DRAFT

UNIVERSITY OF CALIFORNIA

BERKELEY LAB

LRDP

2006 LONG RANGE DEVELOPMENT PLAN

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Director's Foreword

Let's renew our commitment to research, education, and innovation while serving as a positive force in economic, environmental, and community responsibility.

Basic research such as the work performed at Berkeley Lab underpins our discoveries and, ultimately, the security, economic prosperity, and health of our citizens. The Laboratory's combination of strengths in rapidly advancing areas of science and unique research facilities enables the development of large-scale, interdisciplinary research programs to strengthen the foundations of America's competitiveness. Unfortunately, our aging facilities will not accommodate the multi-disciplined collaborations required to meet the future's scientific challenges.

The Laboratory will fall far short of its responsibilities to the nation if the facilities of previous generations are relied upon for a new generation of science. As national challenges emerge we must maximize the use of our scientific resources, revitalize our existing infrastructure, and make long-term investments in new scientific facilities. With renewal and development designed for collaborative science, Berkeley Lab will build stronger partnerships with academia, industry, and government.

As a leading institution in the areas of energy and environmental research, we are committed to developing the Laboratory in a manner that sets the standard for resource conservation and stewardship. To this end, the Berkeley Lab Sustainability Policy was recently established to formalize our simultaneous and balanced pursuit of economic viability, environmental health, and public responsibility over the long-term through appropriate investment decisions and operating practices. As a result, environmental sustainability will be a key decision component in the development of the Laboratory over the coming decades.

Berkeley Lab employees live and work in our community and share in its mutual success. We have a long term commitment for a sustainable Laboratory that is an integral component of the East Bay landscape. This LRDP has been developed as we celebrate our 75th Anniversary, with the intent to provide a quality environment for decades into the future. Our sustainability policy recognizes maintaining proper regard for land-use constraints. As described in this LRDP, these

FIGURE F.1 The new Molecular Foundry building earned the U.S. Green Building Council's "Silver" rating for sustainable design and construction

constraints include: respecting open space and landscaping, maintaining slopes and soil stability, adhering to design guidelines, and improving pedestrian and public transit while minimizing traffic congestion.

Our future prosperity will depend on our preeminence in science and technology. Let's not take our current strength for granted. Let's renew our commitment to research, education, and innovation while serving as a positive force in economic, environmental, and community responsibility. The principles for the responsible development of Berkeley Lab necessary to deliver scientific discoveries for humankind and the environment are embodied in this 2006 Long Range Development Plan.

Steven Chu, Director
Lawrence Berkeley National Laboratory

Introduction

Lawrence Berkeley National Laboratory (Berkeley Lab, the Laboratory) is a multi-program scientific research campus operated by the University of California (UC) for the U.S. Department of Energy (DOE). The Laboratory conducts unclassified research to carry out its mission of reaching a deeper understanding of our world and delivering science-based solutions to problems of national significance.

Berkeley Lab is one of ten national laboratories sponsored by DOE's Office of Science to perform research and development that is not well suited to a university or private sector setting because of its scope, infrastructure requirements, or multidisciplinary nature. Eleven Nobelists have been associated with the Laboratory and eighty-one of its current researchers are members of the National Academies. The Laboratory is regarded by the DOE as a national treasure that while in the pursuit of its mission:

- Performs leading multidisciplinary research in the life & environmental, physical, computing, and general sciences
- Develops and operates advanced experimental facilities for investigators from other institutions worldwide
- Educates and trains future generations of scientists and engineers to sustain national science and technology competitiveness
- Transfers knowledge and technological innovations, and fosters productive relationships among Berkeley Lab's research programs, universities, and industry

Berkeley Lab holds the distinction of being the oldest national laboratory since its inception on the UC Berkeley campus in 1931. The Laboratory still conducts research on the Berkeley campus, while the majority of its scientific and support operations take place at the adjacent "main site" on land owned by the Regents of the University of California. The Laboratory also occupies research, office, and support space in leased facilities in the cities of Berkeley, Oakland and Walnut Creek, California as well as Washington DC. This document is concerned solely with the growth and development of the Laboratory's main site.

This 2006 Berkeley Lab Long Range Development Plan (LRDP, the Plan) will guide the physical development that the Laboratory will require over the next 20 years to achieve its scientific vision. The subsequent scope and nature of the development described in this LRDP reflect current and projected national scientific priorities. The evolution of these priorities over time will drive a corresponding change in the actual development that will occur at the Laboratory.

FIGURE I.1 The view southwest from the Laboratory at sunset

To maximize Berkeley Lab's responsiveness to evolving national priorities, this LRDP provides a general land use plan and development framework to guide the siting of new facilities and infrastructure. The Plan does not define specific buildings or site development, nor commit the institution to any specific project. The LRDP provides Laboratory management, facilities staff, and the UC Regents with decision-making guidance for future projects.

The LRDP balances the Laboratory's scientific goals with environmental stewardship and the flexibility to accommodate future mission needs in order to build a safe, efficient research institution that is conducive to scientific inquiry. Two supporting documents, the *Berkeley Lab Design Guide* and the *Berkeley Lab Sustainability Policy* were developed in parallel with the LRDP. These documents—both of which establish specific guidelines for site planning, landscape, and building design—provide the means to implement the Plan's principles as each new project is developed.

This LRDP is accompanied by a separate Environmental Impact Report (EIR) in compliance with the California Environmental Quality Act (CEQA). The EIR includes a detailed description of the current Berkeley Lab site and an analysis of the potential environmental impacts resulting from the development projected in this LRDP.

The EIR impact analysis is based upon its Illustrative Development Scenario (IDS)—one of many possible development scenarios encompassing the maximum amount of new building space, population, parking, and other site improvements identified

in the LRDP. While the development presented in the IDS is consistent with LRDP principles, it is not necessarily a precise representation of how the Laboratory will develop over time. Rather, the IDS has been designed to assist the EIR in analyzing a broad range of environmental impacts.

The LRDP and its EIR provide a framework for the subsequent review of individual projects as they occur at Berkeley Lab. Each major project with the potential to affect the physical environment will be assessed within this framework and tiered off of this LRDP's EIR to determine the appropriate level of CEQA review. Once CEQA review is complete, each project must then be approved by the UC Regents, the President of the University of California, or the Director of Berkeley Lab, depending on the scope and nature of the project.

ORGANIZATION OF THIS DOCUMENT

The LRDP is organized in three sections.

Background

The Background section frames the planning context for the LRDP with an overview of the Laboratory's location and physical context, history, mission, organization, scientific research, and facilities conditions.

The Vision

This section defines the scientific vision for the Laboratory and explains how achieving that vision will result in population and facilities changes and growth. The Vision also discusses the conceptual framework for development and the fundamental planning principles that guide all elements of the Plan.

The Plan

The Plan section describes the strategies that the Laboratory will employ to meet its facilities needs. It is the core of the LRDP and is comprised of six major elements.

- Land Use
- Development Framework
- Vehicle Access, Circulation, and Parking
- Pedestrian Circulation
- Open Space and Landscape
- Utilities

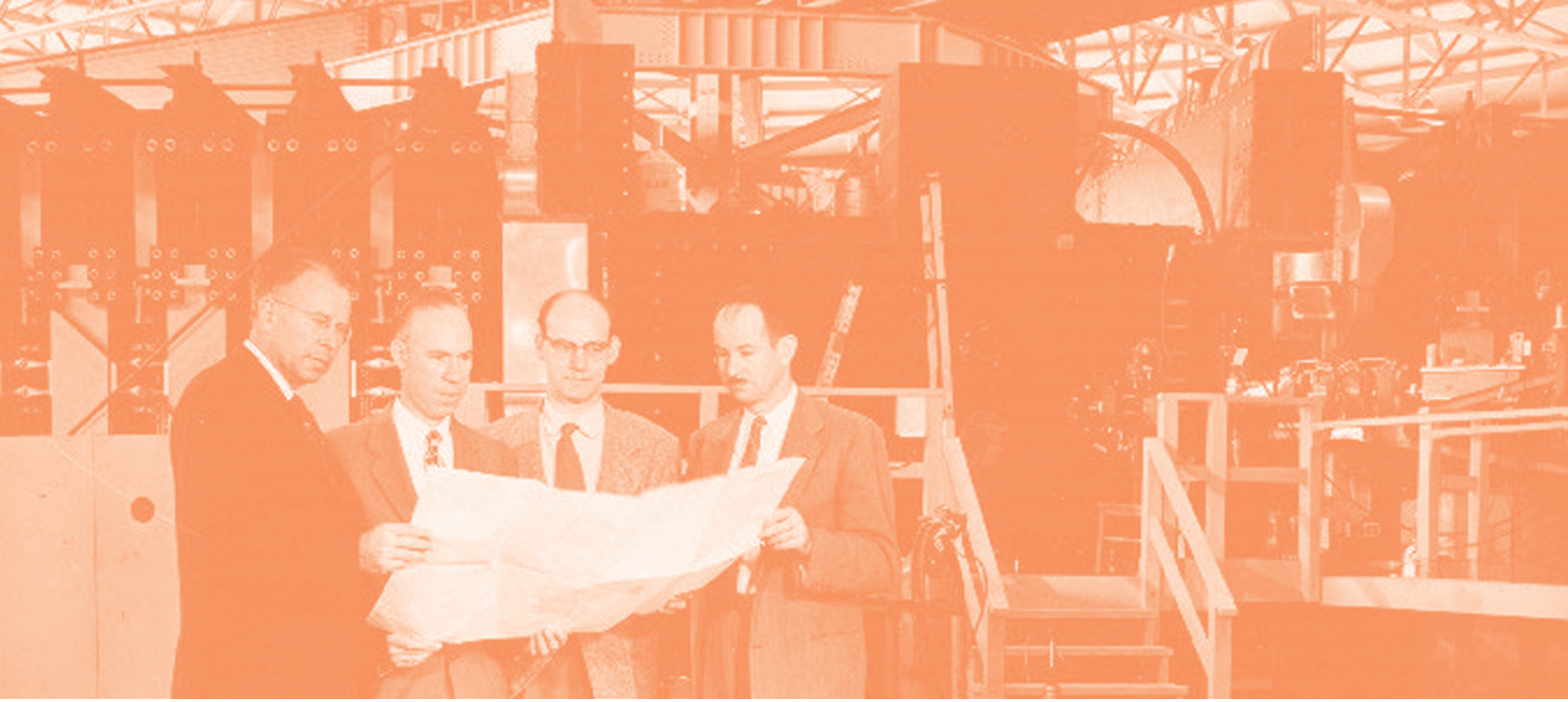
The narrative for each element begins with an overview of existing conditions followed by the strategies and plans for future development.

PREPARATION OF THIS DOCUMENT

This LRDP has been prepared by the Berkeley Lab Facilities Planning Group with the participation of key Laboratory and community constituencies and the UC Office of the President planning staff. The planning process was structured around the direction and guidance of two committees. The Steering Committee, comprised of Laboratory senior managers, served as the decision making body to provide direction on all aspects of the project. The Advisory Committee represented Laboratory requirements for the development of new projects, facilities operations, and public affairs.

The process began with a comprehensive analysis of scientific program needs and existing site conditions. This analysis provided the basis for the Plan's overarching goals and growth projections that were developed with the participation of the Laboratory's scientific division directors. Planning staff worked with the Steering Committee and UCOP planning staff to ensure these goals and projections were consistent with the vision that DOE and the University have for Berkeley Lab. Once the fundamental parameters were established, Laboratory Planning staff produced the document in conjunction with BMS Design Group and Dangermond Architects.

As the LRDP developed, its environmental impacts were assessed and, when necessary, adjustments were made to minimize the overall impacts of the Plan. Periodic reviews were conducted throughout the process to ensure that the LRDP accurately reflects the intentions of the Laboratory's leadership and University requirements.



1 BACKGROUND

This section frames the planning context for the 2006 LRDP with a background discussion that includes:

Laboratory Location

Berkeley Lab Historical Perspective

Berkeley Lab 2006

Facilities Conditions

Laboratory Location

Berkeley Lab is located within the Cities of Berkeley and Oakland in Alameda County and the San Francisco Bay Area. This cosmopolitan region has a population of over 6 million, and a highly diversified, technology and service-oriented labor force of over 3 million people. Alameda County and the greater Bay Area are home to significant educational, research, industrial, agricultural, and recreational resources.

Berkeley is a city with innovative businesses, a population of just over 100,000 residents, and a Mediterranean climate. Its elevation rises from sea level to over 1,300 feet in the Berkeley Hills. The same range also forms the eastern border of Oakland to the south, a city with a population of approximately 400,000 residents. With an international airport and one of the nation's busiest seaports, Oakland has a reputation as the "Hub of the West." Berkeley and Oakland are home to some of California's most beautiful natural parks and open spaces.

Berkeley Lab's main site, the primary location of its scientific, administrative and support operations, is located on a 202 acre parcel of UC Regents' land in the lower- and mid-elevations of the Berkeley/Oakland hills. This range is approximately three miles east of the San Francisco Bay. The Laboratory is bordered by urban development to the west and predominantly open space to the south, east, and north.

Three miles west of the Laboratory is Interstate 80, a freeway that connects the Laboratory to the greater Bay Area. Immediately to the east of the Laboratory is Grizzly Peak Boulevard, an arterial roadway that connects the Laboratory to eastern Alameda and Contra Costa counties via State Highway 24.

Berkeley Lab is built on a spectacular hillside site that affords tremendous views and gives rise to its distinguishing "hillside development pattern." Across the Laboratory, rustic landscape surrounds clusters of research buildings located on the few relatively level areas on the site. These buildings are purpose-built and industrial in nature giving the site a no-nonsense character of simple, unpretentious buildings. The experience of this informal built environment, the hillside terrain, natural landscape and panoramic views is valued as one of the Laboratory's most important assets to be preserved and strengthened.

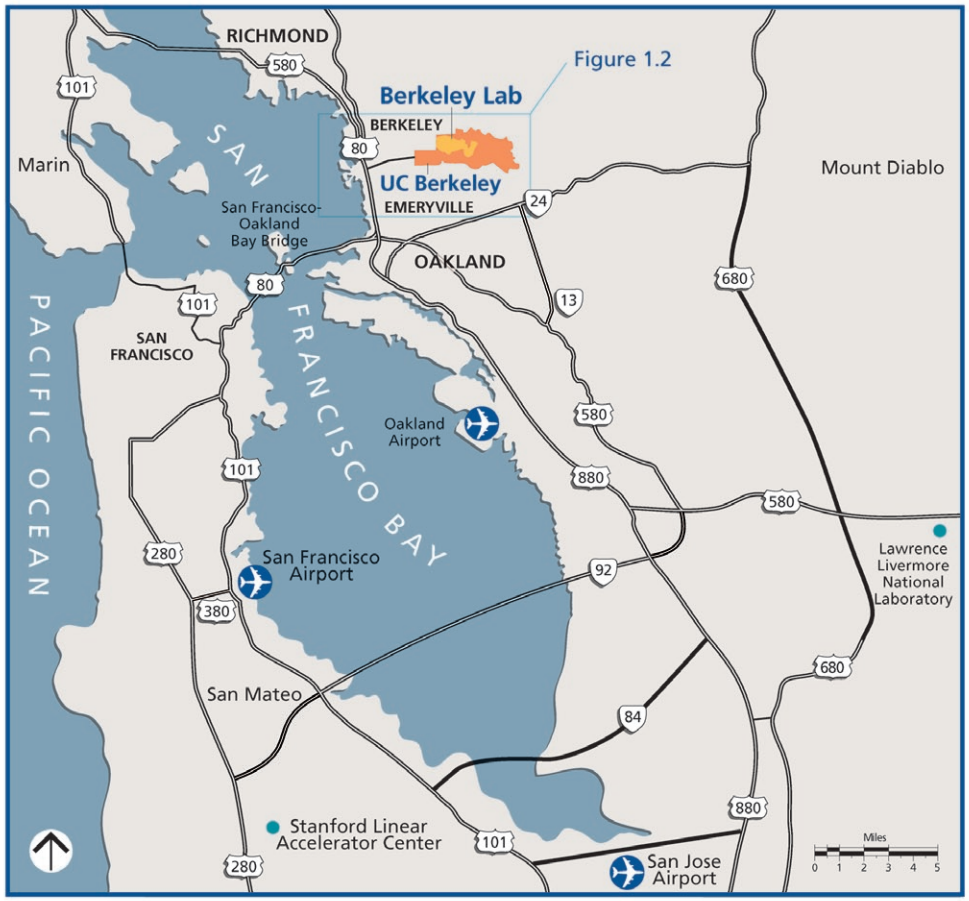
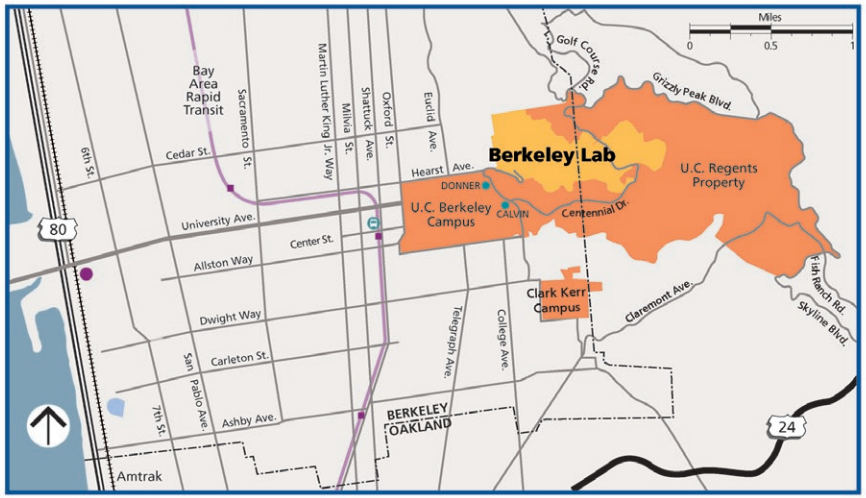


FIGURE 1.1 Berkeley Lab's Location within the San Francisco Bay Area



UC Regents Property

Berkeley Lab

Bay Area Rapid Transit Station

Amtrak Station

FIGURE 1.2 Berkeley Lab's Location within the Cities of Berkeley and Oakland

FIGURE 1.3 Developed clusters follow the hillside terrain at Berkeley Lab

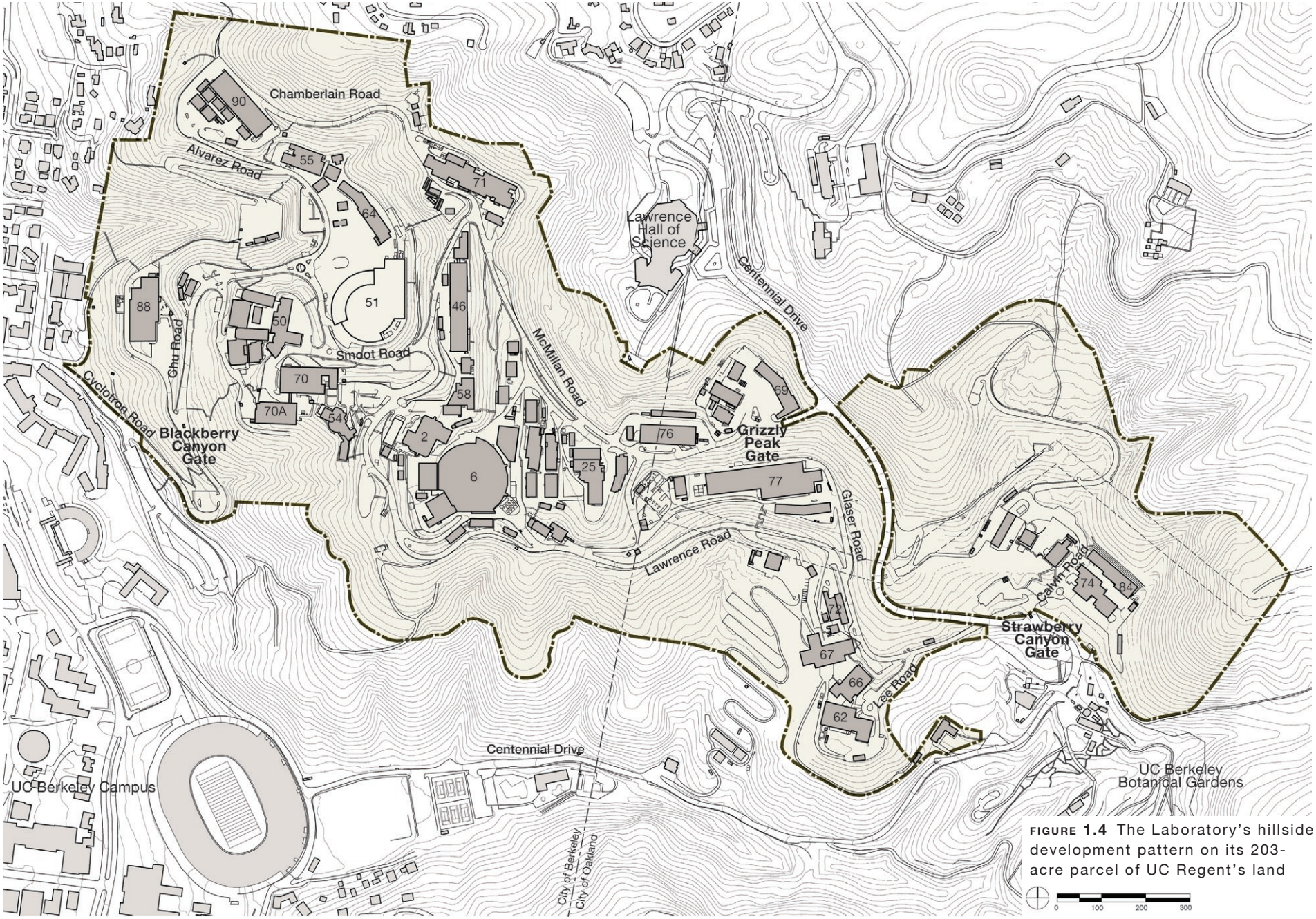


FIGURE 1.4 The Laboratory's hillside development pattern on its 203-acre parcel of UC Regent's land

Berkeley Lab: Historical Perspective

In the Laboratory's first 75 years it has grown from a single-purpose facility into today's Berkeley Lab—a multi-program scientific research facility. As the Laboratory's research portfolio has grown from high-energy physics to include energy, life & environmental sciences, high performance computing, and physical sciences, the Laboratory's facilities have evolved to meet these needs. What follows is the story of the Laboratory's evolution—its science and its facilities.

In the 1920s UC President Robert Gordon Sproul undertook the task of developing UC Berkeley into a major research university. Physics was an important part of this effort, and in 1928 Physics Chair Robert Birge recruited a promising assistant professor, Ernest Lawrence, to join the faculty.

