Report of the Ad Hoc SAS/SEAS Planning Committee For Natural Sciences and Engineering Facilities

To the University Community

With the presentation of its report of February 16, which follows, the Ad Hoc SAS/SEAS Planning Committee for Natural Sciences and Engineering Facilities, chaired by Vice Provost Barry Cooperman and Deputy Provost Richard Clelland, has met its charge to formulate plans for new and renovated facilities in the Natural Sciences and Engineering at Penn. The Committee report articulates a twelve- to fifteen-year plan for the enhancement and expansion of space for research and teaching programs that will move Penn to true eminence in the Natural Sciences and Engineering. It is clear that a major investment in science and engineering at Penn is required over the next decade if Penn is to remain vital in these areas.

The work of the Committee sets a precedent for interschool planning and demonstrates the wisdom of such activity. As the University develops long range space plans in other areas we will be using the Committee report as a model for examining the special opportunities, connections, and changing intellectual horizons offered by existing programs and by emerging interdisciplinary programs. We believe a more broadly based but similarly constituted committee, which includes the biomedical sciences, would be a very positive force in helping Penn develop its longer range space and facilities plans for scientific facilities as a whole and will be appointing such a committee shortly.

—Michael Aiken, Provost *—Sheldon Hackney, President*

Science and Engineering Facilities Planning Report

Executive Summary

This is the report of an ad-hoc committee appointed at the suggestion of President Hackney and then-Provost Ehrlich to formulate plans for new and renovated facilities in the Natural Sciences and Engineering at Penn. The committee is chaired by Deputy Provost Dick Clelland and Vice Provost Barry Cooperman and composed of senior faculty from SAS and SEAS.

The major goal of the Committee report is the articulation of a twelve- to fifteen-year plan for the enhancement and expansion of space for research and teaching programs that will move Penn to true eminence in the Natural Sciences and Engineering. The plan reflects the needs of SAS and SEAS, while taking into account the constraints imposed by the compactness of the campus, the desirability of integrating new buildings into the overall architectural and space planning of the University, and the desirability of locating members of the same department in close proximity to one another. It proposes and evaluates alternative scenarios recognizing that no one scenario fully satisfies all of the above needs and constraints.

Fundamental to the plan are the assumptions that continued joint planning between the Schools is both necessary and desirable, that shared facilities between the Schools are often appropriate, and that new and renovated space must be created both for existing departmental programs and for emerging programs in interdisciplinary areas.

The plan explicitly considers three planning horizons: one to two years, three to five years, and the period 1995 to 2000.

The one to two year horizon addresses urgent needs of the science and engineering departments and suggests how these needs can be met through both renovation and reassignment of space in the following facilities: David Rittenhouse Laboratory; Hayden Hall; Moore, Towne and Chemistry Libraries; 3401 Walnut Street. Some 18,000 square feet is potentially available in 3401 Walnut, while the total space to be considered for renovation in the other facilities is approximately 49,000 net square feet. It is recognized that some renovation will continue into the second planning horizon.

The three to five year horizon envisages the construction of major new facilities, the completion of renovation begun in the first two years, and the renovation of additional substandard spaces within current facilities. The estimated need for net new space in the Physical Sciences and Engineering precinct is 100,000 to 120,000 square feet, principally for the departments of Chemistry, Computer and Information Science, Electrical Engineering, Chemical Engineering, and Bioengineering. The plan considers both one building and two building options for meeting this need. In addition, some 29,000 net square feet of new and replacement space are required for Psychology, to be met either by new construction or by reassignment of space. Renovation of 35,000 net square feet is also proposed in SEAS, Chemistry and Goddard and Leidy Laboratories.

The 1995 to 2000 horizon envisages the construction of new facilities containing an additional 100,000 to 160,000 net square feet, permitting Penn to achieve broad strength in science and engineering. This new space should accommodate growth in the programs of LRSM and the general area of materials research, and the fields of mathematics, physics, biology, astronomy, geology, mechanical engineering and systems engineering.

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Science and Engineering Facilities Planning Report

I. Introduction

This is the century of science and technology. Science and engineering have profoundly changed our world and the way we think about it. We have come to understand the building blocks of our physical world; we are learning how our body works and how it transmits its characteristics from generation to generation; and we are even beginning to penetrate two of mankind's most cherished mysteries—the nature of the mind and the origin of the universe.

We also have seen the rise of remarkable technology. Communication, transportation, materials, agriculture, medicine, energy and information processing have all changed more since 1900 than they did in the previous 50 centuries. These changes have not solved all human problems nor improved all human institutions. Indeed, they have brought new problems of their own. But few would exchange these advances, or the understanding from which they arise, for the hardship and ignorance of previous times.

