Sustainable Design Recommendations for Adaptive Re-use of Building 170 at Fort McPherson

Atlanta, Georgia

Coordinated by
Southface Energy Institute
July 31, 2000

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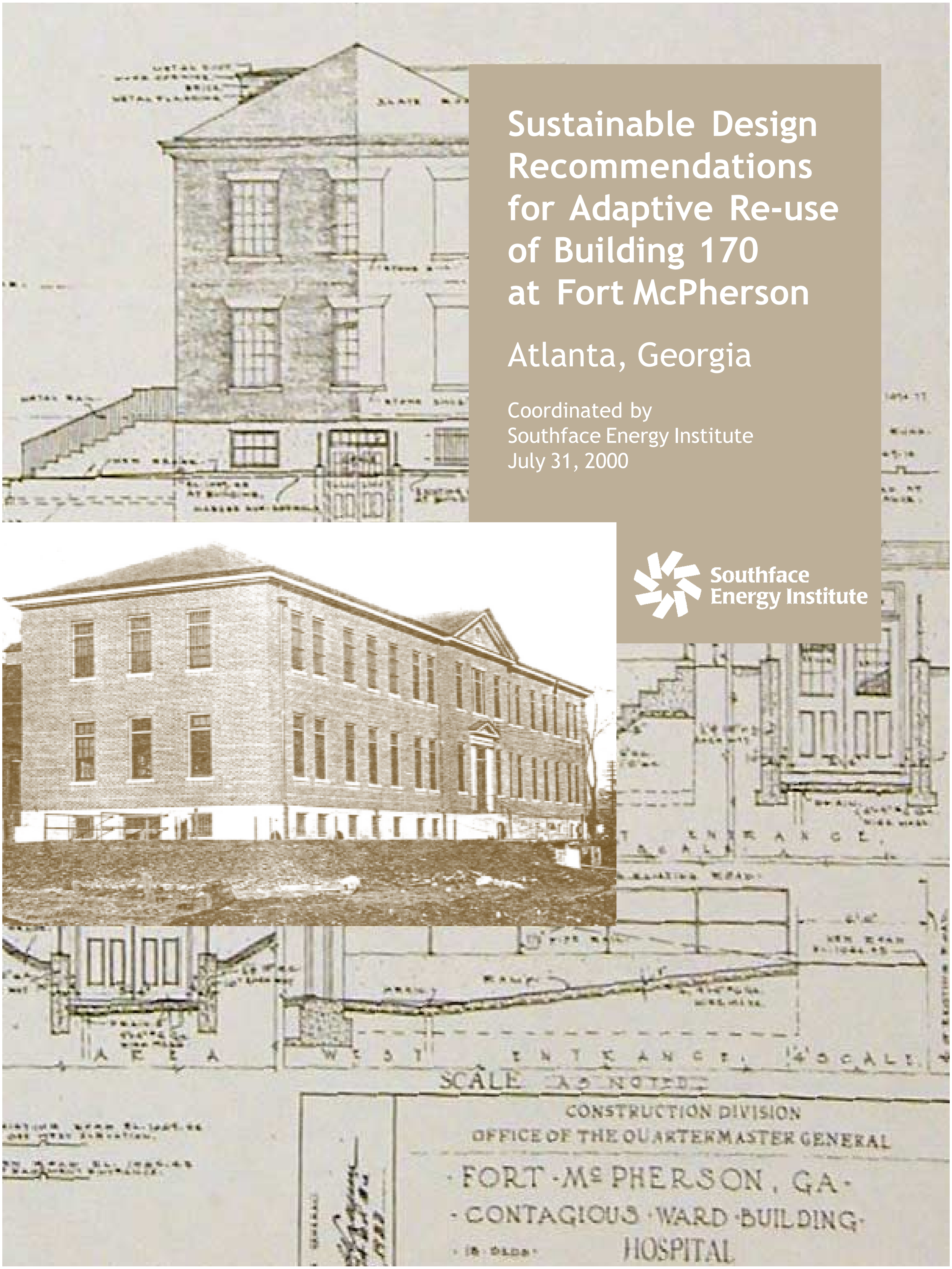

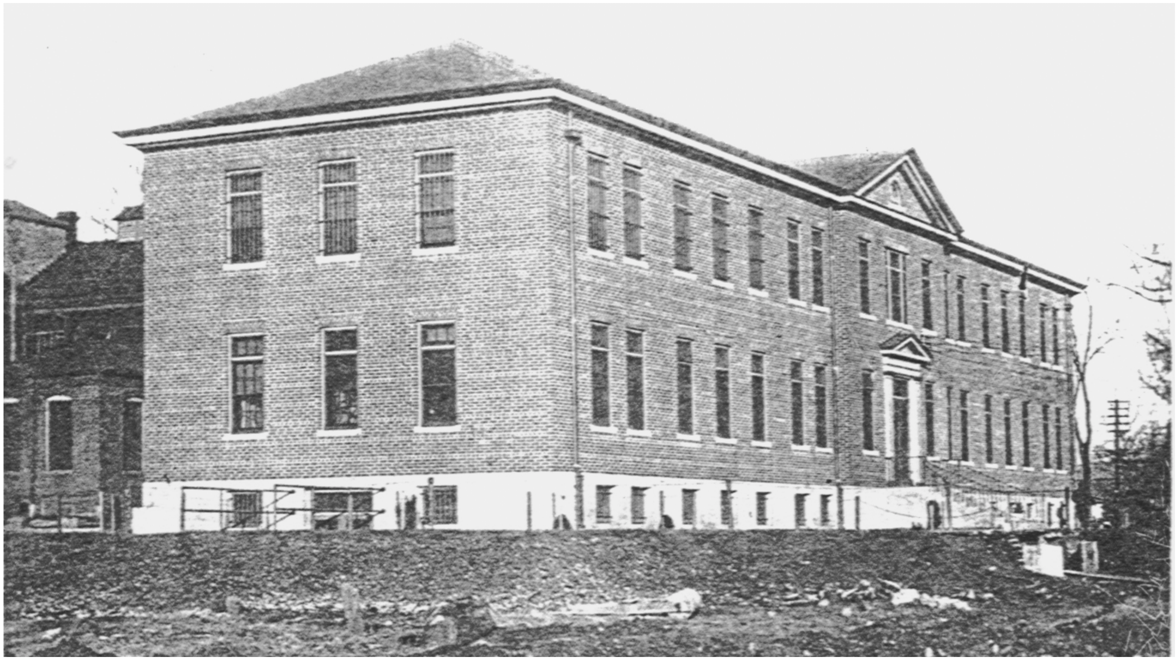

Sustainable Design Recommendations
for the Adaptive Re-use of Building 170 at Fort McPherson

Fort McPherson
Atlanta, Georgia

Report produced under contract DACA01-00-T-0060 on behalf of the
Army Environmental Policy Institute

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1.0 Executive Summary

In 1998 and 1999 two important Executive Orders were signed by the President**, EO 13101** called *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*, and **EO 13123** called *Greening the Government Through Efficient Energy Management*. The purpose of this project is to assist the Army in meeting these important Federal mandates and to demonstrate sustainable design principles on renovation plans for an historic building at Fort McPherson in Atlanta, Georgia. Building 170B will house offices of the Army Environmental Policy Institute (AEPI) which is charged in part with creating policies for the Army that meet the "Green" E.O.s and will provide a showcase for sustainable design. Building 170 was originally two separate structures (A & B) connected by a second story bridge and used as a hospital.

To Green Ends

A sustainable design workshop, or charrette, was held on June 20-22, 2000 at Fort McPherson to develop sustainable design solutions for the renovation project. In order to meet the higher objectives outlined in E.O.s 13123 and 13101, it is widely believed that an integrated design approach is the only effective way to create high performance building designs that meet multiple user and environmental objectives. To this end, AEPI contracted with the Southface Energy Institute to coordinate the design program, and together invited over 20 experts from around the country. (see Appendix A)

An array of general and specific design recommendations were generated which, if broadly or even in part are incorporated in the building development plans, will create a significant national case study of integrated and green design principles. If a significant number of these recommendations are achieved during demolition and construction, the building will become an ongoing "green briefing" for numerous Army policy makers and base construction and operations personnel from around the country for years to come. Taken together, the strategies in this report reduce the environmental impact of the building, improve occupant quality of life, and reduce the operating costs of the facility. The recommendations also help preserve and enhance the historic features of the building, and create an effective educational tool.

More specifically, it is estimated that if all sustainable design recommendations are followed, the building will:

- Use 50% less energy than current conditions (see Appendix F)
- Save over 300,000 gallons of potable water per year (see Appendix I) (50% reduction)
- Save over $17,000 per year in utility costs (see Appendices F & I) (50% reduction)
- Treat over 700,000 gallons of stormwater runoff each year (100% reduction)
- Prevent over 460,000 pounds of carbon dioxide production per year (60% reduction)
- Divert over 2 million pounds from area land fills during construction (90% reduction)
- Save up to $500,000 in construction costs (See Appendix I)(15% reduction)
- Qualify as Gold Certified in the USGBC LEED™ system (see Appendix H)
- Increase real estate value by up to $1.7 million (see Appendix I)
- Cost no more than a conventional renovation (see Appendix I)

2.0 Project Overview

The purpose of this project is to assist the Army in demonstrating sustainable design methods on renovation plans for an historic building at Fort McPherson in Atlanta, Georgia. Once the renovation is complete, Building 170B will house offices of the Army Environmental Policy Institute (AEPI) and will provide a showcase for sustainable design.

A sustainable design workshop, or charrette, was held on June 20-22, 2000 at Fort McPherson to develop sustainable design solutions for the renovation project. AEPI contracted with the Southface Energy Institute to coordinate the design program, and together invited over 20 experts from around the country, including significant support from the Construction Engineering Research Lab (CERL) and Fort McPherson engineering staff. Over a two and one half day period, this interdisciplinary team worked intensively to create a set of recommended strategies and move toward a nationally recognized standard for "green" buildings called the Leadership in Energy and Environmental Design (LEED™) created by the US Green Building Council.

The primary objectives of the renovation are to:

- Preserve and enhance the building's historic quality
- Provide a quality work environment for AEPI
- Create an accessible educational tool to promote green building technology
- Minimize the building's environmental impact

This report summarizes the findings of the sustainable design workshop. Information in this report is grouped into three categories, as described below:

Sustainable Site & Water Use: Includes all aspects of the design outside of the building, such as low-impact landscaping, stormwater management, and sustainable transportation, plus all water conservation issues.

Green Architecture & Materials: Includes the structural design of the building, construction waste management, resource efficient and healthy interior and exterior finishes, windows, lighting, insulation, indoor handicap accessibility, and office operations.

High-Performance Energy Systems: Includes efficient heating, ventilation, and air conditioning (HVAC), water heating, alternative energy sources, occupant health and comfort, and building measurement systems.

3.0 Project Objectives

Four basic objectives were initially established:
- Preserve and enhance the building's historic quality
- Provide a quality work environment for AEPI
- Create an accessible educational tool to promote green building technology
- Minimize the building's environmental impact (maximize pollution prevention)

As part of the design workshop, specific goals were established to meet the four general objectives above. These goals are clearly aggressive, and in many cases may not be feasible with available technology or funding. However, they provide the basis for the recommendations made in the next section.

The following goals were set:

Sustainable Site & Water Use
- Harvest and clean all on-site stormwater
- Eliminate heat island effect of buildings
- Generate no light pollution
- Offset building-created carbon dioxide with new vegetation
- Offset transportation-created carbon dioxide with new vegetation
- Create a pedestrian-friendly site
- Obtain all water from the site
- Clean all building wastewater on site

Green Architecture & Materials
- Re-use all of the existing building and materials
- Obtain all new materials from local resources
- Generate no waste on site (all waste reused or recycled)
- Use only healthy and environmentally benign materials
- Create a maintenance-free building ("self-healing")

High-Performance Energy Systems
- Use no external power sources
- Use only renewable energy sources
- Generate no toxic emissions
- Create more energy than is used
- HVAC systems use no energy and require no maintenance
- All lighting provided by daylight
- No indoor health contaminants
- Total individualized comfort (thermal, light, noise)

4.0 Description of Existing Building Conditions

Building 170 was originally two separate structures, constructed in 1930 and 1939. The buildings were connected in 1939 by a second story bridge, and were used as a hospital until about 1998. The buildings originally faced a central open space. Building 170A (constructed in 1930) sits to the north of the central space, and Building 170B (constructed in 1939) sits to the south of the central space. The buildings are basically mirror images of each other, with minor differences in floor plan and window size. The outside dimensions of both buildings are approximately 34 feet by 130 feet, with the longer sides facing north and south, and are identical in basic construction. Modifications to the original structures beyond the 1939 bridge include a first floor lobby, an ambulance ramp, a connector to Building 171 (to the north), and a connector to the west. The building that once connected to Building 170 from the west no longer exists.

Buildings 170A and B have been vacant for a number of years and have both suffered from delayed maintenance and have not been modernized in terms of life-safety, handicap accessibility (ADA), lighting, electrical and communication wiring, elevators, etc. This fact will add cost to the basic renovations required to bring the building up to modern standards.

The main road near Building 170 runs just east of the building, and is lined with trees and grass. Unshaded asphalt parking areas lie to the south and west of the building, and additional parking is across the street. Deciduous trees located on the east side of each building plus a tree near the southwest corner of Building 170A provide some summer shading. Second floor windows are mostly shaded in summer by a 1.75 foot roof overhang, but other windows are not.

Both original buildings were two-story, plus basements. Each floor includes approximately 4,420 gross square feet. Thus, the total floor area for each building is about 13,260 square feet. The two-story connector rests on a crawlspace and does not connect the two basements. First and second-floor connector areas are about 2,240 and 430 square feet respectively, bringing the total current facility area to about 29,190 gross square feet (excluding connectors to the north and west).

Exterior walls are structural brick and terra cotta tile with plaster interior. Interior walls are primarily plaster on terra cotta tile. The roof is wood-frame rafter construction with slate shingles, and the attic space contains approximately half an inch of fiberglass insulation. There is additional roof insulation in the connector. Most floors are linoleum tile on top of concrete with an original terrazzo perimeter baseboard. The windows are wood-frame, single-pane, with true-divided light. There are transom windows above all exterior windows and transom windows above interior doors within building 170B. Most basement windows do not allow light into the building because they are blocked by dense shrubbery, have been painted over, or have been in-filled with concrete. Some first and second floor windows have been in-filled with brick. Additionally, dropped ceilings throughout the building block light from transom windows.

The building’s storm drainage systems are currently inadequate and have not been maintained. Many downspouts discharge water directly into the foundation, which are likely sources of the high humidity and mold on the basement level.

As-built floor plans and elevations of the original structures are available. Other available drawings include floor plans from a 1995 asbestos survey and proposed demolition plans for the renovation project.

Space heating is provided by a natural-gas-fired boiler, with an estimated seasonal efficiency of 70-75 percent. Air conditioning is by a 110-ton Trane air-cooled chiller with reciprocating compressors, and an estimated EER of 8.0 to 8.5. A two-pipe system distributes hot or chilled water to several air handlers and fan-coil units.

Domestic hot water is supplied by a fairly new electric tank-type heater, which is estimated to be standard efficiency.

The facility is equipped with an automatic sprinkler system in approximately 20 percent of the floor area.

5.0 Sustainable Design Recommendations

The recommendations in this section were collaboratively generated by a diverse team of building experts and site designers who participated in a sustainable design workshop held at the Fort McPherson Army Base in Atlanta, Georgia, June 20-22, 2000. The outcome of this integrated design process is a set of concept drawings and specifications that will significantly reduce the environmental impacts of the building, improve occupant health and performance, reduce the lifecycle operating costs of the facility, preserve and enhance the historic features of the building, and create an effective educational tool to promote green building technology. It is assumed that the building is to be returned to its original 1934 configuration of two facing buildings with a second story bridge.

If all the recommended strategies are incorporated, the project will score 44 out of a possible 69 points on the US Green Building Council's LEED™ rating system, or a rating of Gold Certified. Please see Appendix H.

The following strategies were recommended for this project:

5.1 Sustainable Site & Water Use

Strategy 1: Protect and enhance all existing, healthy trees and shrubs
It is recommended that a tree survey be completed that will identify species, size, location, and health of all trees located on the project site (**Please see Appendix E for the Site Plan**). Install cyclone fencing around all trees selected for saving under a Tree Protection Plan. Existing shrubs that need to be removed should be replanted at another location.

Strategy 2: Use soil retention systems during construction
It is recommended that, as part of a Grading Plan, the existing soil on site be retained during demolition and construction. Wherever soil is exposed, silt fences, mulched berms, and tarps should be erected to minimize soil loss due to wind and water.

Strategy 3: Install xeriscaping
All landscaping on the site should utilize water-efficient, native (or locally adapted), climate-tolerant plant species. By using these species, the need for irrigation can be greatly reduced. Native plants will also be more resistant to local pests and better able to survive in local soil, reducing or eliminating herbicide, pesticide, and fertilizer applications.

Strategy 4: Minimize chemical plant treatments
It is recommended that no chemical herbicides or pesticides be used due to their harmful effects on local ecosystems. In addition, fertilizers should be minimized. These efforts will reduce building operational costs and improve the health of the site. Some environmentally benign chemical applications may be considered in order to maximize health of plants.

Strategy 5: Rebuild parking lots and drives so that stormwater is controlled

> Option 1: For primary parking and driving surfaces, recycle existing asphalt surfaces and re-install with porous concrete. For intermittently used surfaces, such as overflow parking, fire lanes, and handicap parking, reinforced turf surfaces could be installed.
>
> Option 2: For primary parking and driving surfaces, engineer drainage into tree planting bays which function as bio-swales to collect and improve surface run-off. Additional runoff can be directed at micro-pool and excessive overflow into storm drain to Fort McPherson central stormwater pond. **Please see Appendix E for the Site Plan.**

Strategy 6: Install preferred parking for carpools, vanpools, and alternative vehicles
The parking spots closest to the building should be reserved for people using efficient forms of transportation such as carpools, vanpools, electric vehicles, compressed natural gas vehicles, or hybrid vehicles. Recharging and/or refueling stations could be provided for these alternative fuel vehicles (AFV). **Please see Appendix E for the Site Plan**.

Strategy 7: Shade parking lot and building with trees
Shading should be provided throughout most of the grounds, especially the parking lot and the southern and western faces of the building. Parking lot islands should be planted with shade trees to reduce direct sun on the parking lot. The south and west sides of the building should be shaded with deciduous trees to minimize direct solar gain in the summer. These trees will lose most of their leaves in the winter to take advantage of passive solar heat during that season.

Shaded areas should use a mix of small, fast-growing trees and large, slow-growing trees to maximize the amount of shading provided. The smaller trees will provide short-term shade while the larger trees will provide long-term shade. (e.g. yellow poplar with the willow.) It is estimated that 30% of all surfaces can be shaded within 5 years, and a minimum of 50% of all surfaces can be shaded when the trees reach maturity. **Please see the Site Plan in Appendix E.**

Planting vines on south face of the building would provide additional shading to masonry surfaces. Shading the wall in this way could reduce peak cooling by 15-20%, which would significantly reduce utility costs.

Strategy 8: Locate a MARTA bus stop just outside the building
A covered bus stop could be provided at the street curb to encourage use of mass transit. This shelter should be a comfortable place to wait for a bus, possibly with lights, fans, and maps of the local area. **Please see the Site Plan in Appendix E.**

Strategy 9: Provide facilities for bike and pedestrian accessibility
Install a bike rack near the building and a showering facility inside the building to encourage occupants and visitors to bike and walk to the facility. The best location for the shower is the southern end of the basement of Building 170B (or adjacent building), and the best location for the bike rack is just outside at the top of stairs. **Please see the Site Plan in Appendix E.**

Strategy 10: Provide handicap access to the building

Option 1: Provide a ramp from the west side of the building up to a covered portico that leads to the entrances of 170A and 170B (beneath the bridge) and an elevator in each of the of the buildings. The floor of the existing connector to the west could be utilized as such a ramp. This option allows handicapped access directly to the main entrance, which may be preferred by handicapped visitors.