In 1929 Lawrence invented the cyclotron, which made possible the dramatic growth of particle physics and equally dramatic discoveries about the nature of matter over the following decades. Lawrence also launched the modern era of multidisciplinary "team science." When he came to Berkeley, the traditional practice for scientists was to work within their own specialized field, seldom working with engineers or collaborating outside of their departments. But in August of 1931 Lawrence

FIGURE 1.5 The Radiation Laboratory originated the national laboratory system on the campus of UC Berkeley

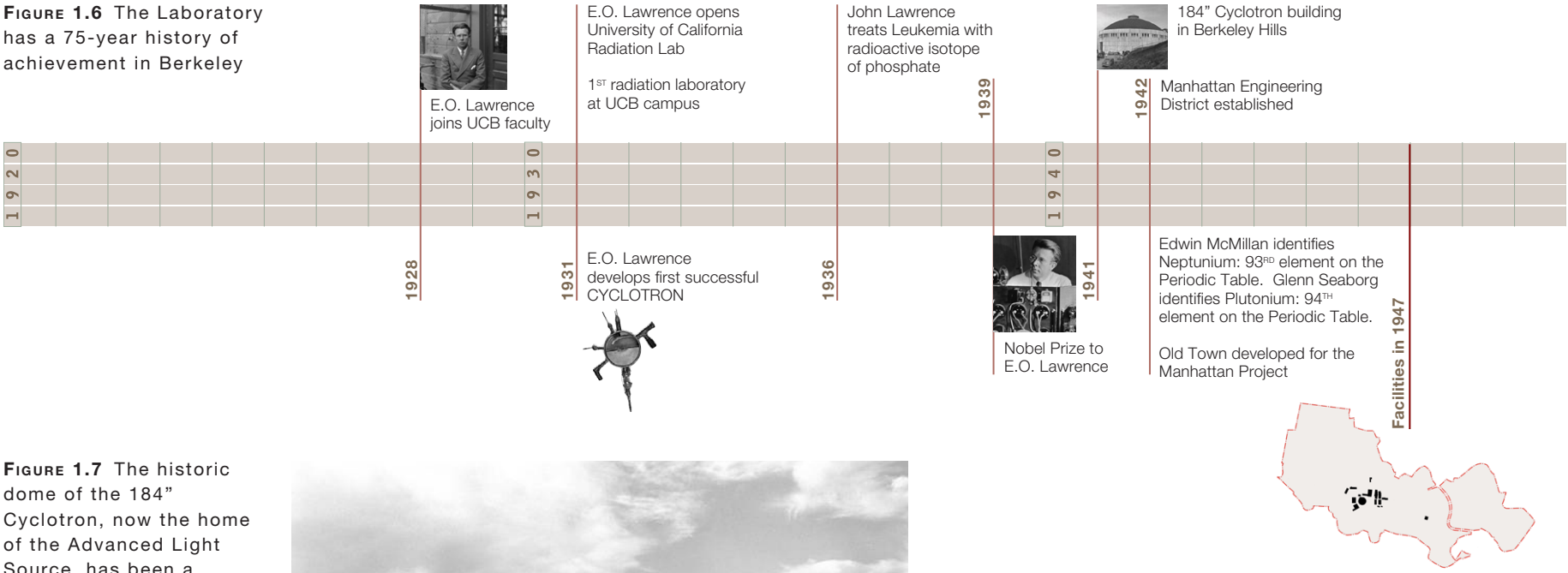


Figure 1.6 The Laboratory has a 75-year history of achievement in Berkeley

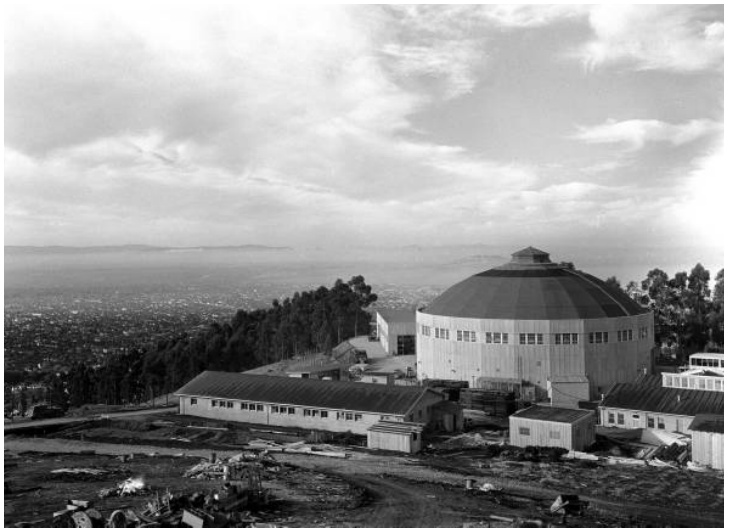
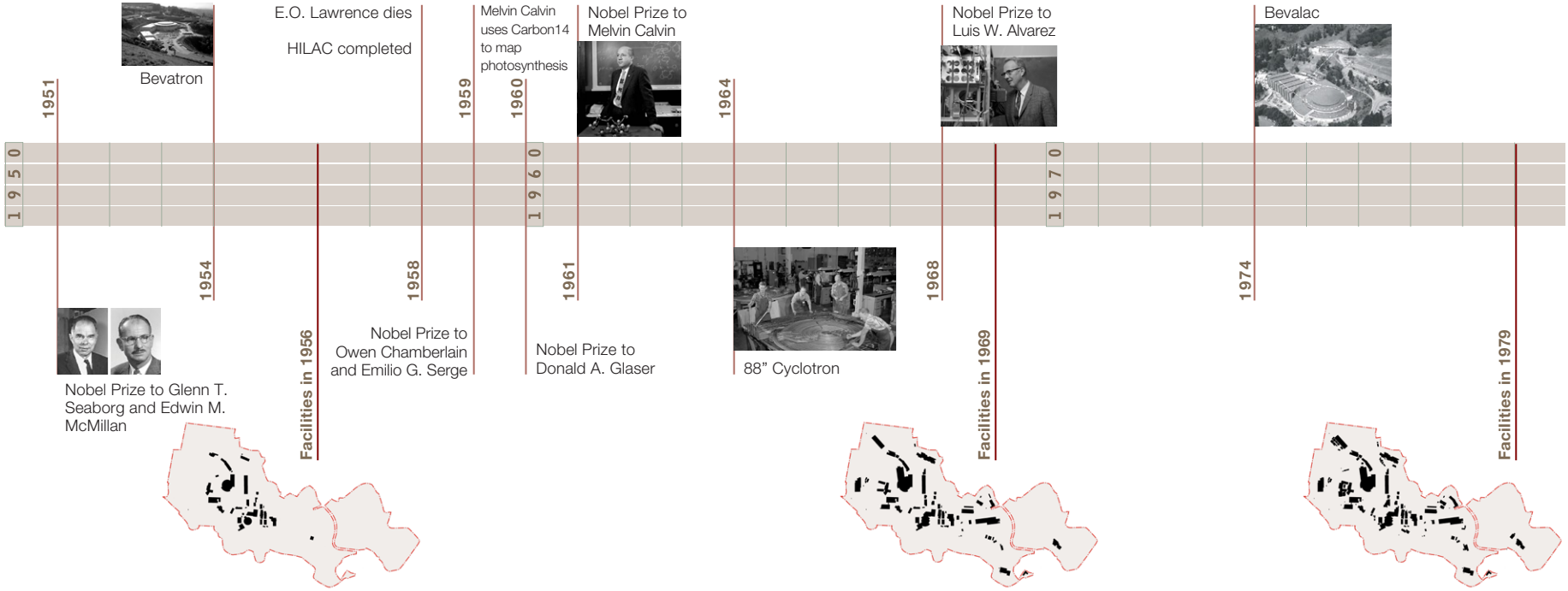


Figure 1.7 The historic dome of the 184" Cyclotron, now the home of the Advanced Light Source, has been a Berkeley Hills landmark since 1941

created his Radiation Laboratory on the Berkeley campus and began recruiting a brilliant circle of colleagues from physics, chemistry, engineering, and medicine whose ground-breaking teamwork would be critical to the Laboratory's legendary success.

In its first decade the Radiation Laboratory outgrew its original building on the UC Berkeley campus, extending into other campus buildings such as Crocker Hall, which housed the 60-Inch Cyclotron. At the same time, the scope of the Laboratory's research expanded to include a wider range of disciplines. In 1936, for example, John Lawrence, Ernest Lawrence's brother, started a biomedical research program. He was the first to treat a leukemia patient with a radioactive isotope and used particle beams for radiation therapy, establishing the Laboratory as the birthplace of nuclear medicine and a center of biophysics and imaging research.

The Laboratory expanded to its present location in 1940, when ground was broken on what was then called Charter Hill for the 184-Inch Cyclotron. Designed by Arthur Brown, architect of San Francisco's City Hall and Coit Tower, the domed building is an East Bay Hills landmark, and reinforces the visual axis created by UC Berkeley campus architect John Galen Howard that runs west through campus, aligning with the Golden Gate Bridge across the Bay.

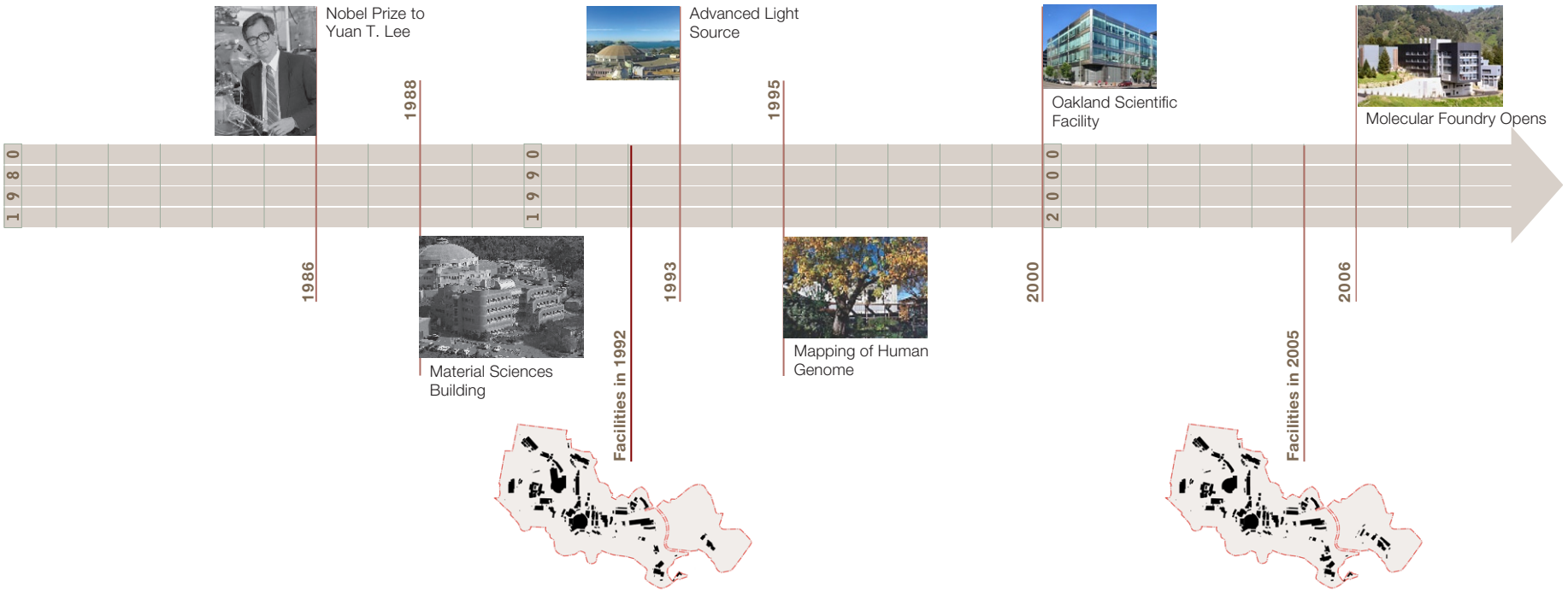


During World War II, the Charter Hill site became crowded with a number of hastily constructed temporary buildings as the Laboratory responded to national defense needs, developing machines for the electromagnetic separation of uranium isotopes as part of the Manhattan Project. Thereafter, development on the main site would feature the construction of permanent concrete and steel-frame structures east and west of the original buildings.

Under the sponsorship of the Atomic Energy Commission, new, more powerful particle accelerators and a broader base of research programs were initiated. 1948 saw the appearance of Luis Alvarez's proton linear accelerator and the first electron synchrotron, invented by Edwin McMillan.

The Bevatron, which followed in 1954, became the nation's leading high-energy physics facility, achieving distinction in the same year with the discovery of the antiproton. In 1958 the Heavy Ion Linear Accelerator (HILAC) came on line. It was later combined

FIGURE 1.8 Laboratory Director and Nobelist Ed McMillan (left) with Edward Lofgren on the Bevatron, 1963



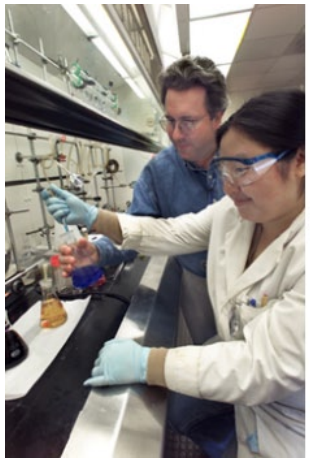
with the Bevatron to form the Bevalac, ushering in a new era of relativistic heavy-ion nuclear physics. The 88-Inch Cyclotron was completed in 1964 as an important experimental facility in low energy nuclear physics. During the 1950s and early 1960s, a number of permanent laboratory and office buildings were constructed to accommodate the growth in accelerator-related and other programs.

In the aftermath of the 1973 oil embargo, new research program growth targeted national energy supply and end use. The Laboratory's population reached a new high point in 1978 following the establishment of the Department of Energy (DOE), but no permanent buildings were constructed to accommodate this growth. Instead, temporary trailers were installed, existing spaces were adapted, and building space was leased in Berkeley and Emeryville for research programs and support services.

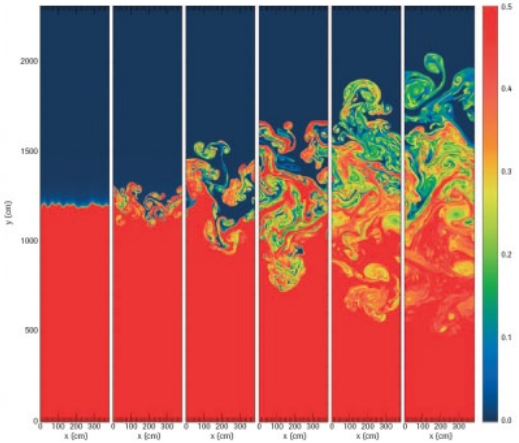
By 1980 Berkeley Lab was a national laboratory with recognized expertise in a broad range of scientific areas, with high energy and nuclear physics accounting for only 25 percent of the research—a dramatic change from 75 percent in 1970. With its research scope supporting DOE's science, energy, health, and environmental missions, as well as the scientific needs of other governmental agencies, the Laboratory emphasized energy sciences, materials sciences, and life sciences while maintaining historically important roles in high energy and nuclear physics.

In the 1980's DOE chose Berkeley Lab as the site for the new National Center for Electron Microscopy (NCEM) and the Advanced Light Source (ALS). These facilities, known as "national user facilities" are operated specifically to provide researchers from academic, private sector and other national laboratories with specialized scientific infrastructure they would not otherwise have access to. For example, the ALS, which reused the 184-Inch Cyclotron Building, is one of the world's brightest sources of x-ray and ultraviolet light and serves scientists from around the world. Other modern research buildings such as the

Materials Sciences



Supercomputer Modeling, Simulation, and Visualization



Life Sciences and Genomics

FIGURE 1.9 The wide range of research disciplines at the Berkeley Lab

Surface Science & Catalysis Laboratory and Advanced Materials Laboratory were completed in the late 1980s.

In the 1990s DOE formulated development plans for programs in genome sciences and computational sciences that built upon Berkeley Lab's multidisciplinary capabilities. The Genome Sciences Building was completed in 1997 to serve DOE's national Human Genome Program. In 1999 the Laboratory adapted buildings in Walnut Creek to house the DOE Joint Genome Institute's Production Sequencing Facility. Three of the human chromosomes were sequenced in this facility for the Human Genome Project. At the same time funding for research programs in some of the older science facilities such as the Bevatron and HILAC was discontinued and the massive equipment and facilities closed down.

Berkeley Lab's computational sciences capability was greatly strengthened when the DOE National Energy Research Scientific Computing (NERSC) Center moved here in 1996, bringing with it one of the nation's most powerful unclassified high-performance computers as well as expertise that further broadened the Laboratory's capabilities. High-performance computing is now regarded as an equal and indispensable partner, along with theory and experiment, in the advancement of scientific knowledge and engineering practice.

In 2006 the Molecular Foundry, a facility for the design, synthesis and characterization of nanoscale materials, began operation. This national user facility was built to provide advanced instrumentation, technical support, and scientific expertise to U.S. and international scientists in their nanoscience research activities. The building earned the U.S. Green Building Council's "Silver" rating for sustainable design and construction.

In many ways the Molecular Foundry sets the standard by which the Laboratory plans to develop facilities in the future. The facility is considered to be a state-of-the-art research facility in 2006 and is designed for collaborative team projects and to be highly adaptable to future research needs. Beyond this, the facility provides scientists with an efficient and collegial work environment within a building that makes the least environmental impact necessary to support the scientific endeavor within.

FIGURE 1.10 The Molecular Foundry is dedicated to supporting nanoscience research by scientists from around the world

Berkeley Lab 2006

Berkeley Lab main site operations occupy 1.8 million gross square feet (gsf) of scientific, administrative, and operations space in permanent facilities and temporary trailers. In addition, the Laboratory occupies 113,000 gsf of space in Donner and Calvin Laboratories and other buildings on the adjacent UC Berkeley campus. The Laboratory currently leases 314,000 gsf of space offsite in Berkeley, Oakland, Livermore, Walnut Creek, California; and Washington DC. These leased spaces are used for administrative and research functions such as facilities for high performance computing in Oakland, biosciences research in Berkeley, and genomics research in Walnut Creek.

Berkeley Lab is a multi-program, interdisciplinary scientific research facility with a mission to reach a deeper understanding of our world while delivering science-based solutions to challenges in life sciences, energy, and the environment. Berkeley Lab has developed internationally-recognized scientific capabilities that support multi-discipline collaborations and make possible new breakthroughs that benefit society and the economy in the areas of:

- Energy science and technology
- Materials synthesis, characterization, and nanotechnology
- Multidisciplinary biology and environmental science
- Chemical physics and surface science, and ultrafast science
- Computational science and engineering
- Detector systems for astrophysics, high energy physics, and nuclear science
- Photon and particle beams

Table 1.1 Building space occupied by Scientific Research Area in assignable square feet (ASF)

Science/Support Area	Main Site	UC Berkeley	Leased	Total
Life & Environmental Sciences	151,000	19,000	75,000	245,000
Physical Sciences	422,000	56,000	23,000	501,000
Computing Sciences	27,000	0	38,000	65,000
General Sciences	304,000	0	0	304,000
Operations	246,000	1,000	156,000	403,000
Subtotals	**1,150,000**	**76,000**	**292,000**	**1,518,000**
Non-Assignable and Common	658,000	37,000	78,000	773,000
Total Gross Square Feet	**1,808,000**	**113,000**	**370,000**	**2,291,000**

The University of California manages Berkeley Lab as a research campus, providing the intellectual leadership, scientific ingenuity, and operational expertise to accomplish the Laboratory's mission. Since its creation, Berkeley Lab has provided continuous support to the University of California's core missions of research, education, and public service. The Laboratory's research is conducted in close collaboration with many UC campuses, especially UC Berkeley, UC San Francisco, and UC Davis. There are 470 faculty associated with Berkeley Lab, over 250 of whom hold both UC faculty and Laboratory appointments. The new knowledge gained from joint research projects advances university education with the latest methods and discoveries.

Berkeley Lab plays a significant role in the development and education of the next generations of scientists and engineers. There are currently more than 760 graduate students, 670 undergraduate students, and 680 postdoctoral associates involved in Berkeley Lab research. This strong university connection provides students with unique research opportunities and prepares them for work in cutting-edge fields.

BERKELEY LAB AT A GLANCE—2006

Management and Operation: University of California

Physical Assets:

- 107 buildings and 53 trailers
- 202 acres

Human Capital:

- 3,014 full time employees;
  - 18% Scientists and engineers
  - 43% technical staff
  - 7% faculty
  - 13% students & post docs
  - 18% support staff
- 480 students
- 4,170 Facility Guests and Visiting Scientists Annually

Adjusted Daily Population: 4,515

Joint UC Appointments: over 250

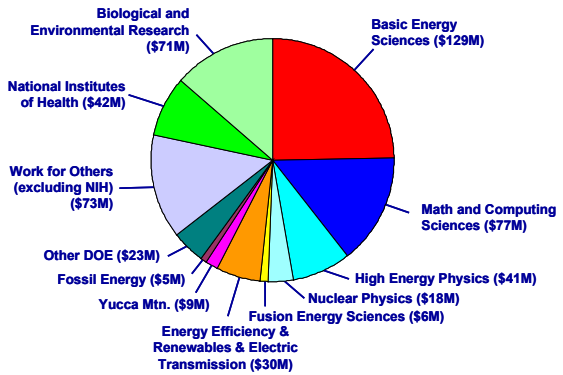
Nobelists: 11 associated with the Laboratory

National Academies Memberships: 81

FY 2005 Budget: >$524 Million

Funding by Sponsor:

- DOE Office of Science – 65%
- Other DOE – 12%
- NIH – 8%
- NNSA/DHS – 2%
- Other WFO – 13%



Berkeley Lab builds partnerships with academia, private industry, and government that deliver scientific tools and results far beyond the capabilities of any one institution. To promote these collaborations the Laboratory operates six national user facilities which are shared with the worldwide science community. These facilities include an ultra-bright light source, electron microscopes, high-speed data networks, supercomputers, a research center for the creation of new materials, and a genome sequencing facility.

The Berkeley Lab research enterprise is supported by a full range of operational support services that include environment, health, safety, and site and facilities management. In addition, the Laboratory includes services and amenities to benefit its employees and work environment, such as site security, a fire station, a medical clinic, logistical services (e.g. shuttle bus and mail) and a cafeteria.

As stewards of this public trust, Berkeley Lab management and staff must protect the public's interest and investment in the people, land, environment, facilities and equipment that make up the Laboratory. Berkeley Lab maintains a balance between ensuring a safe and secure working environment for all employees and visitors, and an open, collaborative work environment that facilitates scientific excellence. With the Laboratory engaged in an unclassified mission, security threats are deemed to be relatively low.

FIGURE 1.11 Berkeley Lab operates user facilities for use by the world-wide scientific community

Sustainability has been a priority at the Laboratory since the 1970's. Subsequently, Berkeley Lab has been a leader in the development of new technologies and industry standards for energy/resource conservation and renewable energy sources. As

FIGURE 1.12 The Laboratory's natural environment and adjacency to UC Berkeley are cherished attributes

such, the Laboratory has managed its own facilities to lead the way in resource conservation within the national laboratory system. In 1985 the Laboratory initiated the "In-House Energy Management Program." By 1996 this program had achieved a reduction of energy use by 43% (from a 1990 baseline) and a commensurate reduction in water consumption. The technologies and policies developed in the program are integrated with the broader sustainable building practices used in the development of its more recent projects.

While the lease of off-site commercial property has worked well to meet short term demand for space, it is more expensive than having the functions located in main site facilities, reduces productivity, and hampers multidisciplinary collaboration. Berkeley Lab recently initiated an effort to return staff to the main site to reduce cost and program fragmentation, improve economies of scale, strengthen employee's sense of identity, and improve communication. Fragmentation of research functions exists on the main site as well, as a result of expanding and contracting research group sizes and infrastructure needs in a relatively fixed building space capacity. The Plan provides a comprehensive solution to the fragmentation problem.

Facilities Conditions

The advancement of scientific discovery requires a constant evolution in facility infrastructure such as environmental controls, space configurations, and safety systems. As Berkeley Lab's facilities developed for an earlier era of scientific endeavor age, they become less able to meet the demands of current research programs. Only fifty-one percent of the Laboratory's buildings have been assessed as suitable for current use.

Sixty-two percent of the Laboratory's buildings are over 40 years old, an age at which demolition and replacement often become more cost-effective than continued use. Moreover, many of the Laboratory's buildings were built as temporary facilities. The outdated condition of these buildings is more pronounced than even their age would suggest. The aging building stock presents three specific challenges to the continued successful operation of the Laboratory:

- Need for upgrades of facilities to meet current seismic restraint requirements and provide a safe workplace
- Need for modernization of facilities to maintain the reliability of building support systems and improve environmental conditions to support the scientific mission
- Suitability of older buildings to the needs of future research equipment and methods

FIGURE 1.13 Inefficient, high-maintenance office trailers make up 5% of the main site's space

The Building Conditions map shown in Figure 1.14 provides a concise assessment of the state of the Laboratory's facilities in 2006.

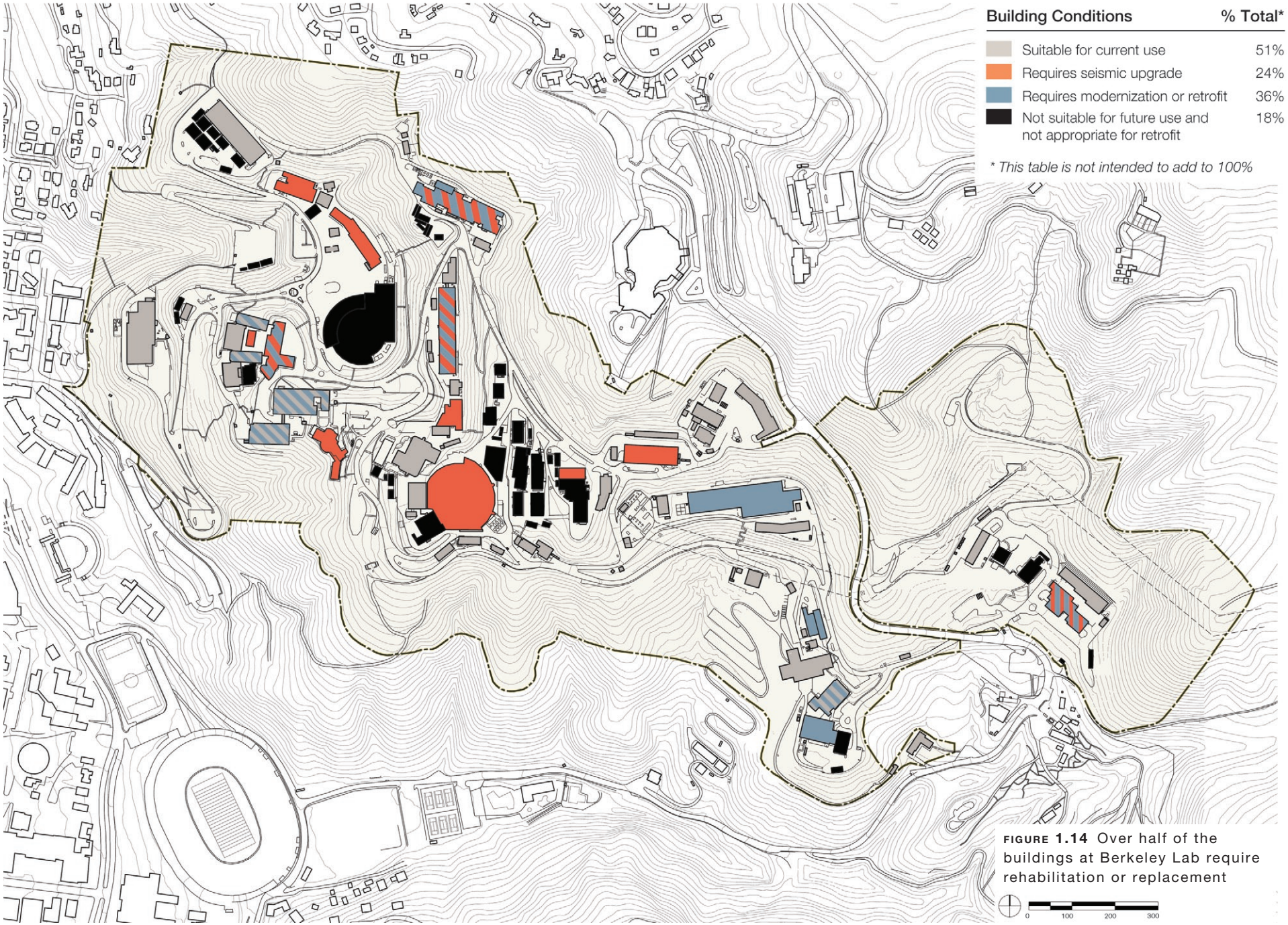


FIGURE 1.14 Over half of the buildings at Berkeley Lab require rehabilitation or replacement

Seismic Restraint Upgrades:
Over the past decades, building code requirements for seismic resistance have advanced to require much greater restraining strength. As the permanent building stock that was built to earlier codes is evaluated relative to the current version, 17% of the square footage at Berkeley Lab's main site has been rated as an appreciable or high life hazard to occupants due to potential structural failure during a major seismic event.

