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LAWRENCE LIVERMORE NATIONAL LABORATORY
SURFACE WATER PROTECTION:
A Watershed Approach

Rev 0

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March 2009

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Abbreviations & Acronyms

BMPs	best management practices
CESA	California Endangered Species Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DOE	Department of Energy
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EMP	Environmental Management Plan
EMS	Environmental Management System
EPD	Environmental Protection Agency
ESA	Endangered Species Act
GSA	General Services Area
ISMS	Integrated Safety Management System
IWS	Integration Work Sheet
LLNL	Lawrence Livermore National Laboratory
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
SFRWQCB	San Francisco Regional Water Quality Control Board
SME	subject matter expert
SPCC	Spill Prevention Control and Countermeasure Plan
SWEIS	site-wide environmental impact statement
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
WDR	Waste Discharge Requirements

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1. INTRODUCTION

This surface water protection plan (plan) provides an overview of the management efforts implemented at Lawrence Livermore National Laboratory (LLNL) that support a watershed approach to protect surface water. This plan fulfills a requirement in the Department of Energy (DOE) Order 450.1A to demonstrate a watershed approach for surface water protection that protects the environment and public health. This plan describes the use of a watershed approach within which the Laboratory's current surface water management and protections efforts have been structured and coordinated.

With more than 800 million acres of land in the U.S. under federal management and stewardship, a unified approach across agencies provides enhanced resource protection and cost-effectiveness. The DOE adopted, along with other federal agencies, the *Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management* (UFP) with a goal to protect water quality and aquatic ecosystems on federal lands. This policy intends to prevent and/or reduce water pollution from federal activities while fostering a cost-effective watershed approach to federal land and resource management. The UFP also intends to enhance the implementation of existing laws (e.g., the Clean Water Act [CWA] and National Environmental Policy Act [NEPA]) and regulations. In addition, this provides an opportunity for the federal government to serve as a model for water quality stewardship using a watershed approach for federal land and resource activities that potentially impact surface water and its uses.[1]

As a federal land manager, the Laboratory is responsible for a small but important part of those 800 million acres of land. Diverse land uses are required to support the Laboratory's mission and provide an appropriate work environment for its staff. The Laboratory comprises two sites: its main site in Livermore, California, and the Experimental Test Site (Site 300), near Tracy, California. The main site is largely developed yet its surface water system encompasses two arroyos, an engineered detention basin (Lake Haussmann), storm channels, and wetlands. Conversely, the more rural Site 300 includes approximately 7,000 acres of largely undeveloped land with many natural tributaries, riparian habitats, and wetland areas. These wetlands include vernal pools, perennial seeps, and emergent wetlands. The watersheds within which the Laboratory's sites lie provide local and community ecological functions and services which require protection. These functions and services include water supply, flood attenuation, groundwater recharge, water quality improvement, wildlife and aquatic habitats, erosion control, and (downstream) recreational opportunities[2]. The Laboratory employs a watershed approach to protect these surface water systems. The intent of this approach, presented in this document, is to provide an integrated effort to eliminate or minimize any adverse environmental impacts of the Laboratory's operations and enhance the attributes of these surface water systems, as possible and when reasonable, to protect their value to the community and watershed.

The Laboratory's watershed approach to surface water protection will use the U.S. Environmental Protection Agency's Watershed Framework and guiding principles of geographic focus, scientifically based management and partnerships[1] as a foundation. While the Laboratory's unique site characteristics result in objectives and priorities that may differ from other industrial sites, these underlying guiding principles provide a structure for surface water protection to ensure the Laboratory's role in environmental stewardship and as a community

partner in watershed protection. The approach includes pollution prevention, continual environmental improvement, and supporting, as possible, community objectives (e.g., protection of the San Francisco Bay watershed).

Geographic Focus
The Laboratory's surface water protection plan includes all areas (at both sites) that drain to surface water bodies or that have the potential to impact groundwater resources (e.g., surface water that recharges or overlays groundwater resources). These geographic areas include habitats and components important to maintaining the Laboratory's surface water quality and protecting its aquatic communities (e.g., riparian habitats). These identified areas provide a geographic focus for a watershed approach.

This surface water protection plan should be carried out in coordination with the Laboratory's Ground Water Protection Program.

Science and Data–based Management
The Laboratory uses science and data–based management, as possible and appropriate, as a basis for surface water protection decisions and actions. This approach provides the foundation for planning, monitoring activities, establishing sampling techniques, determining appropriate laboratory analyses, developing mitigation and control methods, identifying and implementing best management practices, and using adaptive management.

A baseline assessment and characterization of the natural resources at both sites occurred in support of a Site-Wide Environmental Impact Statement (SWEIS)[3]. The SWEIS incorporated a science-based effort to identify and prioritize components for protection, sensitive areas and key issues, and environmental objectives. This baseline assessment provides a foundation to track and evaluate environmental conditions (temporally and spatially) with ongoing monitoring and surveys. The Laboratory's Environmental Management System (EMS) seeks to support continual improvement in protection efforts for surface water quality, riparian habitats, and aquatic communities.

Partnerships and Coordination
The Laboratory is committed to environmental stewardship of its natural resources, which includes its surface waters and their aquatic communities. This surface water protection requires coordination between Laboratory programs and support organizations regarding their work activities, as well as between Laboratory Environmental Protection staff, state and federal resource agency staff, National Nuclear Security Administration (NNSA) staff, and the community (when possible and feasible). These efforts also require integration with other natural resource protection programs (e.g., groundwater, wildlife, and habitat conservation), site planners, and landscaping staff at the Laboratory to ensure comprehensive evaluation, safeguards, and actions are implemented. This necessarily means that Laboratory programs and staff impacted by surface water protection decisions and management are actively involved in this program. The regulatory component of surface water protection provides for communication of environmental stewardship of this resource and integration of a wider watershed initiative (i.e., meeting requirements that protect community waters and objectives). Finally, any watershed approach to surface water protection must incorporate, as feasible, community

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objectives and values into its management efforts as well as communication with community partners. Routine coordination, communication, and awareness of watershed concerns and objectives of other entities also provide the potential for mutually beneficial informal partnerships regarding watershed management.

2. Goals and Objectives

The Laboratory's watershed approach includes multiple principles for achieving integrated management and protection of surface water resources. These include 1) addressing the issues and objectives that occur across both sites and their programs, 2) coordinating planning and management of activities, 3) ensuring communication with all staff involved in surface water protection, 4) ensuring a scientific foundation upon which the surface water protection programs are based, 5) providing ongoing monitoring to continue acquiring necessary scientific data and information and 6) using an iterative process through adaptive management and the EMS to continually improve surface water protection efforts.

Goals:

- Provide a watershed approach to surface water protection and management including associated aquatic ecosystems within a framework that supports the Laboratory's ability to efficiently accomplish its mission.
- Coordinate and collaborate with regulatory agencies, Laboratory operations and programs staff, and the community, as possible and appropriate, to ensure surface water protection through managing Laboratory activities within the watershed.
- Use adaptive management with the Laboratory's EMS and Integrated Safety Management System (ISMS) to continually improve surface water management and protection efforts.

Objectives:

- Protect and/or improve water quality and beneficial uses of waters of the State.
- Provide adequate flood attenuation.
- Minimize maintenance activities needed in and around surface water.
- Provide appropriate soil and sediment management.
- Maintain performance of flood protection and storm water facilities.
- Provide invasive species management related to surface water protection, as possible and appropriate.
- Identify restoration opportunities to enhance ecological structural complexity and control bed/bank erosion/sedimentation impacts.

