September 17th, 2012

# TECHNICAL ASSIGNMENT ONE

PENN STATE SENIOR THESIS

## REPLACEMENT HIGH SCHOOL

MARYLAND


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CONSTRUCTION MANAGEMENT
ADVISOR: CHIMAY ANUMBA

# EXECUTIVE SUMMARY

The following technical assignment serves as a means to familiarize the reader with the conditions and scope of work that the replacement high school is being constructed under. More specifically it will address the opportunities and constraints that affect the design and subsequent construction of the building. This will be accomplished through the use of photographs, tables, figures and background information. It will outline the basic project schedule, summarize the building systems, evaluate project cost, review local conditions, and provide client information.

This project is a 255,000 square foot replacement high school scheduled to open in August 2013. At which point the existing school will be demolished with the exception of the gymnasium, because it will be incorporated into the new school. The new high school will consist of two multi story double loaded classroom wings with a connecting atrium. It will also feature an 896 seat auditorium, media center, cafeteria, and new auxiliary gym facility. The project also calls for two baseball fields, six tennis courts, a football field with field house, track, soccer field, a new bus loop and parking lot.

The owners' goal for this project is to create a state of the art facility for high school students. The building utilizes geothermal energy by the use of over 400 wells on site for heating and cooling. Geothermal energy, although it has a large initial investment, is very cost effective in the long run. It is also environmentally friendly, reliable and a renewable source of energy.

Construction started in December of 2011 and the final completion for the replacement school is set for August 2013. At this point in time the existing school will be demolished and the remaining sports fields and parking lots will be completed. The schedule on this project is very tight and will require an experienced and knowledgeable staff to ensure that it's completed on time.

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# PROJECT SUMMARY SCHEDULE

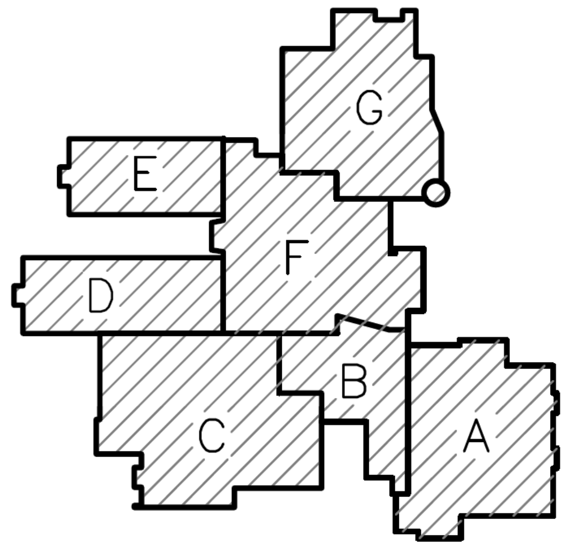



**Figure 1:** *Building Section Breakdown*

A simplified project summary schedule for this project can be found in Appendix A for reference. The high school for this project was broken down into seven different construction areas as shown in figure 1. By breaking the building up into smaller pieces it makes the construction process much more manageable. It allows for the schedule to be broken down into more detail, and makes communication easier.

The project schedule on this job is of extreme importance. Although the entire job is scheduled to be completed in 3 years, HESS only has 18 months to build the replacement school. Because of this tight time frame it is imperative that the CPM schedule is met. Notice to proceed for this job was given on the 1$^{st}$ of December 2011 and the school must be complete and turned over in August for the 2013 school year.

Before any work could start on this project the site had to be cleared of existing features. This also included the partial demolition of the existing gymnasium. Once the site was cleared, fill had to be brought on site and compacted to provide adequate bearing for the schools foundation. This whole process took approximately 65 days, at which point the foundation work began.

The simplified project summary schedule does not do a very good job of illustrating it, but the placement of foundations, structural steel/load bearing masonry, and the building enclosure all followed a progression when put in place. The path of construction for this work went from Section F to E, to D, to G, to C, to B, to A. During this time there was overlap in activities occurring simultaneously. That is to say that when foundations in C were being placed, structural steel was being erected in area F. This staggering of activities greatly improves construction time. This can also be seen in the schedule for interiors; however there is much more overlap in different sections of the building.

After all of the final inspections are complete and the school is turned over the demolition of the existing school begins. Once demolished, the site will be transformed into a new parking lot for faculty and students. It is during this time the remaining sports fields will be completed.

# BUILDING SYSTEMS SUMMARY

The following information found on Table 1 describes key aspects of the design and construction of the building and its systems for this high school project.

**Table 1:** Building System Summary

| Yes | No | Work Scope | If yes, address these questions / issues |
|---|---|---|---|
| X | | Demolition | Types of materials, lead paint, or asbestos? |
| X | | Structural Steel Framing | type of bracing, composite slab?, crane size / type / location(s) |
| X | | Cast in Place Concrete | Horiz. and Vert. Formwork types, concrete placement methods |
| | X | Precast Concrete | Casting location, connection methods, crane size / type / location(s) |
| X | | Mechanical System | Mech. Room locations, system type, types of distribution systems, types of fire suppression |
| X | | Electrical System | size / capacity, redundancy |
| X | | Masonry | Load bearing or veneer, connection details, scaffolding |
| X | | Curtain wall | Materials included, construction methods, design responsibility |
| | X | Support of Excavation | Type of excavation support system, dewatering system, permanent vs. temporary |

## Demolition:

There is a significant amount of demolition involved in this project, the majority of which will take place after the completion of the new school. Special considerations regarding asbestos abatement will have to be taken when demolishing the existing school structure; which was erected in 1959, along with its several additions. However, the existing gymnasium which was completed in 2003 will remain and tie into the new high school.

Other Items to be demolished are the existing parking lots, football field/track, bus loop, and walkways. See highlighted items on figure 2 for a visual representation of items to be demoed.

***Figure 2:*** *Demo Plan (Image Courtesy of Bing Maps)*

## *Structural Steel Framing:*

The new high school is a combination of both CMU load bearing walls and structural steel. The columns for the building are hollow structural steel (HSS) members and wide flange beams supported by at least an 18" by 18" concrete pier on spread footings. Columns are spliced at the third floor level for areas D, E and F. All wide flange beams and girders conform to either ASTM A-572 or A-992 and are of grade 50 (50,000 KSI). Lateral structural steel support is accomplished through the use of cross bracing in 33 different locations and welded moment connections in four bays.

***Figure 3:*** *Steel Erection Section F*

The floors-on-deck of the building are constructed of 3-1/4" light weight concrete on 2" galvanized composite steel deck with welded-wire-fabric, and shear studs. Roofs are comprised of 20 gauge 1-1/2" type B roof deck on K-Series and LH joists.

A 150 ton crawler crane was scheduled to place all structural steel for the building, but because of a loss of time in the schedule a second crane was brought on site to expedite construction.

### *Cast in Place Concrete:*

All cast in place concrete used on this project is designed per ACI 318-05. Additionally all concrete is to have a compressive strength at 28 days of 4,000 psi.

On this project CIP concrete pours were achieved by direct pours and by utilizing concrete pump trucks. Normal weight concrete was used for the foundations, auditorium stage wall, and S.O.G., while light weight concrete was used for slab on deck. To form the auditorium wall interlocking panels were placed on an arced radius and temporarily braced. All other formwork was site constructed out of plywood and 2x4's.

***Figure 4:*** *Auditorium Form Work @ Stage Wall*

### *Mechanical System:*

The mechanical room for the high school is located on the first floor in the south west corner of the building. To ensure the building operates and performs as intended a Building Automation System (BAS) is used to observe and control the schools environment which is monitored both on and offsite. If communication with the system is ever lost the controller will revert to its inherent set points.

The mechanical room has nine 30 ton water to water heat pump modules to manage the four geothermal fields and two geothermal vaults of 437 combined wells all at a depth of 400 feet. The 12" supply and return pipes for this system travel over 1,600 feet each, from building stub up to geothermal vault. The fields encompass approximately 207,000 square feet and sit underneath the proposed football and baseball fields. In addition to the nine modules the mechanical room also houses 10 pumps, four expansion tanks, two gas-fired hot water boilers, and a slew of other equipment.

There are two Dedicated Outdoor Air Systems (DOAS) with a combined 28,170 CFM capacity that serve the north and south wings of the building. Each of these DOAS's have a heat recovery wheel and are connected to three indoor air handling units (one on each floor of the classroom wings.) In addition to this there are 17 separate rooftop air handling units, nine of which have energy recovery wheels. To ensure a healthy indoor air quality all outdoor air intakes have an airflow monitoring system to measure contaminants in the air. Air flow is distributed throughout the building in sheet metal ducts and zone controlled by VAV boxes.

