2012

September 17

Technical Assignment One

University of Maryland Physical Sciences Complex

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Advisor | Anumba

EXECUTIVE SUMMARY

The content contained within this document will summarize the details behind the construction of the Physical Sciences Complex at the University of Maryland. Included are analyses of the project schedule, building systems, construction costs, existing conditions and site planning, local conditions, delivery method, and staffing plan.

The University of Maryland Physical Sciences Complex is expected to be the most advanced, state-of-the-art research facility for biophysics and molecular science in the United States. At 158,000 square feet and 5 above ground stories and two basement levels, the project will house 27 laser and condensed matter labs, 18 preparation labs, and 9 biophysics labs, as well as offices, lounges, study centers, class rooms, and spacious hallways. The nature of the experiments and research that will take place requires that the PSC have absolute control over the lab environment. This includes air, temperate, and exceptional vibration cancelling. This poses a challenge to construction. In order for nano-research to yield accurate and successful results, a way to shield the underground labs from the vibrations induced by traffic, walking, and mechanical units must be used. This document discusses what methods are used and the degree to which they are effective.

The project is the second phase of a three phase plan developed the University of Maryland. The phases are designed to expand the scope of what the campus can research and bring about scientific interest in the academic community and provide potentially ground breaking research for the world. The building rests between two existing science complexes and will replace the existing parking lot. The PSC is designed to attach to the existing Computer Science and Space building through a series of minor renovations and will introduce an entirely new mechanical building for the immediate surrounding buildings.

The PSC also features a slew of sustainable design concepts including a green roof and recycled materials. UM aims to achieve a Silver rating on the LEED scoreboard. Details on how this is achieved are discussed later in this document.

Given the intricate, unique nature of this project, most cost estimating processes are unsuccessful in yielding accurate results. The discrepancies between the estimated results and the actual results are discussed in detail.

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PROJECT SCHEDULE SUMMARY

Long Term

The University of Maryland Physical Sciences Complex is phase two of a three phase plan developed by UM to renovate and reinvigorate the Campus with state of the art scientific labs and work spaces. The latter phase will take place over the next decade after a period of time has passed after substantial completion of the PSC.

Site-work

Construction will commence with the demolition of the existing site improvements from years past. The demolition will rid the property of the existing parking lots located between the existing Computer and Space Lab and Institute for Physical Sciences buildings. Shortly after, a large amount of time is dedicated to the removal of certain existing utilities and the placement of new utilities to supply power, steam, and gas to the PSC. Many trees are removed, and temporary lighting and electric are set into place using the current transformers located just north of the site. Excavation of the underground labs will take place over a two month period.

Foundation

The foundations will take place over roughly half a year. Time is necessary to drill the concrete caissons into the ground and pour the grade beam that will rest on top of them. The sub-basement which will house type 1 and 2 labs requires the foundations be built within a fraction of an inch to specifications to insure proper vibration cancelling alignment.

Superstructure

The structure of the building will proceed over the next 80 days. During this time the post tensioned concrete columns and beams are poured and strung. The completion of a one-way concrete slab will be the determining factor for when construction can begin on the next level.

Enclosure

The building enclosure will take approximately 160 days to complete. During this time the crane located within the opening that will define the eclipse will raise and set large preassembled curtain wall pieces onto the north and south facing walls of the PSC. Concurrently, the masonry facades of the mechanical building and brick veneer of the East Wing of the PSC will be constructed.

Completion

Substantial completion is set for June 14, 2013. This date will allow for faculty and staff to occupy the building and begin to prepare it for typical use. After, punch-list items will be completed and owner orientation will commence. Final completion and turn over is scheduled for September 13, 2013.

BUILDING SYSTEMS SUMMARY

Work Scope	**Required (Y/N)**
Demolition	Y
Structural Steel Frame	Y(Partial)
Cast in Place Concrete	Y
Precast Concrete	Y
Mechanical System	Y
Electrical System	Y
Masonry	N
Curtain Wall	Y
Support of Excavation	Y

Demolition

The existing area located between the Computer and Space Science (CSS) building and Institute for Physical Science and Technology (IPST) building must be demolished. Located here are two large parking lots and a small mechanical/electrical building for the IPST. The first phase of demolition will commence with the removal of all asphalt in the parking lot and the immediate area of Farm Drive connected to these parking lots. During demolition activities, an ADA acceptable path will be provided along Farm Drive. Both the CSS and IPST buildings will continue to be operational during all construction activities. It is important that proper flagging and pedestrian control measures are taken. Furthermore, after successful completion of asphalt and curb removal, a large portion of underground utilities will be demolished and removed from site.

Structural Steel Frame

The PSC utilizes a few members of structural steel through the building. While primarily relying heavily on post-tensioned beams and girders and reinforced concrete columns, the PSC has several steel columns and horizontal members to support curtain wall. These columns, consisting of various HSS sizes are used in critical areas where space is key. Along the perimeter of the building horizontal members are utilized to support the curtain wall.

Cast in Place Concrete

All foundation walls, grade beams, beams, girders, and slabs are made using cast in place concrete of 4000 PSI while all columns from basement level to roof are 5000 PSI. Slabs above grade are 7”. Drilled caissons running the exterior edge of the building are 3’6” in diameter while caissons located internally are 3’. These caissons will support a thick slab on grade measured 14” in depth. The 14” slab will connect to the caisson caps and be cushioned by a smaller, un-reinforced 3” concrete slab below. The slab depth at these locations is higher than normal. The sub-basement which houses many science labs is required to have minimal vibrational interference from surrounding mechanical units, structures, traffic, and natural earth vibrations. For this reason, custom formwork will be used to ensure accurate pouring results. Figure.1 below shows a typical caisson-slab connection and dimensions. Note the unreinforced slab and how the column rests directly upon the 3” un-reinforced slab.

