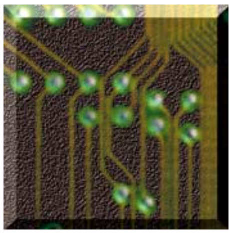


The APL Campus: Past, Present, and Future

Michael L. Hagler, James E. Loesch, William E. Kozak, Ray W. Grose, and Marc R. Connelly

From its establishment in then-rural Howard County, Maryland, in 1954, the campus of APL has played a critical role in supporting the growth and evolution of the Laboratory. This article traces the development of the campus from the groundbreaking in 1954 to its present size of more than 1.6 million square feet of facilities on 365 acres. Insights into future development and into the planning process, which was established to ensure that the campus continues to meet the needs of the Laboratory, complete this history of the development of the campus. (Keywords: Construction, Growth, Land development, Physical plant.)

INTRODUCTION

"The key word characterizing the Laboratory's facilities has been growth—growth in both size and complexity."[1] APL began in a former automotive garage at 8621 Georgia Avenue, Silver Spring, Maryland, which was acquired in 1942. In 1954, the Laboratory moved to a new building on a 290-acre site that was "way out" in rural Howard County, Maryland. Since then, APL has grown to a 365-acre campus (Fig. 1) with more than 1.65 million square feet of laboratory, office, and support space. This growth in floor space is shown in Fig. 2. Today, the facility has an estimated replacement value in excess of $225 million, exclusive of the cost of the land.

THE PROPERTY AND PHYSICAL PLANT

Campus Description and Physical Characteristics

The Howard County campus was procured in two separate acquisitions, the first in 1952–1953 and the second in 1963. The original 290-acre site was purchased for less than $300 per acre! The land slopes gently to moderately from southwest to northeast, with a 200-foot elevation difference. The highest point on the APL campus is 450 feet above mean sea level at the knoll outside the Director's Office in Building 1. The lowest point is along the Middle Patuxent River at Maryland State Route 29. The property is approximately 50% forested. Nearly all of the unforested land is used for buildings, roads, parking, recreational facilities, and open lawns.

Developed and Developable Land

The structures on the property range in size from a 25-square-foot electrical shed to Building 1, the largest building, with 188,000 gross square feet of floor space. Altogether, the buildings and structures have a footprint area of almost 16 acres.

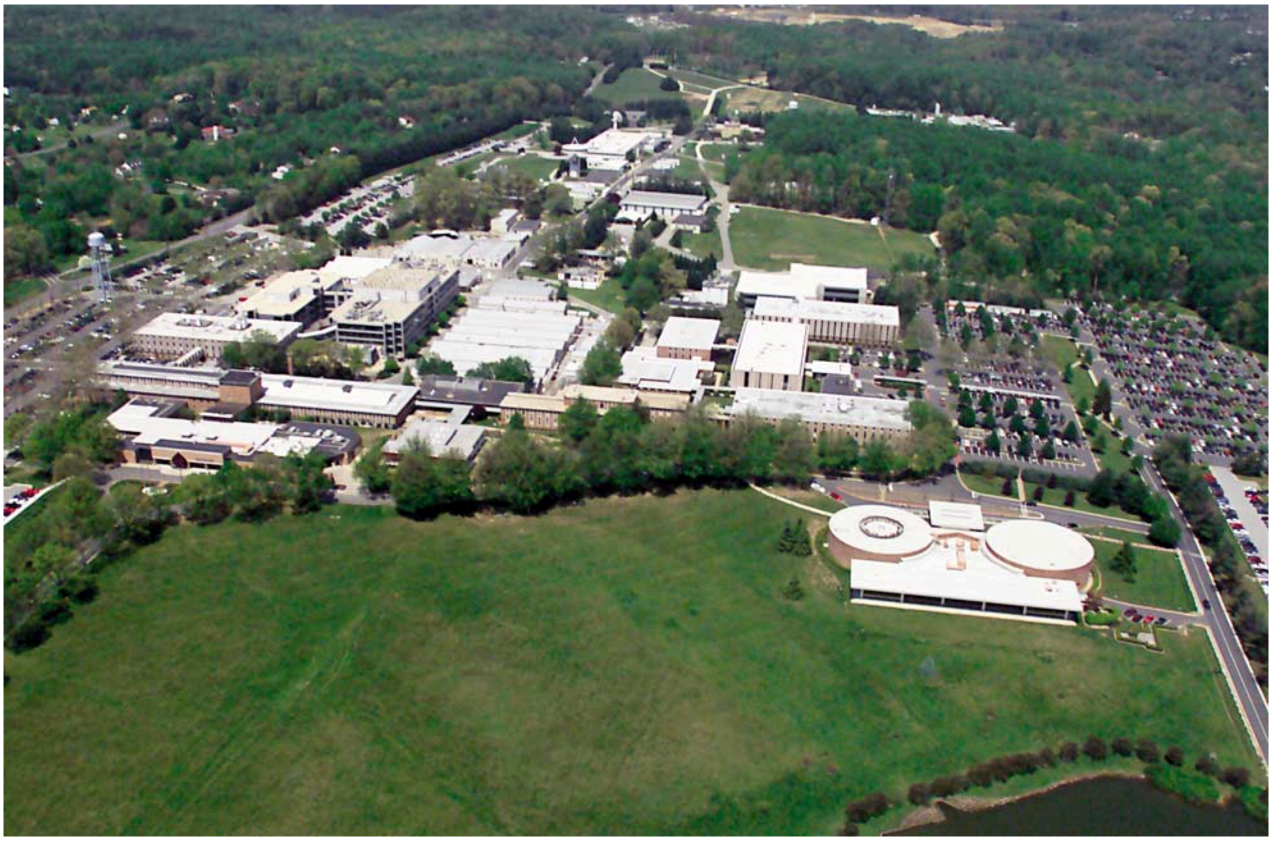


Figure 1. The Johns Hopkins University Applied Physics Laboratory in Howard County, Maryland, today.