- Provide education to staff on the importance of surface water protection, the structure in place that provides a watershed approach to this protection, and ways in which staff may participate in and support these efforts.
- Eliminate or minimize, as possible, non-storm water discharges into surface waters and maintain all non-storm water discharges below discharge limits specified in permits and other regulatory drivers (point and non-point sources).
- Minimize pollutants in storm water discharges, as possible, through the use of best management practices for point and non-point sources as specified in Storm Water Pollution Prevention Plans (SWPPPs) and Spill Prevention Control and Countermeasure Plans (SPCCs).

The California red-legged frog (*Rana aurora draytonii*) is a federally threatened species that uses surface water features and their aquatic habitats at both of the Laboratory's sites. A watershed approach for surface water protection is important. It protects both Laboratory populations of this species and downstream (regional) populations.

3. Regulatory and Policy: Regulatory Requirements and Related Plans

Surface water protection at the Laboratory encompasses 1) direct non-storm water impacts to surface water, 2) storm water impacts to surface water 3) invasive species impacts to surface water, riparian habitats, and aquatic communities, and 4) actions or activities in and around surface water habitats that may affect their structure, function and resources. Discharges and activities impacting surface water drainage courses and riparian habitats potentially may adversely impact surface water quality, wildlife and their habitats, and overall environmental health and integrity.

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Regulatory Requirements

The Laboratory complies with applicable federal and state environmental laws and regulations. The regulatory agencies implementing these surface water-related laws and regulations include the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Toxic Substances Control, California Department of Fish and Game, California State Water Resources Control Board, and the Central Valley and San Francisco Bay Regional Water Quality Control Boards. These laws and regulations provide the regulatory framework within which surface water protection is implemented. A watershed approach couples this framework with additional tools (e.g., best management practices, staff education, regional coordination) for a holistic and adaptive management strategy to protection efforts.

A. Applicable Laws and Regulations

The legislation, regulations, orders, and policies listed in Table 1 regulate the protection of surface water, including aquatic communities/ecosystems, at the Laboratory:

Table 1: Surface water protection-related laws, regulations, orders, and policies implemented at the Laboratory to ensure a watershed approach.

TITLE	DESCRIPTION
California Endangered Species Act	Requires protection of listed and proposed-for-listing species and their habitats. Prohibits the "taking" of these protected species.[17]
Comprehensive Environmental Response, Compensation and Liability Act/Superfund Amendment and Reauthorization Act	Requires cleanup of National Priorities List site.[18, 19]
Clean Water Act (CWA)	Requires EPA- or state-issued permits and compliance with provisions of permits regarding discharge of effluents to waters of the United States, which includes the National Pollution Discharge Elimination System (NPDES) Program and SPCC Program.[20]
DOE Order 450.1A	Requires the implementation of a watershed approach for surface water protection.[21]
DOE Order 430.2B	Requires water conservation and reduction in water use by 16% (based on FY 2007 usage) by 2015.[22]
Sections 404 and 401 Water Quality Certification of Clean Water Act/Rivers and Harbors Appropriations Act: Dredged or Fill Material Subset of Clean water act	Requires permits to authorize the discharge of dredged or fill material into navigable waters or wetlands and to authorize certain structures or work in or affecting navigable waters.[20]
Endangered Species Act	Requires protection of listed and proposed-for-listed species and their habitats.[23]
Fish and Wildlife Coordination Act	Requires consultation on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in

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TITLE	DESCRIPTION
	surface area.[24]
Migratory Bird Treaty Act	Requires protection of migratory birds from any impacts on their populations due to operations.[25]
National Environmental Policy Act	Requires all major Federal actions significantly affecting the environment to prepare an Environmental Impact Statement.[26]
National Pollutant Discharge Elimination System (NPDES) Storm Water Permit	Subset of CWA as well as oil pollution requirements. Requires operators of construction sites, industrial facilities and municipal separate storm sewer systems to obtain authorization to discharge storm water under an appropriate NPDES permit for their operations.20
Porter-Cologne Water Quality Control Act	Gives jurisdiction to State Water Resources Control Board (nine regions) to manage water quality. These regional boards determine beneficial uses of water in the state, establish and enforce water quality standards for surface and groundwaters, and take actions to maintain standards by controlling pollution sources.[27]
Wetlands: Compliance with Floodplain/Wetlands Environmental Review Requirements	Requires DOE to comply with all applicable floodplain/wetlands environmental review requirements.[28]

B. Permits

Two types of permits regulate direct discharges to surface water and storm water discharge: Waste Discharge Requirements (WDR) and NPDES permits. Table 3 (in Section 7) describes the permits in place for the Laboratory. Additional regulations place requirements on activities occurring within waterways to protect their beneficial uses.

C. Best Management Practices

The Laboratory's Environmental Protection Department (EPD) ensures compliance with the applicable environmental regulations, estimates the impacts of operations on the environment, and provides guidance on best management practices (BMPs) to further minimize any adverse environmental impacts. BMPs for surface water protection are found in site- and project-specific (as applicable) SWPPPs, and site-specific SPCC Plans. Section 7 of this Plan describes the SWPPPs and SPCCs in place for the Laboratory. EPD staff provides assistance to programs and staff throughout the Laboratory to implement environmental requirements, maintain compliance with the regulations, and identify alternative means to carry out operations or projects in an effort to minimize adverse impacts.

Watershed Management Plans

A watershed approach to surface water protection at the Laboratory entails multiple elements, efforts, programs, permits, and plans. It also entails integrating or supporting local and regional

watershed management efforts, informally and as appropriate, that ensure surface water protection. Awareness of watershed management plans, both internally and externally, is a critical component of the watershed approach at the Laboratory for protecting the surface water resource.

A. Laboratory Watershed-related Protection Plans

This LLNL surface water protection plan, with its watershed and adaptive management approach, encompasses multiple Laboratory management plans that directly or indirectly protect this natural resource. These plans provide critical elements that are used in the Laboratory's protection approach. The EMS incorporates these plans to protect environmental aspects identified for the Laboratory including 1) discharges to arroyo(s) and 2) discharges to the storm water system. These documents should be referenced for planning purposes, decision-making, operations and management efforts and include:

- Management Plan for Waters of the United States, Arroyo Seco (2001), Prepared for Lawrence Livermore National Laboratory.[4]
- Management Plan for Arroyo Seco at Sandia National Labs, Livermore, CA (2002), Prepared for Sandia National Laboratory.[5]
- Management Plan for Waters of the United States, Arroyo Las Positas (2004), Prepared for Lawrence Livermore National Laboratory.[6]
- Arroyo Mocho Creek Fish Passage Enhancement Project, Draft Study Document (2003), Prepared for Lawrence Livermore National Laboratory.[7]
- Storm Water Pollution Prevention Plan, Livermore Site, Revision 2 (2008). Lawrence Livermore National Laboratory.[8]
- Storm Water Pollution Prevention Plan, Experimental Test Site (Site 300), Revision 2 (2008). Lawrence Livermore National Laboratory.[9]
- Spill Prevention Control and Countermeasure (SPCC) Plan, Livermore Site (2008), Lawrence Livermore National Laboratory.[10]
- Spill Prevention Control and Countermeasure (SPCC) Plan, Experimental Test Site (Site 300) (2000), Lawrence Livermore National Laboratory.[11]
- Lawrence Livermore National Laboratory, Natural Resource Management Plan for Site 300 (2008), Draft Report.[12]
- Lawrence Livermore National Laboratory, Landscaping Plans https://ifm.llnl.gov/sdp_landscaping.html

