collected upon sampler initiation. It may be necessary to take a water source along when the creeks and storm drains are not flowing. The sampler intake and the level actuator are placed so that flow at the site will actuate the sampler, collect representative samples, and not react to moisture or rainfall when the stream is not running.

4.4.1 Maintenance and Calibration

All maintenance will be carried out in accordance with EH&S Procedure 263, Storm Water and Surface Water Sampling Procedure. Equipment will be calibrated to manufacturers' specifications and checked to make sure that it is in good operating condition at least once before October 1st, and prior to any potential sampling event thereafter to assure that the equipment will be working when a storm water discharge occurs. The exception to this is pH meters, which will be calibrated immediately prior to each monitoring session.

5.0 RECORDS AND REPORTS

5.1 RECORD RETENTION AND AVAILABILITY

Berkeley Lab will retain records of all storm water monitoring information and copies of the annual report (see below) and any other required records or reports for a period of at least five years from the date of the sample, observation, measurement, or report. These records are public documents, and will include the following:

- All data used to complete the NOI.
- The Record of Wet Season Visual Observations (see Appendix C), which includes date, place, and time of observation or measurement, the name of the individual who performed it, and observations as to discharge, source of discharge, and any corrective actions taken.
- The Record of Observation of Authorized and Unauthorized Non-Storm Water Discharges (see Appendix C), which includes date, time, and place of observation, the name of the individual performing the observation, and any corrective action taken.
- The date and place of site inspections, the individual who performed them, and any observations.
- Visual observation and sample collection exception records.
- Certifications, based on annual site inspections, that the facility is in compliance with the requirements of the General Permit and the SWPPP.
- Chain of custody forms (see Appendix C) for all samples taken and sent to a laboratory for analysis.
- All lab reports, including the date analyses were performed and the time they were initiated, the individual performing the analyses, method detection limits, and the analytical techniques or methods used and the results.
- Quality assurance/quality control results (see Section 7.0).
- All calibration and maintenance records of instruments used.
- All training certifications as described in Section 6.0 of this document.
- Records of any corrective actions and follow-up activities that resulted from visual observations.

All appropriate information will be retained in the offices of the Environmental Services Group. The records will be available for inspection upon request by a representative of the Regional Board or the local agency.

As a condition of the permit, Berkeley Lab will also maintain on-site a copy of the permit itself and make it available to operating personnel.

5.2 REPORTS

By July 1 of each year Berkeley Lab will submit an annual report in accordance with the reporting requirements of the general industrial storm water discharge permit. The report will include the following:

- A summary of visual observations and sampling results for the previous year, and an evaluation of them.
- Analytical laboratory reports.
- The Annual Comprehensive Site Compliance Evaluation Report as specified in Section A.9 of the General Permit.
- Visual observation and sample collection exception reports, if any, and attendant documentation of all significant storm water discharge events.

The report will be signed and certified by the team leader of the Berkeley Lab Water Quality Program, in accordance with the signatory requirements (Provision 9) of the standard provisions of the general permit, and will contain the following certification:

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

Berkeley Lab will also comply with other reporting requirements pertaining to planned changes, anticipated noncompliance, compliance schedules, and noncompliance reporting, as described in Provision 11 of the Standard Provisions of the general permit.

Monitoring results and other relevant information contained in the annual report will also be published in the annual Berkeley Lab Site Environmental Report.

6.0 TRAINING

In order to ensure that monitoring is conducted by trained personnel, a training program is a necessary element of the quality control program discussed in Section 7.0 of this document. A curriculum has been developed and is available under separate cover. The Table of Contents from the curriculum can be found in Appendix D of this document as an indication of the subjects to be covered during training.

All personnel who will be carrying out observations, measurements, and/or sampling under this SWMP will participate in the training program. Initial training occurred in September of 1992 prior to the startup of the storm water monitoring program, and was conducted by qualified individuals experienced in water quality monitoring and sampling, instrument maintenance and calibration, data management, and the regulatory framework. To the extent possible, training was conducted on the actual equipment that is to be used in sampling.