Universities are among the institutions that have changed the most with the growth of science and engineering. In America the research university has provided most of the ideas, many of the technological developments, and almost all of the trained minds that are the creative sources of these advances. The rapid development of academic engineering and science began after the Second World War, when the Federal government came to appreciate the critical role of the university in economic development. Federal support of research has profoundly changed the nature of the leading American research universities and even changed which universities are the leaders. Those private universities that have emerged as leaders since the War have done so on the strength of their science and engineering.

The rise of science and technology has also challenged our educational programs. The effectiveness with which our society functions is strongly influenced by our skill in managing technology. Yet, far too few of our leaders and disappointingly few of the recent graduates of our colleges and universities appear to understand what it means to think in quantitative, scientific terms. The study of scientific and technological thinking should not be an elective chosen to round out a liberal education; it lies at the core of such an education. Any university that intends to provide a true liberal education for its students must have major programs in science and engineering. Indeed, the ability of its graduates to understand issues of science and technology and integrate them into the broader cultural and historical context is a measure of the quality and true liberality of their education.

This is a time of both opportunity and risk for Penn's programs in engineering and science. We have an opportunity because many of the science and engineering faculty hired in America during the post-War and Sputnik boom are nearing retirement, and much of the physical plant built for their research is in need of renewal. We have a second chance to make the key investments in people and facilities that will ensure prominence for Penn in the coming decades. At the same time we are at risk, because other universities sense the same opportunity. The next few years will challenge most universities to rebuild and redirect their intellectual enterprise. Which universities emerge as leaders at the beginning of the next century will depend on many factors; but no one can doubt that the leading institutions will all have great strength in science and engineering brought about by substantial capital investment.

Penn has certain natural advantages that derive from its long-standing strength in interdisciplinary programs. The "real world" discovered some time ago that problems in science and technology do not come with neat labels such as "chemistry," "physics," or "engineering." The disciplinary distinctions still have important validity in education, but they often fade at the level of advanced graduate research. Cross-disciplinary interaction among traditional departments of science and engineering is often vital for lively and creative advanced research in science and technology.

Any university contemplating major investments in science and engineering should understand the need for broad-based disciplinary and interdisciplinary excellence. The potential for any individual department to achieve true excellence is increasingly linked with the quality of the other departments around it. For example, excellence in physics is enhanced by outstanding programs in mathematics, chemistry, computer science, and electrical engineering. An outstanding program in chemical engineering requires a strong department of chemistry. Psychology draws from mathematics, computer science, and engineering. The study of materials cannot thrive without strong programs in chemistry, physics, and mechanical and electrical engineering. As one example, Penn's LRSM program led the way over 25 years ago in developing strong interactions among departments in science and engineering and established a model which many other universities envy.

Many universities understand the pivotal role engineering and science will play in determining whether their fate is excellence or mediocrity and are making the major investments in science and engineering needed to ensure excellence. The most creative universities also understand that the future of science and engineering is not a simple extrapolation of the present, and that the investments that will ultimately be the most effective are those which both strengthen core programs and foster interdisciplinary creativity. The national funding agencies have also altered their traditional funding patterns by increasingly emphasizing programs that link together contributors from different traditional fields. Examples of major recent university investments in engineering and science include the following;

Columbia is investing $95 million for buildings, facilities, and programs in chemistry, computer science, micro-electronics, and telecommunications.

Cornell has allocated $41 million for buildings and equipment for computer science and a biotechnology institute.

Brown is investing $70 million for buildings, equipment, and programs in information technology.

Johns Hopkins is undertaking construction of a new chemistry building with a currently estimated cost range of $24-40 million. In addition a 220,000 square foot physics building is under construction.

Princeton is investing $20 million to create a program in computer science and is actively considering the establishment of a major program in materials science. It also recently completed construction of a large new molecular biology laboratory, with a total investment of $40-45 million.

Stanford has committed over $50 million for facilites in chemical engineering/chemistry and biology research.

Yale is spending $23 million for buildings and equipment for computer science.

The investments made by these institutions buy the modern laboratories and research equipment essential to advanced education in science and engineering. The linkage connecting facilities, faculty, and students is simple: the best facilities attract the best students. Outstanding faculty candidates also look to see if the university administration considers science and engineering a major priority and understands that it will require continued commitment of university resources.

At Penn, our programs in science and engineering give us many reasons for pride, but none for complacency. We have a large and vigorous scientific and engineering enterprise. Some of our engineering and science departments are among the best in the world, and all of those departments include outstanding faculty. We have a dynamic and compact campus with a fine tradition of free intellectual interchange across departments and schools. Indeed, we are the largest and best full-range research university in the Middle Atlantic region. Moreover, we have the good fortune to be surrounded by one of the greatest concentrations of technological industry in the nation. These strengths are signaled by the substantial revenue brought to the university by research grants in science and engineering—an amount equal to two-thirds of the total tuition income of the university.