B. Local and Regional Watershed Protection Plans

Carrying out a watershed approach to protecting surface waters, including aquatic communities/ecosystems, requires placing the Laboratory's efforts within the broader landscape and watershed. Any opportunity to reinforce local and regional efforts for surface water

protection through Laboratory decisions and actions supports these efforts. In addition, an awareness of these local and regional watershed protection efforts provides opportunities for informal partnerships outside of formal agreements, which are often time-consuming and complicated to achieve. An awareness of area watershed management plans and how the Laboratory's efforts fit into supporting such local and regional efforts is key to a more unified watershed approach. With this intent, it is important that the Laboratory maintain an ongoing awareness of the following management plans. This awareness may allow the Laboratory to align its decisions and actions, as possible and appropriate, with regional watershed protection priorities, needs, and efforts. Ongoing communication and coordination with stakeholders involved in preparing and implementing these plans, as well as other regional watershed managers and organizations, is also important to informing the Laboratory's surface water protection efforts.

- Water Quality Control (Basin) Plan, San Francisco Bay Regional Water Quality Control Board.[36]
- Water Quality Control (Basin) Plan, Central Valley Regional Water Quality Control Board.[37]
- San Francisco Bay Area Integrated Regional Water Management Plan.[13]
- Alameda Watershed Management Plan.[14]
- Local Government Riparian Buffers in the San Francisco Bay Area.[15]
- Principles for Integrated Planning in Watersheds, California Watershed Council.[16]
- Alameda Creek Habitat Conservation Plan,[38]
- San Joaquin County Multi-species Habitat Conservation and Open Space Plan.[39]

4. Environmental Management System

Environmental Policy and Environmental Management System

While complying with regulatory requirements is a key strategy for ensuring surface water protection, a watershed approach requires more than these regulatory instruments for successful protection. A watershed approach requires the integration of surface water stewardship efforts both across the Laboratory (geographically) and throughout its programs (staff partnership and participation). It also requires carrying out these efforts within the larger, broader context of the Laboratory's community objectives and values and the overall watershed. The Laboratory founds its environmental stewardship on principles stated in its Environmental Policy and integrates these principles through its EMS and ISMS. This provides for a systematic and integrated approach to environmental protection and continual environmental improvement. Adaptive management techniques are an integral part of the approach.

The Laboratory EMS began in 2005 and continues to evolve. The Laboratory identified its environmental aspects (i.e., the activities that may adversely impact the environment). Two of these environmental aspects are of direct concern for surface water protection efforts: discharges

to arroyos and discharges to the storm drain system. Two additional environmental aspects may adversely impact the surface water system: ecological resources disturbance and land use or land management practices. Detailed information regarding EMS (including these environmental aspects) is available at the EMS website.

EMS's overarching goal is to eliminate or mitigate environmental aspects through administrative and engineering controls. BMPs are in place, as needed, to protect surface water and aquatic ecosystems. Section 7 describes the administrative and engineering controls employed by diverse staff and departments across the Laboratory.

5. Description of LLNL Surface Water System

Introduction

A watershed approach to surface water protection requires science and data–based management. A watershed is an area of land in which the water all drains (eventually) to the same location. Identification and assessments of the surface water features for both sites provide a foundation upon which ongoing monitoring and protection efforts are built. Surveys conducted for site-wide environmental impact statements (SWEISs)[29, 30] provided delineation of surface water features, their components, and overall status.

The Laboratory's main site is within the San Francisco Bay Watershed. On a smaller (local) scale, this site lies within the Alameda Creek Watershed, which drains directly to the San Francisco Bay. Site 300 is within the Central Valley Watershed. Similarly, on a smaller scale, Site 300 lies within the Corral Hollow Creek Watershed that flows first to the larger Lower San Joaquin River Watershed and then towards the Sacramento–San Joaquin River Delta. See Appendix A for surface water map for both sites.

A. Main Site: An Industrial Campus

The main site consists of 1.3 square miles (821 acres) of land area and is largely developed. The Alameda Creek Watershed, within which the site lies, is the largest in the Bay area, and drains approximately 650 square miles (416,000 acres) of land area.[31] This watershed occurs in Alameda, Santa Clara and Contra Costa counties, with water in arroyos, creeks, and other drainages flowing into Alameda Creek and the Alameda County Flood Control Channel. This water ultimately discharges into the southern San Francisco Bay, near the Dumbarton Bridge.[31]

The mild climate that occurs in the area provides mild, rainy winters, with rainfall occurring mainly between October and April. Although the average rainfall in this watershed varies between 15 and 24 inches,[31] the Livermore area itself receives an average of approximately 14 inches. The main site includes few major surface water features, including Arroyo Las Positas and Arroyo Seco, and more numerous industrial surface water features (e.g., lined storm channels). Figure 1 shows these surface water features at the main site and in the Livermore Valley.

Wetland delineations were last completed in September 2002. In 2002, there were approximately 0.794 hectares (1.963 acres) of wetlands in the channel of Arroyo Las Positas with approximately 0.0692 hectares (0.171 acres) of open water habitat present in the channel. This arroyo historically occurred as an intermittent stream formed from the convergence of many

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small intermittent streams.[32] However, it underwent two significant relocations since the 1940s and is now a realigned, constructed channel with significant changes in its natural profile[6] and changes in influent sources.

The 2005 Final SWEIS provides a comprehensive summary of the surface water components at the main site, as described in the remainder of Section 5.A.[29]

Surface drainage and natural surface infiltration at the main site are generally good, but drainage decreases locally with increasing clay content in surface soils. Surface flow may occur intermittently from October to April, during the valley's wet season. Only intermittent streams flow into the eastern Livermore Valley from the surrounding uplands and low hills, where they merge on the valley floor. The four major intermittent streams that drain into the eastern Livermore Valley are Arroyo Mocho, Arroyo Seco, Arroyo Las Positas, and Altamont Creek (Figure 1). Arroyo Seco and Arroyo Las Positas pass through the main site, while Altamont Creek and Arroyo Mocho flow offsite to the north and southwest, respectively. Recharge to sediments underlying the Livermore Valley is primarily from the arroyos that originate in the eastern foothills and flow across the valley. When surface flow occurs in these channels, water infiltrates into the underlying alluvium and eventually percolates to the aquifers within the Livermore Valley.[29]

The headwaters of the Arroyo Seco drainage are in the hills southeast of the main site. Arroyo Seco has a drainage length of approximately 12 miles and a watershed area of approximately 8,960 acres upstream of Sandia National Laboratory (SNL). The Arroyo Seco flows through SNL before crossing the southwest corner of the Laboratory main site and continuing northwesterly. Flow only occurs in the arroyo during rainfall because discharge to the stream is from storm runoff only. The channel is well defined in the section that passes directly through the main site and is dry for at least 6 months of the year. In fact, during dry years, it may flow only 10 to 15 days per year in the vicinity of the main site.[29]

Arroyo Las Positas is an intermittent stream that drains from the hills directly east of the main site with a watershed area of approximately 3,300 acres. This channel enters the main site from the east, is diverted along a storm ditch around the northern edge of the site, and exits the site at the northwest corner. Discharge from the onsite Drainage Retention Basin (now called Lake Haussmann), discussed below, keeps the arroyo flowing perennially. Additionally, water from springs and runoff in the nearby hills feed into the Arroyo Las Positas. Flow has increased in the arroyo over the past several years, due to treated groundwater discharges. A desilting project was conducted between 1998 and 2001 to restore 100-year flood capacity to the arroyo.[29]