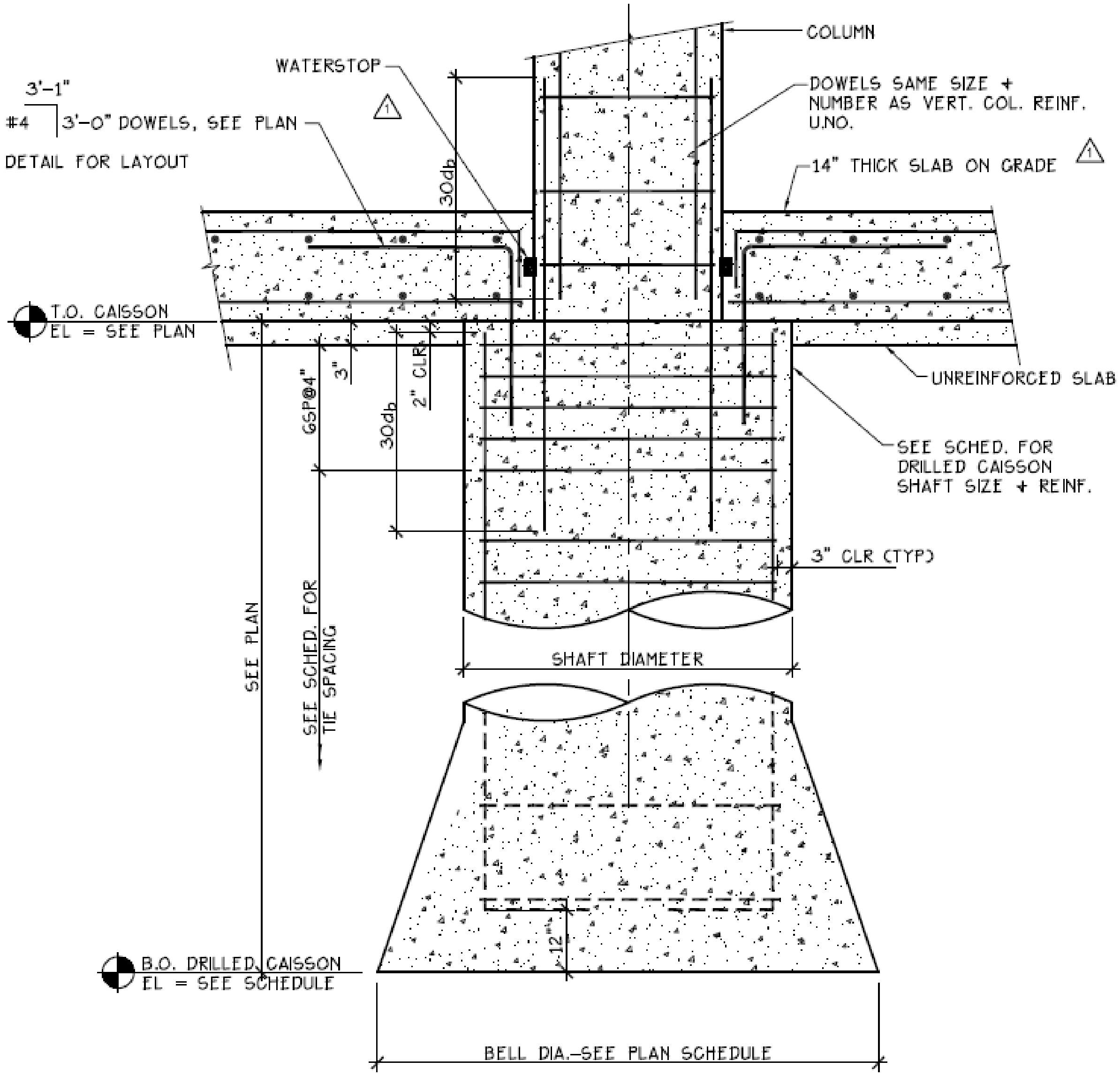


Figure.1

Along the partial perimeter of the ellipse of the PSC, angled columns will be poured with precision. Because the ellipse is not simply a vertical shaft through the building, but a tapering void that increases in radius the higher it gets, special formwork must be used. Figure.2 on the next page illustrates the complexity of this design and the connection.

Precast Concrete

While the PSC does not utilize precast concrete primarily, the mechanical building on the north-west end of the site will. The mechanical building uses precast concrete for an architectural appearance only, not for structural support. In order to lift steel members and precast pieces a tower crane is utilized. The tower crane is located *inside* the building. The large cut out in the center of the PSC created by the stylistic ellipse that characterized the building will serve as a swivel point for the crane. The crane its self is a 79 kW, 140' tall, 213' jib, 22,000lb max capacity tower crane. It sits upon a 4' thick, 10'x10' reinforced concrete bed and is supported by four C40 caissons that were placed during the foundation phase.

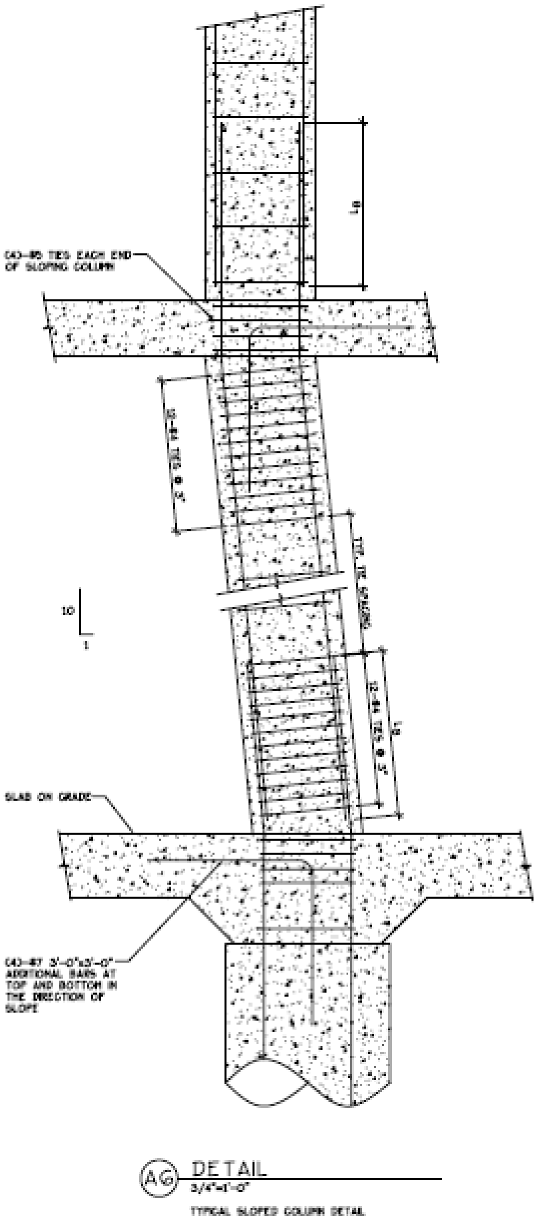


Figure.2

Mechanical

The PSC utilizes standard variable air volume systems to supply heating and cooling to zones. Three 23,000 (6,000 outside) CFM air handling units are dedicated to the Type 1 laboratories, two 48,000 (20,000 outside) CFM units for Type 2 labs, three 21,000 CFM (5,000 outside) units to the under floor systems, and one 13,500 CFM unit for the mechanical building. Type 1 labs are above ground, exposed to light, and will be used for small scale experimentation and learning. They are located on the second and third floors of the building and consume more square feet than Type 2 labs. Type 2 labs will be used for laser based experiments, biochemical research, and micro-matter research. It is imperative that the air quality, flow, and pressure of these underground labs remain absolutely stable if accurate research is to take place. Two 24,000 CFM heat recovery units will work in conjunction with the air handling units to conserve energy.

Two custom made centrifugal water chillers are located in the mechanical wing of the PSC. The chillers each have a capacity of 800 tons and a nominal flow rate of 1,600 GPM. A single 2-cell cooling tower will be located on the west roof of the PSC with a flow capacity of 4,800 GPM.

Sixteen 625 CFM fan coil units, located several mechanical rooms through the structure will supply both warm and cool air using the water from the chiller and the heat exchanged water (from the campus steam lines) respectively.

Future additions to the mechanical systems are planned for phase 3 of University of Maryland's campus expansion which will include two additional cooling towers, three plate & frame heat exchangers, and one additional chiller.

Electrical

Both the PSC and CSS will be powered by a new electrical system located inside of the new mechanical building. The main switch board for the PSC will provide 480Y/277V, 4000A service to the building. A new 3750 KVA transformer will supply a calculated load of 3230 KVA to the breaker. Because of the large addition of the mechanical building, existing electrical utility lines must be demolished and new ones put into place to handle the increased load.

Building power is guaranteed by two diesel powered generator that can supply 750KW, 938KVA power to the PSC building. Upon failure of service, within 10 seconds the generator will supply power to the buildings vital systems.

The PSC will also be equipped with a state-of-the-art security system that includes surveillance, card access, and automated alarms for fire, break-in, and power failure.

Curtain Wall

The curtain wall systems for the PSC are most assuredly the defining form factor of the PSC. The west wing of the PSC is comprised of a metal and class hanging curtain wall on the exterior, and an elliptical tapered curtain wall on the interior (the interior curtain wall wraps around the elliptical opening). Designed by HDR Inc., the interior ellipse is intricate and challenging. With nearly each piece of glazing being a custom shape, there is little room for error. The sloped curtain wall is attached to the structure with a metal plate that is anchored into the slab. Proper insulation and fire-stop installation is accounted for. Figure.3 demonstrates the complexity of the interior façade by showing the south-east quadrant of the ellipse.