Modernization:
The increased reliance on high precision technology in modern science increases the need for higher levels of cleanliness and temperature & pressure stability. When research tools such as robotics and supercomputers evolve, so do their space and infrastructure needs. Buildings configured to support the tools in use decades ago lose their ability to support modern research needs. Thirty-six percent of the higher-quality main site facilities require modernization and retrofit to make them suitable for future use as research facilities.

Suitability:
A facility's adaptation to meet the needs of a new purpose can be driven by new scientific research or by a change in the technologies employed by a scientific program. Newer facilities can usually be made suitable for new research purposes, though as buildings age their adaptability diminishes and they are eventually only appropriate for support functions.

As the type of research performed at the Laboratory has evolved from specialized areas to multi-disciplined team research, the older buildings especially become unsuitable for new research purposes. Eventually, facilities can no longer be effectively rehabilitated for future use and must be demolished and replaced. Eighteen percent of the Laboratory's buildings have been assessed as not suitable for future use and not appropriate for retrofit, and are therefore prime candidates for demolition and replacement.

FIGURE 1.15 Demolition of facilities that are unsuitable for future research purposes

The seismic retrofit and rehabilitation of the Laboratory's facilities that are suitable for modernization, and the replacement of facilities that are not suitable for future use, will underpin the Laboratory's success in the coming decades. Berkeley Lab's rationale and guiding principles for the implementation of these changes is discussed in the next section.

2 VISION

This section forms the programmatic basis for the LRDP in three parts:

Scientific Vision

Space and Population Projections

Site and Facilities Vision

The Scientific Vision for Berkeley Lab

BERKELEY LAB WILL BE THE LOCATION OF CHOICE FOR LEADING SCIENTISTS TO SOLVE MAJOR CHALLENGES OF OUR TIME ON BEHALF OF HUMANKIND AND THE ENVIRONMENT.

Berkeley Lab has been the location of choice for leading scientists for decades, resulting in the rich history of scientific achievement outlined in the prior section. The Laboratory is committed to continuously delivering innovations in science and technology that address significant problems facing humankind and the environment. Figure 2.1 provides a sample of the Laboratory's scientific goals that address energy supply and use, models of living systems, and the nature of the universe.

Discoveries across this broad range of scientific disciplines promise to advance human knowledge and improve health, environmental protection, and our economy. However, continuation as the location of choice for scientists to successfully engage in these endeavors is challenged by eroding infrastructure and a stock of single-purpose facilities whereas research buildings built for multi-discipline collaborations will be the key to future success. These shortcomings threaten Berkeley Lab's ability to sustain its core competencies, obtain sponsorship for leading-edge programs, and attract new scientific talent.

This LRDP focuses on the site, facilities, and infrastructure aspects of achieving Berkeley Lab's scientific vision. Scientific discovery and the development of useful applications are accelerated when facilities consolidate advanced instrumentation with researchers from complementary disciplines. This requires the optimization and rehabilitation of facilities that can cost-effectively be made suitable for the evolution of scientific endeavors.

In addition, the replacement of existing facilities, and construction of additional facilities, will be required to meet the demands of the next generations of scientific endeavors and

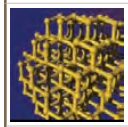
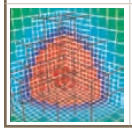
Federal Scientific Research Initiative		Berkeley Lab 20-Year Science and Technology Goals
	Develop New Energy Technologies and Environmental Solutions	Safe, sustainable, and CO2-neutral sources of energy • Understand global climate change • Demonstrate a safe and effective carbon sequestration system • Improved commercial and residential building efficiency
	Discover the Composition of Matter and Energy in the Universe	Greater understanding of the cosmos through the precision measurement of dark energy • Support the Joint Dark Energy Mission Launch • Fabricate advanced detectors to understand the origin of mass and the structure of nucleonic matter • Lead national and international efforts for underground neutrino detectors to determine neutrino mass
	Understand and Engineer Living Systems through Quantitative Biology	Understand and engineer living systems • Overcome the challenges of difficult biomolecular structures to deliver engineered environmental mitigation • Develop new detectors and molecular contrast agents to detect and quantify disease processes • Efficient and targeted synthesis of materials, fuels, and drugs from microbial systems
	**Create Designer Materials through Nanoscience**	Radically new generations of materials with tailored properties, with an emphasis on integrating inorganic and biological nanomaterials • Assembly of complex nanodevices such as nanomotors, nanophotovoltaics, and nanophotosynthetic systems • Transfer of nano-photovoltaic systems to industry for selected commercial applications
	Advance X-ray and Ultrafast Science	Overcome the challenges of moving x-ray science into the femtosecond and attosecond time domain • Develop an x-ray slicing source and further improving time-average brightness at the Advanced Light Source • Conduct x-ray probe experiments in reaction dynamics at sub-femtosecond resolution
	**Enable Scientific Discovery through Advanced Computing**	Develop the next generation of scientific computing architecture and facilities • Overcome interconnect latency, scaling difficulties, and software limitations to provide the best computing tools for the largest scale problems

FIGURE 2.1 Berkeley Lab's scientific goals address significant problems facing humankind and the environment

accommodate growth in space needs and population. Technical challenges presented by the problems to be addressed and the scale of systems that must be understood—from sustainable sources of carbon-neutral fuels to understanding dark energy—exceed Berkeley Lab's current capabilities. New facilities, specifically designed to address major challenges of our time, will be required for Berkeley Lab to continue as *the location of choice for leading scientists*.

A comprehensive renewal of the main site, facilities, and infrastructure that is sufficient for the achievement of Berkeley Lab's scientific vision and goals will require, and result in, a modest increase in building space and population. The Laboratory's approach to achieve this renewal is the basis of the LRDP growth projections and underpins the basic planning principles of the Plan:

- *Strengthen and expand existing research programs to sustain and grow Berkeley Lab's role as a national research institution.* The Laboratory's leadership in areas of emerging federal priority, such as solar energy, energy efficiency, and nanoscience, will result in increased funding with requirements that Berkeley Lab increase staff levels and scientific capabilities.
- *Expand partnerships and collaborations to enhance Berkeley Lab's scientific and technical base.* The Laboratory's partnerships with other national laboratories, academia, and private industry such as the Supernova Acceleration Probe will increase staff levels in supporting programs, related disciplines, and off-shoot research groups.

- *Provide flexibility to return staff from its off-site facilities leased in Berkeley and Oakland to the main site in order to enhance collaboration, productivity, and efficiency.* Projects such as constructing a high-performance computing facility at the Laboratory and returning staff and equipment from leased space would increase the building space and population at the main site without an increase in overall staff levels.
- *Expand the capacity of existing high-demand advanced facilities and provide broader functionality.* Core staff and visitors to Berkeley Lab's advanced scientific facilities are expected to increase as a result of keeping pace with technological advances such as adding new beamlines at the Advanced Light Source.

FIGURE 2.2 (below) The proposed User Support Building would provide staging area and laboratory space for users of the Advanced Light Source, as well as replace a seismically "very poor" building

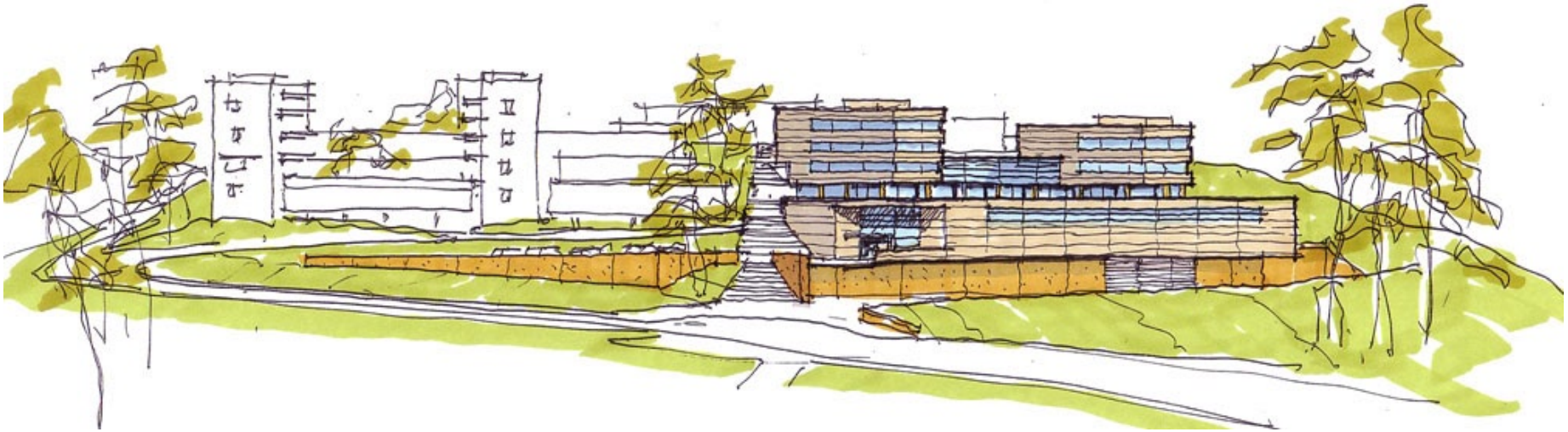
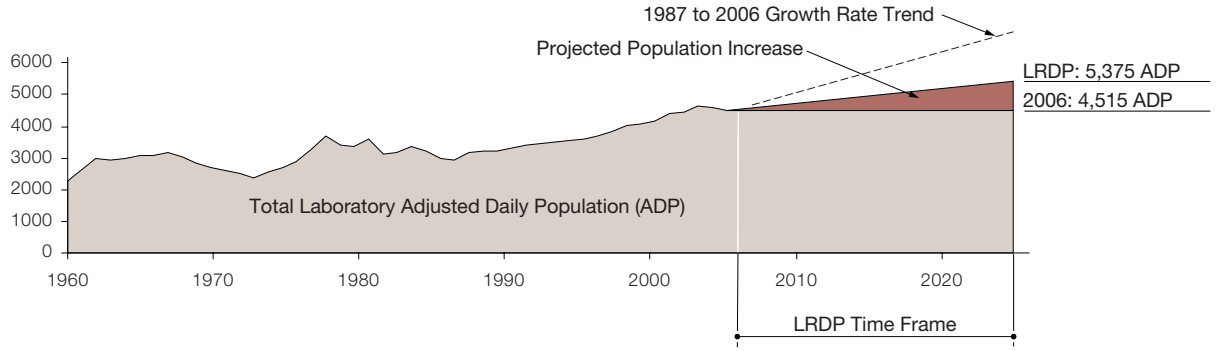


FIGURE 2.3 (above) Prospective high-performance computing facility to accelerate discovery in all scientific and engineering disciplines

- *Rehabilitate facilities that have outlived their intended purpose and can be cost-effectively adapted for use in new regions of scientific discovery.* For example, converting animal care space to life sciences laboratories and solving structural deficiencies in the process would enable an increase in the Laboratory's population while improving safety.
- *Replace single-purpose facilities with new facilities programmed to accommodate multiple disciplines with advanced infrastructure suitable for future scientific endeavors.* An increase in Berkeley Lab building space will result from projects such as the Bevatron demolition, which will provide a three-acre site for development of other new research programs.
- *Construct new scientific facilities to support future research initiatives and continued growth in existing programs.* For instance, developing methods to efficiently convert sunlight to fuels will demand high performance infrastructure and other advanced facility features that renovated space cannot provide. In addition, tackling problems of this scale will attract whole new research groups to the Laboratory and increase employee population.

Space and Population Projections



Note: Data relates to ADP in all facilities occupied by Berkeley Lab

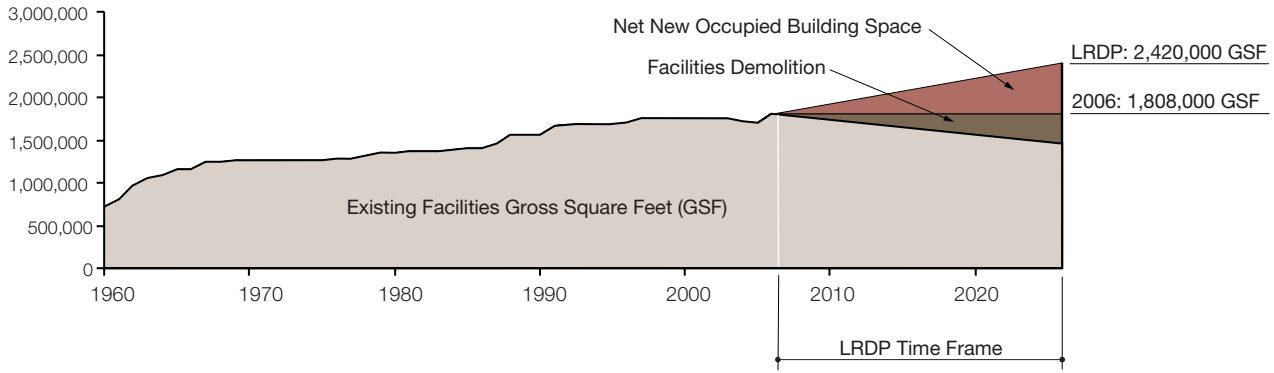
FIGURE 2.4 Berkeley Lab's Projected Population Increase

The achievement of Berkeley Lab's scientific vision and goals will result in growth of research programs, population, and occupied space. Berkeley Lab's population in all of the facilities it occupies is projected to grow from 4,515 in 2006 to 5,375 by 2025. This population increase of 860 represents an average annual growth rate of 0.9 percent over that time period. This rate is less than 40% of the Laboratory's overall 2.3 percent growth rate from 1987 to 2006.

Berkeley Lab uses the Adjusted Daily Population (ADP) to describe the actual population associated with the laboratory on workdays. It is calculated as the full-time equivalent (FTE) employees plus 40% of the registered guests which takes into account travel, vacation, part-time employees, and the periodic nature of guests actually entering the Laboratory. For example, 160 new FTE staff, plus 40% of 100 new registered guests, equals 200 new ADP.

The historical population levels at the Laboratory demonstrate the ebb and flow nature of research sponsorship at a national laboratory. As Figure 2.4 shows, Berkeley Lab's population has fluctuated considerably throughout its history in response to national research imperatives and budget opportunities or constraints. The Laboratory has experienced modest population growth since the late 1980s and reached a peak ADP of 4,643 in 2004. This growth is projected to continue, although at a slower pace through the time frame of this LRDP. Out of Berkeley Lab's total poulation, the main site 2006 ADP of 4,000 is projected to grow to a maximum of 5,000 by the year 2025.

The projected net increase in occupied building area on the main site is 612,000 gross square feet (gsf), from 1,808,000 gsf in 2006 to 2,420,000 gsf. This net growth factors in the demolition of 272,000 gsf of building space that is unsafe or



Note: Data relates to Berkeley Lab's Main Site only

FIGURE 2.5 Berkeley Lab's Projected Occupied Building Space Increase at the main site

beyond its useful life. The projected annual space growth rate of 1.5% is 25% greater than the Laboratory's facilities growth rate of 1.2% from 1987 to 2006 and relatively higher than the projected population growth rate. This increase reflects greater investment in large scale equipment, and the construction of facilities for the return of existing employees from leased facilities to the main site.

The following discussion characterizes the types of facilities that would be required to accommodate the future population and space growth at Berkeley Lab in the scientific and operations areas. Future scientific discoveries and new national challenges will guide a more detailed definition of facilities requirements over the coming decades.

Life & Environmental Sciences

Berkeley Lab's environmental research programs will continue to address the major challenges of environmental restoration and global climate change. A new generation of bioscience laboratories will be required to reveal the molecular mechanisms of living systems' adaptation and response to their environment, utilize microbes and plants to provide a new basis for fuels production, develop biological processes for legacy waste clean-up, and sequester carbon to reduce the advancement of global warming.

Physical Sciences

Berkeley Lab is focusing its strengths to address the national and global need for sustainable, carbon-neutral fuels production. Improvements in the efficiency of solar to chemical energy conversion and photovoltaic cells require new multi-disciplined research laboratories in close proximity to national user facilities existing at Berkeley Lab. The Advanced Light Source is being upgraded to enable science currently not possible and high demand

is expected once the capability is delivered. Further improvements will address user demands for the coming decades.

Computing Sciences

Computation at the largest scales possible will be increasingly important to advance the frontiers in every scientific discipline. Expanded high-performance computing facilities are necessary for improvements in computational power, network bandwidth & reliability, and mathematical & software tools to enhance the scientific productivity of computational scientists.

General Sciences

Berkeley Lab expects to be a leader in accelerator and space-based experimental programs. The recent discovery that the expansion of the universe is accelerating marked a major scientific revolution. The next generation of accelerator-based research facilities will open an era where laboratory experiments shed light on some of the most profound mysteries of the universe. Berkeley Lab is leading the effort to measure dark energy by observing distant Type Ia supernovae spectra with a highly instrumented orbiting telescope - this effort will require sustained engineering laboratories and office space.

Operations

Full-service operational support is provided to enable the Laboratory's scientific programs to focus on research. Growth in the scientific programs will require a corresponding growth in support population and occupied building space. Moving administrative staff from leased facilities to the main site will also increase building space occupied by Operations. A proposed facility for providing short-term accommodations to guests of Berkeley Lab would add occupied space and a small number of new staff to the main site.

Reserve

The occupied space and population reserve would allow Berkeley Lab to quickly deliver the facilities and personnel required to meet national challenges as they emerge. While the facilities would be laboratory, advanced instrumentation, shop, office, and conference space, the types of science to be conducted in these facilities would be determined by new knowledge that will be developed within the time frame of this LRDP.

A conceptual projection for the occupied space and population growth in each functional area over the next 20 years is provided in Tables 2.1 and 2.2.

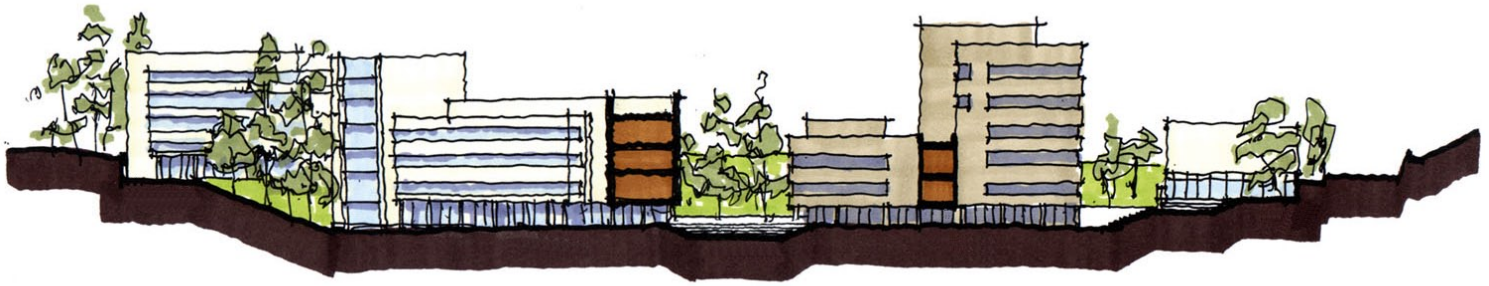


FIGURE 2.6 Genomics and Biosciences facilities with advanced infrastructure are required to address major challenges in energy, health, and the environment

TABLE 2.1 Summary of Projections for Population Growth

Area	New Employees	New FTE	New Registered Guests	Net New ADP (Note 1)
2006 Population Baseline ADP (all sites)				4,515
Life & Environmental Sciences	200	180	50	200
Physical Sciences	300	260	180	330
Computing Sciences	40	30	50	50
General Sciences	100	90	30	100
Operations	80	70	20	80
Reserve	100	90	20	100
Totals, 2006-2025	820	720	350	860
Total Projected Population (all sites)				**5,375**

TABLE 2.2 Summary of Projections for Space Growth

	New GSF	Demolition GSF	Net New GSF
2006 Space Baseline GSF (Main Site only)			1,808,000
Life & Environmental Sciences	115,000	11,000	104,000
Physical Sciences	276,000	34,000	242,000
Computing Sciences	170,000	3,000	167,000
General Sciences	142,000	126,000	16,000
Operations	25,000	5,000	20,000
Reserve	156,000	93,000	63,000
Totals, 2006-2025	884,000	272,000	612,000
Total Main Site Occupied Space			**2,420,000**

Note 1: Adjusted Daily Population (ADP) =
Full-Time Equivalent (FTE) Personnel + (Registered Guests * 40%)

The Site and Facilities Vision

The new development identified in this Plan offers an opportunity to preserve and enhance Berkeley Lab's valued environmental assets while making improvements to functional and experiential qualities of the Laboratory's main site. The 2006 LRDP will realize this opportunity by applying four principles inspired by the special qualities of the Laboratory setting to the future physical development identified in this Plan. These principles are the foundation of the site and facilities vision to make Berkeley Lab "An outstanding place to do world-class science."

Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship.

As a leader in energy and environmental research and the stewards of this extraordinary site, the Laboratory has an opportunity and responsibility with each new project to be a model for environmentally responsible development. Construction of new facilities will take place on land within already developed areas of the site to allow undisturbed open space to remain at the site's perimeter. Sensitive habitats and riparian areas are protected and stands of screening trees will be expanded to screen views of Laboratory buildings from all directions.

New buildings will meet or exceed the *UC Presidential Policy for Green Building Design*. Whenever possible, new building elements and/or design strategies developed by University of California researchers will be showcased in new projects as a way to reinforce a "culture of sustainability" at Berkeley Lab. All of this will be done in a way that enriches the unique place that is Berkeley Lab.

FIGURE 2.7 Laboratory facilities like the historic ALS building complement the Berkeley Hills setting

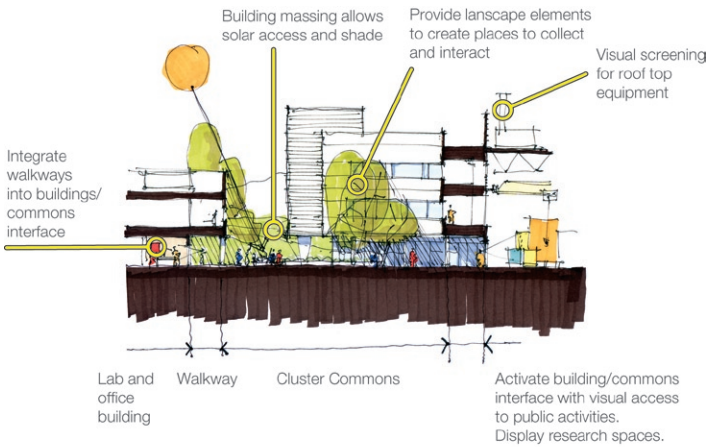


FIGURE 2.8 (far left) New facilities built at higher densities, like the Advanced Materials Laboratory, enhance operational effectiveness and flexibility

FIGURE 2.9 (left) Select architectural elements of a campus-like setting

Build a safe, efficient, cost-effective scientific infrastructure capable of long-term support to evolving scientific missions.

Life safety is a top priority at Berkeley Lab. New facilities will provide state of the art protection against potential occupational hazards and will address the two natural hazards common to the East Bay region—wildland fires and seismic activity. Future development and landscape improvements will continue and strengthen the Laboratory's existing fire protection and vegetation management strategies that have served as a model to the region. The replacement of older facilities with new ones built to modern life safety standards will significantly reduce the threat to life safety in the event of fire and earthquakes as well as the potential occupational hazards of scientific research.

The efficient, long-term operation of a research institution where scientific needs are constantly changing is a challenge that demands a high degree of flexibility in the way new projects are planned and designed. Accordingly, the Plan provides the flexibility needed to meet both known and unforeseen programmatic needs in a cost effective way without compromising the environmental assets of the site.

Operational efficiency is also strengthened by bringing researchers and their programs closer together. Whenever possible, new projects will be located in close proximity to facilities with common activities and/or related research interests to capitalize on the benefits of collaboration and shared use of specialized equipment and facilities.

Build a more campus-like research environment.

Berkeley Lab's scientific endeavors rely on the healthy exchange of ideas sustained through formal and informal social interaction among scientists, engineers, students, and support staff. To build an environment that fosters this valuable social interaction, the design of new Laboratory projects will draw inspiration from university campus type settings. Future development at the Laboratory will place an emphasis on the pedestrian experience both indoors and outdoors to create a setting conducive to interaction and collaboration.