Fire suppression for the school consists of an automatic sprinkler system with high temperature heads in conjunction with a heat and smoke detection system. In locations where duct penetrates fire rated walls fire-dampers are installed. The server room for the school (Rm. F-255) works on a pre-action fire protection system to make sure the system doesn't accidentally go off.

## Electrical System:

The main electrical room is located in the south west corner of the building and is fed from two separate 2,500 KVA pad mounted transformers supplied by PEPCO just outside the building. Each transformer ties into its own 3,000 amp 480/277 volt switchboard with ground fault protection. A backup generator is located in close proximity to the building to power emergency equipment in the event of a power outage.

Additional panelboards and step down transformers are located throughout the building to supply power to all necessary equipment.

## Masonry:

As was mentioned before, a large portion of this high school is constructed out of load bearing concrete masonry units (CMU's). Building sections A, B, C, and G are comprised almost entirely out of load bearing CMU walls. These walls range greatly in thickness depending on their location in the building. In some cases they serve as both structure and architectural façade. Much of the masonry units are placed off of scaffolding.

## Curtain Wall:

The exterior for the school is comprised primarily of ground-face CMU and several different styles of wall panels. Consideration was taken by the architect to pick materials that would complement the exterior façade of the existing gymnasium. Additionally there are a number of glazed curtain walls with different glazing provisions that relate to their orientation on the building. Due to the nature of the building façade, much of it will be installed off of scaffolding

## LEED:

This project has been designed to achieve a LEED Gold rating by acquiring no less than 39 points under the US Green Building Councils LEED® Green Building Rating System ™ for New Construction. The majority of the projects points will be coming from Sustainable Sights and Indoor Environmental Quality. Several ways this rating will be achieved is by focusing on alternative transportation, water efficiency, reducing the heat island effect of the roof, recycling/managing construction waste, and using Low-Emitting Materials. One of the most significant features is the use of geothermal energy, which is the utilization of the earth's natural heat. Geothermal is an economical, pollution free and renewable source of heating and cooling. However, the building falls short of capturing any points for day lighting.

# PROJECT COST EVALUATION

The construction costs for this project were provided by HESS Construction. Values shown have been rounded and do not represent actual bid prices. Square foot costs were calculated based on a 255,000 gross square foot building footprint.

## Actual Building Construction Cost:

Total: **$59,277,000**

Per SF: **$232.45 per SF**

**These costs exclude general conditions, allowances, overhead & profit, Contingency, Bonds & Insurance, paving and landscaping.**

## Total Project Cost:

Total: **$74,225,000.00**

Per SF: **$291.08 per SF**

## Major Building System Costs:

| System | Actual Cost | Cost/SF | % of Total Building Cost |
|---|---|---|---|
| Electrical | $8,900,000 | $34.90 | 11.99% |
| Mech/Plm - Geothermal | $13,500,000 | $52.94 | 18.19% |
| Steel | $5,000,000 | $19.61 | 6.74% |
| Masonry | $4,500,000 | $17.65 | 6.06% |
| Sprinkler | $500,000 | $1.96 | 0.67% |
| Roofing | $2,600,000 | $10.20 | 3.50% |
| Concrete | $2,250,000 | $8.82 | 3.03% |

***Table 2:*** *Building System Costs*

## R.S. Means Estimates:

**Reference Appendix B for R.S. Means CostWorks 2012 Square Foot Cost Data that was used as a source to create table 2.*

The following estimates were created by referencing 2012 R.S. Means data. Five dollars was added to the cost per square foot to adjust for a larger building perimeter.

The costs given in RS Means should reflect present trends for current construction. Prices used for electrical, mechanical and plumbing systems are based off of typical unit cost data for high end Junior High Schools.

| Square Foot Cost Estimate Report | |
|---|---|
| Building Type | School, Jr High, 2-3 Story, Steel frame building with face brick and concrete black back up |
| Location | Maryland |
| Story Count | 3 |
| Floor Area (SF) | 255,000 |
| Building Perimeter (LF) | 3100 |
| Basement Included | No |
| Cost Per SF | $161.40 |
| Total Building Cost | $41,157,000.00 |

***Table 3:** SF Cost Estimate*

| System | % of Total Building | Total System Cost | Cost Per SF |
|---|---|---|---|
| Electrical | 10.60% | $7,867,850.00 | $30.85 |
| Plumbing | 7.25% | $5,381,312.50 | $21.10 |
| Heating, Ventilating, air conditioning | 14.20% | $10,539,950.00 | $41.33 |

***Table 4:** MEP System Costs*

## *Cost Comparison:*

The square foot estimate produced from RS means gave a total building cost of $41,157,000, which is approximately 30.5% cheaper than the actual cost of the high school. This value is considerably lower and is due likely to the fact that the high school being constructed is designed to be a state of the art facility, while RS Means simply averages typical school construction costs. It can be concluded that the use of RS Means does not produce a sufficient Square Foot Cost Estimate for this project.

The RS Means assemblies estimate came closer to the actual project costs. The electrical system estimate was lower by 11% and the mechanical system was over by 17%. As a whole the MEP system estimate was off by 5.8% which is relatively accurate. Discrepancies in the estimates can be contributed to generalizations that were made when defining system components.

# LOCAL CONDITIONS

## *Soils and Subsurface Conditions:*

For this project GEOTECH ENGINEERS, INC. performed 37 test borings and soil laboratory tests in order to prepare a geotechnical report. It was found that the majority of the soils on-site were clays with a water table ranging from 12 to 17.7 feet below grade. Through these findings they recommended using controlled fill for the building support, compacted to at least 95 percent per ASTM D-1557. The existing grade of the proposed building footprint has an overall drop in elevation of 16 feet from elevation 185 to 169. The design elevation for the slab-on-grade is 184.4, this results in a large quantity of fill needed to be brought on site. All existing areas within the outline of the building foundation must be removed and replaced with suitable fill if the current grade elevation is above 176. Additionally any area where the existing soil is within five feet of the bottom of a footing it is to be undercut and replaced with control fill.

## *Parking:*


***Figure 5:*** *Local Conditions (Image Courtesy of Bing Maps*

Figure 5 illustrates the existing conditions of the local geography of the site. To the east and south the site is bounded by residential neighborhoods. This poses a problem because the local municipality will not allow construction deliveries or parking to take place on these roads. The west provides no relief either because there is an interstate in the way. To solve the problem of access and parking to the site a new road, from the south, was installed. This road serves as both temporary parking for construction vehicles, and as the only means of access to and from the site.

## *Other:*

- To protect against frost perimeter footings should be placed at a minimum of 2.5 feet below the final exterior grade.
- Average tipping fees in Maryland run about $68/ton
- High crime rate area
    - Concerns about break ins and thefts

# SITE PLANS

## Existing Conditions


***Figure 6:*** *Existing Conditions (Image Courtesy of Bing Maps*

The Existing Conditions for this job can be seen on figure 6. The access road to the south is the only means of transporting material to and from the site. It also serves as parking for laborers.

## Site Layout Planning

*Refer to Appendix C for detailed site layout plans.*

The "Site Clearing and Building Pad Fill Site Plan" illustrates the initial layout of the construction fence and entrance gates. It also shows where the replacement school will be constructed and the key features of the site layout. At this point in time there are no designated vehicular paths due to the amount of site clearing that needs to be done.

The next site layout displays the plan for the foundation and SOG. At this point in the project the construction fence has been moved to create more room for construction activities. The portion of the new school that is faded illustrates the work that still needs to be completed. The area that is illuminated represents completed foundations and partial SOGs. At this point in the project access paths have been established. At the same time foundations are being installed on the west side of the site, wells are being drilled for the geothermal field in the east. It can also be seen that a portion of the existing school has been demolished and the gymnasium has been left in place so that it can be incorporated into the new school.

The final site plan shows the layout for the superstructure. It is at this time that a crawler crane is brought onto site and additional laydown areas are established. Due to a delay in the schedule a second smaller crane was brought on site to erect sections D and E. laydown areas for the cranes are placed both on the site near the building footprint and on the SOG. Because the foundations have been poured there is no longer vehicular access through the center of the building.

# CLIENT INFORMATION

Prince George's County Public Schools (PGCPS) mission is to "advance the achievement of its diverse student body through community, engagement, sound policy, governance, accountability, and fiscal responsibility." PGCPS oversees over 200 schools in 9 different districts.

