University of Colorado at Boulder

Ekeley Sciences Middle Wing Renovation

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Department of Chemistry and Biochemistry
Ekeley Sciences Middle Wing Renovation
Program Plan

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I. Preface and Summary

Introduction/Summary

The Department of Chemistry and Biochemistry at the University of Colorado at Boulder is a national leader in its field and makes critical contributions to the teaching, research and service missions of the University. The Department provides classroom and laboratory instruction to over 3,080 undergraduate students and 180 graduate students in a single semester to all schools and colleges in the University. This accounts for almost 25,000 credit hours annually.

The strength of the Department arises from the contribution of each faculty and staff member to the undergraduate instructional and graduate studies missions of the department. National and international recognition of the faculty includes the Nobel Prize (1989), selection of eight members to the National Academy of Sciences, an award of the National Medal of Science, and many other prestigious awards to individual faculty. These achievements have a direct impact on students in the energy and enthusiasm recognized by these awards, and the new knowledge that resulted in them, as shared with students in the regular undergraduate courses that all faculty teach. Each faculty member maintains active research programs that are a required element of graduate studies and are critical for the advancement of knowledge.

This Facilities Program Plan focuses on correcting outstanding deficiencies on the first two levels of the middle wing of Ekeley Sciences – set within the context of an overall plan for the future improvement and development of Department facilities requirements. The following issues as addressed in the Program Plan impact on the University's ability to provide state-of-the-art laboratory instruction necessary for implementing its program goals:

- Poor laboratory ventilation resulting from outdated and inadequate fume hoods;
- Lack of safe storage and handling facilities for waste chemicals;
- Non-compliance for accessibility throughout as mandated by the *Americans with Disabilities Act*;
- No provision for computer terminal instruction, research or note taking at student lab stations;
- Outmoded floor plan configurations that do not support current departmental teaching needs and methodologies.

The space in which renovation is proposed will continue to be used for undergraduate laboratory instruction in organic and general chemistry, the two largest core instructional units of the department. Additional space on the first basement level, currently used for graduate studies, will be dedicated to advanced and honors undergraduate laboratory instruction. The space in the lower basement level will be renovated to accommodate graduate instruction in environmental and physical chemistry.

The long range plan for the improvement of Departmental Facilities addresses both the upgrading of existing facilities and providing new ones. A preliminary space evaluation conducted as part of this Program Plan, indicates a need for approximately 80,000 ASF of additional space. The additional space is driven by a lack of instructional and research laboratories and associated support spaces. Although this is quite substantial, upgrading existing space and equipment is the highest priority. Future plans could include a building addition or an additional facility to meet the space needs, however this program plan focuses on existing facility improvements.

The overall plan for improvement of Department facilities includes the following steps:

- Renovation of first and second basement levels totaling 21,660 GSF of Middle Ekeley Sciences;
- Construction of a new building, primarily for graduate instruction and including replacement for Cristol 140 classroom, on the Sibell-Wolle (Fine Arts) site;
- Relocation of Ekeley graduate instructional laboratories to the new structure;
- Phased renovation, by floor, of Middle Ekeley for General, Physical, Analytical and Biochemistry undergraduate instructional laboratories;
- Redevelopment of the Cristol 140 site;
- New renovations of Cristol Building.

The first basement level of the middle wing of Ekeley Sciences contains a total area of nearly 12,000 square feet of space that houses undergraduate laboratories for organic and general chemistry, graduate teaching laboratories for physical organic chemistry, stock rooms, instrumental and other support services for the organic instructional laboratories. This space will be renovated to house primarily organic instructional laboratories and support space, as well as a new honors laboratory for general chemistry and a new advanced laboratory for students in organic and inorganic chemistry.

The second basement level currently houses graduate instructional laboratories for physical and environmental chemistry in approximately 3,400 ASF and mechanical equipment in a large mechanical room. The renovation will result in approximately 2,900 ASF of modern laboratory space for physical and environmental studies and support, with approximately 700 square feet necessary for additional mechanical equipment.

New air supply and exhaust systems will be provided throughout the renovated levels of the building. Provisions for state-of-the-art computer communications will be made at each student and instructor workstation and superior laboratory, safety, and instructional equipment will be provided throughout. This renovation will create an enhanced learning environment that will provide students with the ultimate value in the educational experience with increased productivity from the resources used to produce that experience.

The total cost expected for this renovation is $12,220,000, inclusive of allowances for fume hoods and equipment. The project will be funded through a partnership of University cash funds and State of Colorado Capital Construction Funds. The University plans to provide approximately $1,215,389 through a development effort and request the remaining $11,004,611 via the State's Capital Construction Fund. Since the project will take one and one half years from start to finish, it is anticipated that the University will request funds over a two-year period. The first request will be for the 2002-2003 fiscal year with the balance being requested in fiscal year 2003-2004.

The project schedule best represents a timeline associated with the building improvements once the project is funded. The schedule assumes funds will be available in 2002, design would be complete in 2003, and construction would begin in 2003 and complete in 2005, ready for the 2004-2005 fiscal year. If funds are delayed, the project schedule will shift accordingly.

Planning Process

The planning process used to develop this program plan involved numerous University personnel and consultants. Each person was able to contribute their expertise through multiple meetings, work sessions, on-site research, specific studies, experience, and other general planning practices. This program plan is a result of the valuable input gathered from all those involved and is considered to be the best solution for the campus. A brief description of the process follows. Specific persons involved in the planning process include:

University Representatives
Tad Koch, CU Dept. of Chemistry and Biochemistry
Robert Barkley, CU Dept. of Chemistry and Biochemistry
James Baily, CU Dept. of Facilities Management
Rex Stockwell, CU Dept. of Facilities Management
Denise Donnelly, CU Dept. of Environmental Health and Safety
Patty Feist, CU Dept. of Chemistry and Biochemistry
Carl Koval, Chair, CU Dept. of Chemistry and Biochemistry
Kevin Peters, Chair-Elect, CU Dept. of Chemistry and Biochemistry

Consultants
Joe Bilotta, JBA Incorporated
Mike Ossian, H+L Architecture
Steve Gottesman, H+L Architecture
Ken Dabbs, H+L Architecture
Bruce Appel, Cator, Ruma & Associates, Co.
Marc Valerius, Cator, Ruma & Associates, Co.

Preplanning
Initial meetings began with facilities personnel performing pre-programming requirements. A planning process was then developed for the project to assure consistency during the planning phase. Concurrently, investigations of the buildings led to familiarization with Ekeley Sciences and other space resources of the Department.

Program Information
The consultants met with various members of the Department to develop a complete understanding of the programs and how the Department operates. Discussions included current and future operational issues such as teaching methodologies, program trends, logistical problems, and any program deficiencies.

Develop Facilities Needs
This phase took the program information and developed facilities needs from that information. Space relationships were defined based on the desire to change operational practices. Focus was placed on the Department's ability to renovate current space so it supports an interactive and safe teaching environment.

Review Existing Conditions
After program and space needs were developed, they were compared to the existing conditions and possible uses of the lower two floors in the center of the existing Ekeley building. Space considerations and operational strategies were studied. A building code analysis and building conditions were evaluated so building deficiencies could be identified from both a programmatic and physical standpoint.

Project Description
All the variables described above were then assembled to begin to describe the scope of work needed for the renovation of Ekeley. Schematic design alternatives and floor layouts were created. A recommended schematic plan was then adopted. Consultants recommended appropriate architectural, structural, mechanical, electrical, and landscape systems to support the new layout and program operations. Cost estimates, life cycle costs, funding and scheduling issues were resolved.

Project Relationships
This phase summarized how this project fits the "total" picture within the University and the State of

Colorado. The project's relationships to capital construction and controlled maintenance plans, master plans, University goals and objectives, and State goals help complete the plan. Adjustments were made to assure the project not only makes immediate health and safety improvements but also addresses the long-term needs of the campus as a whole. Assuring the renovations also supported the long-range plan of the department impacted the layout so different uses could be possible in the future.

II. Program Information

Description of Program

University of Colorado
The University of Colorado was founded in Boulder in 1876. There are now four University of Colorado campuses: Boulder, Colorado Springs, Denver, and the Health Sciences Center in Denver.

The five colleges and five professional schools at CU Boulder offer more than 3,000 courses in over 140 fields of study. There are approximately 80 degree programs available at the bachelor's level, 60 at the master's level, and 53 at the doctoral level.

The Boulder campus enrolls approximately 25,200 full time equivalent (FTE) students. Boulder has become a scientific center for the Rocky Mountain region. Close cooperation exists between the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology (NIST), and the National Center for Atmospheric Research (NCAR). JILA (formerly the Joint Institute for Laboratory Astrophysics) and the Cooperative Institute for Research in Environmental Sciences (CIRES) are directly involved in graduate education on the University campus.

Department of Chemistry and Biochemistry
The undergraduate degree in chemistry and biochemistry emphasizes knowledge and awareness of:

- The basic principles of chemistry – atomic and molecular theory, reactivities and properties of chemical substances, and the states of matter;
- The sub-disciplines of chemistry – organic, physical, analytical, inorganic and biochemistry;
- Mathematics sufficient to facilitate the understanding and derivation of fundamental relationships and to analyze and manipulate experimental data;
- The basic principles of physics and, for biochemistry majors, knowledge of biology; and
- Safe chemical practices, including waste handling and safety equipment.

In addition, students completing the degree in chemistry or biochemistry are expected to acquire the ability and skills to:

- Read, evaluate, and interpret information on a numerical, chemical, and general scientific level;
- Assemble experimental chemical apparatus, design experiments, and use appropriate apparatus to measure chemical composition and properties of molecules, including, for biochemistry students, the properties of proteins, nucleic acids and other biochemical intermediates; and
- Communicate results of scientific inquiries verbally and in writing.

The Department offers two undergraduate B.A. programs, one with emphasis in chemistry and the other with emphasis in biochemistry. Majors are encouraged to supplement their course work by participating in undergraduate research with individual faculty members. The Department also provides service teaching of approximately 15 undergraduate courses in chemistry and biochemistry accounting for approximately 3,080 students per semester. These enrollments are distributed over small sections and laboratories for curricula in biological, physical, and health-related sciences and engineering. Vigorous M.S. and Ph.D. programs in chemistry and biochemistry are offered with research experience in all of the subdisciplines. Additionally, the Department provides postdoctoral training annually for over 90 graduates of Ph.D. programs from the U.S. and abroad. Those who have studied in the Department occupy academic and research positions throughout Colorado and the country. The Department of Chemistry and Biochemistry offers minors in both chemistry and biochemistry.

The American Chemistry Society maintains a certification program in which a student graduating with a specified minimum program is certified to the society upon graduation. To be certified, a graduate must satisfy requirements in addition to the minimum for graduation.

Opportunity is provided for qualified chemistry and biochemistry majors to participate in the departmental honors program and graduate with honors (cum laude, magna cum laude, or summa cum laude) in chemistry or biochemistry.

History, Role and Mission, Unique Programs

Besides being a national leader in the Chemistry and Biochemistry fields for those students that are enrolled in the degree programs, the department is critical to the base mission of the University. The Department is responsible for providing instruction in courses that are required for majors in many areas of study. The production of almost 25,000 credit hours annually attests to the fact that the Department is crucial to the success of thousands of students attending the University of Colorado.

The Department of Chemistry and Biochemistry at the University of Colorado has a strong tradition of excellence and centrality in fulfilling its mission within the University, which is to educate students in all aspects of the field and to generate, through research, new knowledge and understanding of the discipline. The Department maintains expertise in the major traditional areas of study (biochemistry, analytical, inorganic, organic, and physical chemistry) and in particular interdisciplinary areas including environmental and atmospheric chemistry, biophysical chemistry, biotechnology, organometallic chemistry, bio-organic chemistry, physical organic chemistry, materials chemistry, and chemical physics.

Among the unique features of the graduate instructional curriculum are the interdisciplinary programs in which students may study and learn to conduct research; this stresses the centrality of the Department. These programs occupy a particularly important position in the curriculum due to the fact that a significant fraction of modern chemistry research is interdisciplinary in nature. These are further discussed in the Department's relationships with other programs and agencies.

Program Strengths

The strength of the Department arises from the contributions of each of its faculty members to both the teaching and research missions. National and international recognition of the faculty includes the Nobel Prize (1989) and selection of eight members to the National Academy of Sciences. Other recent prestigious awards received by individual faculty include the National Medal of Science, the Bonfils Stanton Award for Science, the Irving Langmuir Prize in Chemical Physics, Dreyfus New Faculty Award, and Packard, Searle and Sloan Research Fellowships. Several faculty are joint members of campus institutes, such as JILA (formerly Joint Institute for Laboratory Astrophysics), the Cooperative Institute for Research in Environmental Sciences (CIRES), and the Program in Atmospheric and Oceanic Sciences (PAOS). In addition, distinguished scientists from the National Oceanographic and Atmospheric Administration (NOAA), and the National Institute of Standards and Technology (NIST) have been appointed as adjoint faculty in the Department. All faculty teach regular undergraduate courses and maintain active research programs. Almost all are successful in the competition for federal and non-federal research grants. In the most recent survey by the National Science Foundation, published in *Chemical and Engineering News*, the Chemistry and Biochemistry Department was ranked third in the United States in the amount of off-campus support awarded for research and development.

These strengths carry through from the faculty directly to the students. The energy, enthusiasm, and knowledge are shared with the potential "leaders" of the future. This success brings with it exciting changes in the curriculum and teaching methods that bring the need to improve facilities.

Program Needs and Trends

The academic and strategic planning process the Department and University employs includes a very extensive and thorough program review that occurs every 7 years. This process has outlined many strengths, but also many needs, the Department has in order to continue its excellence in teaching and its national reputation.

As part of the continuous planning process, the Department prepares a Self-Study following specific Program Review Panel (PRP) guidelines. An Internal Review Committee (IRC), made up of three faculty members, an undergraduate student, and a graduate student, who are all from outside the Department, held interviews with the personnel of the Department and analyzed the Self-Study Report. An External Review Committee (ERC) of three chemistry faculty from other institutions visited the campus, reviewed the Self-Study and IRC report, and interviewed Department personnel, students, and University administrators. The ERC report was then reviewed by the PRP along with the Self-Study and the IRC report.

The self-study identified a number of high-priority issues and concerns that have a substantial impact on the future of both the undergraduate and graduate instructional missions of the Department. The most important of these with respect to this Program Plan is:

- Renovation of facilities is needed. The existing department facilities range from 15 to over 75 years old. Although some of the oldest Departmental spaces in Ekeley Sciences have been renovated recently; extensive renovation of space and mechanical systems is urgently required in the middle wing of Ekeley Sciences. This space is now over 25 years old and no longer suitable for its original purposes. In addition, the Department suffers from a serious deficiency in space for its teaching programs for both undergraduate and graduate studies. The large lecture hall, Cristol 140, is obsolete and requires replacement, possibly as part of the development of a portion of the Sibell-Wolle site, which is the proposed location for new graduate instruction laboratories.

The Internal Review Committee studied numerous aspects of the department, including faculty recruitment and retention, undergraduate teaching and research, graduate studies, staff concerns, diversity, facilities, and equipment. The IRC describes the Department of Chemistry and Biochemistry as an exceptionally strong academic unit and perhaps the strongest on the Boulder Campus. It found in interviews with departmental faculty that their interactions are highly collegial. This aspect of the professional interaction is a key reason for both retention of existing faculty and successful recruitment of junior faculty. Both have a major impact on the students' ability to achieve a quality education.

Conclusions from the IRC report with respect to physical facilities include the following:

- The undergraduate teaching laboratories located in the middle wing of Ekeley Sciences are also a top priority for upgrade. These facilities are over 25 years old and require substantial remodeling to support the educational program, which is the foundation to the entire Department.
- Space issues are also a concern. The Department as a whole lacks the proper amount of space necessary to be successful. This includes all educational, research laboratory, and support space.
- The renovation or replacement of Cristol 140 lecture hall is critical to the teaching mission of the Department and the University.

The External Review Committee also came to a similar conclusion as the Internal Committee. The ERC was very impressed with the Department, noting that the University is very fortunate to have such an excellent program. Faculty have established themselves as leaders in their fields on both a national and international level. There will continuously be salary issues for both faculty and staff and these should always be a priority, however the ERC felt strongly about focusing on facilities improvements.

In the judgment of the ERC, the teaching facilities in the department range from adequate to poor. Of most concern to the ERC were the sophomore organic laboratories because of health and safety issues due to inadequate laboratory hoods. The graduate laboratories in the middle wing of Ekeley Sciences also require full renovation in order to meet modern building and life safety codes. The ERC concurs with the Department that Cristol 140 is inadequate for teaching large lecture classes, as its design is not conducive to interaction between faculty and

students. Another obvious weakness is the minimal use of computers in the undergraduate curriculum. The Department is woefully behind in this area. The Physical Chemistry Laboratory needs serious attention with regards to upgrade of experiments and instrumentation. Teaching is clearly taken very seriously by the members of the Department. There are, however some shortcomings because of under staffing at both the faculty and teaching assistant level. Large non-major chemistry lecture courses should be split into two sections. Recitations for students in the sophomore organic courses were recommended and these were recently added to the curriculum.