There are over 45 acres of paved and 12 acres of unpaved roads and parking lots. With the recent completion of the new parking lot in front of Building 1, the Laboratory now has more than 3,600 paved parking spaces campuswide.

With the current development and use, about 150 acres of property are still developable. The rest of the property (95 acres) is not readily developable because of the presence of flood plain, wetlands, or steep slopes.

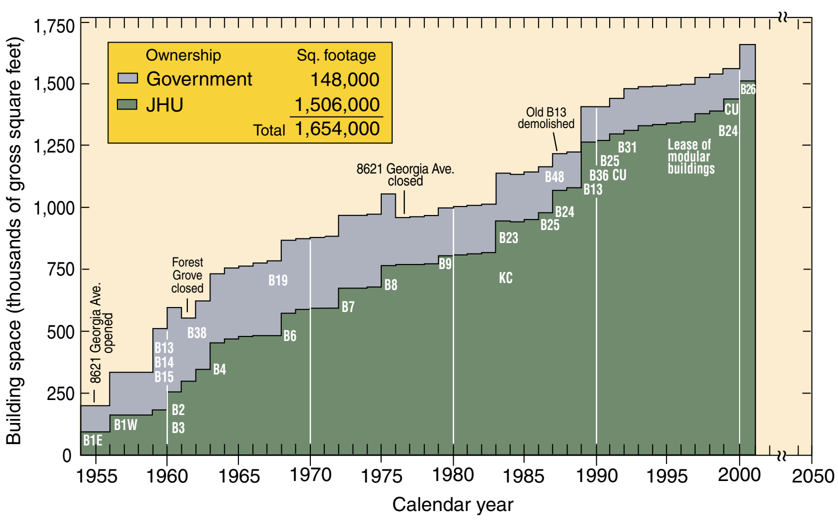


Figure 2. History of growth in floor space at the Laboratory (B = Building, CU = Credit Union, KC = Kossiakoff Center, JHU = The Johns Hopkins University).

The Buildings

Of the 116 structures on campus, almost half are incidental structures having a floor area of less than 5,000 gross square feet. Nine buildings are in the range of 5,000 to 10,000 gross square feet, and 17 buildings are in the range of 10,000 to 50,000 gross square feet. The largest structures, which have more than 50,000 gross square feet, are Buildings 1, 4, 6–8, 12–14, 23, 24, and the new Building 26.

On 10 October 1951, The Johns Hopkins University Trustees' Committee on APL gave initial approval to a resolution authorizing the Laboratory to construct a building on the Howard County site. The

University agreed to defray one-third of the cost, and the Navy agreed to amortize the remainder. The Board of Trustees granted final approval in June 1952 for the $2.05 million building. Ground was broken in February 1953. On 1 September 1954, the Laboratory accepted the first building from the contractor: a 63,000 square-foot structure known as "the new Laboratory."

After construction of the first permanent building at the new APL location, the next priority was to move operations from Forest Grove, a site in Silver Spring that included the APL Propulsion Test Laboratory and temporary buildings housing test, fabrication, and assembly operations. Nearby residents in the fast-growing Silver Spring area had been complaining about the noise of jet engine testing. Because University funds for constructing facilities of this magnitude were limited, inexpensive sheet metal "Butler" buildings, rather than brick, were selected to house the operation at the Howard County site. The result was construction of what was later named the Avery Research and Technology Laboratory, the original Building 13, as well as Building 14. The Avery Laboratory was erected at the northern end of the APL campus, where its noise would be well sheltered from neighbors. Buildings 13 and 14 were located just to the north and west of Building 1.

The next phase was construction of general-purpose office and laboratory buildings to house the staff still at 8621 Georgia Avenue. These buildings were erected at intervals of 3 to 5 years as contract fee accumulations permitted the investment in new construction.

The initial group of permanent laboratory and office buildings was arranged in a cluster located toward the southwestern part of the Howard County site, with Building 1 forming the southwestern corner. Building 2 was built to the east of Building 1 to house the APL Research Center. Building 4, comparable in size to Building 1, was located to the east of Building 2. From 1968 to 1975, three more buildings (6–8) were constructed to the north to house the APL staff who remained at Georgia Avenue. All of these buildings had interconnecting corridors to promote communications among the principal working areas of the Laboratory.

The oldest part of Building 1 is now 46 years old. The newest building, Building 26, with 74,000 gross square feet of floor space, was completed and occupied this spring. Even considering this newest building, the weighted average age of floor space for the major buildings on campus is close to 25 years.

Except for special-use buildings such as Shipping and Receiving (Building 31), the R. E. Gibson Library and Information Center, the Kossiakoff Center, and the shop buildings, essentially all of the major structures on campus can be classified as mixed-use buildings. That is, they contain a mixture of both office space and specialized laboratory space. The general approach to the design of mixed-use buildings has been to put the laboratory spaces in the center of the buildings, between corridors. In this location, the laboratories are less influenced by light and temperature fluctuations. The arrangement also permits offices to be located on the buildings' perimeters, with access to natural light.