Before 1992, it was determined that storm water was infiltrating and dispersing contaminated groundwater in the area of what is currently Lake Haussmann. Therefore, the lake was constructed with a liner in 1992 to prevent this infiltration of storm water. The lake collects about one-fourth of the surface water runoff from the site and a portion of the Arroyo Las Positas drainage. The lake discharges north to a culvert that leads to Arroyo Las Positas. During wet weather, the majority of the discharge from the lake is storm water, but a substantial amount of the flow is discharged from groundwater treatment facilities.[29]

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Nearly all of the surface water runoff at the main site is discharged into the Arroyo Las Positas; only surface runoff along the southern boundary and storm drains in the southwest corner of the main site drain into Arroyo Seco. Regional drainage flows through the southwestern part of the Livermore Valley into the San Francisco Bay through Alameda Creek. There are more than 27 ponds located in and around the eastern Livermore Valley. The majority of the small ponds are used for private water storage for livestock watering; some have other uses, such as ornamental. The Patterson Reservoir is located 0.8 mile northeast of the main site. This reservoir covers 3.23 acres and contains about 100 acre-feet of water. The South Bay Aqueduct is an open canal that circles the Livermore Valley and delivers drinking water to the South San Francisco Bay Area, as well as to the main site.[29]

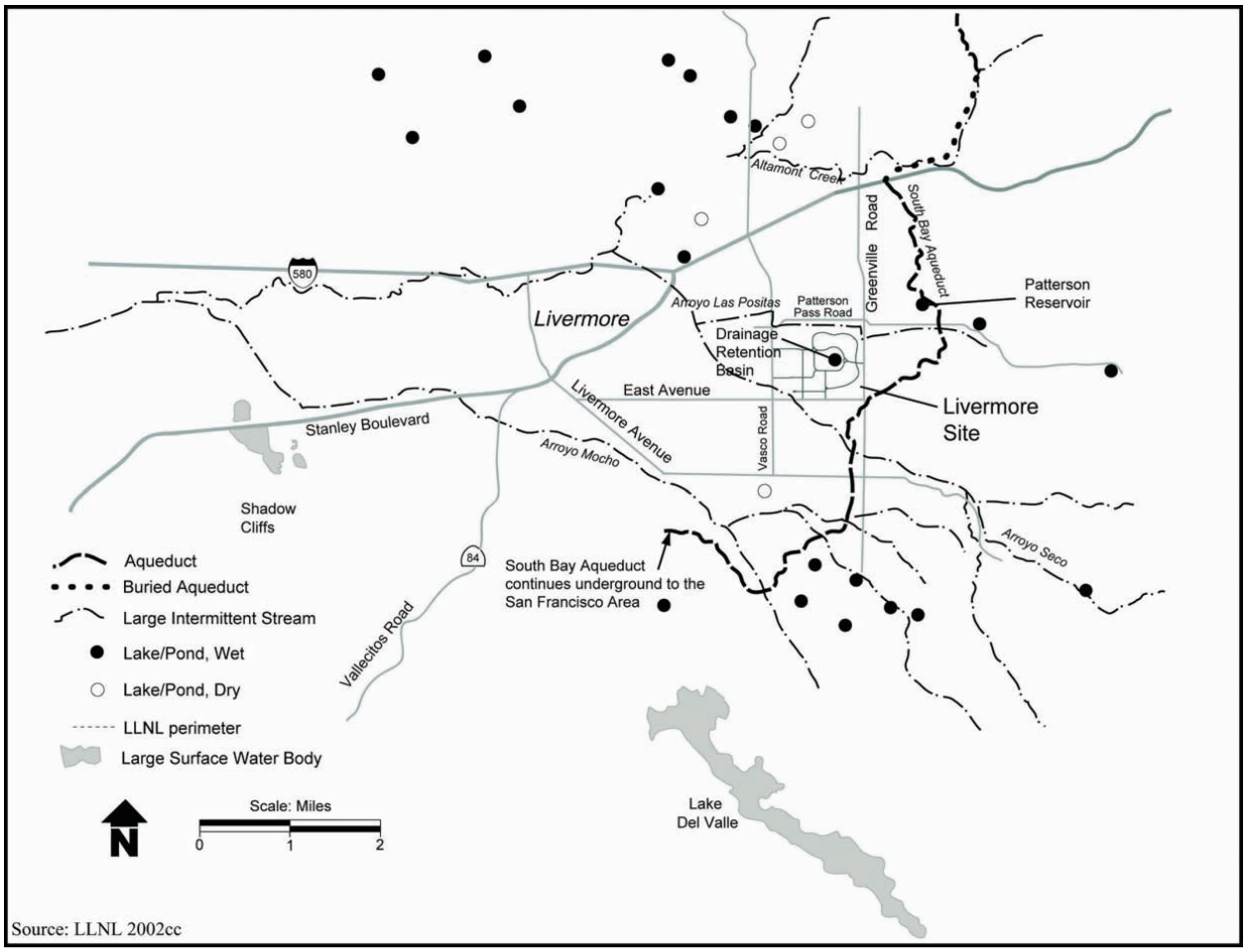

Figure 1: Surface water features in the area (sub-watershed) surrounding the Laboratory's main site.

B. Site 300: A Rural Campus

A wetland delineation of Site 300 was completed in 2002. In 2002, forty-six wetlands were found at Site 300 with a total area of 3.482 hectares (8.605 acres). These wetlands include vernal pools, freshwater seeps and seasonal ponds. Of these, wetlands, approximately 4.388 acres meet the criteria for federal jurisdictional wetlands.[33]

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The 2005 Final SWEIS provides a comprehensive summary of the surface water components at Site 300 as described in the remainder of Section 5.B.[29]

Surface water at Site 300 consists of seasonal runoff, springs, and natural and man-made ponds (see Figure 2). There are ridges at Site 300 that drain into intermittent streams. The majority of the intermittent streams within the site drain south to Corral Hollow Creek, also intermittent, which runs along the southern boundary of Site 300 toward the east into the San Joaquin Valley. Elk Ravine, a major drainage channel for most of Site 300, extends from the northwest portion of the site to the east-central area and drains the center of the site into Corral Hollow Creek. Portions of Draney Canyon and Elk Ravine are perennial streams. Some of the canyons in the northeast section of Site 300 drain to the north and east toward the city of Tracy in the San Joaquin Valley. Downstream of the General Services Area (GSA), Corral Hollow Creek has flow from a groundwater treatment facility.[29]

Naturally occurring springs are shown by the presence of flowing water or wet soils where the water table is close to the surface and the presence of distinct hydrophytic vegetation (e.g., cattails, willow). There are at least 22 springs at Site 300. Most of the springs have very low flow rates and are recognized only by small marshy areas, pools of water, or vegetation. A sewage oxidation pond and a sewage percolation pond are located in the southeast corner of the site in the GSA. In addition, four mitigation pools occur at Site 300. These four mitigation pools include two California red-legged frog pools located in Elk Ravine, a California tiger salamander mitigation pool located in the northwest of the site, and a recovery/mitigation pool located in Round Valley.

Although no perennial springs exist at Site 300, ephemeral surface water features support the federally threatened California tiger salamander (*Ambystoma californiense*). Both surface water quality and aquatic habitat integrity are key protection concerns.