Relation to Academic or Institutional Strategic Plans

In December 1996 the Department developed and adopted a Strategic Plan that is consistent with the strategic plan of the campus. This plan addresses all of the areas in which the Program Review Panel made recommendations. Consistent with University requirements, the Department also has formulated and implemented a Diversity Plan, which guides the Department in the recruitment of women and minority students, staff and faculty. The Department also established a Curriculum Committee that now continuously reexamines the curricula at both undergraduate and graduate levels.

Highlights of this plan include several methods for enhancing the educational experience of the students. In the undergraduate program the Department proposed to personalize the students' education by establishing small group recitation sections for the large organic, physical and biochemistry courses similar to those already in place for the freshmen courses. A longer term goal is to reduce the size of the largest introductory chemistry courses by offering additional sections of each class. New course development will be focused on interdisciplinary topics and implementation of new technologies for better preparing the department's majors for the job market of the future. Curriculum development will support the establishment of a B.S. degree in chemistry. Specific plans have been developed for the involvement of all faculty members in the advising of undergraduates both in course options and in career pathways after graduation.

Planned developments in scholarly programs include the strengthening of already existing interdisciplinary programs, including those in atmospheric chemistry, biotechnology, chemical physics and biophysics. The Department will apply for federally funded training grants for graduate students as one means of financing program enhancements. Some faculty expansion may be achieved by joint interactions with existing programs on campus, such as the Environmental Program and programs in Biotechnology and Material Sciences. These interactions will strengthen both the Department and the interdisciplinary efforts.

The strategic plan gives considerable detail about the goals of the Department of Chemistry and Biochemistry. The following is a brief summary of the most important goals that the Department desires to accomplish in the next seven years.

To enhance the educational and research aspects of the program the Department plans to:

- Obtain permission and funding for renovation of the first and second basements of the middle wing of Ekeley Sciences.
- Obtain permission for construction of a graduate teaching laboratory on the Sibell-Wolle site and for renovation or replacement of Cristol 140.
- Improve the subdisciplines of inorganic chemistry through the addition of world-class faculty.
- Introduce new teaching technologies into classrooms and laboratories, such as developing a staffed computer laboratory for students at all levels.
- Obtain additional staff and teaching assistants for recitations and laboratories in organic chemistry courses and recitations in physical and biochemistry courses.
- Obtain funding for major new instrumentation in undergraduate laboratories and research facilities through grants and matching initiatives and reinvestment.
- Provide advising that will apprise students of multiple opportunities available in the classroom, outside the classroom, and beyond graduation.
- Develop new courses and interdisciplinary courses to better prepare undergraduate majors for the modern job market.
- Provide more opportunities for undergraduate research/independent study.
- Establish a B.S. degree program.

- Complete funding for an endowed Chair in biochemistry and appoint additional adjoint faculty, especially in the area of inorganic chemistry.
- Improve classified staff morale and maintain staff excellence by personal interactions and internal departmental reward mechanisms.
- Improve recruitment of graduate students to advanced degree programs.

Relation to Other Programs or Agencies

The Department has extensive ties to other Departments in the University and with a variety of Institutes on campus and in the scientific community in Boulder. The Department currently shares faculty with JILA, CIRES, PAOS, and MCDB and several NOAA scientists are appointed as adjoint faculty in the Department. Some faculty also have appointments in the Howard Hughes Medical Institute and as adjunct faculty with Departments at the Health Sciences Center in Denver. This wide range of direct interactions with other disciplines demonstrates the centrality of the research being performed in the Department of Chemistry and Biochemistry to all areas of the natural sciences.

The Department participates in joint training programs for predoctoral students in a variety of interdisciplinary areas, including Atmospheric Chemistry, Biotechnology, Biophysical Chemistry and Chemical Physics. The Department currently has externally funded predoctoral training grants in Atmosphere Chemistry (NSF funded), Biotechnology (NIH and CIRB funded), Genetics (NIH funded), Medical Scientist Training Program (NIH funded) and Cardiovascular Disease (NIH funded). These interdisciplinary programs provide students in the Department with opportunities for doing graduate research in almost any area from Chemical Physics to Human Genetics.

The research programs in the Department of Chemistry and Biochemistry span a huge range of disciplines that touch many areas in the natural sciences as evidenced by the ties that faculty have with Centers and Institutes on campus, at the Health Sciences Center in Denver and various national labs in Boulder. The following is a brief description of the centers, programs and institutes that the faculty in the Department are involved in.

In 1992 the department introduced a new Ph.D. graduate program in atmospheric chemistry. In collaboration with CIRES, the Environmental Program, NOAA, NCAR and PAOS, the department developed new courses and research opportunities to train scientists in interdisciplinary areas that overlap with chemistry and atmospheric science. The strength in atmospheric chemistry in the Department combined with various University and Federal institutes makes Boulder a world center for training of atmospheric chemists.

The **Biotechnology** program involves three departments at the University: Chemical Engineering, MCD Biology, and Chemistry and Biochemistry. In addition to the standard set of courses in their home department, students in this program take courses in biotechnology and also do a research internship in a local biotechnology company. Graduate students completing this program receive an interdisciplinary certificate. This program allows students to experience research in industry and it also strengthens the ties between the Department and local biotech industry leaders.

The Chemical Physics program is an interdisciplinary graduate program that involves faculty in the Departments of Physics and Chemistry and Biochemistry. This program offers the Ph.D. student an opportunity for flexible advanced training in areas of common interest to chemistry and physics. Students in chemical physics carry out course work in the Department of Physics and the Department of Chemistry and Biochemistry and can have faculty mentors in either Department. This program has historically attracted some of the best students to Colorado.

CIRES is jointly sponsored by the University and the Environmental Research Labs of NOAA. CIRES encourages interdisciplinary research in the sciences related to the earth and its environment. Students from several academic departments perform research in CIRES, and Chemistry graduate students affiliated with CIRES take courses and

receive their Ph.D. in the Department of Chemistry and Biochemistry. CIRES provides these students with an opportunity to collaborate with scientists from disciplines throughout the environmental sciences.

JILA was established by an agreement between the National Institute of Standards and Technology (NIST) and the University of Colorado. The senior staff in JILA have appointments in either NIST or at the University. All the NIST-appointed scientists also hold a faculty appointment at the University and several adjoint faculty in the Department of Chemistry and Biochemistry have appointments at NIST. JILA represents a center for advanced research and teaching in a variety of areas including: atomic, molecular and optical physics, surface chemistry and physics, laser physics, chemical physics and astrophysics.

The **Center for Optoelectronic Computing Systems** is an NSF Engineering Research Center focusing on research in areas where optics has an advantage over electronics in computing. The center helps to place Boulder at the frontier of new technologies in ultra-fast computing using optical rather than electric fields. Center-related work in the Department focuses on design, synthesis, and evaluation of new organic materials for optical computing.

The **Colorado Advanced Materials Institute** coordinates research in materials science at the University of Colorado and several other local Universities. The goals of this institute are to establish Colorado as a leader in advanced materials technologies by forging strong cooperative links between Colorado materials industry, universities and government. A number of faculty in the Department of Chemistry and Biochemistry are actively involved in this Institute.

The **Colorado RNA Center** fosters research and technology transfer between universities and the biotech industry in all areas of RNA research. The Department of Chemistry and Biochemistry has a strong group of researchers working in the areas of RNA biochemistry, structure and function. This RNA research being performed at the University of Colorado and in local biotech companies makes Boulder what most consider to be the best center for RNA research in the world.

The **Center for Separation using Thin Films** is an Industry/University Cooperative Research Center established by the National Science Foundation. The main objectives of the Center are: to conduct basic research and related developmental activities for the use of membrane technology in separation processes; to provide technology transfer between the Center and its industrial participants and to promote education in membrane technology. A number of faculty in the Department of Chemistry and Biochemistry are affiliated with the center, which allows graduate students to obtain valuable research training in this important technical area.

The **University of Colorado Cancer Center at the Health Sciences Center** in Denver is an NCI-funded center for basic and clinical research, patient care, education, prevention and early detection of cancer. Research at the University of Colorado Cancer Center is supported by 13 shared core facilities in Biostatistics, NMR spectroscopy, clinical investigations, cytogenetics, fermentation, flow cytometry, histopathology/tissue procurement, laboratory animals/transgenic animals, tissue culture/monoclonal antibodies, DNA sequencing, immunology, protein microsequencing and radiological sciences. A number of faculty in the Department of Chemistry and Biochemistry belong to the Cancer Center and thus have access to these valuable research core facilities.

Existing Programmatic/Operational Deficiencies

Many of the programmatic or operational deficiencies are related to issues surrounding the number of faculty and staff required to support such a large program. These issues are similar to those all University departments struggle with but are exacerbated in Chemistry and Biochemistry because of its size, role as a core curriculum for the entire student body at Boulder, and its national reputation.

Undergraduate Teaching

The program plan focuses on improving space related to the core programs in the Department. General Chemistry is the largest instructional unit in the Department. Enrollments in the program have increased in the past several years reaching 3,260 students. The Department expects continued growth in the future. These courses are taught by faculty from all divisions of the Department, as well as the General Chemistry Coordinator, Dr. Margaret Asirvatham. There are some feelings that a disproportionate amount of this load is placed on some divisions. The teaching evaluations of the courses are generally quite good. The Department has had major advances in the courses

over the last few years with the addition of multi-media teaching, increased access to computers for the students and additional support staff for the undergraduate teaching laboratory.

The general chemistry program offers a wide range of classes designed to meet the needs of specific student groups. In general, it was felt that the courses currently offered are meeting the needs of the students and preparing them for their future careers. The honors general chemistry program has been particularly successful in meeting the needs of the best-prepared incoming freshmen and has been enthusiastically received by them. It offers small class sizes, with a great deal of interaction between students and the professor.

Undergraduate Research

The ability to participate in advanced "cutting-edge" research as an undergraduate is of great value to the University both for recruiting and retaining top-notch undergraduate students and for providing these students with a unique level of knowledge and experience in their undergraduate education. Because undergraduate research has essentially become a requirement for admission to nearly all competitive graduate programs in chemistry and biochemistry, for employment at most scientific companies, and for admission to medical schools, strong research experience can make our students exceptionally competitive in their career goals. Currently, approximately half of the 60-80 majors per year finish with at least some undergraduate research experience. As indicated in surveys done by the Department, undergraduates who become involved in research find it to be one of the most rewarding aspects of their educational experience. Furthermore, involvement in the Honors Program has made the Department a leader in the College of Arts and Sciences with 14% of the students earning honors degrees. Student response to the Honors Program has been overwhelmingly enthusiastic, and the benefits to these students are very apparent in their successes in graduate and professional careers.

Description of Remodeled Space and Incorporation of Technology

Advances and improvements in modern technology and laboratory design will enable the Department to improve its undergraduate teaching program in many ways. Of paramount importance will be the addition of state-of-the art ventilation and fume hood equipment for organic teaching laboratories to meet current and future health and safety requirements. Improvements in laboratory design and space utilization will also solve egress and space utilization problems. The proposed design incorporates four (4) interconnecting 20 student pods for sophomore organic laboratory, plus a 12 student pod for advanced undergraduate laboratory with all pods having facile access to a glass enclosed high tech instrument room at basement level 1. The advanced laboratory, which has never been available before due to space shortage, will be used for advanced undergraduate organic and inorganic chemistry. Because of the layout, sophomore students will be able to see the exciting experiments being performed by the senior students.

The design also creates two state of the art general chemistry (freshman level and Honors General Chemistry) teaching laboratories at the first basement level, and two graduate instructional labs in environmental and physical chemistry at the sub-basement level. These will be prototypes to help define future renovated general chemistry teaching laboratories on the first floor of the middle Ekeley building in a future capital project. They will incorporate the appropriate new technology as described below for organic teaching laboratories and state-of-the-art general chemistry style fume hoods.

The instrument room of the organic teaching laboratory complex will be a focal point for the new organic chemistry teaching laboratories. New spectroscopic and chromatographic instrumentation will allow students to perform experiments on a smaller scale and still accurately analyze their results. Smaller scale experiments consume less chemicals and produce less waste and realistically model the scale of many reactions that the students will perform in their future careers as chemists. Analytical data collected in the instrument room can be transferred via the Internet to student portable computers located at their desk space. New computer technology will also allow students to theoretically analyze and model reactions and experiments before performing them. The advanced instrument room proposed for the basement level of the Ekeley building will include shared computers and software. Further, each desk space will be equipped with a computer hookup to the internet such that each student can connect his/her portable computer for the purpose of downloading data from the internet bringing access to shared software

and shared data. Computer connection to ongoing experiments will also be available at the fume hood workstations such that digital information on an experiment can be collected and transmitted in real time. Student portable computers will be used for keeping an electronic notebook for recording data and experimental procedures and observations. Scientific reports on each experiment will be submitted electronically. Specialized chemical graphics software will be available to enhance report preparation. Although some calculations and report preparation in principle could be performed at a remote site, training in the use of the software is best accomplished where experienced technical staff are located.

The laboratory design will include specialized areas for waste collection for recycling or environmentally safe disposal. An important aspect of the laboratory teaching program will be the proper disposal of hazardous waste chemicals. Such a facility is not currently available in the undergraduate teaching laboratory area.

A shared breakout room has been incorporated in the design for short presentations, brief discussions, and help sessions with 10-20 students in a more isolated environment. This room will be equipped with state of the art audio-visual-computer technology. This facility is also not available in the current laboratories. Each pod and the breakout room will be equipped with an electronic white board such that written material can be printed or transmitted to student portable computers via the Internet.

Computers are needed in the laboratories or in adjacent rooms. This will allow students to take advantage both at the lower and upper level of the many programs that are being developed to illustrate complex concepts and do simple calculations valuable to the respective courses. Enrollments, particularly in the general chemistry program, have increased in the past several years, and point to the need for additional instructional laboratory space. Safety within the teaching and research labs is an important consideration.

Program Delivery Alternatives

Chemistry is an experimental laboratory-intensive science and the program plan when implemented will provide students with a first class laboratory experience at four different levels: General Chemistry, Organic Chemistry, Inorganic Chemistry, Graduate Environmental and Physical Chemistry.

The only alternative for program delivery is to provide less actual hands-on laboratory experience and replace actual chemistry experiments with computer simulated experiments. A consequence would be that CU students will not learn the manipulative skills required of practicing chemist and scientists. Further, undergraduates will not meet the entrance requirements for medical and dental schools and many graduate programs.

III. Facilities Needs

Long Range Needs

There are many academic, strategic and facility planning processes that contribute to the University of Colorado being able to make good, sound decisions related to the physical development and maintenance of its physical environment. The facilities of the Department of Chemistry and Biochemistry range in age from 15 to 75 years and, although renovation is an on-going activity, it often does not keep up with the stresses that increasing numbers of undergraduate students, new technologies and graduate studies exert on older buildings. The middle portion of Ekeley sciences, for example, has seen very little modification since it was completed over 25 years ago and now requires substantial renovation of space, electrical systems, and mechanical systems in order to continue as a safe building for both undergraduate and graduate studies in chemistry. The Department, with the support of the consultant team and the University's Planning Department has created a long range plan, that when implemented, will solve the Departmental facilities needs.

The University has been making improvements to the Ekeley Building section by section. Renovations have occurred to the East Wing of Ekeley as recently as two years ago, and minor renovations occur almost annually using operating budgets and research grants. Knowing this band-aid approach will eventually create negative impacts on the life of the department's buildings; the University created a long-range plan to assure improvements are made with a common goal in mind.

The Department is currently located in primarily two buildings, Ekeley Sciences and Cristol Chemistry. These facilities are connected at the upper levels with a wing that is currently dedicated to the Cooperative Institute for Research in Environmental Sciences (CIRES), which has direct program affiliations with the Department.

The overall plan identifies space needs, the quality of existing facilities, and the adjacencies or relationships among programs. Preliminary space studies have indicated the Department has a space deficit of approximately 80,000 ASF. This is primarily due to the success of the program's research and graduate programs, increases in enrollment, and more stringent regulatory requirements.

Changes in policies and procedures have required more space for items such as waste and chemical storage. It requires much more space today to teach a chemistry student than it did almost 30 years ago when Middle Ekeley was designed. This explains the apparent overcrowding and unsafe conditions seen in today's laboratories. The following table summarizes where the space deficits are.