Laboratory Ownership

The Johns Hopkins University

APL is unique among large defense-oriented university laboratories in that ownership of its facilities is vested in the University rather than in the U.S. government. The original and subsequent contracts between Johns Hopkins and the Navy and other agencies were of the commercial type (Class II) rather than the university type (Class III), in which Hopkins earns a fee instead of the usual university overhead. The fee accumulations are largely devoted to providing facilities, working capital, and a stabilization fund for the Laboratory. These fee accumulations have been instrumental in providing the capital to acquire the land and most of the facilities at the APL site.

In the initial arrangement for financing the construction of facilities in Howard County, the Navy agreed to an amortization schedule with an option, valid until a specified future date, of purchasing them from the University for the unamortized price. In 1968, a trust agreement was concluded between the Navy and the University that dedicated the Laboratory's land, facilities, and accumulated reserves to be used for continued service to the government for as long as this was desired. The amortization method of compensation for permanent buildings by the government was replaced by a 2% use charge, and the option to buy was canceled. As a result of these arrangements, the land and permanent laboratory and office buildings are owned by JHU, while the temporary and special-purpose buildings are owned by the Navy.

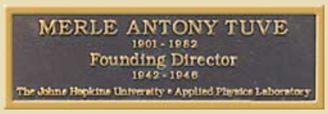
Other Owners

The Navy owns 45 buildings on campus. The most significant of these include Buildings 14, 15, and 19. The rest are smaller test and special-purpose buildings such as the excess property warehouse (Building 42), the Security Force shelters, and the collimation building. The Army owns the Satellite Communications and Control Evaluation Facility (Building 48).

Dedicated Facilities

To keep alive the memory and spirit of the leaders and outstanding scientists who have been associated with APL since its founding more than 50 years ago, the Laboratory has dedicated buildings and facilities (see the boxed insert) to some of the most notable of

DEDICATIONS[2]



In 1992, newly renovated Bldg. 1 was dedicated in honor of Merle A. Tuve, APL's first Director (1942–1946). His personal contribution to the World War II effort was to help invent the proximity fuze and organize APL to develop and produce it. He put the "applied" in the Laboratory's name, establishing the unusual operating philosophy of carrying scientific and engineering developments into factory and field.

Across from the Parsons Auditorium is the Carlyle Barton Room. During his tenure as Chairman of JHU's Board of Trustees, the University established APL in response to wartime need. He continued to serve as a member of a trustee advisory subcommittee on APL. In 1958, upon Barton's retirement, then-Director R. E. Gibson named the special conference and dining facility to honor Barton's faith in APL.

The Director's conference room in Bldg. 1 is dedicated to Peter Stewart Macaulay, who for 30 years was a senior officer of JHU and a strong supporter of APL. Macaulay played a leading part in establishing APL as a division of Hopkins.

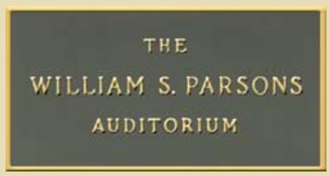
Ralph E. Gibson, Director of APL from 1948–1969, guided the Laboratory through the missile era and into the Space Age. During his tenure, APL gained worldwide recognition for the development of guided missiles, the invention of satellite navigation, and achievements in space science and biomedical engineering. In 1969, as a tribute to his scholarship and leadership, the library building was rededicated in his honor.

Building 7 was dedicated in 1976 to David Luke Hopkins, Vice President of the JHU Board of Trustees during World War II. He was instrumental in the University's decision to assume responsibility for critical wartime research and the establishment of APL to carry it out.

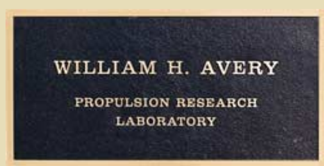
Frank T. McClure came to APL during World War II and became the first Director of the Research Center in 1948. Under his leadership, Research Center scientists proposed the "big bang" model. McClure invented the concept of satellite navigation. He established biomedical research in cooperation with the JHU School of Medicine, an effort that continues today. Recognizing in the late 1950s the role that computers were to play in scientific research, he stressed the need for a state-of-the-art computing center. After his death in 1973, Bldg. 3 was renamed in his honor.

Richard B. Kershner also came to APL during World War II. He was a missile development pioneer who headed the development of 46 Earth satellites for navigation geodesy, geophysics, etc. Kershner led the Space Department from 1959–1978. In 1980, APL's large, modern spacecraft engineering and test facility, Bldg. 23, was dedicated to him.

Alexander Kossiakoff became Assistant Director of APL in 1948. He and Director R. E. Gibson formed a leadership team that lasted for more than 20 years. Kossiakoff served as Director from 1969–1980 and has been APL's Chief Scientist ever since. He headed the Bumblebee guided missile program; contributed to the development of sophisticated computer-assisted shipboard missile defense systems; and directed APL talents and technologies toward solving a variety of national problems. The Kossiakoff Conference and Education Center, constructed in 1982, was formally dedicated in 1983.



When Bldg. 1 was opened in 1954, its auditorium was named for William S. Parsons in tribute to his service to APL, the Navy, and the nation. RADM Parsons, as part of the National Defense Research Committee, was assigned to Section "T" (named for Tuve) to coordinate APL's development of a better fuze for ordnance and later helped introduce it to the Fleet.



William H. Avery did pioneering research on rocket propulsion technology. He served as Head of the Aeronautics Division, Assistant Director for Exploratory Development, and Director of Ocean Energy Programs. The Hypersonic Propulsion Research Laboratory (Bldgs. 10A–F), built under his direction in 1961 and updated throughout the years, was dedicated in honor of its founder.