New projects will be planned to segregate pedestrian and vehicular circulation. Buildings, built at greater densities than they are now, will better define outdoor spaces between them. Future development will build upon the informal character of the Laboratory and lead it in a direction where buildings are

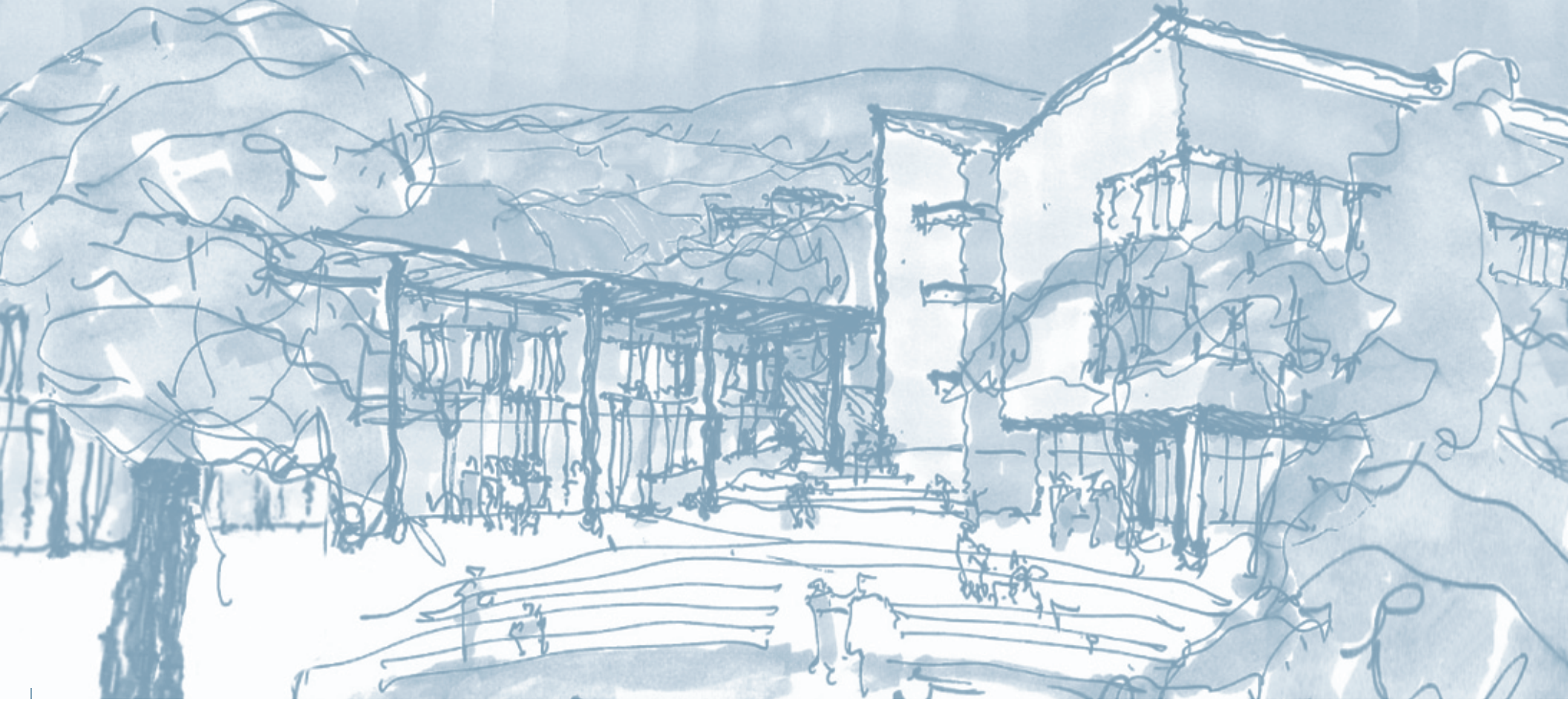
FIGURE 2.10 Access to advanced scientific equipment like the Advanced Light Source supports international collaborations

not thought of as individual objects, but work in concert to weave the Laboratory site into a coherent whole.

Improve access and connections to enhance scientific and academic collaboration and interaction.

As the Laboratory takes on new challenges it will increasingly rely on the rapid innovation that emerges from interdisciplinary collaboration. Whether at the scale of individual researchers, or a consortium of public and private institutions working together, clear and convenient access to and around the Laboratory is vital to the work and culture of team science at Berkeley Lab.

The Laboratory is committed to providing access in the safest, most environmentally responsible way possible. In 2006 nearly half of the Laboratory's adjusted daily population commuted to the main site on its shuttle system which has connections to UC Berkeley and regional mass transit systems. New and improved pedestrian routes will provide safe and direct linkages between onsite shuttle stops, facilities, and parking. The improved walkways will offer an outdoor amenity that not only provides a sense of connection to the natural setting and views, but also promotes chance meetings along the way.



3 THE PLAN

The Plan section of this LRDP describes the strategies that Berkeley Lab will employ to meet its long term facilities needs and support its daily operations. The Plan is organized in the following sections.

Land Use

Development Framework

Vehicular Access, Circulation, and Parking

Pedestrian Circulation

Open Space and Landscape

Utilities and Infrastructure

Introduction to The Plan

The Berkeley Lab 2006 Long Range Development Plan provides a general land use plan and a framework for the revitalization of Laboratory facilities and infrastructure; and the preservation of open space and landscape. Strategies for each of these elements provide guidance to ensure that each new project contributes to a cohesive development of the site that forms a safer, more efficient and campus-like research environment.

This Plan reflects an evolutionary process and not a dramatic departure from the previously adopted plan. All of the basic concepts embodied in the 1987 LRDP are retained and strengthened, or adjusted to reflect existing site conditions and the Laboratory's current scientific vision and goals. This Plan provides the flexibility necessary to accommodate both known and unforeseen programmatic needs yet places an emphasis on the qualitative aspects of the site's natural and built environment.

The Plan's basic principles and the strategies discussed in this section are in step with the Laboratory's institutional values and scientific work. The 2006 LRDP has been developed in conjunction with the *Berkeley Lab Sustainability Policy* that formalizes the Laboratory's continuing role as a leader in resource conservation and environmental stewardship. As each new project is developed according to this policy and the strategies provided in the *Berkeley Lab Design Guide*, the Laboratory will build an environmentally sustainable research facility that reflects its scientific endeavors.

Sustainability is broadly defined as "providing for the needs of the present generations without impinging on the ability of future generations to meet their own needs." Accordingly, each project at Berkeley Lab will consider the long-term effects of actions taken during development. This Plan integrates the sustainability principles of energy efficiency, waste minimization, high quality, lowest lifecycle cost, stimulating architecture, and open space preservation with the functional aspects of facilities and infrastructure.

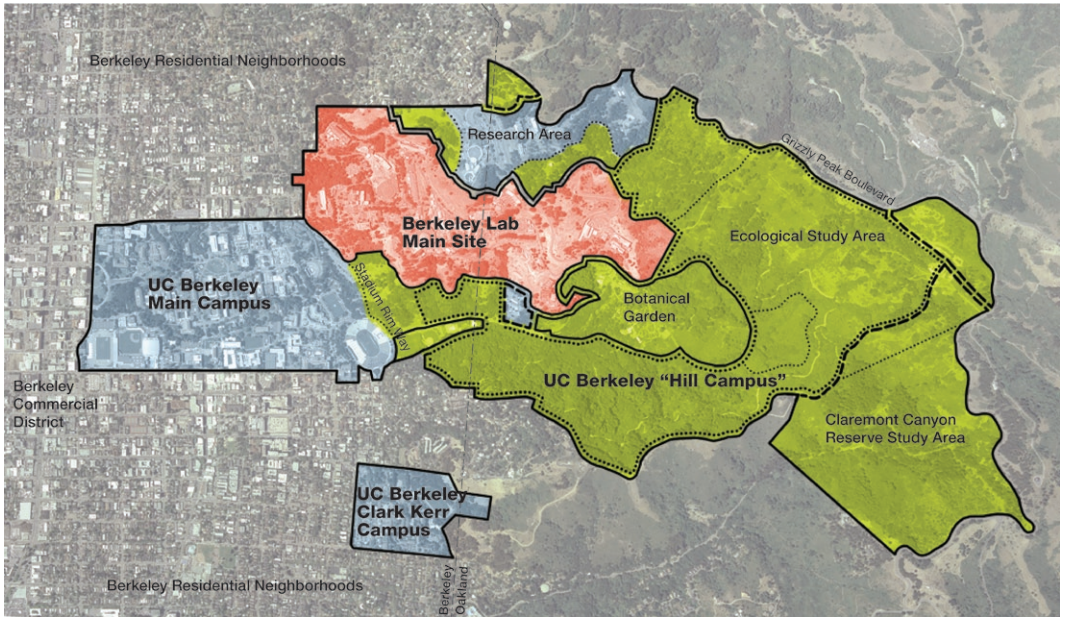
FIGURE 3.1 The Berkeley Lab site in 2006 is a blend of landscape and building clusters

Land Use

CONTEXT AND EXISTING CONDITIONS

The Laboratory's main site is located mid-level of the Berkeley/Oakland hills at elevations ranging from 500 to 1,000 feet above sea level. Roughly one-half of the main site is within Strawberry Canyon and has a south-facing orientation; the balance is within Blackberry Canyon and is oriented toward the San Francisco Bay. The Laboratory's western edge adjoins an area defined by residential use and a number of UC Berkeley facilities such as student housing and academic buildings adjacent to the main campus. A portion of the main site's northern border adjoins residential neighborhoods.

The site is surrounded on the north, east, and south sides by the 800-acre portion of UC Berkeley known as the Hill Campus, which extends from Stadium Rim Way to Grizzly Peak Boulevard. The UC Berkeley Hill Campus is primarily designated as open space and includes a 300-acre Ecological Study Area and the Botanical Garden. The UC Berkeley Hill Campus also includes the Strawberry Canyon Recreation Area and the Witter and Levine-Fricke sports fields at lower elevations as well as the Lawrence Hall of Science, Space Sciences Laboratory, and the Mathematical Sciences Research Institute at higher elevations.



In 1998 the Laboratory assumed management responsibilities for 68 acres of adjacent Regents land to broaden and strengthen its wildland fire and vegetation management programs. Since then the Laboratory has cared for these lands in accordance with the UC Berkeley's LRDP. Once approved, land use regulations and other such guidance for future projects within this "management zone" will fall under the jurisdiction of this Plan.

FIGURE 3.2 The Laboratory's main site blends with the rustic landscape of the UC Berkeley Hill Campus

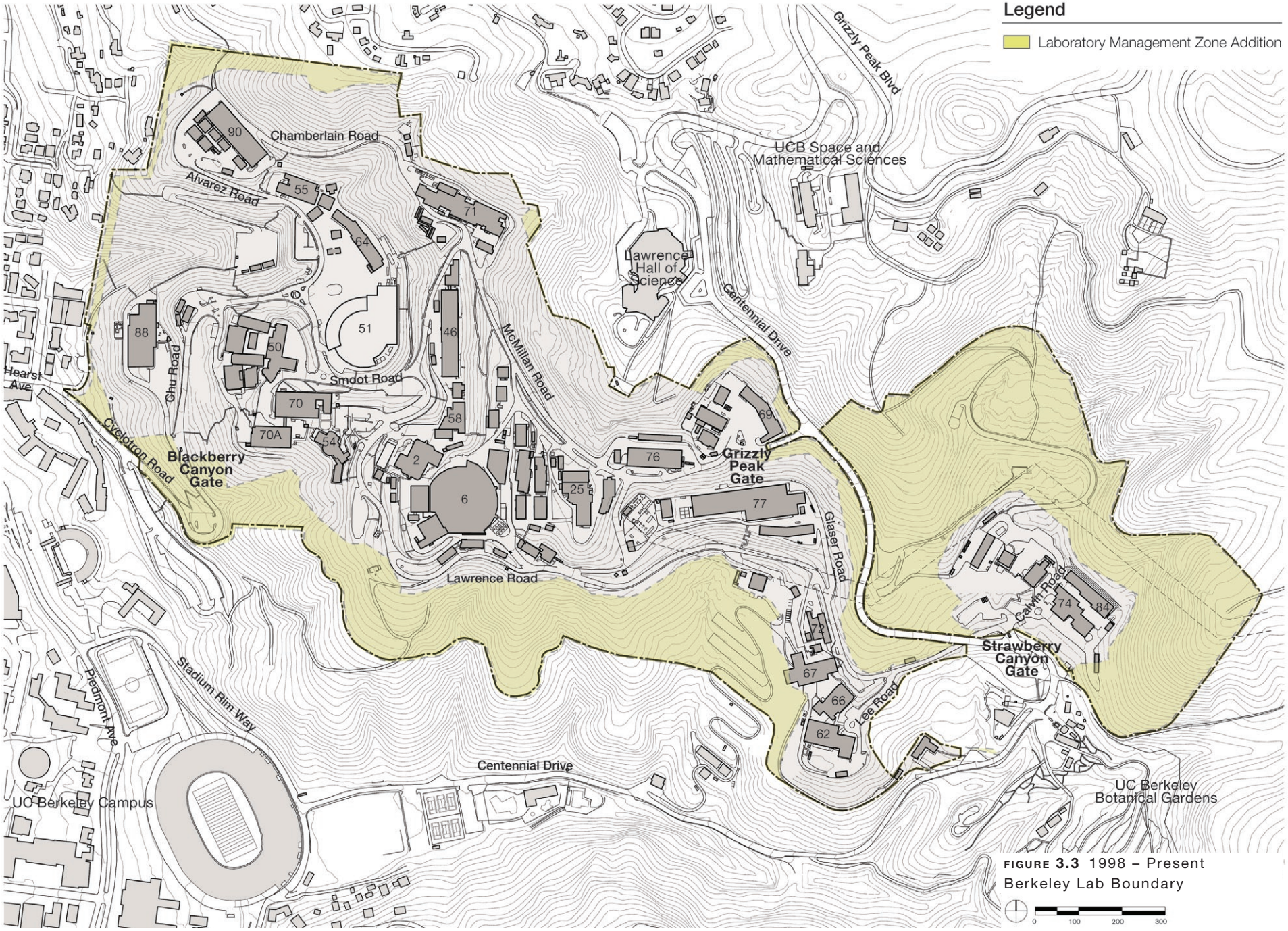


FIGURE 3.3 1998 – Present Berkeley Lab Boundary

SITE CONSTRAINTS

The portions of the Laboratory site where development would be avoided to the extent feasible have been identified and are generally characterized by two different kinds of constraints: fixed and easement/setback. Beyond these constraints, there are a host of other conditions such as steep slopes found in portions of the site that affect facility siting and design. These constraints will be considered when selecting suitable sites for specific buildings.

FIXED CONSTRAINTS

Fixed constraints include areas afforded special status or protection prescribed by law or policy.

Protected Habitats

Lee's Micro-Blind Harvestman (Microcina Leei) is listed as threatened under both federal and state law. This arachnid was first identified on the main site in the 1960s and again in the 1980s. An area of the Laboratory on the south-facing slope of Blackberry Canyon has been identified as the type of locality where the species occurs. This area consists of a dense canopy of oak-bay woodland with undisturbed sandstone rocks that are embedded in the soil and have moist conditions underneath.

Alameda Whipsnake. This snake species *(Masticophis lateralis euryxanthus)* is listed as threatened under both federal and state law and is found in open-canopied shrub communities, including coastal scrub and chaparral, and adjacent habitats including oak woodland/savanna and grassland areas. One area of potential Whipsnake habitat is shown on the Fixed Constraints Plan at the easternmost portion of the site.

Riparian and Wetland Habitat. A number of drainages exist on the main site; some are ephemeral or intermittent, and others like the North Fork of Strawberry Creek, Chicken Creek, and their tributaries are considered "jurisdictional" under the Clean Water Act and thus warrant special attention. According to the California Department of Fish and Game these jurisdictional drainages along with four freshwater seeps support riparian habitat. These areas are indicated on the Fixed Constraints Plan as Riparian Habitat.

Hayward Fault Zone.

The Hayward Fault, at the western edge of the main site, near the Blackberry Gate, is a part of the active San Andreas Fault system that developed as the Berkeley Hills were uplifted.

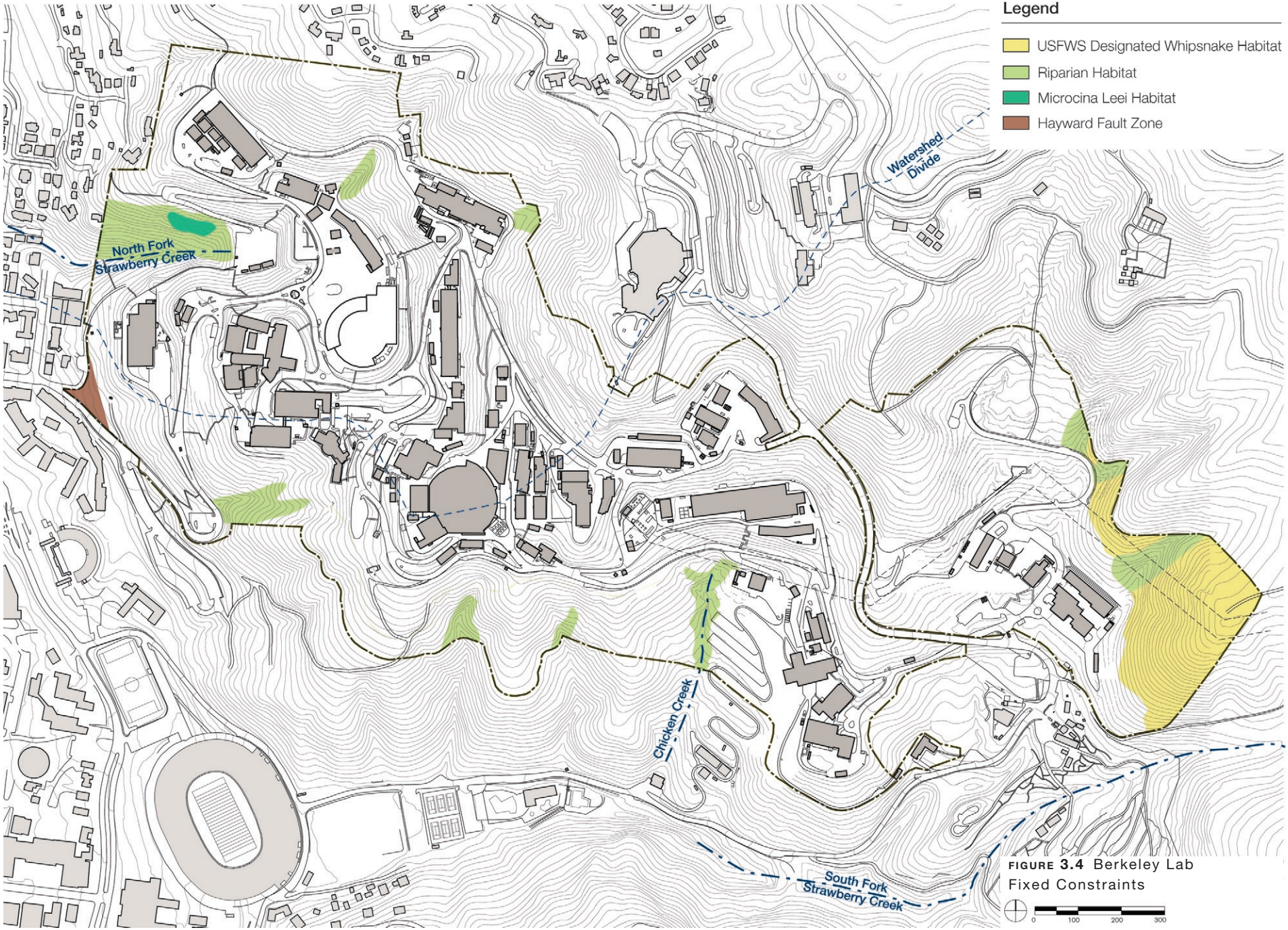


FIGURE 3.4 Berkeley Lab Fixed Constraints

EASEMENT/SETBACK CONSTRAINTS

Additional constraints include those areas that preserve or enhance views, and maintain adequate distance from the Laboratory boundary or major utilities. These include:

Major Utilities Lines or Easements

A Pacific Gas and Electric (PG&E) easement passes through the eastern portion of the main site corresponding to the alignment of a 115,000 volt overhead power transmission system. Since the effort and cost to relocate this easement would be significant, this corridor has been identified as a constraint to development. Future facilities will not be sited within the easement, nor will they be located in such a way that would limit access or maintenance operations.

Setbacks

Two zone types have been identified as appropriate places to impose development setbacks. These setbacks will:

- Protect the visual character of the hillside landscape that figures prominently in the wooded, grassy hillside image of the Laboratory and East Bay region (Viewshed Reserve).
- Ensure that Laboratory buildings are set back appropriately from adjoining residential neighborhoods (Neighborhood Setback).

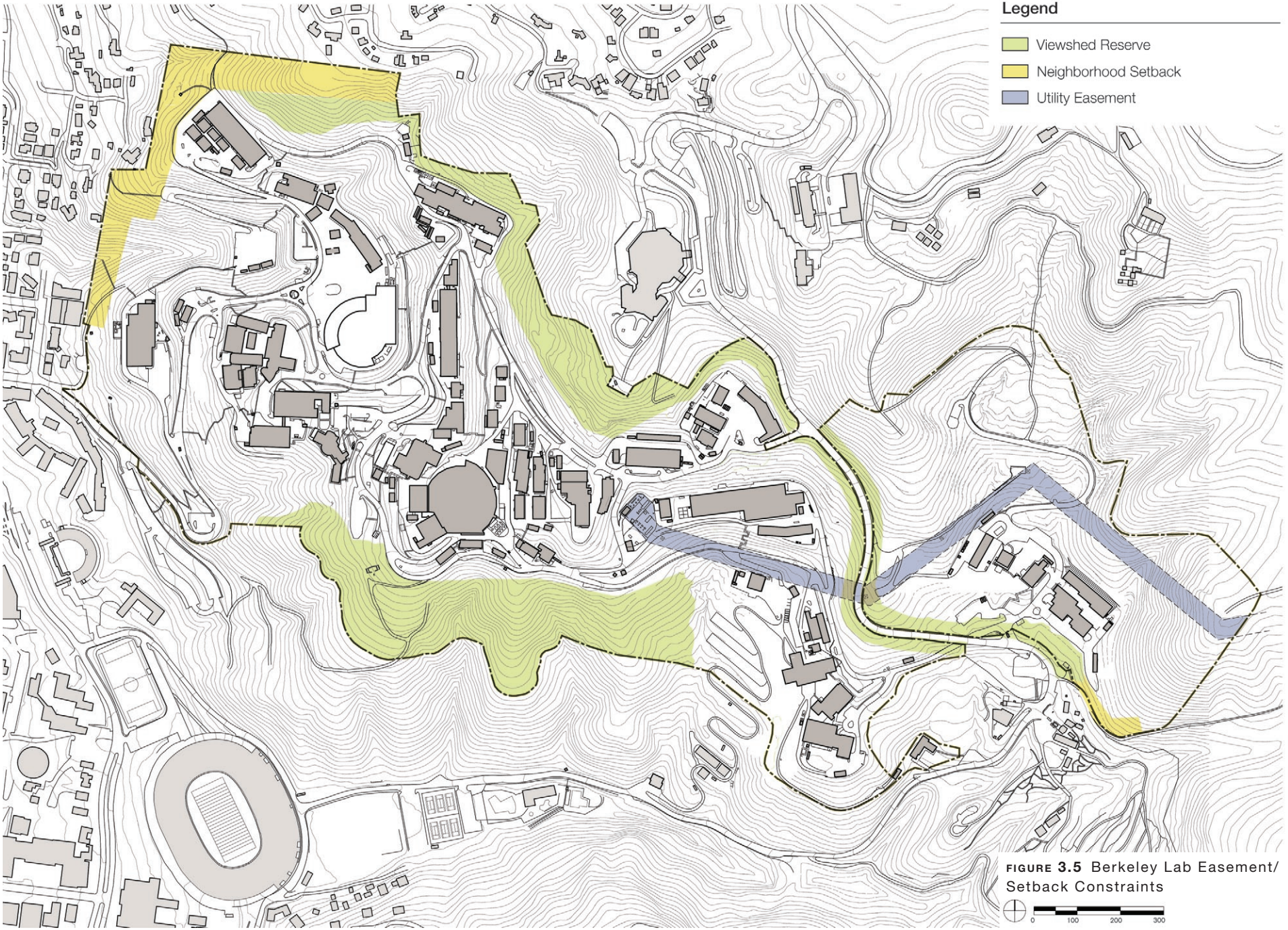


FIGURE 3.5 Berkeley Lab Easement/ Setback Constraints

LAND USE STRATEGIES

The Land Use Plan will guide future planning decisions; it has been configured to manifest four strategies that derive from an appreciation of the site's existing assets and constraints, the Laboratory's scientific vision and goals, and the planning principles that underlie this LRDP:

- Protect and enhance the site's natural and visual resources, including native habitats, riparian areas, and mature tree stands by focusing future development primarily within the already developed areas of the site
- Provide flexibility in the identification of land uses and in the siting of future facilities to accommodate the continually evolving scientific endeavor
- Configure and consolidate uses to improve operational efficiencies, adjacencies, and ease of access
- Minimize the visibility of development from neighboring areas

LAND USE PLAN

The Land Use Plan defines four land use zones that will guide the location of all new buildings and site improvements. These zones have been designed to strengthen existing functional adjacencies and promote an overall density of development that is appropriate to the main site.

LAND USE ZONES

Research and Academic

The Research and Academic zone encompasses the majority of the Laboratory's developable area and largely corresponds with, or is adjacent to, the already developed portions of Berkeley Lab. This 121-acre zone includes almost all of the Laboratory's existing research and academic functions and is primarily reserved for similar uses. These uses include scientific research and associated support such as administration, health services, security and fire protection. Non-research/academic uses would be permitted in this zone if no other suitable location was identified.