SPACE TYPE	Existing ASF	Projected ASF	Deficit
Classroom Service	559	600	41
Instructional Laboratories	21,497	55,169	33,672
Equipment/Computer Support	2,601	4,498	1,897
Instructional Laboratories Service	6,246	13,792	7,546
Open Lab	418	1,600	1,182
Open Lab Service	44	160	116
Graduate Laboratory	64,627	77,000	12,373
Graduate Laboratory Service	13,370	23,100	9,730
Staff Offices	879	5,400	4,521
Faculty Offices	9,141	9,950	809
Student Offices	3,283	6,125	2,842
Office Support	2,191	2,148	-44
Office Service	975	2,148	1,173
Conference	2,367	990	-1,377
Conference Service	17	198	181
Greenhouse	1,914	3,390	1,476
Lounge	567	1,200	633
Lounge Service	94	120	73
Shop	3,476	3,500	24
Shop Service	31	700	669
Central Storage	5,968	8,000	2,032
TOTAL	**140,265**	**219,787**	**79,569**

Assignable to Gross Ratio 62%

Gross Square Foot Needs **128,337**

In order to meet these space needs, the Department plans to construct a new facility in the adjacent area immediately east of Cristol Chemistry. This will keep all the facilities adjacent to one another providing an efficient layout among the programs, keeping operating costs at a minimum, and in a central location for students. The location is also important programmatically. Since the Chemistry Department plays such a major role in the core curriculum of the University's undergraduate population, it warrants being centrally located and within the academic core. Providing the additional space somewhere other than adjacent to current facilities would also require the existing facilities to be reconstructed at the new location. This is not economically feasible, especially since the existing facilities are not conducive to change or use by other programs. The facility is extremely wet lab intensive.

The long-range plan will consolidate graduate programs and research programs into the new space and in Cristol Chemistry once constructed. This will allow the Department to use Middle Ekeley exclusively for undergraduate instructional purposes. Until that can be accomplished the Department must keep its current facilities in good operating condition, safe from hazards, and supporting today's teaching and research methodologies. This should also be done in a manner that supports the long-range plan. Since there will eventually be the need to relocate programs, renovations of current spaces must be performed in a way that allows space to be easily utilized by other programs in the sciences. As seen in the project description and goals of this program plan, the renovation will

create a more adaptable and flexible space for instructional laboratory uses in the future. This will reduce the life cycle costs of the space and minimize the potential for another major renovation.

This program plan, the renovation of the lower two floors of the middle wing of Ekeley, is the first phase in the long-range plan. This area currently houses undergraduate teaching laboratories for general and organic chemistry and graduate teaching laboratories in environmental and physical chemistry. Although the building is a little more than 25 years old, it is inadequate with respect to present environmental health and safety requirements for chemistry laboratory teaching and research. Because the middle section of Ekeley Sciences cannot be vacated during renovation, a multi-step renovation plan is being proposed. This project improves the heart of the undergraduate teaching labs.

Unique or Special Features

The undergraduate and graduate chemistry instructional programs at the University of Colorado at Boulder are unique in the State of Colorado in many respects. The undergraduate program provides career options in all areas of chemistry but is particularly strong in the biomedical area with high enrollment from students interested in pre-medical sciences, biochemistry, and molecular biology. The University at Boulder sends more students to medical school than any other undergraduate institution in the state. Two to three years of chemistry education, including general chemistry, organic chemistry, and biochemistry, are a critical part of the undergraduate premedical curriculum. The department sends many of its undergraduate majors to the best graduate schools in the country, including its own, for advanced study in medicine, chemistry and biochemistry. The undergraduate chemistry program also supports a strong chemical engineering program whose students take at least three years of chemistry. Strong undergraduates with majors in chemistry, biochemistry, chemical engineering, and molecular biology are a valuable resource to the rapidly growing biotechnology industry along the Colorado Front Range.

The graduate instructional program in chemistry and biochemistry is one of the strongest in the nation. Its faculty have been recognized by a Nobel Prize in Chemistry and election of eight members to the National Academy of Sciences amongst many awards mentioned earlier in this program plan. The Department's graduates are recruited to important advanced positions in chemical and biotechnology industry, academia, and government laboratories.

The Department offers graduate degrees in all areas of chemistry and biochemistry but has special strength in nucleic acid biochemistry and environmental/physical chemistry. The strength in biochemistry has been an important contributing factor to the growing biotechnology industry in the region. The strong environmental/physical chemistry program interfaces with the vigorous Federal Government environmental and technology research labs and institutes in Boulder described earlier. Additional areas in which the Department is building strength at the graduate level through hiring new faculty are synthetic chemistry and material sciences, which are also very attractive to prospective graduate students and emerging technology industry.

Health, Life Safety, and Code Issues

The following health, life safety and code issues are key to the solutions proposed by the Program Plan. They will significantly enhance the Department’s ability to provide an optimal experience for both students and faculty as described below:

- Correct poor laboratory ventilation resulting from outdated and inadequate fume hoods by their complete replacement, as well as providing safe handling storage for chemicals – now unavailable;
- Provision for adequate electrical equipment and computer terminal outlets where currently unavailable or improperly configured;
- Extending sprinkler system coverage that progressively brings all of Ekeley into current Life Safety code compliance as approved by the Fire Marshal;
- Renovating outmoded assignable floor areas that do not comply with current accessibility requirements throughout the two basement levels of Middle Ekeley.

The program plan code review of Middle Ekeley Chemistry is based upon information known at the time of this document preparation, and has revealed several deficiencies. Ekeley was designed and constructed under the 1973 Uniform Building Code. Since that time the regulatory codes have evolved, and in most cases have become stricter in their enforcement of life/safety issues. As Ekeley stands today with its present occupancy use and occupant load it falls short of meeting the 1997 Uniform Building Code as described below.

Ventilation

Laboratories for organic chemistry require adequate supply air and exhaust capability to remove toxic and noxious fumes from the work area. The current condition of the laboratories in Middle Ekeley Sciences is unacceptable because air exchange and exhaust are so poor, causing students to become ill from the effects of these fumes. Modern instructional laboratories for sophomore organic chemistry are necessarily equipped with full fume hood space for each student as well as ventilated chemical waste storage areas for safe handling. Currently, rated, self-closing, corridor doors from classrooms are propped open due to poor ventilation, violating code requirements for fire separations.

Electrical

There are insufficient quantities of electrical outlets required to meet current teaching laboratory needs. Extension cords are used, which is a safety hazard. There are not data outlets available for student use at their desks.

Fire Sprinkler System

Basements are required to be fully protected with an automatic fire sprinkler system when over 1,500 SF and not fire department accessible from above grade openings in the exterior walls. Ekeley is not constructed with the required exterior wall openings, and therefore must be fully sprinkled when remodeled. Middle Ekeley presently has fire sprinklers in the existing corridors and stairs. It is assumed that all of Ekeley will be fully sprinklered upon completion of phased renovations. As a result, areas of refuge are not required at fire stairs.

Accessibility

Floor plan reconfigurations will not only enhance instruction, but will be made fully accessible according to the Americans with Disabilities Act (ADA). Elevator car controls and signals will be modified to bring the operating system into compliance with current ADA requirements.

Plumbing Fixture Analysis (Basement, Levels One & Two Only)

Total Occupied Space (including offices, instrument labs, and laboratory classrooms): 14,229 SF

1997 Uniform Building Code, Appendix, Chapter 29, Minimum Plumbing Fixtures, Table A29-A (Education Facilities, Colleges/Universities:

1 WC/40M
(50% required for urinals)
1 WC/30F
1 Lav/40 M&F

Total Fixtures Required (assuming 50% gender split – 7,115 SF/50 SF per occupant = 142 people per facility:

Males:	4 WC (2 urinals) (*met by program plan*) – 1 per ADA
Females:	5 WC (*met by program plan*) – 1 per ADA
M/F:	4 Lavatories (*met by program plan*) – 1 per ADA

Elevator

Door openings from elevator shafts shall be separated from the exit corridors by 20 minute rated fire doors. Existing elevators open directly onto the exit corridors at each floor level, requiring this upgrade. During design, the consultants will further investigate all code requirements for Middle Ekeley in coordination with the University jurisdictional authorities, according to the UC campus code review format.

Site Requirements

The Ekeley renovation is an interior project that is located in the two lowest levels of the existing building. The only site issues related to this project are general building access, which already exists on the north side of the facility, and civil sitework as a result of the proposed chilled water central plant connection to Ekeley is discussed in the architectural, structural and mechanical issues – Section IV, *Project Description*. Phasing issues related to the project site are discussed in Section IV, *Project Impact on Building Use and Operation.*

Laboratory Equipment Requirements

Programs within science departments, such as Chemistry and Biochemistry, are equipment intensive programs. These disciplines rely heavily on having the proper equipment to deliver their programs. Although space is important as well, many feel space is irrelevant without equipping the space so it operates as a complete laboratory "tool". In many cases, equipment becomes more important than the space in which the equipment sits.

The department has much of the equipment it needs for its instructional programs. Glassware and most other items will continue to be utilized after the renovation; however, some of the inventory will need to be replaced or does not exist today. Equipment needs associated with each lab is outlined below. Each lab supports approximately twenty students, regardless of the final physical layout or design of the space.

Glassware to outfit one Organic Chemistry laboratory	
($300 per drawer for 140 drawers/pod for 7 sections of 20 students each)	$42,000
Equipment per lab (MelTemps, stir motors, Variacs, balances, hot plates)	$22,000
Vacuum system for one lab ($6,500 x 2)	$13,000
Rotary evaporators for one lab ($2,200 x 3)	$6,600
Total for four basic pods	*$334,400*
Equipment for the instrument room:	
Infrared Spectrometers ($16,000x2)	$32,000
Gas Chromatographs ($3,000x10)	$30,000
High Pressure Liquid Chromatograph	$30,000
UV-Vis Spectrometer	$15,000
Computers and specialized software ($2,500 x 12)	$30,000
Total for instrument room equipment	*$137,000*
Equipment for the waste collection facility	$5,000
Advanced Laboratory glassware and specialized equipment	$60,000
(glassware, vacuum pumps, rotary evaporators, gas handling equipment, stirring apparatus, hot plates, variacs, heating mantles)	
Equipment and glassware to outfit one General Chemistry Laboratory	
(stocked drawers 9 sections of 20 students each plus shared balances, pH meters, colorimeters)	$56,000
Total for 2 General Chemistry Laboratories	*$112,000*
Equipment for one graduate instructional laboratories in environmental/physical chemistry	
(lasers, spectroscopy equipment, photon counting equipment, optical accessories detection equipment, mass spectrosocopy equipment)	$100,000
Total for 2 Graduate Instructional Laboratories	*$200,000*
Lab audiovisual equipment (Breakout Room at $5,000 plus 9 electronic whiteboards at $2,000 each)	$23,000
Total Cost to Equip New Teaching Labs and Instrument Room	**$871,400**

Acquisition of Real Property

All property pertaining to this project is already University (State of Colorado) property. There is no need for the acquisition of additional lands, buildings, or other properties for this project.

Existing Facilities

Ekeley Sciences Building houses the undergraduate and graduate teaching laboratories for general, organic, physical, analytical, and biochemistry, as well as a few graduate student laboratories in physical, inorganic, and analytical chemistry. Although not old in comparison to many CU-Boulder buildings, middle Ekeley was reconstructed in 1973. The labs have become outdated for the teaching of chemistry and have health and safety deficiencies.

The University of Colorado Facilities Department performs an audit on all its buildings on a three-year cycle. This audit is in conformance with State of Colorado guidelines adopted by the Real Estate and Building Division. The most recent audit of Ekeley is attached in the Appendix Section (Facilities Audit) of this Plan.

Besides extending the life of the facility by incorporating all new building components in the lowest two levels of the building, the renovation project will address many deficiencies identified in the facilities audit. These include making the toilets comply with ADA and Uniform Building Code requirements; upgrading fire and life safety to current code; allow for Department's goal of providing electronic access to each student for levels 1 and 2 lab classrooms; and specifying lighting, finishes and laboratory equipment to 21st Century standards.

A summary of the audit is included in the appendix.

Previous Improvements

The Department of Chemistry and Biochemistry is located in two adjacent buildings recently connected by construction of the Cooperative Institutes for Research in Environmental Sciences. Other recently completed and ongoing construction includes a new four story biochemistry wing, a completed addition for the chemical storerooms, construction of a new Magnetic Resonance Instrumentation Laboratory, renovation of most of the laboratory space in the Cristol Building, and major renovation of the electronics, machine, glassblowing, and instrument fabrication shops.

The Department has renovated the south part of the first floor in Ekeley, vacated by the School of Pharmacy, as recommended by the Program Review Panel. In addition, the Department has renovated the main office space and the second and third floor of the west wing of Cristol Chemistry for new biochemistry labs.

The East Wing of Ekeley Sciences has also been recently renovated to improve health and safety issues, providing up-to-date instructional classrooms and laboratory space such as the Central Analytical Laboratory and the Boulder Campus resource for mass Spectrometry that is used by approximately half of the research groups of the Department.

IV. Project Description

General Project Description/Scope of Work

Architectural Issues
The program plan renovation incorporates and expresses the mission to provide modern, first class academic facilities for its students and staff. Antiquated, double-loaded corridor layouts are reconfigured into lab "pods" for effective student/faculty interaction, which will enhance the educational experience.

Essentially, the renovation involves total rehabilitation of basement levels 1 and 2, exclusive of the elevator (except for ADA upgrades to the cab and controls) and stairs (which may only require handrail adaptations per review by the University Fire Marshall).

Demolition includes removal throughout of: vinyl asbestos floor tile; suspended acoustical ceilings – including light fixtures and HVAC diffusers; existing partitions, doors and frames; toilet partitions; all furnishings and equipment (recycled by the University as required).

New construction includes: vinyl composition tile or sheet vinyl and exposed stained concrete floor finishes throughout; sound attenuated gypsum wallboard at corridor and all other room partitions – except for the instrument rooms – which shall have storefront glass for instructional viewing; hollow metal rated doors and frames with vision panels (and sidelights where appropriate).

Because of low floor-to-floor heights, new acoustical or gypsum ceilings will be provided only at the breakout room, toilet and office areas. Elsewhere, existing structural slab and beams will remain exposed to view combined with integrated HVAC ducts, new sprinkler lines and suspended pendant fluorescent lighting fixtures. Acoustical baffles providing adequate noise control shall be specified, creating in concert with all other elements of construction, a "high tech" design appropriate for this facility.

As additional toilets, toilet partitions and lavatories are required for ADA and UBC compliance, existing finishes will be replaced with new ceramic tile floors and wainscots (full-height behind water closets), along with grab-bars and sink counter revisions. Graphic room signage and inclusion of display/interactive areas - which support ease of operational use - will be provided as strong design elements within budgetary guidelines for this project.

Because of new HVAC system exhaust requirements, possibly two new exterior fume hood exhaust stacks must be added to the facility above the basement levels. These are likely to be located along the northeast and northwest corners of Middle Ekeley. This fire-rated element will be clad in masonry matching the indigenous sandstone featured throughout the Boulder campus, integrated seamlessly with the existing façade. Besides providing the needed vertical stack for ventilation ducts, it will also enhance the north elevation of the facility. Ekeley is a major component of the Norlin Quadrangle Historic District, so the concept for these shafts is to replicate a chimney appearance seen in nearby buildings.

Sitework will include mobilization, demolition, and sidewalk restoration due to the need for an approximate 1,000 LF underground utility chilled water access trough from Middle Ekeley to the central plant.

Structural Issues
Structural areas of work for this project include provision of a new concrete foundation wall below the exterior exhaust stacks described above, as well as periodic steel reinforcement of the shafts to the existing structure. Depending on the particular mechanical solution chosen by the University, roof structural systems may need to be enhanced for additional equipment loads. Because the issue of availability of chilled water is not resolved by the submitted date of this report, monies must be provided in the budget for steel framing support of a new cooling tower (alternate option no. 2), as well as equipment/fans at the roof, regardless.

Structural support will be required for openings at new interior mechanical shafts cut into existing floor slabs from Basement Level 1 through the roof (4 floors).

Excavation within a portion of the existing mechanical room is required for additional headroom for vibration isolation needed at new equipment supports. A concrete areawell – 20' x 7' x 20' deep – along the north façade, matching two adjacent existing areaway/lightwells must be provided for new equipment air intake requirements (see below).

Mechanical Issues

Existing Building Mechanical Systems

The following major mechanical equipment serves the Middle Chemistry Wing of the Ekeley Chemistry Building:

Chilled Water:	The building system is connected to the Norlin/Ekeley Chilled Water Plant (approximate capacity is 400 tons).
Steam:	Served by the Central Boiler Plant, 6″ high-pressure steam, 2″ condensate return
Sanitary Sewer:	6-inch
Air Handling Units:	Research Areas 51,585 cfm Teaching Areas 61,020 cfm
Exhaust:	Five (5) fans at 25,000 cfm (each). Approximately 3,900 cfm in the Second Basement and 12,800 cfm in the First Basement.