Site 300 is primarily on undeveloped land characterized by steep hills and deep ravines. Floodplain analysis was conducted for the 1992 LLNL Environmental Impact Statement /Environmental Impact Report (EIS/EIR) for this site to determine depth and width of inundation due to the 100-year storm event. Based on the results, there are no 100-year floodplains on Site 300 as the 100-year event is contained within all channels.[29]

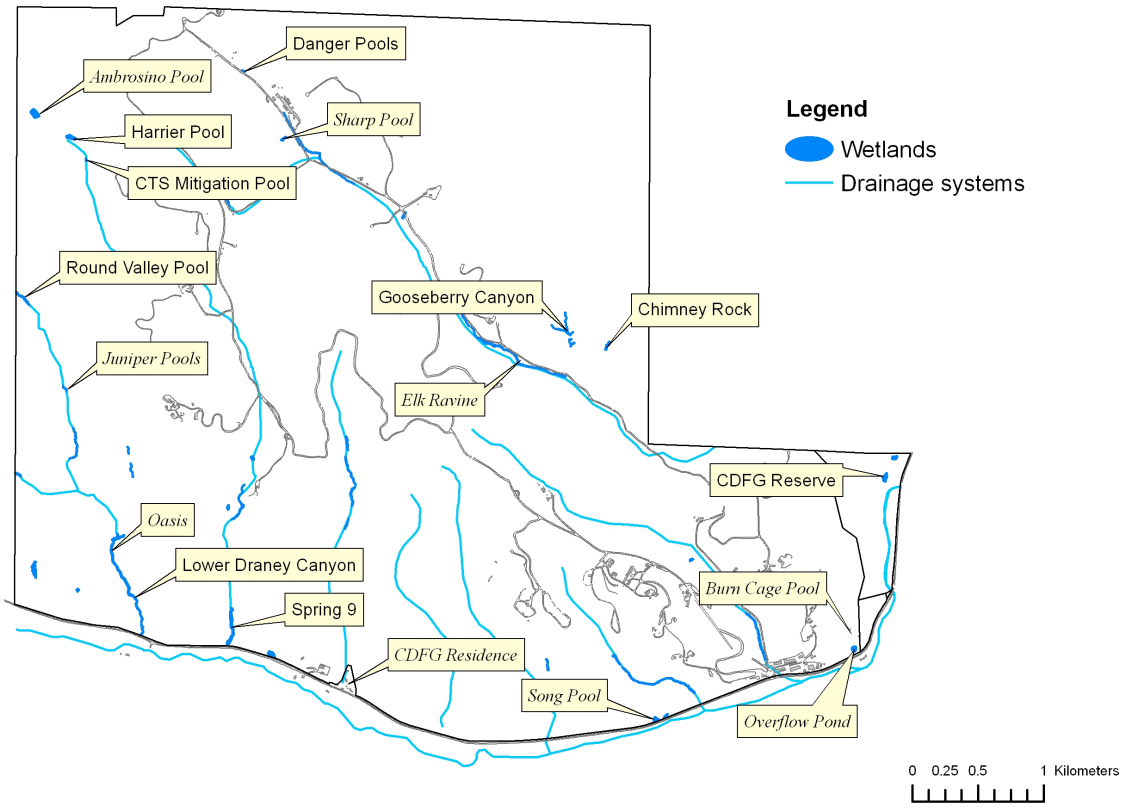

Figure 2: Surface water features at Site 300.

6. Water Quality: Activities and Contaminants

Surface water protection requires the delineation of surface water elements that exist at each site and the identification of the potential and actual sources of discharges, activities, or invasive species that may adversely impact these water bodies. These sources include Laboratory operations or activities, direct or indirect discharges to the storm water system, and direct or indirect discharges to surface waters. Table 2 provides a list of potential or actual sources of storm water pollution at the Laboratory.

Surface water quality and quantity may be adversely impacted by environmental aspects that include discharges to the arroyos and surface waters, discharges to the storm water drainage system, wastewater generation and discharge, spills, construction and maintenance, freshwater and energy consumption, solid waste generation and disposal, and radiation.

Administrative and engineering controls provide surface water protection from adverse environmental impacts, as described in Section 7.

Table 2: Potential or actual sources of storm water pollution.[34]

SOURCE
Non-storm water discharges to drains
Vehicle and equipment fueling
Vehicle and equipment washing and steam cleaning
Vehicle and equipment maintenance and repair
Transportation and loading or unloading of industrial materials and waste
Outdoor container storage of liquids
Outdoor process equipment operations and maintenance
Outdoor storage of raw materials, products and byproducts
Waste handling and disposal
Management of contaminated or erodible surface areas
Building and grounds maintenance
Building repair, remodeling and construction
Soils and debris management
Pesticide and herbicide use

Sources that adversely impact surface water and their aquatic ecosystems include nonnative species, such as the largemouth bass (*Micropterus salmoides*) and bullfrog (*Rana catesbeiana*) shown above. These may occur as intentional releases, which is against the Laboratory's environmental policy, or as a result of other surface water impacts that make these aquatic habitats accessible or desirable to encroachment by these nonnative species. For example, a degraded or highly impacted surface water is at an increased risk for nonnative species establishment.

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7. Surface Water Protection Elements: Watershed Approach, EMS Framework

The Laboratory's mission results in a diverse range of work activities and operational efforts that may adversely impact the environment, including surface waters and their aquatic ecosystems. With these activities, it is important to use a framework within which to ensure surface water protection. The Laboratory uses the framework of its EMS to systematically address activities that have markedly differing scopes, yet all may adversely impact surface water quality, quantity, and/or aquatic ecosystem integrity.

The EMS allows staff to identify the environmental aspects and significant environmental aspects that activities impact. As a second step, it allows staff to identify those environmental aspects, within this identified set, that may be mitigated. The EMS then provides staff guidelines for the development of an Environmental Management Plan (EMP) that delineates specific and measurable controls to minimize or eliminate these environmental aspects resulting from their work activities. This system also incorporates adaptive management, a tenet of a watershed approach. The system encourages staff to strive for continual environmental improvement and to use metrics that allow for appropriate evaluation of efforts and, therefore, an iterative management strategy to achieve desired results.

As described above, this framework provides a systematic strategy for protecting surface water by unifying diverse elements of the protection efforts. The framework is used across both Laboratory sites (i.e., is geography-based), uses science-based efforts and metrics, and relies upon partnerships. These partnerships involve each employee and the coordination of their efforts across departments, directorates, and the Laboratory as a whole. This coordinated effort also includes Laboratory programs, and their staff, responsible for regulatory compliance. This is a watershed approach in an industrial setting that, when rolled up to the larger watershed unit, ideally will improve the local and regional context of surface water protection.

At the most fundamental level of implementing the EMS and unifying the elements of a surface water protection program across the Laboratory and its departments, staff participation is key. Employees need to identify the manner in which their work impacts the watershed or surface water. They also need to know about the controls, training, procedures, and documentation of efforts to ensure surface water protection.

Surface water protection requires the use of administrative and engineering controls to provide for effective environmental stewardship. These controls include a range of tools, typically identified in permits, plans, and BMPs, which mitigate environmental aspects impacting surface water and aquatic habitats. These controls are described below.

Surface Water Protection Elements

Implementing a watershed approach within the framework of EMS requires effective communication. An important component of this communication is education. The Laboratory began implementation of its EMS in 2005 and provides ongoing education regarding this system to staff. Only with effective coordination and collaboration across the Laboratory's programs and staff will surface water protection efforts reach its objectives.

