Breadth Studies:
Construction Management
LEED Certification

Breadth Studies:

Two breadth topics were studied in addition to the structural depth work. In order to effectively compare the existing structural system with the new system, the cost and construction time must be compared. The second breadth topic will be an investigation into what could have been incorporated into the design and construction process in order to receive a LEED certification.

Construction Management Study:

The first breadth study involves construction management issues. A cost analysis was performed on the new system using the 2006 version of RS Means Building Construction Costs. In order to effectively compare the cost of the new system to the actual cost of the existing system, some items were added to the cost analysis that was not affected by this thesis project. For example, prefabricated light gauge metal trusses are still being used as the roof framing material. As a result, an estimate for these trusses was added to the cost. The actual cost of the structural package was $3.2 million. The total cost of the estimate for the new structural package is $3,176,357. This results in a savings of $23,643. I was not able to compare individual systems because the actual cost breakdown was not permitted to be released for this project. However, since the total system results in a savings of almost $24,000, it is definitely a considerable alternative to the existing system. The complete estimate calculations can be seen in the appendix. Cost is only one factor in the decision between different systems. Another major factor is the duration of the construction process.

A construction schedule was also done using Primavera Project Manager. For the purposes of this study, the building was broken down into four sections for the construction process. By breaking the building down into different sections, several activities can be done at the same time. The duration of the activities was determined based on the daily output of a typical crew found in RS Means. The schedule can be adjusted based on the crew size for each activity. The larger the crew, the faster the activity can be completed. The schedule is shown below. The red bars indicate the critical path of the work. The green bars are activities that can be done simultaneously with another activity, and the start of another activity is not directly related to their completion.

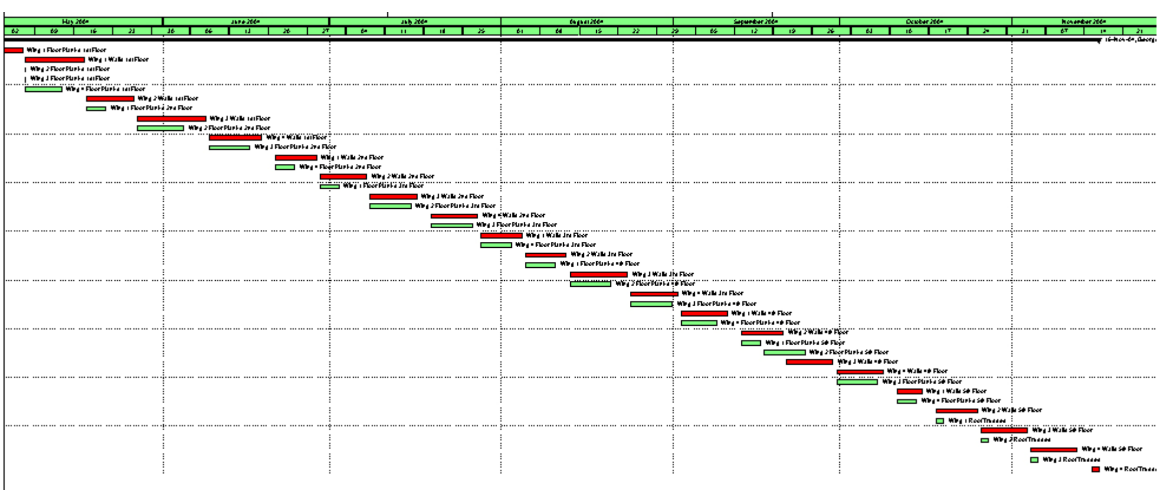


Figure 13: Construction Timeline

The actual duration of the structural aspect of the project was six months. The project began in May 2004. For this study, I assumed that the structural work began on May 3, 2004. The end of the structural construction as determined from the schedule above is November 16,

2004. The total time is approximately two weeks more than six months. This is virtually the same amount of time as the actual construction. Therefore, the new system of masonry walls and hollow core planks is a viable solution in terms of construction time. A larger version of the schedule can be seen in the appendix.