The air handling units (AHUs) and exhaust systems are operating at or near their maximum capacity. The existing teaching laboratories on the First Basement Level and research laboratories at the Second Basement Level are not functioning to acceptable laboratory standards at this time. Occupants are exposed to hazardous fumes, as ventilation is inadequate in the laboratory areas.

Proposed Mechanical Systems – Central Plant

Heating

The building is presently served by a 6-inch high-pressure steam main from the central campus boiler plant. A 6-inch pipe at 100 psig and a velocity of 10,000 feet per minute is capable of supplying 30,000 pounds per hour. The added load to the heating system is approximately 5,000 pounds per hour. The existing steam main should be adequate for the proposed air handling unit system changes.

Proposed Mechanical Systems – Chilled Water Options

There are two (2) chilled water options. A specific chilled water solution should be determined during the design phase with the impact on the central plant, plant capacity and other factors considered at that time. Advantages and disadvantages, as well as limitations of each option are discussed below. Preliminary estimates are that the total building load is approximately 800 tons (after a complete building remodel at sometime in the future). The total load for the remodeled area is approximately 200 to 300 tons. According to the Refrigeration Shop Supervisor, the existing inactive, 211-ton Carrier chiller is not serviceable as one of the tube bundles leaks badly. It also uses CFC refrigerant in the chiller, which poses its own legal and environmental issues. Based on this information, the unit should be removed as part of this Project.

Option No. 1 (Preferred Option)

Connect the building to the central chilled water plant. Recent conversations with central plant personnel indicate that after ATLAS is added to the central plant, there would be some additional capacity available for the Ekeley building. They indicated approximately 400 tons of capacity will be available after Porter is removed from the plant. Their opinion is that adding 800 tons to the plant may be possible. However, the plant capacity will be very marginal at that time. This is the preferred chilled water option for space reasons and also gives the benefits of lower overall maintenance costs.

During the design phase, the chilled water pipe routing should be evaluated. The piping could either be direct buried or an existing tunnel should be considered as another option. The tunnel is quite full of piping, however.

Option No. 2 (Alternate)
A new 300-ton chiller is proposed for the building only if Option No. 1 cannot be implemented due to unforeseen circumstances. A new cooling tower, installed on the building roof would be required, and could be located where the existing tower is located.

The existing connection to the Norlin/Ekeley chiller system should remain, and would be used for off-peak cooling and process cooling loads during times the building chiller is not operating.

The chiller would be located in the Second Basement Mechanical Room. A new Chiller Room ventilation system and controls should be provided.

The major design issue associated with this Option are possible structural limitations of the roof for a new cooling tower and very limited roof space for new equipment. Depending on space constraints, the chiller could either be an electrical chiller or an absorption-type machine. Again, this option is less desirable than Option No. 1 for the reasons stated.

Air Handling Units (AHU) and Terminal Units
New, 100% outside air, AHU(s) would be installed in the Second Basement Mechanical Room and would serve the Second Basement and the First Basement Teaching Laboratories. Due to the large number of new fume hoods in the remodeled area, new air handling capacity is required.

Current projections are for one or two new AHUs, which will provide make-up air for approximately 62 eight-foot hoods and 20 four-foot hoods. The total air quantity is 75,000 to 80,000 cfm for the First Basement Level and about 9,000 cfm for the Laboratories in the Second Basement Level. Removing the Second and First Basement from the existing systems will provide additional capacity for the remaining floors served by the existing system. It is also possible, if necessary, to use some of the exhaust and supply capacity for the remodeled areas.

Air system terminal units will be variable air volume (VAV) boxes with reheat coils. Controls would be Direct Digital Controls (DDC) for the AHU and local pneumatic controls for the VAV units and coils.

Campus Plant Air System
The Campus central plant air system should be relocated. There are several options including moving it within the Mechanical Room, to the new mechanical space or if possible to the Campus Central Plant. A new AHU would be installed in the air systems present location.

Exhaust Systems
Two (2) new exhaust fans of approximately 40,000 to 45,000 cfm each would be connected to a common plenum, and serve the new fume hoods and laboratory exhaust needs. The proposed parallel operation provides a level of redundancy and back up in the event of a fan failure. The new fans would be located in the remaining area on the building roof.

The laboratory fume hoods would be manifolded together within each “Laboratory Unit” and combined in newly created shafts, rising to the roof of the building.

Controls
Controls that maintain the laboratories at a negative pressure with respect to the surrounding areas will be provided. The fume hoods could be a combination of variable flow and constant flow. The constant flow hoods would be used to maintain a minimum air change rate in the laboratory spaces.

Energy Recovery
Heat recovery coils will be installed in the exhaust system and the supply air-handling unit. Approximately 50% of the energy will be recovered with this run-around-heat recovery system.

Fire Protection
A new fire sprinkler system will be installed in all of the remodeled and affected adjoining areas of the building. The system will be designed so it can be expanded to eventually serve the entire remaining unsprinklered area of the building.

Plumbing and Laboratory Utilities
The following plumbing and laboratory utilities would be available to laboratories:

- Vacuum
- Laboratory Compressed Air
- Process Cooling Water (Second Basement only)
- Natural Gas
- Hot and Cold Domestic Water
- Distilled Water
- Acid Waste

In addition, emergency shower/eye wash stations should be installed in locations required by governing design standards. All of the above utilities except vacuum and process cooling are available in the building at present. A new vacuum pump is needed to serve the Organic Chemistry Laboratory.

Fire and Domestic Water Mains
The existing 4″ fire and 4″ domestic water mains enter the building in the Northeast corner of the Mechanical Room. They will require relocation, as this area is planned for a new area well and air intake serving the new air-handling unit.

Asbestos Abatement
The University of Colorado (CU) Facilities Project Manager and the CU Asbestos Abatement Manager surveyed the Project work areas, which resulted in establishing a budget for abating the asbestos in the Project areas. This cost is included in the Project budget.

Mechanical System Opinion of Probable Costs

New Exhaust System	$ 260,000
New Air Handling Unit(s) and Ductwork in Mechanical Space	490,000
New Supply and Exhaust Ductwork in the Laboratory Spaces	543,000
Laboratory Pressure Controls	100,000
Heating Piping/Pumps and Heat Exchangers	180,000
Heat Reclaim System for New AHUs	290,000
Vacuum, Air, Gas, Hot and Cold Water, Distilled Water, Acid Waste and Vent	392,000
Fire Protection	90,000
Chilled/Central Plant Option	600,000
Relocate Plant Compressed Air	120,000
Relocate Pumps, Piping, Domestic Service, and Fire Main Service Inside the Building	40,000
Relocate Domestic and Fire Service Outside Building	20,000
Total	**$3,125,000**

Electrical Issues

Existing Electrical Distribution System
The Ekeley Science Building electrical service entrance is a Square “D” double-ended 1600A-480V-3ϕ unit substation located in the sub-basement electrical room. The service is fed from the Campus high-voltage loop system. The unit substation has a 1000 KVA, 13.2KV-480Y/277V transformer on each end, 1600A main circuit breakers, and a 1600A Kirk keyed tiebreaker. The unit substation feeds a lighting/distribution panelboard on each floor as well as a 225 KVA, 480V-208Y/120V transformer and 600A horizontal bus duct that serves branch circuit panelboards on that floor. The unit substation also feeds a number of distribution panelboards and large motor loads throughout the building.

Proposed Electrical Systems

Loads

The unit substation at Ekeley currently has a metered peak demand of 538 KW on the East side transformer and 338 KW on the West side transformer. This is a total load of 876 KW (973 KVA). Adding 125% safety factor to the load, per NEC requirements, yields a total existing load of 1095 KW (1217 KVA/1465A) with the East side transformer at 673 KW (748 KVA) and the West side transformer at 423 KW (470 KVA). These numbers suggest that the existing service has adequate capacity for minimal additional load with the tiebreaker open, and near capacity with the tiebreaker closed.

The anticipated additional load for the renovation of Ekeley is approximately 300 KW of mechanical air handling equipment and pumps. The renovated laboratory areas will add an additional 30 KW of anticipated receptacle and miscellaneous equipment loads. The anticipated overall building load is 1095 KW + 330 KW = 1425 KW (1583 KVA/ 1905 A).

Power

The existing electrical service appears to be adequate to accommodate the proposed new building air handling and exhaust equipment. Based upon the projected mechanical load summary and the renovation areas anticipated load, the existing West side of the unit substation could be utilized. The existing load of 470 KVA plus the anticipated new load of 367 KVA for the mechanical load is still within capacity of the 1000 KVA service, but would leave the distribution system with minimal or no spare capacity. The cost of a new electrical service is beyond the scope of this project. New electrical service would add in costs approximately $500,000 to $600,000 to the project. This will need to be included in future phases of building renovation for Ekeley. The West side contains five (5) available spaces for additional power circuit breaker installation. However, the addition of the new load would put the West side of the substation near its capacity and exceed the capacity of the overall board when the tiebreaker is closed. The tiebreaker would not be able to be closed if the new load is added. It is understood this will limit the operation of the Facility until the future service is provided. An updated maximum metered load measurement would need to be conducted on the unit substation before the actual project design is started in order to verify the load at that time.

The new building loads would be fed from a new 480V, 600 A – 800 A distribution board. A new power circuit breaker would be provided in one of the existing spaces located in the West side of the existing unit substation to feed the new distribution board.

It is anticipated that at least one 208Y/120V two-section branch circuit panelboard will need to be added to the 1B and 2B levels to accommodate added plugmold and receptacles for computers, instrumentation and other laboratory equipment. The panels would be fed from the new distribution board with individual K-rated transformers provided to accommodate computer and small laboratory equipment loads. During design, locations would need to be determined for the new electrical equipment and coordinated with existing and new conditions.

The existing transformer and panelboards in the Third Floor Electrical Room will need to be relocated to accommodate a new mechanical shaft. It is anticipated to provide new electrical equipment at a new location and transfer the existing loads individually from the existing Electrical Room location. This would help minimize downtime of equipment served from the existing Electrical Room equipment.

A future generator (up to 900 KW) is anticipated to be provided for the building in the future. The new mechanical loads for this project will be fed from a new distribution board. This board could be connected through the generator system fairly easily when the generator system is installed. Boards feeding existing equipment or devices would need to be reconfigured when the generator system is installed to accommodate any additional code or Owner requested emergency loads. No costs for this work is included in this project.

The existing 480Y/277V lighting panelboards should be able to adequately handle new lighting loads as the lighting load should decrease with T-8 lamps and energy efficient electronic fluorescent ballasts.

Chiller Option No. 1 (Preferred Option)

This option obtains chilled water for the building from the chilled water plant. It appears the new pumps that would be required in Ekeley could be accommodated by the new distribution board that would be provided for the air handling unit and exhaust fans. The anticipated additional load for the pumps would be 75 – 80 KVA. The

additional load along with the mechanical air handling equipment would put the West side of the substation at capacity and exceed the capacity of the tiebreaker.

Chiller Option No. 2 (Alternate)
This option removes an old unused 211-ton chiller and provides a new 200- to 300-ton chiller in the Second Basement Mechanical Room and a new cooling tower on the roof. A new chiller is proposed for the building only if Option No. 1 cannot be implemented due to unforeseen circumstances. (The existing metered maximum electrical demand for the building does not include the existing 211-ton chiller or the associated pump loads. The chiller has not been in service the past few years, and therefore is not included in the building metered load.) Providing a new chiller and cooling tower would add approximately 195 KW (216 KVA) to the building service. It appears the chiller and the associated pumps could be connected to the unit substation, along with the air handling equipment, if existing branch feeders and power circuit breakers are reconfigured on the two (2) sides of the tiebreaker. A new power circuit breaker would be provided to accommodate the chiller/cooling tower loads. This would equalize the load on the two (2) sides of the substation, but would put both sides of the substation at capacity and exceed the tie breaker capacity. Again, it is understood this would limit the operation of the Facility until the future service is provided.

The addition of the mechanical loads and the upgrade of the laboratory areas for this project will use up most, if not all the remaining capacity of the electrical system. Future additions or upgrades will necessitate a service entrance replacement.

Lighting
The existing pendant-mounted lensed fluorescent luminaires on the 1B and 2B levels of Ekeley would be replaced with new direct/indirect pendant-mounted fluorescent luminaires. The new luminaires would be provided with the downlight component being the majority of the light output. A minimal amount of uplight would be provided to light up the ceiling areas. The new pendant mounted luminaires would be provided with T-8 lamps and electronic ballasts to meet the University Standards. The existing luminaires have T-12 lamps and may contain PCB ballasts.

The existing area exit signs are green LED battery type that appear to meet the University design requirements. Existing signs could be reused with additional units provided where necessary to meet new laboratory layouts and code requirements. The existing emergency egress lights are battery-powered and self-testing/self-diagnostic. Laboratories included in the scope of the project that exceed 200 square feet will be provided with exit signs at both egress doors, and with emergency egress lighting.

Fire Detection System
The existing fire alarm system is a Simplex 4120 addressable type. The system devices would be reworked and expanded to accommodate any new required duct detectors, flow and tamper switches, smoke detectors, horn/strobes, etc. for the new area layout and space functions. The annunciator panels would be required to be upgraded to reflect the floor plan changes and detection upgrades.

Telecommunications
Telecommunication raceways would be provided for access to individual station devices. Raceways would be routed to the main terminal room located in the sub-basement telecomm room. It appears the building system is adequate to accommodate the remodel of the lab areas. Possible addition of some electronics within the telecom room may be required to meet the needs of the new area depending on the level of technology the University is utilizing at the time of construction.

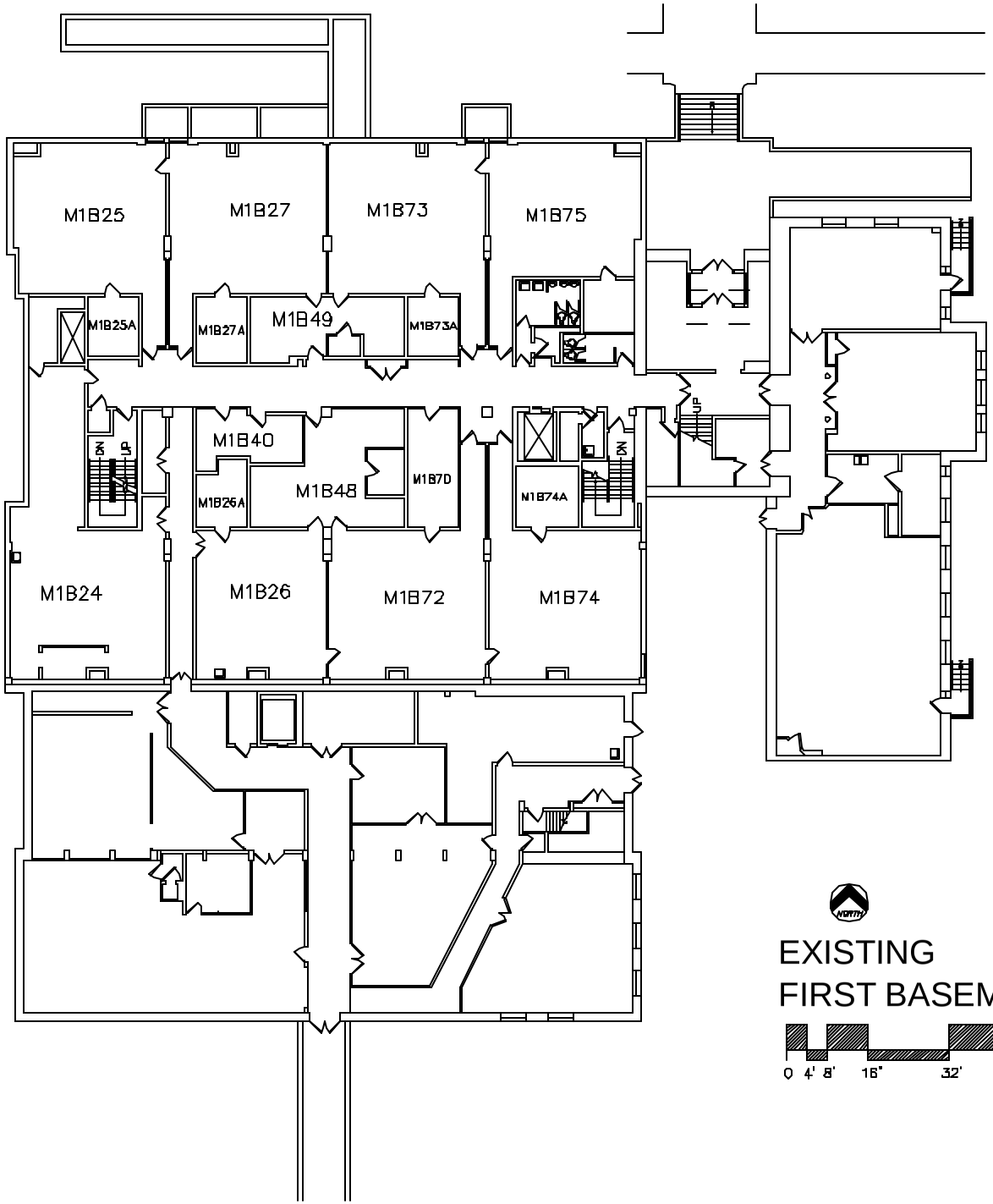
The existing main telecommunication service currently enters the building through the steam tunnel at the West end of the Mechanical Room (Second Basement). The cabling is routed through the corridor to the main Telecommunications Room located to the south of the Second Basement Mechanical Room. The conduit and cabling would need to be relocated to accommodate the renovation work. Cost for this work is included in the overall project costs. It is not indicated in the Electrical System Opinion of Probable Cost, but is provided for by Section C, Item 4, “Utilities,” in the project cost and financing summary sheet.