Training consisted of an introductory session followed by two four-hour classroom training periods. A test was administered at the end of the training, and, upon successful completion of the test, individuals were certified to participate in monitoring and sampling activities. Training records were placed in a file kept by the Team Leader and also became part of the records retained as described in Section 5.0 of this document.

New or re-classified employees whose duties will include monitoring, observations, and sampling subsequent to the initial training will be provided with the curriculum given in Appendix D for self-study and given on-the-job training by personnel who have been trained and certified in this training program or are otherwise qualified by experience in this area as above. This will include a thorough review of the latest SWMP, SWPPP, ESG Storm Water Procedures, and any other relevant material. They may also be tested and certified as described above. Training records will be maintained by the Storm Water Program Manager and/or Team Lead as discussed in Section 5.1. As conditions or parameters change, or the scope of operations increases, additional training may be designed and implemented.

7.0 QA/QC AND PROGRAM EVALUATION

7.1 PURPOSE

This SWMP will become a part of the overall environmental monitoring program at Berkeley Lab, which is based on DOE/EH-0173T and regulatory permits and requirements such as this SWMP. In keeping with DOE objectives pertaining to compliance, minimization of risks to the public and the environment, and the conducting of environmental monitoring to identify and evaluate the effects of DOE activities, Environmental Services personnel will exercise oversight over this program by monitoring the completion of the following quality assurance/quality control activities:

- All monitoring is conducted by trained personnel. See Section 6.0, Training Program.
- All personnel are familiar with the SWMP. A statement certifying that each staff member who will be conducting sampling has read and is familiar with the SWMP will become part of the individual's training record.
- Records are maintained certifying that all instruments are calibrated and maintained in accordance with manufacturers' instructions and EH&S procedures.
- Only state-certified laboratories with approved quality assurance programs for the analysis of samples are used, and such analysis is documented by chain of custody and laboratory reports.
- Quality Control is carried out in accordance with EH&S Procedure 263, Storm Water, Surface Water, and Rainwater Sampling Procedure.
- Verification of data quality is carried out in accordance with EH&S Procedure 252, Data Quality Objectives and Assessment.
- Procedures are initiated by which management will review activities and confirm that all elements of the SWMP have been carried out (see Section 1.4, Implementation Activities).

The purpose of periodic evaluation is to monitor, in an ongoing and systematic fashion, the effectiveness of the SWMP in meeting the objectives stated in the general permit and repeated in Section 1.0 of this document. The main goal of the SWMP is to produce accurate, representative data on the amount of contaminants, if any, discharged by Berkeley Lab in its storm water runoff, and, by using this data, to demonstrate a reduction in such contaminants due to measures and practices described in the SWPPP.

7.2 PROCEDURES AND SCHEDULES

Upon receipt of the laboratory results, an ESG-trained storm water monitoring and sampling technician will review them for completeness and any reduction/increase in any contaminants determined to be present. The Program Leader will validate them and address any unusual or unexpected results. During the dry season the only activity will be the observation of non-storm water discharge, if any. During the wet season both the Record of Observation and the results of any sampling analyses will need to be reviewed. The ESG storm water technician will also review the monitoring design (Table 2-4) to assure that all activities which need to be conducted are in fact carried out. Since rainfall and significant storm water discharge are unpredictable, and sampling cannot be scheduled at regular intervals, particular emphasis must be placed upon ensuring that two storm events per season are monitored at all locations which are slated to be monitored. During the dry season, activity should be reviewed once per month to assure that observations are completed, since there will be no sampling results. The ESG storm water technician will periodically report the status of storm water monitoring to the team leader. Any anomalies in monitoring results must be reported immediately. The team leader will also monitor the status of the program by reviewing the data base once per month at a minimum.