LEED Certification Study:

George Read Hall was not originally designed as a green building. This study was performed to see what changes could have been implemented to achieve certification on the LEED checklist. This was done using the US Green Building Council's Green Building Rating System for New Construction and Major Renovations, Version 2.2. In order to reach certification, twenty six points must be achieved on this checklist. Time did not allow for a complete study of all sixty nine possible points, so the sustainable sites category was chosen for a more in depth study. Fourteen possible points can be achieved in this category, as well as one required point.

Prerequisite 1: Construction Activity Pollution Prevention

In order to meet the prerequisite, construction activity pollution must be reduced. This is accomplished by creating an erosion and sedimentation control plan for the project. The goal of this credit is to prevent loss of topsoil during construction, to prevent sedimentation of storm sewer or receiving streams, and to prevent polluting the air with dust. To prevent the loss of topsoil, it will be stockpiled in the location shown on the plan on the next page. In addition, the stockpile will be temporarily seeded to prevent erosion until it is needed. The silt fence

will help to prevent run off from reaching the sewer or any surrounding streams. More care will be taken during the construction process to help reduce polluting the air with dust and other particles.

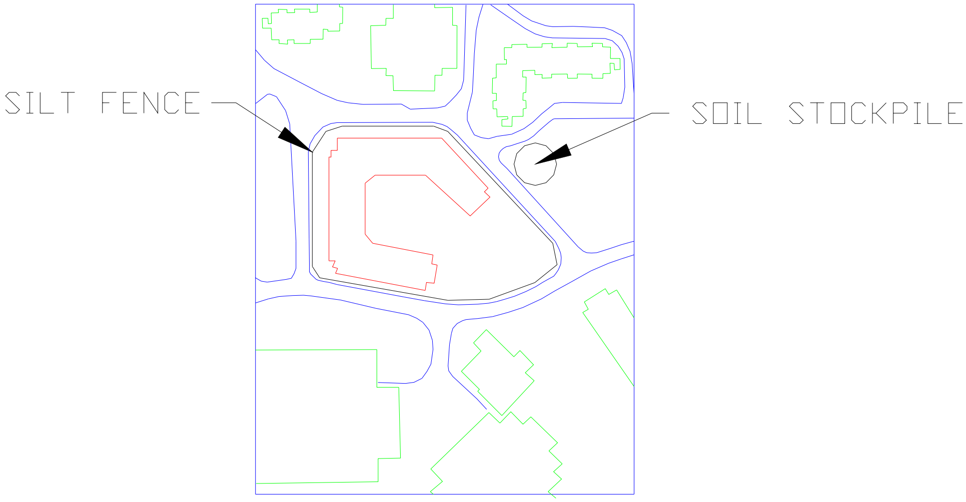


Figure 14: Erosion and Sedimentation Control Plan

Credit 1: Site Selection

The building must be constructed in a manner that results in the least environmental impact. The building cannot be constructed on a site that meets any of the following conditions:

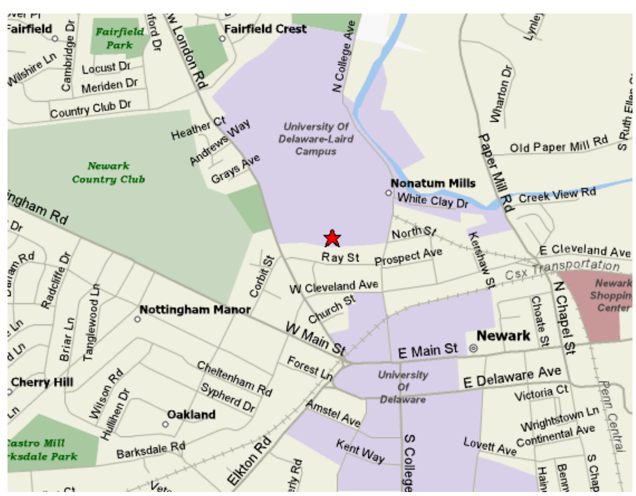
- Prime farmland as defined by the United States Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5)
- Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA (Federal Emergency Management Agency)
- Land that is specifically identified as habitat for any species on Federal or State threatened or endangered lists

- Within 100 feet of any wetlands as defined by United States Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent
- Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries which support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act
- Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt)

The site does not meet any of these criteria; therefore, this point can be attained.