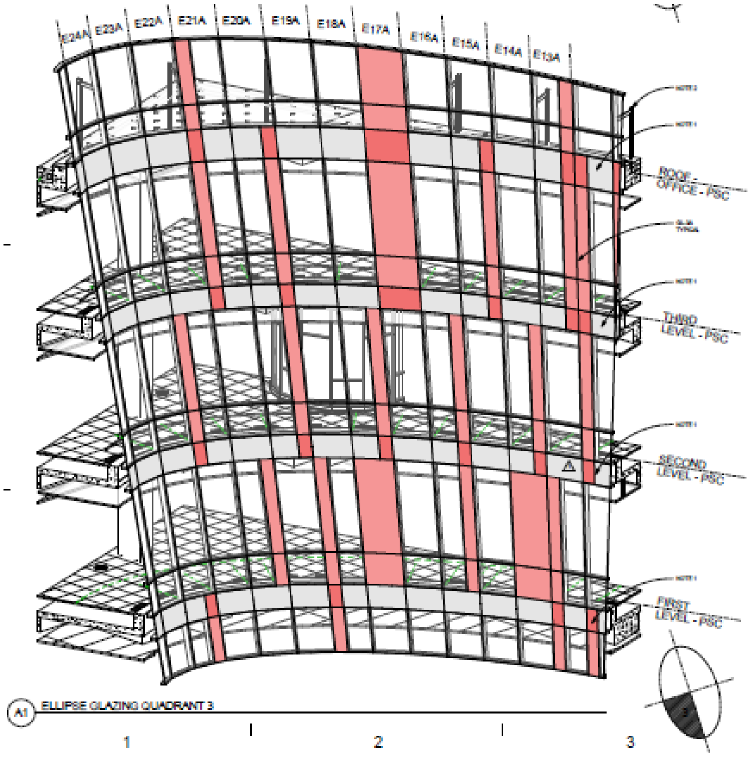


Figure.3

The exterior curtain wall, which covers the north and south walls, is similar in concept with regards to anchoring but does not have a slope. The interior curtain wall will be assembled in place, while the exterior wall will be preassembled and hoisted via crane into position.

The exterior of the east wing of the PSC is a brick veneer that is shored to the wall by way of steel angles that are anchored to the slab.

Excavation Support

Because of the depth of the underground labs, excavation support is a primary concern during construction. During excavation, retaining walls will be placed and shored with tie-backs. Dewatering pumps and deep-wells are also utilized and have a budget of $300,000.

Unique Features

The University of Maryland Physical Sciences Complex is a state-of-the-art scientific establishment. The PSC is anticipated to receive a Silver LEED rating. In order to accomplish this, the PSC has several notable features:

- A green roof to reduce heat island effects and collect rain water for reuse with non-potable water fixtures.
- Low emitting construction materials as well as 20% of its materials from recycle.
- Automatic lighting controls.
- Under floor ventilation systems that are designed to boost efficiency in heating and cooling.
- Large portion of lighting received from internal façade.

PROJECT COST EVALUATION

Total Square Footage:	158,058 SQFT
Building Construction Costs:	$67,063,310
Construction Cost per Square Foot:	*$424.29/SQFT*
Total Project Costs:	$99,383,363
Total Cost per Square Foot:	$628.78/SQFT

Major Building Systems:

Major Building Systems		
System	Cost	Cost/SQFT
Structural Concrete	$9,037,247	$57.17
Masonry	$1,233,220	$7.80
Structural Steel	$1,398,048	$8.85
Mechanical/Plumbing	$19,217,151	$121.58
HVAC Controls	$3,020,782	$19.11
Electrical	$12,393,022	$78.40
Lab Casework	$1,847,364	$11.69

RS Means Square Foot Estimate:	*$39,026,500*
RS Means Cost per Square Foot:	*$247/SQFT*

The RS means estimate was done using a typical price per square foot of a 5 story hospital complex with a basement. Because of the intricate nature of this project, a comparison to a hospital is a much better fit than a comparison to an office building or college laboratory of similar dimensions. The large demand for mechanical and electrical equipment, as well as the specialized construction, more appropriately matches the demand found in a 5 story hospital. However, even with this assumption and partial correction, the square foot cost given by an RS Means estimate is only 58% of the actual building costs. The discrepancy can be explained by the details of the PSC. The table above shows that a large portion of the costs of the PSC comes from MEP. These costs are uniquely higher than normal. The PSC aims to house state of the art labs, and as such required state of the art coordination, equipment, and construction. Furthermore, the PSC has a deeper foundation than most other commercial structures. The additional cost of excavation, shoring, concrete, and equipment is not accounted for in an RS Means estimate.

RS Means MEP Assemblies Cost Estimate: $5,084,382

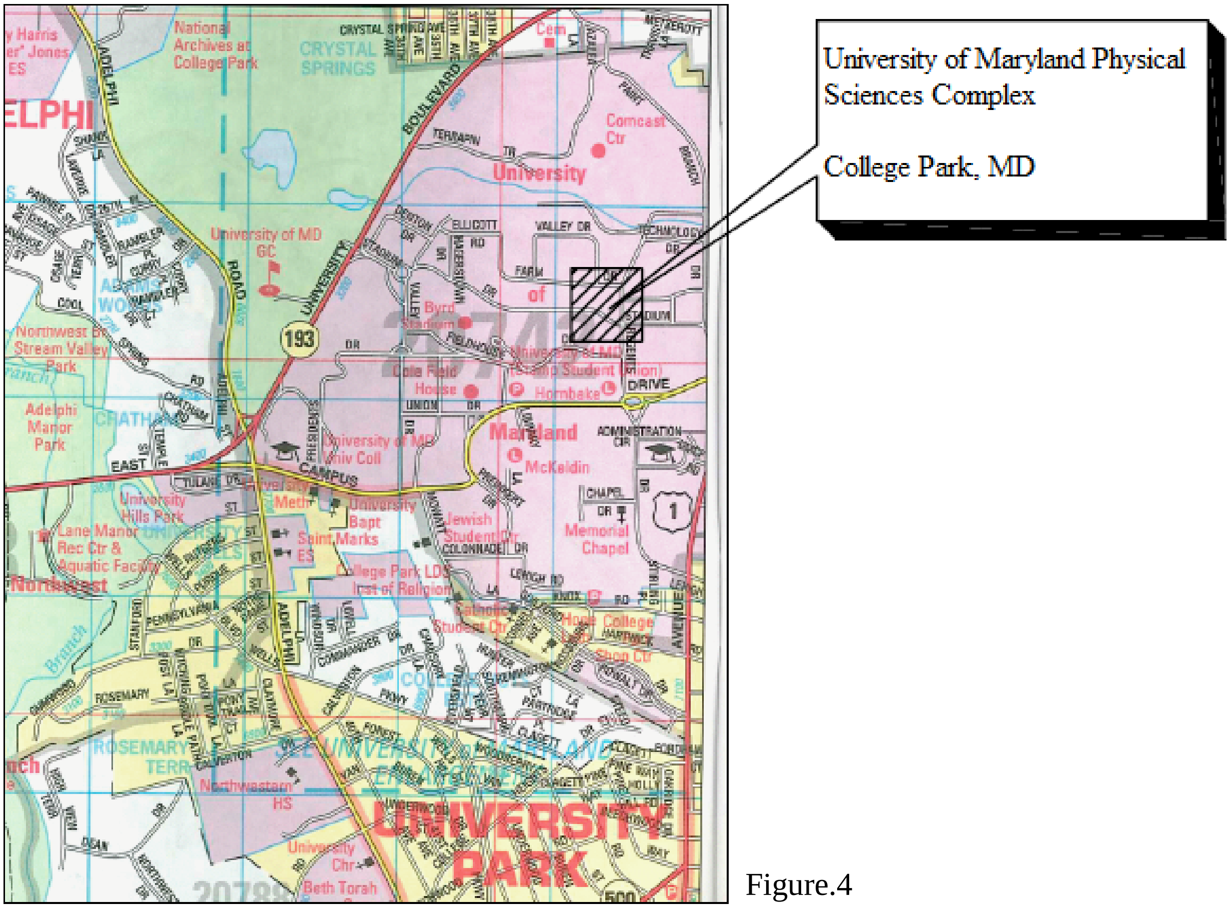
The RS means assembly estimate returned a cost which is significantly lower than the actual MEP costs. There are several reasons for this. The first and most substantial reason is that the chillers and cooling tower are custom built. While the difference can be accounted for by comparing the custom unit's values to those found in the assemblies cost data, the price for the custom units will still be higher. Secondly, the security system accounts for over half of the electrical costs. The cost of the security system is confidential.

Comparison of values

The estimated costs for the Physical Sciences complex are below the actual cost of the building. While several reasons were already discussed in detail above, the most noticeable cause for this discrepancy is the shear uniqueness of the building. The PSC is not a cookie-cutter structure that can be easily valued by looking at typical cost data. This is also the reason that Gilbane Inc. is entrusted with such a project. The mechanical systems, electrical systems, architecture, and general sustainability of the project put it above and beyond any other structure that could be called a college laboratory.