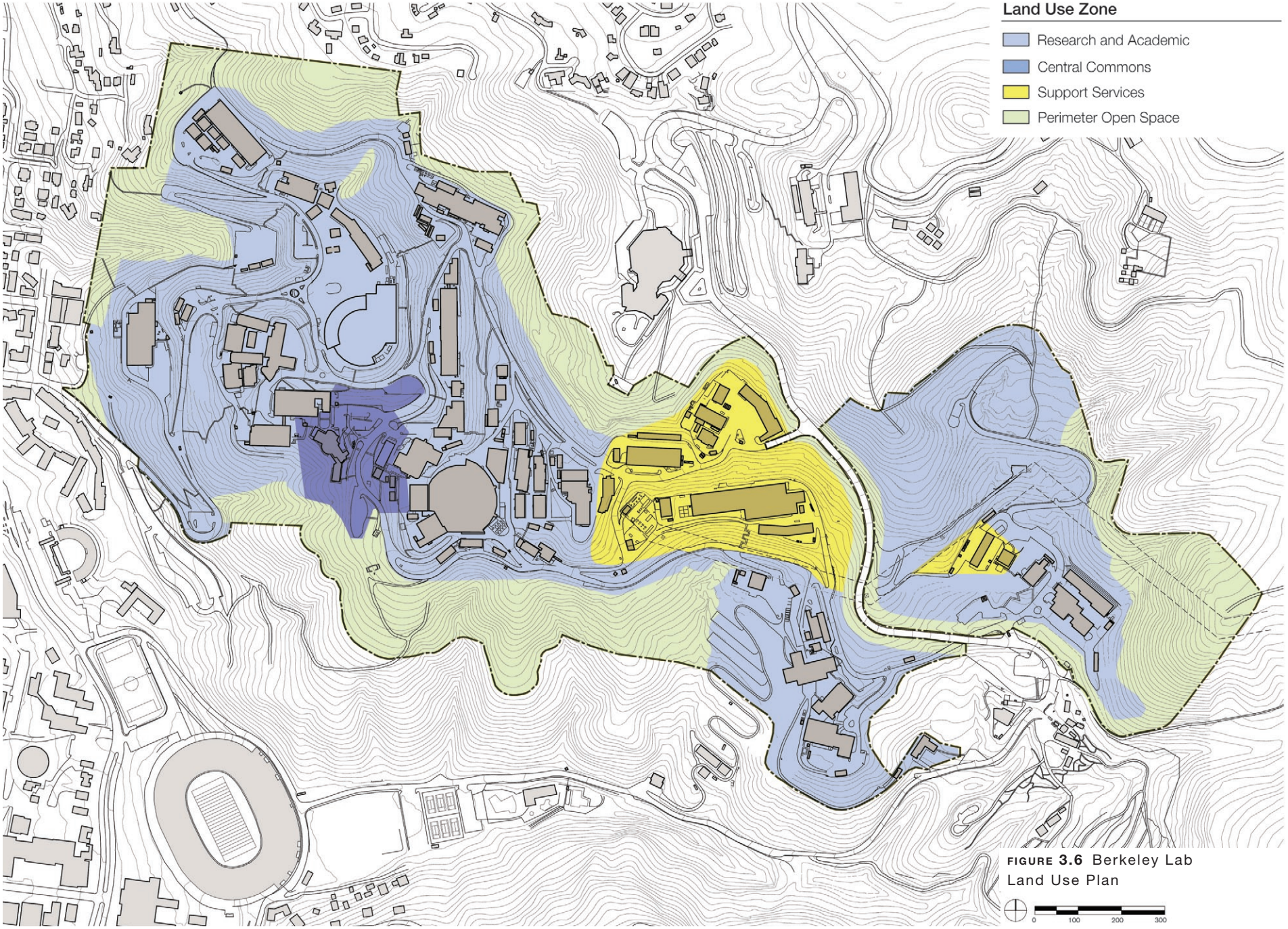


FIGURE 3.6 Berkeley Lab Land Use Plan

Central Commons

The Central Commons zone is centered around the Laboratory's Cafeteria and outdoor gathering areas. Future uses intended for this zone would reinforce this small but centrally located area as the "heart of the Laboratory" where shared amenities such as the Cafeteria would draw Laboratory personnel together in an environment conducive to interaction. The primary uses intended for this zone include food services, short-term accommodations, gatherings and meetings, mass transit hub, and other shared activities. While research and academic functions will be permitted, it is preferable that most of this zone be reserved for common, shared uses.

Support Services

The Support Services zone provides a centralized location for the Laboratory's plant operations and support activities, such as shops, environmental services, corporation yards, central mail distribution and maintenance. While research and academic functions are permitted in this area, this zone will generally be reserved for non-research uses so that efficiencies can be achieved in the organization and management of critical Laboratory support services.

TABLE 3.1 Land Use Plan Area Calculations

Land Use Zone	Area	Percentage	
	Acres	Of Developable	Of Total
Research and Academic	121	83%	60%
Central Commons	6	4%	3%
Support Services	19	13%	9%
Total Developable Area:	**146**	**100%**	**72%**
Perimeter Open Space	56		28%
Total Berkeley Lab Area:	**202**		**100%**

Perimeter Open Space

The Perimeter Open Space zone encompasses areas identified in the Site and Easement/Setback Constraints section and comprises 56 acres or over one-quarter of the main site. The Perimeter Open Space designation indicates areas of the site where future development would be avoided to the extent feasible. Development will primarily be reserved for trails, maintenance roads, power supply and utilities equipment and distribution, and minor structures that support those functions.

DEVELOPMENT DENSITY

Density, measured by the ratio of building floor area to the area of a site, (FAR) is a defining characteristic of development. The current overall FAR of the main site is 0.20. With the occupied building area increase of 620,000 gsf projected in this LRDP the FAR for the overall site would increase to 0.27 which is considerably less than that of a university campus or modern office park which typically have an FAR of 0.5 to 1.0.

Like in a campus setting, the density of future development will vary greatly across the site, however the overall density is a good indication of the impact and character that future development will have with respect to neighboring communities. A look at the issue of development density is provided in more specific terms in the next section, Development Framework.

Development Framework

FIGURE 3.8 (right) Building and infrastructure forms at Berkeley Lab have a purpose-built, industrial character with a consistent palette of materials, and colors

CONTEXT AND EXISTING CONDITIONS

As the country's oldest national laboratory, Berkeley Lab has a long history of constructing facilities on an as-needed basis in response to national scientific priorities. When new scientific initiatives warranted, new facilities designed to meet the specific need at the time were constructed on the relatively level areas available on the main site.

Across the Laboratory, rustic landscape surrounds clusters of research buildings constructed with the most appropriate and cost-effective methods available at the time under a design framework that emphasized function. These straightforward buildings among a rustic landscape and the extraordinary views defines the Laboratory's informal character and unique sense of place.

During the earliest periods of construction, development resulted in clusters of stand-alone buildings that are mostly one to two stories in height. The space between these buildings is largely undefined and congested with support equipment, vehicular service access, and parking. While the main site includes several landscaped areas dedicated to pedestrian circulation, they often overlap with vehicular uses.

As a result, research programs are often dispersed among dissimilar buildings across the site and access between these buildings can be confusing. This situation underutilizes the land that is best suited for development and tends to dampen operational efficiencies and opportunities for interaction among researchers.

FIGURE 3.7 (left) Aerial view of the Laboratory in 2003 reveals how the cluster development pattern follows the main site's hillside topography

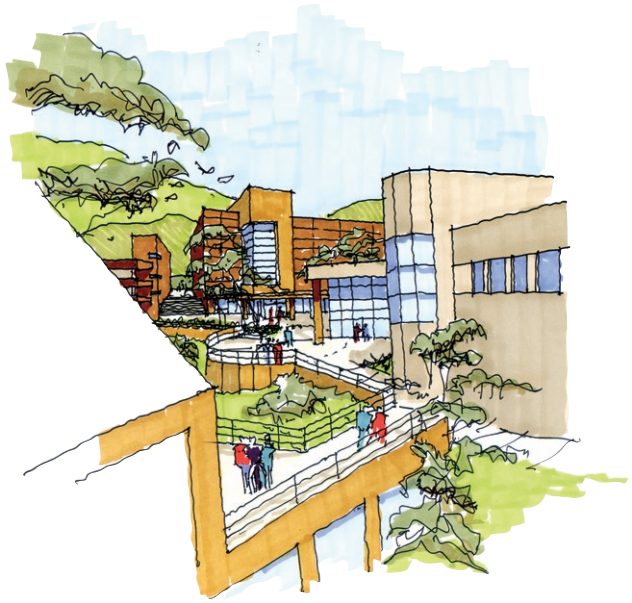


FIGURE 3.9 Future development will focus on creating Research Clusters which will reinforce a more campus-like environment at the Laboratory

DEVELOPMENT FRAMEWORK STRATEGIES

The Development Framework defines the rationale for where and how new development should occur within the zones defined in the Land Use Plan, and provides a means to implement these six strategies:

- Increase development densities within areas corresponding to existing clusters of development to preserve open space, and enhance operational efficiencies and access
- To the extent possible, site new projects to replace existing outdated facilities and ensure the best use of limited land resources
- To the extent possible, site new projects adjacent to existing development where existing utility and access infrastructure may be utilized
- Create a more "collegial" environment that encourages and facilitates interaction among the variety of Berkeley Lab employees and guests
- Site and design new facilities in accordance with *UC Presidential Policy for Green Building Design* to reduce energy, water, and material consumption and provide improved occupant health, comfort, and productivity
- Exhibit the best practices of modern sustainable development in new projects as a way to foster a greater appreciation of sustainable practices at the Laboratory

The Development Framework illustrated in Figure 3.10 has four components: research clusters, outdoor use areas (cluster commons), linkages among research clusters, and the Central Commons.

Research Clusters

Future development at Berkeley Lab will build upon and strengthen the existing hillside cluster development pattern to create a more campus-like setting that reflects its unique site and functional needs. The main site is organized into six "research clusters" defined by major topographic features encompassing research functions that share common needs and interests. One "service cluster" provides a central location for facilities and shipping/receiving operations.

A network of pedestrian paths links these clusters to the "Central Commons" area that serves as the social heart of the Laboratory. The Central Commons and pedestrian pathways are essential elements of the Laboratory's functional and experiential qualities and are discussed in further detail on the pages that follow.

Most new buildings will be located on infill sites and/or adjacent to existing facilities, resulting in a higher density of development within each cluster, improving operational efficiencies and creating a

FIGURE 3.10 Development Framework

more collegial setting. These new facilities will also be planned and designed to segregate vehicular and pedestrian uses. Spaces for vehicular circulation, parking, deliveries, and service activities will be located at the perimeter of each research cluster. Outdoor spaces for pedestrian uses will be located towards the center of these clusters, in spaces formally defined by the edges of new and existing buildings.

The specific configuration and design of new development within these clusters will be guided by illustrative plans and design guidelines prepared by the Laboratory. These guidelines, while separate from this LRDP, support the objectives of the Laboratory and address the specific design of outdoor spaces and buildings. They are intended to result in an arrangement of facilities that will improve the Laboratory's appearance and functionality, and foster a sense of community and interaction.

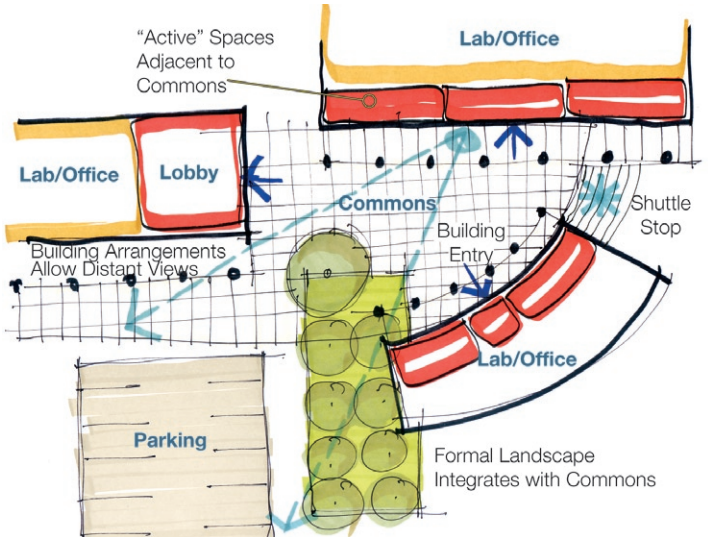


FIGURE 3.11 Cluster commons will create outdoor use areas

Cluster Commons

Within each research cluster at the Laboratory, improvements will be made to the outdoor areas at their centers. These outdoor areas, many of which are currently occupied by surface parking, temporary buildings, or service fixtures, will be transformed into small quads or plazas as might be found on a university campus. These outdoor areas, furnished with benches, lighting and other amenities will provide informal venues for discussion, relaxation or meals. Located at the front doors of adjoining facilities and on pedestrian routes linking parking and other clusters, these areas will be opportunities for interaction for Laboratory researchers and guests.

FIGURE 3.12 (left) Pedestrian paths and walkways among research clusters will be enhanced to stimulate interaction and ease circulation

Pedestrian Linkages among Research Clusters

The network of major pedestrian routes through the Laboratory is important, not just for ease of circulation and wayfinding, but also as a means for interaction, as seing one's colleagues outside the workplace is an important means to share insights and generate new ideas. These pathways between neighborhoods will be improved where already existing and added where needed. In addition, the path between the Laboratory and the Berkeley campus will be improved. Improvements may include better lighting, paving, seating and other amenities.

FIGURE 3.13 (right) The area near the Cafeteria will be developed into the Central Commons

Central Commons

The area around the Cafeteria presently serves as an important hub for Laboratory activity and will be further improved to become the Central Commons. Like a traditional campus quad, this social heart of the Laboratory will be developed into the place where the primary eating, meeting, and event activities take place. To support these uses, additional usable outdoor areas will be provided, furnished with pedestrian-scaled lighting and seating, protected from wind but taking advantage of views and providing areas of sun and shade. All of the important pedestrian circulation pathways will lead to this area, and it will be well-served by the shuttle system and by a comprehensive signage and wayfinding system.

Vehicle Access, Circulation, and Parking

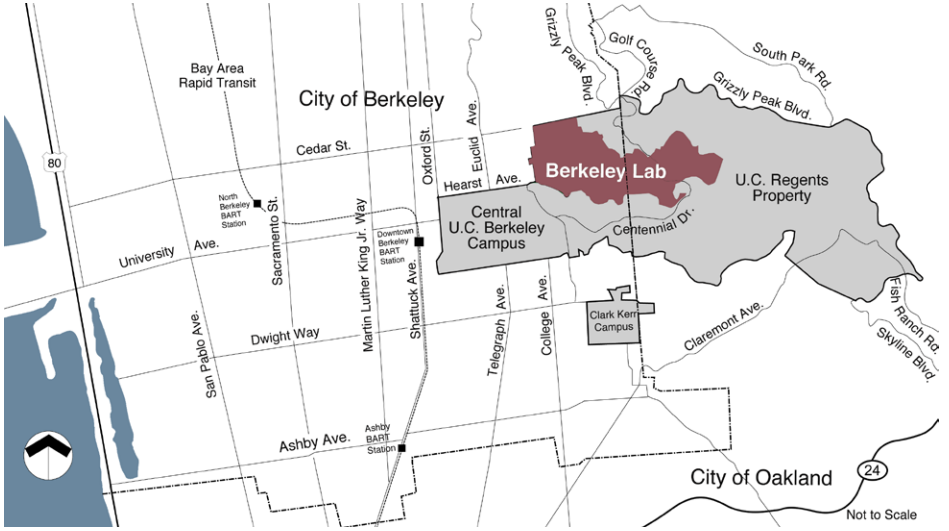


FIGURE 3.14 Laboratory Regional Access

CONTEXT AND EXISTING CONDITIONS

Main Site Access

Berkeley Lab is located in the East Bay hills, approximately two miles east of Interstate 80, the nearest major freeway, and five miles from the San Francisco-Oakland Bay Bridge. The Laboratory is located within a mile of a regional mass transit station (Bay Area Rapid Transit – BART) and regional bus stops (AC Transit), and approximately two miles from the Amtrak commuter rail station in Emeryville.

Vehicular access to the site occurs primarily along two routes: Hearst Avenue, which borders the north side of the UC Berkeley campus and becomes Cyclotron Road at Gayley Avenue, and Centennial Drive which extends from Memorial Stadium through Strawberry Canyon to Grizzly Peak Boulevard.

Off of these two main routes lie three primary entry gates: Blackberry Canyon Gate on Cyclotron Road, and Strawberry Canyon and Grizzly Peak Gates on Centennial Drive. These three gates are controlled points of entry staffed by security personnel. Grizzly Peak Gate is currently used as an entry gate during morning commute hours, although it is available as an egress point at all times. Two additional gates, one at "PG&E Point," and one by Building 73 on Centennial Drive provide ingress/egress to the Laboratory site for maintenance operations and emergency access.

Modes of Transportation

The Laboratory's Transportation Demand Management program facilitates a range of commute options for its employees and guests. Berkeley Lab's shuttle bus system connects the Laboratory to the downtown Berkeley BART station, UC Berkeley campus, and numerous stops en route. The shuttle buses accommodate bicycles, a feature which is widely used.

Figure 3.15 (right) Berkeley Lab's shuttle bus system minimizes individual vehicle use

figure 3.16 (far right) One way traffic pattern on Chamberlain Road allows for parking on both sides of the street

In addition, the Laboratory coordinates vanpools and carpools, encourages bicycle commuting, provides multiple access points for pedestrians arriving from surrounding residential areas or from the UC Berkeley campus, and supports telecommuting as appropriate. Forty percent of Laboratory staff and guests use personal vehicles or carpools to commute to the main site.

Vehicle Circulation

Within the site, vehicular circulation is characteristic of hillside development—major roadways follow the hillside contours and in places they are relatively narrow. There are two major east-west traffic routes, supplemented by secondary roadways that provide service and emergency access to individual buildings. As shown in Figure 3.18, Chamberlain and McMillan Roads make up one east-west route with Lawrence and Alvarez Roads forming the other. Berkeley Lab's shuttle bus system connects a series of stops within the Laboratory itself. Bicyclists share all roadways with vehicles and are provided bicycle lanes where feasible.

Due to the hillside nature of the site, roadway geometries impact the maneuverability of larger trucks and in places visibility is constrained. In addition, roads, parking, pedestrian routes, and building access and service are often overlapping, creating potential conflicts between vehicles and pedestrians. Parking has been added to the sides of a number of roads, both major and minor. Some of these roads have been converted to one-way operations to ensure pedestrian and vehicular safety.

Figure 3.17 Existing surface parking lots unevenly distribute capacity relative to adjacent demand

Parking

The Laboratory provides parking for approximately 50% of its adjusted daily population, reflecting the high degree to which access is achieved by transit, bicycling, or walking. There are 2,300 parking spaces on the main site, of which 250 are for government-owned vehicles stored on-site for day use, and 20 are reserved for guests. In addition, there are 5 emergency vehicle spaces, 45 loading zone spaces, and 25 motorcyle spaces. Parking permits are provided to career employees and participating guests.

The level portions of the Laboratory's hillside site are mostly occupied by buildings and support structures with little area available for large surface parking lots. Parking spaces are provided in moderate to small size lots located on what level land remains either between or directly adjacent to these facilities. Some of these lots overlap and conflict with pedestrian walkways as well as delivery and service areas. Within the more constrained portions of the site some facilities have only a relatively few spaces available which are mostly reserved for visitors and government vehicles.

To provide adequate volume and distribution of spaces across the site, some parking lots provide high-density stacked parking patterns. Additional spaces are provided along roadways where conditions permit.

Service

Service and delivery vehicles of a variety of sizes regularly circulate throughout the site, often to reserved parking spaces near building access points. Large service bays or docks are integrated with most research facilities to accommodate deliveries of large equipment and materials.

Consistent with the ad hoc and opportunistic nature of development throughout the history of the Laboratory, service areas have been located as needed, consolidated with adjoining similar uses when possible, at locations where pedestrian circulation also occurs or where they create visual or functional conflicts. The curving, sometimes narrow roadways and the presence of parking and pedestrians along roadsides also constrain circulation of large vehicles and pose safety hazards.

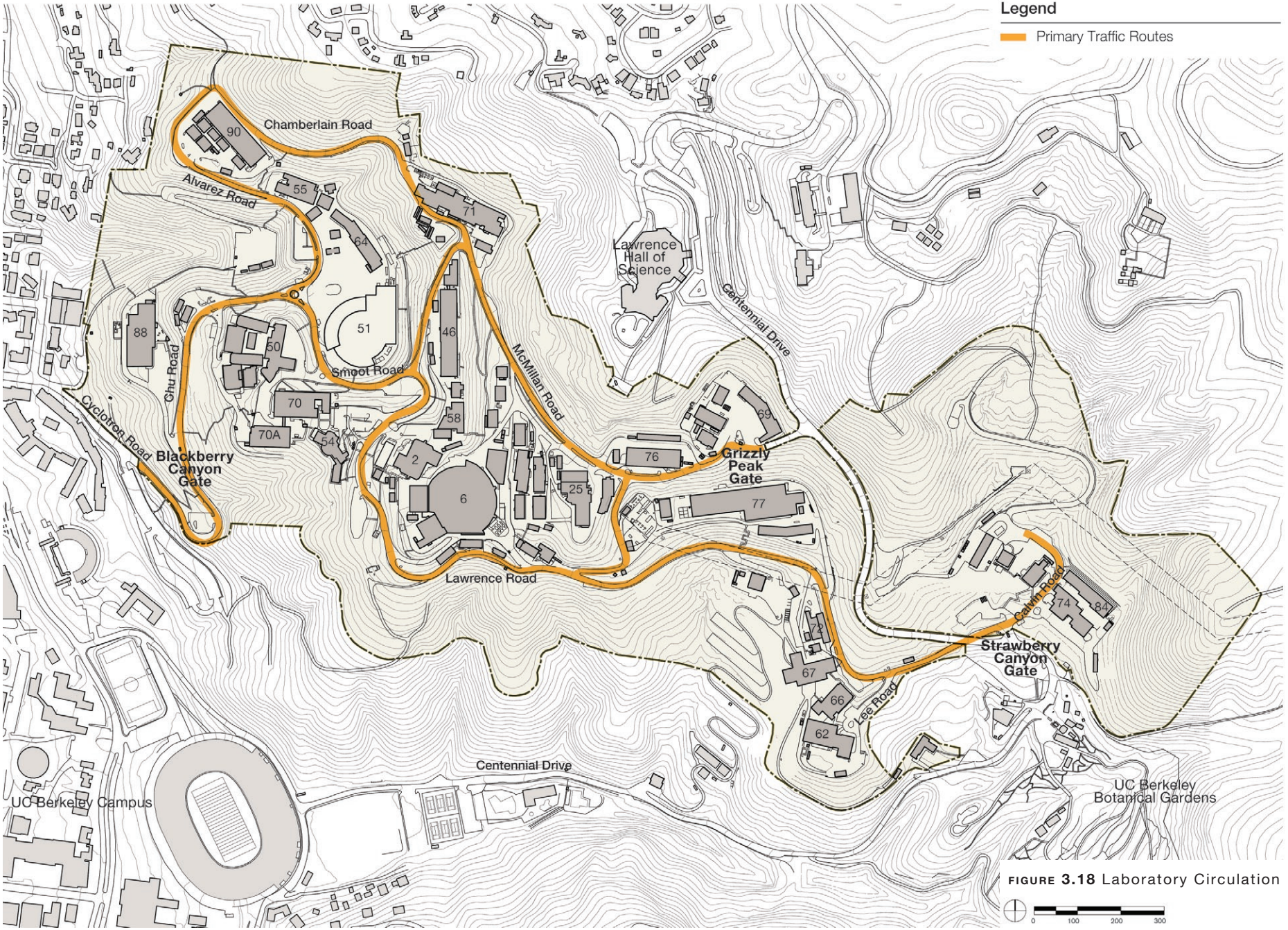


FIGURE 3.18 Laboratory Circulation

FIGURE 3.19 Service areas often conflict with parking areas and pedestrian pathways

VEHICLE ACCESS, CIRCULATION, AND PARKING STRATEGIES

The Vehicle Circulation and Parking Framework is based on a series of strategies designed to improve transit, access, circulation, parking, and safety at the Laboratory.

- Increase use of alternate modes of transit through improvements to the Laboratory's shuttle bus service
- Promote transportation demand management strategies such as vanpools and employee ride share programs
- Improve efficiency and security of Laboratory access through improvements to existing gates and the creation of new gates
- Create a better linkage between parking, shuttle stops, and pedestrian circulation on site
- Provide separated routes of travel wherever possible for pedestrians and vehicles
- Promote use of bicycles by providing additional bicycle storage racks, and shower facilities
- Eliminate parking from the sides of major roadways, thereby improving safety and allowing one-way roads to be converted to two-way traffic
- Maintain or reduce the percentage of parking spaces relative to the adjusted daily population
- Consolidate parking into larger lots and/or parking structures; locate these facilities near Laboratory entrances to reduce traffic within the main site
- Remove parking from areas targeted for outdoor social spaces and service areas
- Consolidate service functions wherever possible in the Corporation Yard

VEHICULAR ACCESS, CIRCULATION, AND PARKING FRAMEWORK

Access

The Laboratory gates create an important first impression of the institution and provide orientation and wayfinding. The four existing gates are being considered for improvements. The design of these improvements would be coordinated to provide a consistent image to those arriving at Berkeley Lab.