Electrical System Opinion of Probable Costs		
Existing Equipment Relocations (Lower Basement		$ 40,000
Relocate Equipment (Third Floor)		50,000
Secondary Distribution		115,000
Mechanical Equipment		75,000
Branch Distribution		175,000
Lighting		75,000
Fire Alarm		30,000
Telecommunications (Individual box/conduit rough-in only)		15,000
Chiller Electrical Service		140,000
	Total	**$ 715,000**

Diagrammatic Plans/Sketches

The following pages graphically depict the project location within Middle Ekeley, existing floor plans, and proposed schematic layout of basement levels 1 and 2.

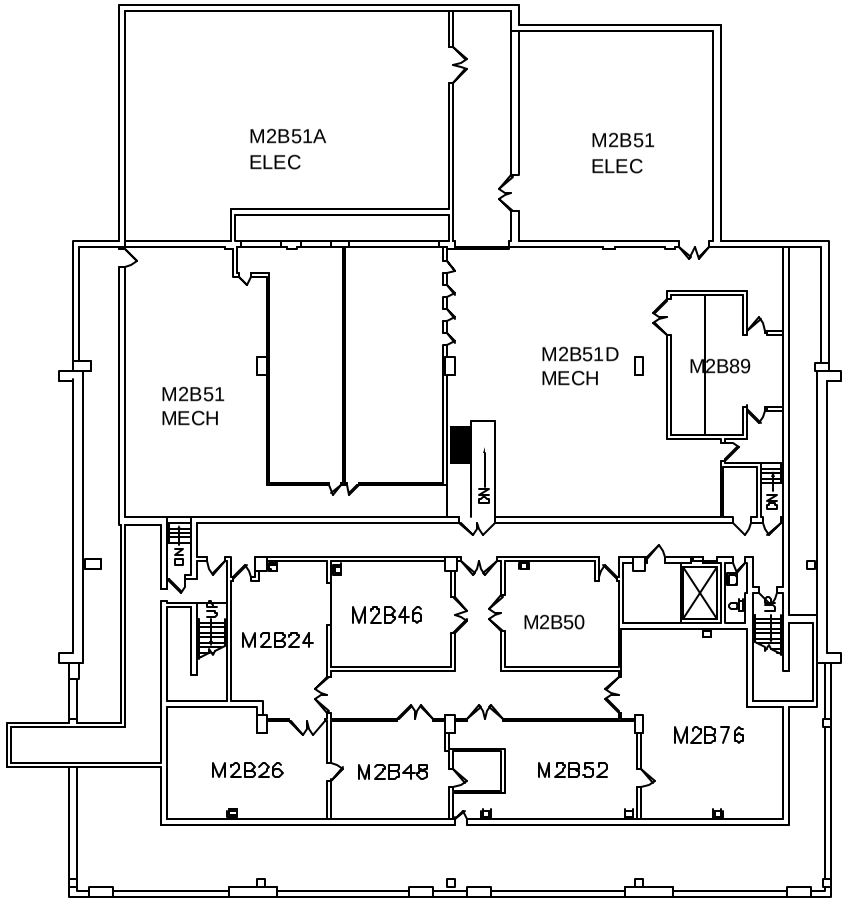
- Existing First Basement Level
- Existing Second Basement Level
- Proposed First Basement Level
- Proposed Second Basement Level



NORTH

EXISTING
FIRST BASEMENT LEVEL

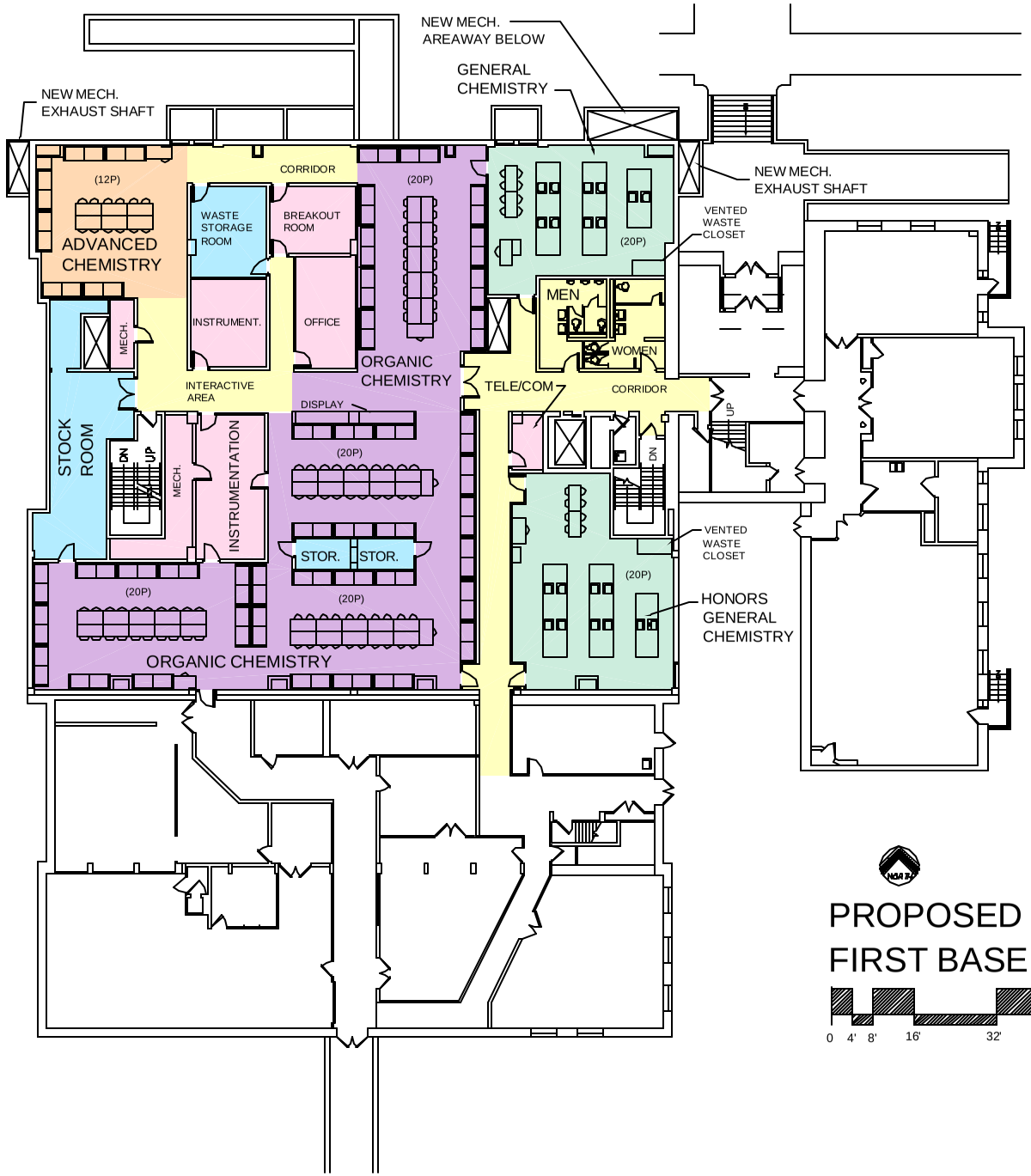
0 4' 8' 16' 32' 64'



NORTH

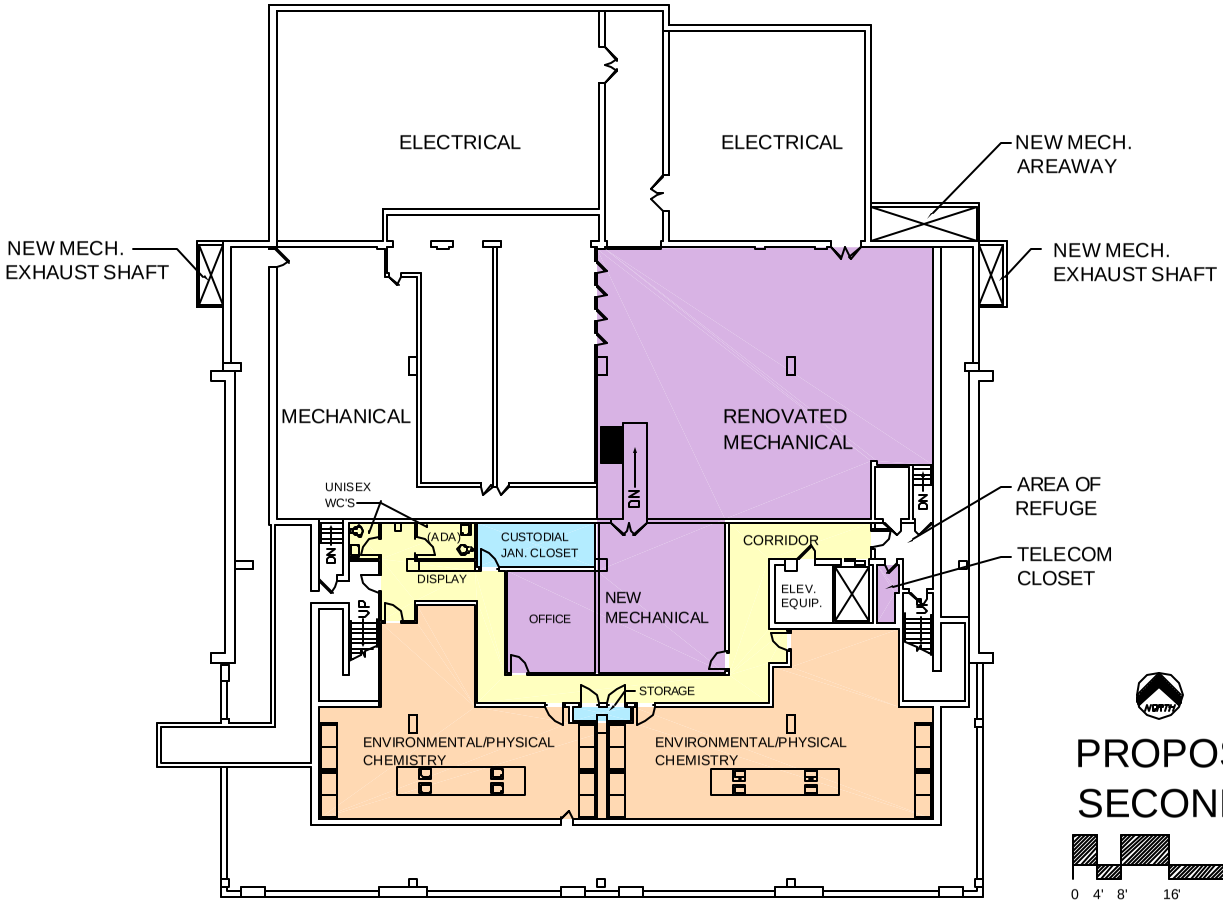
EXISTING
SECOND BASEMENT LEVEL

0 4' 8' 16' 32' 64'



PROPOSED
FIRST BASEMENT LEVEL

0 4' 8' 16' 32' 64'



PROPOSED
SECOND BASEMENT LEVEL

Floor Plan Space Summary

	Existing (GSF)	Proposed (GSF)
Basement Level One – Existing Teaching Laboratories		
Laboratory Floor Area	6,443	7,181
Interactive Areas	768	360
Instrument Laboratories	1,273	792
Stock Rooms	839	536
Miscellaneous Lab Space (Breakout Room)	111	162
Tech. Offices	205	240
Subtotal Laboratory	*9,639*	*9,271*
Corridors	1,335	1,156
Stairs/Elevator	439	439
Restrooms, Mechanical, Electrical, Janitor closets, etc.	519	1,066
Total Area Basement Level One	**11,932**	**11,932**
Basement Level Two – Graduate Instructional Laboratories		
Laboratory Floor Area	3,356	2,592
Tech Office	---	280
Subtotal Laboratory	*3,356*	*2,872*
Corridors	1,300	823
Stairs/Elevator	497	497
Restrooms, Mechanical, Custodial	4,575	5,536
Total Area Basement Level Two	**9,728**	**9,728**
Grand Total of Area Both Floors	**21,660**	**21,660**
Area of Remodel as Laboratories	**12,995**	**12,143**

Life-Cycle Cost Analyses

Life cycle costs were not a determining factor as to how the project solution was developed. The proposed space was determined to be functionally obsolete and in dire need of renovation. The decision was not determined on its economic pay back. Facilities conditions, health and life safety issues, and having adequate space to support the programs were the determining factors. The renovation is one of many steps that have been incorporated to maintain the existing facility.

Although life cycle costs did not determine the solution, it is important to understand long range costs associated with a project of this size. Based upon current operating costs and changes to the building systems due to the renovation, the following are estimated changes in the operating costs for the two floors of Ekeley.

Type of Costs	Current Costs	New Costs	Additional
Maintenance	$ 34,439	$ 37,905	$ 3,466
Custodial	$ 28,241	$ 28,241	$ 0
Utilities	$396,304	$616,027	$219,723
Police	$ 3,682	$ 3,682	$ 0
Env. Health/Ins	$ 8,664	$ 8,664	$ 0
TOTAL	$471,330	$694,519	$223,189

Operating costs, combined with repair and replacement costs drive life cycle costs for a building. These costs associated with the value of today's dollar is what gives the total life cycle costs of any investment. The life cycle costs indicate operating, maintenance, and replacement costs that are likely to occur once this project is complete are located in Appendix Section, Facilities Life Cycle Owning and Operating Cost Analyses.

Project Impact on Existing Building Use and Operations

The construction phase of renovation will be highly disruptive to the normal operation of Ekeley Sciences and adjacent buildings. A construction staging area in Norlin quad, with access from Pleasant Street, will be required for access by large construction vehicles. Both will impact the normal course of business on the affected parts of campus. A large portion of the project is the replacement of mechanical systems. The disconnection of existing mechanical systems in the space to be renovated, and the installation of new ones, will affect all areas of the building and require periodic interruptions in service to virtually all building utilities including ventilation, electrical, domestic water, chilled water and others. Even with careful scheduling, these activities may result in periods when it is not possible to use the building in a normal manner. It is likely that unplanned outages will occur. The extension of chilled water lines from the central plant to Ekeley Sciences will require a large excavation of the walkway south of Norlin Library to Colorado Street. It may be necessary to move a portion of the campus compressed air system that is located in the Ekeley mechanical room. This work could result in limitations on the campus supply of compressed air.

Undergraduate space will be increase by approximately 2500 ASF, but the net loss of graduate laboratory space will total nearly 3000 ASF. Graduate laboratories on the first basement levels will revert to undergraduate instructional space, as will part of the current hallway. A graduate laboratory, room M2B89 in the sub-basement, will revert to mechanical space and an additional mechanical area will be constructed from some of the other assignable space on that level. The requirement for additional ventilation shafts may necessitate the loss of some assignable space on upper floors within the building. As stated in the architectural issues, project description section, external shafts will also be required. The final design will dictate the final number and location of these shafts.

Construction Phase Accommodations

The present Program Plan is for renovation of space for existing programs that cannot be accommodated easily during the construction phase of the project. The specialized laboratories that are necessary for even short-term use are simply not available other than in space occupied by the Department and currently assigned to other programs. However, the undergraduate and graduate instructional programs that are conducted in the portions of Ekeley Sciences that are to be renovated and in the rest of Cristol-CIRES-Ekeley complex must continue in operation

throughout construction. Careful consideration by the Department of the requirements necessary to maintain an acceptable level of instruction and other building functions has led to the plan presented below. It is important to note that the Department fully understands that the magnitude of this renovation will be highly disruptive to its operation and will be inconvenient to students, faculty, staff and visitors who require access to Ekeley Sciences and surrounding buildings. Careful planning, sequencing, and scheduling of construction activities by architects, engineers, contractors, and University and Department personnel will be necessary to minimize these problems.