SITE CONDITIONS & PLANNING

The new University of Maryland Physical Sciences Complex is set on the north-east end of the college campus and will bring new life to a time-weathered area (see Figure.4 for location). The site is set upon an existing parking lot that will be demolished and in between two existing buildings that will continue to be operational during construction.



University of Maryland Physical Sciences Complex

College Park, MD

Figure.4

Because the surrounding buildings will continue normal operations, space is extremely tight. The initial mobilization will place all job trailers on the north-east end of construction activities, approximately 150 yards away. The existing road, Stadium Drive, will serve as traffic access for deliveries of equipment, materials, and personnel. Construction traffic will enter the south end of the site via Stadium drive, and exit turning back onto stadium drive. The surrounding roads are rather narrow, therefor construction traffic must use the appropriate path so as not to risk damaging the vehicles or surrounding architecture and injuring pedestrians. Parking has been provided for workers off-site in a parking lot south-west of the site. Notice in Figure.5 on the next page how the site sits between several structures, all of which will require full access.

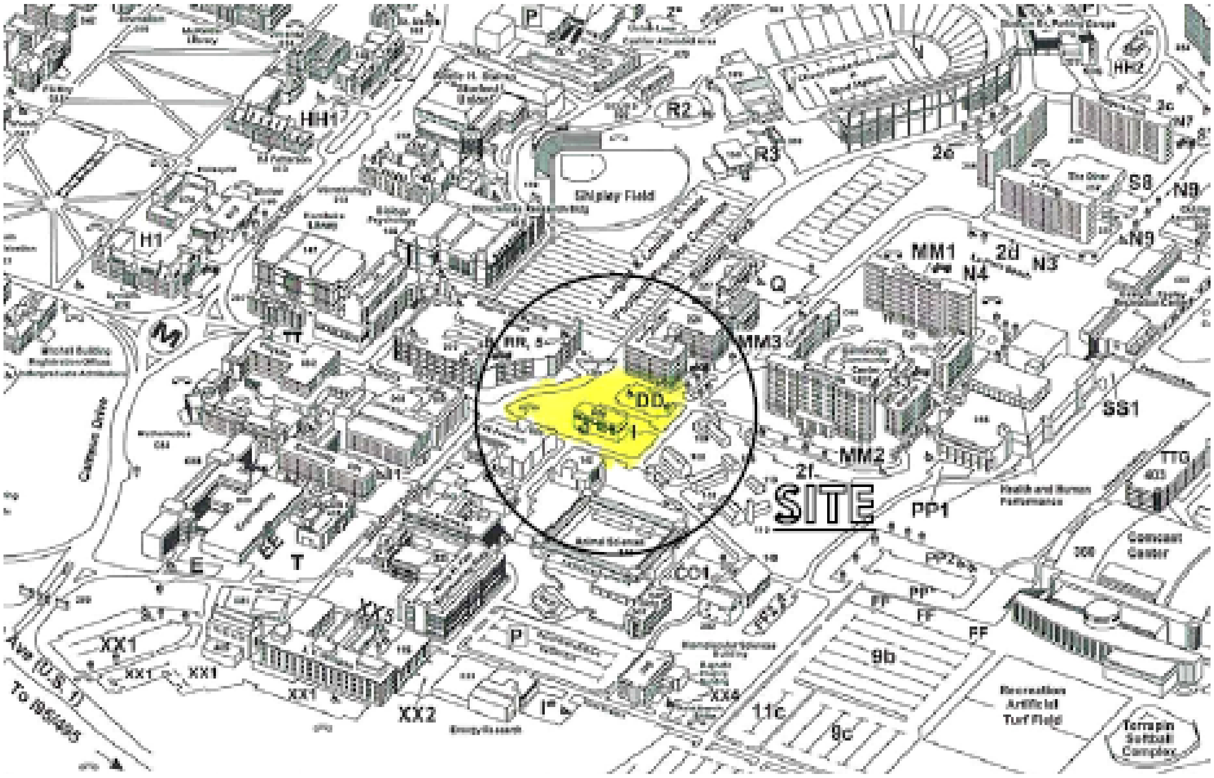


Figure.5

During the demolition phase, all debris and waste materials will be stowed at the south end of the site near the construction traffic entrance. During the two weeks of demolition, trucks are scheduled to take the field debris. Farm Drive will be torn up and new utility lines will be set. During this process, Farm Drive will be narrowed two half its width, and demolition will take place in two phases, both laying new utilities and repaving the surface.

When construction of the actual building begins, a large crane will be used as the primary means of hoisting. This crane rests in the center of the PSC and has a radius of 213’, large enough to lift and deliver materials to both the west and east wing of the PSC and the mechanical building. Scaffolding will be utilized primarily on the new mechanical building. Moving in a pattern as indicated in Appendix D. Scaffolding will not be used on the PSC. The curtain wall will be lifted into place with the crane, and secured from personnel inside the building. The prefab brick veneer of the east wing will be constructed in a similar manner.

LOCAL CONDITIONS

Soil conditions are important to consider when designing the PSC. The area it is located in is known for clayey soils and excessive settlement. In a geotechnical analysis which involved the boring samples of 15 locations across the site, the soil at elevations that correspond to shallow footings was determined to be loose sand and soft clay. While it is feasible to compact the soil to allow for stable spread footings, it was determined that drilled caissons that extend to the stable consolidated clay at deeper elevations was more cost efficient. With column loads of approximately 1800 kip and a spacing of roughly 28' by 28', it was determined that 3' diameter drilled caissons that support a 500psf skin friction can be used. Figure.6 shows the locations of the boring samples with regards to the proposed area of construction.

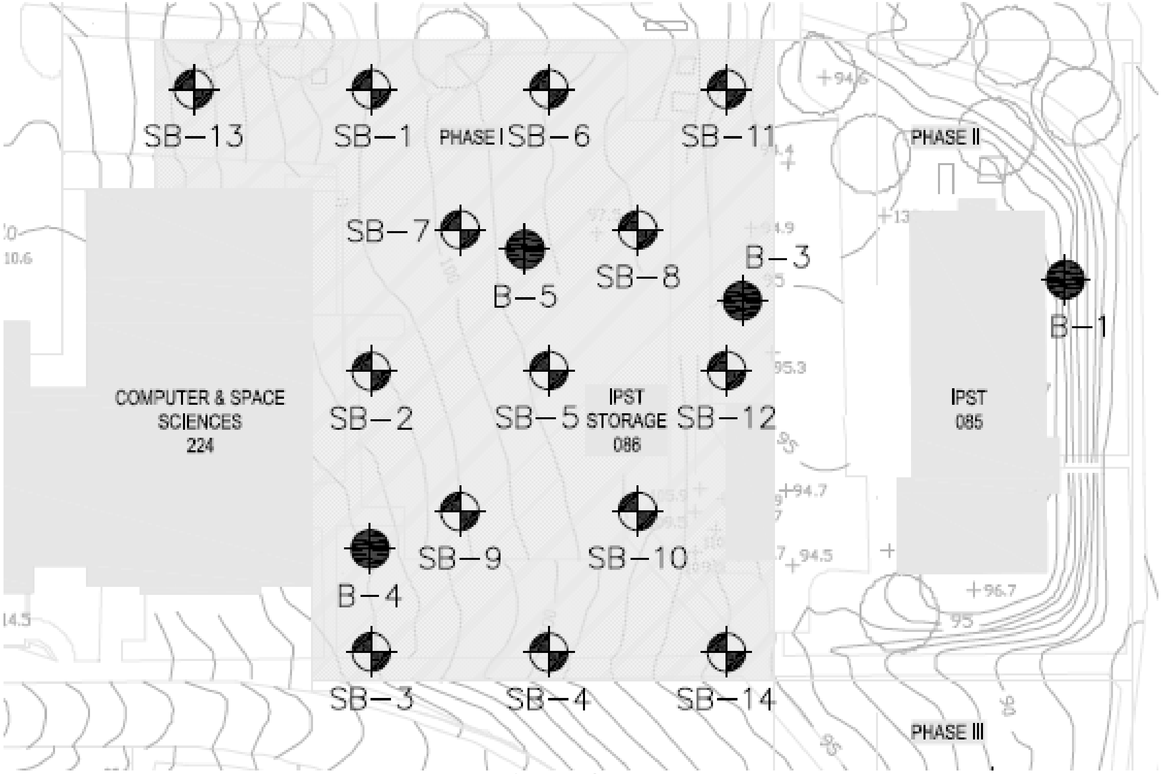


Figure.6

Dewatering is also an important factor when excavating in this area. The soils in this area are low permeability, fine-grained soils with layers of saturated, high permeability soils that act as perched water zones. While the subsurface water pressure is not high enough to cause a flash flood, it is suggested that the water table be kept at least 3' below the lowest excavated surface to reduce risk of damaged equipment or cave-in. In order to accomplish this, a deep-well dewatering system will be used in conjunction with large pumps. Because these areas of perched water cannot be fully discovered by the conventional means of soil boring, the dewatering process should account for any excess, undocumented areas.