Option 2: Provide ramps to the west entrances of the basements in 170A and 170B and elevators in both buildings. This option allows the central courtyard area to remain more open and flexible and still provides handicapped access to all parts of the building. **For a view of Option 2**, **Please see the Site Plan in Appendix E.**

Strategy 11: Provide an inviting outdoor setting for wildlife and humans
Set aside part of the site for outdoor use, possibly including a pavilion with tables and chairs beneath it, fountains or pools, trees and shrubbery, and wildflowers. This interplay of natural and built environments will provide birds and other wildlife with needed habitat, encourage outdoor meetings or other work (which reduces lighting and other energy needs), and make walking between buildings more pleasant and therefore more common. **Please see Site Plan in Appendix E.**

Strategy 12: Minimize light pollution
All outdoor lights should be directed down so that the night sky remains dark. Outdoor lights should be operated on photocells to ensure that they are lit only at night, and should be installed only where needed.

Strategy 13: Install a rainwater catchment system
All rainwater falling on the building roof should be collected and directed into catchment troughs in the courtyard between the two buildings and on both sides of the building. These troughs could be made partially from the building's existing slate roofing material. From the troughs, water should either be directed to a drip irrigation system installed beneath landscaping or to an underground retention tank. The tank could provide water for irrigation, flushing of sanitary fixtures, or for a cooling tower. An approximately 6000 gallon tank is recommended. (See also Sustainable Site & Water Use Strategy 16.)

Strategy 14: Utilize stormwater overflow
To allow for times when the amount of stormwater falling on the site is greater than what the site can absorb or what is collected in the underground detention systems, one of the following options should be exercised.

Option 1: Direct the water to the Fort McPherson golf course for settling in the holding pond and irrigation of the grounds.

Option 2: Create a "micro-pool" on site that will collect overflow and cleanse water (phyto-remediation) prior to release into the Fort McPherson storm water collection system (see Option 1 above).

Please see Site Plan in Appendix E.

Strategy 15: Use very low flow fixtures
All water fixtures in the building should use fixtures that exceed SCBBI Standard Plumbing Code requirements for water conservation by 30%. These include primarily showers, faucets, toilets, and urinals (consider waterless urinals only). If a washing machine or dishwasher is installed, it should be chosen for its water-saving qualities. (Energy Star equipment, which conserves both water and energy, is recommended)

Strategy 16: Reuse graywater on site
Consider collecting graywater from non-sanitary plumbing fixtures in building. Graywater can be directed to the “micropool” at rear of site for cleansing (phyto-remediation) and recirculation into a cistern (underground retention tank). Graywater would provide a constant source of water for on-site irrigation, a possible supply for flushing sanitary fixtures in building, and could overflow to a central base catchment pond. (see also Sustainable Site & Water Strategy 18)

Integrated Fort McPherson Strategies

The following strategies involve more than the local Building 170 site, and address issues of sustainability on a larger scale.

Strategy 17: Provide a shaded corridor to rail system
Currently, the walk to the MARTA rail station is uncomfortably hot in the summer. A row of shade trees should be planted all along this path, encouraging people to walk to and use the rail system. No cost estimate available. **Please see Site Context Map in Appendix E.**

Strategy 18: Install an ecological waste treatment system
This strategy involves installing a system to biologically treat wastewater generated in the building. One company that makes such a system is *Living Technologies*. For this system to be cost-effective, a large volume of wastewater would be needed (approximately 1500 gallons per day), and would therefor need to come from at least one other building at Fort McPherson. Treated water could then be used to flush toilets or irrigate landscape.

5.2 Green Architecture & Materials

Strategy 1: Insulate and air seal attic
The under-roof area of the building should be insulated with R-30 insulation, and all roof vents sealed. This will create semi-conditioned attic space that will reduce cooling load on building and mechanical equipment. HVAC equipment will be in the attic and will therefore be inside the building envelope. Blown-in cellulose insulation is recommended.

Strategy 2: Install an apron around the base of the building
By installing a waterproof apron around the base of the building, bulk moisture can be kept away from the foundation and moisture problems in the basement can be remedied. An insulating material (recommend boric acid-treated foam or mineral wool) can be installed with the water barrier to provide some additional insulation for the basement. **Please see Apron Sketch in Appendix E.**

Strategy 3: Restore existing windows

Existing windows should be restored with new paint and new putty. Install a spring-loaded jamb liner to replace window weights. Spaces in the wall formerly used for weights should be filled with insulating foam. All original window openings currently filled in with masonry (basement and upper levels) should be re-opened to harvest daylight. New windows should match all existing windows. Replacement windows should be minimum double-pane, low-emissivity, argon filled windows that meet glass specifications outlined below (see Green Architecture & Materials Strategy 4). Consider replacing all existing windows with historical reproductions that use these specifications.

Strategy 4: Add secondary energy-efficient windows inside of existing historic windows

Wherever existing windows are kept, it is recommended that double-pane, low-emissivity double hung windows be added inside of the existing windows. This will preserve the historical look of the exterior of the building while simultaneously improving the energy efficiency and thermal comfort of the interior space. Where original window openings have been filled in with brick or concrete, it is recommended that new high-efficiency historical reproduction windows with true divided light be installed. All new windows should have the following characteristics, in order of priority:

- Solar Heat Gain Coefficient (SHGC) less than 0.4 (to minimize summer heat gain)
- Visible Light Transmittance (VT) greater than 0.7 (to maximize daylighting)
- Argon gas filled
- Thermal Conductivity (U-value) less than 0.33 (r-value = 3.0)

Please see Window Assembly Sketch in Appendix E.

Strategy 5: Customize windows based on orientation

Cooling-season optimized windows should be selected for the south, east, and west faces of the building while heating-season optimized windows should be selected for the north face of the building. Low-emissivity windows can be optimized for either the heating season or the cooling season, based on the location of the low-emissivity coating. These two different optimizations are visually identical, and will not be noticed by observers.

Strategy 6: Restore transom windows

All transom windows should be opened and restored. Transom windows on exterior walls could be operable, while transom windows in interior walls need not be operable. Where no interior transom windows previously existed, consider adding to match other openings and to optimize daylight harvesting. This feature will help light the hallway and presents an interesting indoor architectural feature. Consider replacing all exterior transom window glass with high performance glass according to specifications listed in Green Architecture & Materials Strategy 4

Strategy 7: Remove lowest dropped ceiling & reuse original ceiling

The existing eight-foot dropped-ceiling blocks light from transom windows. By removing this ceiling, light from outside can reach offices, and light from offices can reach hallways. The original eleven-foot ceiling should be reused and covered with an acoustical panel material. If use of existing ceiling prohibits proper installation and access to life-safety system, electrical, and other systems, consider demolition of original ceiling to be replaced with new ceiling system at highest possible position.

Strategy 8: Harvest daylight and install energy-efficient lighting

Daylighting should provide as much building lighting as possible. To minimize the energy used by light fixtures, all lights should be fluorescent. All lights should be dimmable, and the maximum level of light should be controlled based on daylight levels in the building. It is expected that energy use as low as 0.3 Watts per square foot can be achieved. Lights in conference rooms, offices, bathrooms, kitchens, and other non-central areas should be operated on occupancy sensors. Four basic types of lights should be used:

- Pendants: Compact fluorescent (CFL) hanging lights should be used in spaces where aesthetically pleasing general area lighting is needed. This may include much of the first floor, where visitors are likely to tour, including the entrance area, any first floor conference rooms, and executive offices. These pendants can be designed to look historically appropriate.

- Indirect banisters: Twin T-8 fluorescent tubes should be installed along the top of existing (see Green Architecture & Materials Strategy 9) walls. These lights will shine on the ceiling, providing indirect lighting on both sides of the walls with minimal glare.

- Wall sconces: These CFL lights should be installed in stairwells, hallways, and other areas where the indirect banisters are unable to provide adequate general area lighting.

- Task lighting: At each workstation CFL task lighting should be provided to give occupants sufficient lighting for detailed work.

- Emergency Lighting: All emergency and exit lights should be LED lit. Consider any new LED lighting available for other light fixtures when available.

Strategy 9: Re-use existing interior walls

By re-using existing interior walls, large amounts of construction waste and cost can be avoided. The existing walls in Building 170B provide spaces that can be adapted for AEPI office needs. If the future occupants of Building 170A cannot easily use the existing floor plan, some walls there may be removed. The top two feet of all interior walls should be removed to allow air to easily travel between spaces. (see Energy Systems Strategy 2) For those spaces which need to be fully separated from the general space (executive offices, conference rooms), a glass dividing panel can be installed all the way to the ceiling with provisions made for HVAC return air paths. *Note that some vertical support structures in addition to existing structural columns may be necessary to maintain wall stability.*

Please see two options for Floor Plans in Appendix E.

Strategy 10: Reuse existing usable materials

There are a number of reusable materials within the building. Most of these materials should be salvaged before demolition to protect them from damage. All materials should be checked for harmful contaminants (such as asbestos) prior to reuse. The following list is the result of a building walk-through; a more thorough inventory should be performed:

- Throughout: slate roof tiles (for stormwater system: see Sustainable Site & Water Use Strategy 12), doors, frames, transoms, floor tile (could be covered with old carpet during demolition and construction for protection from damage), metal cabinets, wood shelving, modular office system, smoke detectors, fire alarm pull stations and panels, fire extinguishers, hoses, electrical panels, 11-foot ceiling (unless it completely prohibits access to the space above for sprinkler systems and wiring), terrazzo, base threshold, stairs, handrails, iron security grids over basement windows, exit signs (after relamping with LED)

- Mechanical: water heater, boiler, existing air-cooled chiller and air handlers (not necessarily to be reused in this building)

- Bathrooms: tile, porcelain (do not reuse high volume flush toilets), marble dividers (can be specified for kitchen counters, conference table tops, or reused in place)

- First floor connector: brick (for pavers or retaining walls), windows, wood, carpet, copper and metal roofing, cabinetry, doors, frames, etc.

Strategy 11: Recycle existing unusable materials

Some materials in the building are not reusable but should be recycled.

- Ceiling tile: test for contaminants and have Armstrong World Industries check for reclaimability.
- Slate roof: consider reuse first (see Green Architecture & Materials Strategy 10) check with Jeff Packer Industries and Beers Construction for recycling opportunities
- Brick: consider reuse first (see Green Architecture & Materials Strategy 10); could be recycled for other projects as brick, downgraded to filler material, or ground into stone dust
- All flashing and gutter materials, especially copper and other metal
- Communications and electrical wiring
- Awnings and rod metal from ambulance ramp
- Metal from eight-foot ceiling grid, chiller pipes, plus the boiler if possible
- Carpet: test for contaminants

Strategy 12: Use recycled content materials

Recycled content materials can be used in the following situations:

- Carpets: Carpets, where desired, should be produced from recycled content material. It is recommended that a tiled carpet service be employed. With this service, carpeting is segmented into square tiles that are periodically rotated to encourage even wear. Through this method, the carpet life can be greatly extended. When the carpet life has come to an end, the service provider should recycle the carpet.

- Roofing: It is recommended that the existing slate roof be replaced with recycled rubber shingles. These shingles have a long life (50+ years), are easy to install, historically accurate, and are environmentally benign.

- Concrete: All concrete for the building should contain fly ash from coal-fired power plants. This provides a productive outlet for this waste product and creates stronger concrete.

- Counter tops: In cases where reused marble cannot be specified, use recycled solid surfaces.

- Ceiling: Acoustical ceiling panels with high recycled content and formaldehyde-free binders should be used. Companies that produce these sort of products include:
  Armstrong World Industries, Inc. (acoustical tiles with high recycled content)
  Tectum, Inc. (high-impact, formaldehyde-free acoustical wood-fiber panels)
  US Gypsum Company (recycled content mineral fiber ceiling tiles and panels)
  Homasote, Inc. (high-density, recycled, formaldehyde-free fiberboard panels)

- Paint: A number of low-VOC (volatile organic compound) emitting products are available. *Environmental Building News* issue 8:2 includes a useful table.

- Wall Coverings: All walls should have sound-absorbing coverings to minimize unwanted office noise, and this covering should be selected to provide additional R-value to exterior walls. It is expected that 1-inch thick wall covering could provide an additional R-3. Some companies that make appropriate products are:
  Design Materials, Inc. (no-flame, durable, agave leaf fiber sheets)
  Roxul, Inc. (rigid mineral wool board)

Strategy 13: Create occupant recycling infrastructure
A central recycling collection area should be provided near a maintenance entrance to the building to allow easy transfer to vehicles. The recycling area should provide enough space for recycling of paper, cardboard, plastic, and metal. It may be possible to utilize existing medical shoots as recycling shoots.

Integrated Fort McPherson Strategies

The following strategies involve more than the local Building 170 site, and address issues of sustainability on a larger scale.

Strategy 14: Reuse materials in other Fort McPherson projects
Materials that are recovered from Building 170 could be reused on Fort McPherson for optimal resource efficiency and cost savings. Please see Green Architecture & Materials Strategy 10 for a partial list of available materials.

Strategy 15: Establish detailed Waste Management Plan during construction
Maximize recycling or re-use of new construction material waste including collection systems for cardboard, glass, metals, wood, wall board, etc. Establish safe staging areas for construction materials and carefully protect hazardous materials and cleaning areas with appropriate retention and capture systems. Adhere to tree and soil protection plans during construction.

5.3 High-Performance Energy Systems

Energy performance goals for the HVAC system designer have been established. These energy design goals are achievable thresholds and the intent is to not constrain the designer as to how to achieve them.

Energy Design Goals:

• Chiller	< 0.7 kW / ton
• Cooling Tower	< 0.012 kW / ton
• Pumps	< 0.026 kW / ton
• Fans	< 0.035 kW / ton
• Total system Pressure	< 1inch w.c.
• Lighting	< 1 W / sq. ft. (peak) and < 0.3 W / sq. ft. (average)

Strategy 1: Use high-efficiency heating and cooling equipment

> Option 1: Use geothermal heat pumps to heat and cool air. Geothermal heat pumps provide highly efficient heating and cooling by utilizing ground temperature water to transfer heat to and from the building. Loops of piping will need to be placed underground to provide the heat pumps with ground temperature water. These loops can be placed in vertically drilled holes beneath the on-site parking area. Desuperheaters that utilize heat pump waste heat should be installed to help provide domestic hot water (for sinks and showers) for the building and to boost overall system efficiency. Geothermal systems typically feature reduced maintenance.

> Option 2: As an alternative strategy, consider a water-cooled, rotary screw chiller. This alternative to an air-cooled reciprocal chiller would require a cooling tower but would achieve high system efficiency. This would be used in conjunction with a gas boiler to provide heat in the winter.

Strategy 2: Install a high-efficiency heating and cooling distribution system

> Option 1: A centralized variable air volume (VAV) air handler that pumps heated and cooled air through the building ductwork is recommended. This air handler should be located in the attic (see Green Architecture & Materials Strategy 1) and provide air to a loop of ductwork on each floor of the building. The air handler would maintain a constant pressure in the ductwork, varying air volume in response to occupant demand. Flow through each supply vent could be independently controlled for maximum individualized comfort. **A suggested supply duct layout is provided in Appendix E**.

> The exposed supply ducts would be approximately 24 inches in diameter, and could be painted to minimize visibility and maximize reflected daylight. Central plenums on each floor would provide return air to the air handler. With the top two feet of interior walls removed (see Green Architecture & Materials Strategy 9), air in each office could easily make its way back to the return plenum. Besides being efficient and providing individualized comfort, a centralized air handler allows air filters to be changed in one location only, making maintenance cheaper and easier.

Option 2: An alternative approach includes a heat pump recirculating loop strategy. With this method, water would be cooled by an exterior cooling tower and circulated through loops on each floor. Individual water-to-air heat pumps would transfer heat to and from the loop; this would allow each zone to be cooled and heated separately. This system provides excellent opportunities for waste heat recovery from one zone to another during the swing seasons of spring and fall. This system would be about the same efficiency as Option 1, but maintenance may be more complicated since there are so many units to maintain.

Strategy 3: Install a separate ventilation system
A fresh air ventilation system that is separate from the heating and cooling system would allow for better control of ventilation air quantity and optimize the building's ability to use free energy periods in the fall and spring. A centralized ventilation air handler should be located in the attic. Outside air should be provided through an intake at the roof level (perhaps through the gable), where outside air quality is highest since ground-level air will likely be contaminated with more dust, moisture, fertilizers, car exhaust, etc. The air would then be filtered, efficiently pre-conditioned, and ducted through a chase to each floor of the building. A single duct (approximately 6-10 inches in diameter) would run above the ceiling of each floor and vent into the central hallway area. **Please see the Duct System Sketch in Appendix E.**

Opportunities for outside air pre-conditioning include a high-efficiency DX system, enthalpy (desiccant wheel) technology, bypass (run-around) coils, or other forms of efficient dehumidification.

Strategy 4: Positively pressurize building
The building should be positively pressurized to minimize air leakage from areas of potential poor air quality. The building could be configured to provide the most pressure to the second floor, somewhat less pressure to the first floor, and still less pressure to the basement. The basement should still be greater than outdoor pressure, however. By configuring the system this way, second floor air will move to the first floor, first floor air will move to the basement, and basement air will vent to the outside.

Small ducted fans between each floor of the building can be configured to provide this pressure difference. The basement vent should be dampered to minimize unwanted infiltration and the basement will also have its own separate fresh air duct as well. One significant benefit of this system is that basement air will be continuously vented with the most outside air, helping to remove any moisture or radon that may otherwise collect there. **Please see the Ventilation System Sketch in Appendix E.**

Alternative strategies may include separate ventilation supply and relief fans for each floor, while always maintaining the desirable positive pressure. The ability to control each ventilated zone is the key to efficiency.

Strategy 5: Provide ventilation fans at indoor pollution sources
Spot ventilation fans should be provided in the bathrooms, kitchen, and copier rooms to remove indoor air contaminants from the building. The bathroom and copier room fans should be operated on occupancy sensors to ensure that they are fully utilized only when needed. The building's air handlers will compensate to maintain positive pressure due to any reduced pressure this ventilation strategy causes.

Strategy 6: Monitor indoor air quality

Indoor air quality (IAQ) should be monitored to ensure healthy indoor conditions. Carbon dioxide monitors should be coupled to the ventilation system, and call for more outside air whenever the interior carbon dioxide level is greater than 530 ppm above the outside level. Each separate section of the building (where walls rise all the way to the ceiling, see Green Architecture & Materials Strategy 9) should have its own monitoring system. Humidity should be closely monitored to ensure building longevity and occupant comfort. Other indoor air factors, such as Total VOC's, may also be monitored, based on AEPI needs.

Strategy 7: Monitor building energy and water use

Energy use (both gas and electric) in the building should be monitored and segmented into plug load, lighting, HVAC, and any other significant categories so that the "other" category represents 10% or less of building energy use. This will allow easy documentation of energy consumption and trends, as well as being a useful training tool for the public. A similar system should be installed for water use.

Strategy 8: Install photo-voltaic (PV) panels

On-site production of electricity through PV panels will not save operating costs during the life of the building, due to the high cost of technology and the low utility rates obtained by Fort McPherson. However, the use of PV panels would be educational, and it is recommended that PV panels be installed as a demonstration of renewable energy. Good uses of demonstration PV panels include: parking lot and other outdoor lighting; ceiling fan, light, and heater in bus stop (see Sustainable Site & Water Use Strategy 7); and water fountains. If money and space is available, a larger array of PV panels could be installed and connected to the electric grid.

Strategy 9: Install a prototype fuel cell

A grid-connected fuel cell should be installed to provide a portion of the building's energy needs. A 7 kW prototype could be obtained through CERL at no cost to Fort McPherson. This size fuel cell could provide approximately 10% of the building's energy needs. Waste heat from the fuel cell can be used to heat water that can be piped to the attic for outside air pre-treatment. Hot water could also be used for space heating and for domestic hot water (bathroom sink, kitchen sink, shower). A 7 kW fuel cell is a good size for this building because all of the waste heat could be utilized within the building. Please see High-Performance Energy Systems Strategy 11 about larger fuel cells.

Strategy 10: Install a solar hot water heater

A solar water heating system should be installed on the roof of the bridge between the two parts of the building. This system could be tied into the existing electrical hot water tank. A panel could be sized for dedicated use for either the shower, bathroom and kitchen sinks, or could be sized to provide almost all the hot water for the building, especially in the summer. By placing the panel on the bridge roof, it will not be visible from below and will not disrupt the historic look of the building.

Integrated Fort McPherson Strategies

The following strategies involve more than the local Building 170 site, and address issues of sustainability on a larger scale.