Improvements to the Blackberry Canyon and Strawberry Canyon Gates will provide for longer queuing lanes, new guard houses and improved signage and landscaping. A new gate is

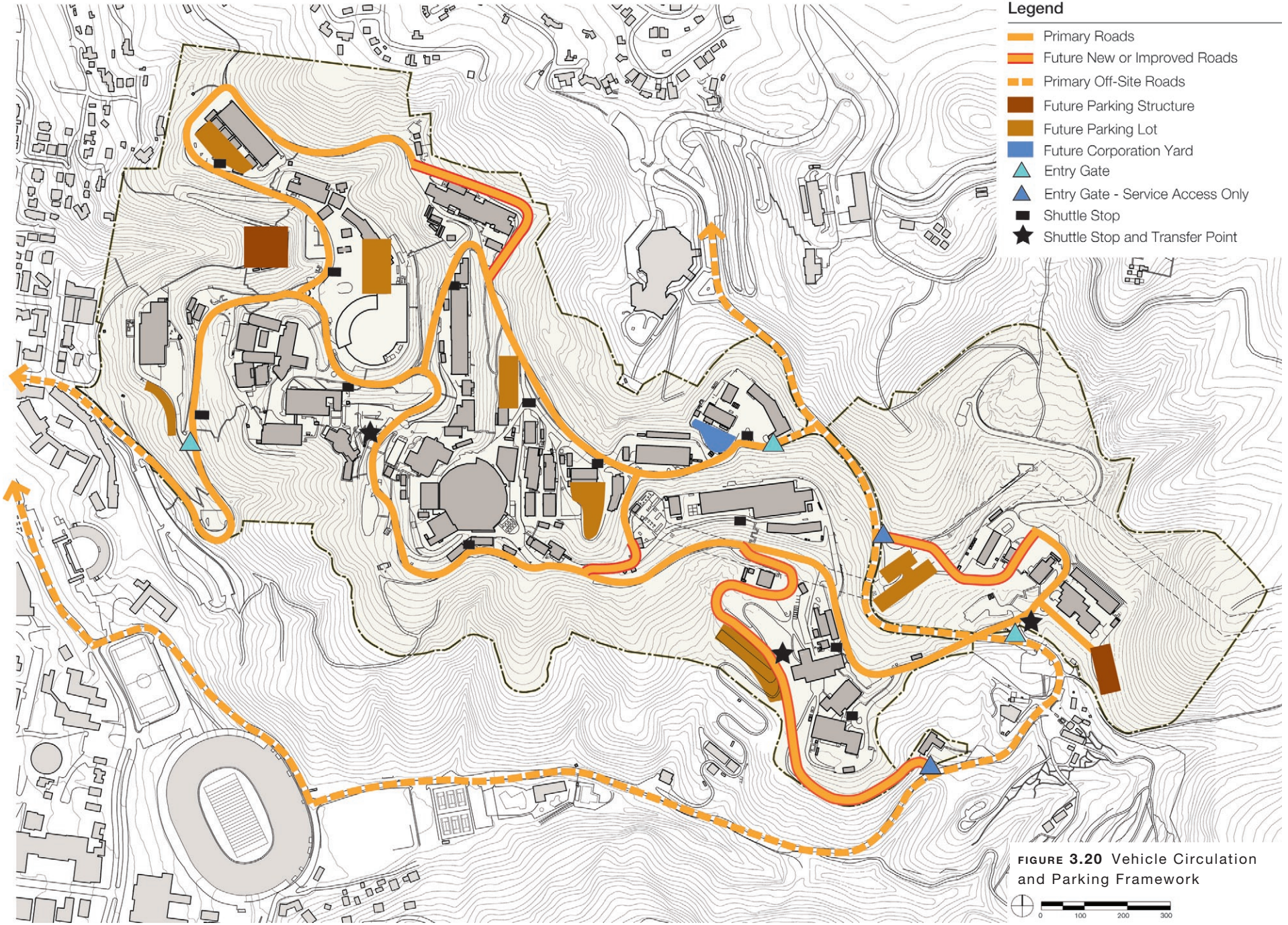


FIGURE 3.20 Vehicle Circulation and Parking Framework

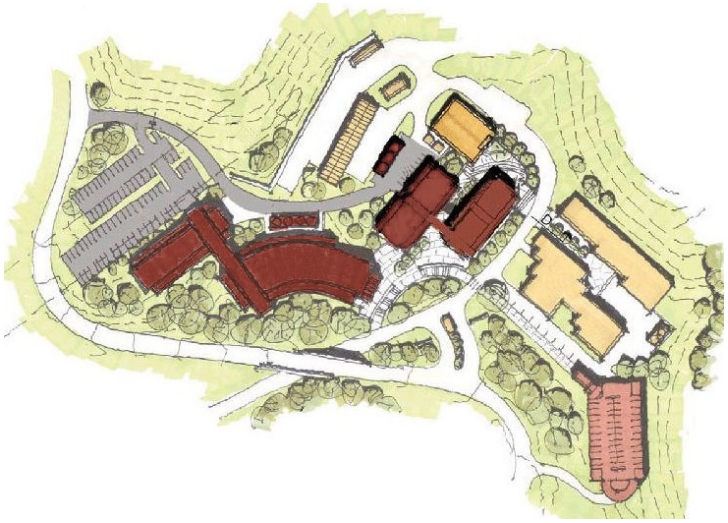


FIGURE 3.21 Illustrative improvement to vehicular access, circulation, and parking

being considered off of Centennial Drive near Building 73 for the Redwood Cluster area. The existing Centennial Drive service access gate at "PG&E Point" would be improved in conjunction with the development of a new service road.

Circulation

A variety of road improvements will provide more efficient circulation in a way that minimizes potential pedestrian and vehicular conflicts.

Improvements will be made to widen certain areas and remove roadside parking. Shuttle stops will be adjusted to provide convenient access to research destinations and the Central Commons. Bicycle access will continue to be provided on the major and minor roads and additional bicycle lanes will be added where feasible.

From the new access gate on Centennial Drive near Building 73, a new road is planned that will allow service access directly to the Redwood Cluster area. This new road will connect to Lawrence Road and provide an emergency egress point from this part of the Laboratory.

From the improved access gate off Centennial Drive near "PG&E Point," a new service access road would connect to Calvin Road and provide access to any new buildings built in this area, as well as egress from a new parking lot conceived for location near the gate.

Parking

This LRDP includes the projection of 500 net new parking spaces being added within Berkeley Lab over the next two decades. With the population growth projected over this time frame, the percentage of parking spaces will be maintained at 50% or be reduced to 48% of the adjusted daily population. Maintaining or decreasing the per capita supply of parking spaces will be accomplished through the approaches outlined in the *Vehicle Access, Circulation and Parking Strategies* section.

If the practice of parking in surface lots were to continue, the new parking spaces planned would require approximately 4.8 acres of level area, which is simply not feasible given the main site's topography and density. It is projected, therefore, that the increased parking demand will be accommodated in two new parking structures located near the Laboratory gates and in a series of mid-sized parking lots located primarily on sites of

demolished buildings. These lots and structures will consolidate parking spaces in areas that are removed from road sides, service areas, the interiors of research clusters, and building sites.

Consolidating the parking closer to the gates will have the added benefits of reducing vehicular circulation within the main site, helping to create a more pedestrian-friendly environment, and minimizing the parking-related impervious surface area at the Laboratory. The preferred sites for two major parking structures and a series of mid-sized parking lots are indicated on the Vehicle Circulation and Parking Framework map.

Bicycle parking will be located at building entries and/or at the edges of outdoor open spaces that would be at the centers of clusters of buildings.

TABLE 3.2 Parking Program

	Minimum Demolition & Construction	Maximum Demolition & Construction
Existing parking spaces:	2,300	2,300
Existing spaces to be removed:	(150)	(800)
New spaces to be added in lots:	300	450
New spaces to be added in structures:	350	850
Total spaces per plan:	**2,800**	**2,800**

Pedestrian Circulation

CONTEXT AND EXISTING CONDITIONS

Good pedestrian access to and within Berkeley Lab is important to ensure efficient operations and support Transportation Demand Management strategies which minimize vehicle use. Pedestrians enter the Laboratory from surrounding neighborhoods via the primary vehicle access gates as well as through a handful of pedestrian gates that are fed by surrounding trails and accessed using a card key system.

Major pedestrian spines include highly traveled sidewalks and paths that link important destinations. At times these run at the side of roads or cross service zones; in other areas these are routed through wooded or grassy open space areas. An extensive system of pedestrian paths traverses the Laboratory site that may be difficult for the first time visitor to navigate.

Secondary pedestrian routes are found along service roads and in wooded areas; these are less traveled but provide important access to individual buildings. An informal trail system provides additional routes throughout the hilly site, and provides access to undeveloped areas for vegetation maintenance and other operations. For those familiar with the site, the stairs or elevators of buildings are often used as a means of accomplishing significant grade changes in areas with steep terrain.

FIGURE 3.22 Pedestrian circulation often overlaps with service access and parking

At present, there are few pedestrian-only zones on the Laboratory site. Most notable is the area immediately adjacent to the Central Commons, where outdoor seating is available. In most other parts of the campus, parking lots, roads, trailers, and support structures fill up most available space adjacent to research buildings, and make it difficult to create usable outdoor space.

FIGURE 3.23 Buildings are used as a means to overcome the Laboratory's steep topography for pedestrians

PEDESTRIAN CIRCULATION STRATEGIES

The Pedestrian Circulation Framework incorporates the following strategies:

- Use pedestrian routes to connect the various developed terraces of the site which host the central and research clusters
- Improve the pedestrian spaces at the heart of the research clusters and adjacent to research facilities so as to support interaction among Laboratory users
- Separate pedestrians and vehicles whenever possible
- Retain and improve walkways as appropriate throughout the open space portions of the site, carefully integrating these pathways to minimize intrusion in the natural environment
- Improve pedestrian access and safety throughout the Laboratory site by developing new routes and enhancing existing routes
- Improve wayfinding through a comprehensive and coordinated signage system and through the naming of buildings and research clusters
- Improve the path providing access to and from the UC Berkeley campus

PEDESTRIAN CIRCULATION FRAMEWORK

The Pedestrian Circulation Framework illustrates proposed improvements to the pedestrian network at the Laboratory, and the relationship of the pedestrian network to the shuttle system and to the commons areas.

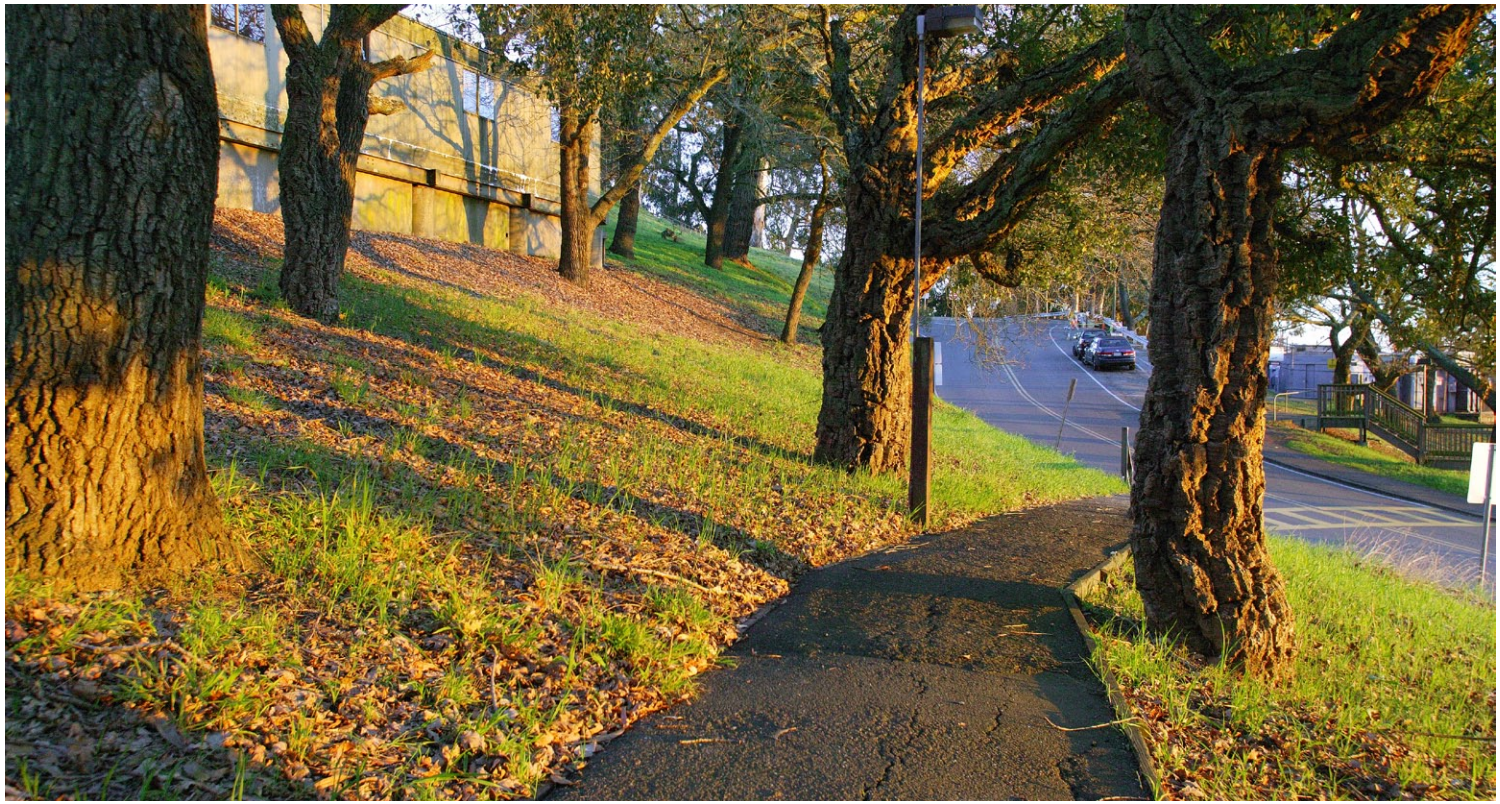


FIGURE 3.24 A network of pedestrian paths accommodate circulation through the park-like setting of the Laboratory

Primary pedestrian paths will be improved or added in key areas of the site, in particular where they reinforce important connections between and within the research clusters. They will be aligned to support connections into the heart of the Laboratory at the Central Commons, where dining, visitor facilities, and events will occur. This system of paths, illustrated on Figure 3.25, will provide the principal pedestrian linkages at the Laboratory.

An improved connection is proposed between the Laboratory and the UC Berkeley campus, a route regularly used by students and researchers moving between facilities on the two sites.

Shuttle bus stops will be located to directly connect to the primary pedestrian paths, to provide convenient access by commuters as well as to facilitate connections between the Laboratory, UC Berkeley facilities, and downtown Berkeley.

Secondary paths and trails throughout the Laboratory site will be maintained and improved as needed to accommodate important maintenance activities and limited pedestrian access.

Improvements to the outdoor environment at the center of each research cluster will be accomplished through strategic siting of new facilities and the alignments of pedestrian paths, in many cases replacing the current ad hoc arrangement of surface parking that dominates the cluster environments. These outdoor areas will provide attractive, usable and comfortable places for researchers, visitors, staff, and students to interact informally.

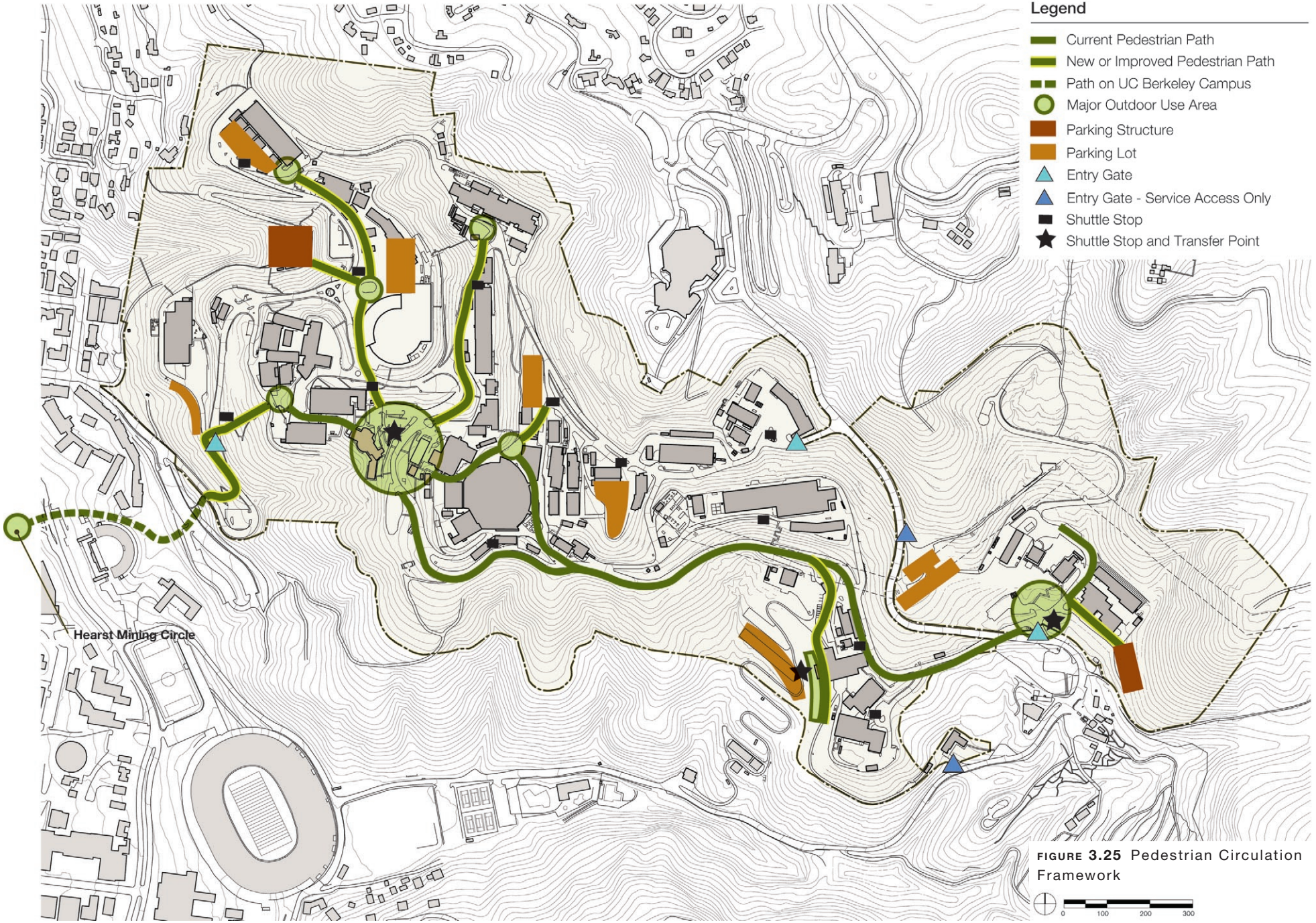


FIGURE 3.25 Pedestrian Circulation Framework

Open Space and Landscape

CONTEXT AND EXISTING CONDITIONS

Currently about 40% of the main site is open space, the majority of which consists of steep slopes and a rustic landscape of grasslands, chaparral, forests, and occasional riparian areas that surround the site's developed areas. This area of rustic landscape is host to more than 120 species of birds, mammals, and reptiles / amphibians and includes all of the protected habitats found on the main site.

The open space within the developed clusters is generally a vehicular and service-oriented setting consisting mostly of roadways, utility/service yards, parking, and areas for pedestrian access. Landscape planting in this area, such as shade trees and shrubs, are designed and maintained to mitigate the impacts of this more pragmatic setting consisting mostly of hard surfaces.

Open spaces specifically designed and maintained for pedestrian use provide a valuable amenity within several of the developed clusters. The most notable being the outdoor dining and lawn area adjacent to the Cafeteria, the historic redwood grove, and the entry plaza near the ALS building. These "commons" areas are highlighted by a formal landscape of lawns, ornamental plantings, patterned hardscape, and outdoor furnishings that work together to contrast these special places from the more rustic open space areas.

Stands of mature redwoods, eucalyptus, pine and oak trees within each of these open space areas provides a visual screen for views of the Laboratory from the urban areas to the west. From these lower level areas, views to the Laboratory are in

FIGURE 3.26 Views of Laboratory buildings from the City of Berkeley are softened by screening tree stands and open space reserves

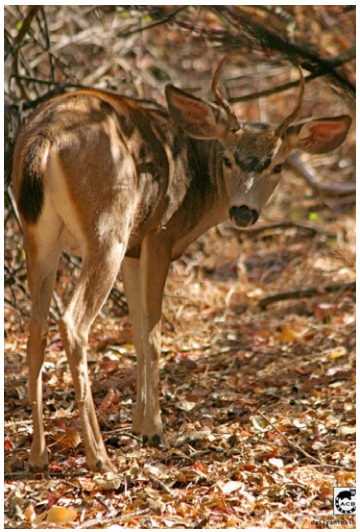


FIGURE 3.27 The Laboratory is host to more than 120 different animal species, including Columbian Black-Tailed deer

keeping with the general character of the East Bay hills—predominantly a mix of grasslands, woodlands and partial views of buildings among the trees. While these tree stands provide an effective cover they are also positioned to frame numerous vistas from the Laboratory to the San Francisco Bay Area.

The Berkeley/Oakland Hills region is susceptible to wind-driven firestorms such as the Oakland hills fire of 1991. Following this event, the Laboratory implemented an extensive vegetation management program that, by reducing the amount of fuel and potential flame intensity, should allow Laboratory buildings to survive such a fire. As a result of this program tree stands have been thinned regularly and a clear understory is maintained annually giving the forested areas of the site a "park-like" quality.

The Laboratory's main site consists of a wide variety of native and non-native vegetation. In more recent years, as a part of the Laboratory's vegetation management program, invasive exotic plants are being thinned or removed and replaced with native, drought-tolerant plants.

The region is also susceptible to unstable hillside slopes. Over the years, slope stabilization projects have corrected the most serious landslide conditions. The remaining slide areas have been stabilized. Slope retention and drainage control structures are located throughout the site and visually extend the purpose-built architectural character of Laboratory buildings into the landscape.

OPEN SPACE AND LANDSCAPE STRATEGIES

Both the Open Space Framework and the Landscape Framework are based on strategies that aim to preserve the environmental quality and enhance the overall experience of the Laboratory main site.

- Preserve and enhance the native rustic landscape and protect sensitive habitats
- Develop new campus-like outdoor spaces such as plazas within clusters of facilities and improve those that already exist
- Maintain and enhance tree stands to reduce the visibility

of Laboratory buildings from significant public areas in neighboring communities

- Improve the overall appearance and experience of the Laboratory through improvements to the main entry gates and the landscape areas associated with roadways, parking lots, and pedestrian pathways
- Continue to use sustainable practices in selection of plant materials and maintenance procedures
- Develop all new landscape improvements in accordance with the Laboratory's vegetation management program to minimize the threat of wildland fire damage to facilities and personnel
- Utilize native, drought-tolerant plant materials to reduce water consumption; focus shade trees and ornamental plantings at special outdoor use areas
- Minimize impervious surfaces to reduce storm water run-off and provide landscape elements and planting to stabilize slopes and reduce erosion and sedimentation

OPEN SPACE AND OPEN AREA FRAMEWORK

Like that of a university campus, the Laboratory is comprised of different kinds of open space with distinctly different character and purpose. The Open Space and Open Area Framework illustrated in Figure 3.28 is a conceptual illustration of the Laboratory's four primary kinds of open space. While these spaces may share physical characteristics, the purpose and intended uses of these spaces vary. Therefore, each category has a unique set of parameters that ensure the development of a more campus-like setting at Berkeley Lab. The four open space categories are:

Perimeter Open Space

The Perimeter Open Space corresponds directly with the 66 acre land use zone of the same name and includes most of the site's protected habitats. This area of the site, consisting of a rustic landscape similar to that of adjacent properties, provides a buffer to neighboring uses and visually enhances the natural quality of the Berkeley Hills setting. These lands will generally be maintained as they have been and in accordance with the limitations discussed in the Land Use section.

FIGURE 3.28 Open Space and Open Area Framework

Developed Open Area

The Developed Open Area is of a similar landscape as the Perimeter Open Space but encompasses the rustic hillside terrain that lies between each research cluster. While new projects may be sited within this area, it is considered less likely due to the unfavorable site conditions and relatively remote building sites within this area.

Cluster Open Area

Within the research clusters, where most of the future development will occur, much of the unimproved land surrounding existing and future buildings will be dedicated to vehicular and service uses. Yet these areas will often need to provide for pedestrian access and landscape features. These landscaped areas, planned for each cluster, are identified as Cluster Open Area.

Even though unimproved land will be limited in this area, special attention will be given to developing clear and safe pedestrian access. Site improvements will be planned and designed to separate vehicular and pedestrian traffic where possible. Land will be set aside to provide for vegetation for visual screening, shade, and an overall enhancement to the quality of the pedestrian environment.

Cluster Commons Open Area

As new projects develop, Cluster Commons Open Areas will provide a center of pedestrian activity within each research cluster. This space is intended to be used much like the quads or plazas found on a traditional university campus and would be scaled to be appropriate for the cluster of research facilities, with features to encourage informal use. The largest of these would occur at the Laboratory Commons, in the center of the Laboratory where the highest levels of activity and events will occur.

LANDSCAPE FRAMEWORK

The Landscape Framework illustrated in Figure 3.29 defines the ways in which open spaces will be improved or maintained.

Rustic Landscape Zones

The vast majority of the Laboratory's open space is characterized by the rustic, diverse landscape mosaic of oak and mixed hardwood forests, native and non-native grasslands, chaparral, coastal scrub, marsh and wetland communities, and riparian scrubs and forests. Maintenance activities will be undertaken to maintain the health of these areas.