Steven Muller became the President of JHU in 1972. Throughout his tenure, he carried on the tradition of staunch support for APL. When the need to modernize APL's mechanical and electronic design and fabrication facilities became clear, Muller supported the decision to replace the old "temporary" metal buildings with a new facility. The new structure (Bldg. 13) was dedicated in 1990 in honor of his retirement.

Milton S. Eisenhower, longtime President of JHU, cemented policies between JHU and the Navy that identified APL as a national resource. APL's Research Center (Bldg. 2) became a monument both to Eisenhower's vital spirit and to the spirit of basic science at APL. In 1979, the Center (now the Research and Technology Development Center) was formally dedicated in his name.

these men. Each played a memorable role in shaping APL's identity and guiding it to its place as an internationally recognized research laboratory and an integral part of the University.[2]

Utility Metrics

The Laboratory owns, maintains, and operates all of the public utilities on the property other than the meters themselves (Fig. 3).

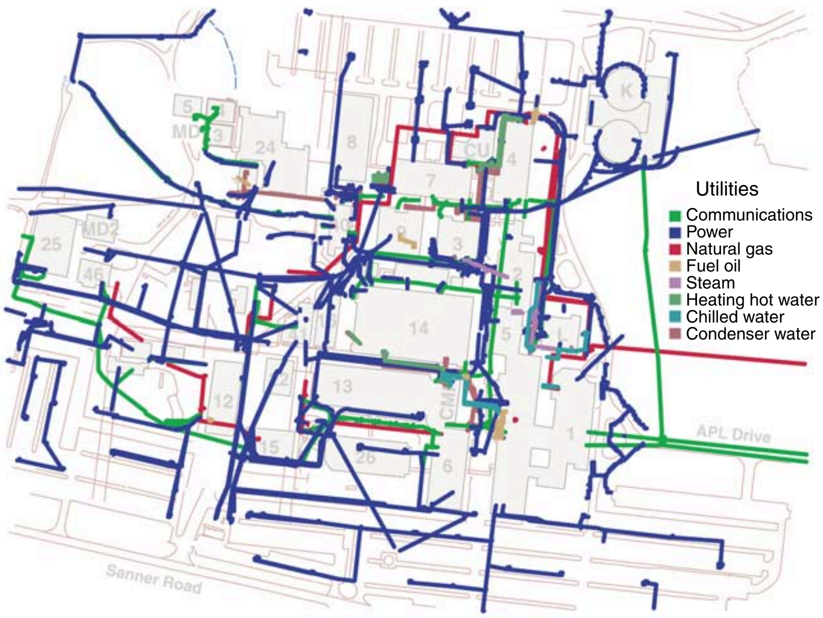


Figure 3. Utility networks at APL.

Water

When the Laboratory first moved to Howard County, the only public water and sewer systems in the county were in Ellicott City. Therefore, APL built and operated its own well water system, including elevated water tanks and a sewage treatment plant.

Since 1987, the Laboratory has been purchasing water, which is distributed across the facility through a 5-mile network of underground mains. The system includes a 55,000-gallon storage tank near Building 6. The sanitary sewer collection system consists of almost 3 miles of pipe. The system removes waste from the buildings and conveys it through a series of underground lines northward through the property to a meter vault located near Building 48. From the metering manhole, the sewer line connects to the Howard County interceptor sewer located along the Middle Patuxent River.

To safely convey rainwater runoff, the Laboratory has over 4 miles of storm drainpipes and an extensive network of catch basins, storm water management ponds, and bioretention facilities. Local and state regulations require APL to control both the rate and the quality of runoff from rainwater that falls on the developed portion of the property. These ponds capture the runoff from roofs, roadways, and parking lots and then release the water to the local drainage basins at a rate no greater than it was when the area was covered with natural vegetation.

New regulations now also require the Laboratory to remove hydrocarbon and other contaminants from the rainwater runoff before releasing it from the property. To accomplish this, the Laboratory has begun installing bioretention facilities. The first facility is a series of depressed and landscaped areas constructed in the medians of the new visitors' parking lot in front of Building 1. The second and third bioretention facilities are both underground structures that were constructed to treat the runoff from Modular Building 6 and the new Credit Union building. The rainwater is treated by routing it through a biologically active soil mix. There, natural bacteria degrade any hydrocarbons into harmless components before the water is discharged into open waterways.

Electricity and Gas

The Laboratory receives its electrical power from Baltimore Gas and Electric's High-Ridge Substation through two independent feeders, one underground and one overhead, to the metering station located just outside Gate 2. After the metering station, the 33-kV power is split into a north and a south feed for distribution to APL-owned substations. Figure 4 shows the locations and service areas for the 13 substations on the property.

With substantial energy costs and decreasing budgets, maintaining the lowest possible demand rate for the Laboratory's electrical service is a prime concern. In 1995, a networked, solid-state metering system was installed. The system has 42 submeters located at the main service entrance for buildings that are large electrical energy consumers and for major equipment in the central mechanical plant. The system gathers data from the submeters and displays electrical demand load profiles for specific buildings (Fig. 5), which can be used to analyze energy consumption, determine load conditions during critical events, and develop a load-shedding procedure to minimize electrical demand charges.

A continuous supply of electrical power is critical to APL operations. Power disruption can be very costly and inconvenient in terms of lost productivity and data, as well as in potential damage to experimental or prototype equipment. Plant Services has adopted a three-prong program to minimize unscheduled shutdowns and expensive repairs through the use of infrared imaging, automatic transfer between main feeders, and distributed backup power supplies.