Yet, except for the medical sciences, Penn has not been perceived either from without or within as a great center of science and engineering. Investments in engineering and science that Penn should have made in past years were not made. The result is that many of Penn's facilities for science and engineering are woefully inadequate, and many consider Penn a university without a strong commitment to science and engineering. These factors make it increasingly difficult to attract excellent faculty, outstanding students, and sufficient research support. In a number of cases, the best faculty have left Penn, tempted by excellent offers elsewhere and driven by the sense that Penn does not rank science and engineering high on its scale of priorities. It may be tempting to believe that these points are exaggerated, but they are not.

We must face squarely the prospects of being unable to attract the best students in science and engineering, of being unable to compete for the very best faculty, and ultimately, of seeing our reputation as a major institution of higher education and research decline if major investments in science and engineering at Penn are not made soon. This is a time of renewal for American university efforts in science and engineering and of realignment of university rankings. It must also be the time in which key investments are made in science and engineering at Penn.

Motivated by the long-range concept of what Penn can become and by some very pressing short-term space needs, the School of Engineering and Applied Science and the School of Arts and Sciences have begun joint facilities planning. We believe that such joint planning will enable us to provide superior research facilities in a way that is not only more economical but also more intellectually fertile than conventional planning within the separate schools. This report presents the first products of this joint effort.

II. The Planning Process

During the past half-year an ad-hoc committee (hereinafter called "the Committee") has been meeting to formulate plans for new and renovated research and teaching facilities in the Natural Sciences and Engineering at Penn. The Committee was formed as a result of a June 23, 1987 memo from then-Provost Ehrlich to Dick Clelland and Barry Cooperman, written at the request of President Sheldon Hackney, requesting them to "work with Deans Aiken and Bordogna, together with Titus Hewryk, to analyze the options for new University Science Facilities to meet the needs of both Arts and Sciences and Engineering." Dean Bordogna and then-Dean Aiken nominated members of their faculties to serve on the Committee. The Committee has been staffed by Facilities Planning and by the Office of the Vice Provost for Research. A complete list of its membership may be found on page II.

The underlying rationale for constituting the Committee was the perception at both the University and School levels that joint facilities planning between SAS and SEAS made good sense in view both of the physical proximity of SEAS and many of the scientific disciplines within SAS, and of the large overlap in both research and instructional programs between the Schools. Also driving the process was the realization that only limited space on the University campus was available for new construction, thus putting a premium of efficient use of such space, as well as the prospect of a major University fund-raising campaign that would have the construction of new facilities for Natural Science and Engineering as a major priority.

The Committee began its work in July and August and continued meeting regularly during the fall semester. As part of its information gathering process it designed a questionnaire to obtain data from department chairpersons on current resources, teaching loads, faculty staffing, student enrollments and space utilization, as well as on projected future levels in these areas. The collected data, along with a descriptive narrative written by each of the chairpersons, are presented in appendices available from the Office of the Vice Provost for Research. The Committee also interviewed each of the chairpersons individually (except for the chairperson of Biology, John Cebra, who was off-campus until recently), and conducted a site tour of SEAS facilities. In addition, it had available to it for reference the five-year plans of each of the Schools, the Davis and Brody plan for the development of new and renovated space in SEAS, Alan Levy's recent Campus Master Plan, and the Westat report on *Science and Engineering Research Facilities at Doctoral Granting Institutions,* NSF (1986).

In the course of its deliberations the Committee was able to achieve consensus on several key points regarding the improvement of facilities for the Natural Sciences and Engineering:

1) Penn should set as a goal the achievement of true eminence in science and engineering, so that this area will be a major strength of the University. The building plans we discuss in Section III will, in an orderly fashion over a 12 to 15 year period, provide the high quality facilities allowing such development in both SAS and SEAS.

2) Future funding of research in universities is expected to place greater emphasis than has heretofore been the case in large, multidisciplinary research efforts, many of which will require integration of both fundamental science and applied science and engineering. The NSF block grant for materials research, which is housed in the LRSM, is a forerunner of such efforts. More recent examples include the Army Research Office grants to Penn for research in polymer science and artificial intelligence, the establishment by NSF of Science and Technology research centers, and the proposed creation by the State of Pennsylvania of Centers of Research Excellence in high-technology fields. This expectation strengthens the Committee's belief that the process it has begun of jointly planning space and facilities for SAS and SEAS is desirable and should be continued.