The records of observations and results of analyses become part of the permanent record and provide the basis for the annual report which is due to the RWQCB on July 1 of each year (see Section 5.0). The periodic program evaluation is the basis for the annual evaluation of the SWMP also found in the annual report, and for any revisions or amendments to the SWMP. In accordance with the permit, for example, if toxic chemicals or other pollutants are not detected in significant quantities after two consecutive sampling events, that toxic chemical or pollutant may be eliminated from future sampling events.

To be effective, the SWMP must collect and present accurate, representative data which characterize Berkeley Lab's storm water runoff. Evaluation of the SWMP should demonstrate that it is in fact carrying out this goal. The ultimate goal is to document the achievement of a reduction in any contaminants which may at first be present in that runoff. By evaluating and keeping track of the results of various analyses, it will become clear which areas are producing contaminants and which areas are improving by reducing contaminants in storm water runoff. If the levels of contaminants decrease with each succeeding analysis, this will clearly demonstrate that both the SWPPP and the SWMP are fulfilling their respective functions, the former by achieving the reduction, if not the elimination, of any contaminants through BMPs, and the latter by documenting that achievement.

Appendix A

RECORD OF REVISIONS

RECORD OF REVISIONS

Number	Description	Section	Date	Initials
Rev. 0	Original Document	All	10/92 and 1/93	REL
Rev. 1	General Revision	All	3/97	REL
Rev. 2	General Revision to meet requirements of reissued General Permit	All	6/97	REL
Rev. 3	General Revision	All	12/01	REL
Rev. 4	General Revision	All	10/05	REL/JJ/PAT

Appendix B

LIST OF ACRONYMS

Acronyms

BMPs	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CFR	Code of Federal Regulations
DOE	Department of Energy
DSA	Drum Storage Area
EPA	Environmental Protection Agency
ESG	Environmental Services Group
GC/MS	Gas Chromatography/Mass Spectroscopy
Berkeley Lab	Ernest Orlando Lawrence Berkeley National Laboratory
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWMP	Storm Water Monitoring Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
UST	Underground Storage Tank
WAA	Waste Accumulation Area

Appendix C

FORMS AND RECORDS

U.C. Lawrence Berkeley National Laboratory
1 Cyclotron Road
Berkeley CA 94720

LBNL ENVIRONMENTAL SERVICES GROUP
Chain of Custody

Environmental Reviewer: ____________________

Phone: ____________ Fax: ____________

Mailstop: ____________ e-mail: ____________

Purpose:

COC No.: ______

Page ___ of ___

Release Number / DocumentControl No.: ____________

Collections: ____________________

Sample Location	Sampler Initials	Date & Time Sampled	Reference Date/time*	Collection Method	Sample Type	Container Volume & Code** #	Preservative	Analysis Required	Notes to Lab

Total No. of Containers:

Shipping Document ID:

Turnaround Time:

Lab Name:

Special Instructions/Comments:

Relinquished By (Sampler)	Relinquished By	Relinquished By
Signature / Time	Signature / Time	Signature / Time
Printed Name / Date	Printed Name / Date	Printed Name / Date
Company	Company	Company
Received By	**Received By**	**Received By**
Signature / Time	Signature / Time	Signature / Time
Printed Name / Date	Printed Name / Date	Printed Name / Date
Company	Company	Company

*REFERENCE DATE/TIME: Use this value for decay calculations in radiological analyses when applicabl **Container Codes: AG = amber glass CG = clear glass PE = polyethylene VV = VOA vial

ESG Sample Collection Form

U.C. Lawrence Berkeley National Laboratory
1 Cyclotron Road
Berkeley CA 94720

Collection: ____

Sample Data					Apparatus					
SampleId	Location	SampleType	QC Type	Coll Type	Serial	Date/time	Container	Presv	Amount	Sample Notes
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									
	Sample Collected?									