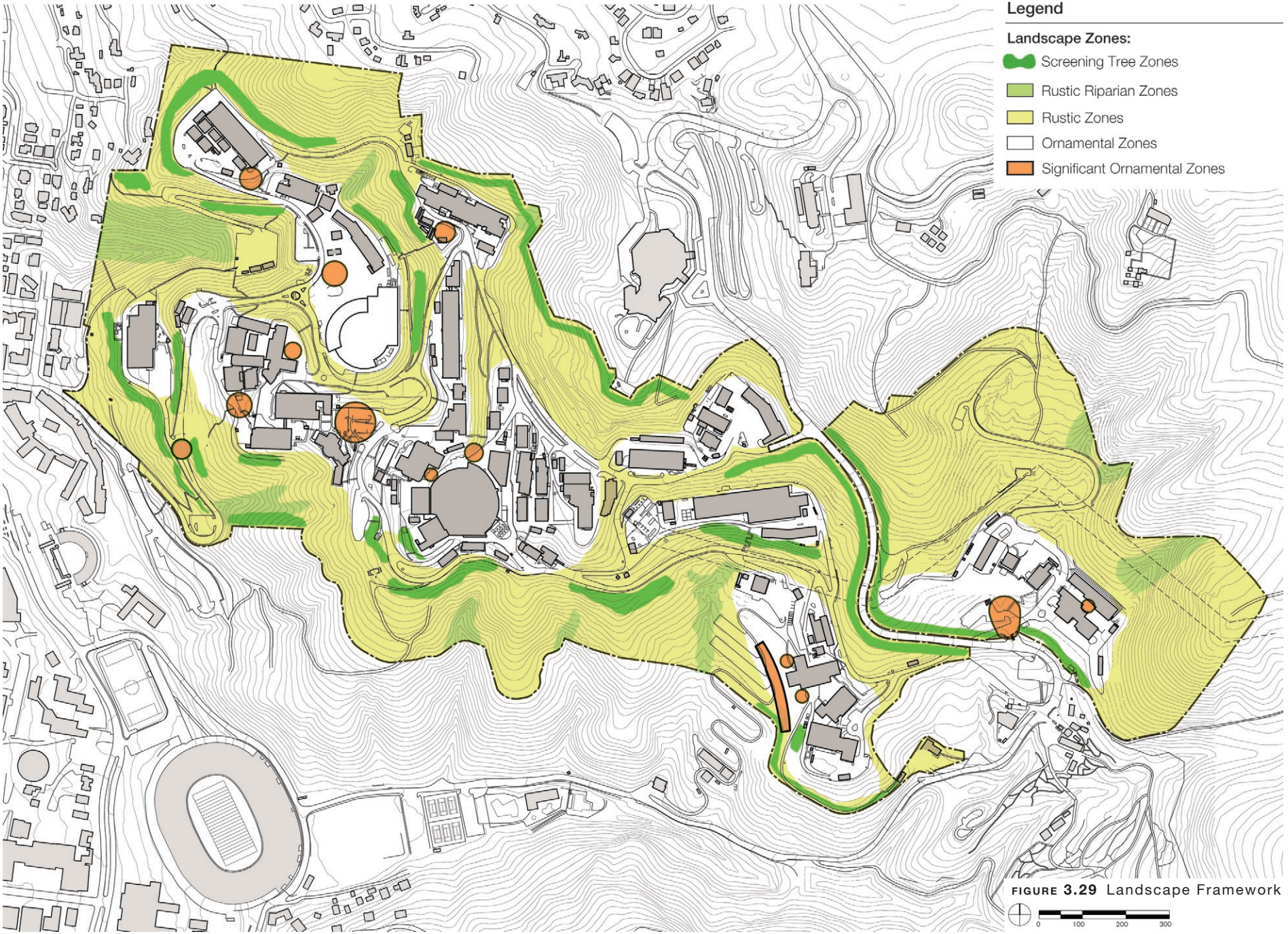


FIGURE 3.29 Landscape Framework

Rustic Riparian Landscape Zones

Several riparian environments occur on the main site and have significant habitat value. These environments will be protected from development, with only maintenance activities permitted.

Screening Tree Landscape Zones

The existing and proposed screening tree areas will filter views of Laboratory buildings. Important stands of trees that currently screen the view of Laboratory buildings from the surrounding community will be maintained, and additional screening will be added where it can help maintain the distinctive character of the site. Screening trees will also be added along Centennial Drive within the Laboratory boundary to provide a visual buffer for views from public areas at higher elevations.

FIGURE 3.30 (far left)
The Laboratory's open space is characterized by a rustic landscape of native and naturalized woodlands and grasslands

FIGURE 3.31 (left)
Areas of Rustic Riparian Landscape on the Laboratory are protected from future development

FIGURE 3.32 (left)
Stands of trees screen the view of Laboratory buildings from neighboring communities

FIGURE 3.33 (right) Ornamental landscapes are placed near pedestrian spines

FIGURE 3.34 (far right) Special plantings used to heighten visual interest in high-activity pedestrian areas

Ornamental Landscape Zones

Within the developed portions of Berkeley Lab, where high levels of pedestrian activity occur, ornamental landscapes will be used to add color, visual interest, and other amenities. The developed areas of the Laboratory, corresponding to research clusters, support areas, and parking lots are currently landscaped with a variety of plant materials. This strategy will be continued as aging or outdated facilities are removed and new are added.

Significant Ornamental Landscape Zones

As the common area within each research cluster is reconfigured to provide more usable outdoor areas, landscaping will be used to reinforce their attractiveness through the use of color, texture, and visual interest. In particular, the Laboratory Commons, the primary gathering space of the Laboratory, will be landscaped and furnished to provide a diversity of usable outdoor environments for special events.

Utilities and Infrastructure

CONTEXT AND EXISTING CONDITIONS

Berkeley Lab owns and maintains a utility infrastructure that enables the safe, efficient, and reliable operation of its scientific and support facilities. The Laboratory's utility infrastructure consists of the following systems described in this section:

- Water Supply and Distribution
- Sanitary Sewer System
- Storm Drainage
- Electrical Power and Distribution
- Natural Gas Distribution
- Telecommunications and Network Distribution

All of the Laboratory's permanent utilities are located underground. Continual investment in the rehabilitation and replacement of these systems has ensured that they are in good to excellent condition. However, some of the older utility lines were routed through potential building sites, constraining their potential.

The Laboratory will continue to upgrade and replace utilities throughout the life of this plan to maintain reliability and meet increased demand. New distribution lines and related facilities will be constructed on an as needed basis within the overall framework discussed on the following pages.

UTILITIES AND INFRASTRUCTURE STRATEGIES

- Maintain a safe and reliable utility infrastructure capable of sustaining the Laboratory's scientific endeavors
- Consolidate utility distribution into centralized utility corridors that generally coincide with major roadways
- Ensure that utility infrastructure improvements accommodate future facility expansion and alterations in the most cost effective means possible
- Design infrastructure improvements to embody sustainable practices

UTILITIES FRAMEWORK

Water Supply and Distribution

Berkeley Lab's water supply and distribution system is designed and maintained to provide a reliable water supply for its current and future needs. The East Bay Municipal Utility District (EBMUD) provides water to the Laboratory at two points of connection. In 2005 the Laboratory consumed 33.6 million gallons of water, which was less than 10% of the capacity of its

FIGURE 3.35 Berkeley Lab's sedans and pickups operate on 85% ethanol to minimize air pollutants and reduce dependence on foreign oil (buses run on biodiesel)

water supply system. Full implementation of the 2006 LRDP will generate an estimated demand of approximately 56.5 million gallons per year—a 30 percent increase that is well within the capacity of both the Laboratory's and EBMUD's infrastructure.

The on-site distribution system delivers high-pressure domestic and fire protection water to Laboratory facilities through a gravity-feed loop system. This system enables full operation during maintenance activities and interruptions due to natural hazards. The system includes three on-site 200,000-gallon water storage tanks that provide emergency water supply in the event of service interruption from EBMUD.

Existing water supply and distribution lines will be replaced over the duration of this LRDP if necessary to ensure continued reliability and reduce "line-loss" attributed to outdated, deteriorating pipelines. Outdated water mains will be replaced by new lines located within the utility corridors indicated in Figure 3.36. Proposed system upgrades include the replacement of an existing 8-inch line located under Centennial Drive.

Sanitary Sewer System

The Laboratory's sanitary sewer infrastructure primarily consists of a gravity flow system with two points of discharge. One, located at Hearst Avenue connects to the City of Berkeley's public sewer system through the Hearst Monitoring Station. The other connects to the UC Berkeley main under Centennial Drive through the Strawberry Monitoring Station. Effluent from both the Laboratory and UC Berkeley flows to the EBMUD treatment facility in Oakland through the City of Berkeley's sewer system.

Aging sewer infrastructure is a regional problem affecting flow volumes and system capacities as pipes in poor condition allow storm water infiltration during wet weather conditions. Through a phased replacement program the Laboratory has improved enough of the system to reduce its discharge volumes by half over the past 15 years. This replacement program will continue through the duration of the LRDP. Sewer mains on site will be replaced with new pipe located within the utility corridors where possible. The Strawberry Monitoring Station will be upgraded and the Centennial Drive sewer main from the Life Sciences area will be replaced.

Effluent discharged from the Strawberry Monitoring Station eventually flows through a constrained portion of the City of Berkeley's sewer system adjacent to the Memorial Stadium. The Laboratory will partner with the City of Berkeley and UC Berkeley in an effort to replace or bypass this section of City sewer main.

The Laboratory's peak daily flow during wet weather is approximately 821,000 gallons per day (gpd). With the development identified in this Plan this rate is expected to increase by 72,000 gpd to 893,000 gpd. At this rate the Laboratory's sewer system would continue to have the capacity and reliability necessary to accommodate further growth. Both the City of Berkeley and EBMUD anticipate that their systems would have available capacity to accommodate the Laboratory's projected wastewater flows.

Storm Drainage

Berkeley Lab is situated within Blackberry and Strawberry Canyons which lie mostly within the Strawberry Creek Watershed. Surface drainage naturally flows from higher elevations and the Laboratory site to Strawberry Creek in Strawberry Canyon to the south and to the North Fork of Strawberry Creek in Blackberry Canyon.

The Laboratory's storm drainage system directs surface water runoff and piped flows from higher elevations away from unstable slopes, buildings, and parking lots. Storm water is then discharged at points below the developed area of the site. Peak flows generated by the Laboratory site and the surrounding properties is approximately 1,686 cubic feet per second (cfs).

The Laboratory's drainage system has been constructed of galvanized steel pipe that is in need of repair. Over the duration of this Plan approximately two thirds of this steel pipe will be replaced or fitted with nonmetallic lining. As new projects are developed the drainage system will be expanded as necessary to drain surface water from buildings and parking lots and unstable slopes. New projects will be developed in accordance with the Laboratory's site and landscape design guidelines to minimize impervious surfaces, and conditions that result in unstable slopes, erosion and siltation. By making improvements to existing landscaped areas in accordance with the Laboratory's design guidelines, no increase in storm water peak flows should be generated by the development identified in this Plan.

Electrical Power and Distribution

The Laboratory's electrical supply and distribution system has the capacity to meet current and future demand beyond what is

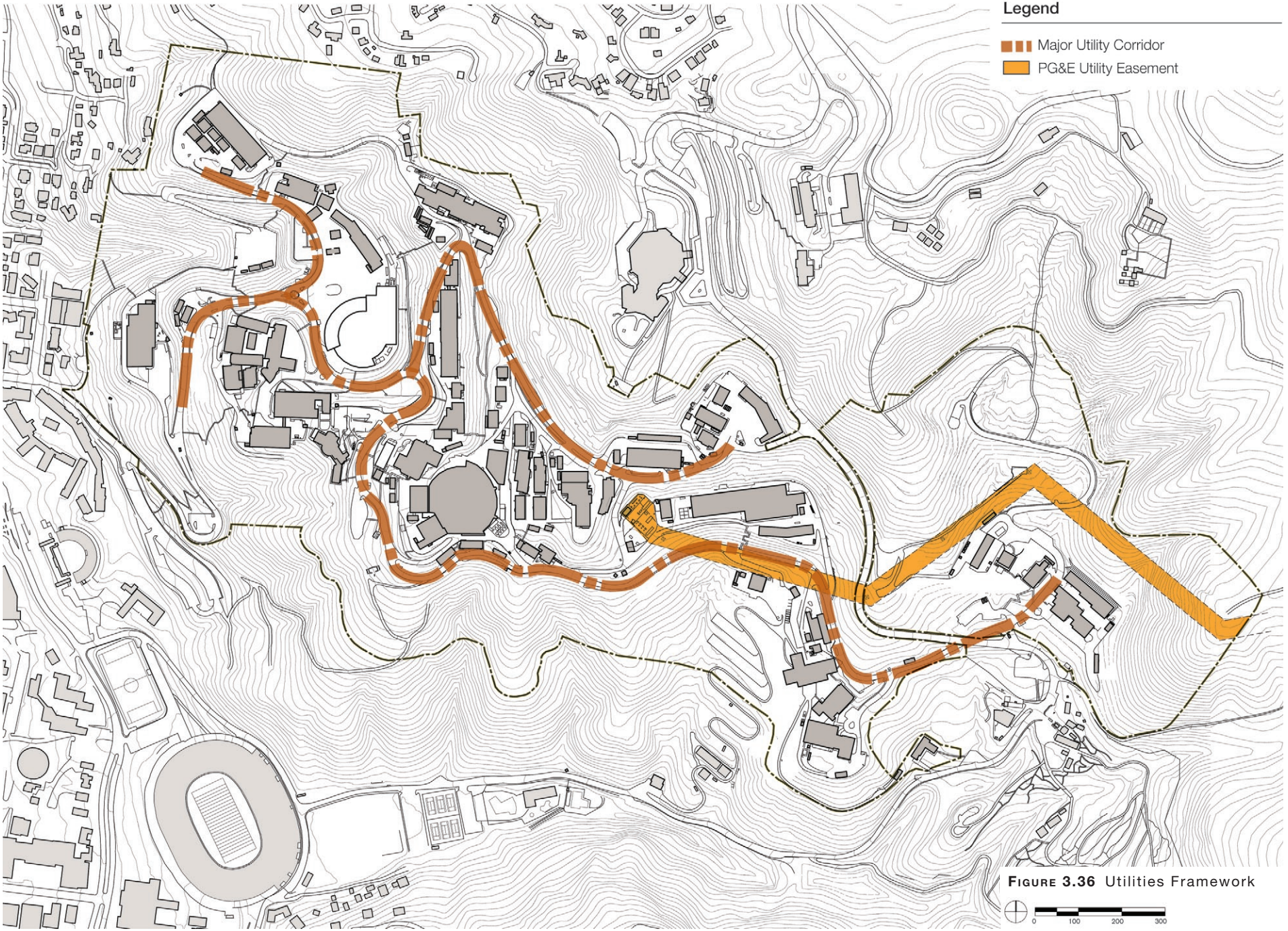


Figure 3.36 Utilities Framework

forecast in this Plan. The Laboratory's electricity is purchased from the Western Area Power Administration and is delivered by the regional power utility Pacific Gas and Electric (PG&E). Berkeley Lab's 2005 baseline consumption was 72,400 megawatt hours (MWh) with a maximum demand of 12.5 megawatts (MW). The capacity of the Laboratory's electrical system is 50 MW with 100% equipment backup.

Electrical power is delivered to the on-site Grizzly Substation through a pair of overhead transmission lines with a capacity of 50 Megawatts each. In the event of a power outage from its primary supply the Laboratory may switch to a secondary source supplied from UC Berkeley's Hill Area Substation, located adjacent to the Grizzly Substation. The main on-site power distribution system consists of a 12,470 volt underground feeders with smaller substations and transformers located throughout the site. The main distribution system has dual primary feeders to provide reliable power. Stationary and portable emergency power generators are located throughout the site to provide an emergency power supply for critical process systems and life safety facilities such as the Fire Station, Radio Communications Facility, and the Health Services Building.

Development under the 2006 LRDP would not require a major expansion or upgrade to the Laboratory's existing electrical distribution system. However, new projects would require specific power connections to the existing distribution system. New building and existing equipment replacement projects would enhance the Laboratory's on-going energy conservation efforts.

Natural Gas Distribution

The Laboratory's natural gas distribution system provides a safe supply of high-pressure natural gas with a capacity to meet current and future demand. Natural gas is purchased through the Defense Fuel Supply Center and supplied through PG&E, the regional transporter of natural gas. Natural gas usage in 2005 was approximately 1.6 million therms. Full implementation of the 2006 LRDP would increase the demand for natural gas by as much as 814,000 therms per year.

PG&E provides gas to the site through a 6-inch high-pressure main that connects with the on-site system at a meter vault near the Laboratory's Blackberry Gate. The on-site distribution consists primarily of 6-inch and 4-inch high-pressure lines

FIGURE 3.37 Grizzly Substation and UC Berkeley's Hill Area Substation each provide emergency backup for the other

equipped with pressure reducing stations and earthquake emergency shut-off valves.

Older gas mains will be replaced through a phased replacement program that would relocate gas mains to the utility corridors identified in Figure 3.36 whenever possible. Development under the 2006 LRDP would require a lateral connection for each new building. New building and existing equipment replacement projects would enhance the Laboratory's on-going energy conservation efforts and reduce its per-capita natural gas consumption.

Telecommunications and Network Distribution

The Laboratory's external communication link is provided by the regional telecommunications company AT&T. Both fiber and copper communication circuits are delivered through underground communications lines via the main Hearst Street route. The current system supplies 5,000 communications lines and can be expanded to 35,000 lines with additional hardware. The telecommunication system is distributed via four nodes, each equipped with backup generators and battery back up to support extended communications for the Fire Station and the Health Services buildings.

Berkeley Lab's computer network system (LBLnet) also utilizes the fiber optic and wiring infrastructure for distribution. LBLnet is maintained as a leading edge infrastructure and is planned using an industry-standard 5 year life cycle. Currently LBLnet serves one gigabit per second (Gbps) Ethernet with a high speed (720Gbps) backbone. Plans are underway to upgrade both Internet connectivity and building connections to 10Gbps to support multiple high-bandwidth streams for research activities. In the future it is expected that 100Gbps will be essential to research disciplines such as high performance computer simulation and bioinformatics that require the expeditious movement of massive data sets among research institutions.

Berkeley Lab's communications and distribution system has the capacity to meet current and future demand beyond what is forecast in this Plan. Development under the 2006 LRDP would not require a major expansion or upgrade to the Laboratory's existing communications distribution system. However, new projects will require connections to the existing distribution system.

Appendix A: Main Site Building Inventory 2006

Note: See Figure A.1 Building Inventory Key Map on Page 93 for building location

BLDG. ID	NAME	(B)UILDING (T)RAILER	MAP GRID REF	SIZE (GSF)
002	Advanced Materials Lab	B	D4	85,506
002A	Central Chemical Storage	B	D4	182
004	ALS Support Facility	B	D5	10,176
005	Laboratories and Research Offices	B	D5	7,176
006	ALS (Advanced Light Source)	B	D4	118,573
007	ALS Support Facility	B	D4	21,433
007A	Storage	B	D4	128
007C	Offices	T	D4	479
010	ALS Support Facility	B	D4	15,200
010A	Telecommunications Equipment	T	E4	242
013A	Environmental Monitoring Station	B	•	76
013B	Environmental Monitoring Station	B	A2	76
013C	Environmental Monitoring Station	B	•	76
013D	Environmental Monitoring Station	B	•	76
013E	Environmental Monitoring Station	B	C1	68
013F	Environmental Monitoring Station	B	•	36
013H	Environmental Monitoring Station	B	E4	90
014	Laboratory and Offices	B	D5	4,201
016	Laboratories and Research Offices	B	D5	11,808
016A	Storage	B	D5	339
017	Shop, Assembly, and Office	B	C4	2,222
025	ENG Shops	B	D5	20,304
025A	ENG Shops	B	D5	7,548
025B	Waste Treatment Unit Shelter	B	D5	360
026	Medical Services, Labs, and Offices	B	D5	10,562
027	Dry Lab and Offices (Special Instrument)	B	C4	3,299
028	Radio Shelter Facility	B	E5	544
029A	(vacant)	T	D3	1,751
029B	(vacant)	T	D4	1,440
029C	(vacant)	T	D4	1,440
029D	(vacant)	T	•	276
031	Chicken Creek Building	B	E6	7,327

BLDG. ID	NAME	(B)UILDING (T)RAILER	MAP GRID REF	SIZE (GSF)
031A	FA	T	E6	623
031B	Storage	T	E6	157
031C	Storage	T	E6	157
033A	Strawberry Canyon Guard House	B	E8	52
033B	Blackberry Canyon Guard House	B	D2	94
033C	Grizzly Peak Guard House	B	D6	80
034	ALS Chiller Building	B	E4	5,163
036	Grizzly Substation	B	D5	880
037	Utility Services Building	B	E4	5,833
040	Storage	B	D5	993
041	Communications Lab	B	D5	995
043	Site Air Compressor/FD Emerg Gen	B	E5	1,020
044	ENG	B	D5	805
044A	ALS Offices	T	D5	481
044B	ENG	T	D5	1,441
045	Fire Apparatus	B	E5	3,342
046	Laboratories, Shops, and Offices	B	C4	54,133
046A	Offices	B	C4	5,563
046B	ENG	T	C4	1,238
046C	AFR	T	C4	1,029
046D	AFR	T	C4	771
047	Offices	B	C4	6,242
048	Fire Station, Emerg. Command Ctr.	B	E5	6,622
048A	Storage Container	Cargo Container	E5	320
050	Laboratories, Shops, and Offices	B	C3	48,534
050A	Laboratories, Shops, and Offices	B	C2	66,628
050B	Laboratories, Shops, and Offices	B	C2	63,603
050C	Offices	B	C2	2,768
050D	Offices (limited use files storage)	B	C2	4,959
050E	Offices	B	C2	10,643
050F	Offices	B	C2	9,449
051	The Bevatron	B	C3	96,562

BLDG. ID	NAME	(B)UILDING (T)RAILER	MAP GRID REF	SIZE (GSF)
051A	Bevatron	B	C3	28,478
051F	ES, EET	T	B3	1,499
052	Dry Laboratory and Offices	B	D5	6,425
052A	Storage	B	•	516
053	Laboratories, Shops, and Offices	B	D4	6,944
053B	AFR	T	•	519
054	Cafeteria	B	D3	15,451
054A	Automated Teller	B	D3	195
055	Laboratories and Offices	B	B3	19,048
055A	Laboratories and Offices	B	B3	1,535
055B	Standby Generator Shelter	B	B3	209
056	Accelerator and Research Office	B	B3	1,782
058	Heavy Ion Fusion	B	D4	10,279
058A	Accelerator R&D Addition	B	D4	12,653
060	Hibay Lab	B	B3	3,615
061	Storage	B	E5	323
062	MS, CH Lab	B	F7	55,904
062A	EE, MS	T	F7	1,238
062B	Telephone Equip. Storage	B	F7	169
063	EE	B	B3	2,696
064	LS/ES	B	B3	29,358
064B	FAC	T	B3	480
065	Offices	B	C2	3,423
065A	Offices	T	C2	1,453
065B	Offices	T	C2	1,020
066	Ctr for Surface Sci. Catalysis	B	F7	44,134
067	Molecular Foundry	B	F7	90,712
067A	Molecular Foundry	B	E7	6,443
068	Upper Pump House	B	D6	500
069	Facilities Dept. Operations	B	D6	20,461
070	NS, EE LAB	B	D3	63,427
070A	NS, LS, CS, ES, ENG LAB	B	D3	68,430

BLDG. ID	NAME	(B)UILDING (T)RAILER	MAP GRID REF	SIZE (GSF)
070B	Telephone Equip. Storage	B	D2	382
070E	Storage Container	T	D2	432
070G	Storage	T	D3	173
071	Ion Beam Tech, Ctr Beam Phy	B	B4	53,744
071A	Low Beta Lab	B	B4	4,041
071B	Ctr Beam Phys	B	B4	6,892
071C	Offices	T	B4	511
071D	Offices	T	B4	520
071F	Offices	T	B4	516
071G	Offices	T	B4	517
071J	Offices	T	B4	1,289
071K	Offices	T	B4	474
071P	Offices	T	B4	511
071Q	Restroom Trailer	T	B4	357
071T	Offices	T	B4	949
072	Nat'l Ctr for Electron Microscopy	B	E7	5,352
072A	High Voltage Electron Microscopy	B	E7	2,532
072B	Atomic Resolution Microscope	B	E7	4,508
072C	NCEM	B	E7	8,409
073	ATM AEROSOL RSCH	B	F8	4,228
073A	Utility Equipment Building	B	F8	403
074	LS LABS	B	E9	45,382
074F	Dog Kennel	B	E9	1,560
075	EH&S Radiological Services	B	D6	8,498
075A	EH&S	B	C6	4,000
075B	EH&S	T	D6	4,640
075C	Calibration Building	B	D6	450
075D	Storage	B	D6	1,895
075E	EH&S Offices	T	D6	410
076	FAC Shops	B	D6	31,642
076K	FA Offices	T	D5	371
076L	FA Offices	T	D5	1,439

BLDG. ID	NAME	(B)UILDING (T)RAILER	MAP GRID REF	SIZE (GSF)
077	ENG Shops	B	D6	68,438
077A	Composites Lab and Assembly Facility	B	D7	12,118
077H	Utility Storage	B	D7	576
078	Craft Stores	B	D6	5,391
079	Metal Stores	B	D6	4,564
080	ALS Support Facility	B	D4	29,930
080A	ALS Support Facility	B	D4	960
081	Chemical Storage	B	B4	1,129
082	Lower Pump House	B	B4	537
083	LS LAB	B	E9	6,856
083A	LS Lab Trailer	T	E9	507
084	LS Human Genome Lab	B	E9	55,031
084B	Utility Building	B	E9	1,633
085	Hazardous Waste Handling Facility	B	E8	15,405
085A	Storage Racks	B	D8	885
085B	Offices	T	E8	3,601
088	88 Cyclotron	B	C2	54,428
088D	Emergency Generator Building	B	•	265
090	DOE, EE, EHS, ES Offices	B	B2	87,837
090B	Offices	T	A2	1,443
090C	Ops Offices	T	B2	1,143
090F	FA Offices	T	A2	2,464
090G	HR Offices	T	A2	1,851
090H	FA Offices	T	B2	1,849
090J	FA Offices	T	B2	2,845
090K	EETD Offices	T	B2	2,846
090P	Ops Offices	T	B2	2,133
090Q	Restroom Trailer	T	B2	425
090R	Transformer Equipment	T	•	160