CLIENT INFORMATION

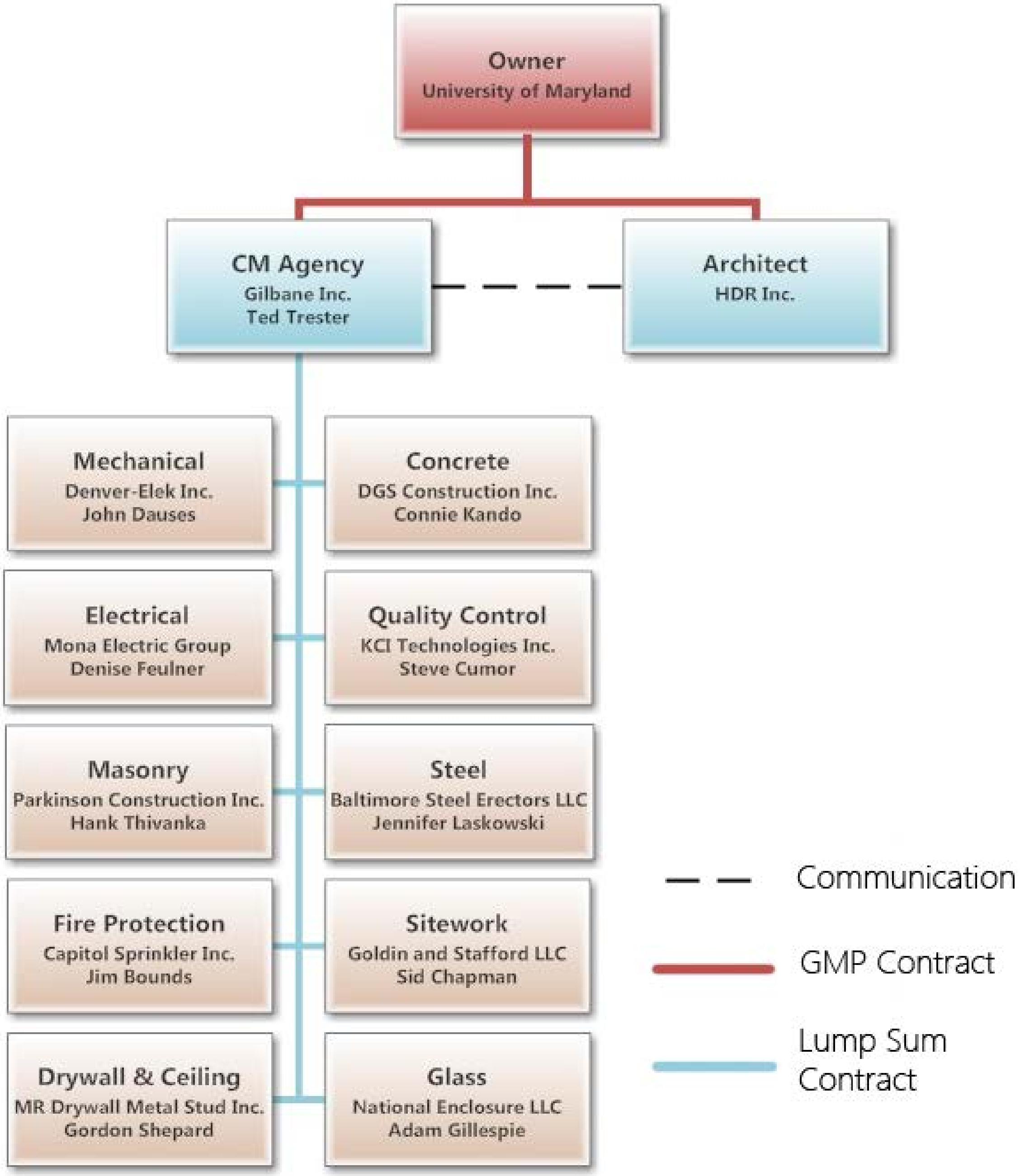
The owner of the Physical Sciences Complex is the University of Maryland. UM is determined to create the most advanced, state-of-the-art science complexes in the United States. It is the second phase of a three phase project developed by UM to strengthen their role in scientific advancements. With the aging of the Computer and Space Sciences building and Institute for Physical Sciences and Technology building, the college has dedicated a large investment into giving the sciences a new breadth of freedom.

The project its self is receiving 80% of its funding from University of Maryland while the other 20% is from the 2009 American Recovery and Reinvestment Act (ARRA). The 20% funding is being used to develop the Type 2 “Enhancement” labs.

UM has made it clear that a fall 2013 deadline is critical to the mission success of its phased planning. Many scientific programs, faculty, and staff are planning on moving in September of 2013 to begin experiment and careers.