3) In planning new and renovated space it is important to maintain close proximity among members of the same department, as well as to minimize the number of moves a department or department section is required to make during the period that new facilities are being created. Spreading a department among several non-proximal buildings is highly undesirable and, inversely, gathering together a spread-out department into a common facility is highly desirable.

4) Significant enhancement of functionality and of efficient utilization of space can be achieved through construction of joint facilities meeting common needs. An outstanding example of a joint facility is the Hayden Hall Library, discussed below. Others might include very large-scale computing, machine and electronic shops, a conference center, large classrooms, and a dining facility.

5) Even with substantial new construction over the next several years, it is important to note that some departments will continue to occupy space that is currently substandard for either research or instructional use. Accordingly, a major effort should be directed toward renovation of the existing physical plant, much of which is based in older buildings that are acutely in need of rehabilitation. A case in point is the ongoing plan to renovate the Edison building in order to provide much-needed space both to the research program of the LRSM and the instructional program of the Department of Materials Science and Engineering (MSE).

In formulating plans for the creation of new and renovated space for the Natural Sciences and Engineering, the Committee has proceeded with three different planning horizons in mind:

1) *One to two years (1989)* This includes immediate needs for new and upgraded space that can be met either by renovation or by space reassignment.
2) *Three to five years (1992)* This includes needs that can be met both through renovation and through construction of major new facilities.
3) *The period 1995-2000* This requires new construction for long term needs of several programs.

As would be expected, these plans are more precise for the first planning horizon than for the latter two. At present, square footage figures for the latter two time periods should be considered only as reasonable and defensible estimates. Greater precision will require more detailed critical analyses of the space needs listed by the department chairpersons than has so far been attempted.

Although virtually all of the departments surveyed presented credible requests for new and/or renovated space, it was possible to establish priorities based on the application of a set of rational criteria to evaluate such requests, relying to a large extent on prior judgments as reflected in the five-year plans of the Schools. Some of these criteria were strictly quantitative. What were the past and present levels of sponsored research funding? Of teaching load? Of undergraduate majors and graduate students? Of Ph.D. degrees awarded? Others were more qualitative and based on the collective judgment of the Committee. How intellectually vibrant is the field or fields represented by the department? What is the urgency of the need? What comparative advantage does being at Penn confer on the department? How central are the programs of the department to the overall mission of the University? What is the comparative national ranking of the department and what will it take to maintain or enhance its ranking? How attractive are the programs of the department to graduate students? To funding agencies? The plans presented in Section III reflect these priorities.

III. Plausible Scenarios for Creation of New and Renovated Space

A. Short-term Plans; One to Two Years

The major goals in this immediate time frame are to provide modest amounts of new and renovated space to meet the urgent programmatic needs of departments in the Physical Sciences and Engineering precinct and to create a combined Engineering and Chemistry Library on the third floor of the front portion of Hayden Hall. Toward these goals the Committee has identified three areas that can provide appropriate space. These are: David Rittenhouse Laboratory (DRL), 3401 Walnut, and the current Moore, Towne and Chemistry Libraries.

1. *DRL*—All three departments occupying this facility, Astronomy, Mathematics, and Physics have space needs, with those of Mathematics for faculty and graduate student offices being particularly urgent. Such space can be made available by one or more of the following options: a) renovation of the space (5500 square feet) left behind in the move of the DRL Computing Facility to 3401 Walnut; b) renovation of additional underutilized space in the basement of DRL (4000 square feet); c) renovation and improved utilization of existing space on floors three and four of DRL; d) new construction to complete the fourth floor of DRL. Options a) and b) may well involve double moves, i.e. student laboratories on the third floor of DRL to the basement, and renovation of third floor space.

2. *3401 Walnut Street*—Approximately 18,000 square feet of office-type space is available in this building. Such space would be appropriate for several of the programmatic needs of SEAS. The Computer and Information Sciences (CIS) department has particularly urgent needs and could make good use of this space. Alternatively, other programs within SEAS could be moved into 3401 Walnut, thereby creating space for renovation within current SEAS buildings for expansion of such departments as CIS and Electrical Engineering (EE).

3. *Hayden Hall Library*—Creation of a combined Engineering and Chemistry Library on the third floor front portion of Hayden Hall equipped with the latest in information-handling technology will provide an important new teaching and research resource. With a mezzanine it will have approximately 13,000 square feet of space, and will be somewhat crowded (but see part B below), since it will be replacing about 15,000 square feet of library space, some of it already quite cramped, in the Chemistry, Moore and Towne Libraries.

4. *Chemistry*—Merging the Chemistry and SEAS Libraries will liberate 6,000 square feet of space on the fifth floor of Chemistry, which will be converted to new, high-utility, research space that is urgently needed by the department.