The sophomore organic laboratory courses are the most difficult to accommodate in temporary space because each of between 520 and 560 students per semester requires one three-hour laboratory period per week. Although some adjustment to the type and number of experiments might allow for a small reduction in the amount of laboratory time that is required, major reductions are not possible without an unacceptable impact on the content and quality of these courses. With modification to experimental procedures and apparatus, most of the required experiments can be adapted, on a temporary basis, for use in the general chemistry laboratories on the first and second floors of Ekeley Sciences. These laboratories are fully scheduled during the week for use by students in general chemistry courses, but sufficient space and time for use by organic students is available on Tuesday and Friday evenings and Saturday mornings. Other weeknights are not available because the examination schedules for students in science classes pre-empt use of those times for regular courses. Saturday afternoon sessions may be required. Although these times will be inconvenient for some students, faculty and staff, there are no other times possible. No addition to staff should be necessary to implement this schedule. It should be noted that some general chemistry laboratories are currently and successfully scheduled for Tuesday evenings. Given that the construction phase of this project is estimated at 18 months, this temporary use of space would last for three semesters.

The graduate laboratories currently used by the students of three faculty members will need to be vacated in order to complete the renovation. Since it is uncertain when construction will begin, it is not possible to identify specific rooms that will be used for relocation; however, once the program plan is approved, the Department will maintain a continuously updated plan for relocation of the affected programs. This approach allows for adjustments to the plan based on requirements for individual programs with respect to new programs, the conclusion of completed programs and the plan for renovation. The Department is committed to the accommodation of programs within space already assigned to it, though, in this case, it may be necessary to use space on the East Campus to minimize disruption to ongoing programs. It is possible that implementation of this process could result in delays in the expansion of existing or the creation of new programs.

Financial Analysis

The financial plan to fund the project involves a partnership between the University and the State of Colorado. The University proposes providing cash funds acquired through an aggressive development effort, to supplement state funds via the Capital Construction Budget Request process. The University contribution will be $1,215,389 of the $12,220,000. The remaining $11,004,611 will be requested in University's Capital Construction Budget Request to the State of Colorado. The first request for design funds will be made in FY 2002-2003 for $2,184,011. The $10,035,989 balance will be requested in FY 2003-2004. A detailed breakout is located in the Preliminary Capital Construction Budget Request, Appendix Section 7.04.

Project Cost and Financing - See following page.

Project Cost and Financing

	Cost per GSF	Total Project Cost	Prior Appropriation	Future Request FY 2002-2003	Future Request FY 2003-2004	Future Request FY 2004-2005	Other Future Requests
A. Land Acquisition		**$0**					**$0**
B. Professional Services							
1. Master or Program Planning		$0					$0
2. Architect / Engineer (bldg.)		$1,135,625		$1,135,625			$0
3. Architect / Engineer (other)		$125,200		$125,200			$0
4. Construction Management		$502,711		$502,711			$0
5. Code Review		$0		$0			$0
6. Site Information and Tests		$110,475		$110,475			$0
7. Other (_____)		$310,000		$310,000			$0
8. Total Professional Services		**$2,184,011**	**$0**	**$2,184,011**	**$0**	**$0**	**$0**
C. Construction							
1. Building							
a. New (_____GSF)		$0			$0		$0
b. Renovate (21,660 GSF)	$268.86	$5,823,583			$5,823,583		$0
c. Demolition		$200,000			$200,000		$0
d. Other		$623,913			$623,913		$0
2. Site Work		$250,000			$250,000		$0
3. Landscaping		$6,000			$6,000		$0
4. Utilities		$392,000			$392,000		$0
5. Other (_____)		$50,000			$50,000		$0
6. Total Construction Cost		**$7,345,495**	**$0**	**$0**	**$7,345,495**	**$0**	**$0**
D. Equipment and Furnishings							
1. Equipment		$934,400			$934,400		$0
2. Furnishings		$203,000			$203,000		$0
3. Communications		$135,000			$135,000		$0
4. Other (_____)		$0			$0		$0
5. Total Equipment Cost		**$1,272,400**	**$0**	**$0**	**$1,272,400**	**$0**	**$0**
E. Miscellaneous							
1. Art in Public Places		$66,109			$66,109		$0
2. Relocation Costs		$271,794			$271,794		$0
3. Project Contingency		$1,080,191			$1,080,191		$0
5. Total Miscellaneous Costs		**$1,418,094**	**$0**	**$0**	**$1,418,094**	**$0**	**$0**
F. Total Cost		**$12,220,000**	**$0**	**$2,184,011**	**$10,035,989**	**$0**	**$0**
Source of Funds:							
Capitial Construction Funds							
Capital Construction Funds -- Exempt		$11,004,611	$0	$1,966,791	$9,037,820	$0	$0
Cash Funds							
Cash Funds -- Exempt		$1,215,389	$0	$217,220	$998,170	$0	$0
Federal							

Project Schedule (Tentative)

September 2000	Feasibility Study Review by BCPC
October 2000	Feasibility Study Review by CECS
February 2001	Initiate Program Plan
March 14-28, 2001	Campus Reviews
March 28 – April 2, 2001	Incorporate Campus Review Comments
April 5, 2001	Print and Distribute Program Plan
April 12, 2001	BCPC Program Plan Approval
April 25, 2001	Chancellor's Executive Committee
May 10, 2001	Regents Capital Planning Committee
June 21, 2001	Board of Regents Program Plan Approval
June 2001	FY 2002-03 Capital Construction Request
August 2001	CCHE Program Plan Approval
May 2002	Funding by the State Legislature
July 2002	Architect Selection
August 2002 – October 2003	Design
November 2003	Project Bid
January 2004	Construction Start
June 2005	Construction Completion
July 2005	Occupancy

V. Relation to the Master Plan/Other Projects

The *Campus Master Plan* states: "Older science buildings are often deficient on suitable space. Chemistry facilities are an example. Many science buildings built across the country in the early 1970s need significant renovation". This project falls within the "Miscellaneous Academic Renovations" category of Exhibit IV-A-4, "Proposed Capital Projects". The *Campus Master Plan* supports the underlying principle to "locate uses in functional relationship with adjoining uses" and to remodel existing facilities whenever possible. An upgraded, expanded facility for Chemistry and Biochemistry will further the vision, mission, and strategic plan of the University of Colorado in multiple ways. It will enhance student learning by providing state-of-the-art instructional labs, emphasizing hands-on, experiential learning. Chemistry/Biochemistry is an important key to many of the other sciences on campus.

VI. Facilities Alternatives

Several alternative means to accomplish the program have been considered and evaluated with respect to their effectiveness, timeliness, and practicality. These evaluations have been made within the context of the overall undergraduate and graduate teaching program of the Department of Chemistry and Biochemistry and the Boulder Campus Master Plan. None of the following options adequately address the immediate need to provide a safe, modern laboratory for undergraduate studies in organic chemistry.

- *Full repair and refurbishment of existing mechanical systems in the organic laboratories in the first basement level and a full remodel of the sub-basement laboratories:* Repair of the existing mechanical systems in the organic chemistry laboratories will not yield adequate airflow to mitigate the severe health and safety deficiencies in this space, nor would such space accommodate the modern teaching program envisioned for fully remodeled space. The laboratories in the sub-basement are substandard for any purpose and require a full remodel for any chemistry program that would be considered therein.

- *Construction of a new building to accommodate the full scope of undergraduate chemistry instruction:* This would allow subsequent remodeling of Ekeley Sciences for graduate teaching and research laboratories. Given the pressing, severe health and safety deficiencies in the Ekeley organic chemistry laboratories, the development and implementation of such a plan would require more time to develop than is prudent. In addition, the Ekeley Building is somewhat land-locked. There are additional difficulties due to limited availability of sites adjacent to the building.

- *Construction of one large complex to accommodate the full teaching and research program of the department*: The future requirement for an entirely new complex is unquestioned, with the timing of such a project in the next 10 to 50 years being the only issue. Though beyond the scope of the present program plan, a complete life cycle analysis of the space assigned to the Department of Chemistry and Biochemistry and planning for future space requirements should be included in the next Boulder Campus Master Plan. It is anticipated that existing department facilities could be modified more readily and cost effectively for use by other departments than for continued use by the Department.

- *Comprehensive renovation of Middle Ekeley:* All floors of middle Ekeley need renovation and to do so would cost up to $30 million. There is a certain logic in doing the entire building at once, but nowhere can so many lab uses be moved at one time which necessitated work to be done in phases. This program plan must be the first phase of the eventual renovation for all of middle Ekeley.

VII. Appendix

7.01 Room Utilization

7.02 Life-Cycle Owning and Operating Cost Analyses

7.03 Enrollment Information

7.04 Preliminary Capital Construction Budget Request

7.05 Facilities Audit

7.06 Program Plan Regulatory Code Analysis

7.07 Independent Third-Party Review

Appendix Section 7.01

Room Utilization

EKELEY SCIENCE BUILDING
LABORATORY ROOM UTILIZATION

Room	Time	Mon	Tue	Wed	Thurs	Fri
25	8-9	prep	prep		prep	
	9-10		X	open	X	open
	10-11		X	open	X	open
	11-12		X		X	open
	12-1	prep		prep	prep	
	1-2	X	X		X	prep
	2-3	X	X	X	X	prep
	3-4	X	X	X	X	
	4-5			X		

Room	Time	Mon	Tue	Wed	Thurs	Fri
27	8-9		prep		prep	
	9-10	open	X	open	X	open
	10-11	open	X	open	X	open
	11-12	open	X		X	open
	12-1		prep	prep	prep	
	1-2	prep	X	X	X	prep
	2-3	X	X	X	X	prep
	3-4	X	X	X	X	
	4-5	X				

Room	Time	Mon	Tue	Wed	Thurs	Fri
72	8-9		prep		prep	
	9-10	open	X	open	X	open
	10-11	open	X	open	X	open
	11-12		X		X	open
	12-1	prep		prep		
	1-2	X	prep	X	prep	prep
	2-3	X	X	X		prep
	3-4	X	X	X		
	4-5		X			

EKELEY SCIENCE BUILDING
LABORATORY ROOM UTILIZATION

Room	Time	Mon	Tue	Wed	Thurs	Fri
73	8-9		prep		prep	
	9-10	open	X	open	X	open
	10-11	open	X	open	X	open
	11-12		X		X	
	12-1	prep	prep		prep	prep
	1-2	X	X	X	X	X
	2-3	X	X	X	X	X
	3-4	X	X	X	X	X
	4-5					

Room	Time	Mon	Tue	Wed	Thurs	Fri
74	8-9	prep	prep	prep	prep	prep
(gen chem)	9-10		X		X	
	10-11		X		X	
	11-12		X		X	
	12-1		prep		prep	
	1-2	X	X	X	X	X
	2-3	X	X	X	X	X
	3-4	X	X	X	X	X
	4-5					

Room	Time	Mon	Tue	Wed	Thurs	Fri
75	8-9	open	prep		prep	open
(gen chem)	9-10	open	X		X	open
	10-11	open	X		X	open
	11-12	open	X		X	open
	12-1	open		prep		open
	1-2	open	prep	X	open	open
	2-3	open	X	X	open	open
	3-4		X	X	open	
	4-5		X			

Appendix Section 7.02

Life-Cycle Owning and Operating Cost Analysis

LIFE CYCLE COST ANALYSIS
MAJOR REPAIR AND REPLACEMENT COSTS

Project:	**Ekeley Building Renovation**
Date:	**28 March, 2001**
Inflation Factor:	**5%**
Construction Cost:	**$5,823,583**
Study Period:	**30 years**

Facility Subsystem	Likely Life	Range	Useful Life Chosen	% of Pjct. Costs	Current Replace. Cost	Provision for Renewal w/o Inflation	FV factor 5%, useful life	Total Replace. Cost with Inflation:	Total Annual Provision for FV Renewal
Foundations/structure	n/a	n/a		0%	0				
Roofing	25	15-40	20	3%	174,707	8,735	2.653	463,499	$23,175
Exterior Cladding	n/a	50 up	30	2%	116,472	3,882	4.322	503,391	$16,780
Interior Partitions	50	25 up	30	9%	524,122	17,471	4.322	2,265,257	$75,509
Interior Finishings	10	5-15	15	20%	1,164,717	77,648	2.079	2,421,446	$161,430
Elevators	40	25 up	30	2%	116,472	3,882	4.322	503,391	$16,780
Plumbing	30	20-80	40	6%	349,415	8,735	7.040	2,459,881	$61,497
HVAC - moving	15	15-25	15	37%	2,154,726	143,648	2.079	4,479,675	$298,645
HVAC - static	50	30-75	50	5%	291,179	5,824	11.467	3,338,951	$66,779
Electrical - moving	35	20-50	25	10%	582,358	23,294	3.386	1,971,865	$78,875
Electrical - static	50	30-75	40	2%	116,472	2,912	7.040	819,960	$20,499
Fire Protection	50	20-100	40	2%	116,472	2,912	7.040	819,960	$20,499
Special Equip/Misc	30	10-50	20	2%	116,472	5,824	2.653	308,999	$15,450
TOTALS				100%	$5,823,583	$304,768		$20,356,276	$855,916

Note: Foundation and Structural Costs ususally dictate when a building has met its useful life and should be razed. These figures can be ignored when considering a major repair and replacement costs for a facility, unless special circumstances dictate otherwise.

LIFE CYCLE COST ANALYSIS

Project:	**Ekeley Building Renovation**	
Study Period:	**30 years**	
Discount Rate:	**6%**	
Date:	**28 March, 2001**	
Study Method:	**Present Value of One Dollar**	
Building Value:	**$5,823,583**	
Addtitonal Optg & Maint Costs:	**$219,723**	first year
Additonal Energy/Utilities:	**$9,098**	first year
Inflation Factor:	**5%**	

Year	Princ & Int and/or Investment	Major Repair & Replacement	Operating & Maintenance	Energy/ Utilities	Salvage Value	Total	Discount Rate	Present Value
1	$5,823,583		$219,723	$9,098		$6,052,404	0.9434	$5,709,838
2			$230,709	$9,553		$240,262	0.8900	$213,833
3			$242,245	$10,031		$252,275	0.8396	$211,810
4			$254,357	$10,532		$264,889	0.7921	$209,819
5			$267,075	$11,059		$278,133	0.7473	$207,849
6			$280,428	$11,612		$292,040	0.7050	$205,888
7			$294,450	$12,192		$306,642	0.6651	$203,948
8			$309,172	$12,802		$321,974	0.6274	$202,007
9			$324,631	$13,442		$338,073	0.5919	$200,105
10			$340,862	$14,114		$354,976	0.5584	$198,219
11			$357,906	$14,820		$372,725	0.5268	$196,352
12			$375,801	$15,561		$391,362	0.4970	$194,507
13			$394,591	$16,339		$410,930	0.4688	$192,644
14			$414,320	$17,156		$431,476	0.4423	$190,842
15		$3,319,442	$435,037	$18,013		$3,772,492	0.4173	$1,574,261
16			$456,788	$18,914		$475,702	0.3936	$187,236
17			$479,628	$19,860		$499,488	0.3714	$185,510
18			$503,609	$20,853		$524,462	0.3503	$183,719
19			$528,790	$21,895		$550,685	0.3305	$182,001
20		$291,179	$555,229	$22,990		$869,398	0.3118	$271,078
21			$582,991	$24,140		$607,130	0.2942	$178,618
22			$612,140	$25,347		$637,487	0.2775	$176,903
23			$642,747	$26,614		$669,361	0.2618	$175,239
24			$674,884	$27,945		$702,829	0.2470	$173,599
25		$582,358	$708,629	$29,342		$1,320,329	0.2330	$307,637
26			$744,060	$30,809		$774,869	0.2198	$170,316
27			$781,263	$32,350		$813,613	0.2074	$168,743
28			$820,326	$33,967		$854,293	0.1956	$167,100
29			$861,343	$35,665		$897,008	0.1846	$165,588
30		$757,066	$904,410	$37,449	($18,926,645)	($17,227,721)	0.1741	($2,999,346)

Total Present Value for Owning and Operating Costs over the Study Period: **$9,605,861**

OPERATION COST ANALYSES **Ekeley Sciences**

University of Colorado

Operational Costs (in $ per gross square foot)

				Space Costs	Current Costs	New Costs (FY 2005)	Difference	
Utilities (annual)								
1	Analysis by University				**$396,304**	**$616,027**	**$219,723**	New central CHW
2								
Police								
1	0.17 x	21,660	GSF (1)	$3,682	**$3,682**	**$3,682**	**$0**	No Change
2	0.17 x	0	GSF (2)	$0				
Maintenance								
1	2.01 x	21,660	GSF (1)	$43,537	**$34,439**	**$43,537**	**$9,098**	$1.59 psf current vs $1.75 psf new escalated to FY 2005 dollars
2	0.90 x	0	GSF (2)	$0				
Custodial								
1	1.35 x	21,660	GSF (1)	$29,241	**$28,241**	**$28,241**	**$0**	No Change
2	0.09 x	0	GSF (2)	$0				
Environmental Health & Insurance								
1	0.40 x	21,660	GSF (1)	$8,664	**$8,664**	**$8,664**	**$0**	No Change
2	0.2 x	0	GSF (2)	$0				
			TOTAL	$85,124	**$471,330**	**$0 $700,151**	**$228,821**	