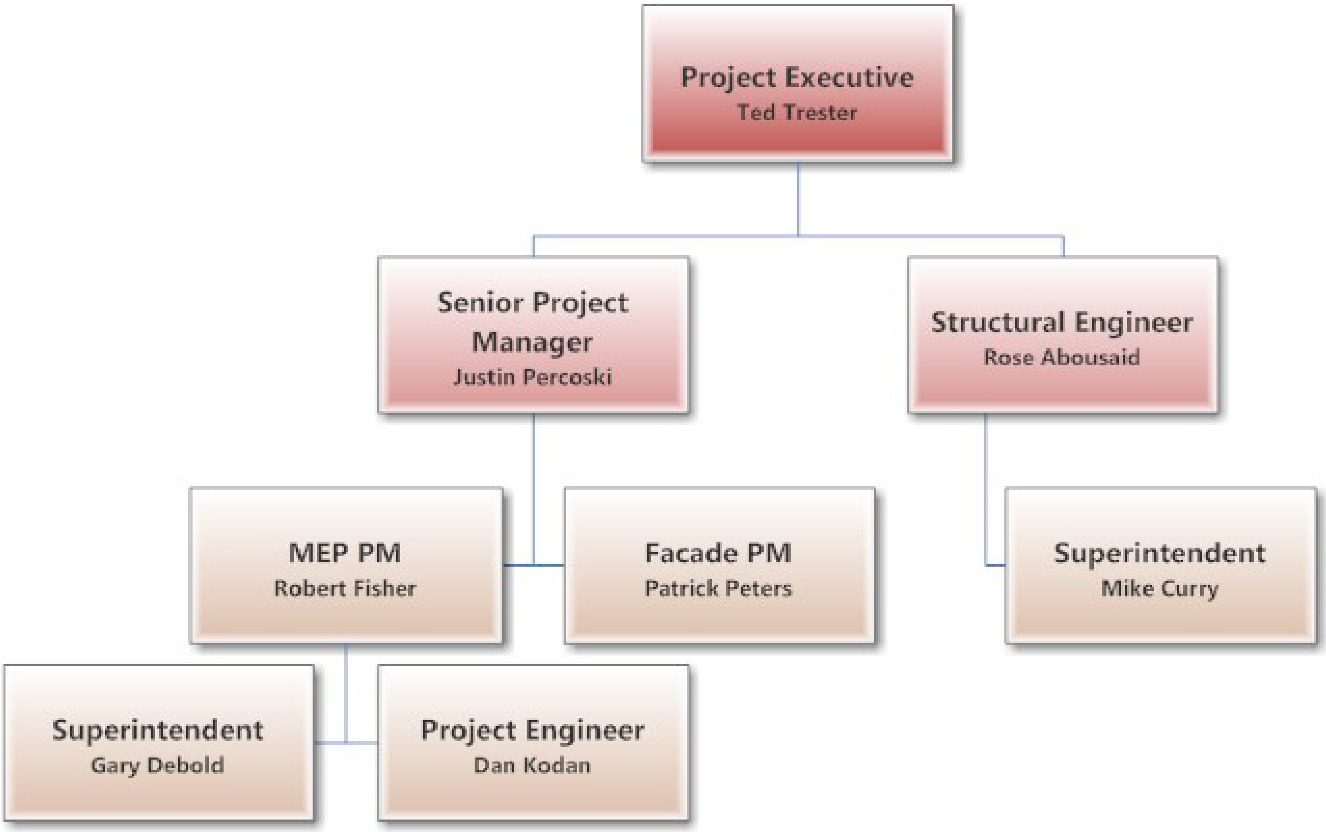
PROJECT DELIVERY

The delivery method for the PSC is straight forward and easy to follow. The University of Maryland holds two GMP contracts. The first is with Gilbane Inc. as CM at risk. The second is with HDR Inc., the architectural design firm for the project. From there, Gilbane holds lump sum contracts with 33 trades. HDR and Gilbane do not hold a contract with one another and communicate through the university for coordination and design feasibility. Below is an organizational chart illustrating the parties involved in project delivery and how they relate to one-another. Included are only a few of the 33 contracts held by Gilbane, while HDR holds none with any specialty trades or contractors.

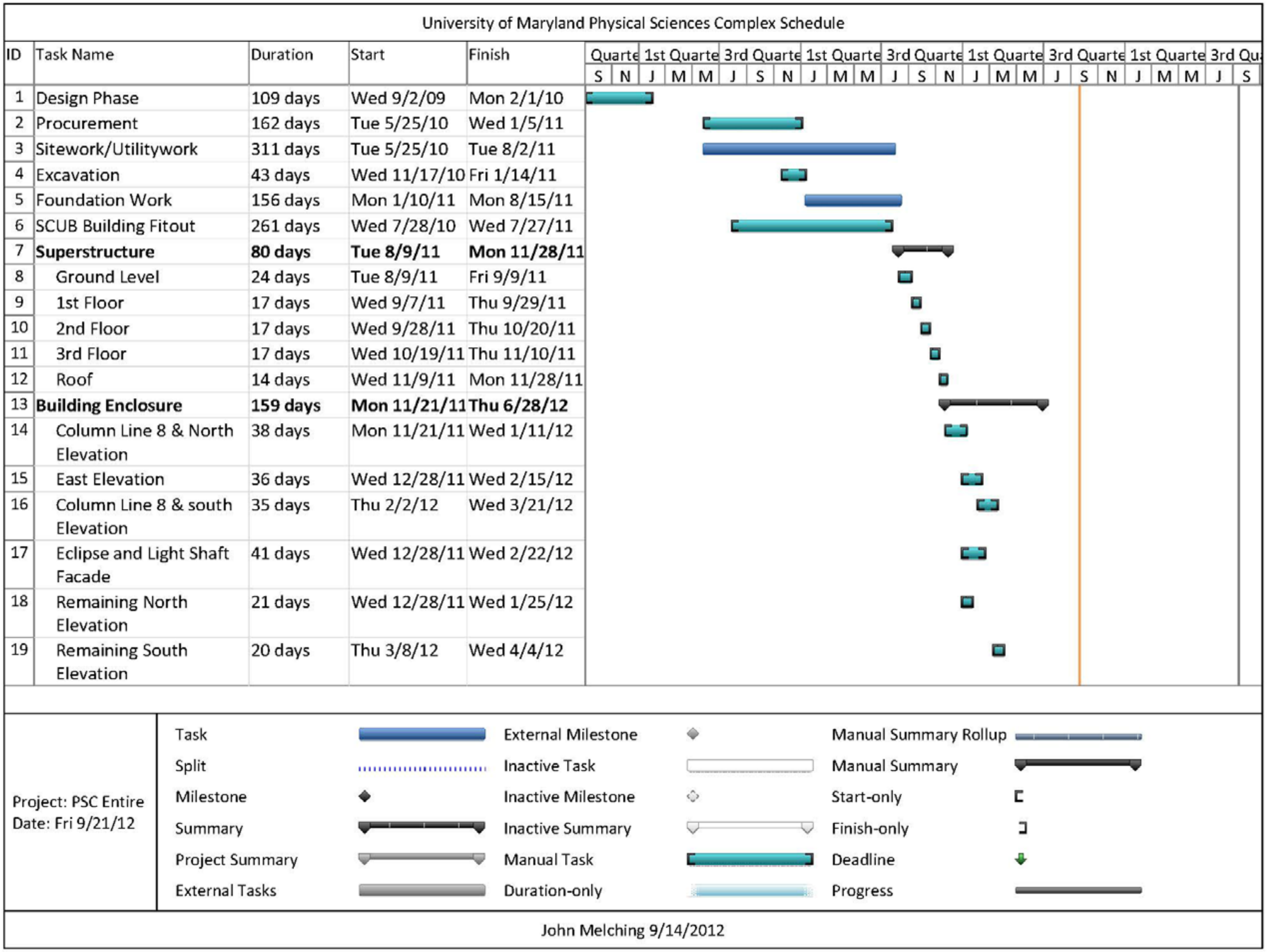


STAFFING PLAN

Below is the Gilbane staffing organization for the PSC project. There are two superintendents on site, Gary and Mike. Gary is responsible for MEP coordination and communication with MEP trades while Mike is responsible for structural coordination and communication. While the chart suggests that each person has a responsibility to report to the next highest block, direct communication between staff is highly encouraged for project success.



Appendix A: Project Schedule



University of Maryland Physical Sciences Complex Schedule

ID	Task Name	Duration	Start	Finish
1	Design Phase	109 days	Wed 9/2/09	Mon 2/1/10
2	Procurement	162 days	Tue 5/25/10	Wed 1/5/11
3	Sitework/Utilitywork	311 days	Tue 5/25/10	Tue 8/2/11
4	Excavation	43 days	Wed 11/17/10	Fri 1/14/11
5	Foundation Work	156 days	Mon 1/10/11	Mon 8/15/11
6	SCUB Building Fitout	261 days	Wed 7/28/10	Wed 7/27/11
7	**Superstructure**	**80 days**	**Tue 8/9/11**	**Mon 11/28/11**
8	Ground Level	24 days	Tue 8/9/11	Fri 9/9/11
9	1st Floor	17 days	Wed 9/7/11	Thu 9/29/11
10	2nd Floor	17 days	Wed 9/28/11	Thu 10/20/11
11	3rd Floor	17 days	Wed 10/19/11	Thu 11/10/11
12	Roof	14 days	Wed 11/9/11	Mon 11/28/11
13	**Building Enclosure**	**159 days**	**Mon 11/21/11**	**Thu 6/28/12**
14	Column Line 8 & North Elevation	38 days	Mon 11/21/11	Wed 1/11/12
15	East Elevation	36 days	Wed 12/28/11	Wed 2/15/12
16	Column Line 8 & south Elevation	35 days	Thu 2/2/12	Wed 3/21/12
17	Eclipse and Light Shaft Facade	41 days	Wed 12/28/11	Wed 2/22/12
18	Remaining North Elevation	21 days	Wed 12/28/11	Wed 1/25/12
19	Remaining South Elevation	20 days	Thu 3/8/12	Wed 4/4/12

Project: PSC Entire
Date: Fri 9/21/12

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

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University of Maryland Physical Sciences Complex Schedule

ID	Task Name	Duration	Start	Finish
20	Remaining West Elevation	40 days	Thu 2/23/12	Wed 4/18/12
21	Ground Floor Plaza	61 days	Thu 4/5/12	Thu 6/28/12
22	Mechanical Building Exterior	58 days	Wed 11/23/11	Fri 2/10/12
23	Penthouse	67 days	Tue 12/6/11	Wed 3/7/12
24	Roof	66 days	Fri 12/30/11	Fri 3/30/12
25	**MEP Infrastructure**	**241 days**	**Wed 11/23/11**	**Wed 10/24/12**
26	Mechanical Building	241 days	Wed 11/23/11	Wed 10/24/12
27	Penthouse	82 days	Thu 3/22/12	Fri 7/13/12
28	Finishes	341 days	Thu 9/29/11	Thu 1/17/13
29	Commissioning and Testing	412 days	Fri 1/27/12	Mon 8/26/13
30	Substantial Completion	0 days	Fri 6/14/13	Fri 6/14/13
31	Final Completion	0 days	Fri 9/13/13	Fri 9/13/13

Project: PSC Entire
Date: Fri 9/21/12

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Appendix B: RS Means Square Foot Estimate

Estimate Name:	PSC	

Building Type:	**Hospital, 4-8 Story with Face Brick with Structural Facing Tile / Steel Frame**
Location:	**National Average**
Story Count:	**5**
Story Height (L.F.):	**14**
Floor Area (S.F.):	**158000**
Labor Type:	**Union**
Basement Included:	**Yes**
Data Release:	**Year 2008 Quarter 1**
Cost Per Square Foot:	**$247.00**
Building Cost:	**$39,026,500**

Costs are derived from a building model with basic components.

Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per S.F.	Cost
A Substructure		**2.70%**	**$4.92**	**$777,500**
A1010	**Standard Foundations** Strip footing, concrete, reinforced, load 14.8 KLF, soil bearing capacity 6 KSF, 12" deep x 32" wide Spread footings, 3000 PSI concrete, load 400K, soil bearing capacity 6 KSF, 8' - 6" square x 27" deep		**$2.28**	**$360,500**
A1030	**Slab on Grade** Slab on grade, 4" thick, non industrial, reinforced		**$0.92**	**$145,500**
A2010	**Basement Excavation** Excavate and fill, 10,000 SF, 8' deep, sand, gravel, or common earth, on site storage		**$0.59**	**$94,000**
A2020	**Basement Walls** Foundation wall, CIP, 12' wall height, pumped, .52 CY/LF, 24.29 PLF, 14" thick		**$1.12**	**$177,500**
B Shell		**19.80%**	**$35.81**	**$5,658,500**
B1010	**Floor Construction** Cast-in-place concrete column, 16" square, tied, 400K load, 12' story height, 251 lbs/LF, 4000PSI Steel column, W10, 200 KIPS, 10' unsupported height, 45 PLF Flat slab, concrete, with drop panels, 6" slab/2.5" panel, 12" column, 15'x15' bay, 75 PSF superimposed load, 153 PSF total load Floor, composite metal deck, shear connectors, 5.5" slab, 30'x30' bay, 26.5" total depth, 75 PSF superimposed load, 116 PSF total load Fireproofing, gypsum board, fire rated, 2 layer, 1" thick, 10" steel column, 3 hour rating, 17 PLF		**$19.04**	**$3,008,500**
B1020	**Roof Construction** Floor, steel joists, beams, 1.5" 22 ga metal deck, on columns, 30'x30' bay, 28" deep, 40 PSF superimposed load, 62 PSF total load		**$1.58**	**$249,000**
B2010	**Exterior Walls**		**$9.49**	**$1,500,000**

	Brick wall, cavity, standard face, 4" glazed tile back-up, 10" thick, styrofoam cavity fill			
B2020	**Exterior Windows**		**$3.63**	**$573,500**
	Windows, aluminum, sliding, insulated glass, 5' x 3'			
B2030	**Exterior Doors**		**$0.67**	**$105,500**
	Door, aluminum & glass, with transom, full vision, double door, hardware, 6'-0" x 10'-0" opening			
	Door, aluminum & glass, with transom, non-standard, double door, hardware, 6'-0" x 10'-0" opening			
	Door, steel 18 gauge, hollow metal, 1 door with frame, no label, 3'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**$1.38**	**$217,500**
	Roofing, single ply membrane, reinforced, PVC, 48 mils, fully adhered, adhesive			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, copper, no backing, 16 oz, < 500 lbs			
B3020	**Roof Openings**		**$0.03**	**$4,500**
	Roof hatch, with curb, 1" fiberglass insulation, 2'-6" x 3'-0", galvanized steel, 165 lbs			
C Interiors		**23.70%**	**$43.04**	**$6,800,500**
C1010	**Partitions**		**$7.43**	**$1,173,500**
	Metal partition, 5/8" vinyl faced gypsum board face, 5/8"fire rated gypsum board base, 3-5/8" @ 24",s ame opposite face, no insulation			
	Gypsum board, 1 face only, 5/8" with 1/16" lead			
C1020	**Interior Doors**		**$9.65**	**$1,525,000**
	Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8"			
	Door, single leaf, kd steel frame, metal fire, commercial quality, 3'-0" x 7'-0" x 1-3/8"			
C1030	**Fittings**		**$0.93**	**$146,500**
	Partitions, hospital curtain, ceiling hung, poly oxford cloth			
C2010	**Stair Construction**		**$1.26**	**$199,000**
	Stairs, steel, cement filled metal pan & picket rail, 12 risers, with landing			
C3010	**Wall Finishes**		**$7.09**	**$1,119,500**
	Glazed coating			
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Vinyl wall covering, fabric back, medium weight			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**$9.83**	**$1,552,500**
	Composition flooring, epoxy terrazzo, maximum			
	Terrazzo, maximum			
	Vinyl, composition tile, maximum			