5. *SEAS Facilities including Moore and Towne Libraries*—Creation of the Hayden Hall Library will liberate approximately 9,000 square feet within SEAS that will be developed in accord with the School's priorities. In addition, much needed renovation of substandard space in SEAS should continue during this period.

B. Middle-term Plans, Three to Five Years

The key goals in this frame are to construct major new facilities that will have a significant impact on several programs, to complete renovation efforts begun in part A, and to renovate additional substandard spaces within our current facilities. The major issues to be considered are:

1) what are the approximate total needs for net square feet in the new facilities?;
2) what site or sites should be built on in order to accomodate these needs?;
3) how may departments and programs be placed in new facilities so as to optimize synergistic interactions between them?;
4) what is the long-term future of the Hayden Hall Library?;
5) what provision will be made for departments displaced from existing facilities by expansion of science and engineering departments?

We begin with three features common to all scenarios.

First, within this period space needs for Math, Physics, and Astronomy should be able to be accommodated within a significantly renovated DRL, as discussed in Section III-A above. If the Math-Physics Library were to be made part of a Physical Sciences and Engineering Library (PSEL), additional space (3500 square feet) in DRL would be made available for renovation, which could include creation of a reading room.

Second, Psychology needs approximately 29,000 square feet of new space in close proximity to its current laboratory building. About half of this total would be replacement space for the collection of scattered sites it now occupies, and an additional quarter each would be for laboratory space and for classrooms to be shared with other departments. One possibility for accommodating this need would be via relocation of a major unit having space next to the Psychology laboratory building and occupancy of the vacated space by Psychology, with appropriate renovation and new construction as needed. An alternative possibility would be construction of a new building close to the current Psychology laboratory building, as part of a more general plan for the conversion of the 38th Street shopping area.

Third, the Biology Department needs to reassign and renovate space in Goddard and Leidy Laboratories. The major move will involve the relocation of teaching laboratories in Goddard to the basement of Leidy, and the conversion of the vacated Goddard space to research laboratories. In addition, some modest renovation of existing laboratories in Goddard and Leidy will be required. The total space to be renovated is approximately 5,000 square feet.

Critical needs for new and renovated space

Major amounts of new space in this time frame are needed by the Chemistry department and by several of the departments in SEAS, in particular CIS, EE, Bioengineering (BE) and Chemical Engineering (ChE). We estimate the total square feet need in these departments at 130,000-150,000 net square feet. Of this total, some 30,000 square feet can be met by renovation of space within the current SEAS and Chemistry buildings, leaving 100,000-120,000 net square feet to be provided by new construction.