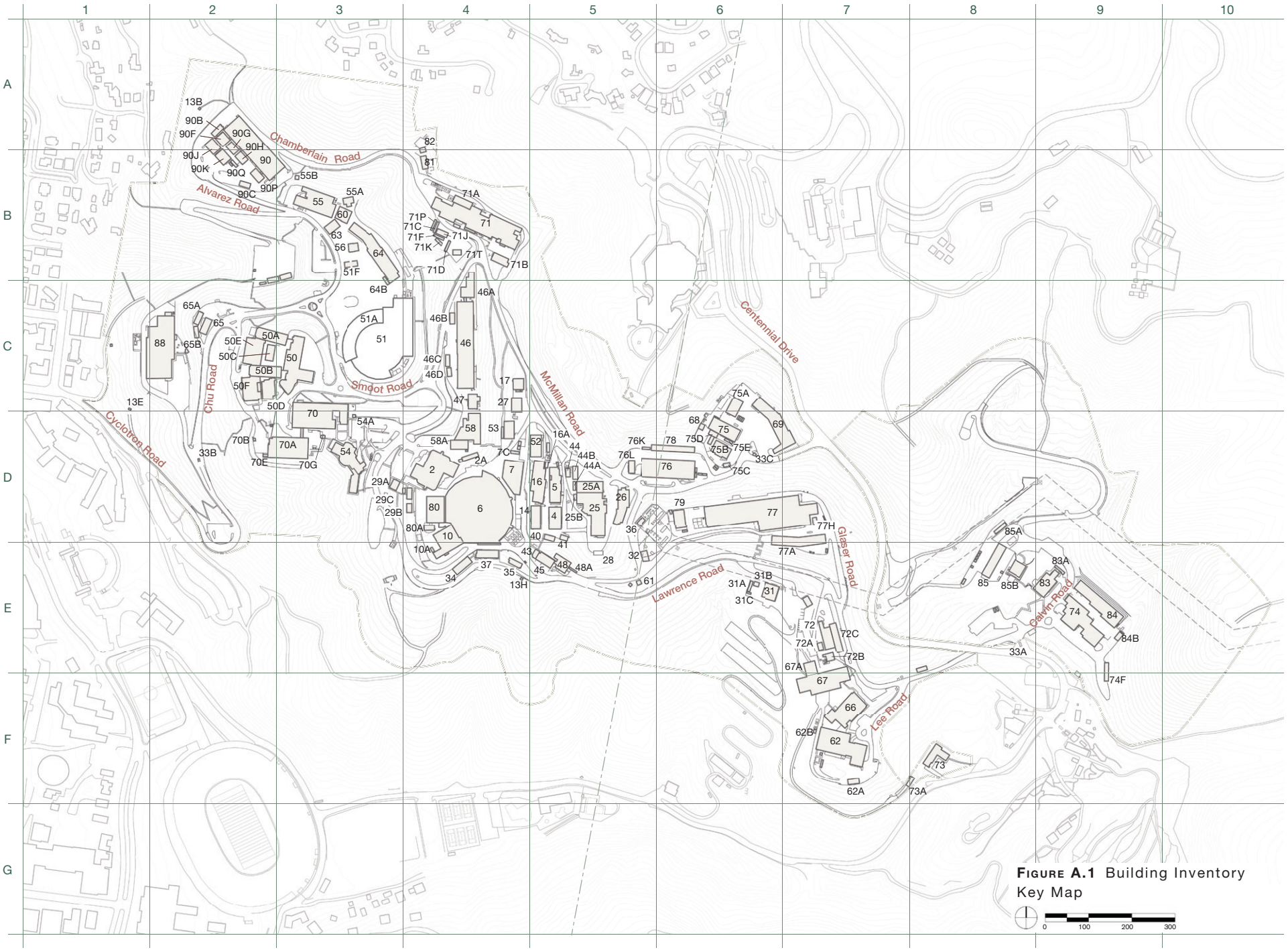


Figure A.1 Building Inventory Key Map

Appendix B: Land Leases

The Berkeley Lab main site is a 202 acre parcel of land owned and managed by the University of California. The majority of the facilities at the Laboratory are owned by the US Department of Energy and are located on discreet parcels of land that are leased by the DOE from the University. These leased parcels are defined on the following table and Land Lease Key Map.

Tract / Parcel / Buildings	Acres
Wilson Tract	
Parcel 1 (Bldg 51)	8.695
Parcel 2 (Bldg 46)	2.161
Parcel 3 (Bldg 50)	1.76
Parcel 4 (Bldg 70)	1.55
Parcel 5 (Bldg 58)	4.32
Parcel 6 (Bldg 55)	2.296
Parcel 7 (Bldg 71)	4.39
Parcel 9 (Bldg 90)	5.395
Parcel 10 (Bldg 88)	3.916
Parcel 16 (Bldg 50A-F)	1.85
Parcel 22 (Bldg 81)	0.218
Bailey Tract	
Parcel 20 (Bldg. 26)	0.632
Parcel 26 (Bldg 6)	4.14
State Univ Tract (Plots 80 & 82)	
Parcel 5A (Bldg 2)	1.8
Parcel 11 (Bldg. 70A)	2.314
Parcel 21 (Bldg. 54)	1.654
Parcel 27 (Bldg 10)	1.99
State Univ. Tract (Simmons Plot)	
Parcel 14 (Bldg 73)	1.035
Parcel 15 (Bldg 74)	3.891
Parcel 19 (Bldg 62)	3.412
Parcel 23 (Bldg 61)	0.312
Parcel 25 (Bldg 83)	3.243
Parcel 25A (Bldg. 85)	3.889
Parcel 28 (Bldgs 31, 66, 72, 72A, 72B, 72C, 67)	4.947
State Univ. Tract (Plot "O")	
Parcel 12 (Bldg 75)	4.512
Parcel 17 (Bldg 77)	5.88
Parcel 18 (Bldg 76)	1.938
Parcel 29 (Grizzly Peak Substation)	0.503

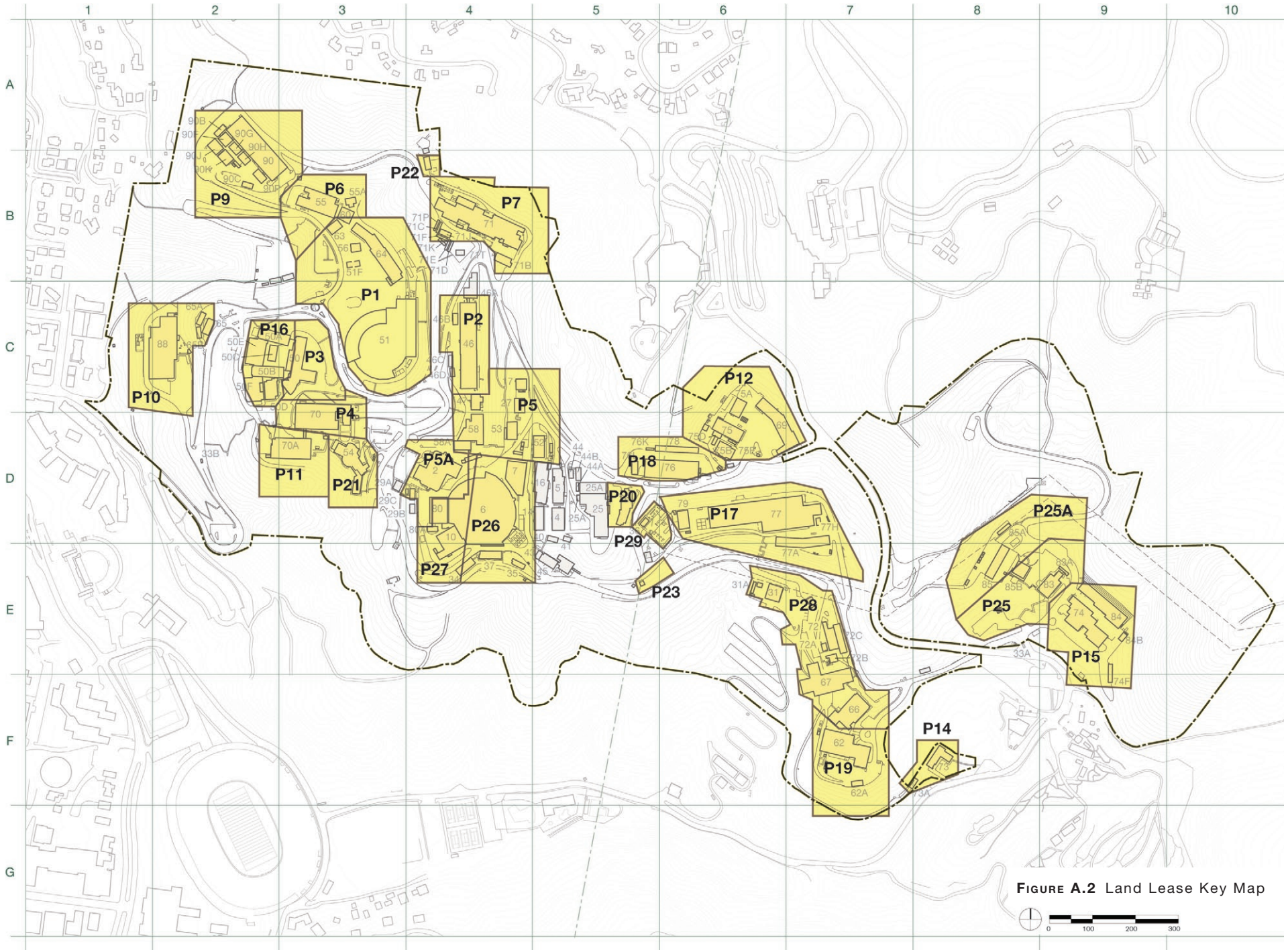


Figure A.2 Land Lease Key Map

Appendix C: Figures and Tables

Figure F.1	3	*Photo* The new Molecular Foundry building earned the U.S. Green Building Council's "Silver" rating for sustainable design and construction
Figure I.1	5	*Photo* The view southwest from the Laboratory at sunset
Figure 1.1	11	Berkeley Lab's Location within the San Francisco Bay Area
Figure 1.2	11	Berkeley Lab's Location within the Cities of Berkeley and Oakland
Figure 1.3	12	*Photo* Developed clusters follow the hillside terrain at Berkeley Lab
Figure 1.4	13	***Map*** The Laboratory's hillside development pattern on its 203-acre parcel of UC Regent's land
Figure 1.5	14	*Photo* The Radiation Laboratory originated the national laboratory system on the campus of UC Berkeley
Figure 1.6	15	The Laboratory has a 75-year history of achievement in Berkeley
Figure 1.7	15	*Photo* The historic dome of the 184" Cyclotron, now the home of the Advanced Light Source, has been a Berkeley Hills landmark since 1941
Figure 1.8	16	*Photo* Laboratory Director and Nobelist Ed McMillan with Edward Lofgren on the Bevatron, 1963
Figure 1.9	18	*Photo* The wide range of research disciplines at the Berkeley Lab
Figure 1.10	19	*Photo* The Molecular Foundry is dedicated to supporting nanoscience research by scientists from around the world
Figure 1.11	22	Berkeley Lab operates user facilities for use by the world-wide scientific community
Figure 1.12	23	*Photo* The Laboratory's natural environment and adjacency to UC Berkeley are cherished attributes
Figure 1.13	24	*Photo* Inefficient, high-maintenance office trailers make up 5% of the main site's space
Figure 1.14	25	***Map*** Over half of the buildings at Berkeley Lab require rehabilitation or replacement
Figure 1.15	27	*Photo* Demolition of facilities that are unsuitable for future research purposes
Figure 2.1	31	Berkeley Lab's scientific goals address significant problems facing humankind and the environment
Figure 2.2	32	*Photo* The proposed User Support Building would provide staging area and laboratory space for users of the Advanced Light Source, as well as replace a seismically "very poor" building
Figure 2.3	33	Prospective high-performance computing facility to accelerate discovery in all scientific and engineering disciplines
Figure 2.4	34	Berkeley Lab's Projected Population Increase
Figure 2.5	35	Berkeley Lab's Projected Occupied Building Space Increase at the main site
Figure 2.6	37	Genomics and Biosciences facilities with advanced infrastructure are required to address major challenges in energy, health, and the environment
Figure 2.7	39	*Photo* Laboratory facilities like the historic ALS building complement the Berkeley Hills setting
Figure 2.8	40	*Photo* New facilities built at higher densities, like the Advanced Materials Laboratory, enhance operational effectiveness and flexibility
Figure 2.9	40	Select architectural elements of a campus-like setting
Figure 2.10	41	*Photo* Access to advanced scientific equipment like

the Advanced Light Source supports international collaborations

Figure 3.1 45 The Berkeley Lab site in 2006 is a blend of landscape and building clusters

Figure 3.2 46 The Laboratory's main site blends with the rustic landscape of the UC Berkeley Hill Campus

Figure 3.3 47 ***Map*** 1998 – Present Berkeley Lab Boundary

Figure 3.4 49 ***Map*** Berkeley Lab Fixed Constraints

Figure 3.5 51 ***Map*** Berkeley Lab Easement/Setback Constraints

Figure 3.6 53 ***Map*** Berkeley Lab Land Use Plan

Figure 3.7 56 *Photo* Aerial view of the Laboratory in 2003 reveals how the cluster development pattern follows the main site's hillside topography

Figure 3.8 57 *Photo* Building and infrastructure forms at Berkeley Lab have a purpose-built, industrial character with a consistent palette of materials, and colors

Figure 3.9 58 Future development will focus on creating Research Clusters which will reinforce a more campus-like environment at the Laboratory

Figure 3.10 59 ***Map*** Development Framework

Figure 3.11 60 Cluster commons will create outdoor use areas

Figure 3.12 61 *Photo* Pedestrian paths and walkways among research clusters will be enhanced to stimulate interaction and ease circulation

Figure 3.13 61 *Photo* The area near the Cafeteria will be developed into the Central Commons

Figure 3.14 62 Laboratory Regional Access

Figure 3.15 63 *Photo* Berkeley Lab's shuttle bus system minimizes individual vehicle use

Figure 3.16 63 *Photo* One way traffic pattern on Chamberlain Road allows for parking on both sides of the street

Figure 3.17 64 *Photo* Existing surface parking lots unevenly distribute capacity relative to adjacent demand

Figure 3.18 65 ***Map*** Laboratory Circulation

Figure 3.19 66 *Photo* Service areas often conflict with parking areas and pedestrian pathways

Figure 3.20 67 ***Map*** Vehicle Circulation and Parking Framework

Figure 3.21 68 Illustrative improvement to vehicular access, circulation, and parking

Figure 3.22 70 *Photo* Pedestrian circulation often overlaps with service access and parking

Figure 3.23 71 *Photo* Buildings are used as a means to overcome the Laboratory's steep topography for pedestrians

Figure 3.24 72 *Photo* A network of pedestrian paths accommodate circulation through the park-like setting of the Laboratory

Figure 3.25 73 ***Map*** Pedestrian Circulation Framework

Figure 3.26 74 *Photo* Views of Laboratory buildings from the City of Berkeley are softened by screening tree stands and open space reserves

Figure 3.27 75 *Photo* The Laboratory is host to more than 120 different animal species, including Columbian Black-Tailed deer

Figure 3.28 77 ***Map*** Open Space and Open Area Framework

Figure 3.29 79 ***Map*** Landscape Framework

Figure 3.30 80 *Photo* The Laboratory's open space is characterized by a rustic landscape of native and naturalized woodlands and grasslands

Figure 3.31 80 *Photo* Areas of Rustic Riparian Landscape on the Laboratory are protected from future development

Figure 3.32 80 *Photo* Stands of trees screen the view of Laboratory buildings from neighboring communities

Figure 3.33 81 *Photo* Ornamental landscapes are placed near pedestrian spines

Figure 3.34 81 *Photo* Special plantings used to heighten visual interest in high-activity pedestrian areas

Figure 3.35 83 *Photo* Berkeley Lab's sedans and pickups operate on 85% ethanol to minimize air pollutants and reduce dependence on foreign oil (buses run on biodiesel)

Figure 3.36 85 ***Map*** Utilities Framework

Figure 3.37 87 *Photo* Grizzly Substation and UC Berkeley's Hill Area Substation each provide emergency backup for the other

Figure A.1 93 Building Inventory Key Map

Figure A.2 95 Land Lease Key Map

Table 1.1 20 Building space occupied by Scientific Research Area in assignable square feet

Table 2.1 37 Summary of Projections for Population Growth

Table 2.2 37 Summary of Projections for Space Growth

Table 3.1 54 Land Use Plan Area Calculations

Table 3.2 69 Parking Program

Appendix D: Related Documents

Department of Energy Laboratory Plans, FY 2007 - FY 2011, US Department of Energy, March 2006.

Ernest Orlando Lawrence Berkeley National Laboratory Institutional Plan, FY 2004 - FY 2008, Lawrence Berkeley National Laboratory, January 2004.

Final Environmental Impact Report: UC Berkeley 2020 Long Range Development Plan & Chang-Lin Tien Center for East Asian Studies, University of California Berkeley, January 2005.

Lawrence Berkeley National Laboratory Transportation Demand Management Plan, Working Draft, Lawrence Berkeley National Laboratory, November 2006.

Lawrence Berkeley Laboratory Long Range Development Plan, Lawrence Berkeley National Laboratory Office of Planning and Development, August 1987.

Policy on Approval of Design, Long Range Development Plans, and the Administration of the California Environmental Quality Act, The Regents of the University of California, January 2003.

University of California Policy on Green Building Design, Clean Energy Standards, and Sustainable Transportation Practices, UC Office of the President, January 2006.

Appendix E: Abbreviations and Definitions

ADP Adjusted Daily Population

ALS Advanced Light Source: a national user facility that generates intense light for scientific and technological research. See also www.als.lbl.gov

BART Bay Area Rapid Transit District: see www.bart.gov

baseline Refers to population, area, or parking data that was established as the current reference data at the beginning of the planning process; the data upon which the LRDP is based.

CEQA California Environmental Quality Act. See http://ceres.ca.gov/ceqa/

cfs Cubic feet per second

commons spaces Central, campus-like collegial spaces creating a focal point and gathering space in each research cluster.

constraints Significant habitats, resources, facilities, environmental qualities, or other features of a study area that serve to restrain, restrict, or prevent the implementation of proposed improvements in a given area.

cyclotron a circular particle accelerator in which charged particles are confined by a vertical magnetic field and accelerated by an alternating high-frequency applied voltage, in order to study the way they interact.

DHS Department of Homeland Security: see www.dhs.gov

DOE United States Department of Energy: see www.energy.gov

EBMUD East Bay Municipal Utility District: see www.ebmud.com

EIR Environmental Impact Report

ESnet Energy Sciences Network: a national user facility that is a high-speed computing network serving Department of Energy scientists and collaborators worldwide. See www.es.net.

FAR Floor Area Ratio: The ratio of floor area in a building to the land area of the lot on which it sits. Used to regulate or measure building volume and planning density.

framework A system of concepts and principals that bring order to a portion of the LRDP.

FTE Full-Time Equivalent

Gbps Gigabit per second

GPD Gallons Per Day

GSF Gross Square Feet

HILAC Heavy Ion Linear Accelerator

IDS Illustrative Development Scenario: one of many possible development scenarios under this LRDP, specifically designed to encompass the maximum amount of new building space, population, parking, and other site improvements identified in the LRDP, as a basis for assessing the environmental impacts in the EIR.

JGI Joint Genome Institute: a national user facility whose mission is to provide integrated high-throughput sequencing and computational analysis to enable genomic-scale/systems-based scientific approaches to DOE-relevant challenges in energy and the environment. See www.jgi.doe.gov.

MW Megawatt

MWh Megawatt hour

NCEM National Center for Electron Microscopy

NIH National Institutes of Health

NSF Net Square Feet

on-site Refers to projects or facilities on the Berkeley Lab main site, as opposed to projects or facilities owned, leased or managed off-site.

off-site Refers to projects or facilities that are not on the Berkeley Lab main site, as opposed to on-site.

open area The rustic hillside terrain within Berkeley Lab that lies between each research cluster.

open space The area within Berkeley Lab that includes most of the site's protected habitats and provides a buffer to neighboring uses.

LBNL Lawrence Berkeley National Laboratory: a United States Department of Energy National Laboratory, managed by the University of California. See also www.lbl.gov

LEED Leadership in Energy & Environmental Design: A green building rating system developed by the US Green Building Council.

LRDP Long Range Development Plan

main site The 202 acre portion of UC Regents land in the Oakland/Berkeley Hills that forms the primary location of the Lawrence Berkeley National Laboratory, that is the subject of this LRDP. In contrast to other facilities leased or owned by the Berkeley Lab.

NERSC National Energy Research Scientific Computing Center: a national user facility that is one of the largest facilities in the world devoted to providing computational resources and expertise for basic scientific research. See www.nersc.gov.

NNSA National Nuclear Security Administration: see www.nnsa.doe.gov

registered guests Non-employee population that are granted access to the Laboratory for a variety of scientific or operational activities for a set period of time.

research clusters Areas within the Berkeley Lab main site defined by major topographic features encompassing research functions that share common needs and interests.

TDM Traffic Demand Management

UC University of California see www.universityofcalifornia.edu/

UCB UC Berkeley

UCOP UC Office of the President

user facility any of the national user facilities operated by the Berkeley Lab for the US Department of Energy Office of Science; major scientific resources that are available for use by the larger scientific community.

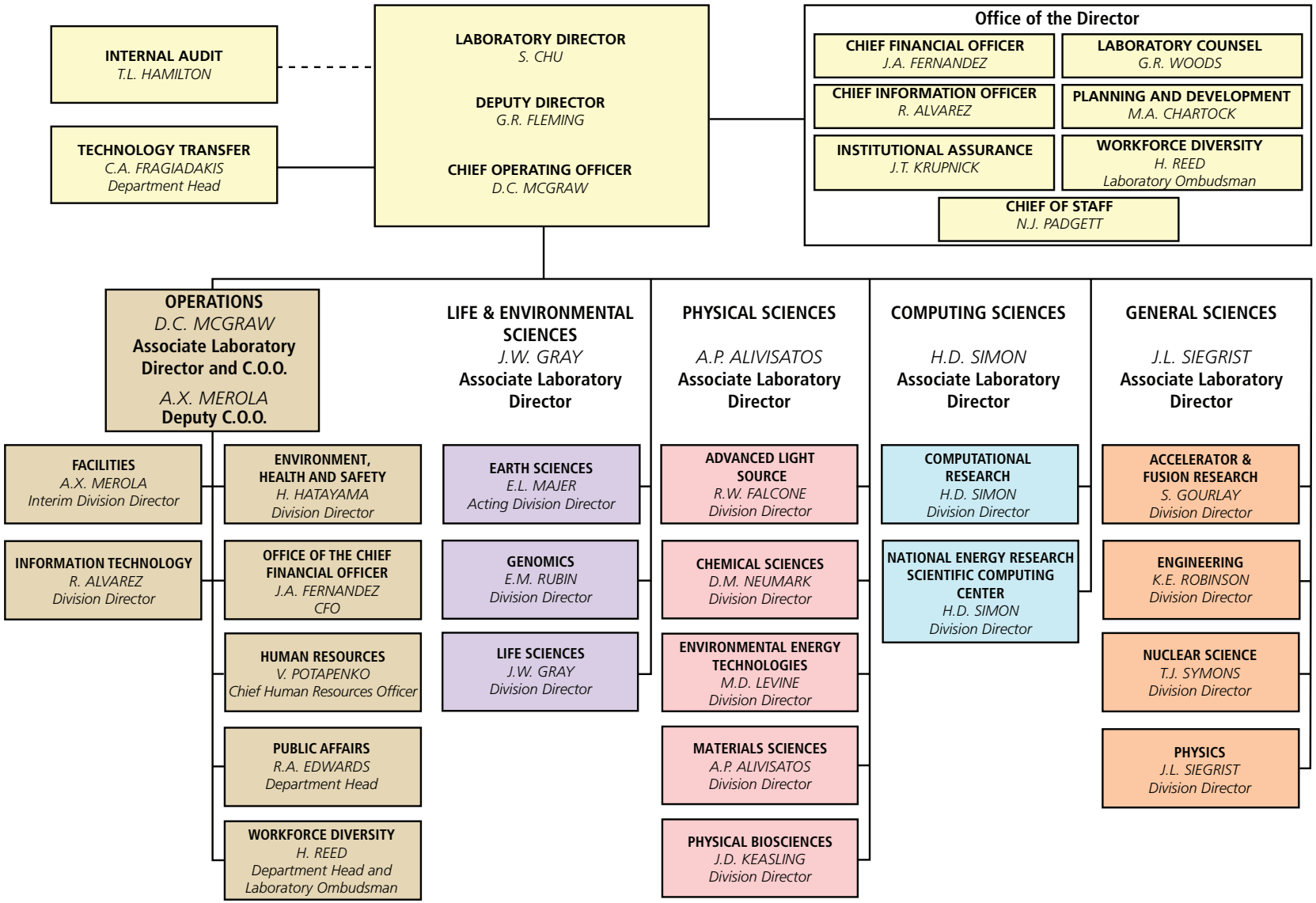
USGBC United States Green Building Council: see www.usgbc.org.

viewshed An area of particular scenic or historic value that is deemed worthy of preservation against development or other change.

visitors Non-employee population visiting the Laboratory for meetings or tours on a single-visit basis; as opposed to registered guests.

WFO Work For Others

Appendix F: Berkeley Lab Organization



Appendix G: Acknowledgments

The 2006 Long Range Development Plan (LRDP) was prepared by the Facilities Division, Lawrence Berkeley National Laboratory, University of California with guidance from the LRDP/EIR Executive Steering Committee.

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