The entire electrical distribution system is scanned periodically using a thermographic imaging system that responds to heat sources and detects arcing and overheating created by loose, corroded, or dirty terminals.

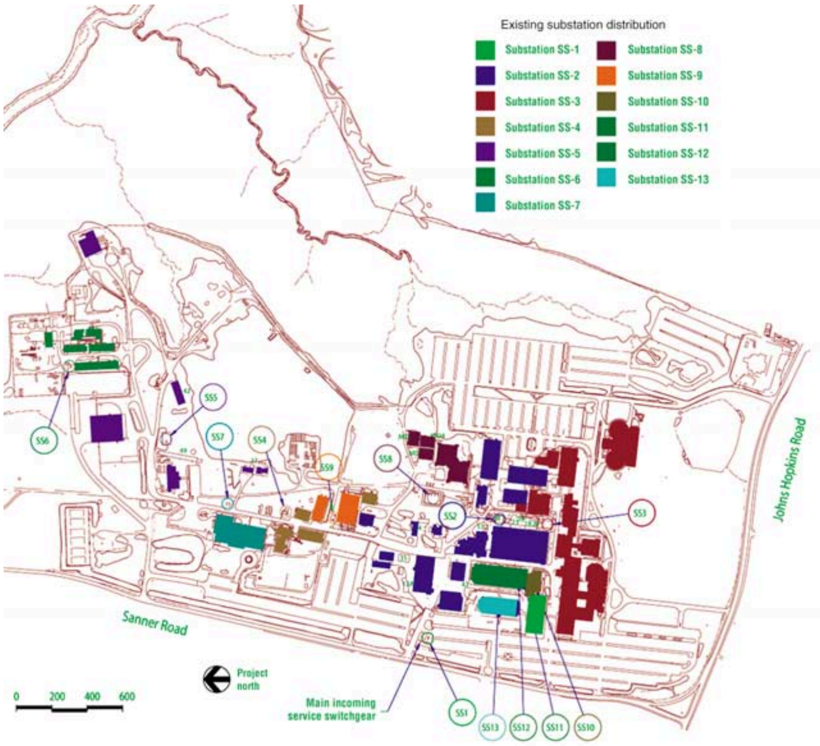


Figure 4. Site Development Master Plan showing locations and service areas of the 13 APL-owned electrical substations.

This process allows potential problems with the electrical system to be detected in time to effect orderly repairs and avoid emergency or unscheduled outages.

Working in partnership with Baltimore Gas and Electric, the Laboratory has entered into an agreement to control the two incoming 33-kV main electrical feeders with a transfer switch that is cutting-edge technology. The Medium Voltage Subcycle Transfer Switch went online in October 1999. It can detect small voltage drops or momentary loss of power in the primary feeder and then transfer the entire electrical load to the alternate feeder within 1/4 of a cycle. The actual transfer is completed so quickly that it is imperceptible to people and equipment. This transfer switch is only the second of its kind at this voltage rating currently installed in the United States.

Figure 5. Sample electrical load profile from the networked, solid-state metering system. The profiles show peak demand for power during daily operations in particular buildings. (The profile for Building 23 is shown.)

Although this new switch minimizes power losses from the electrical distribution system external to the Laboratory, there is also a requirement to eliminate sags, surges, and power outages within the APL distribution system. Because of the critical nature of many projects and programs, the Laboratory has installed nine emergency generators that provide emergency power for life safety systems (e.g., egress lighting and fire alarms) and for crucial operations during an extended outage. Portable generators can provide power to critical building systems during scheduled shutdowns, and uninterruptible power supplies (UPS) of various capacities provide limited power to preserve data while computer systems are methodically shut down.

With the growth in environmental regulations, the Laboratory decided to eliminate the possibility of groundwater contamination from underground oil storage tanks by converting existing oil-fired boilers to natural gas. A 6-inch medium-pressure line supplies natural gas to an outdoor metering and pressure-reducing facility just outside the R. E. Gibson Library. The meter was recently upgraded to continuously report actual usage rates. This has allowed APL to join a consortium of natural gas purchasers in the area who buy gas on the open market to reduce costs.

Districted Utilities

In addition to the regular public utilities, a number of large heating and cooling plants serve more than a single building. Boilers in Building 1 provide heating for Buildings 1–3, 5, 6, 13–16, 18, 21, 26, and 28. Additional boilers in Buildings 4 and 24 provide heating for Buildings 4, 7, 8, 24, and the original Credit Union building. The Central Mechanical Plant just south of Building 13 provides cooling for Buildings 1, 2, 6, 13, 26, and the Gibson Library. These districted utilities provide reliable and cost-effective heating and cooling to almost 75% of the total gross floor space at the Laboratory.