Strategy 11: Install a large fuel cell
Fuel cells are available in sizes much larger than the 7 kW mentioned above in High-Performance Energy Systems Strategy 9. Some manufacturers offer a fuel cell in the 250 – 300 kW range. These larger fuel cells can often provide electricity with very few emissions quite economically. The waste heat produced by these fuel cells is greater than can be utilized by Building 170, but it may be possible to utilize this waste heat in the nearby steam plant or in other buildings.

6.0 Estimated Renovation Budgets

6.1 Construction & Demolition Budget

An approximate construction budget was generated by Southface Energy Institute with assistance from Mike Hutt and sustainable design workshop participants. The budget assumed three potential scenarios:

Base case
This scenario assumes that the building is renovated in a conventional manner, and uses budgetary assumptions from the renovation of Building 62. Since Building 62 is 16,000 square feet and Building 170 is 26,540 square feet, all values from the Building 61 renovation budget were scaled appropriately. This base case shows the renovation budget to be $3,325,735.

LEED™ Certified
This scenario assumes that most, but not all, of the recommended strategies in this report are executed in order to meet the minimum requirements for the USGBC's LEED™ certification requirements. The specific strategies that are followed in this scenario can be viewed in Appendix G. The LEED™ Certified case shows the renovation budget to be $2,923,315. The lower renovation cost compared to the base case is largely due to the reduced size of the HVAC system. By installing high-efficiency windows, insulating the attic, and making other building envelope improvements, the heating and cooling requirements of the building can be greatly reduced (see Appendix F). This allows a much smaller heating and cooling system to be installed, which more than pays for the cost of improving the building envelope. According to the energy-use modeling performed, the size of the heating and cooling system for the building could be reduced from the existing 110 ton system to a 46 ton system.

LEED™ Gold
This scenario assumes that all of the recommended strategies in this report are executed to the degree required for a Gold Certification in the USGBC's LEED™ system. LEED™ scoring can be viewed in Appendix H. The LEED™ Gold case shows the renovation budget to be $3,086,565. This case is still lower in cost than the base case. It uses the savings from the smaller HVAC system (see LEED™ Certified case above for explanation) to fund a more intense sustainable landscape package and install geothermal heat pumps. These additions allow the building to better meet its objectives and reduce its annual operating cost. (see Appendix I)

6.2 Operating Savings

A sustainable design must include consideration of the lifecycle costs of the building, not just the initial costs of construction and demolition. Three general categories of operating costs were considered by Southface Energy Institute, energy costs, water costs, and maintenance costs.

Energy

As shown in Appendix F, the projected energy savings for the complete renovation is $14,169, due to decreased peak electrical usage and lower overall usage of electricity and natural gas. If a 7 kW fuel cell is installed, the energy cost would be even less, saving approximately $1,193 per year in electricity (includes cost of natural gas to run fuel cell).

Water

Water savings result from using super low flow fixtures and from collecting rainwater on the roof. The super low flow fixtures are projected to save $796 per year, while the rooftop rainwater collection is projected to save $1,350 per year.

Maintenance

The use of durable roofing and finishing materials and the installation of a centralized HVAC system will lead to lower maintenance costs over the life of the building. However, these savings are difficult to calculate and have not been included in the budget.

6.3 Equity Value of Green Design

The present value of the utility savings projected for the renovated building using the recommended strategies is $97,552. The real estate value increase due to reductions in operating costs is projected to be $143,170. The real estate value increase due to upgrading the building from Class B to Class A is projected to be $1,300,000. The total increase in equity value of the green renovation is estimated at $1,682,340. Please see notes below Appendix I for assumptions.

7.0 Implementation Strategies

The next step with this project is for the owner to specify which design strategies to implement in this renovation and select a design team to work out the details of these strategies. Southface Energy Institute has prepared a basic resource packet to assist in the process of selecting design strategies. The owner will need to set priorities in order to decide among different strategies.

Due to the complexity of modern buildings and the high degree of specialization of building professionals, it is necessary that an interdisciplinary design team be assembled to create the renovation plans for Building 170. This team should consist of at least an architect, engineers, lighting designer, landscape architect, environmental consultant, and a building commissioning agent, as well as representatives of AEPI and Fort McPherson. An interdisciplinary team will be able to design the building using a holistic approach, creating strategies that are synergistic in nature. These synergistic strategies will achieve maximum building performance.

A crucial part of a green design is total building commissioning. Building commissioning ensures that the constructed building meets the design intent and requirements of the owner. The building commissioning agent should be involved starting with the design process, in order to help establish a role and make design and construction contacts. The building commissioning agent should be responsible for documenting the design intent, reviewing the design for internal compatibility, testing systems for proper operation, and creating a building operations manual.

APPENDIX A

LIST OF DESIGN WORKSHOP PARTICIPANTS

Appendix A: List of Design Workshop Participants

Southface Energy Institute

AEPI Building 170 Adaptive Re-Use

Sustainable Design Workshop: June 20-22, 2000

LAST NAME	FIRST NAME	AFFILIATION	EXPERTISE
Abballe	Bill	TVS Architects	sustainable design/architecture
Barcik	Mike	Southface Energy Institute	mechanical engineering
Barkaszi	Steve	Florida Solar Energy Center	renewable energy expert
Bewley	Geoff	Beers Construction Company	c&d waste reduction
Brown	Walter	Southface Energy Institute	sustainable design/construction (building science)
Clanton	Nancy	Clanton Engineering	lighting specialist
Creech	Dennis	Southface Energy Institute	building science
Deal	Brian	US Army Construction Engineering Research Laboratory	sustainable design/architecture
Eady	David	US Army Environmental Policy Institute (AEPI)	sustainable planning and development
Ferguson	Bruce	University of Georgia	environmental design
Fournier	Don	US Army Construction Engineering Research Laboratory	energy/engineering
Grashof	Beth	US Army Garrison, Fort McPherson	historic preservation
Hendry	Bob	Georgia Tech Research Institute	indoor air quality
Hutt	Mike	US Army Garrison, Fort McPherson	engineering
Jones	Sheila	Georgia Tech Research Institute	sustatainable development
Koniecki	Dennis	US Army Garrison, Fort McPherson	energy management
Loechl	Paul	US Army Construction Engineering Research Laboratory	landscape architecture
McCanless	Forrest	McCanless & McCanless Designs, Inc.	mechanical engineering and sustainable design
Messenger	Manette	US Army Forces Command (FORSCOM)	pollution prevention
Pearce	Annie	Georgia Tech Research Institute	sustainable engineering
Perkins	Ron	Super Symmetry	mechanical engineering and systems integration
Pullen	Jean	Southface Energy Institute	mechanical engineering
Rose	Bill	Building Research Council/Univ. of Illinois	building science
Sinclair	Rick	US Army Environmental Policy Institute (AEPI)	pollution prevention
Wilhite	Robert	Beers Construction Company	sustainable construction
Wuichet	John	US Army Environmental Policy Institute (AEPI)	green design and construction
Yost	Peter	Environmental Building News	green materials specialist
Senior Army Leadership			
Apgar	*Mahlon*	*Assistant Secretary of the Army (Installations and Environment)*	*community development and real property management*
Clark	*Ray*	*Principal Deputy ASA (I&E)*	*environmental quality*
Clingempeel	*COL William*	*US Army Garrison, Fort McPherson*	*Garrison Commander*
Abernathy	*LTC Mark*	*US Army Garrison, Fort McPherson*	*Director of Installation Support*
Conrad	*COL (USA, Ret.) Chris*	*Office of the ASA (I&E)*	*strategic planning*
Wright	*COL (USA, Ret.) Dick*	*US Army Environmental Policy Institute (AEPI)*	*Director*
Resource Assistants			
Baker	Lindsay	Southface Energy Institute	intern
Brennan	Molly	Southface Energy Institute	intern
Hayes	Anne	Southface Energy Institute	intern
Hercules	Jason	Southface Energy Institute	intern
Newey	Mark	Southface Energy Institute	intern
Snow	Mac	Southface Energy Institute	intern
Additional Resource Experts			
Culp	Charlie	Texas A&M University, Energy Systems Laboratory	continuous commissioning and monitoring/verification
Fisher	Caroline	Army Office of Historic Properties, Deputy Director	Historic Preservation
Murton	Ed	Slate Roofing Contractor	Roofing Expert
Robinson	Gary	Army Office of Historic Properties, Director	Historic Preservation
Rosing	Alan	Rosing Group	miltary utilities systems
Vanegas	Jorge	Georgia Tech Construction Research Center	sustainable engineering/construction

APPENDIX B

AEPI PROJECTED FACILITY REQUIREMENTS

Appendix B: AEPI Projected Facility Requirements

Based on a recent needs assessment, the AEPI anticipates requiring space allocation similar to that in their present location. Approximately 13,000 square feet is currently used, and some growth in the number of employees is anticipated. The AEPI will occupy Building 170B (each part of the building has approximately 13,260 square feet available). The part that is not occupied by AEPI will be used by another Army organization. Both parts of the building are to be renovated. The following spaces are required in the new facility:

- 4 large offices, approximately 14‘ x 17’ for executive level positions
- 26 smaller offices, approximately 10’ x 14’ (at least 3 of which can accommodate record storage)
- Large conference room, approximately 24’ x 14’, and possibly additional smaller conference room(s)
- Library, 10’ x 15’
- Wiring closet for each floor, 8’ x 8’ or smaller
- Computer room, near the information technology systems office (one of the 26 smaller offices), which houses 4-5 servers
- Large, well-lit reception area near the main entrance
- Resource rooms. One large one on the main floor and smaller ones on the 2 additional floors. These will house counter space, a copier, printer, etc.
- Galley kitchen(s). One larger kitchen on the main floor with a couple of tables, sink, and refrigerator. Outdoor seating is also desired.
- Guest workstations where visitors can access a computer and telephone. Cubicles may be appropriate to satisfy this requirement
- Training room to support multi-media educational and outreach activities
- Bike storage and showering facilities

As part of the design workshop, AEPI created a potential new floor plan for Building 170B that satisfies all of these needs with minimal movement of interior walls. Sketches of two potential layouts can be found in Appendix C. Please note that the floor areas are approximate.

Additional Considerations

The AEPI wants to document the historical evolution of the building, as well as the recycling and reuse of current building components, sources of new building materials and their recycled content. Other features for consideration include the following:

- Recycling center and possible composting facilities
- May need wooden 2” X 4” studs to support current wall-mounted furniture. AEPI may be acquiring new furniture and wooden studs would not be essential
- Real-time monitoring of energy use and indoor air quality indicators
- Compressed natural gas fueling station and/or electric vehicle charging stations
- Possible alternative fuel station car for shuttling visitors to and from the MARTA station
- Landscaping to shade the south and west sides of the building and to improve parking areas

- Smart wiring and ample data ports (2 data drops per room)
- Uncovering and restoring terrazzo floor in corridors and entryway, and carpeting offices with recycled, leased carpeting.
- Main entrance will need to be opened up to allow space for educational displays about the building.

Cut-aways and other visuals to educate visitors about “green” building technologies used in the renovated buildings

Building 170B - current

Building 170A & B - east exposure sharing bridge

APPENDIX C

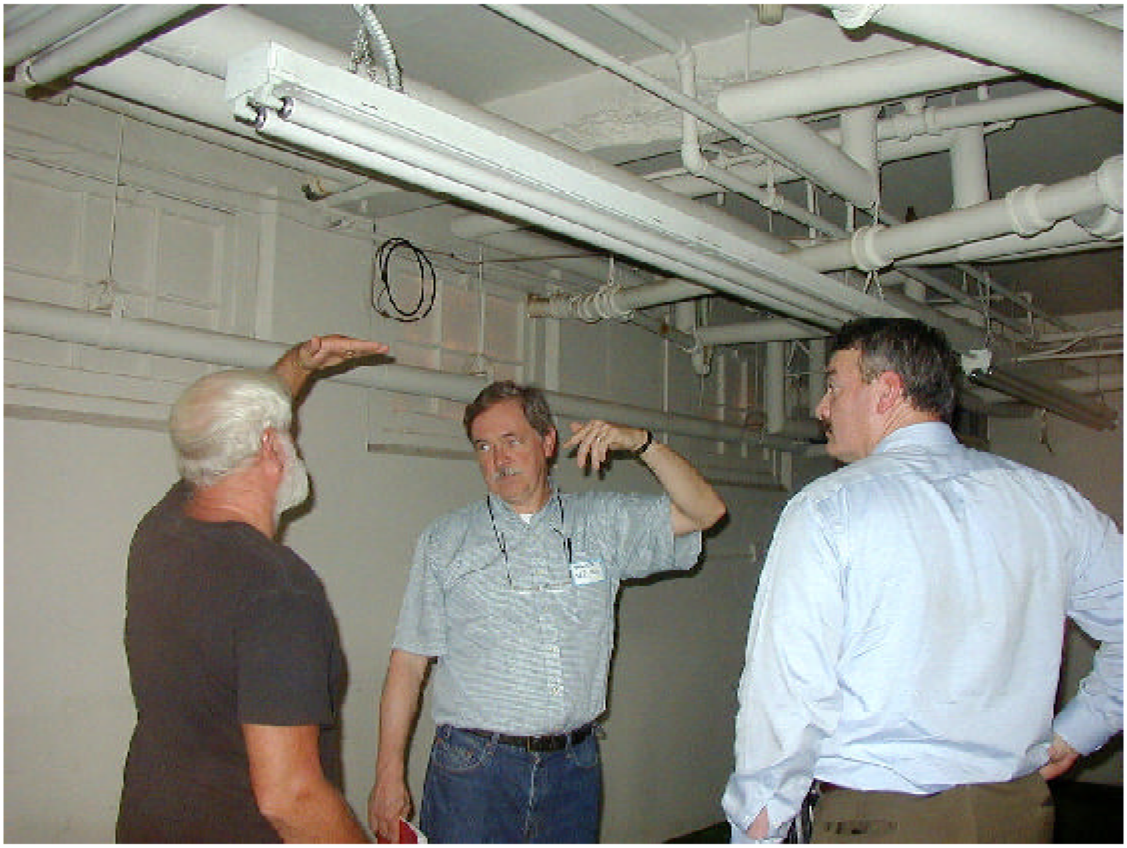
PHOTOS OF BUILDING 170 AND DESIGN WORKSHOP

Building 170B - northeast exposure with bridge

Building 170A - historical photo

Building 170B - southwest exposure

Jean Pullen examines bulk moisture problem at bridge connection



Mike Hutt, Bill Rose and Geoff Bewley on tour

Mike Hutt and Peter Yost
inspecting ceiling

Basement level

Bill Rose and Brian Deal inspect basement mechanical room

Daylit stairwell

Lt. Colonel Abernathy on tour

Interstitial space to be maintained

Full group meeting -June 21

Architecture and Materials team breakout

Site and Water team breakout

Dennis Creech during IAQ team breakout

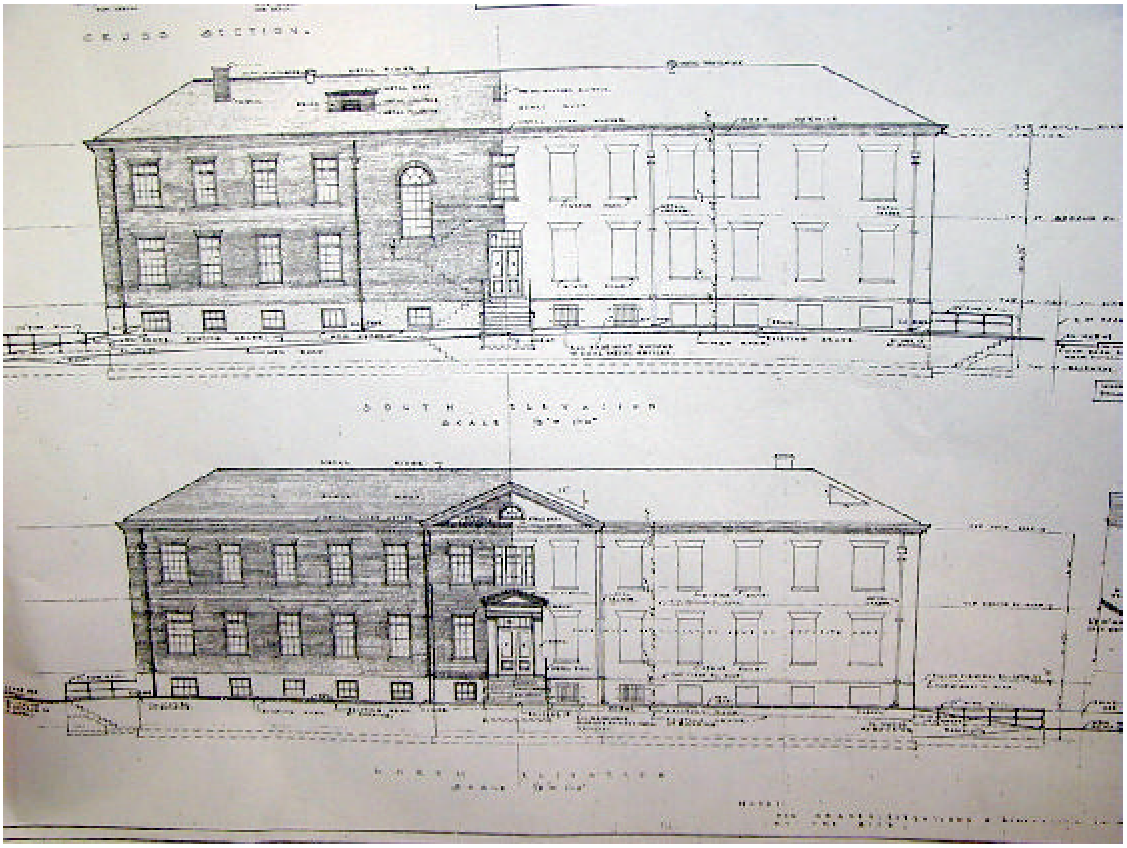
Mike Barcik presents air and light flow penetration solution

David Eady presents to Lt. Colonel Abernathy

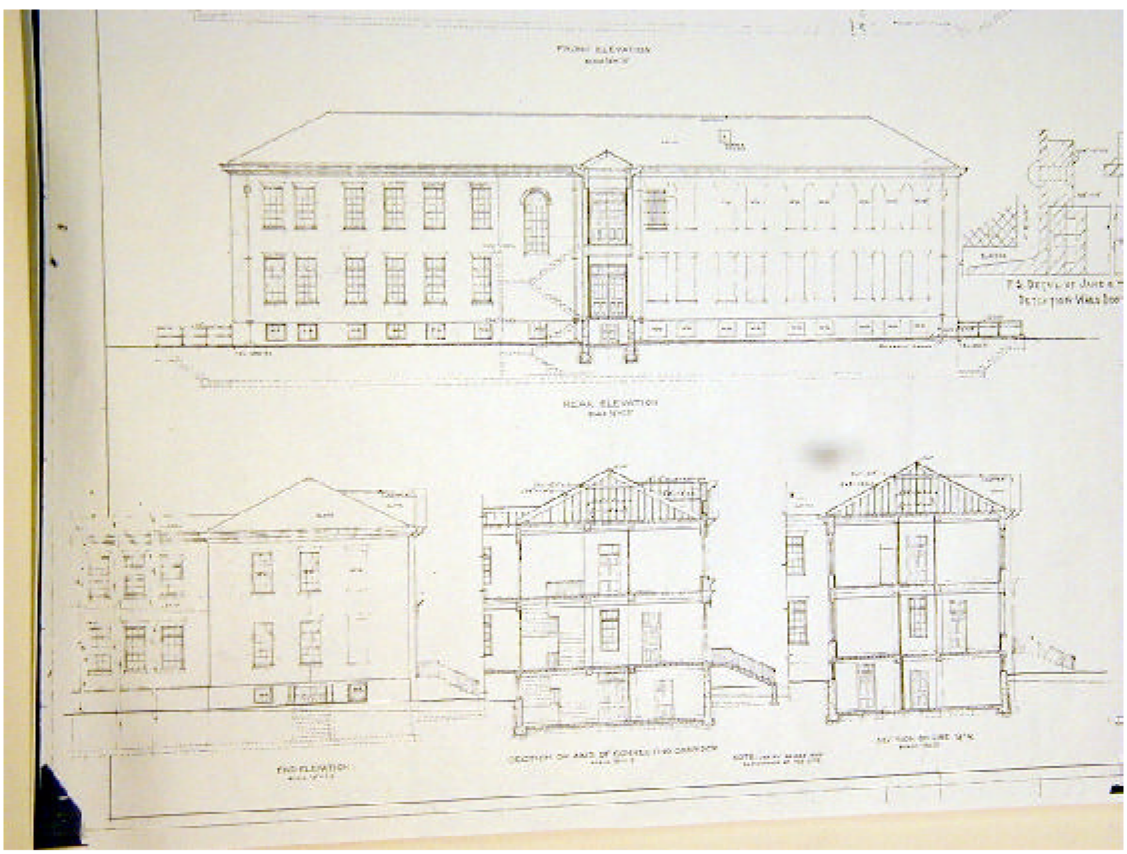
Beth Grashof presents historic preservation compromise plan