The reason PGCPS is replacing the existing high school is because over 50 percent of the buildings are over 40 years old and haven't seen any renovations in that time. Based on academic program requirements and existing conditions of the facilities the Board and State were able to justify approving the construction of a new school. Originally the project was designed for a capacity of 2,300 students because of projected enrollment growth in the area. Unfortunately, the State did not approve the student capacity because of a surplus of seats in high schools. This caused a redesign in the building which omitted one of the three classroom wings reducing the schools capacity to 1,200; which correlates more closely with current enrollment trends.

PGCPS, more specifically the current tenants of the existing high school, have several concerns with the construction of the new school, primarily stemming from the fact that the two are in such close proximity. First and foremost they are concerned for the safety of their students and staff, because construction will be taking place concurrently with the present school year. They have expressed concerns about heavy equipment, noise levels, fumes, and dust control. Due to this HESS Construction has been able to implement strategies and schedule activities to mitigate these concerns. Another hot topic has been the issue of available parking. With all of the work taking place, most of the existing parking has been taken over and torn out. To remedy this HESS has turned over a temporary parking lot to be used until the final lot is complete. Additionally any and all utility shut downs must occur during non-school hours.

The School is scheduled to be complete in August 2013 for the start of the school year. However, temporary occupancy may be granted in some areas of the building as long as it does not interfere with the completion of other construction activities. The new high school will meet the owner's needs by providing a much needed up to date, state-of-the-art facility for its students.

# PROJECT DELIVERY SYSTEM

The delivery system used for this project is a CM at Risk, Cost plus Fee with a GMP. This delivery system was chosen because of the economic climate and the intrinsic benefits it has for the owner. Over the years HESS Construction has been able to foster a longstanding relationship with Prince George's County Public School District which has helped HESS secure many projects with the district. HESS prides itself on only pursing jobs in education and for this reason, claims to be able to provide a much better product than their competitors.

PGCPS holds contracts with the architect, construction manager and a third party consultant. HESS construction holds lump sum contracts with all of their subcontractors and prequalifies each one based off of relevant quantitative experience, requisite skills, project capacity and work history. All subs were required to submit a Bid Bond on AIA Document A-310 issued by a surety licensed to issue bonds in the state of Maryland with their bids. The bond capacity had to be at least 95 percent of the largest possible total of bids submitted.

If for some reason the subcontractor awarded is unable to carry out the contract they would then be responsible to pay HESS the difference in their contract, amount and the subsequently hired sub, as liquidation damages.

For a visual representation of the contracts held on this project reference figure 7 on the following page.