Multiple programs and operations generate wastewater and other discharges that potentially may adversely affect surface water quality and/or quantity. Many activities not directly involved in generating discharges also result in surface water impacts (e.g., construction activities resulting in sediment air transport to surface waters). Similarly, multiple programs and operations implement surface water protection controls or elements. It is the network of these elements that, as a whole, provide for surface water protection, despite organizationally unrelated staff or activity. These elements include:[35]

- Environmental Management System (Laboratory-wide)
  - Project Reviews
  - Storm Water Discharge Management
  - Non-storm Water Discharge Management

These protection efforts require, at minimum, staff knowledgeable of the surface water resources that are present at the Laboratory's two sites, potential hazards to these resources, the Laboratory's Environmental Policy, EMS, and their environmental stewardship responsibilities.

Description of Surface Water Protection Elements

A. Project Reviews

Project reviews provide an early opportunity to protect surface water from environmental impacts of projects and activities carried out at the Laboratory. Environmental Protection Department staff provide project design reviews, NEPA project reviews, and pre-activity surveys. Staff that carry out projects and activities provide Integration Work Sheets (IWSs) that describe their projects and environmental controls. These IWSs also undergo review by appropriate staff before the project or activity is implemented. Guidance on BMPs is also provided during project reviews and related oversight activities by subject matter experts (SMEs).

B. Storm Water Discharge Management

Although storm water naturally occurs as a result of precipitation, its capacity to carry pollutants and other materials is a concern for surface water protection. Storm water discharges are generally considered point discharges and, as such, are primarily regulated under NPDES permits. See Appendix B for surface water monitoring networks at both sites. However, the primary management strategy for storm water discharges is BMPs. NPDES permits include:

- Individual Permit (main site)
- General Industrial Activity Permit (Site 300)
- General Construction Activity Permit (both sites)

The Laboratory's three storm water discharge permits require that both sites maintain and implement SWPPPs (as listed below). This requires the Laboratory to monitor storm water discharges and to conduct annual inspections of its facilities to ensure that BMPs (documented in the SWPPPs) are appropriately in place, implemented, and adequate. In addition to BMPs, other

administrative controls include monitoring, inspecting, recordkeeping, reporting, and training. For inadequacies, corrective actions are identified, tracked, and implemented.[20]

Storm water discharge regulations, requirements, and responsibilities for their management are documented in the following plans.

- Storm Water Pollution Prevention Plan, Livermore Site
- Storm Water Pollution Prevention Plan, Experimental Test Site (Site 300)
- Construction Storm Water Pollution Prevention Plan(s) for individual construction projects affecting one acre or more

An example of a common, but also significant, potential contaminant source that the Laboratory must manage is the presence of sediment from erosion or runoff from soil areas into storm water. Erosion and sedimentation from work activities may impact several environmental aspects including adverse impacts to surface water and ecological resources (aquatic habitats and their wildlife).[35] Administrative and engineering controls implemented by staff work to minimize erosion and sedimentation while protecting riparian areas.

The Laboratory ensures a minimization of erosion and sedimentation and impacts to riparian areas by:

- Project design and pre-activity reviews
  - Provide planning
  - Provide technical guidance to avoid wetland and riparian areas
- Best Management Practices (General Site SWPPP or Project SWPPP)
  - Provide guidance to avoid and/or minimize erosion
  - Provide guidance to avoid and/or minimize sedimentation
  - Provide guidance to avoid and/or minimize impacts to wetlands and riparian areas
- Permits, Memorandums of Agreement/Understanding and Notifications, as needed
- Erosion Control Projects
  - Conducted a Preliminary Erosion Assessment at Site 300 in 2000 which established erosion control project priorities for the site[40]
  - Several erosion control projects completed and others implemented as funding becomes available

The Laboratory is also considered by the Sate Water Resources Control Board to be a small municipal separate storm sewer system (MS4) under the Phase II Storm Water Rule. The main site is a non-traditional small MS4 and, as such, applied for a permit from the Water Board for storm water discharges from the site. When the San Francisco Bay Regional Water Quality Control Board designates the main site as a non-traditional small MS4, the Laboratory will develop and implement a Storm Water Management Plan (SWMP).

C. Non-storm Water Discharge Management

The Laboratory generates wastewater and discharges this wastewater either to surface water, the storm water drainage system, land, or the sanitary sewer system. Wastewater discharges to land

and the sanitary sewer system are not covered in a surface water protection plan although these discharges play an important role in surface water quality protection. Wastewater discharges may impact several environmental aspects including adverse impacts to surface water and ecological resources (aquatic habitats and their wildlife). As shown in Table 3, all wastewater discharges at the Laboratory have regulatory control such as a permit or permit-like mechanism (waste discharge requirement).[35]

Management of oil-containing equipment is also a part of the watershed approach to the Laboratory's surface water protection. The regulations, requirements, and responsibilities for their management are documented in the following plans.

- Spill Prevention Control and Countermeasure (SPCC) Plan for Livermore Site
- Spill Prevention Control and Countermeasure (SPCC) Plan, Site 300, Experimental Test Site

The most current versions of these site-wide plans, individual project plans, and any associated permits provide updated and specific information on the regulations, requirements, and potential or actual sources of pollution.[20] For more detailed information, see the plan of your interest above.

Table 3: NPDES or WDR Permits for both Laboratory sites.[29]

Livermore Site	**Site 300**
WDR Order No. 95-174, NPDES Permit No. CA0030023 for discharges of storm water associated with industrial activities and low-threat non-storm water discharges to surface waters.	WDR Order No. 93-100 for post-closure monitoring requirements for two Class I landfills.
WDR Order No. 99-08-DWQ, NPDES California General Construction Activity Permit No. CAS000002; Soil Reuse Project, Site ID No. 2015305529; and National Ignition Facility, Site ID No. 201S306762, for discharges of storm water associated with construction activities affecting two hectares or more.	WDR Order No. R5-2008-0148 for operation of a domestic sewage oxidation and percolation pond system, mechanical equipment percolation pits, septic systems, and low threat discharges,
FFA for groundwater investigation/remediation.	WDR Order No. 97-03-DWQ, NPDES California General Industrial Activity General Permit No. CAS000001 for discharge of storm water associated with industrial activities.
	WDR Order No. R5-2008-0081, NPDES Permit No. CAG995001 for discharges from the drinking water system that reach surface waters.
	FFA for groundwater investigation/remediation.
	34 registered Class V injection wells.

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D. Examples of Source Activities and Controls

The following descriptions of activities that occur at the Laboratory provide more specific examples of potential sources for surface water impacts and controls for surface water protection from these sources. This list is not meant to be complete but rather a subset presented for illustrative and informational purposes. For further information on specific Laboratory activities and controls, refer to key documents in the additional resources section of this plan.

Appropriate Wastewater Disposal
The appropriate management of wastewater streams from Laboratory operations protects surface water and the sub-watershed and watershed. Appropriate management of these streams involves separating wastewater into the sanitary sewer, to systems engineered to discharge to ground, to misters, or to retention tanks. These controls essentially divert potential adversely impacting sources from surface waters and prevent any adverse environmental impacts.

Outdoor Storage Practice and Management
The use of BMPs (identified in the SWPPPs, as needed) minimizes the contaminants that potentially could enter surface water drainages. These management practices include grounds maintenance that use erosion and sediment controls and controls on outdoor activities and storage.