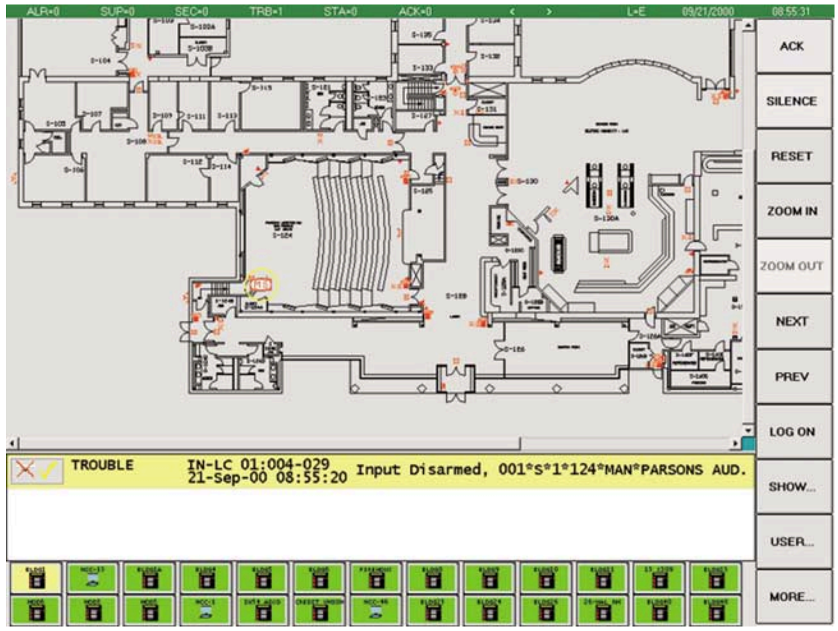


Figure 6. Network command center graphics locate and display alarm and trouble events, supporting quick reaction to a life safety emergency.

Life Safety and Fire Protection Systems

Fire protection systems. A computer-controlled fire alarm system protects the life safety of all APL employees. The Laboratory has trained and certified personnel on staff who are responsible for maintaining, programming, and operating the system.

In 1995, a multi-year program was begun to install a microprocessor-based fire protection system throughout the Laboratory. Over 90% of the building square footage is now protected by a system consisting of 18 control panels that are networked to support approximately 7000 devices. In this addressable-type fire alarm system, each smoke detector or initiating device has its own identification, and if that device goes into trouble or alarm, the fire alarm system console operator knows exactly where it is and can quickly dispatch someone to investigate. Each event is reported and recorded at the network command center, where screen images show the exact location of the device on the building's floor plan (Fig. 6). The system is monitored by the Security Force 24 hours a day, 7 days a week. The facilities that are not yet protected by the new addressable fire protection system are protected by conventional analog fire alarm systems that are tied into the new addressable system to ensure consistent response.

Approximately 1.5 million square feet of the Laboratory's buildings are currently protected by wet-pipe sprinkler systems. The systems safeguarding 45% of the total protected area have been designed and installed since 1991 in buildings that previously had no sprinklers.

Indoor air quality. Ensuring good indoor air quality for Laboratory staff is a high priority and joint responsibility of Plant Services and the Environmental Health and Safety Office. Procedures have been established for monitoring and ensuring acceptable air quality standards by providing adequate outdoor air ventilation, regularly sampling the indoor environment for concentration levels of carbon dioxide, and promptly investigating reports of unusual odors. The Laboratory's primary method of ensuring good air quality is to eliminate contaminants at their source and provide a ventilation rate that meets or exceeds the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 62-1999, "Ventilation for Acceptable Indoor Air Quality." The methodology for monitoring indoor air quality involves measuring the concentration of carbon dioxide, a normal constituent of the atmosphere exhaled by building occupants, at several locations within the buildings. Maintaining a steady-state carbon dioxide concentration level at or below a threshold set at 700 ppm above the outdoor air concentration, which normally ranges from 300–500 ppm, is an indication that the ventilation rate meets the ASHRAE standard.

A building automation system has been integrated into new equipment installations and has replaced older pneumatic and electric control points in 24 of the 26 major buildings. These points control equipment startup and shutdown, temperature, and humidity, as well as the operation of valves, dampers, relays, and other on–off functions. With approximately 1700 sensors and switches, the system primarily monitors and controls heating, ventilation, and air-conditioning systems; however, outside lighting and special requests for monitoring critical areas within the Laboratory can also be accommodated. This system has proven to be a great benefit to APL because it provides instant updates on the building systems and allows problems to be solved before building occupants can perceive any significant variation from normal conditions.

High-Tech Facilities

Clean rooms. In the microelectronics operation on the first floor of Building 13, electronic components are fabricated in clean rooms down to Class 100. These laboratories were designed with 100% raised floors to facilitate changing of equipment with minimal cost and impact on the clean environment. In addition, a central utility corridor serves the area with utilities, reverse osmosis and deionized water, and special gases. This utility corridor allows the fabrication work to go on in the clean space uninterrupted by equipment maintenance or refurbishment of gas sources.

Building 23 has the largest clean space at the Laboratory, large enough to assemble and test a satellite the size of a small pickup truck. These rooms are served by a bank of fans that circulate the air horizontally through special HEPA (high-efficiency particle arrestor) filters.

Specialized computer/electronics laboratories. The essence of APL is its laboratories. Sometimes these high-tech areas are designed and constructed with in-house construction forces. The Combat Systems Evaluation Laboratory (CSEL) in Building 6 (Fig. 7) is an example of a highly sophisticated laboratory built by in-house staff. Others were designed and constructed by outside companies.

Common to most of the laboratories is a raised floor that facilitates both cabling between different pieces of equipment and, in some cases, cooling. The Laboratory has more than 115,000 square feet of raised floor. Another common feature in most of APL's high-tech laboratories is specialized utility requirements, from shipboard 400-cycle power to UPS systems. Where there is power, there is heat, and therefore the need for air-conditioning. The base building systems are designed to cool a standard office. However, most computer laboratories far exceed this standard heat loading; therefore, supplemental room cooling from booster air-conditioners has been designed and installed.

Since many of these laboratories also contain one-of-a-kind equipment that is essential to meeting mission objectives, security and safety are of particular concern. For critical applications or where sponsors require redundant protection, early detection and specialized fire suppression systems are installed. These systems continuously monitor ambient conditions in the laboratories. They send an alarm to the Security Force at the first hint of a problem. This early warning allows the Security Force and the Fire Department to respond and contain problems before they spread and cause serious damage, possibly destroying irreplaceable data and equipment or taking entire laboratories out of service for extended periods.