Credit 2: Development Density and Community Connectivity

This credit is achieved by constructing on a previously developed site and within ½ mile of a residential zone with an average density of ten units per acre net as well as within ½ mile of at least ten basic services. A few examples of basic services include banks,



Project Location

places of worship, fire stations, beauty salons, libraries, restaurants, and schools. Using Mapquest, it was determined that at least ten basic services are located within ½ mile of the building location. However, the intention of this point is to be located within ½ mile of a residential zone so that people can walk to the building for work. Because George Read Hall is a dormitory, it is unlikely that it will qualify for this point.

Credit 3: Brownfield Redevelopment

The purpose of this point is to rehabilitate a contaminated site. George Read Hall was not constructed on a contaminated site; therefore, this point cannot be earned.

Credit 4.1: Alternative Transportation: Public Transportation Access

This credit is intended to reduce pollution from automobiles. It can be achieved by locating the project within ¼ mile of one or more stops for at least two campus bus lines. Several different campus bus routes make stops right outside the building. Two of these routes are shown on the following page. The arrows along the route represent the bus stops. The arrows with an asterisk represent stops by request. George Read Hall is labeled near the top of the maps. It is evident that several bus stops are located within ¼ mile of the building. Thus, the building already qualifies for this point.

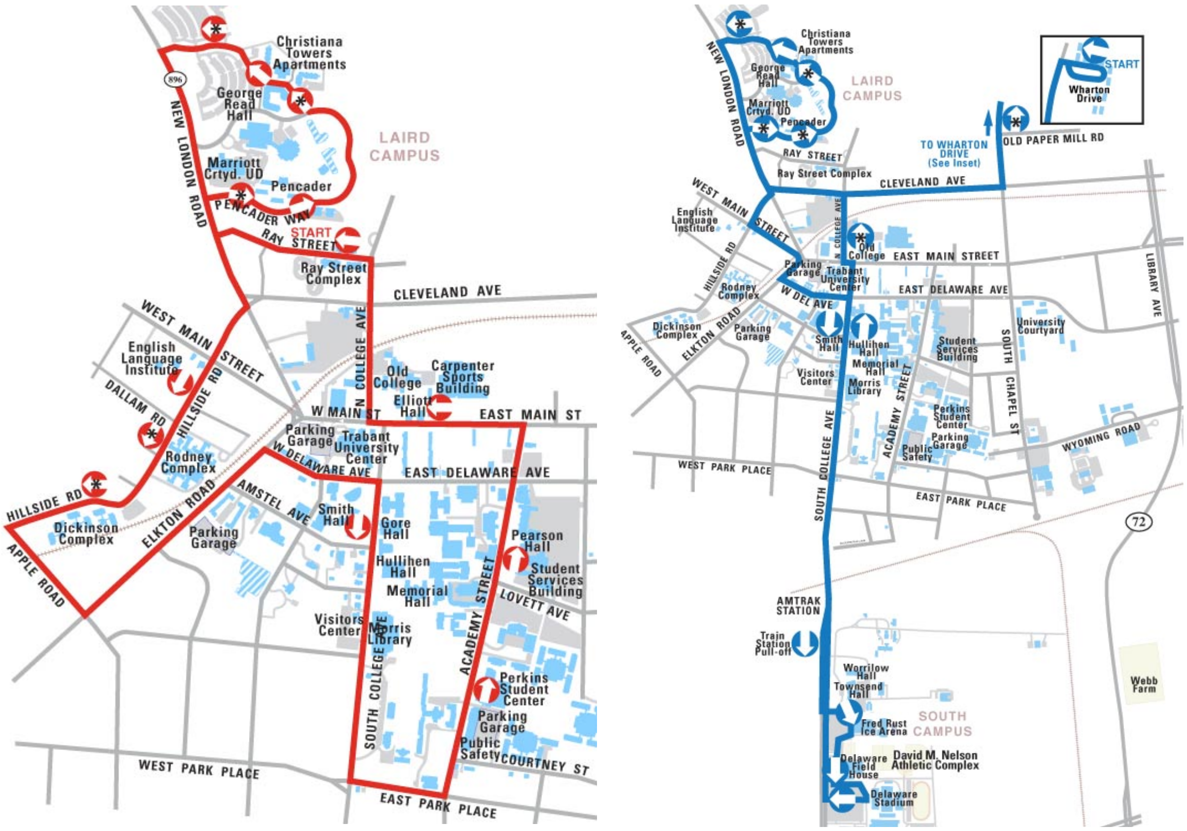


Figure 15: Campus Bus Routes

<u>Credit 4.2: Alternative Transportation: Bicycle Storage</u>

For residential buildings, this credit can be earned by providing covered storage facilities for bicycles for 15% of the building occupants. The building houses five hundred people. This results in the need for seventy five storage facilities. The easiest way to provide covered storage is the use of bike lockers. These lockers can be placed in the open space adjacent to the building. This credit can be easily attained.