Construction Practices and Management
Construction activities at the Laboratory have the capacity to greatly impact surface water and aquatic ecosystems, especially if carried out near these sensitive environmental elements. The main site is largely developed, yet ongoing construction and demolition projects occur and require diligent control of sources. Site 300 is largely undeveloped with many more sensitive species dependent on the existing quality and quantity of the surface water system. Project design reviews early in the project planning process represent a key and first line administrative control to prevent adverse environmental consequences. Other administrative controls used early in the planning process that similarly offer this capacity include NEPA evaluations and reviews, IWS reviews, and pre-activity surveys. Construction activities at both sites make every effort to minimize habitat alteration and use BMPs for erosion and sediment control as well as discharge management.

Permits represent another administrative control, and may also include engineering controls, for surface water protection with construction activities. A General Construction Storm Water NPDES permit is required for construction projects of one or more acres. These permits include elements of surface water protection including erosion and sediment control, BMPs for storage and use of construction-related chemicals, as well as post-construction BMPs to ensure protection of water quality.

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Fleet Management
The connection between operating vehicles or managing the fleet at the Laboratory and surface water protection may seem unclear, yet it represents an important source control area. Spills from the storage or use of this fleet may either directly discharge into surface water or may indirectly come into contact with surface water through storm water. Spill control is essential to surface water protection and is described in detail in SPCC plans for both sites. It is also controlled administratively through the Laboratory's emergency response network.

Soil Disturbing Projects
Potential effects to surface water from soil disturbing projects are controlled through stabilization of the project area with either hydroseed or hydromulch, in combination, if needed, with other stabilization practices such as straw wattles, silt fences, terracing, and erosion blankets.

Landscaping Practices
Surface water protection requires a coordinated and appropriate landscaping strategy that includes:

- Best Management Practices
- Irrigation controls
- Limited and appropriate use of pesticides and herbicides
- Soil and sediment control including sediment basins
- Erosion control and erosion control restoration projects
- Storm channel maintenance
- Maintenance of vegetation
- Native vegetation
- Minimization of development, as possible
- Minimization of impervious surfaces, as possible

8. CONCLUSION

This surface water protection plan describes the watershed approach the Laboratory uses with its EMS framework to provide for environmental stewardship of this sensitive resource. The plan provides a description of how the diverse elements implemented across the Laboratory come together in a systematic and unified approach to carry out an effective protection program. This plan does not provide detailed information on the surface water protection elements such as the specific controls within the various permits, plans, agreements, and BMPs. Rather, this plan provides the reader with a broad understanding of the Laboratory's surface water protection program and approach. For more specific details and descriptions, see the documents listed in the Documents Cited and Additional Resources sections.

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9. CHANGE HISTORY

CHANGE HISTORY		
Date	**Revision**	**Revision Description**
03/2009	**00**	**Initial Issue**

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ADDITIONAL RESOURCES

Watershed Approach

U.S. Environmental Protection Agency. 2008. *Watershed Approach, Guiding Principles*. Website last updated, September 12, 2008. Accessed November 10, 2008. Available at: http://www.epa.gov/owow/watershed/framework/ch3.html.

Laboratory Surface Water Related Documents

Management Plan for Waters of the United States, Arroyo Seco .

Management Plan for Arroyo Seco at Sandia National Labs, Livermore, CA.

Management Plan for Waters of the United States, Arroyo Las Positas.

Arroyo Mocho Creek Fish Passage Enhancement Project, Draft Study Document (2003), Prepared for Lawrence Livermore National Laboratory.

Storm Water Pollution Prevention Plan, Livermore Site

Storm Water Pollution Prevention Plan, Experimental Test Site (Site 300)

Spill Prevention Control and Countermeasure (SPCC) Plan for Livermore Site

Spill Prevention Control and Countermeasure (SPCC) Plan, Site 300, Experimental Test Site

Non Point Source Resources

Plan for California's Non Point Source Pollution Control Program

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APPENDIX A: SURFACE WATER MAPS

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Figure A1. Livermore Site (Main Site) Surface Water Elements