Figure 7. CSEL in Building 6 was constructed by in-house staff.

POSITIONING APL FOR THE FUTURE

Although future details of the Laboratory's facility are difficult to predict, looking at the past reveals trends that will continue to affect the development of the campus. The staff level has remained relatively constant since the 1960s, but the gross square footage has more than doubled. This growth is the result of increasing demands for specialized laboratories and facilities. These same specialized laboratories and facilities differentiate APL from peer organizations and other similarly oriented entities.

A New Approach

To ensure that planning would be approached systematically, the Laboratory established a Site Development Planning Team composed of Laboratory-wide, department-level management to develop a high-level, long-range vision for the facility. Site development required a unified, disciplined systems approach. APL is known for its systems approach to solving problems of national importance, and the team reasoned that this same approach would be most appropriate for a long-range site development activity. The team's broad charter was to look at potential development scenarios for the entire campus without attempting to project changes in staff size or business areas. By eliminating these constraints, the team could look objectively at existing facilities and form long-range strategies. Their approach was to examine the current site development plan and see how it had evolved in the past. They then investigated site development activities at other organizations similar to APL. The team developed a survey for the potential residents of the site in 2015 to understand their perceptions of facility needs. They assessed APL's current and anticipated needs, noting where the existing facility development approach had resulted in shortfalls to those needs.

The team developed a list of important planning factors. Co-location surfaced as one of the most important factors. However, the definition of co-location was expanded beyond its traditional meaning of departments or groups having adjacent locations. Often co-location with facilities and resources is just as important as co-location within an organizational structure. The square footage required per staff member, exclusive of laboratories and specialized facilities, was examined. It became clear that more informal and formal meeting space was needed to facilitate increasingly team-based work methods.

The importance of access to the facility for both staff and sponsors was recognized. Space must be easily and inexpensively reconfigured as demands and evolving sponsor requirements dictate. Maintaining the proximity of parking was also a significant factor. Even though APL has excellent parking compared with many organizations, staff members still place a high priority on preventing degradation of the current parking parameters and, if possible, improving them.

Aesthetics took on increased importance. Although the Laboratory has an attractive external appearance, its much more industrial character inside the perimeter is not conducive to the movement of staff or materials.

The commercial and residential development of the area surrounding the Laboratory was another important factor. Initially, the APL campus was considered so rural that provisions were even made for supplying gasoline to staff members because there were no gas stations within a reasonable distance of the site. This has certainly changed. The Laboratory is now being ringed by both commercial and residential development, which is having an impact on traffic flow around the campus.

Vision and Goals

The Site Development Planning Team articulated a vision for site development: to "create a unified and attractive campus that optimizes flexibility of space, accessibility of people, facilities, and services, and fosters a work environment which supports APL's mission."

Among the goals of the long-range site development process is one to ensure flexibility of space. At present, the need for even a small increase in space for an activity requires a series of moves. Flexibility of space is the ability to reconfigure areas rapidly and at a reasonable cost to respond to changing requirements. The environment needs to support the diverse range of activities at the Laboratory and the various methods of work and interaction among the staff. It must be attractive, conducive to work, and professional in appearance.

Another goal was that site development should enhance productivity for all staff members in all facets of their work life. Several subgroups were formed to pursue various strategies for site development. Many common ideas and themes evolved, such as moving the industrial and services areas farther north. The campus has grown around these areas, making the movement of materials and staff more difficult. It was felt that the space occupied by these services would be better used for the core business of the Laboratory.

There is also a need for a centrally located office building with a cafeteria and other employee services. The subgroups concluded that the renovation of existing buildings, rather than their total rehabilitation, would be the most cost-effective approach to meeting the Laboratory's evolving needs. Substandard buildings, of course, must be eliminated and replaced. However, the basic approach will not be to tear down or totally rebuild existing buildings but to effectively renovate them to meet the Laboratory's current needs. The internal roads and walkways will be redesigned to provide a more efficient flow of pedestrians and motorized traffic and to facilitate interaction and movement throughout the campus.

A long-range goal of a more campus-like environment with larger green spaces was an overall theme. This would produce a collegial atmosphere with facilities that foster interaction.

The team also recognized that although the Laboratory has many areas of expertise and a skilled and talented plant facilities staff, site development is a specialized area. Therefore, APL established an ongoing arrangement with the site architectural engineering firm of Einhorn, Yaffee, and Prescott to provide continuity and perspective to the site development process. The firm was selected through a rigorous competition to ensure their technical capability and their compatibility with the Laboratory's culture.

The initial Site Development Master Plan has been completed. It calls for construction of general-purpose buildings at the northern end of Buildings 13 and 14, a districted utilities building, and a systems integration building north of Building 24.