Wednesday, August 24, 2005

Page ___ of ___ Pages

ESG Composite Collection Form

U.C. Lawrence Berkeley National Laboratory
1 Cyclotron Road
Berkeley CA 94720

Collection: ______

Flow measurements

Location	Apparatus	Dates/times		Flowrates		Volumes		Composite Notes
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		
		Start		Start		Start		
		Stop		Stop		Stop		
		Elapsed		Composite Collected?		Total		

Wednesday, August 24, 2005

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Lawrence Berkeley National Laboratory
Environmental Services Group
Stormwater Monitoring Program

Date:	
Observer:	
Observation Dates:	

Quarterly Visual Observations of NON-Authorized Non-Stormwater Discharges

Site	STW 2 North Fork Strawberry Creek	STW 3 B69 Manhole	STW 4 Chicken Creek	STW 5 East Canyon	Sitewide
Visual Observations	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:
Non-Stormwater Discharge Observed (Y/N)					
General Site Observations					
Corrective Action Taken					

Comments:

Lawrence Berkeley National Laboratory
Environmental Services Group
Stormwater Monitoring Program

Date / Time: ____________________
Observer: ____________________
Date / Time Discharge Began: ____________________

Monthly Visual Observations of Stormwater Discharges

Site	STW 2 North Fork Strawberry Creek	STW 3 B69 Manhole	STW 4 Chicken Creek	STW 5 East Canyon
Weather Observations				
Flow				
Total Discharge				
Floating or Suspended Material Present				
Oil and Grease Observed				
Discolorations				
Turbidity				
Odor				
General Site Observations				
Comments				

Lawrence Berkeley National Laboratory
Environmental Services Group
Stormwater Monitoring Program

Date:	
Observer:	
Observation Dates:	

Quarterly Visual Observations of Authorized Non-Stormwater Discharges

Site	STW 2 North Fork Strawberry Creek	STW 3 B69 Manhole	STW 4 Chicken Creek	STW 5 East Canyon	Sitewide
Visual Observations	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:	Runoff: Sheen: Water Stains: Other:
Non-Stormwater Discharge Observed (Y/N)					
General Site Observations					
Corrective Action Taken					

Comments:

Appendix D

TRAINING CURRICULUM
TABLE OF CONTENTS

Training Curriculum Table of Contents

Section

APPENDICES

A. Selected Sections from the *EPA Guidance Manual for the Preparation of NPDES Permit Applications for Storm Water Discharges Associated with Industrial Activity*

B. Certification of Training

C. Tests

Appendix E

CHANGES IN MONITORING PARAMETERS

(SEE ALSO SECTION 2.4, RATIONALE FOR MONITORING PARAMETERS,

FOR NARRATIVE DETAILS)

Table 2-3

Potential Contaminants and Building Area Sources at LBL

Building or Area	Potential Contaminants
Blackberry Canyon	
7, 7E	PCBs, gasoline, acetone, alcohol, MEK, TCE, kerosene, metals, diesel
16	PCBs
46	Kerosene
50	BTEX, TPH, TCE, PCE, THC, PCBs
51	PCBs, diesel, VOCs, THC
52, 53	PCE, TCE, cis-1,2 DCE, vinyl chloride, carbon tetrachloride
58	TPH
64	Lead
71	Freon 113, PCBs
88	THC, PCBs
North Fork of Strawberry Creek	Ni, Ba, Zn, Cr, Mo
Cooling Towers	Chromates[1]
Strawberry Canyon	
4	Radioactivity[2]
5	Radioactivity[2]
25	Copper, zinc
6, 37	BTEX, THC, copper, chromium
62	VOCs, PCE, TCE, BTEX, THC, TPH, diesel
74	Diesel, gasoline
75	Tritium
76	THC, TCE, cis-1,2 DCE, Ni, BTEX, VOCs
77	PCE, TCA, cyanide