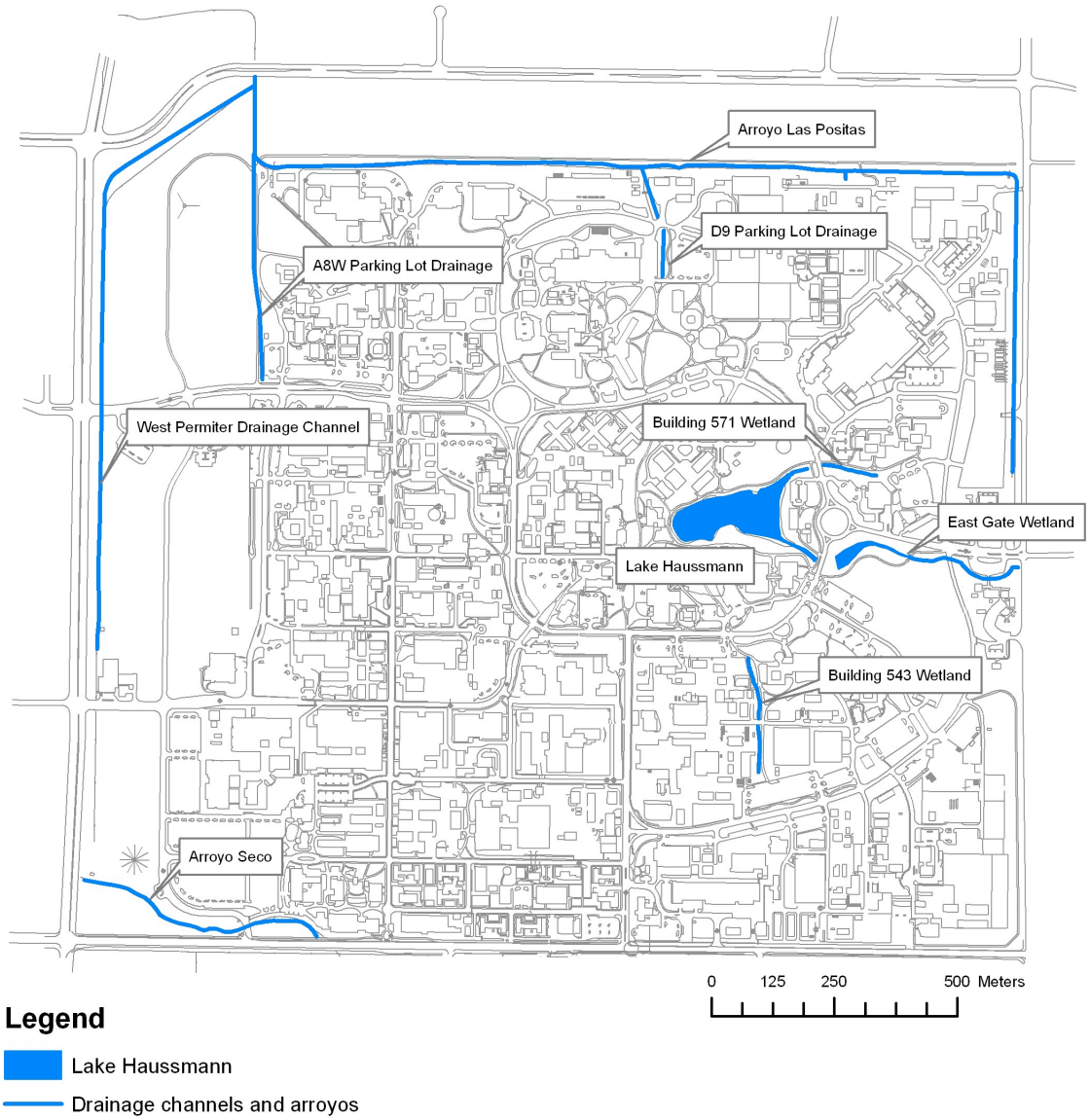

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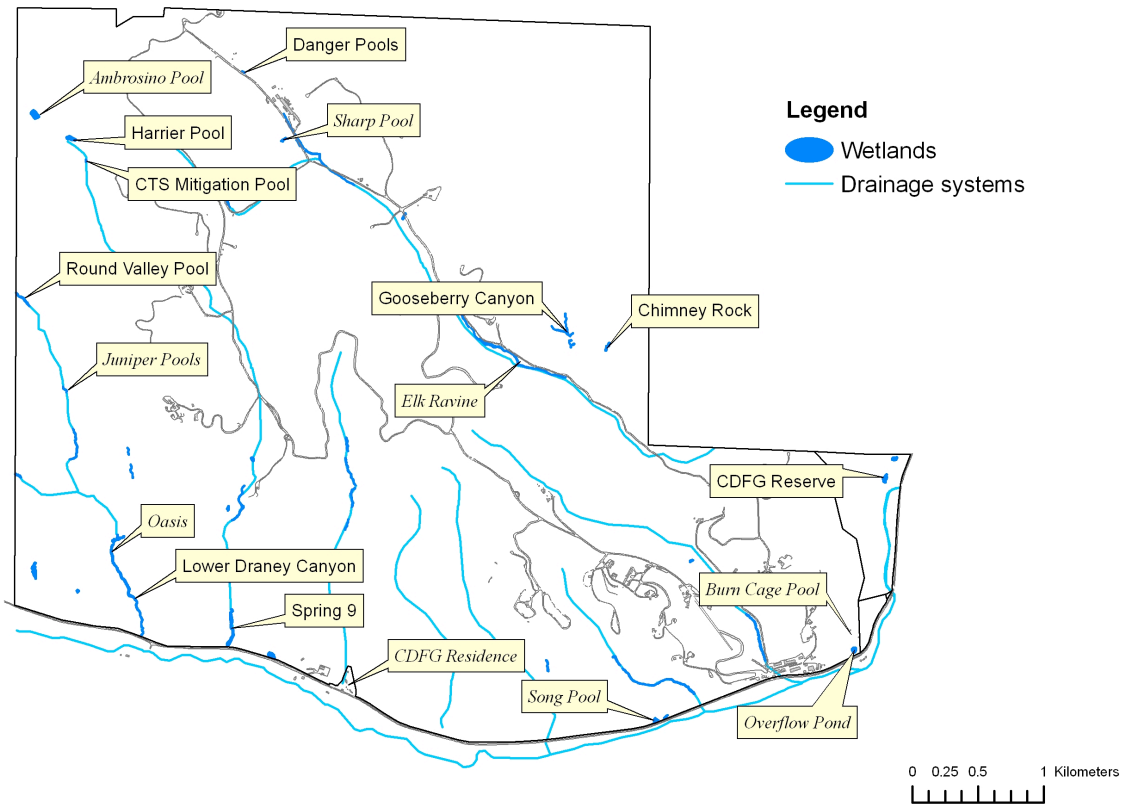
Figure A2. Experimental Test Site (Site 300) Surface Water Elements



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APPENDIX B: SURFACE WATER MONITORING NETWORKS

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Figure B1. Livermore Site (Main Site) Surface Water Monitoring Network

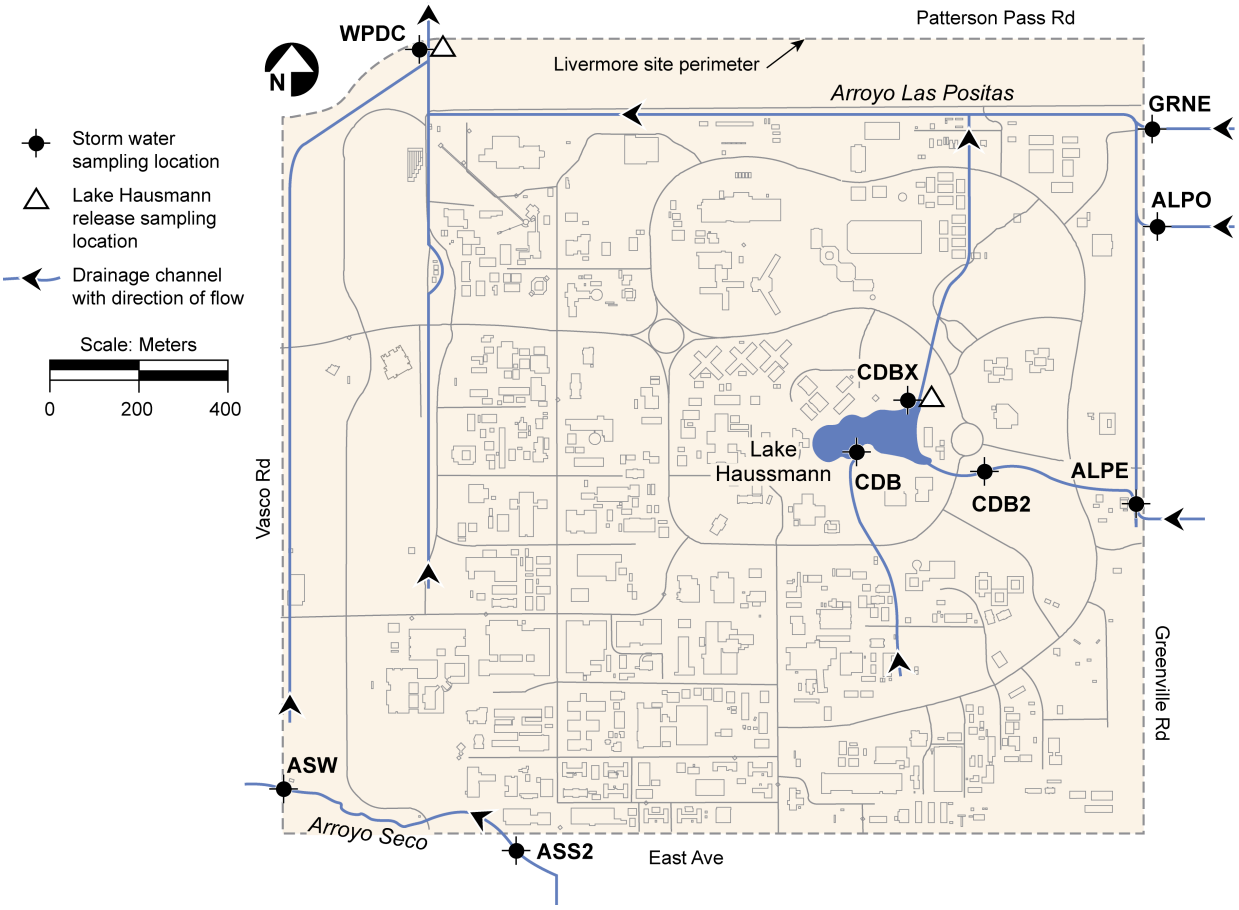

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Figure B2. Site 300 Surface Water Monitoring Network