Credit 4.3: Alt. Transportation: Low Emitting & Fuel Efficient Vehicles

There are three options that meet this credit. The first option is to provide low emitting, fuel efficient vehicles for 3% of the building occupants as well as providing preferred parking for these vehicles. The second option is to provide preferred parking for low emitting, fuel efficient vehicles for 5% of the building occupants. The third option is to install alternative fuel refueling stations for 3% of the total vehicle parking capacity of the building. Because of the site restraints due to existing roads, there is no space for new parking. Therefore, options one and two cannot be obtained. The third option is possible, but could be quite expensive. Space for such a refueling station is also fairly limited. Because of these reasons, this credit cannot practically be achieved.

Credit 4.4: Alternative Transportation: Parking Capacity

For residential buildings, two options exist to meet this credit. The first is to provide parking capacity no greater than the minimum local zoning requirements and implement programs that promote shared vehicle usage. The second option is not to supply any new parking. As mentioned in Credit 4.3, no new parking is provided due to lack of space. Therefore, this credit is already attained.

Credit 5.1: Site Development: Protect or Restore Habitat

The purpose of this credit is to conserve existing natural areas and also restore damaged areas. This is done by restoring or protecting 50% of the site area with native vegetation. This area does not include the building footprint. After construction was completed, the area around the building was seeded and trees were planted. The trees are represented by the circles on the following site plan.

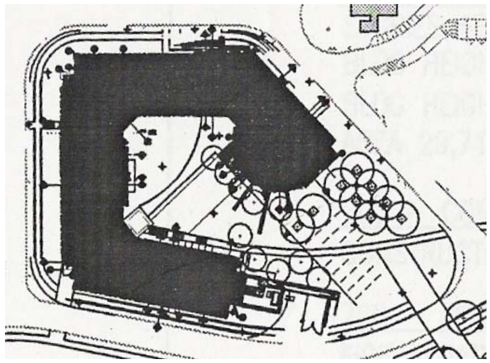


Figure 16: Site Plan

The majority of the area adjacent to the building is vegetated. The only area that is not vegetated is a limited area of sidewalks. Thus, this point is already attained as well.