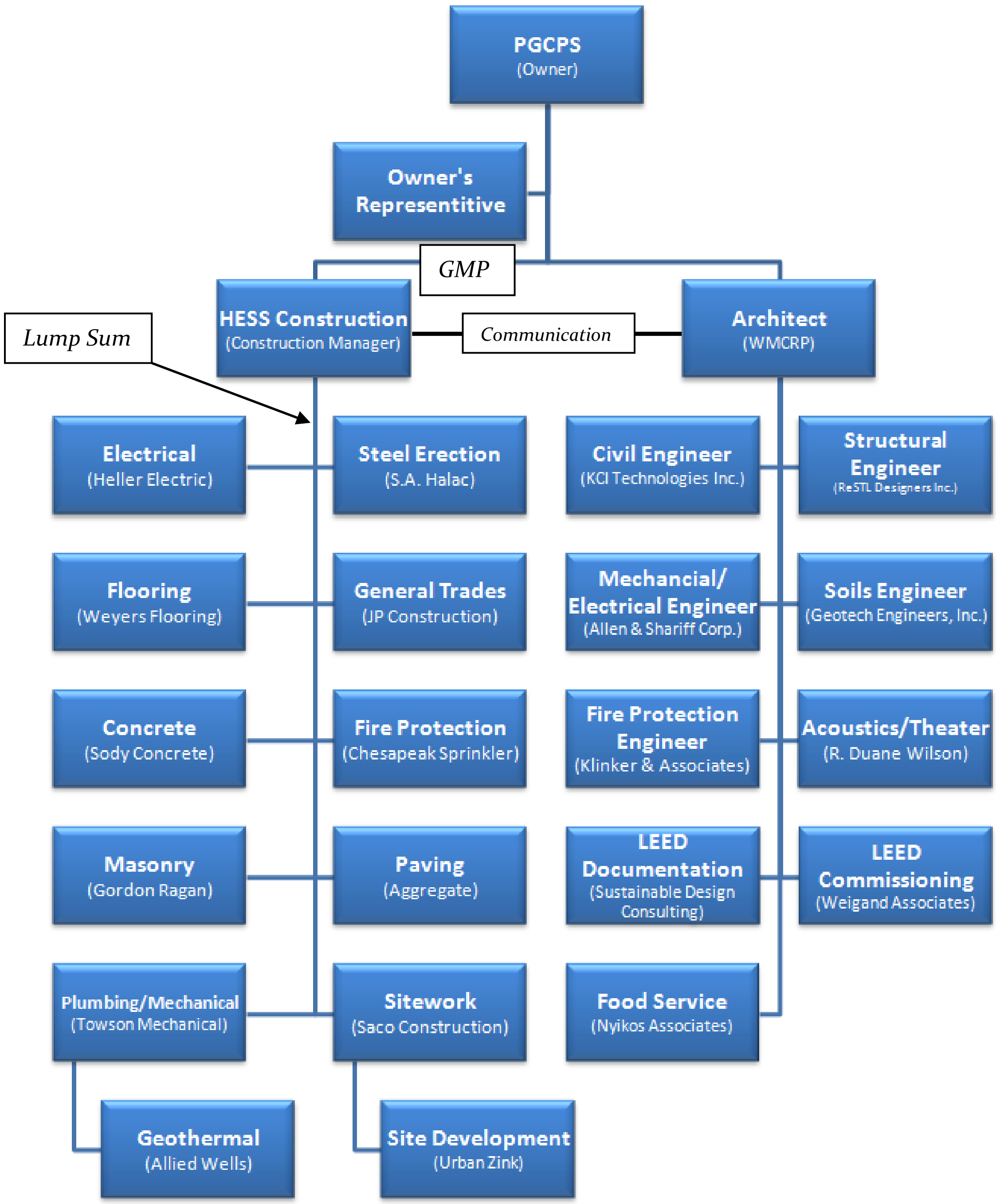



***Figure 7:*** *Project Organizational Chart*

# STAFFING PLAN

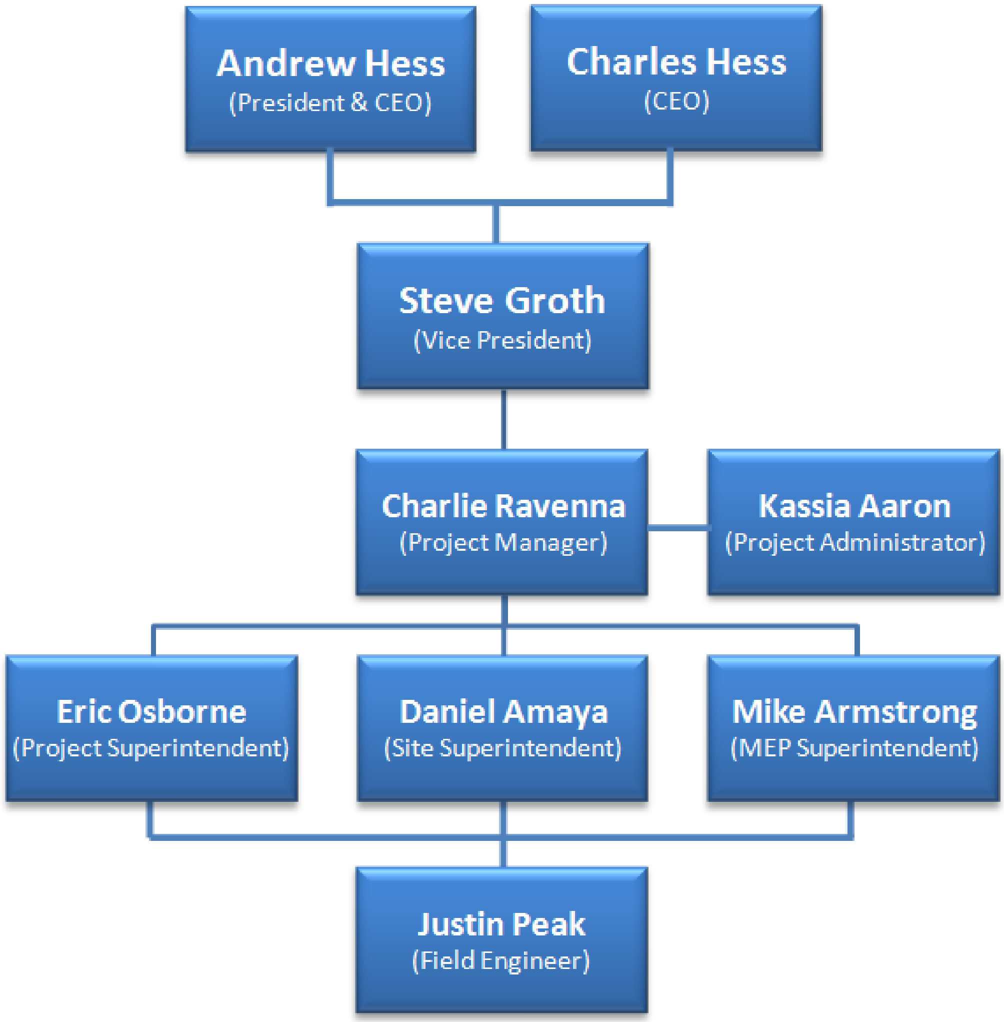
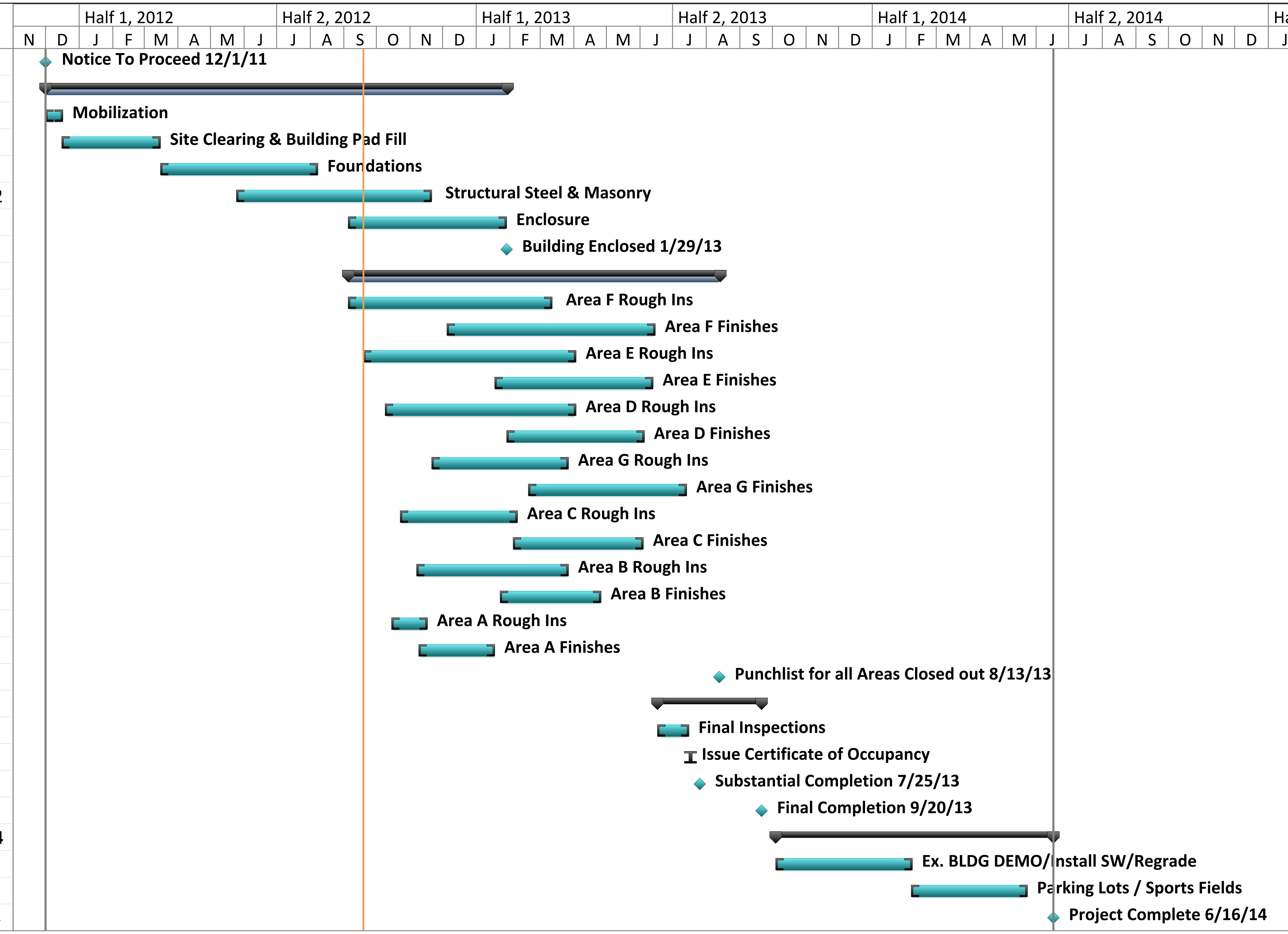



***Figure 8:** HESS Staffing Plan*

Figure 8 depicts the staffing plan used on this project. HESS assigns their teams based off of project size and complexity. Throughout the course of this project this team will be altered depending on the needs of the project. During the beginning phases of the job only the Field Engineer and Site Superintendent are on site every day. As time progresses and construction starts to pick up the rest of the project staff from the PM down move out to the field full time with the exception of the MEP Superintendent who splits his time between two different jobs. With the advancement of the project the MEP Superintendent starts dedicating more time to the job and the Site Superintendent starts phasing out. By the time the job is about to be turned over the only two people dedicating all of their time to the job are the Project Admin and Field Engineer.