APPENDIX D

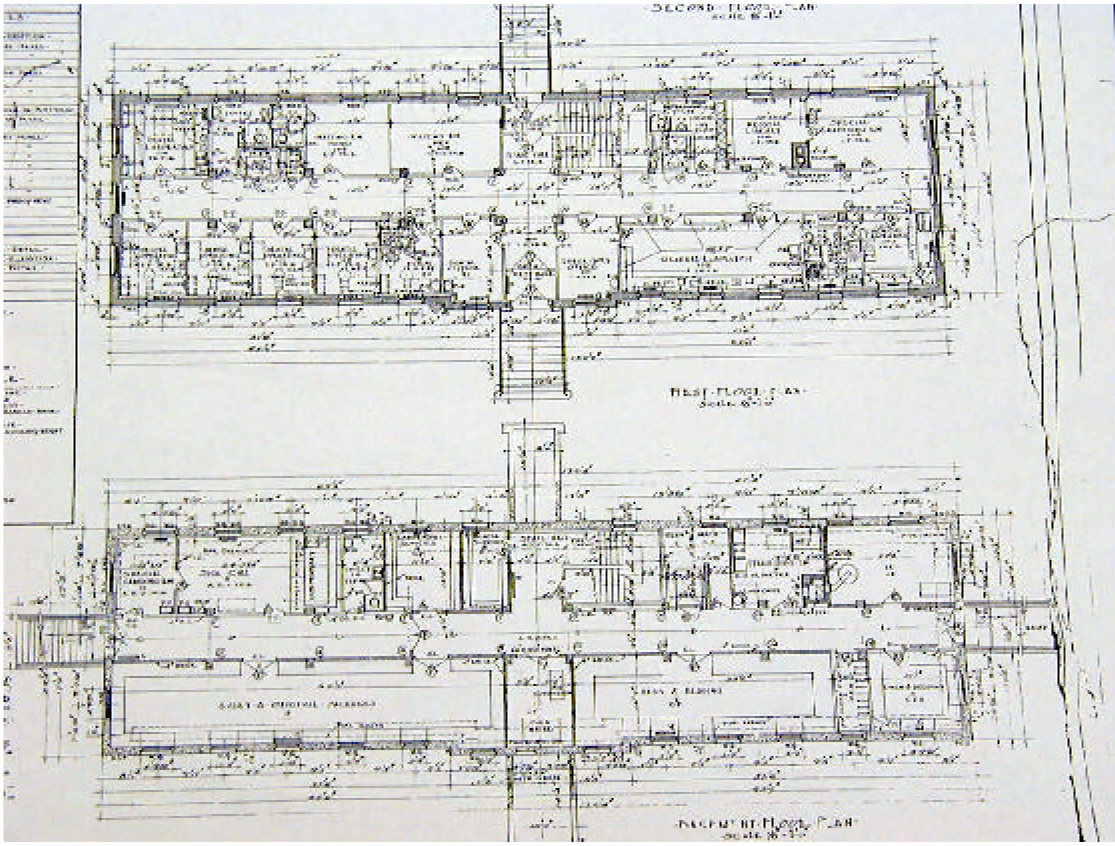
ARCHITECTURAL DRAWINGS



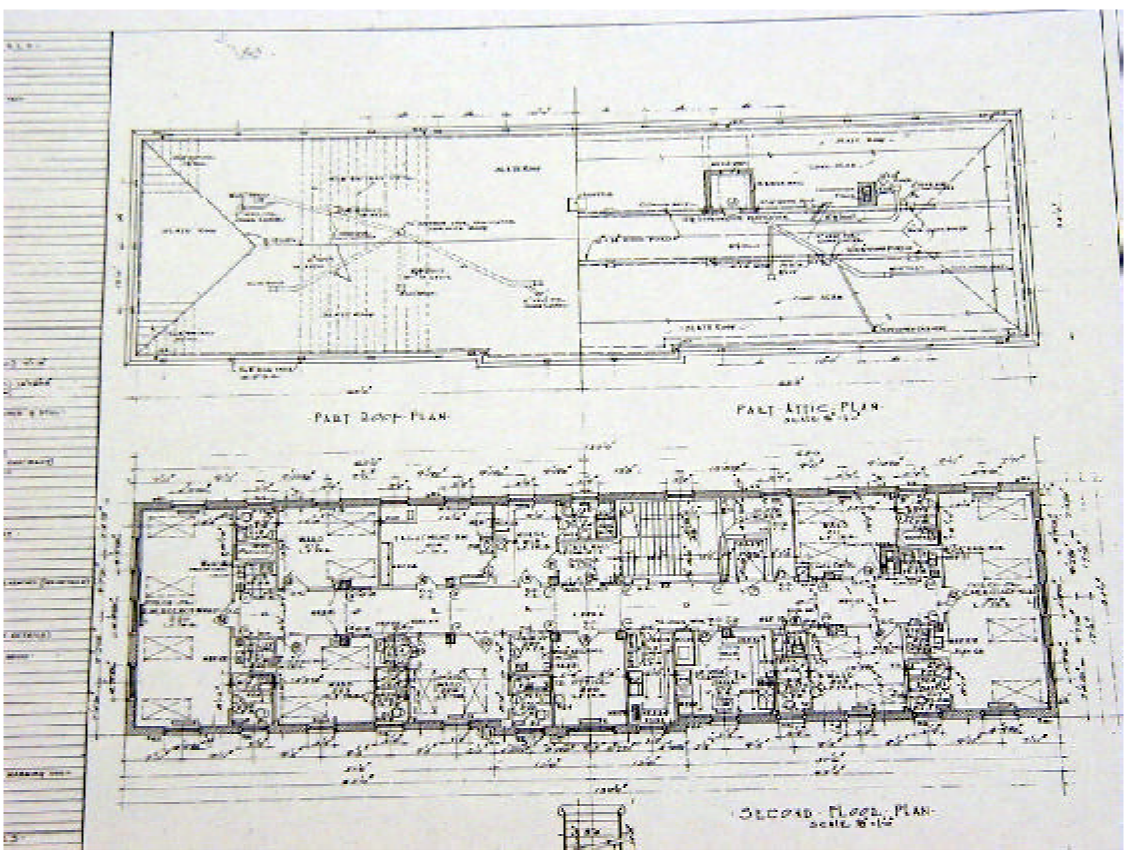
Original blueprints - front/rear elevations



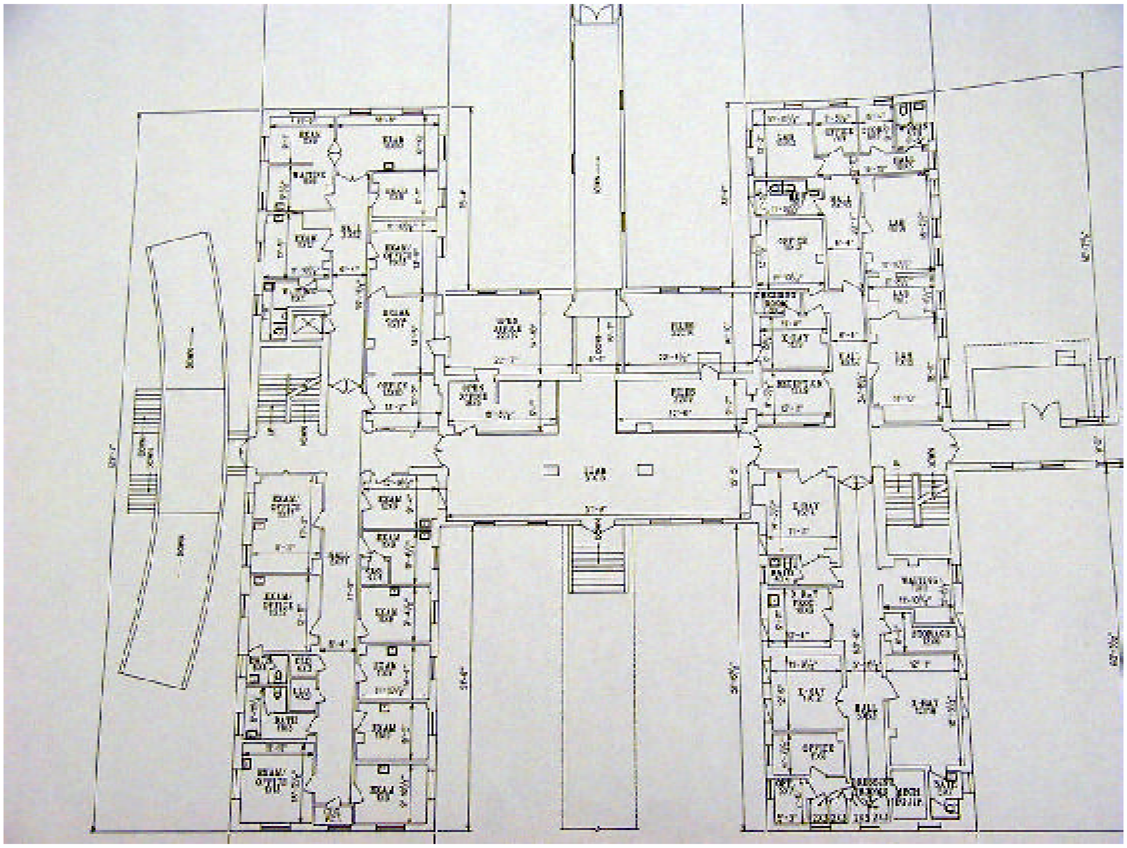
Original blueprints - left/right elevations



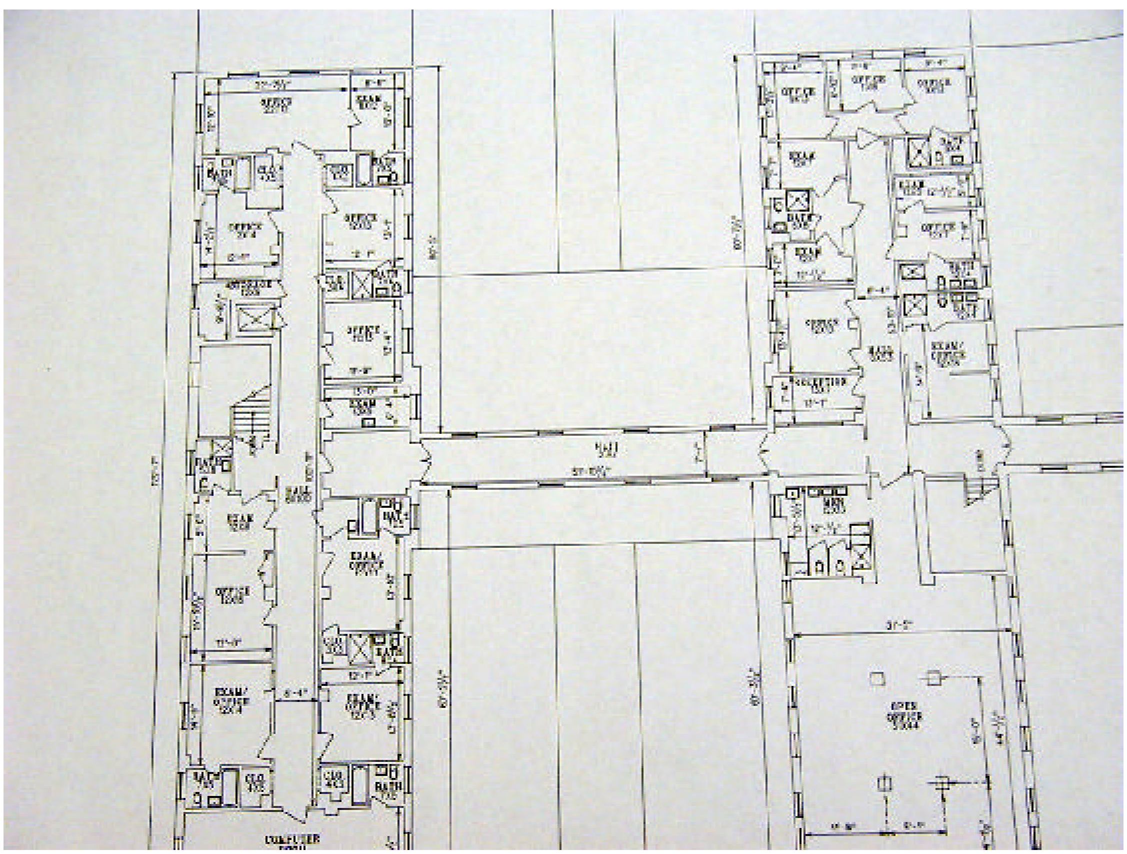
Original blueprints - basement and first floor plans



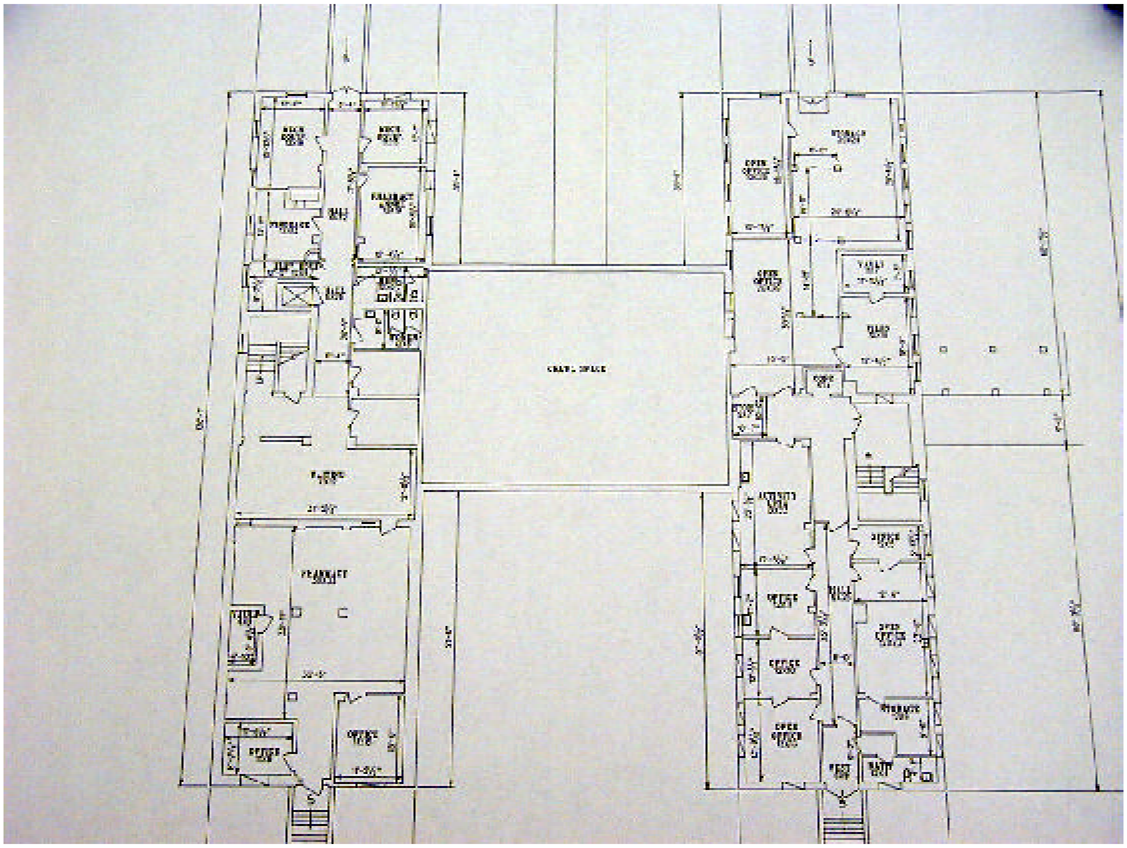
Original blueprints - second floor and roof plans