1 Historical use only.

2 Historical radioactivity consisting of alpha and beta emissions. Not presently detected.

E2-098.0
10/92

Table 2-3
Analyses to be Performed for Monitoring Locations at LBL

	Parameters of Concern[1]								
Monitoring Locations	Metals	VOCs	PCBs	CN	TPH/ BTEX	TPH/ Extractable	Gross alpha & beta	Tritium	Whole Effluent Toxicity
StW 1[2]	•	•	•	•	•	•	•	•	
StW 2	•	•	•		•	•			
StW 3[2]	•	•	•	•	•	•	•	•	
StW 4	•	•	•	•	•	•	•	•	
StW 5			•		•	•			•
StW 6	•	•				•			•
StW 7[3]									•
StW 8		•				•			•
StW 9[3]									•
StW 10						•			•

1 All samples are tested for pH, Total Suspended Solids (TSS), specific conductance, and Total Organic Carbon (TOC) or oil and grease.
2 For the first storm event, all analyses will be run for the two influent locations. For subsequent storm events, analyses will be modified as appropriate according to previous results and any contaminants expected to be present.
3 No contaminants are expected to be present at these outfalls. Analyses for the standard parameters as in footnote 1 above will be performed.

1/93

Table 2-3
Analyses to be Performed for Monitoring Locations at Berkeley Lab

	Parameters of Concern[1]						
Monitoring Locations	Metals[2] (Total)	TPH/ Diesel	Gross alpha & beta	Tritium	NH_3	COD	N+N
StW 1	●	●	●	●		●	●
StW 2	●	●	●	●		●	●
StW 3	●	●	●	●		●	●
StW 4	●	●	●	●		●	●
StW 5	●	●	●	●	●	●	●

[1] All samples are tested for pH, Total Suspended Solids (TSS), specific conductance, and Total Organic Carbon (TOC) or oil and grease.

[2] The General Permit requires analysis for total metals. In addition, Berkeley Lab has committed to analyzing one sample per year for dissolved metals, on the request of the local administering agency. Metals will include aluminum, iron, and magnesium.

Rev. 1
3/97

Table 2-3
Analyses to be Performed for Monitoring Locations at Berkeley Lab

	Parameters of Concern[1]						
Monitoring Locations	Metals[2] (Total)	TPH/ Diesel	Gross alpha & beta	Tritium	NH_3	COD	N+N
StW 1	•	•	•	•		•	•
StW 2	•	•	•	•		•	•
StW 3	•	•	•	•		•	•
StW 4	•	•	•	•		•	•
StW 5	•	•	•	•	•	•	•

[1] All samples are tested for pH, Total Suspended Solids (TSS), specific conductance, and Total Organic Carbon (TOC) or oil and grease.

[2] The General Permit requires analysis for total metals. In addition, Berkeley Lab has committed to analyzing one sample per year for dissolved metals, on the request of the local administering agency. Metals will include aluminum, iron, and magnesium.

Rev. 2
6/97

Table 2-3
Analyses to be Performed for Monitoring Locations at Berkeley Lab

	Parameters of Concern[1]						
Monitoring Locations	Metals[2] (Total)	TPH/ Diesel	Gross alpha & beta	Tritium	NH_3	COD	N+N
StW 2	●	●	●	●		●	●
StW 3	●	●	●	●		●	●
StW 4	●	●	●	●		●	●
StW 5	●	●	●	●	●	●	●

1 All samples are tested for pH, Total Suspended Solids (TSS), specific conductance, and Total Organic Carbon (TOC) or oil and grease.
2 The General Permit requires analysis for total metals. In addition, Berkeley Lab had committed to analyzing one sample per year for dissolved metals, on the request of the City of Berkeley. This was done from 1996 to 2001 with inconclusive results, and was discontinued starting with the stormwater season of 2001/2002.