# APPENDIX A – Project Schedule Summary

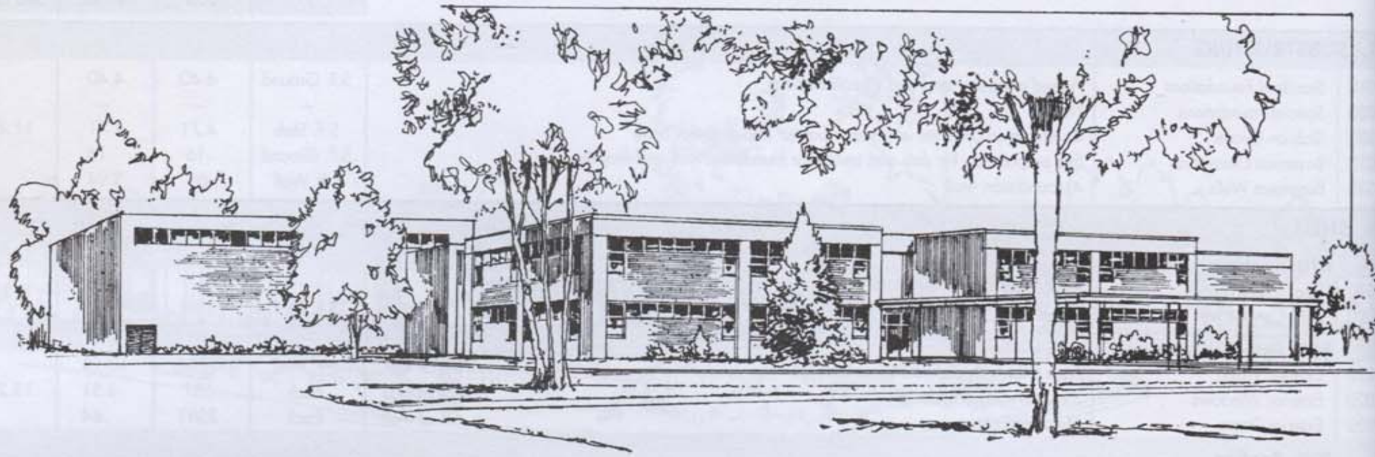
| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Notice To Proceed 12/1/11 | 0 days | Thu 12/1/11 | Thu 12/1/11 |
| 2 | **Sub & Superstructure** | **304 days** | **Thu 12/1/11** | **Tue 1/29/13** |
| 3 | Mobilization | 12 days | Thu 12/1/11 | Fri 12/16/11 |
| 4 | Site Clearing & Building Pad Fill | 65 days | Fri 12/16/11 | Thu 3/15/12 |
| 5 | Foundations | 103 days | Fri 3/16/12 | Tue 8/7/12 |
| 6 | Structural Steel & Masonry | 128 days | Fri 5/25/12 | Tue 11/20/12 |
| 7 | Enclosure | 104 days | Wed 9/5/12 | Mon 1/28/13 |
| 8 | Building Enclosed 1/29/13 | 0 days | Tue 1/29/13 | Tue 1/29/13 |
| 9 | **Interiors** | **245 days** | **Wed 9/5/12** | **Tue 8/13/13** |
| 10 | Area F Rough Ins | 134 days | Wed 9/5/12 | Mon 3/11/13 |
| 11 | Area F Finishes | 138 days | Wed 12/5/12 | Fri 6/14/13 |
| 12 | Area E Rough Ins | 140 days | Wed 9/19/12 | Tue 4/2/13 |
| 13 | Area E Finishes | 104 days | Fri 1/18/13 | Wed 6/12/13 |
| 14 | Area D Rough Ins | 126 days | Tue 10/9/12 | Tue 4/2/13 |
| 15 | Area D Finishes | 91 days | Tue 1/29/13 | Tue 6/4/13 |
| 16 | Area G Rough Ins | 90 days | Wed 11/21/12 | Tue 3/26/13 |
| 17 | Area G Finishes | 106 days | Mon 2/18/13 | Sat 7/13/13 |
| 18 | Area C Rough Ins | 78 days | Tue 10/23/12 | Thu 2/7/13 |
| 19 | Area C Finishes | 86 days | Mon 2/4/13 | Mon 6/3/13 |
| 20 | Area B Rough Ins | 100 days | Wed 11/7/12 | Tue 3/26/13 |
| 21 | Area B Finishes | 67 days | Wed 1/23/13 | Thu 4/25/13 |
| 22 | Area A Rough Ins | 25 days | Mon 10/15/12 | Fri 11/16/12 |
| 23 | Area A Finishes | 50 days | Fri 11/9/12 | Thu 1/17/13 |
| 24 | Punchlist for all Areas Closed out 8/13/13 | 0 days | Tue 8/13/13 | Tue 8/13/13 |
| 25 | **Turnover** | **70 days** | **Mon 6/17/13** | **Fri 9/20/13** |
| 26 | Final Inspections | 21 days | Mon 6/17/13 | Mon 7/15/13 |
| 27 | Issue Certificate of Occupancy | 3 days | Tue 7/16/13 | Thu 7/18/13 |
| 28 | Substantial Completion 7/25/13 | 0 days | Thu 7/25/13 | Thu 7/25/13 |
| 29 | Final Completion 9/20/13 | 0 days | Fri 9/20/13 | Fri 9/20/13 |
| 30 | **Ex BLDG DEMO/ New Parking / Athl. Fields** | **182 days** | **Fri 10/4/13** | **Mon 6/16/14** |
| 31 | Ex. BLDG DEMO/Install SW/Regrade | 90 days | Fri 10/4/13 | Thu 2/6/14 |
| 32 | Parking Lots / Sports Fields | 77 days | Thu 2/6/14 | Fri 5/23/14 |
| 33 | Project Complete 6/16/14 | 0 days | Mon 6/16/14 | Mon 6/16/14 |




Project: Schedule
Date: Wed 9/19/12

| | | | | |
|---|---|---|---|---|
| Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline |
| Split | External Tasks | Inactive Summary | Manual Summary | Progress |
| Milestone | External Milestone | Manual Task | Start-only | |
| Summary | Inactive Task | Duration-only | Finish-only | |

# APPENDIX B – R.S. Means Cost Data



## Costs per square foot of floor area

| Exterior Wall | S.F. Area | 50000 | 65000 | 80000 | 95000 | 110000 | 125000 | 140000 | 155000 | 170000 |
|---|---|---|---|---|---|---|---|---|---|---|
| | L.F. Perimeter | 850 | 1060 | 1280 | 1490 | 1700 | 1920 | 2140 | 2340 | 2560 |
| Face Brick with Concrete Block Back-up | Steel Frame | 162.10 | 160.10 | 159.10 | 158.30 | 157.65 | 157.30 | 157.05 | 156.55 | 156.40 |
| | Bearing Walls | 154.90 | 152.95 | 151.90 | 151.05 | 150.45 | 150.05 | 149.80 | 149.35 | 149.15 |
| Concrete Block Stucco Face | Steel Frame | 154.60 | 152.90 | 152.05 | 151.30 | 150.75 | 150.50 | 150.25 | 149.80 | 149.65 |
| | Bearing Walls | 148.25 | 146.50 | 145.65 | 144.95 | 144.35 | 144.10 | 143.85 | 143.45 | 143.30 |
| Decorative Concrete Block | Steel Frame | 156.35 | 154.60 | 153.70 | 153.00 | 152.45 | 152.15 | 151.90 | 151.45 | 151.30 |
| | Bearing Walls | 148.70 | 146.95 | 146.00 | 145.30 | 144.70 | 144.40 | 144.15 | 143.70 | 143.55 |
| Perimeter Adj., Add or Deduct | Per 100 L.F. | 3.30 | 2.60 | 2.10 | 1.70 | 1.45 | 1.30 | 1.15 | 1.10 | 1.00 |
| Story Hgt. Adj., Add or Deduct | Per 1 Ft. | 1.60 | 1.60 | 1.55 | 1.50 | 1.45 | 1.50 | 1.45 | 1.45 | 1.45 |
| ***For Basement**, add $29.80 per square foot of basement area* | | | | | | | | | | |

*The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from $91.95 to $216.05 per S.F.*

## Common additives

| Description | Unit | $ Cost |
|---|---|---|
| Bleachers, Telescoping, manual | | |
| To 15 tier | Seat | 120 - 169 |
| 16-20 tier | Seat | 255 - 315 |
| 21-30 tier | Seat | 270 - 325 |
| For power operation, add | Seat | 51 - 80.50 |
| Carrels Hardwood | Each | 735 - 1575 |
| Clock System | | |
| 20 room | Each | 17,700 |
| 50 room | Each | 41,200 |
| Elevators, Hydraulic passenger, 2 stops | | |
| 1500# capacity | Each | 68,200 |
| 2500# capacity | Each | 71,200 |
| Emergency Lighting, 25 watt, battery operated | | |
| Lead battery | Each | 271 |
| Nickel cadmium | Each | 750 |
| Flagpoles, Complete | | |
| Aluminum, 20' high | Each | 1525 |
| 40' high | Each | 3500 |
| Fiberglass, 23' high | Each | 1325 |
| 39'-5" high | Each | 3375 |

| Description | Unit | $ Cost |
|---|---|---|
| Kitchen Equipment | | |
| Broiler | Each | 3975 |
| Cooler, 6 ft. long, reach-in | Each | 4125 |
| Dishwasher, 10-12 racks per hr. | Each | 5025 |
| Food warmer, counter, 1.2 KW | Each | 560 |
| Freezer, 44 C.F., reach-in | Each | 3150 |
| Lockers, Steel, single tier, 60" to 72" | Opening | 193 - 330 |
| 2 tier, 60" to 72" total | Opening | 103 - 147 |
| 5 tier, box lockers | Opening | 64 - 76 |
| Locker bench, lam. maple top only | L.F. | 22 |
| Pedestals, steel pipe | Each | 65.50 |
| Seating | | |
| Auditorium chair, all veneer | Each | 244 |
| Veneer back, padded seat | Each | 310 |
| Upholstered, spring seat | Each | 297 |
| Classroom, movable chair & desk | Set | 81 - 171 |
| Lecture hall, pedestal type | Each | 233 - 705 |
| Sound System | | |
| Amplifier, 250 watts | Each | 1900 |
| Speaker, ceiling or wall | Each | 194 |
| Trumpet | Each | 370 |