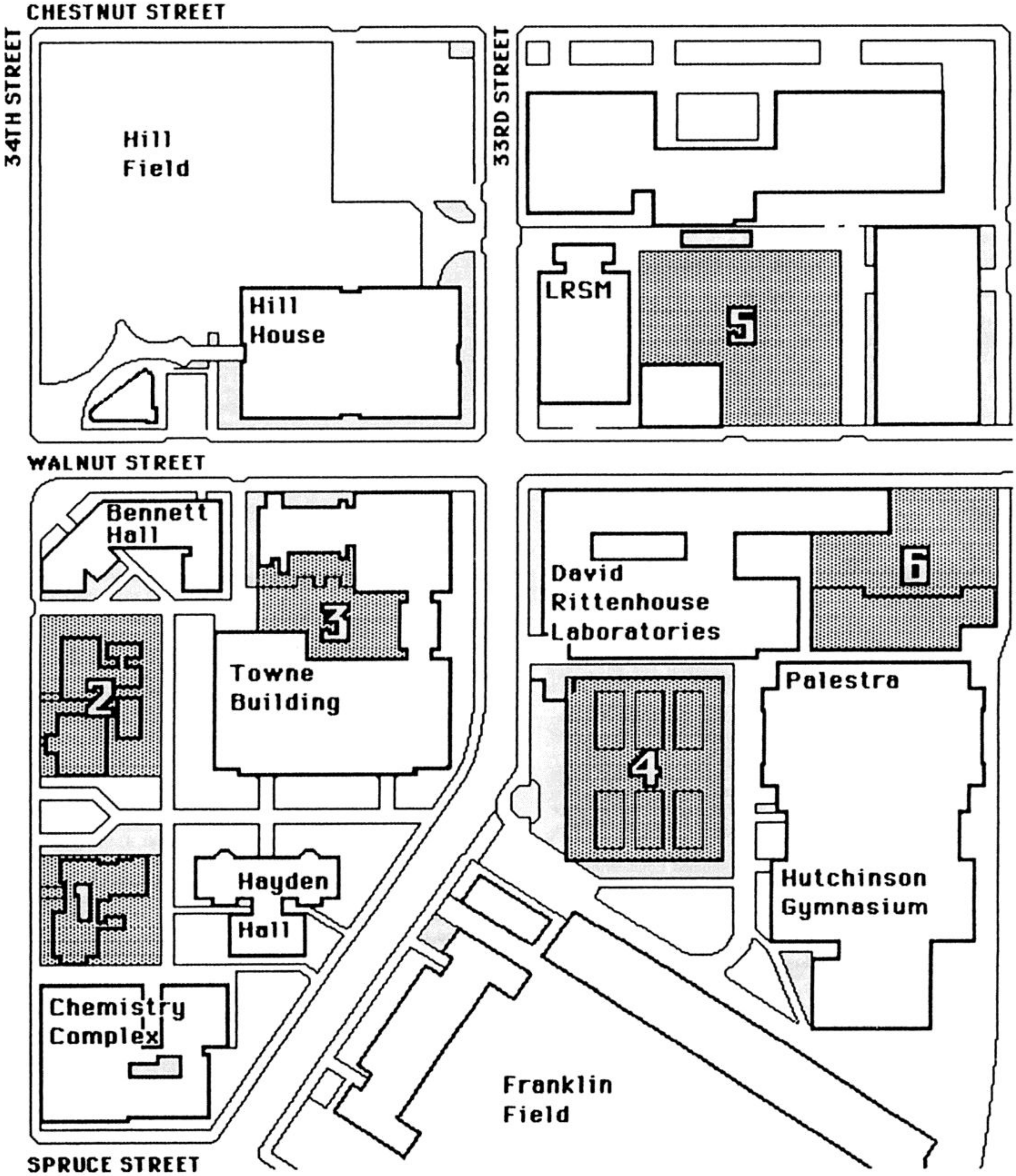
Building sites

With respect to construction in the Physical Sciences and Engineering precinct, the most desirable locations are 1) the Smith building lot; 1a) the Smith building lot expanded in the direction of Hayden Hall; 2) the Morgan-Music lot; 3) the SEAS parking lot infill; 4) the Lott tennis courts; 5) the LRSM parking lot and 5a) the LRSM parking lot expanded to include the Edison building. Of these, 5, 5a) is less desirable because of its distance from current activities in the affected departments. Relocation of only portions of departments such as BE, Chem, ChE, CIS, and EE to this site would be extremely undesirable from a programmatic point of view, and total relocation of large departments such as CIS, Chem, and EE would be prohibitively costly. In what follows, therefore, the Committee restricts its considerations to sites (1)-(4).

Scenario 1. *One major building to meet the total new space needs of Chemistry and SEAS*

The possible locations are (1a), (2), and (4), since (3) is too small a site. The total usable footprint of either (1a) or (2) is approximately 25,000 square feet. A building containing 100,000 to 120,000 net square feet would require a gross square footage of approximately 165,000 to 195,000 square feet. This would correspond to 7 to 8 floors (including basement) of a 25,000 square feet building. As between these two sites, (1a) is somewhat preferable on two grounds: it involves Smith, a less controversial building

POTENTIAL BUILDING SITES



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than Morgan, and it offers a direct physical link to the Hayden Hall library. A difficulty with the one building scenario for either of these sites is that in terms of height and total size such a building would risk being out of proportion with its neighbors.

Site (4), with a 38,000 square feet footprint, could also serve as the site of a single five-six floor (including basement) building that would accommodate the space needs under consideration. It is less desirable for Chemistry than site (1a) would be, since it would put the department in two non-adjacent locations, but would be conveniently close to SEAS, especially if a direct connection to the Towne building (e.g. via tunnel) could be built. Construction of a large building on site (4) would not violate the local scale, would not involve displacement of academic programs, and would leave intact that portion of Penn's architectural heritage represented by the Smith, Morgan and Music buildings. On the other hand, such a building would sit astride the major access routes to the Palestra, which could pose major problems with respect both to pedestrian traffic and building security. In addition, it would necessitate relocation of the Lott tennis courts, one of Penn's major outdoor recreational facilities.

Scenario 2. *Two major buildings to meet the total new space needs of Chemistry and SEAS*

The two possibilities for this scenario are to use site (1), (1a) together with site (2) or site (1), (1a) together with site (3). Use of site (2) together with site (3) is less desirable because of the distance of both of these locations from Chemistry, and use of site (4) to construct a relatively small building (less than 100,000 gross square feet) is inefficient. Use of sites (1), (1a) and (2) has the advantage that the two buildings could be planned as an architecturally unified complex, since they occupy adjacent lots. This would be desirable esthetically and might be attractive for fundraising. The total footprint of 50,000 square feet would allow new space needs to be met with two 4 floor buildings (including basement), thus allowing preservation of the building scale of this part of campus. Use of sites (1), (1a) and (3) has the advantages that the current (Davis and Brody) plan for building on this space could be used intact, consistent with the SEAS planning process. It would allow preservation of the Morgan and Music buildings and require a 7 to 8 floor (including basement) building on site (3). Use of these two sites would obviously represent two separate building projects and might make fund-raising more difficult.