Table 2-4
Monitoring Program Design

	Task[1]		
Monitoring Locations	Observation of Authorized and Unauthorized Non-Storm Water Discharges (Quarterly)[2]	Visual Observation of Storm Water Discharges (once per month, wet season)	Sampling[3]
North Fork of Strawberry Creek Outlet (StW2)	●	●	●
Building 69 Inlet (StW3)	●	●	●
Chicken Creek Outlet (StW4)	●	●	●
East Canyon Outlet (StW5)	●	●	●

1 Sampling and observation of storm water discharges must be preceded by three working days of dry weather and must occur during the first hour of the discharge. At Berkeley Lab, this may not be possible during the same event at all locations.
2 Must be performed on days when there is no storm water discharge.
3 Consists of two storm water events per season, the first storm event of the season and one other.

APPENDIX B

Environmental Monitoring and Surveillance Summary Table

Sample Type	Collection Frequency	Collection Type	Radiological Analyses	Non Radiological Analyses
Ambient Air	Monthly	Continuous	Gross Alpha, Gross Beta	
Meteorology	15 min. and Hourly	Continuous		Wind Speed, Direction, Temperature, Dew point, Barometric Pressure, Solar radiation and Precipitation
Penetrating Rad	Quarterly	Continuous	Gamma	
Penetrating Rad	Direct Reading	Continuous	Gamma, Neutron	
Rainwater	Monthly, Wet Months	Continuous	Gross Alpha, Gross Beta, Tritium	
Sediment	Annually	Grab	Gross Alpha, Gross Beta, Tritium	Metals, Polychlorinated Biphenyls (8080), pH, Oil & Grease, Diesel Fuel
Soil	Annually	Grab	Gross Alpha, Gross Beta, Tritium, Gamma	Metals, pH
Stack Air Emissions	Direct Reading	Continuous	Gross Alpha, Positron	
Stack Air Emissions	Monthly/ Quarterly	Continuous	Gross Alpha, Gross Beta, Tritium, Carbon-14, Iodine-125	
Storm Water	2 Storm Events	Composite	Gross Alpha, Gross Beta, Tritium	Metals, Total Petroleum Hydrocarbons-Extract, pH, Chemical Oxygen Demand, Filtered, Total Suspended Solids, Specific Conductance, Oil & Grease, Ammonia as Nitrogen, Nitrite & Nitrate as Nitrogen
Creeks	Quarterly	Grab	Gross Alpha, Gross Beta, Tritium	Mercury
Vegetation	Every 5 years	Grab	Tritium	
Wastewater-Nonrad	2-4 Times/Year	24-Hour Composite*		Metals, pH, Chemical Oxygen Demand, Filtered, Total Identifiable Chlorinated Hydrocarbons (624), Total Suspended Solids
Wastewater-Rad	4 Weeks	Composite	Gross Alpha, Gross Beta, Tritium, Iodine-125, Carbon-14, Phosphorus-32, Sulfur-35	

* Building 25 is a grab sample due to batch release. The samples at 25 and 77 are only analyzed for metals.

APPENDIX C

Environmental Monitoring Procedures

Environmental Services Group – Environmental Monitoring Procedure List

Procedure Title	Number
Environmental Reporting and Correspondence	200
Environmental Permits Process	201
Onsite Analysis of Environmental Samples	206
Dose Measurement and Calculations for Monitoring Environmental Penetrating Radiation	207
Nonconformance and Corrective Action Reporting	208
Auditing Radionuclide NESHAP Compliance	217
Calculating Dose from Radioactive Emissions for NESHAP Compliance	218
Categorizing Potential Sources of Radioactive Air Emissions	219
Storm Water Facilities Inspection	220
Data Quality Objectives and Assessment	252
Data Calculating and Reporting	253
Sample Processing, Packaging, and Transportation	254
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Soil, Sediment, and Vegetation Sampling	266
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Stack Effluent Flow Rate Measurement and Calibration	287
Meteorological Monitoring	291