**Model costs calculated for a 2 story building with 15′ story height and 110,000 square feet of floor area**



| | | | | Unit | Unit Cost | Cost Per S.F. | % Of Sub-Total |
|---|---|---|---|---|---|---|---|
| **A. SUBSTRUCTURE** | | | | | | | |
| 1010 | Standard Foundations | Poured concrete; strip and spread footings | | S.F. Ground | 2.14 | 1.07 | |
| 1020 | Special Foundations | N/A | | — | — | — | |
| 1030 | Slab on Grade | 4″ reinforced concrete with vapor barrier and granular base | | S.F. Slab | 4.71 | 2.36 | 3.9% |
| 2010 | Basement Excavation | Site preparation for slab and trench for foundation wall and footing | | S.F. Ground | .16 | .08 | |
| 2020 | Basement Walls | 4′ foundation wall | | L.F. Wall | 69 | 1.07 | |
| **B. SHELL** | | | | | | | |
| **B10 Superstructure** | | | | | | | |
| 1010 | Floor Construction | Open web steel joists, slab form, concrete, columns | | S.F. Floor | 26 | 12.78 | 15.4% |
| 1020 | Roof Construction | Metal deck, open web steel joists, columns | | S.F. Roof | 10.80 | 5.40 | |
| **B20 Exterior Enclosure** | | | | | | | |
| 2010 | Exterior Walls | Face brick with concrete block backup | *75% of wall* | S.F. Wall | 29 | 10.05 | |
| 2020 | Exterior Windows | Window wall | *25% of wall* | Each | 50 | 5.80 | 14.0% |
| 2030 | Exterior Doors | Double aluminum & glass | | Each | 2319 | .62 | |
| **B30 Roofing** | | | | | | | |
| 3010 | Roof Coverings | Single-ply membrane and standing seam metal; polyisocyanurate insulation | | S.F. Roof | 9.74 | 4.87 | 4.1% |
| 3020 | Roof Openings | Roof hatches | | S.F. Roof | .04 | .02 | |
| **C. INTERIORS** | | | | | | | |
| 1010 | Partitions | Concrete block | *20 S.F. Floor/L.F. Partition* | S.F. Partition | 8.12 | 4.87 | |
| 1020 | Interior Doors | Single leaf kalamein fire doors | *750 S.F. Floor/Door* | Each | 1162 | 1.55 | |
| 1030 | Fittings | Toilet partitions, chalkboards | | S.F. Floor | 1.25 | 1.25 | |
| 2010 | Stair Construction | Concrete filled metal pan | | Flight | 13,300 | .73 | 24.0% |
| 3010 | Wall Finishes | 50% paint, 40% glazed coatings, 10% ceramic tile | | S.F. Surface | 3.61 | 4.33 | |
| 3020 | Floor Finishes | 50% vinyl composition tile, 30% carpet, 20% terrrazzo | | S.F. Floor | 9.25 | 9.25 | |
| 3030 | Ceiling Finishes | Mineral fiberboard on concealed zee bars | | S.F. Ceiling | 6.26 | 6.26 | |
| **D. SERVICES** | | | | | | | |
| **D10 Conveying** | | | | | | | |
| 1010 | Elevators & Lifts | One hydraulic passenger elevator | | Each | 84,700 | .77 | 0.7% |
| 1020 | Escalators & Moving Walks | N/A | | — | — | — | |
| **D20 Plumbing** | | | | | | | |
| 2010 | Plumbing Fixtures | Kitchen, toilet and service fixtures, supply and drainage | *1 Fixture/1170 S.F. Floor* | Each | 5920 | 5.06 | |
| 2020 | Domestic Water Distribution | Gas fired water heater | | S.F. Floor | .60 | .60 | 5.3% |
| 2040 | Rain Water Drainage | Roof drains | | S.F. Roof | 1.20 | .60 | |
| **D30 HVAC** | | | | | | | |
| 3010 | Energy Supply | N/A | | — | — | — | |
| 3020 | Heat Generating Systems | Included in D3050 | | — | — | — | |
| 3030 | Cooling Generating Systems | N/A | | — | — | — | 15.1 % |
| 3050 | Terminal & Package Units | Multizone unit, gas heating, electric cooling | | S.F. Floor | 17.75 | 17.75 | |
| 3090 | Other HVAC Sys. & Equipment | N/A | | — | — | — | |
| **D40 Fire Protection** | | | | | | | |
| 4010 | Sprinklers | Sprinklers, light hazard | *10% of area* | S.F. Floor | 2.43 | 2.43 | 2.4% |
| 4020 | Standpipes | Standpipe, wet, Class III | | S.F. Floor | .34 | .34 | |
| **D50 Electrical** | | | | | | | |
| 5010 | Electrical Service/Distribution | 1600 ampere service, panel board and feeders | | S.F. Floor | 1.36 | 1.36 | |
| 5020 | Lighting & Branch Wiring | High efficiency fluorescent fixtures, receptacles, switches, A.C. and misc. power | | S.F. Floor | 9.06 | 9.06 | 12.6% |
| 5030 | Communications & Security | Addressable alarm systems, internet wiring, communications systems and emergency lighting | | S.F. Floor | 3.96 | 3.96 | |
| 5090 | Other Electrical Systems | Emergency generator, 100 kW | | S.F. Floor | .43 | .43 | |
| **E. EQUIPMENT & FURNISHINGS** | | | | | | | |
| 1010 | Commercial Equipment | N/A | | — | — | — | |
| 1020 | Institutional Equipment | Laboratory casework and counters | | S.F. Floor | 2.10 | 2.10 | 2.7 % |
| 1030 | Vehicular Equipment | N/A | | — | — | — | |
| 1090 | Other Equipment | Bleachers, basketball backstops | | S.F. Floor | 1.04 | 1.04 | |
| **F. SPECIAL CONSTRUCTION** | | | | | | | |
| 1020 | Integrated Construction | N/A | | — | — | — | 0.0 % |
| 1040 | Special Facilities | N/A | | — | — | — | |
| **G. BUILDING SITEWORK** | **N/A** | | | | | | |
| | | | | | **Sub-Total** | 117.86 | **100%** |
| | CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%) | | | | 25% | 29.48 | |
| | ARCHITECT FEES | | | | 7% | 10.31 | |
| | | | | | **Total Building Cost** | **157.65** | |