A noteworthy feature of either two-building scenario is that programs requiring high-utility laboratory space could be placed into one building and programs needing only office and computer laboratory space could be placed in the other, thereby reducing the cost of the second building.

Placement of departments and programs within new and renovated space

While the ultimate disposition of space is clearly the prerogative of the Deans of SAS, SEAS, and the Provost, the Committee would like to note the following points:

1) there is a strong rationale for achieving close proximity between Chemistry, Chemical Engineering, and Bioengineering. These departments have common needs for high utility space (e.g. hoods, cold rooms, cell growth facilities) and strong overlaps in intellectual agenda, around the theme of molecular science and technology. A building on site (1), (1a), if large enough, could accommodate parts of these three departments. Members of the Materials Science and Engineering department also share in this overlap, although the distance of (1), (1a) from the LRSM building might prevent a meaningful sharing of new space.

2) It is clearly desirable to maintain the close proximity of Computer and Information Sciences and Electrical Engineering. These departments have strong overlaps with a variety of other departments in the University and it would be desirable to reserve some space within or near these departments that would foster collaborations. Four specific examples are the Electronic Materials, Cognitive Science, Communications and Information Science and Policy, and Computational Neural Science programs. The growing collaboration between CIS and Math, and Physics and EE are others, as is the strong ongoing instructional and research interaction between EE and Materials Science.

The Hayden Hall Library

The long-term future of the Hayden Hall Library depends on whether it can be constructed in an attractive enough manner, both with respect to facilities and functionality, to overcome the traditional preference of departments for having in-house libraries, even if the capabilities of such libraries are limited. The three possibilities for the Hayden Hall Library are that it a) expand to a fully unified Physical Science and Engineering Library (PSEL) that would serve SEAS as well as the departments of Astronomy, Chemistry, Geology (including the map collection), Mathematics, and Physics, b) continue as a joint SEAS and Chemistry library, or c) contract to an Engineering library only with re-creation of a Chemistry library in the appropriate new building, as discussed above. The first two of these possibilities would require relocation of one or both of the BE and Geology departments to allow for appropriate expansion of the Hayden Hall Library.

Relocations

Construction of a new building on site (1), (1a) would require relocation of the History and Sociology of Science (HSS) Department, as well as some studio programs of the Graduate School of Fine Arts (GSFA). Construction of a new building on site (2) would require relocation of the Music Department, as well as of other GSFA programs.