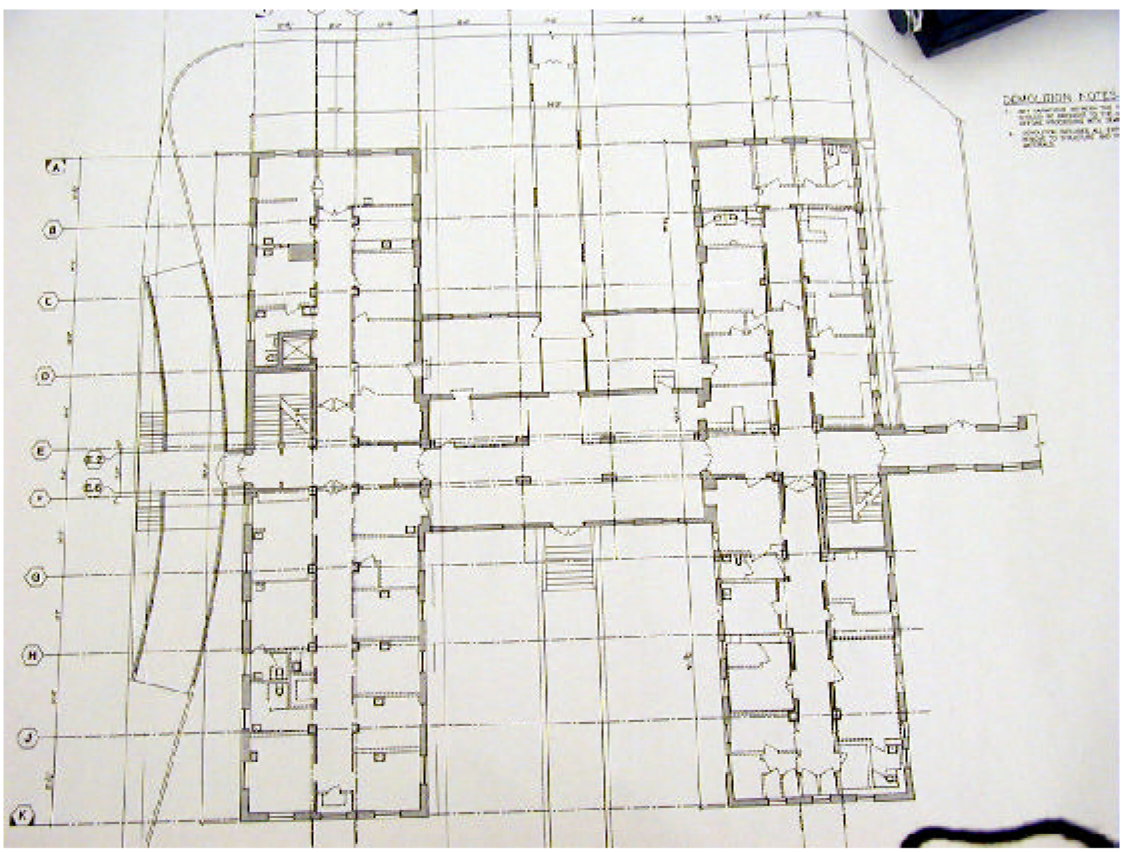
Last use - first floor plan



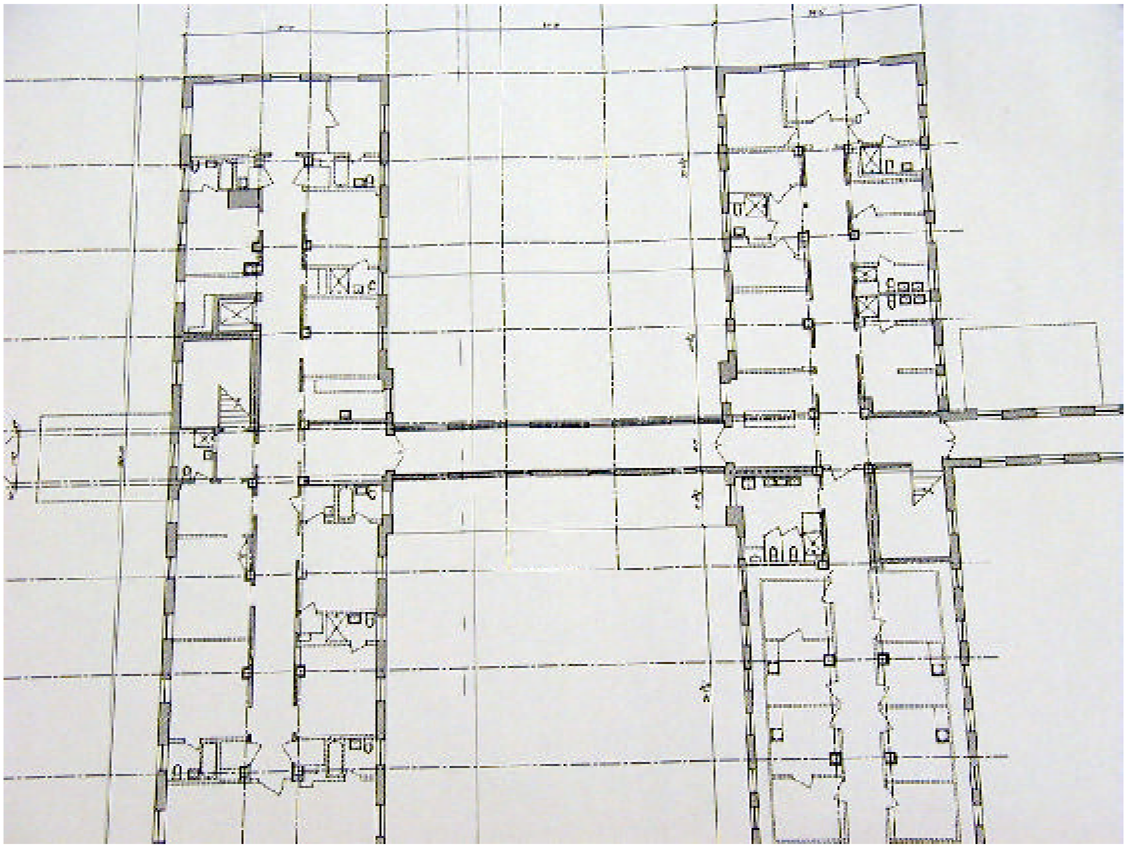
Last use - second floor plan



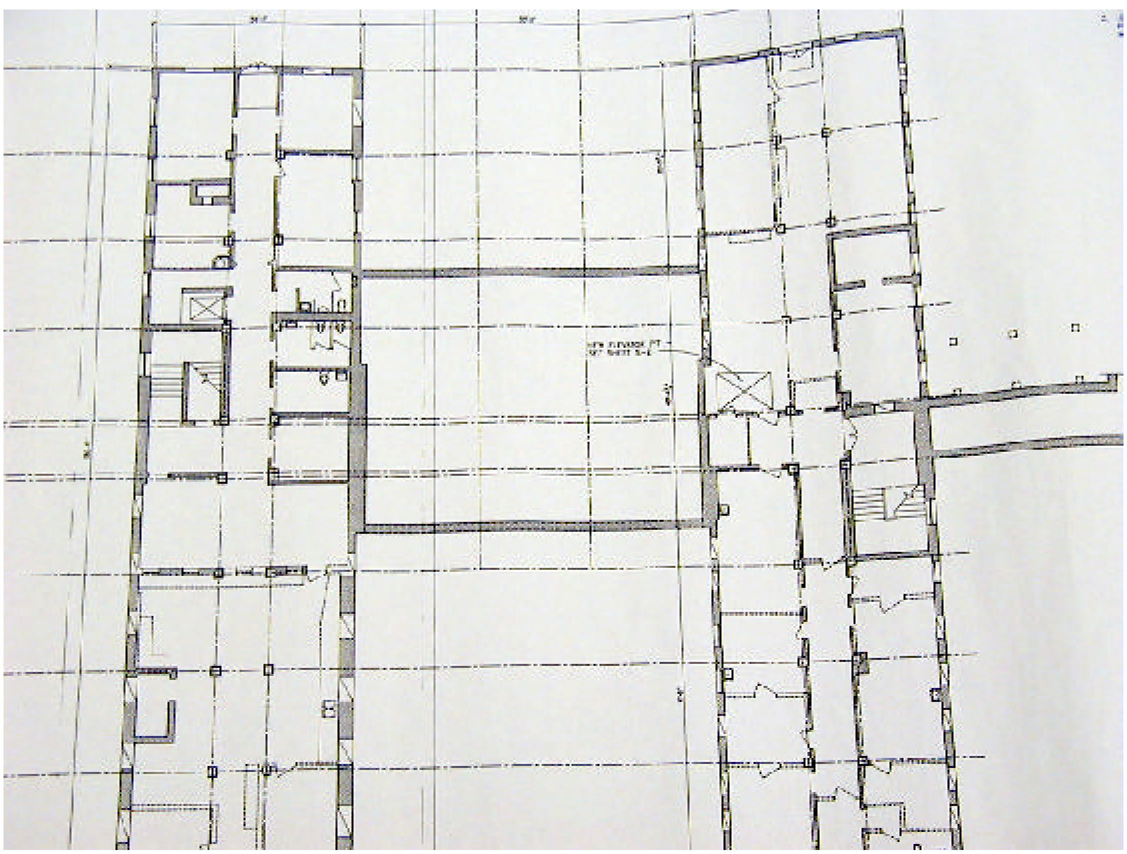
Last use - basement floor plan



Demolition plan - first floor



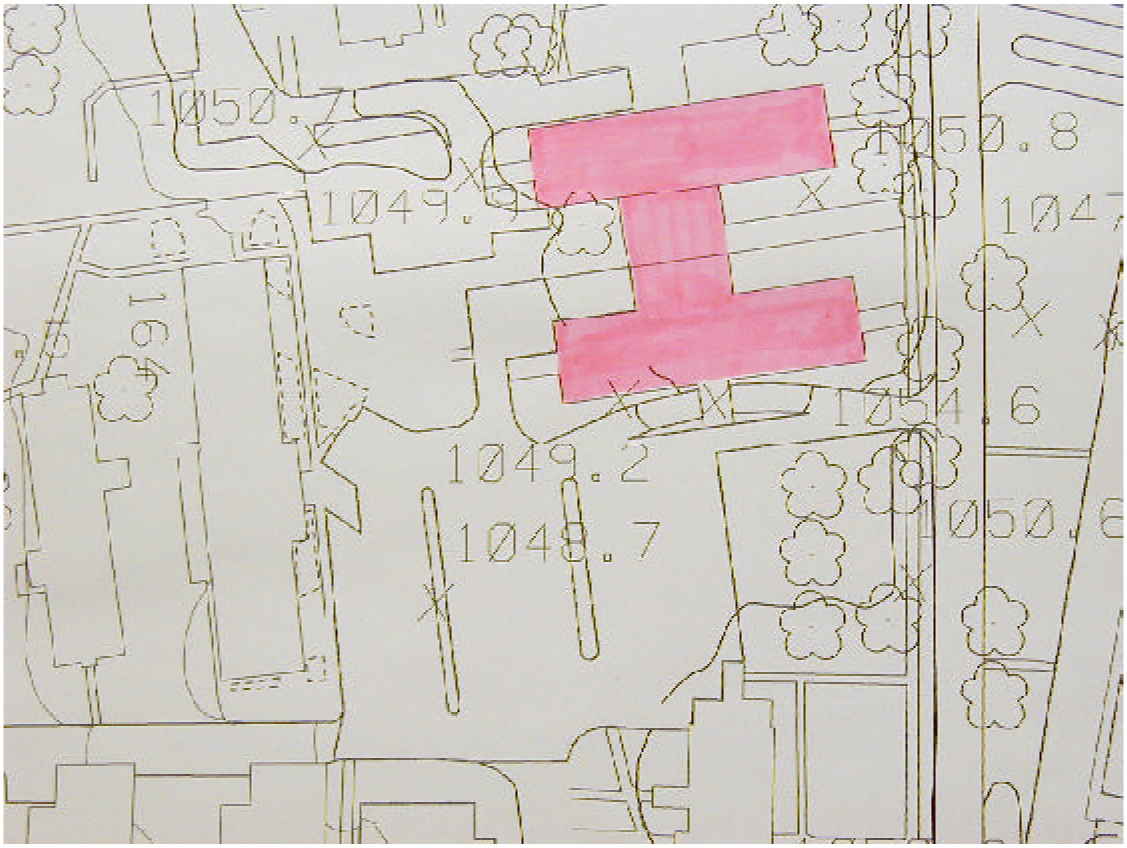
Demolition plan - second floor



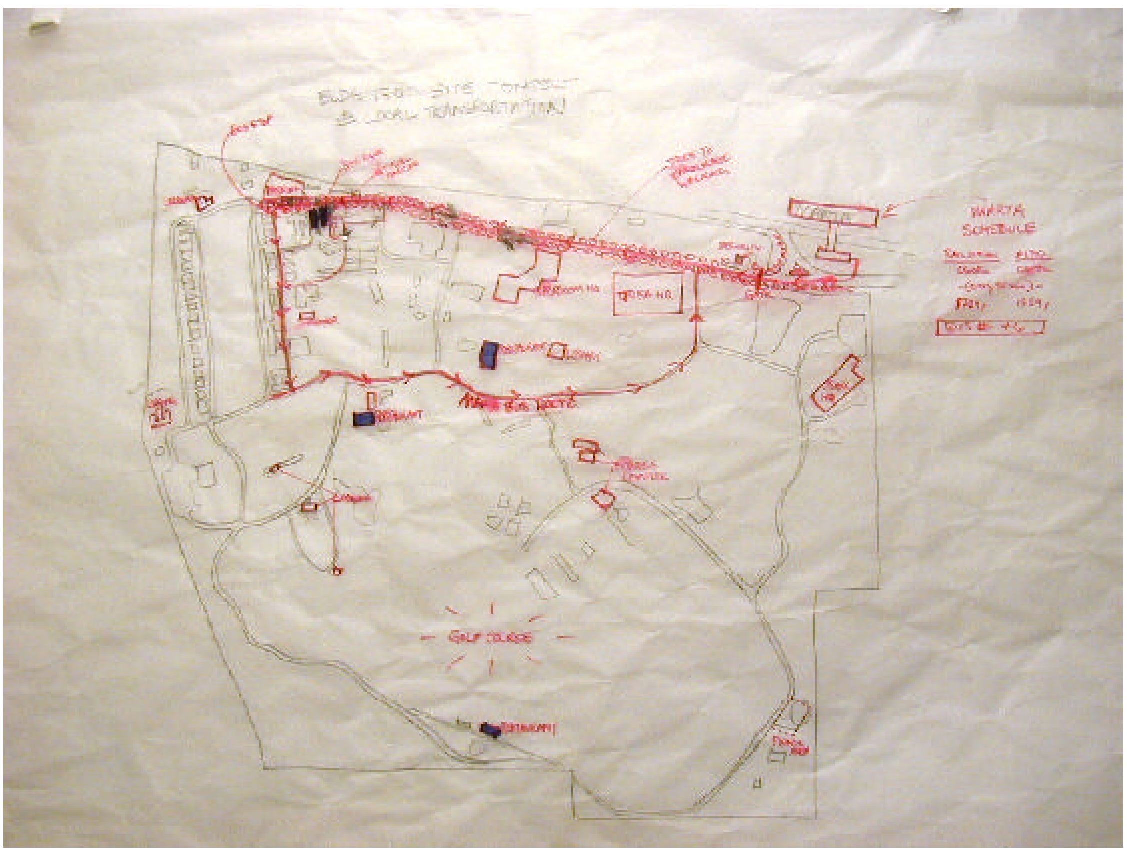
Demolition plan - basement

APPENDIX E

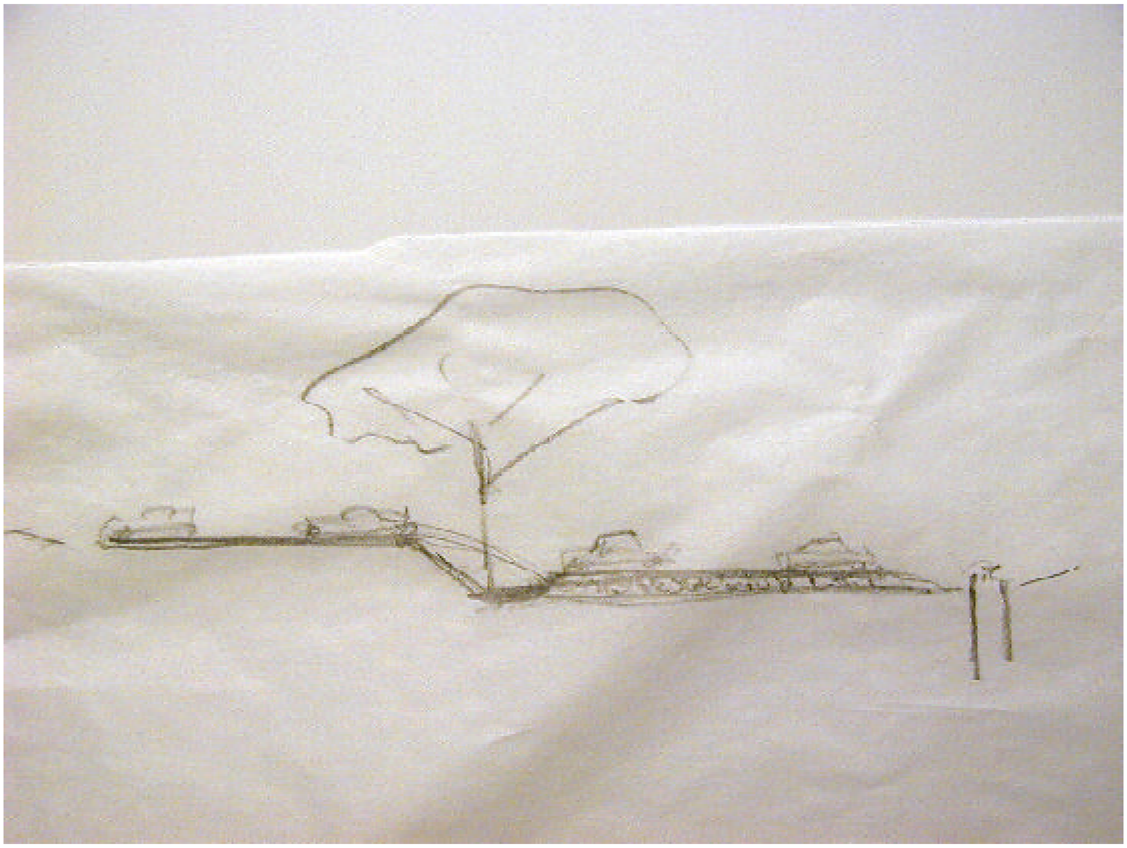
SKETCHES FROM DESIGN WORKSHOP



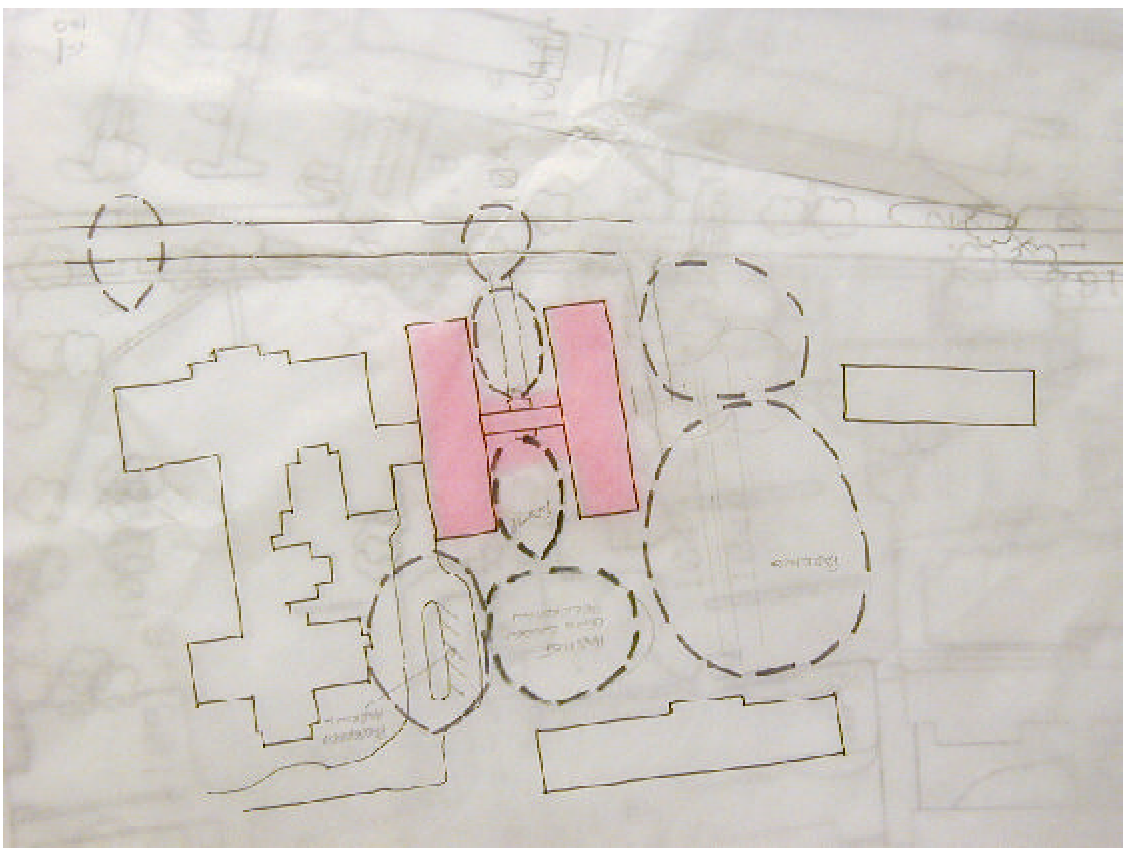
Existing site



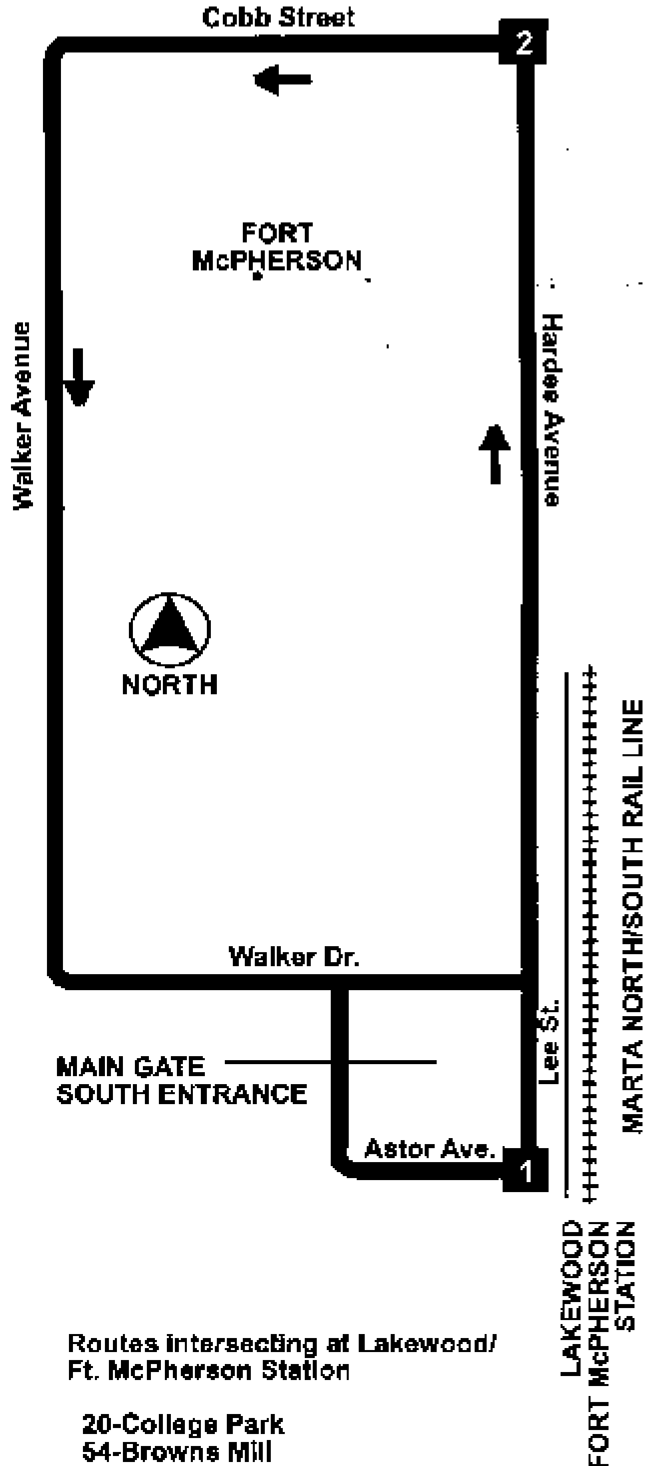
Site context and transportation



Parking lot idea



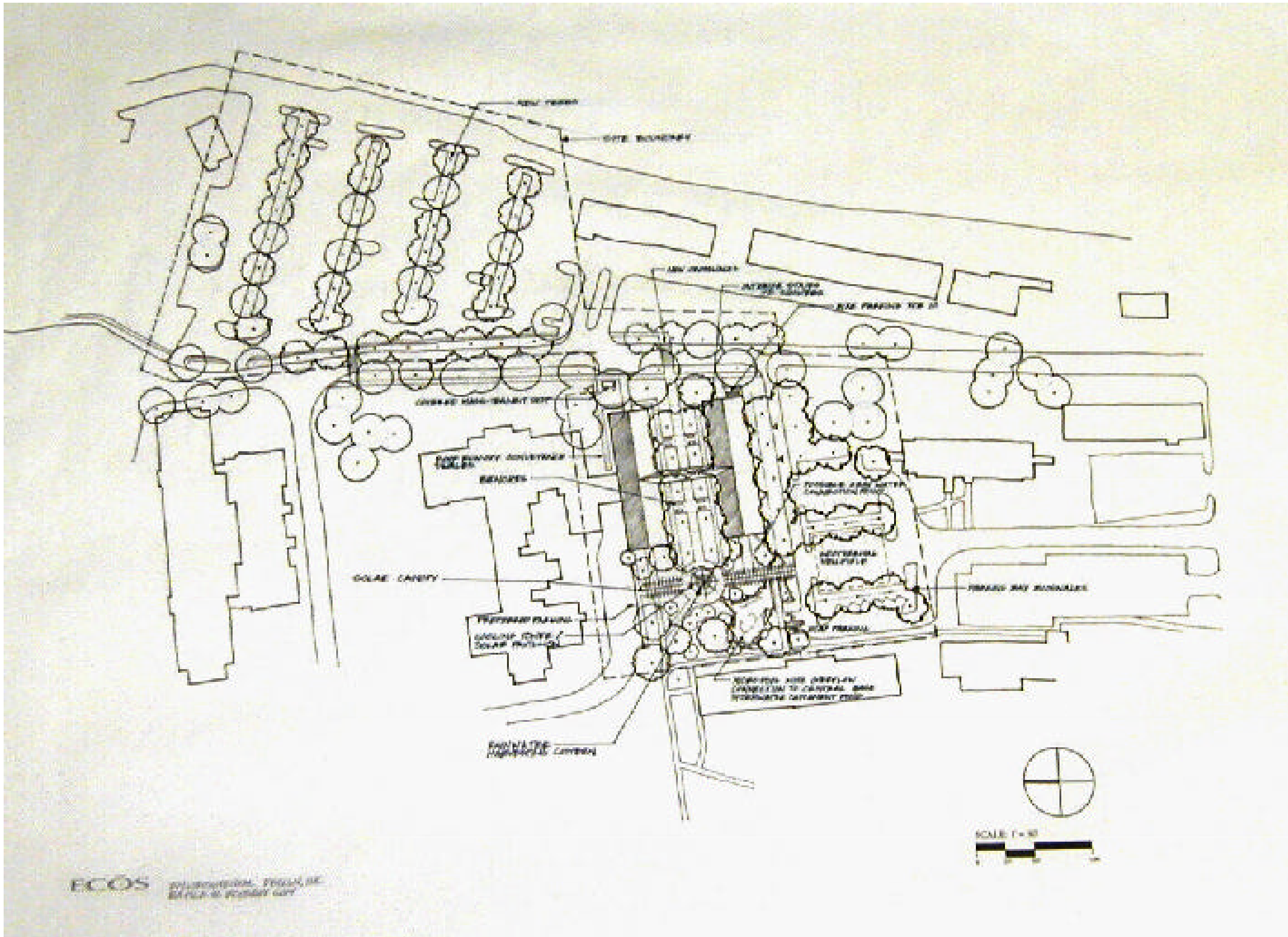
Landscape option



Routes intersecting at Lakewood/