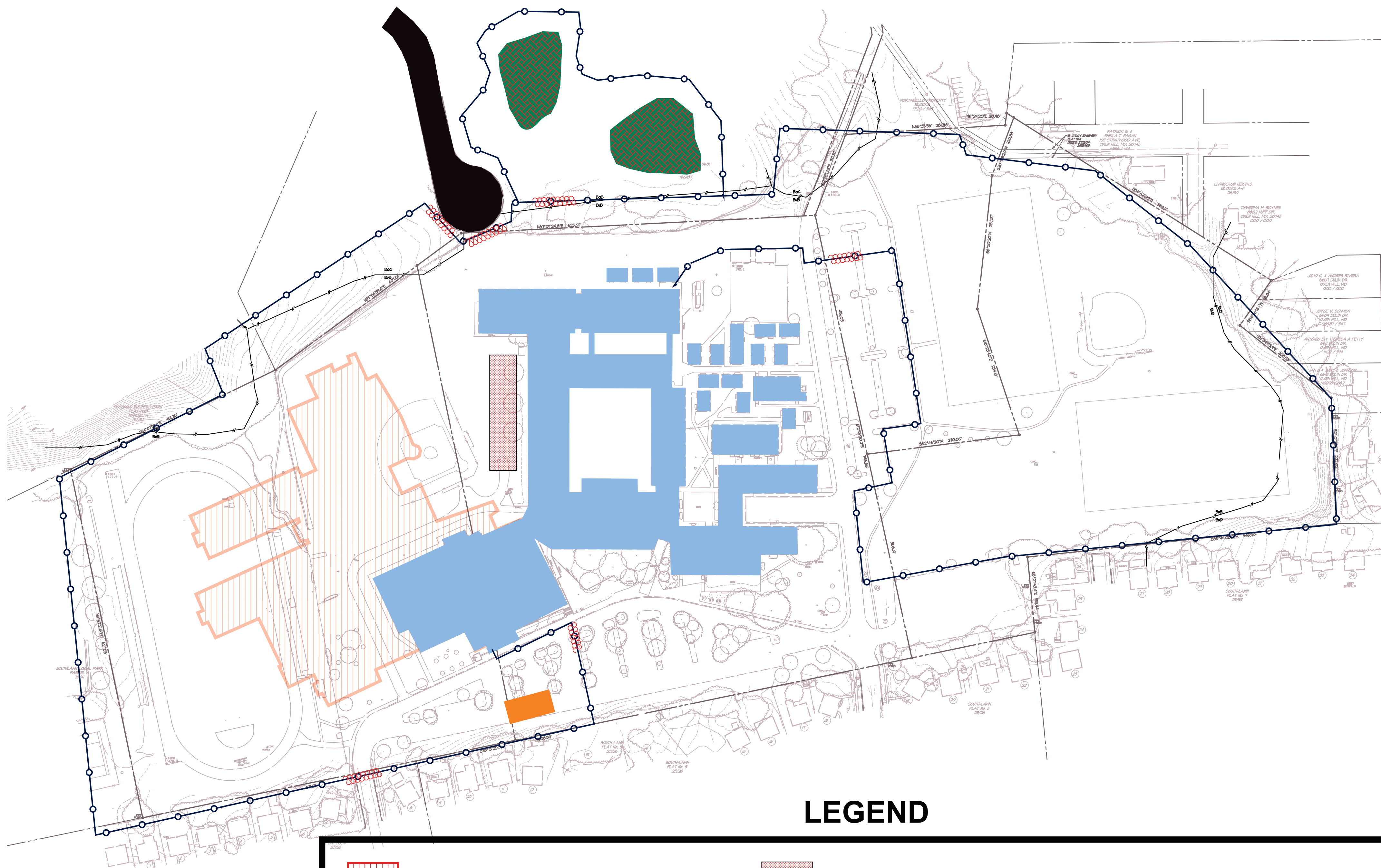
| | | 50 17 00 \| S.F. Costs | UNIT | UNIT COSTS 1/4 | UNIT COSTS MEDIAN | UNIT COSTS 3/4 | % OF TOTAL 1/4 | % OF TOTAL MEDIAN | % OF TOTAL 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| 74 | 0010 | **SCHOOLS Elementary** | S.F. | 106 | 132 | 161 | | | |
| | 0020 | Total project costs | C.F. | 6.90 | 8.85 | 11.45 | | | |
| | 0500 | Masonry | S.F. | 9.20 | 16.15 | 24 | 5.25% | 10.65% | 14.05% |
| | 1800 | Equipment | | 2.89 | 4.88 | 9 | 1.83% | 3.13% | 4.61% |
| | 2720 | Plumbing | | 6.10 | 8.60 | 11.50 | 5.70% | 7.15% | 9.35% |
| | 2730 | Heating, ventilating, air conditioning | | 9.10 | 14.50 | 20.50 | 8.15% | 10.80% | 14.90% |
| | 2900 | Electrical | | 10 | 13.25 | 16.90 | 8.45% | 10.05% | 11.80% |
| | 3100 | Total: Mechanical & Electrical | | 36.50 | 44.50 | 55 | 25% | 27.50% | 30% |
| | 9000 | Per pupil, total cost | Ea. | 12,100 | 18,000 | 40,400 | | | |
| | 9500 | Total: Mechanical & Electrical | | 3,425 | 4,325 | 10,900 | | | |
| 76 | 0010 | **SCHOOLS Junior High & Middle** | S.F. | 109 | 134 | 163 | | | |
| | 0020 | Total project costs | C.F. | 6.90 | 8.95 | 10.05 | | | |
| | 0500 | Masonry | S.F. | 13.60 | 17.80 | 21.50 | 8% | 11.60% | 14.35% |
| | 1800 | Equipment | | 3.48 | 5.60 | 8.25 | 1.80% | 3.09% | 4.86% |
| | 2720 | Plumbing | | 6.35 | 7.80 | 9.70 | 5.30% | 6.80% | 7.25% |
| | 2770 | Heating, ventilating, air conditioning | | 12.70 | 15.45 | 27 | 8.90% | 11.55% | 14.20% |
| | 2900 | Electrical | | 10.70 | 12.90 | 16.60 | 7.90% | 9.35% | 10.60% |
| | 3100 | Total: Mechanical & Electrical | | 35 | 44.50 | 55.50 | 23.50% | 26.50% | 29.50% |
| | 9000 | Per pupil, total cost | Ea. | 13,800 | 18,100 | 24,400 | | | |
| 78 | 0010 | **SCHOOLS Senior High** | S.F. | 113 | 139 | 174 | | | |
| | 0020 | Total project costs | C.F. | 6.85 | 9.85 | 16.25 | | | |
| | 1800 | Equipment | S.F. | 2.98 | 7 | 9.75 | 1.88% | 2.91% | 4.56% |
| | 2720 | Plumbing | | 6.35 | 9.55 | 17.45 | 5.60% | 6.90% | 8.30% |
| | 2770 | Heating, ventilating, air conditioning | | 13 | 14.85 | 22.50 | 8.95% | 11.60% | 15% |
| | 2900 | Electrical | | 11.45 | 14.85 | 22.50 | 8.65% | 10.20% | 12.25% |
| | 3100 | Total: Mechanical & Electrical | | 37.50 | 44 | 74 | 23.50% | 26.50% | 28.50% |
| | 9000 | Per pupil, total cost | Ea. | 10,700 | 21,700 | 27,200 | | | |
| 80 | 0010 | **SCHOOLS Vocational** | S.F. | 92 | 133 | 165 | | | |
| | 0020 | Total project costs | C.F. | 5.70 | 8.20 | 11.35 | | | |
| | 0500 | Masonry | S.F. | 5.40 | 13.30 | 20.50 | 3.20% | 4.61% | 10.95% |
| | 1800 | Equipment | | 2.87 | 7.15 | 9.85 | 1.24% | 3.10% | 4.26% |
| | 2720 | Plumbing | | 5.85 | 8.75 | 12.85 | 5.40% | 6.90% | 8.55% |
| | 2770 | Heating, ventilating, air conditioning | | 8.20 | 15.30 | 25.50 | 8.60% | 11.90% | 14.65% |
| | 2900 | Electrical | | 9.55 | 13.05 | 17.85 | 8.45% | 11% | 13.20% |
| | 3100 | Total: Mechanical & Electrical | | 36 | 36.50 | 63 | 27.50% | 29.50% | 31% |
| | 9000 | Per pupil, total cost | Ea. | 12,800 | 34,200 | 51,000 | | | |
| 83 | 0010 | **SPORTS ARENAS** | S.F. | 80 | 107 | 165 | | | |
| | 0020 | Total project costs | C.F. | 4.35 | 7.80 | 10.05 | | | |
| | 2720 | Plumbing | S.F. | 4.65 | 7.05 | 14.90 | 4.35% | 6.35% | 9.40% |
| | 2770 | Heating, ventilating, air conditioning | | 10 | 11.85 | 16.45 | 8.80% | 10.20% | 13.55% |
| | 2900 | Electrical | | 8.35 | 11.35 | 14.65 | 8.60% | 9.90% | 12.25% |
| | 3100 | Total: Mechanical & Electrical | | 21 | 37 | 49.50 | 21.50% | 25% | 27.50% |
| 85 | 0010 | **SUPERMARKETS** | S.F. | 74 | 85.50 | 101 | | | |
| | 0020 | Total project costs | C.F. | 4.13 | 4.99 | 7.55 | | | |
| | 2720 | Plumbing | S.F. | 4.14 | 5.20 | 6.05 | 5.40% | 6% | 7.45% |
| | 2770 | Heating, ventilating, air conditioning | | 6.10 | 8.10 | 9.85 | 8.60% | 8.65% | 9.60% |
| | 2900 | Electrical | | 9.30 | 10.60 | 12.60 | 10.40% | 12.45% | 13.60% |
| | 3100 | Total: Mechanical & Electrical | | 23.50 | 25.50 | 34 | 23.50% | 27.50% | 28.50% |
| 86 | 0010 | **SWIMMING POOLS** | S.F. | 120 | 201 | 430 | | | |
| | 0020 | Total project costs | C.F. | 9.60 | 12 | 13.10 | | | |
| | 2720 | Plumbing | S.F. | 11.10 | 12.70 | 17 | 4.80% | 9.70% | 20.50% |
| | 2900 | Electrical | | 9 | 14.60 | 21.50 | 5.75% | 6.95% | 7.60% |
| | 3100 | Total: Mechanical & Electrical | | 22 | 56 | 76.50 | 11.15% | 14.10% | 23.50% |
| 87 | 0010 | **TELEPHONE EXCHANGES** | S.F. | 159 | 227 | 296 | | | |
| | 0020 | Total project costs | C.F. | 9.90 | 15.90 | 22 | | | |
| | 2720 | Plumbing | S.F. | 6.70 | 10.40 | 15.20 | 4.52% | 5.80% | 6.90% |
| | 2770 | Heating, ventilating, air conditioning | | 15.60 | 31.50 | 39 | 11.80% | 16.05% | 18.40% |

# APPENDIX C – Site Plans

# HIGH SCHOOL REPLACEMENT

## SITE CLEARING & BUILDING PAD FILL SITE PLAN

## BRADY SHEERIN



## LEGEND

- Replacement High School Footprint
- Existing School
- Access Road & Employee Parking
- HESS Trailer
- Construction Fence
- Laydown area
- Entrance Gate
- Soil Storage

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PRINCE GEORGE'S COUNTY
MARYLAND