<u>Credit 5.2: Site Development: Maximize Open Space</u>

This credit is similar to credit 5.1. The amount of vegetated open space must be equal to the building footprint. The building footprint is approximately 27,500 square feet. The area of the site is approximately 73,000 square feet. The majority of the area adjacent to the building is vegetated. Therefore, this point can be achieved.

<u>Credit 6.1: Stormwater Design: Quantity Control</u>

The requirement for this credit is to implement a storm water management plan that prevents the discharge rate of storm water after construction from being higher than the discharge rate before construction for the one and two year twenty four hour storm. The two year twenty four hour design storm for New Castle County, Delaware is 3.2 inches/24 hour period. The easiest way to keep the storm water from running off the site is to promote infiltration. This can be done by

allowing the storm water to discharge onto vegetated areas instead of impervious areas. Once discharged onto vegetated areas, the water can slowly perk into the ground. This prevents the storm water from leaving the site. Therefore, this credit can be earned.

Credit 6.2: Stormwater Design: Quality Control

The intention of this point is to limit the disruption and pollution of natural water flows by managing the storm water runoff. This is accomplished by treating the storm water runoff. The purpose of treating the water is to remove the suspended solids. Certain types of vegetation are able to treat the runoff. However, this requires in field monitoring to determine if the treatment level is sufficient to meet the requirements of this credit. Because of this, earning this credit requires careful monitoring, making it impractical.

Credit 7.1: Heat Island Effect: Non-roof

In order to meet the requirements of credit 7.1, 50% of the site hardscape must be a combination of shaded, paving materials with a solar reflectance index of 29, or an open grid pavement system. The use of Portland cement concrete meets the required solar reflectance value. Thus, to meet this requirement, all sidewalks should be constructed of this type of concrete. Additionally, the trees planted on the site will provide shade within five years. Therefore, with the use of Portland cement concrete, this credit can be earned.

Credit 7.2: Heat Island Effect: Roof

The intent of this credit is to reduce heat islands on the roof surface. This can be done by using roofing materials having a Solar

Reflectance Index value of 29 or higher, installing a green roof, or a combination of both for a minimum amount of the roof area. The Solar Reflectance Index is a measure of the surface's ability to reflect solar heat. Because of the slope of the roof, installing a green roof might be quite difficult. The existing roofing material is black asphalt shingles. Black shingles do not have a Solar Reflectance Index high enough to meet these standards. As a result, the roofing material must be changed in order to meet the requirements of this credit. A solution to this is to change the roofing material from asphalt shingles to a metal roof. To achieve the desired Solar Reflectance Index a coating can be applied to the metal roof. This coating is available in a variety of colors that still meet the requirements. This allows for a level of architectural freedom to give the building the desired appearance. With a change in the roofing materials, this credit can be earned.

Credit 8: Light Pollution Reduction

The requirements for light pollution reduction include interior and exterior lighting. For interior lighting, the angle of maximum candela must intersect opaque building surfaces instead of exiting out through windows. For exterior lighting, site and building mounted luminaries cannot produce an initial illuminance value higher than 0.20 horizontal and vertical footcandles at the site boundary and 0.01 horizontal footcandles fifteen feet beyond the site boundary. A lot of the luminaries in the building are indirect type light fixtures. This meets the requirements for interior lighting. However, in areas with different types of lights, as well as exterior lights, this credit can be earned by simply selecting appropriate fixtures and laying them out so that light does not escape through the windows.

LEED Summary

In summary, ten out of fourteen of the credits in the sustainable sites category can feasibly be incorporated into the design of George Read Hall. This is a very good indication that at least twenty six credits can be earned, and the building can be LEED certified. An important aspect to consider is the cost of this process. A cost analysis was not performed on this study, but it is evident that additional costs may be incurred from the use of different materials. Additional costs may also come from items such as bike lockers. However, these initial additional costs would be offset by the increased efficiency of the green systems. Overall, if properly incorporated into the design, this process could be done and would allow the building to make less of an environmental impact.