Ft. McPherson Station

20-College Park
54-Browns Mill
62-Headland
72-Virginia Avenue
76-Ft. McPherson
78-Cleveland Avenue/Hutchens Road
84-Mt. Olive
166-Ben Hill

Marta bus route map

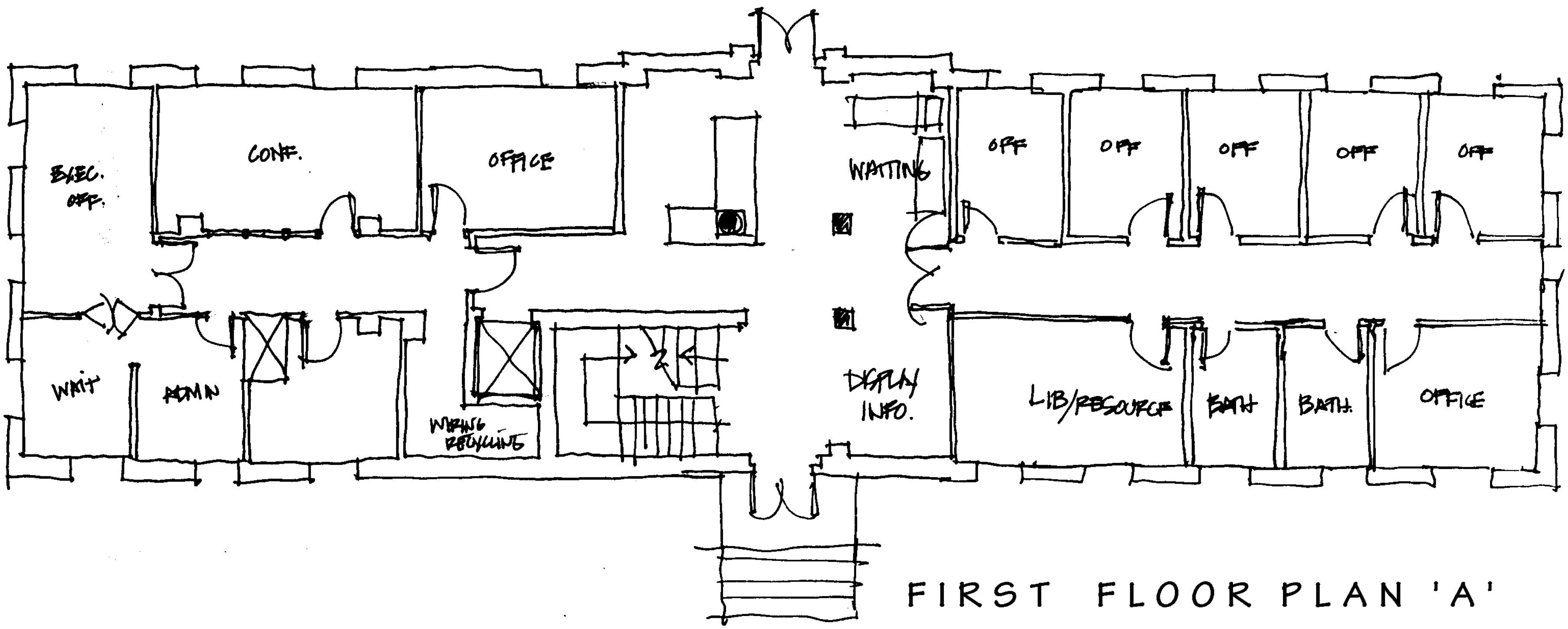


Final site plan

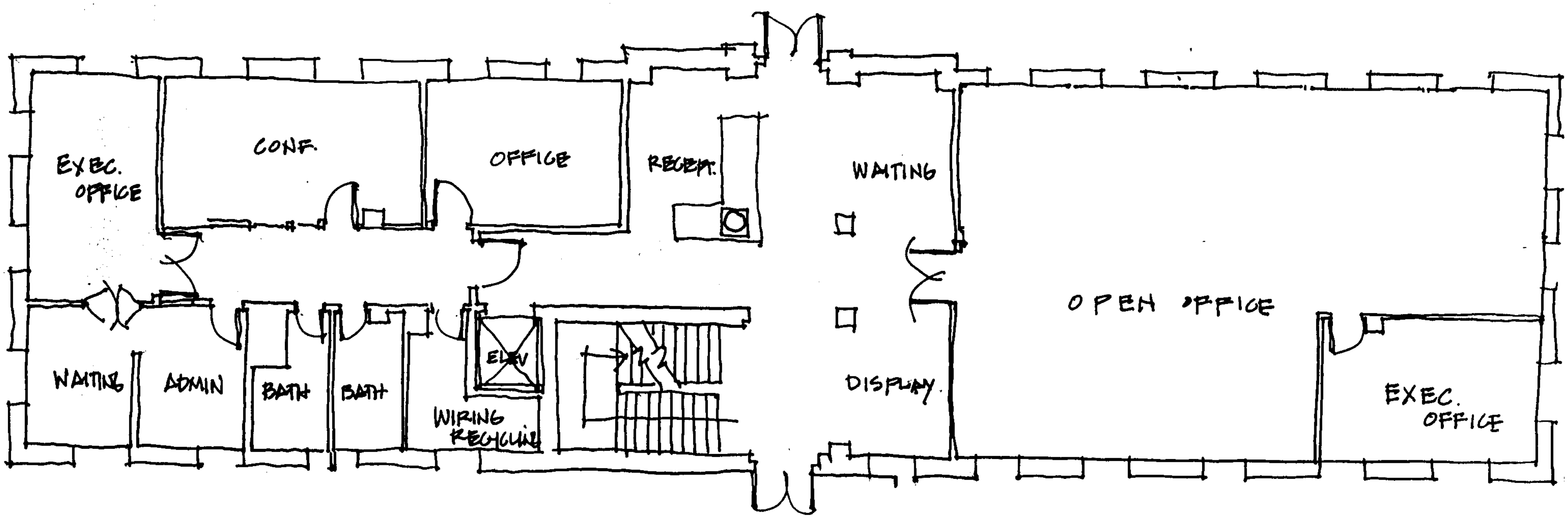
Courtyard with Portico Staircase - View Looking West from Street

Courtyard with ADA Compliant Ramp - View Looking West from Street

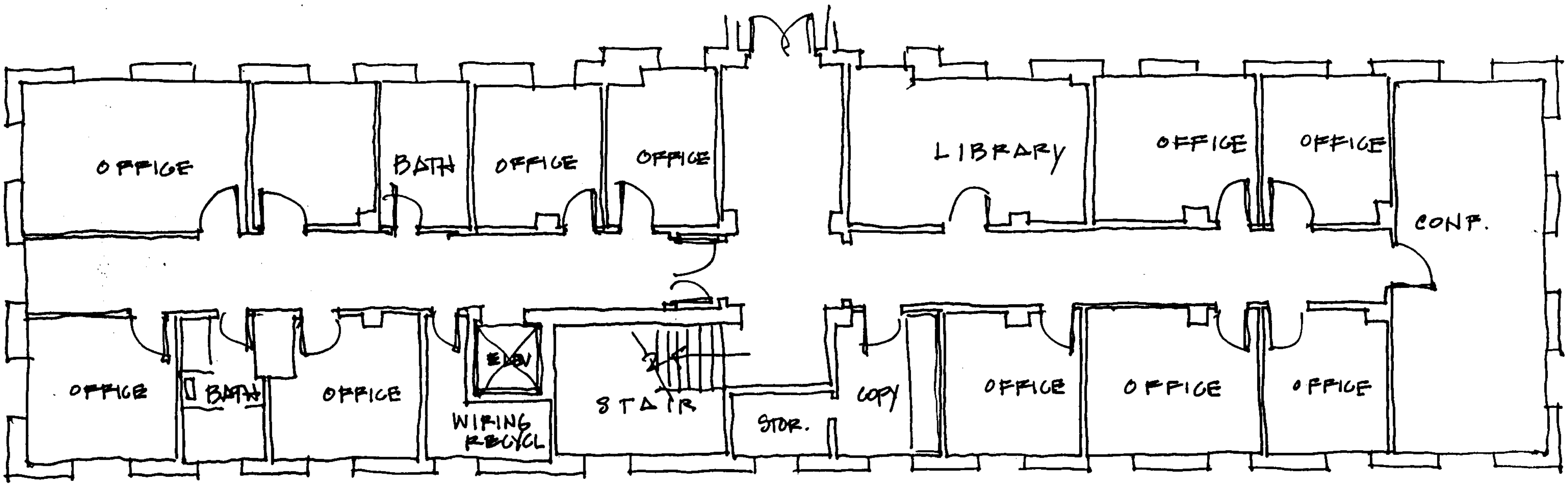
Courtyard Greenway - View Looking West from Street
Fountain/sculptural feature in background



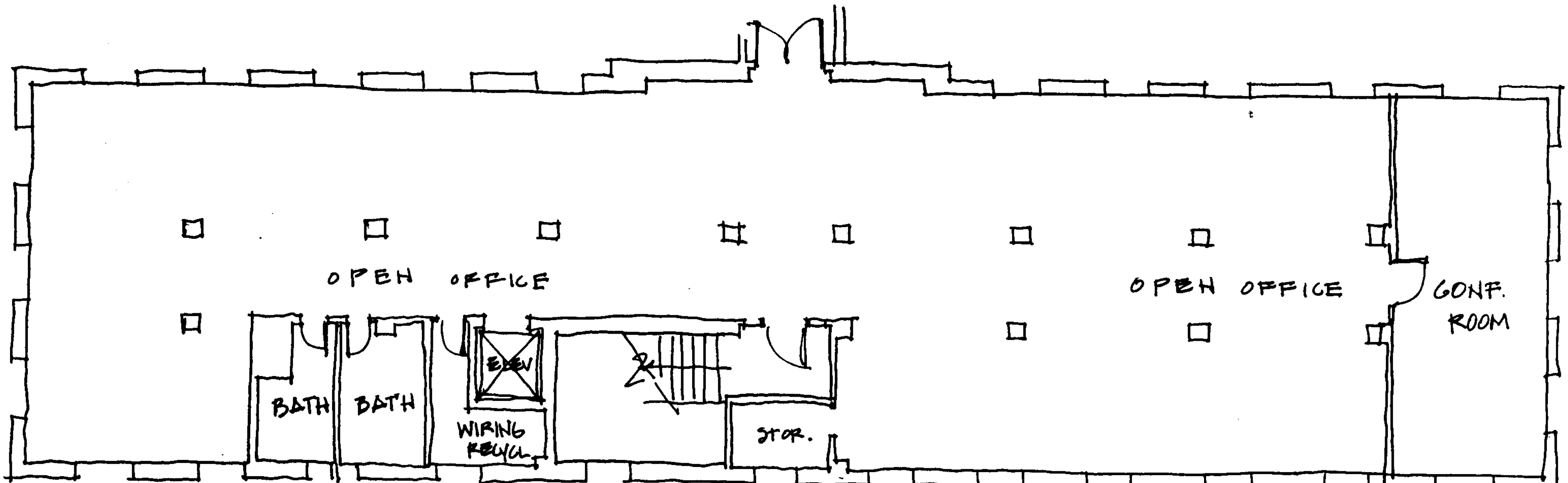
FIRST FLOOR PLAN 'A'



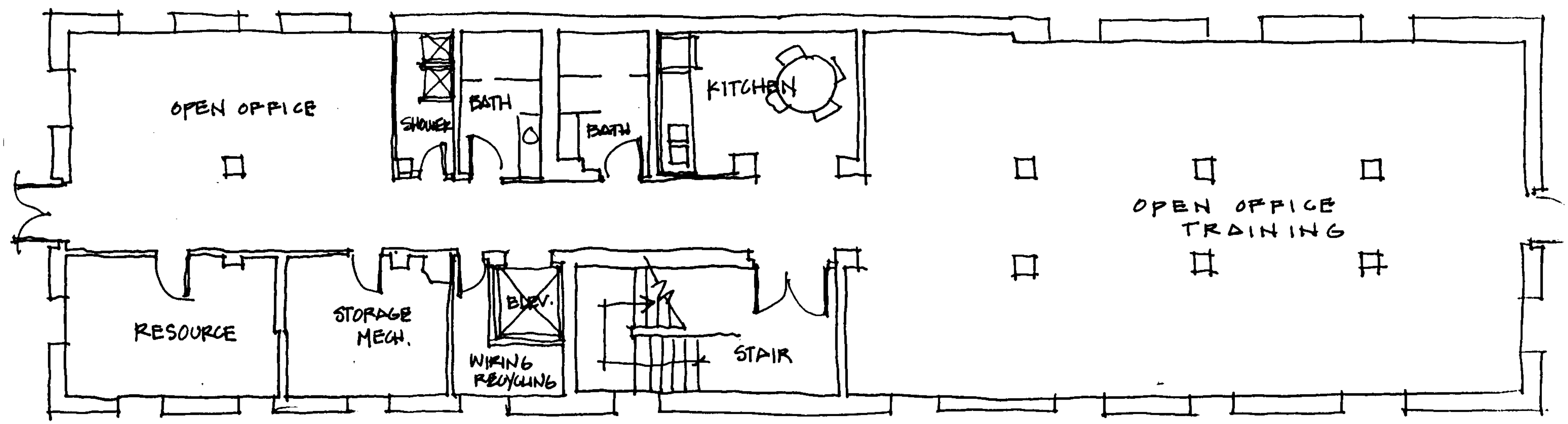
FIRST FLOOR PLAN 'B'



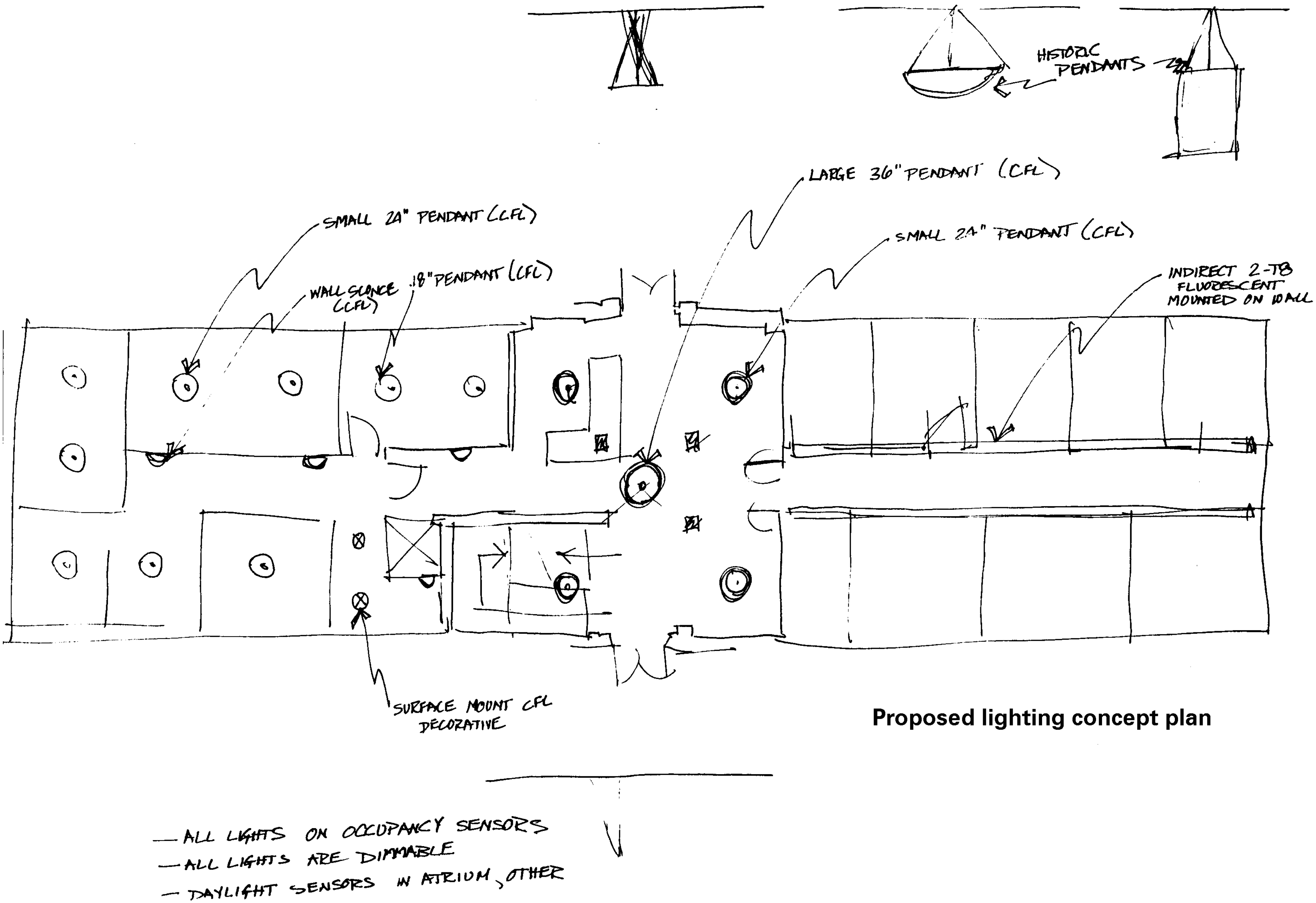
SECOND FLOOR PLAN 'A'