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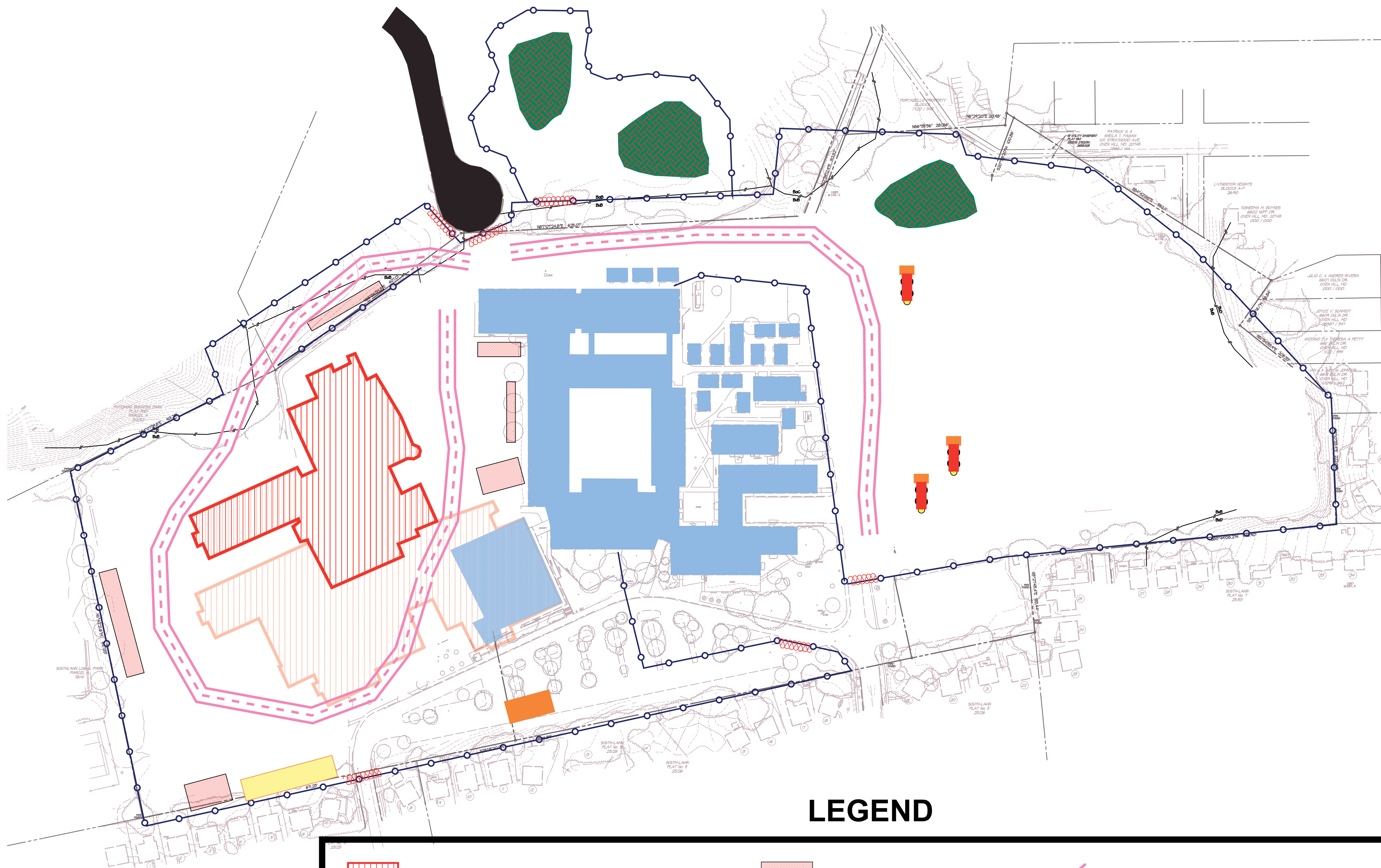
| | COMM. NO.: 0600 |
| | DRAWING NO.: |

PLOTTED: "11:56 AM on Wednesday, November 30, 2011"

# HIGH SCHOOL REPLACEMENT
## FOUNDATIONS & SOG SITE PLAN
## BRADY SHEERIN



## LEGEND

- Replacement High School Footprint
- Existing School
- Access Road & Employee Parking
- HESS Trailer
- Construction Fence
- Laydown area
- Entrance Gate
- Soil Storage
- Storage Containers & Sub Trailers
- Geothermal Well Driller
- Access Paths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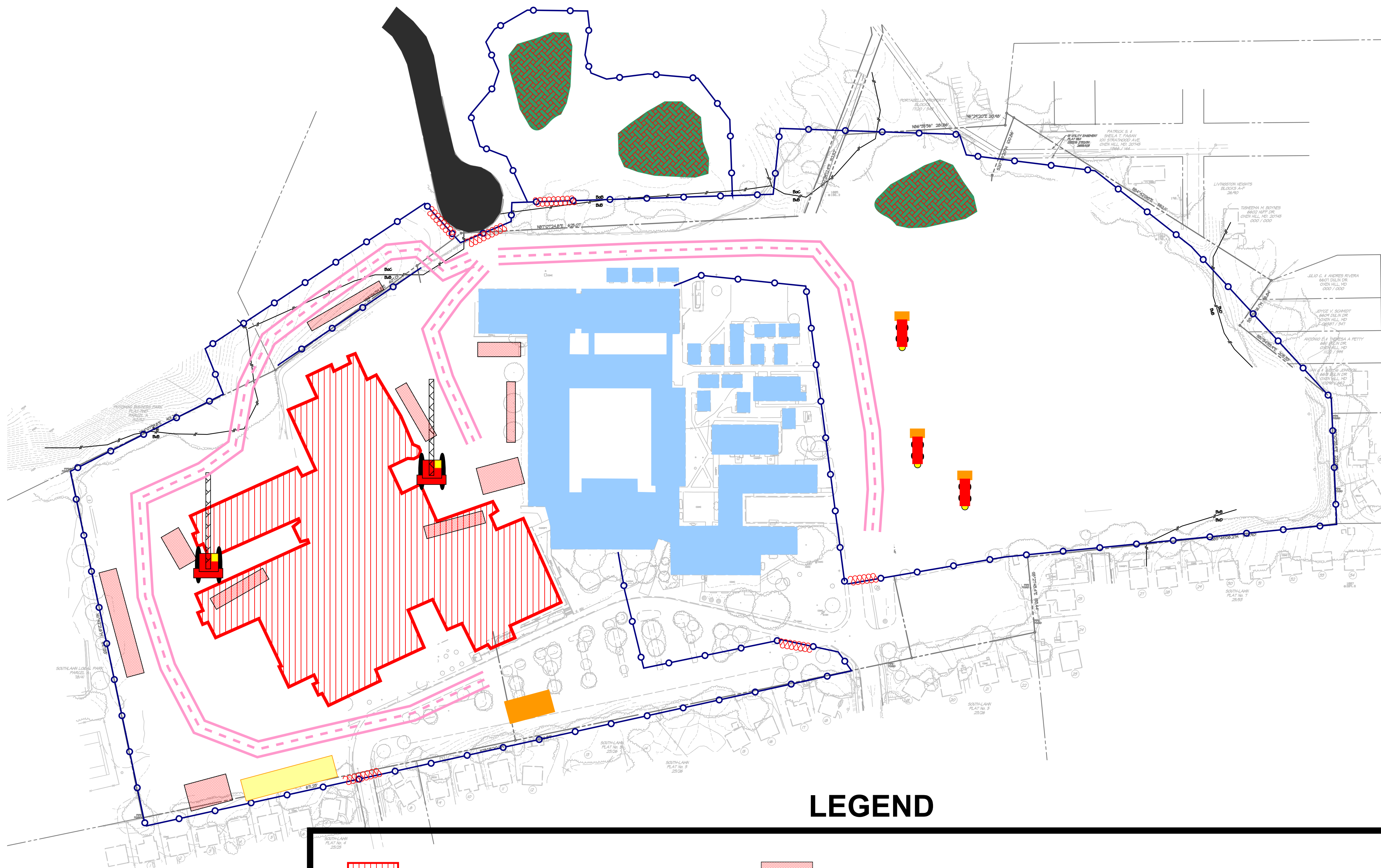
| | DRAWING NO.: |

# HIGH SCHOOL REPLACEMENT
## SUPERSTRUCTURE SITE PLAN
## BRADY SHEERIN



## LEGEND

- Replacement High School Footprint
- Existing School
- Access Road & Employee Parking
- HESS Trailer
- Construction Fence
- Laydown area
- Entrance Gate
- Soil Storage
- Storage Containers & Sub Trailers
- Geothermal Well Driller
- Crawler Crane
- Access Paths

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