(1) Space categorized as instructional lab space
(2) Space categorized as dry space or office type space

* It is anticipated that the only operational costs implications associated with the renovated space are those related to the increase in utility and maintenance costs. Utility costs rise due to the additional air system required for the lower levels. Additional air will become available for the upper levels since the new system eliminates the need for the existing building system to support these two floors. The assumption is the building system will continue to operate as today, just distributing air in different locations. Thus the new system is considered additional operating costs. Maintenance costs will rise only slightly due to additional laboratory equipment.

f

Appendix Section 7.03

Enrollment Information

Table C2-a Enrollment Trends (Relating to Campus and to Programs to be accommodated by Project)

Enrollment Category	Actual FY 1995/96	Actual FY 1996/97	Actual FY 1997/98	Actual FY 1998/99	**Actual FY 1999/00**	*Projected 2006/07*
Campus Full-time Equivalent Students						
a. Enrollment (FTE)	21,527	21,683	22,196	22,445	**22,881**	*24,345*
b. Enrollment (Headcount)*	24,440	24,622	25,157	25,135	**26,349**	*27,500*
c. Resident (FTE)	14,632	14,934	15,239	15,242	**15,666**	*16,555*
d. Non-Resident (FTE)	6,895	6,749	6,957	7,203	**7,215**	*7,375*
Department: Chemistry and Biochemistry - Division of Chemistry						
a. Undergraduate FTE in Degree Program	445	435	439	430	**431**	*440*
b. Undergraduate Headcount Instructed	3,106	2,993	3,090	3,060	**3,050**	*3,300*
c. Graduate FTE in Degree Program	180	180	180	180	**180**	*190*
d. Graduate Headcount Instructed	288	296	309	297	**295**	*325*

* Fall Term Data

Appendix Section 7.04

Preliminary Capital Construction Budget Request

April 4, 2001

CC-C: CAPITAL CONSTRUCTION BUILDING PROJECT REQUEST FY__ - __

PROJECT COSTS COVER SHEET

Project Title:	Ekeley Science Renovation	Purpose Code:	Name of Preparer:
Institution:	Univ. of Colorado/Boulder	Strategic Plan Objective(s):	Mike Ossian
Program:	Chemistry & Biochemistry	Dept. Approval by:	Date:__/__/___
Priority Number: ___ of___		CCHE Approval:	Date:__/__/___

		Total Project Costs	Prior- Year Appropriation	Current Request	Year 2 Request	Year 3 Request	Year 4 Request	Year 5 Request
A.	***Land Acquisition***							
(1)	Land Purchase Cost							
B.	***Professional Services***							
(1)	Arc/Engrs. (Bldg.)	1,135,625		1,135,625				
(2)	Arc/Engrs. (Other)	125,200		125,200				
(3)	Construction Mgmt.	502,711		502,711				
(4)	Code Review	0		0				
(4)	Site Info and Tests	110,475		110,475				
(6)	Other (_____)	310,000		310,000				
(7)	*Total Professional Services*	$2,184,011		2,184,011				
C.	***Construction***							
(1)	*Building (Note: fill in total cost lines only)*	$6,697,496			$6,697,496			
	(a) New (_____GSF)							
	(b) Renovate (21,660 GSF)	6,697,496			$6,697,496			
(1a)	**Foundation Total**	$66,975			$66,975			
1	standard foundations							
2	special foundations							
3	slab on grade							
4	basement excavation							
5	basement walls							
(1b)	**Superstructure Total**	$401,850			$401,850			
1	floor construction							
2	roof construction							
(1c)	**Exterior Closure Total**	$0						
1	exterior walls							
2	exterior windows							
3	exterior doors							
(1d)	**Roofing Total**	334,875			$334,875			
1	roof coverings							
2	roof openings							
(1e)	**Interior Construction Total**	$803,700			$803,700			
1	interior partitions							
2	interior doors							
3	interior specialties							
(1f)	**Interior Circulation Total**	$0						
1	stair construction							
2	stair finishes							
(1g)	**Interior Finishes Total**	$669,750			$669,750			
1	wall finishes							
2	floor finishes							
3	ceiling finishes							
(1h)	**Conveying Systems Total**	$53,580			$53,580			
1	elevator and lifts							
2	escalators/other							
3	other conveying systems							

CC-C: CAPITAL CONSTRUCTION BUILDING PROJECT REQUEST FY__ - __

PROJECT COSTS COVER SHEET

Project Title:	Ekeley Science Renovation	Purpose Code:		Name of Preparer:
Institution:	Univ. of Colorado/Boulder	Strategic Plan Objective(s):		Mike Ossian
Program:	Chemistry & Biochemistry	Dept. Approval by:		Date:__/__/___
Priority Number: ___ of___		CCHE Approval:		Date:__/__/___

		Total Project Costs	Prior- Year Appropriation	Current Request	Year 2 Request	Year 3 Request	Year 4 Request	Year 5 Request
(1i)	**Mechanical Systems Total**	$3,125,000			$3,125,000			
1	plumbing							
2	HVAC							
3	fire protection							
(1j)	**Electrical Systems Total**	$715,000			$715,000			
1	service and distribution							
2	lighting and branch wiring							
3	communications and security							
4	other electrical systems							
(1k)	**Selective Demolition Total**	$506,766			$506,766			
1	building demolition							
2	hazardous abatement							
(2)	Site Work	250,000			$250,000			
(3)	Landscaping	6,000			$6,000			
(4)	Utilities	392,000			$392,000			
(5)	*Total Construction Costs*	7,325,495			7,325,495			
D.	***Equip. and Furnishings***	$1,272,400			1,272,400			
(1)	Equipment	934,400			934,400			
(2)	Furnishings	203,000			203,000			
(3)	Communications	135,000			135,000			
(4)	Equip./ Laboratory Hoods	0			0			
E.	***Miscellaneous***	$1,418,094			1,418,094			
(1)	Art in Public Places = 1% of C(5) Total Construction Costs	66,109			66,109			
(2)	Relocation Costs	271,794			271,794			
(3)	Project Contingency Costs							
(3a)	5% for New							
(3b)	10% for Renovation	1,080,191			1,080,191			
(4)	*Costs*							
F.	**Total Project Costs [A(1)+B(7)+C(5)+D(4)+E(4)]**	**$12,200,000**		**$2,184,011**	**$10,015,989**			
G.	***Source of Funds***							
	CCFE	$10,777,889		$1,965,610	$9,014,390			
	CF							
	CFE			$218,401	$1,001,599			
	FF							

Appendix Section 7.05

Facilities Audit

FACILITY INSPECTION DATA				COMPONENT DESCRIPTION			COMPONENT EVALUATION		ACTION REQUIRED		
BLDG #	NAME	LOCATION	SHOP	#	COMPONENT NAME	COMPONENT DESCRIPTION	#	DEFICIENCY NAME		P	COST
226	Ekeley Chemistry	E166	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Air handling units		Replace AHU	DM	1	20000
226	Ekeley Chemistry	E266A	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Air handling units		Replace AHU	DM	1	20000
226	Ekeley Chemistry	S1B53	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Air handling units		Replace evaporative cooling media	DM	2	4000
226	Ekeley Chemistry	2Roof	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Air handling units		Replace evaporative cooling media	DM	5	5000
226	Ekeley Chemistry	E1B30A	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Air handling units		Replace evaporative cooling system	DM	8	0
226	Ekeley Chemistry	ceilings	EH&S	B.15	Safety Standards	Asbestos		Redo spayed on ceilings	RC	5	175000
226	Ekeley Chemistry		424	B.10	Plumbing Systems	Condensate cooler		Replace/repair condensate cooler (coil only)	DM	4	3000
226	Ekeley Chemistry		424	B.10	Plumbing Systems	Condensate pump		Replace/repair condensate pump	DM	3	5500
226	Ekeley Chemistry	building	268	B.10	Plumbing Systems	Controls		Replace all gauges	DM	1	2500
226	Ekeley Chemistry	BSMT FANS (2)	248	B.10	Plumbing Systems	Controls		replace control linkage on both wins coils	DM	4	10000
226	Ekeley Chemistry	building	246	B.15	Safety Standards	Detection alarm systems	3	Duct detectors	DM	1	1656
226	Ekeley Chemistry	building	246	B.15	Safety Standards	Detection alarm systems	4	Heat detectors	DM	2	756
226	Ekeley Chemistry	building	246	B.15	Safety Standards	Detection alarm systems	2	Pull stations	DM	3	2700
226	Ekeley Chemistry	building	246	B.15	Safety Standards	Detection alarm systems	1	Smoke detectors	DM	2	16443
226	Ekeley Chemistry		424	B.10	Plumbing Systems	Domestic hot water coils		Replace/repair domestic coil	DM	5	6000
226	Ekeley Chemistry	M2B51	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Ductwork and Piping		Clean supply fan ductwork	DM		7000
226	Ekeley Chemistry	BSMT FANS (2)	248	B.09	Heating, Ventilating, and Air Conditioning Systems	Ductwork and Piping		loose insulation clogging ducts	DM	1	3000
226	Ekeley Chemistry	elevator	256	B.13	Conveying System	Elevator		Cab finish upgrade: -new decorative (P-Lam) wall panels, stainless steel reveals & base - New florescent lighting package with stainless steel frame and plastic eggcrate panels - New tile flooring	IM		6000
226	Ekeley Chemistry	elevator	256	B.13	Conveying System	Elevator		New 15kw motor generator set	DM		7400
226	Ekeley Chemistry	elevator	256	B.13	Conveying System	Elevator		New A.D.A. compliant fixtures: - car control stations LED digital car and corridor position indicators - corridor call stations - retrofit hall lanterns - audible floor passing tone - entrance braille	RC		11000
226	Ekeley Chemistry	building	290	B.03	Exterior Wall System	Exterior Doors and Frames		prepare for card access	IM		0
226	Ekeley Chemistry	building	290	B.03	Exterior Wall System	Exterior Doors and Frames		Replace to correct performance deficiencies and regulatory compliance	DM, RC		8000
226	Ekeley Chemistry	building	240	B.03	Exterior Wall System	Exterior doors and Frames, Exterior Windows		Repair/replace/refinish	DM		20000
226	Ekeley Chemistry	E. Side	254	B.03	Exterior Wall System	Exterior Walls		Repoint stone walls E. Side	DM	3	400
226	Ekeley Chemistry	old section East end	248	B.09	Heating, Ventilating, and Air Conditioning Systems	Fans		replace all 4 fan units East end, old section and rebalance duct work (substandard)	DM	1	200000
226	Ekeley Chemistry	E400	268	B.09	Heating, Ventilating, and Air Conditioning Systems	Fans, ductwork and piping		Exhaust fans (5), asbestos ductwork need replaced, abandoned equipment needs removed	DM	1	20000
226	Ekeley Chemistry	building	240	B.06	Floor Covering Systems	Floor Coverings		Repair/replace/refinish	DM		120000
226	Ekeley Chemistry	NE entry	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	1	New ash receptacle	DM		300
226	Ekeley Chemistry	NW entry	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	1	New ash receptacle	DM		300
226	Ekeley Chemistry	NE entry, bottom level	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	2	New trash receptacle	DM		500
226	Ekeley Chemistry	NE entry, by fence	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	2	New trash receptacle	DM		500
226	Ekeley Chemistry	NW entry	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	2	New trash receptacle	DM		500
226	Ekeley Chemistry	SW entry	554	I.02	Site Improvements	Furniture:benches, bike racks, waste receptacles, kiosks, signage	2	New trash receptacle	DM		500
226	Ekeley Chemistry	roof	262	B.04	Roof Systems	Gutters and downspouts		Gutter	DM	2	60350
226	Ekeley Chemistry	building	290	B.07	Interior Wall and Partition Systems	Hardware		Replace to correct performance deficiencies and regulatory compliance	DM, RC		280884
226	Ekeley Chemistry		424	B.10	Plumbing Systems	heating hot water coils		Replace/repair heating coil	DM	5	12000
226	Ekeley Chemistry	Stairway and Fire Doors	290	B.07	Interior Wall and Partition Systems	Interior doors and frames		may contain asbestos	RC		0
226	Ekeley Chemistry	corridor separation points	290	B.07	Interior Wall and Partition Systems	Interior doors and frames		replace doors that have concealed vertical rods, maintainability	IM		0
226	Ekeley Chemistry	building	290	B.07	Interior Wall and Partition Systems	Interior doors and frames		Replace knob-type locksets with lever-handle locksets	RC		0
226	Ekeley Chemistry	building	290	B.07	Interior Wall and Partition Systems	Interior doors and frames		replace pot closers with Icn 4041 door closers	RC		0
226	Ekeley Chemistry	building	290	B.07	Interior Wall and Partition Systems	Interior doors and frames		Replace to correct performance deficiencies and regulatory compliance	DM, RC		22250
226	Ekeley Chemistry	building	240	B.07	Interior Wall and Partition Systems	Interior doors and frames, Interior walls		Repair/replace/refinish	DM		325000
226	Ekeley Chemistry	NW corner	554	I.02	Site Improvements	Landscaping	14	Fine Prune Locust	DM		500
226	Ekeley Chemistry	W side in shrub bed	554	I.02	Site Improvements	Landscaping	13	Install Groundcovers	DM		1000
226	Ekeley Chemistry		424	B.10	Plumbing Systems	Piping, valves, and traps		Replace/repair 1 1/4" Leslie regulator	DM	5	10000
226	Ekeley Chemistry		424	B.10	Plumbing Systems	Piping, valves, and traps		Replace/repair 3" Leslie regulator	DM	5	5000
226	Ekeley Chemistry	E400	268	B.10	Plumbing Systems	Piping, valves, and traps		Still needs new plumbing system. Steam still needs to go away	DM	1	200000
226	Ekeley Chemistry	building	230	B.10	Plumbing Systems	Plumbing fixtures, piping, valves, and traps	5	Replace and upgrade the entire plumbing system, except restrooms. Acid waste & vent system does not meet today's code	RC	1	200000
226	Ekeley Chemistry	M2B51	268	B.10	Plumbing Systems	Pumps		Domestic hot water pump OK now, Replace in 5-10	DM	5	1000
226	Ekeley Chemistry	roof	262	B.04	Roof Systems	Roofing		Built-up roof	DM	5	119470
226	Ekeley Chemistry	roof	262	B.04	Roof Systems	Roofing		Metal roof	DM	5	5610
226	Ekeley Chemistry	roof	262	B.04	Roof Systems	Roofing		Tile roof	DM	5	1000
226	Ekeley Chemistry	building	240	B.05	Ceiling Systems	Suspended Systems		Repair/replace/refinish	DM		10000
226	Ekeley Chemistry	M2B51	268	B.10	Plumbing Systems	Water heater		Replace domestic water heater	DM	5	5000
226	Ekeley Chemistry	building	240	B.08	Specialties	Window coverings		Replace	DM		10000
226	Ekeley Chemistry	roof	262	B.12	Electrical Lighting	Wiring		Heat cable	DM	3	4970
226	Ekeley Chemistry	building	232	B.12	Electrical Lighting	Wiring, Safety switches, Lighting fixtures		Some resent upgrades, however it still needs some work to bring it up to code at present usage levels	RC	3	750000

Appendix Section 7.06

Program Plan Regulatory Code Analysis

H+L ARCHITECTURE
1621 18TH STREET, SUITE 110
DENVER, COLORADO 80202
VOICE: 303.295.1792
FACSIMILE: 303.292.6437
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1. PROJECT

Project Name:	**EKELEY SCIENCES MIDDLE WING RENOVATION (Basement Levels 1 & 2)**
Location:	University of Colorado, Boulder Campus, Colorado
Owner:	Univerity of Colorado

2. GENERAL REQUIREMENTS

Applicable Building Code:	Uniform Building Code (IBCO)	Year:	1997
Applicable Fire Code:	Uniform Fire Code (IBCO)	Year:	1997
NFPA 45	Fire Protection for Laboratories	Year:	1996
NFPA 101	Life Safety Codes	Year:	1997

3. OCCUPANCY REQUIREMENTS - GENERAL

Table 3-A

1. Occupancy Classification: — Area of Renovations

A. Primary Occupancy	B	Laboratories	Approx.	12,657 GSF
B. Accessory occupancy	B	Mechanical Rooms	Approx.	6,088 GSF

Table 3-B

2. Occupancy Separations(s) Required:

A. B Office to B Laboratories - One Hour

3. Occupancy Requirements - By Group:

A. Chapter 3 Group B - Educational above the 12th grade, Laboratories - Testing and Research:

304.2.2.1	Laboratories in buildings used for educational purposes shall be separated from each other and other portions of the building by 1-hour. Labs over 200 SF shall have 2 exits. All portions of the lab shall be within 75 feet of an exit way.
304.3	Location on property - Main entrance shall be located on a public street or on min. 20' exit discharge.
304.4	Access and exit facilities - refer to chapter 10 and chapter 11.
304.5	Light, ventilation and sanitation - refer to chapter 12, plumbing fixtures per section 2902.2.
304.6	Shafts and exit enclosures - refer to chapter 10.
304.7	Sprinklers and standpipes - refer to chapter 9.
304.8	Special hazards - refer to section 405.3.3, 302.5 heat equip. Rooms to have 1-hour separation.