The conceptual mid-term development of the campus is illustrated in Fig. 8. Although it is unlikely that all of these facilities will be constructed, planning and siting ensures that they will be located according to a well-conceived and integrated scheme consistent

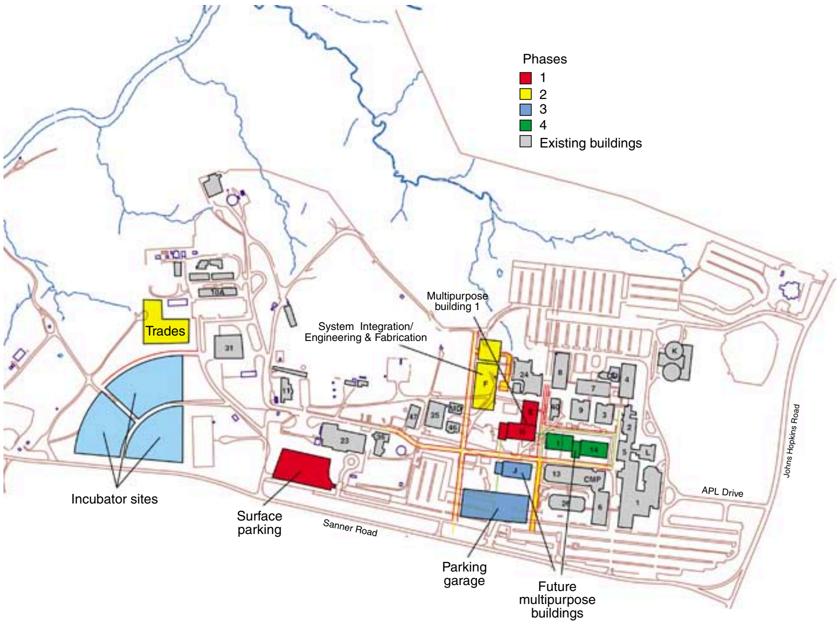


Figure 8. Mid-term development blueprint of the APL campus. While it is unlikely that all of the new facilities shown on this proposed site plan will be constructed, planning and siting them ensures that all new construction will conform to the goals for the Laboratory established by the Long-Range Site Development Team.

with the goals for the facility established by the Long-Range Site Development Team.

The staff has been and always will be the single most important resource of APL. However, the facilities enable the staff to perform their work efficiently and effectively. The Laboratory has a campus that it can be justifiably proud of. It is robust, has evolved to support new program needs, and through the long-range site development process, will continue to support an evolving Laboratory throughout the next century.

REFERENCES

[1]"The Laboratory's Facilities—Micromilling and Megabytes," in *The First Forty Years: A Pictorial Account of the Johns Hopkins University Applied Physics Laboratory Since its Founding in 1942*, Schneidereith & Sons, Baltimore, MD, p. 159 (1983).

[2]Knox, M. L., Edgeworth, E., Kundratic, A. L., Mothershead, J. W., Rogers, G. W. III, et al., *Dedications at APL*, JHU/APL, Laurel, MD (1995).

ACKNOWLEDGMENTS: The authors gratefully acknowledge Dr. Alexander Kossiakoff for his contributions on the early history of the APL campus.

THE AUTHORS

MICHAEL L. HAGLER is a member of the APL Principal Professional Staff and the Assistant Department Head for Services in the Technical Services Department. He received a B.A. from the State University of New York at Buffalo, an M.S. and a postgraduate certificate from JHU, and a Ph.D. from the Union Institute, Cincinnatti, Ohio. Since joining APL in 1984, he has supervised the Mechanical Fabrication Group and the Plant Engineering Branch in TSD. Dr. Hagler has been an instructor of technical management in the JHU School of Engineering since 1989 and is a Student Advisor and member of the Technical Management and System Engineering Program Committee for the Whiting School. His e-mail address is mike.hagler@jhuapl.edu.

JAMES E. LOESCH received his B.S. in civil engineering in 1973 from Pennsylvania State University and his M.S. in technical project management in 1998 from JHU. He joined APL in 1986. He is currently the Plant Facilities Chief Engineer and a member of the Principal Professional Staff. Since joining APL, he has managed projects representing a capital investment of over $70 million and a gain of more than 500,000 square feet to the Laboratory's physical plant. He currently manages the strategic Site Development Master Planning Project. Mr. Loesch teaches and writes on code compliance, facilities management, and organizational topics. He is President of the Chesapeake Chapter of IFMA; a licensed professional engineer in Maryland, Virginia, and Pennsylvania; a certified facility manager; a member of the Building Officials and Code Administrators; and a member of the Board of Directors for the Maryland Energy Institute. His e-mail address is james.loesch@jhuapl.edu.

WILLIAM E. KOZAK is the Group Supervisor for Plant Operations in APL's Technical Services Department and a member of the Senior Professional Staff. He received a B.S. in engineering from the U.S. Coast Guard Academy in 1970, a B.S.C.E. from the University of Illinois in 1974, and an M.E.A. in engineering administration from The George Washington University in 1988. Before joining APL in 1996, he served in a variety of civil engineering and facility management positions with the Coast Guard. He is a Fellow in the Society of American Military Engineers and a registered professional engineer. His e-mail address is william.kozak@jhuapl.edu.

RAY W. GROSE is the Group Supervisor for Plant Construction in APL's Technical Services Department and a member of the Senior Professional Staff. He received his B.S. in engineering from The Johns Hopkins University in 1977. Prior to joining APL in 1985, he spent 21 years working for Henry Adams, Inc., Consulting Engineers in Towson, Maryland, as an electrical project engineer responsible for the design of power and associated electrical and communications systems for industrial, commercial, and health care facilities. His e-mail address is ray.grose@jhuapl.edu.

MARC R. CONNELLY is the Group Supervisor for General Maintenance Operations in APL's Technical Services Department and a member of the Senior Professional Staff. He is a certified executive housekeeper and a certified executive laundry manager. Prior to joining APL in 1989, he worked for various hospitals as the housekeeping manager. He is a member of the Cleaning Management Institute, the Maryland Recyclers Coalition, and the National Recyclers Coalition. His e-mail address is marc.connelly@jhuapl.edu.