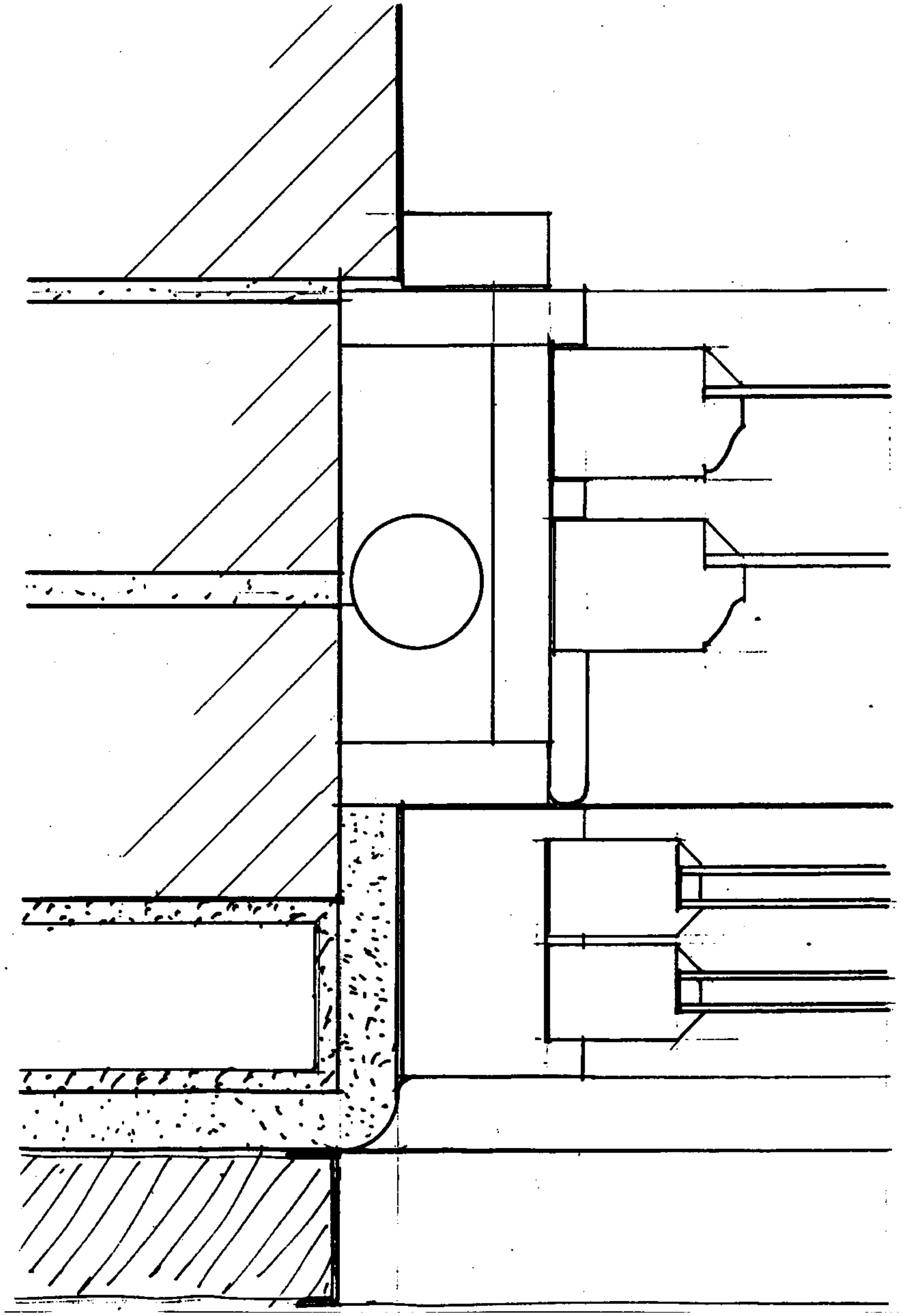
SECOND FLOOR PLAN 'B'



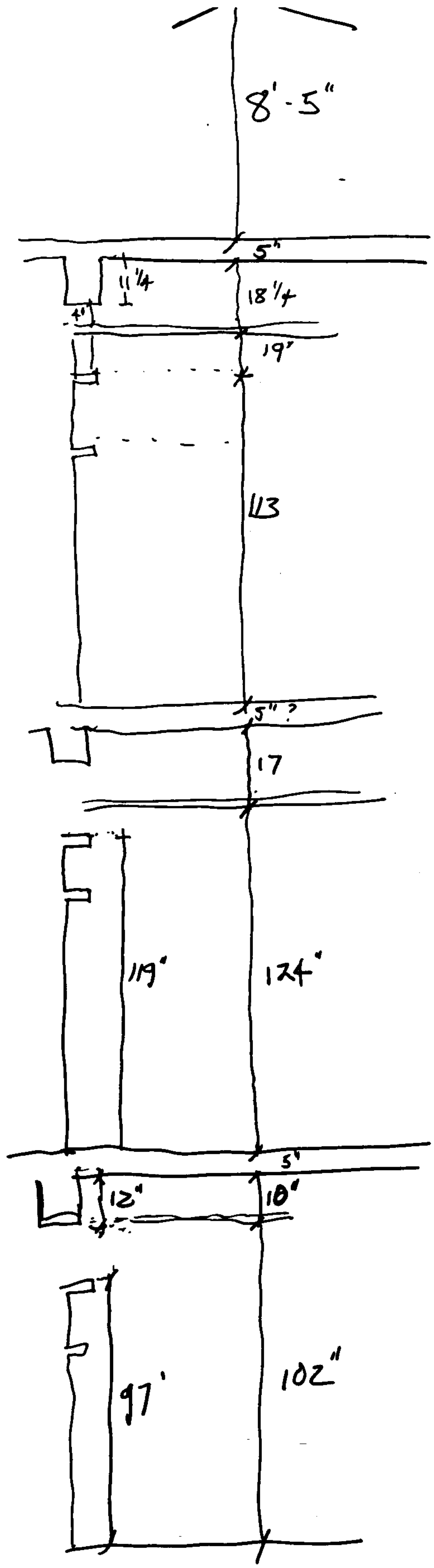
LOWER LEVEL PLAN



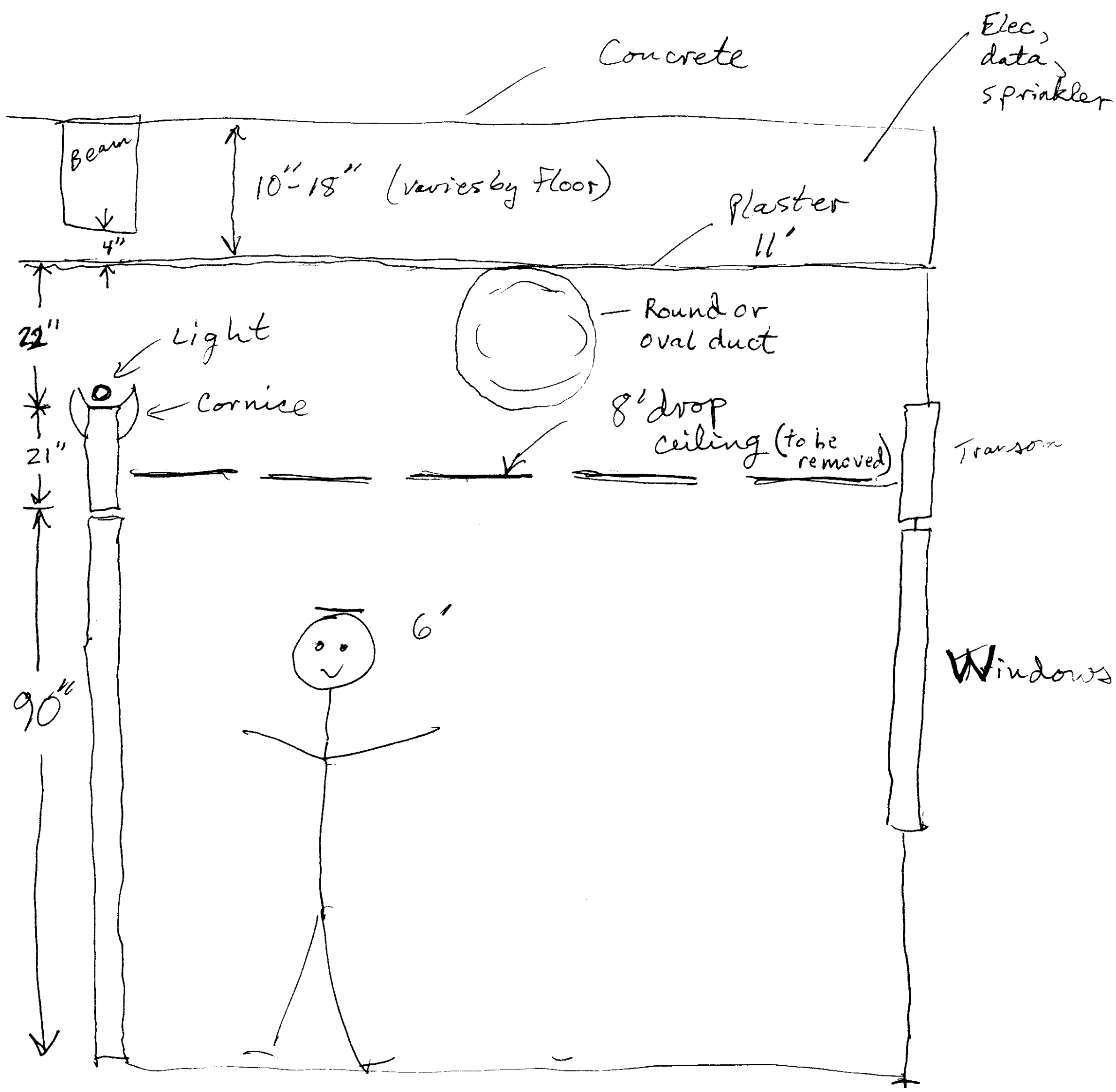
Proposed lighting concept plan



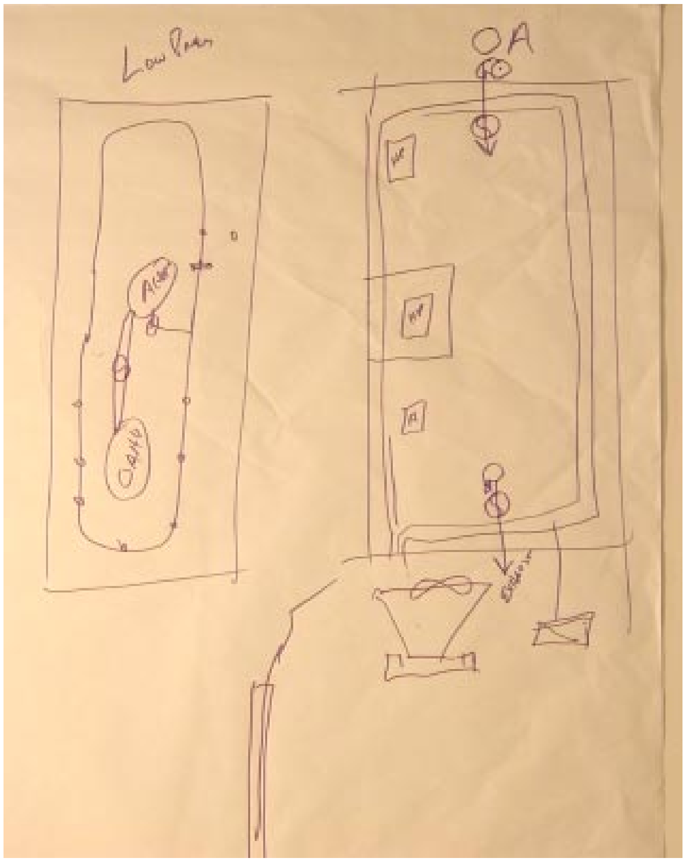
Vertical cross section showing new windows and interior insulation



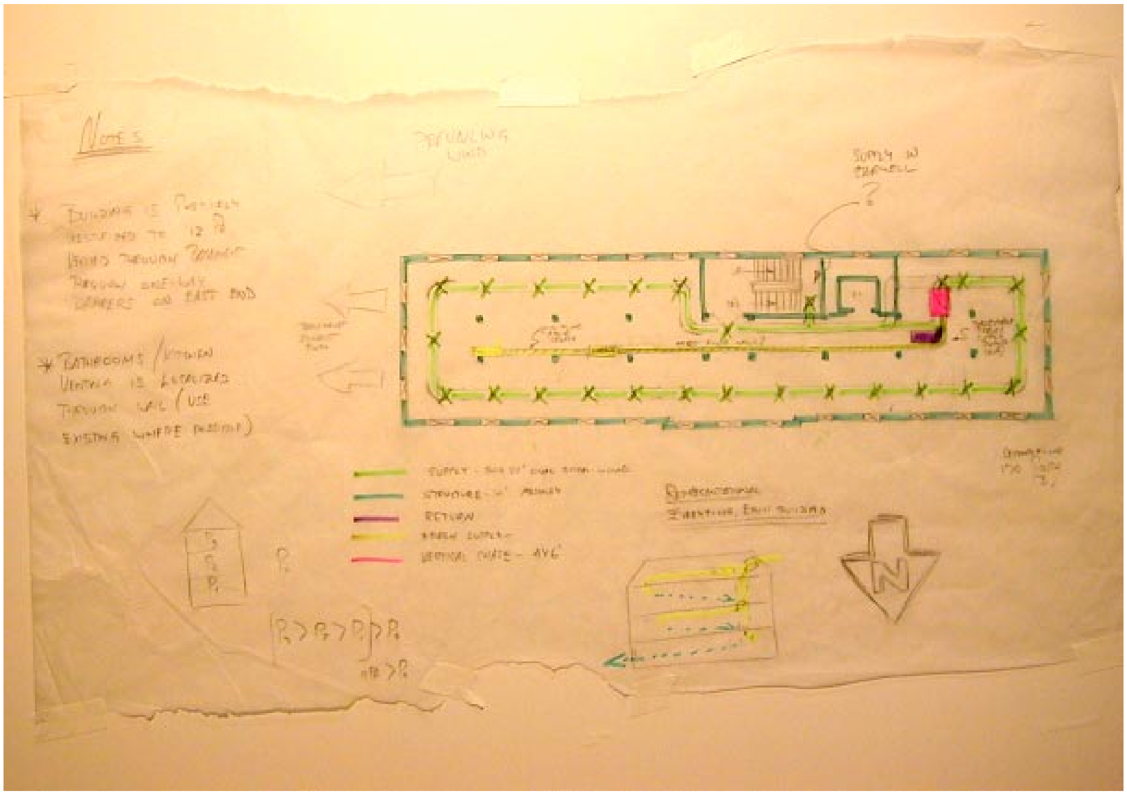
Cross section showing interstitial spaces



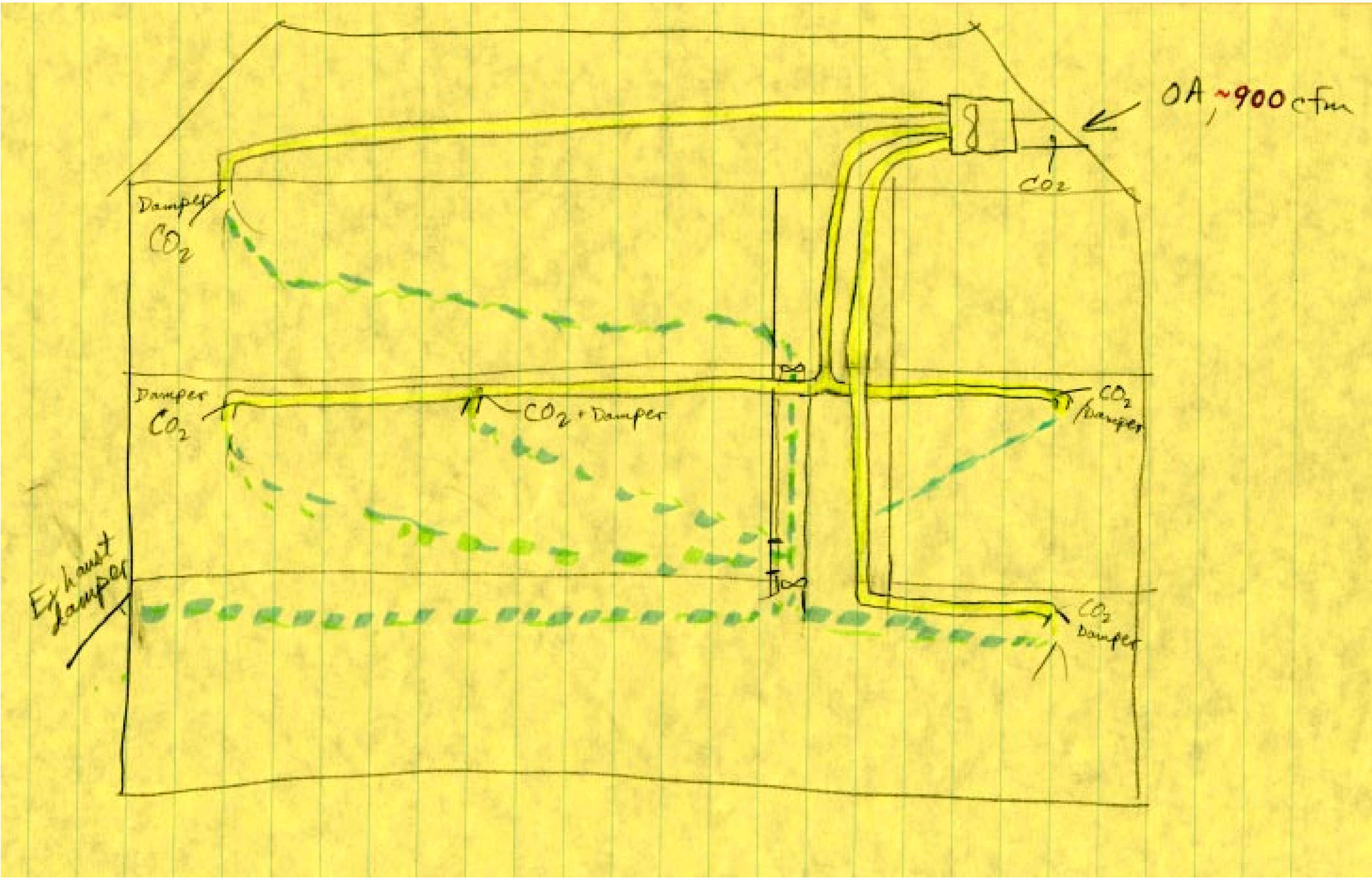
Proposed room cross section



HVAC distribution options



Proposed HVAC distribution



Possible separate ventilation system

APPENDIX F

BUILDING ENERGY USE SIMULATIONS

Appendix F: Building Energy Use Simulations

Energy use simulations were performed using both Energy-10 and Trane System Analyzer software. The two different models produced different results for the suggested upgrades, but the trends are consistent and a useful approximation can be generated by averaging the results of the two models.