4. GENERAL BUILDING LIMITATIONS

1. Existing Building (all Ekeley wings):

A. Basement 2	12,200 GSF
B. Basement 1	26,873 GSF
C. First	33,700 GSF*
D. Second	33,700 GSF*
E. Third	21,642 GSF*
Total	**128,115 GSF (*89,042 GSF - Area above grade)**

2. Proposed Remodel Area (Middle Ekeley):

A. Basement 2	12,200 GSF	
B. Basement 1	11,932 GSF	
Total	**21,660 GSF**	

3. Proposed Building Height:

A. Number of stories:	3 stories above grade plus 2 basement levels
B. Height in feet:	40 feet ± above grade

Table 5-A

4. Exterior Wall Opening Protection:

A. Group B - II, 1-hour:
Bearing walls - 1-hour N/C
Nonbearing wall - 1-hour NR, NC 40' or greater
Openings - Not permitted less than 5'. Protected less than 10'.

Table 5-B

5. Total Allowable Height and Area (Alternatives):

A. Group B Type II - Fire Resistive (Building not fully sprinklered)		Group B Type II -1-hour*
Basic Allowable Area	39,900 GSF	18,000 GSF
Increase for Multi-floor	39,900 GSF	18,000 GSF
Increase for Separation on 3 sides	79,800 GSF	36,000 GSF
Total	**159,000 GSF**	***72,000 GSF**

505.3 **Note: Allowable Area of 72,000GSF may be doubled when entire Ekeley Sicence Building is fully sprinklered at completion of all phased renovations. Type II - 1-hour construction is asumed as basis for design.*

B. Allowable Height:	12 Story	4 Story

6. Location on Property:

503.3 When a new building is erected on the same property as an existing building, the assumed property line location shall be such that the wall opening protection of the existing buildings comply with table 5-A and chapter 6.

5. FIRE RESISTIVE REQUIREMENTS

Table 6-A 1.

Construction Element:	Type II - 1-hour Construction:	
Exterior bearing walls	1-hour	
Interior bearing walls	1-hour	
Exterior non-bearing walls	1-hour	
Structural frame	1-hour	
302.3 Partitions - permanent	1-hour	
Shaft enclosures	1-hour	*see section 711
Floors and floor/ceiling	1-hour	
Roofs and roof/ceiling	1-hour	
Exterior door and windows	Not permitted less than 5', protected less than 10'.	
Table 15-A Roof coverings	Minimum class B	
302.5 Boiler room enclosure	1-hour, openings 1-hour rated	

*711.2 Shafts shall be enclosed at the bottom or protected with fire damper

*711.3 Openings made through floors for cables, tubes, pipes, etc. need not be enclosed provided they are fire stopped to the same fire-resistance as the floor/ceiling construction.

*711.4 Openings into shaft enclosures shall be protected 1-hour for 1-hour shaft.

6. STRUCTURAL REQUIREMENTS - BY CONSTRUCTION TYPE

602 1. Construction Elements:

A. Framework: Steel - chapter 22, Concrete - chapter 19, Masonry - chapter 21.
B. Stairs: Steel or reinforced concrete. Refer to chapter 10
C. Roofs: Structural frame rated per Table 6-A.

7. EXIT REQUIREMENTS

104.2.2.4 **TABLE 10-A Occupant Load and Exit Required 1004.2.3.4 (Basement Remodels Only)**

FLOOR	USE	LOAD FACTOR	GROSS S.F.	# OCC.	TOTAL OCC.	ADJACENT FLOOR	TOTAL # OF EXITS
Basement	lab	50	2,592	51.84			
Level 2	office	100	280	2.80			
	mech.	300	5,240	17.47			
	other	50	1,613	32.26			
totals			9,728		104.37	0.00	2
Basement	lab	50	9,031	180.62			
Level 1	office	100	240	2.40			
	mech.	300	200	0.67			
	other	50	2,461	49.22			
totals					232.91	104.37	2
TOTAL			21,660		337.28		2

1003.2.3.4 **TABLE 10-B Width of Required Exits**

FLOOR	OCC. LOAD PER FLR.	ADD'L. ACCUM. LOAD	ADJUSTED OCC. LOAD	REQ'D. TOTAL WIDTH (0.2)	WIDTH PER EXIT	REQ'D. STAIR WIDTH (0.3)
Basement 2	104.37	0.00	104.37	20.87	36"	44" MIN.
Basement 1	232.91	104.37	337.28	67.46"	36"	50.6"

3. Arrangement and Distance to Exits:

1004.2.4. A. Half diagonal distance overall for building:
1004.2.5.1 B. Maximum allowable travel distance: 200 feet, 250 feet if sprinkled
1004.2.6 C. Dead end corridors allowed? Yes, 20' - 0" maximum length

4. Exit Doors:

1003.3.1.3 A. Minimum width allowed: 3'-0" with 32" clear
1003.3.3.3.1 B. Maximum leaf witdth allowed: 4'-0"
C. Width required for No. of occupants: See table, table - 10-B all doors 3'-0"

5. Exit Corridors:

1004.3.4.1 A. Minimum allowable width: 44"
B. Exit required at each end of corridor? Yes

	C.	Wall fire resistance required:	1-hour for Type II construction
1004.3.4.3.2	D.	Doors and frames fire resistance required:	20 min. self-closing.
304.2.2.1		Corridor doors from laboratories containing chemicals are 1-hour self-closing.	
	E.	Other openings fire resistance required:	3/4-hour rated and not more than 25% of the wall of the room separated by the corridor.

6. Stairs:

1003.3.3.3.2	A.	Minimum. Width:	44" (36" for less than 50 occupants)
	B.	Stairs and ladders used to attend equipment are exempt.	

7. Rise/Run:

1003.3.3.3	A.	Minimum and Maximum riser allowed:	4" minimum, 7" maximum
	B.	Stairs and ladders used to attend equipment are exempt.	

8. Landings:

1003.3.3.5	A.	Minimum length:	Not less than the stair width, but need not be more than 44" for a straight run stair.
	B.	Basement stairs:	No storage below stairs.
	C.	Max. vertical distance between landings:	12'-0"

9. Handrails:

1003.3.3.6	A.	Required at each side?	Yes, and must be continuous for > 44" stairs.
	B.	Intermediate rails required at stairs?	If more than 88 inches wide.
	C.	Height above nosing:	Not less than 34", not more than 38"
	D.	Handrails return to wall at ends?	Yes, or terminate in newel posts
	E	Handrails extend beyond end?	Minimum 12" beyond top riser and 12" beyond the bottom riser
	F.	Handrail diameter:	Not less than 1 - 1/2" dia., to more than 2" dia.

10. Roof access:

1003.3.3.11	A.	Stair to roof required?	N/A

11.	Stair required to continue to basement?	Provide barrier at first floor.
1003.3.3.12 12.	Stair hatchway access to roof required?	N/A
13.	Ladder access to roof high point required?	No
1003.3.3.4 14.	Stair Head Room:	Not less than 6 feet, 8 inches.

15. Ramps:

1003.3.4	A.	Maximum slope to use as exit:	Maximum 1 vertical to 8 horizontal. If on an accessible route, 1 vertical to 12 horizontal.
	B.	Handrails required?	Yes, but if less than 88 inches wide, no intermediates required.
	C.	Width and Landings:	44 inches: minimum width. Landing at top and bottom with intermediate at each 5' of vertical rise.

16. Exception #2:

1004.2.2	A.	Spaces requiring only one exit may exit through an adjoining room.

17. Exit Enclosures:

1005.3.3	A.	Where required:	At all exit stairs and ramps except where serving only one adjacent floor and not connected with corridors or stairs serving other floors.
	B.	Construction:	1-hour construction for building less than four stories in height.
	C.	Openings:	Only openings necessary for exiting are permitted. Rating of fire assembly at opening is minimum one hour.

18. Pressurized Enclosure:

1005.3.3.7	A.	Where required:	Where an occupied floor is more than 75' above fire department vechicle access (N/A).

1003.2.8 19. Exit signs required: Where two or more exits are required. No point more than 100' from sign.

20. Guard Rails:

A.	Where required:	Landings, etc. more than 30" above grade or floor below.
B.	Height required:	Not less than 42".
C.	Intermediate rail dimension or pattern:	Such that 4" sphere cannot pass.

8. ROOF STRUCTURES

1511 1. Penthouses:

A.	Area limitations:	Maximum 33-1/3 percent of the roof.
B.	Height limitations:	28 feet above roof.
C.	Use limitations:	Only for mechanical equipment and shafts.
D.	Construction requirements:	Same as floors, walls and roof of the main building.

Table 5-A Minimum roof class for type B occupancy is "B."

709.4.1 2. Parapet Walls:

A. Not required where wall, due to location from property line, may have unprotected openings.

9. FIRE PROTECTION SYSTEM REQUIREMENTS

904	1.	Fire extinguishing systems:	Yes. Required.
	A.	Sprinklers required:	In any story or basement where floor area exceeds 1,500 S.F. and there is not at least 20 S.F. of opening in each 50 lineal feet of wall.

904.5 2. Standpipes:

Table 9-A	A.	Standpipe	Yes. Class I required (until building is fully sprinklered).

10. FIRE-RESISTANT MATERIALS AND CONSTRUCTION

708.1 1. Fire Blocking:

A.	Where required:	In combustible construction at all concealed vertical and horizontal space at 10' intervals.
B.	Construction:	Nominal 2" lumber or gypsum board.

2. Draft Stops:

A.	Where required:	In combustible construction at floor/ceiling assemblies with concealed spaces.
B.	Area limitations:	Concealed spaces not to exceed 1000 S.F. with maximum dimension of 60' (3000 S.F. and 100' if sprinkled).
C.	Attics:	Area between attic draft stops is not to exceed 3000 S.F. with maximum dimension of 60' (9000 S.F. and 100' if sprinkled).
D.	Construction:	Nominal 2" lumber or gypsum board.
E.	Openings:	In draft stops, self closing with automatic latches.

712 3. Usable Space Under Floors:

A.	Protection:	Usable space below the first story shall be enclosed and protected on the usable side with one-hour fire-resistive construction.
B.	Openings:	20-minute, self-closing.

UNIFORM FIRE CODE

1. FIRE DEPARTMENT ACCESS AND WATER SUPPLY

901.2.2.1 1. Fire apparatus access to be approved prior to construction.

902.2.1 2. Access roads to be provided when any portion of the building is in excess of 150' from access point on public street. (Exception 1. Roads may be waived by Fire Marshal if building is fully protected.)

902.4 3. Key boxes to be provided for access to secured buildings.

903.2 4. Fire hydrants to be installed on site such that no portion of the building is in excess of 150'.

2. FIRE PROTECTION SYSTEMS AND EQUIPMENT

1002.1 1. Provide portable extinguishers as required by Fire Marshal and UFC Standard 10-1.

Table 1004-A 2. Standpipes are required for buildings four stories or higher.

3. COMPRESSED GASES

7401.1 1. Storage use and handling of compressed gases shall be in accordance with article 74.

7501.1 2. Storage use and handling of cryogenic fluids shall be in accordance with article 75.

8003.11 3. Cryogenic fluids in individual containers which exceed 1000 pounds shall not be stored in buildings.

4. FLAMMABLE AND COMBUSTIBLE LIQUIDS

7901.1 1. Storage, use, dispensing and mixing of flammable and combustible liquids shall be in accordance with article 79.

7901.8 2. Buildings, rooms and areas shall be provided with means of spill control per section 8003 and 8004.

7903.2.1.6.2 3. Occupancy quantity limits, quantities in offices, classrooms or laboratories within group B occupancies shall not exceed quantities set forth in Table 7903.2-B.

5. HAZARDOUS MATERIALS

8001.1 1. Prevention, control and mitigation of dangerous conditions related to the use of hazardous materials and information needed by emergency response personnel shall be accordance with article 80.

8004.2.2.5.1 2. Spill control is required in areas where hazardous liquids are dispensed into vessels exceeding 1.1 gallons (4L)

8004.2.3.6.1 3. Spill control is required in areas for hazardous liquids which exceed 55 gallon vessels or 1000 gallons total.

NFPA 45 FIRE PROTECTION FOR LABORATORIES USING CHEMICALS

1. CHAPTER 1: GENERAL

1.4 Laboratory unit: An enclosed space used for experiments or test, may or may not include office and support areas. Laboratory units are to be classified as type "A," "B," "C," or "D" per tables 2 - 2 and 3 - 1.

2. CHAPTER 2: LABORATORY UNIT HAZARD CLASSIFICATION

2-2.1 Instructional Laboratory Unit:

2-2.2.2 1. Laboratory units used for instructional purposes shall be limited to 50% of the flammable and combustible liquids for class B laboratory units. Table 2-2(a).

Table 2-2(a) Maximum Quantities of Flammable and Combustible Liquids in Sprinklered Laboratory Units Outside of Flammable Liquid Inside Liquid Storage Areas

		Excluding Quantities in Storage Cabinets or Safety Cans		*Including* Quantities in Storage Cabinets or Safety Cans	
Laboratory Unit Fire Hazard Class	Flammable or Combustible Liquid Class	Maximum Quantity per (100 ft2) of Lab Unit	Maximum Quantity per Lab Unit	Maximum Quantity per (100 ft^2) of Lab Unit	Maximum Quantity per Lab Unit
C	I I, II, & IIIA	7.5 L (2 gal) 15 L (4 gal)	570 L (150 gal) 757 L (200 gal)	15 L (4 gal) 30 L (8 gal)	1136 L (300 gal) 1515L (400 gal)

3. CHAPTER 3: LABORATORY UNIT DESIGN AND CONSTRUCTION

Table 3-1(a) Construction and Fire Protection Requirements for Sprinklered Laboratory Units

Sprinklered Laboratory Units			
		Any Construction Type	
Laboratory Unit Fire Hazard Class	Area of Laboratory Unit (ft^2)	Fire Separation from Nonlaboratory Areas	Fire Separation from Laboratory Units of Equal or Lower Hazard Classifications
C	<930 (<10,000) >930 (>10,000)	NC; LC NC; LC	NC; LC NC; LC

Note: Section 304.2.2.1 from the UBC is more restrictive and shall override this table when required.

3-1.8 Penetrations of fire-rated floor/ceiling and wall assemblies shall be protected to retain required fire resistance rating.

3-4 Means of access to an exit:

3-4.1 1. A second means of access to an exit shall be provided from a laboratory work area if any of the following situations exist:

A. If an explosion hazard could block access to the exit.
B. If the laboratory work area (Class C) exceeds 1,000 SF.
C. If a hood is located adjacent to the exit.
D. If a compressed gas cylinder is in use that contains a flammable or health hazard rating of three or four.
E. If there is a cryogenic container in use that contains a flammable or health hazard rating of three or four and could prevent safe egress in the event of an accident.

A-3-4.1 2. A door to an adjoining laboratory work area is considered to be a second exit if the lab is not of a higher fire hazard class.

3-4.4 3. Exit doors within class C laboratory units may swing against the direction of exit travel or may be a horizontal sliding door complying with NFPA 101.

4. CHAPTER 4: FIRE PROTECTION

4-1.1 1. All laboratory units shall be provided with fire protection appropriate to the fire hazard as follows:

A.	Portable fire extinguishers:	(4-4)
B.	Fire alarm systems:	(4-5)
C.	Evacuation and emergency plans:	(4-6)

4-2.1.1(b) 2. Automatic sprinkler systems (when required by table 3-1(a) for class C laboratory units shall be in accordance with NFPA 13.

NFPA 101 LIFE SAFETY CODE

1. CHAPTER 4 - CLASSIFICATION OF OCCUPANCY AND HAZARD OF CONTENTS

4-1.8 1. Business occupancy used for college and university instructional buildings and laboratories.

4-2.2.4 2. High hazard of contents: Contents that are likely to burn with extreme rapidity or from which explosions are likely. See 5-11.

2. CHAPTER 5 - MEANS OF EGRESS

5-1.3.1 1. Exit separation shall be one-hour construction.

5-2.1.4.2 2. During its swing, any door in a means of egress shall leave unobstructed at least one half of the required width of an aisle, corridor, or passageway.

5-11.3 3. At least two means of egress shall be provided from high hazard areas, except when the area is less than 200 SF with an occupant load of less than three and the maximum travel distance is 25'.

5-12.1 4. The common path of egress travel shall not exceed 50' in mechanical equipment room (100' if fully sprinklered.)

Appendix Section 7. 07

Independent Third-Party Review

April 4, 2001

The Third Party Review will be performed prior to review by the University of Colorado Board of Regents

April 4, 2001