C. Long-term Plans: 1995 to the Year 2000

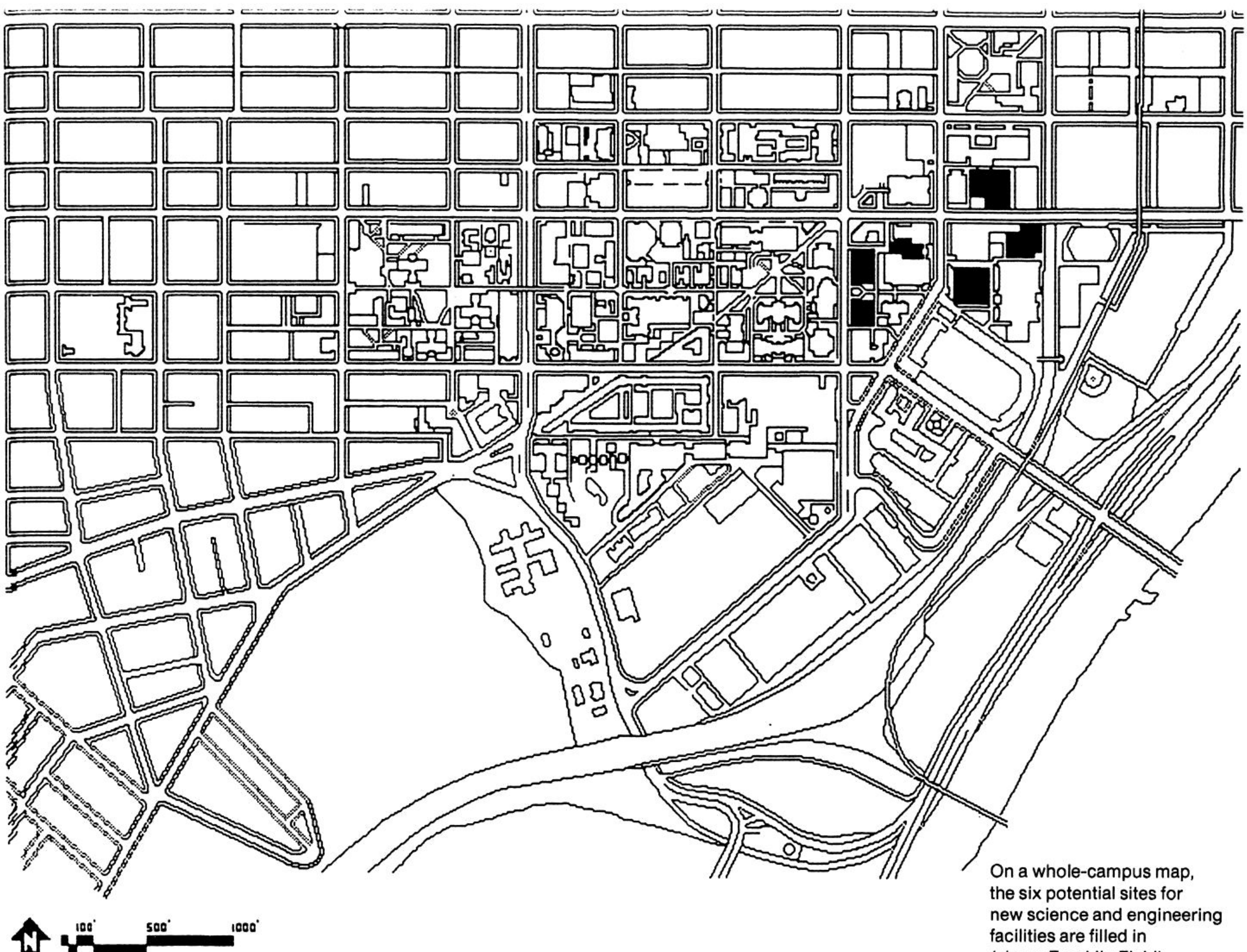
The Committee gathered considerable information , and a strong sense of excitement and commitment from the Natural Science and Engineering departments about their plans for the period 1995-2000. In agreement with School plans the Committee believes that broad strength in science and engineering is vital if Penn is to preserve and enhance its position as the leading research university in the Middle Atlantic region. The momentum achieved through the new and renovated space we have discussed above will move us strongly in the right direction.

Based on current trends, a pressing need in the mid-to-late 1990s will be for new space to accommodate growth in the programs of the LRSM, and, more broadly, in the general area of materials research. Further, by the year 2000, in addition to the space discussed above, the University should have created significant new space in the fields of mathematics, physics, biology, astronomy, geology, mechanical engineering and systems engineering. Planning of such space should also include provision of space for the development of interdisciplinary research, as discussed above.

Preliminary projections lead to an estimate of an additional 100,000 to 160,000 net new square feet that will be needed in the period 1994-2000, including approximately 15,000-20,000 square feet for biology. Most of the new space needs in other disciplines could be accommodated by a new building at a single site. Site (4) would be an attractive candidate if it is not previously utilized (see above). Other attractive potential sites are the LRSM parking lot, possibly expanded to include the Edison building [previously considered as site (5), (5a) in part B above] and the area immediately east of DRL, corresponding to the corner of 32nd Street, site (6).

IV. Concluding Remarks

A major investment in science and engineering at Penn is required over the next decade. The appropriate strategies for optimizing this investment are complex and their implementation urgent if Penn is to enhance its capabilities in these areas. The appointment of the Committee sets a precedent for interschool planning. The Committee's deliberations have been guided by a standard of future excellence in science and engineering and this mutual goal served as a unifying factor in its deliberations. It is important to note that the Committee's charge was limited to a review of current and future needs for renovation and construction of space and facilities for science and engineering. However, as the University develops longer range space plans, it should be examining the special opportunities, connections and changing intellectual horizons offered by science and engineering activities at Penn. We expect that the coming era will be more exciting and more fruitful for science and engineering than the past. It is also clear that new alliances and new disciplines will emerge. Penn, with its compact campus, its broad science and engineering base, and its strategic location, is ideally positioned to take a leadership role in these developments. This Committee has shown the wisdom of Schools planning together. We believe a more broadly based but similarly constituted committee, drawn from all the Penn natural sciences and engineering and having the active cooperation of the respective Deans, would be a very positive force in helping Penn develop its longer range space and facilities plans in the context of emerging intellectual opportunities and initiatives.



On a whole-campus map, the six potential sites for new science and engineering facilities are filled in (above Franklin Field). See more detail, page VI.