The building was modeled as two identical 3-story rectangular buildings (A&B) with no connector (or an unconditioned connector). Care was taken to model the actual properties of the building walls, roofs, windows, and equipment for the reference case and upgraded cases.

Base Case

The base case is based on the assumption that the building has been returned to its original condition and used as office space. This assumption would mean that:

- The conditioned connector between A & B is removed
- All blocked windows are opened
- Existing single pane windows are used
- Existing or typical mechanical equipment is used
- No additional insulation is added
- Actual or typical office lighting levels are installed
- Typical office equipment is installed and operated on a typical office schedule

The results of the simulations show that energy use is predicted to be high, with the total energy use for Building 170 at 2.1 billion Btu per year, or 80.9 kBtu per square foot per year. This is considerably higher than the AEPI goal of 35 kBtu per square foot as outlined in *AEI, Design Guidelines.* The estimated annual cost of this energy use, based on current Fort McPherson utility costs, is $24,987.

Complete Upgrade

Energy use simulations were also run for an upgraded case, where the building is renovated according to the suggested design strategies outlined in this report. This would mean that:

- All windows replaced with double pane, wood frame, low emissivity windows
- The equivalent of nine inches of fiberglass insulation (R-30) is added to the attic
- Foam insulation added to walls (R-3)
- Lighting modified from the standard 1.78 Watts per square foot to 1.0 Watts per square foot due to increased use of daylight
- High efficiency heating and cooling equipment (90 AFUE, 16 SEER)
- HVAC controls setback at night and on weekends

The results of the simulation show the total energy use for Building 170 as 976 million Btu per year, or 37 kBtu per square foot per year. This is nearly as low as the energy use budget of 35 kBtu square foot, as set forth in the *AEI, Design Guideline*, Chapter 11, and represents a 55% reduction in energy use. The estimated cost of energy use in the combined upgrade, based on current Fort McPherson utility costs, is $10,818. This represents a reduction of 57%, or an annual cost savings of $14,169 over the reference case.

Note that the Complete Upgrade simulation does not consider any of the following features:

- Tree shading
- Air sealing (such as tighter windows)

Based on the simulations, it is estimated that each year the renovated building will prevent 425,261 lbs of carbon dioxide production, 3133 lbs of sulfur dioxide production, and 1346 lbs of nitrous oxide production as compared to the base case.

APPENDIX G

DESIGN SCENARIOS

Appendix G: Design Scenarios

Two design scenarios for the renovation have been generated: the LEED™ case and the LEED™ Gold case. The LEED™ case includes most of the strategies, but not all of them are carried out to extent needed to earn points in the LEED™ system. The LEED™ Gold case represents the execution of all strategies in order to gain a LEED™ Gold certification. The checklist below demonstrates which recommended strategies are included in each of these two cases. Appendix H shows how these two cases are scored in the LEED™ system.

Sustainable Site & Water Use

Strategy	LEED™ Certified	LEED™ Gold
1. Protect and enhance existing trees and shrubs	✓	✓
2. Use soil retention systems during construction	✓	✓
3. Install xeriscaping	✓	✓
4. Minimize chemical plant treatments	✓	✓
5. Rebuild parking lots and drives Option 1: Porous concrete		✓
Option 2: Bio-swales	✓	
6. Install preferred parking	✓ (no refueling station)	✓ (includes refueling station)
7. Shade parking lot and building with trees	✓ (<30% after 5 years)	✓ (>30% after 5 years)
8. Locate MARTA bus stop just outside of building		✓ (include direct shuttle?)
9. Provide facilities for bike and pedestrian accessibility	✓	✓
10. Provide handicap access to the building Option 1: Ramp to main entrance		
Option 2: Ramp to basement entrances	✓	✓
11. Provide an inviting outdoor setting	✓	✓
12. Minimize light pollution	✓	✓
13. Install rainwater catchment system	✓	✓
14. Utilize stormwater runoff Option 1: Direct water to golf course	✓	
Option 2: Micro-pool		✓
15. Use very low flow fixtures	✓ (20% less than baseline)	✓ (30% less than baseline)
16. Reuse graywater on site		✓

Green Architecture & Materials

1. Insulate and air seal attic	✓	✓
2. Install an apron around base of building	✓	✓
3. Restore existing windows	✓	✓
4. Add interior energy efficient windows	✓	✓
5. Customize windows based on orientation	✓	✓
6. Restore transom windows	✓	✓
7. Remove lowest dropped ceiling & reuse original ceiling	✓	✓
8. Harvest daylight and install energy efficient lighting	✓	✓
9. Reuse existing interior walls	✓	✓
10. Reuse existing usable materials	✓	✓
11. Recycle existing unusable materials	✓	✓
12. Use recycled content materials	✓ (<25% of materials)	✓ (>25% of materials)
13. Create occupant recycling infrastructure	✓	✓

High-Performance Energy Systems

1. Use high-efficiency heating and cooling equipment Option 1: Use geothermal heat pumps		✓
Option 2: Rotary screw chiller and gas boiler	✓	
2. Install a high-efficiency distribution system Option 1: Centralized VAV air handler	✓	✓
Option 2: Heat pump recirculating loop		
3. Install a separate ventilation system	✓ (E<0.9)	✓ (E>0.9)
4. Positively pressurize building	✓	✓
5. Provide ventilation fans at indoor pollution sources	✓	✓
6. Monitor indoor air quality	✓	✓
7. Monitor building energy and water use	✓	✓
8. Install PV panels		✓
9. Install a prototype fuel cell		✓
10. Install a solar water heater	✓	✓

APPENDIX H

LEED™ SCORING

Appendix H

Southface Energy Institute

LEED v2.0 Worksheet

		Possible	LEED Certified	LEED Gold
	SUSTAINABLE SITES			
P1	Erosion and Sedimentation Control	Reqd		
1	Site Selection	1	1	1
2	Urban Development	1	1	1
3	Brownfield Development	1		
4	Alternative Transportation			
	Locate building close to public transportation	1		1
	Provide bicycling facilities	1	1	1
	Install alternative refueling station(s)	1		1
	Reduce parking capacity and provide carpool parking	1	1	1
5	Reduced Site Disturbance			
	Limit site disturbance / restore open area	1		1
	Reduce the development footprint	1		
6	Stormwater Management			
	Decrease stormwater runoff	1	1	1
	Stormwater treatment systems	1		
7	Landscape and Exterior Design			
	Reduce parking lot heat production	1		1
	Reduce roof heat production	1		
8	Light Pollution Reduction	1		1
	SUSTAINABLE SITES TOTAL	**14**	**5**	**10**
	WATER EFFICIENCY			
1	Water Efficient Landscaping			
	Highly efficient irrigation OR 50% from rainwater	1	1	1
	No irrigation OR 100% from rainwater	1	1	1
2	Innovative Wastewater Technologies	1		
3	Water Use Reduction			
	Reduce water use 20% from baseline	1	1	1
	Reduce water use another 10% from baseline	1		1
	WATER EFFICIENCY TOTAL	**5**	**3**	**4**
	ENERGY & ATMOSPHERE			
P1	Fundamental Building Systems	Reqd		
P2	Minimum Energy Performance	Reqd		
P3	CFC Reduction	Reqd		
1	Optimize Energy Performance	10	6	10
2	Renewable Energy	3		
3	Additional Commissioning	1		
4	Elimination of HCFC's and Halons	1		
5	Measurement and Verification	1		1
6	Green Power	1		
	ENERGY & ATMOSPHERE TOTAL	**17**	**6**	**11**

	MATERIALS & RESOURCES			
P1	Storage and Collection of Recyclables	Reqd		
1	Building Reuse			
	Maintain 75% of existing structure & shell	1	1	1
	Maintain another 25% of structure & shell	1		
	Maintain 100% structure & shell plus 50% non-shell	1		
2	Construction Waste Management			
	Recycle / salvage at least 50% construction waste	1	1	1
	Recycle / salvage another 25% construction waste	1		
3	Resource Reuse			
	Specify 5% salvaged / refurbished materials	1		
	Specify another 5% salvaged / refurbished materials	1		
4	Recycled Content			
	Specify 25% recycled building materials	1		1
	Specify another 25% recycled building materials	1		
5	Local / Regional Materials			
	Specify 20% locally manufactured building materials	1		
	Of these, specify 50% extracted locally	1		
6	Rapidly Renewable Materials	1		
7	Certified Wood	1		
	MATERIALS & RESOURCES TOTAL	**13**	**2**	**3**
	INDOOR ENVIRONMENTAL QUALITY			
P1	Minimum IAQ Performance	Reqd		
P2	Environmental Tobacco Control	Reqd		
1	Carbon Dioxide Monitoring	1	1	1
2	Increase Ventilation Effectiveness	1		1
3	Construction IAQ Management			
	Construction measures	1		1
	Building flushout OR IAQ testing procedure	1	1	1
4	Low-Emitting Materials			
	Low VOC adhesives	1	1	1
	Low VOC paints and coatings	1	1	1
	Green label carpet systems	1	1	1
	No added urea-formaldehyde in composite products	1		1
5	Indoor Chemical and Pollutants	1	1	1
6	Controllability of Systems			
	Provide operable windows	1	1	1
	Provide individual controls	1	1	1
7	Thermal Comfort			
	Comply with ASHRAE standard	1	1	1
	Install temperature and humidity monitoring system	1	1	1
8	Daylight and Views			
	Daylight in 75% of all space	1	1	1
	Direct line of sight to windows	1	1	1
	INDOOR ENVIRONMENTAL QUALITY TOTAL	**15**	**12**	**15**
	INNOVATION & DESIGN PROCESS			
1	Innovation Credits	4		1
2	Accredited Professional	1		
	INNOVATION & DESIGN PROCESS TOTAL	**5**	**0**	**1**
	GRAND TOTAL		**28**	**44**

Certification Levels:	*LEED Certified*	*Silver*	*Gold*	*Platinum*
Points:	*26 - 31*	*33 - 38*	*39 - 51*	*52 +*

APPENDIX I

ESTIMATED CONSTRUCTION BUDGETS

Southface Energy Institute

Appendix I: AEPI Building 170 Adaptive Re-Use/Green Budget Estimate

Estimate prepared by Southface Energy Institute with input from Mike Hutt

	Item Description	*Units*	*Unit Cost*	*Estimated Total Costs*		
				*Base Case	LEED Cert.	LEED Gold
	Demolition and Site Preparation					
1-1	Demo Waste Removal	TBD		$35,205		
1-2	Reduce Demo from Int. Walls	172 tons			$25,704	$25,704
1-3	Re-use brick and concrete	600 tons	$6.25		-$3,750	-$3,750
1-4	Recycle asphalt parking lots	375 tons			-$1,470	-$1,470
1-5	Salvage building materials	TBD			TBD	TBD
1-6	Recycle Ceiling Tiles	26,000 SF			-$1,470	-$1,470
1-7	Demolition for Elevator Shaft			$34,629	$34,629	$34,629
1-8	Additional Lead and Asbestos Removal			$200,000	$200,000	$200,000
1-9	Haz Mat Abatement			$83,241	$83,241	$83,241
	Subtotal			**$353,076**	**$336,884**	**$336,884**
	Restoration and Construction					
2-1	Building Structural			$27,156	$27,156	$27,156
2-2	Structural for Bridge option				TBD	TBD
2-3	Exterior Wall Structural	17,000 SF		$12,104	$12,104	$12,104
2-4	Façade Restoration (includes demo of bridge)			$100,000	$100,000	$100,000
2-5	Slate Roof Replacement	111,800 SF	$35.78	$400,000		
2-6	Recycled Rubber "Slate"	111,800 SF	$13.50		$159,300	$159,300
2-7	Gut and replace interior walls			$44,815		
2-8	Remove only top 22" of interior cooridor walls				$33,611.60	$33,611.60
2-9	Historic Window Restoration			$300,000	$300,000	$300,000
	Subtotal			**$884,075**	**$632,172**	**$632,172**
	Mechanical Systems					
3-1	Specialties			$132,685	$132,685	$132,685
3-2	Plumbing			$93,791	$93,791	$93,791
3-3	Install Super low flow fixtures				TBD	TBD
3-4	Fire Protection			$69,848	$69,848	$69,848
3-5	Base HVAC	100 tons	$4,152.41	$415,241		
3-6	Heating / Cooling with High Efficiency Cooling Tower and Gas Furnace	46 tons	$4,000.00		$184,000	
3-7	Heating / Cooling with Geothermal system	46 tons	$4,500.00			$207,000
3-8	Separate Ventilation System (ducts and air handler)				$10,000	$10,000
3-9	Electrical including standard lighting			$412,818		
3-10	Elec. w/ High Efficiency Lighting (reduced size but better fixtures)				$412,818	$412,818
3-11	Install New Elevator at 170-A			$65,000	$65,000	$65,000
3-12	Install 7 Kw Fuel Cell. GE Microgen 7000					
	Mechanical Systems Subtotal			**$1,189,383**	**$968,142**	**$991,142**

Southface Energy Institute

Appendix I: AEPI Building 170 Adaptive Re-Use/Green Budget Estimate
Estimate prepared by Southface Energy Institute with input from Mike Hutt

	Estimated Cost Savings				***Estimated Pollution Prevented (Landfill is one time saving)***									
	Initial	%	Annual	%	Landfill (tons)	%	H_2O (gals)	%	CO_2 (lbs)	%	SO_x (lbs)	%	NO_x (lbs)	%
[redacted]														
1-1														
1-2	$700				172									
1-3	3750				600									
1-4	$1,470				375									
1-5	$2,500													
1-6	$1,470													
1-7														
1-8														
1-9														
	$9,890				**1147**									
[redacted]														
2-1														
2-2														
2-3														
2-4														
2-5														
2-6	$240,700													
2-7														
2-8	$11,203.87	25%			See Line 1-2									
2-9														
	$251,904													
[redacted]														
3-1														
3-2														
3-3			$796	30%			132,600							
3-4														
3-5														
3-6	$231,241	55%	$14,169	57%					425,261	47%	3,133	47%	1,346	47%
3-7	See 3-6 above													
3-8	See 3-6 above													
3-9														
3-10	See 3-6 above													
3-11														
3-12			$1,193	11%					210,975	13%	930	25%	337	25%
	$231,241		**$16,158**	**N/A**				**30%**	**636,236**	**60%**	**4,063**	**72%**	**1,683**	**72%**

Southface Energy Institute

AEPI Building 170 Adaptive Re-Use/Green Budget Estimate
Estimate prepared by Southface Energy Institute with input from Mike Hutt

	Interior Finish Work					
4-1	Finishes			$138,209.36	$138,209.36	$138,209.36
4-2	New Windows and Doors			$95,844.88	$95,844.88	$95,844.88
	Interior Finish Work Subtotal			**$234,054**	**$234,054**	**$234,054**
	Thermal Envelope Upgrades					
5-1	Add Thermal Acoustic Panels to all exterior walls	20000 SF	$2.00		$40,000.00	$40,000.00
5-2	Add Interior high performance operable windows				$85,000.00	$85,000.00
5-3	Add cellulose attic insulation	12000 SF	$1.00		$12,000	$12,000
	Thermal Envelope Subtotal				**$125,000**	**$125,000**
	Sustainable Site and Landscape Package					
6-1	Tree and Soil Protection	TBD	TBD		TBD	
6-2	Grading	TBD	TBD		TBD	
6-3	Install porous concrete	12000 SF	$5.00			$60,000
6-4	Marta Transit Stop		NC			
6-5	Bike Rack for 10 Bikes		$400.00		$400.00	$400.00
6-6	Grass Pave System for Handicap Parking	1000 SF				
6-7	New Pathways	300 LF	$20.00		$6,000.00	$6,000.00
6-8	New Trees (2-3" caliper)	40	$900		$36,000	$36,000
6-9	Other Landscaping	TBD	TBD		TBD	
6-10	Water Collection Cistern	6000 gal	$0.43			$2,600
6-11	Rainwater Catchment System and Micro-pool	1	TBD			TBD
6-12	Solar Electric Pavillion and Walkways	300 SF				$45,000
	Sustainable Site & Landscape Package Subtotal			**$0**	**$42,400**	**$150,000**
	Subtotal			**$2,660,588**	**$2,338,652**	**$2,469,252**
	Total Costs					
7-12	With Overhead and Profit @ 25%			**$3,325,735**	**$2,923,315**	**$3,086,565**
7-13	Costs per Square Foot			**$125**	**$110**	**$116**
7-14	*Present Value of Utility Savings at 10% interest*					**$120,384**
7-15	*Real Estate Value of Savings from reduced NOI at 10% cap rate*					**$176,680**
7-16	*Class B vs. Class A Valuation. Assume $5 per Sq ft for Class A upgrade at 10% cap rate*					**$1,300,000**
7-17	*Total Increased Equity Value of Green Design*					**$1,715,850**

Southface Energy Institute

AEPI Building 170 Adaptive Re-Use/Green Budget Estimate
Estimate prepared by Southface Energy Institute with input from Mike Hutt

4-1														
4-2														
5-1	See 3-6 above													
5-2	See 3-6 above													
5-3	See 3-6 above													
6-1														
6-2														
6-3							319,736							
6-4														
6-5														
6-6							27,631							
6-7														
6-8														
6-9														
6-10			$1,350	100%			225,000							
6-11							156,799							
6-12			$160						6,000		61		22	
	$0		**$1,510**				**729,166**		**6,000**		**61**			
	$493,035		**$17,668**		**1147**		**729,166**		**642,236**		**4,124**		**1,683**	

1-2	Estimate of 3450 CF of wall material maintained @ 100lbs per CF = 172 tons = 10 tandem loads @ $70 per load = $700 + 25% labor savings of $8,801 = $9501.25 total
1-4	Cost savings based on 375 tons of asphalt = 21 tandem truck loads times $70 per load = $1470 total diverted from landfill. (Per Geoff Bewley)
1-6	Cost savings based on dumpster loads of tile at $210 per load
2-6	Assumes $3.50 per sf for material and $10.00 per sf for slate removal and new roof installation. Need bid to verify.
2-8	Assumes 25% reduction in wall construction cost due to saving in place majority of partition walls.
3-3	Assume 17 gallons per sq. ft. = 442,000 per year at $6.00 per 1000 gal = $2652 base. Assume 30% reduction = $796 savings
3-6	Assumes thermal envelope and lighting improvements as recommneded to reduce cooling load
3-7	Geothermal system savings were averaged with high eff. Chiller and shown on line 3-6.
3-10	Recommend reduction to 1 watt per sf installed. While less watts, daylight controls, etc. may require total current budget under electrical
3-12	Based on a GE Micro-gen (Ballard) Fuel Cell at 7000 watts net metered year round with 61,152 kWh produced (assume 4 cents per kWh = $2446 in an. Savings) Requires 70 CF gas per hour or 6,268 therms per year (at $.2/therm =$1253)
3-12	Assumes 50% reduction in CO2 output and no Nox or Sox compared to comparable electric power supply. Actual total reduction based on Total power consummed on site.
5-1	Specification for wall panel included in resource package
6-10	Assume 45 inches rain per year. Roof top collection = 5000 gallons per inch rain = 225,000 irrigation water provided annually. Cost savings = $1350 at $6.00 per 1000 gallons.
6-11	Assume total volume of rain on AEPI site =729,000 gallons less other catchment strategies = 155,799 gallons cleaned by micro-pool (overflow)
6-12	Assume 4000Kwh produced at 4cents per kWh = $160 per year savings
7-12	$3.5 million total budget currently allocated
7-12	2 Buildings each 13,260 Square feet (total of 26,540 SF)
7-12	Com and Data not included in total budget ($250,000 is estimate) Distance to man hole cover is 200 feet.
7-12	*Costs above based on Bldg. 62 which is 16,000 SF.
7-12	(Costs adjusted upward using 1.66 multiplyer for greater square footage of Building 170)