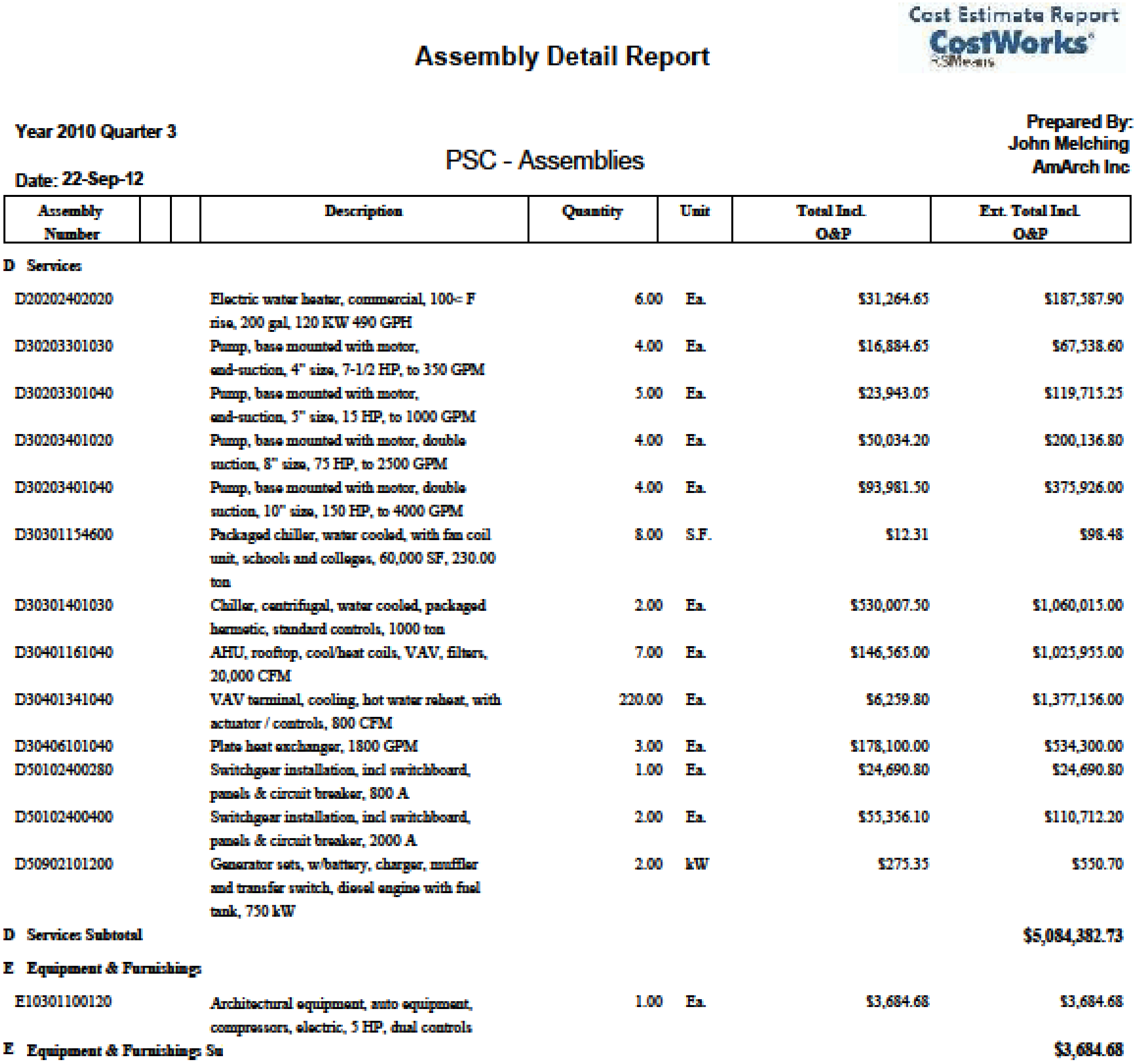
	Tile, ceramic natural clay			
C3030	**Ceiling Finishes**		**$6.86**	**$1,084,500**
	Plaster ceilings, 3 coat prl, 3.4# metal lath, 3/4" crc, 12"OC furring, 1-1/2" crc, 36" OC support			
	Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support			
D Services		**45.20%**	**$81.97**	**$12,952,000**
D1010	**Elevators and Lifts**		**$5.63**	**$889,000**
	Traction, geared hospital, 6000 lb, 6 floors, 12' story height, 2 car group, 200 FPM			
D2010	**Plumbing Fixtures**		**$6.36**	**$1,005,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, stall type			
	Lavatory w/trim, wall hung, PE on CI, 19" x 17"			
	Kitchen sink w/trim, raised deck, PE on CI, 42" x 21" dual level, triple bowl			
	Laundry sink w/trim, PE on CI, black iron frame, 48" x 21" double compartment			
	Service sink w/trim, PE on CI, corner floor, wall hung w/rim guard, 22" x 18"			
	Bathtub, recessed, PE on CI, mat bottom, 5'-6" long			
	Shower, stall, baked enamel, terrazzo receptor, 36" square			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**$5.84**	**$922,500**
	Electric water heater, commercial, 100< F rise, 1000 gal, 480 KW 1970 GPH			
D2040	**Rain Water Drainage**		**$0.68**	**$107,500**
	Roof drain, CI, soil,single hub, 5" diam, 10' high			
	Roof drain, CI, soil,single hub, 5" diam, for each additional foot add			
D3010	**Energy Supply**		**$3.15**	**$497,500**
	Hot water reheat system for 200,000 SF hospital			
D3020	**Heat Generating Systems**		**$0.34**	**$54,500**
	Boiler, electric, steel, steam, 510 KW, 1,740 MBH			
D3030	**Cooling Generating Systems**		**$2.67**	**$421,500**
	Chiller, reciprocating, water cooled, standard controls, 100 ton			
	Chiller, reciprocating, water cooled, standard controls, 150 ton			
	Chiller, reciprocating, water cooled, standard controls, 200 ton			
D3090	**Other HVAC Systems/Equip**		**$26.73**	**$4,223,500**
	Ductwork for 200,000 SF hospital model			
	Boiler, cast iron, gas, hot water, 2856 MBH			
	Boiler, cast iron, gas, hot water, 320 MBH			
	AHU, rooftop, cool/heat coils, VAV, filters, 5,000 CFM			
	AHU, rooftop, cool/heat coils, VAV, filters, 10,000 CFM			
	AHU, rooftop, cool/heat coils, VAV, filters, 20,000 CFM			

	VAV terminal, cooling, hot water reheat, with actuator / controls, 200 CFM		
	AHU, rooftop, cool/heat coils, VAV, filters, 30,000 CFM		
	Roof vent. system, power, centrifugal, aluminum, galvanized curb, back draft damper, 1500 CFM		
	Roof vent. system, power, centrifugal, aluminum, galvanized curb, back draft damper, 2750 CFM		
	Commercial kitchen exhaust/make-up air system, rooftop, gas, 5000 CFM		
	Plate heat exchanger, 400 GPM		
D4010	**Sprinklers**	**$2.17**	**$343,000**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF		
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF		
D4020	**Standpipes**	**$0.50**	**$79,500**
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor		
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, additional floors		
	Cabs, hose rack assembly, & extinguisher, 2-1/2" x 1-1/2" valve & hose, steel door & frame		
	Alarm, electric pressure switch (circuit closer)		
	Escutcheon plate, for angle valves, polished brass, 2-1/2"		
	Fire pump, electric, with controller, 5" pump, 100 HP, 1000 GPM		
	Fire pump, electric, for jockey pump system, add		
	Siamese, with plugs & chains, polished brass, sidewalk, 4" x 2-1/2" x 2-1/2"		
	Valves, angle, wheel handle, 300 lb, 2-1/2"		
	Cabinet assembly, includes. adapter, rack, hose, and nozzle		
D5010	**Electrical Service/Distribution**	**$4.85**	**$766,000**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A		
	Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A		
	Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A		
D5020	**Lighting and Branch Wiring**	**$17.19**	**$2,716,000**
	Receptacles incl plate, box, conduit, wire, 20 per 1000 SF,2.4 W per SF, with transformer		
	Wall switches, 5.0 per 1000 SF		
	Miscellaneous power, 1.2 watts		
	Central air conditioning power, 4 watts		
	Motor installation, three phase, 460 V, 15 HP motor size		
	Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP		
	Fluorescent fixtures recess mounted in ceiling, 1 watt per SF, 20 FC, 5 fixtures @40 watts per 1000 SF		

D5030	**Communications and Security**		**$1.75**	**$276,500**
	Communication and alarm systems, includes outlets, boxes, conduit and wire, fire detection systems, 100 detectors			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		**$4.11**	**$650,000**
	Generator sets, w/battery, charger, muffler and transfer switch, diesel engine with fuel tank, 100 kW			
	Generator sets, w/battery, charger, muffler and transfer switch, diesel engine with fuel tank, 400 kW			
	Uninterruptible power supply with standard battery pack, 15 kVA/12.75 kW			
E Equipment & Furnishings		**8.60%**	**$15.53**	**$2,454,500**
E1020	**Institutional Equipment**		**$11.89**	**$1,878,500**
	Architectural equipment, laboratory equipment glassware washer, distilled water, economy			
	Architectural equipment, sink, epoxy resin, 25" x 16" x 10"			
	Architectural equipment, laboratory equipment eye wash, hand held			
	Fume hood, complex, including fixtures and ductwork			
	Architectural equipment, medical equipment sterilizers, floor loading, double door, 28"x67"x52"			
	Architectural equipment, medical equipment, medical gas system for large hospital			
	Architectural equipment, kitchen equipment, commercial dish washer, semiautomatic, 50 racks/hr			
	Architectural equipment, kitchen equipment, food warmer, counter, 1.65 KW			
	Architectural equipment, kitchen equipment, kettles, steam jacketed, 20 gallons			
	Architectural equipment, kitchen equipment, range, restaurant type, burners, 2 ovens & 24" griddle			
	Architectural equipment, kitchen equipment, range hood, including CO2 system, economy			
	Special construction, refrigerators, prefabricated, walk-in, 7'-6" high, 6' x 6'			
	Architectural equipment, darkroom equipment combination, tray & tank sinks, washers & dry tables			
E1090	**Other Equipment**		**$0.00**	**$0**
E2020	**Moveable Furnishings**		**$3.65**	**$576,000**
	Furnishings, hospital furniture, patient wall system, no utilities, deluxe , per room			
F Special Construction		**0.00%**	**$0.00**	**$0**
G Building Sitework		**0.00%**	**$0.00**	**$0**
SubTotal		**100%**	**$181.28**	**$28,643,000**
Contractor Fees (General Conditions,Overhead,Profit)		**25.00%**	**$45.32**	**$7,161,000**
Architectural Fees		**9.00%**	**$20.40**	**$3,222,500**

User Fees	**0.00%**	**$0.00**	**$0**
Total Building Cost		**$247.00**	**$39,026,500**

Appendix C: RS Means Assembly Estimate For Major Components



Assembly Detail Report

Year 2010 Quarter 3

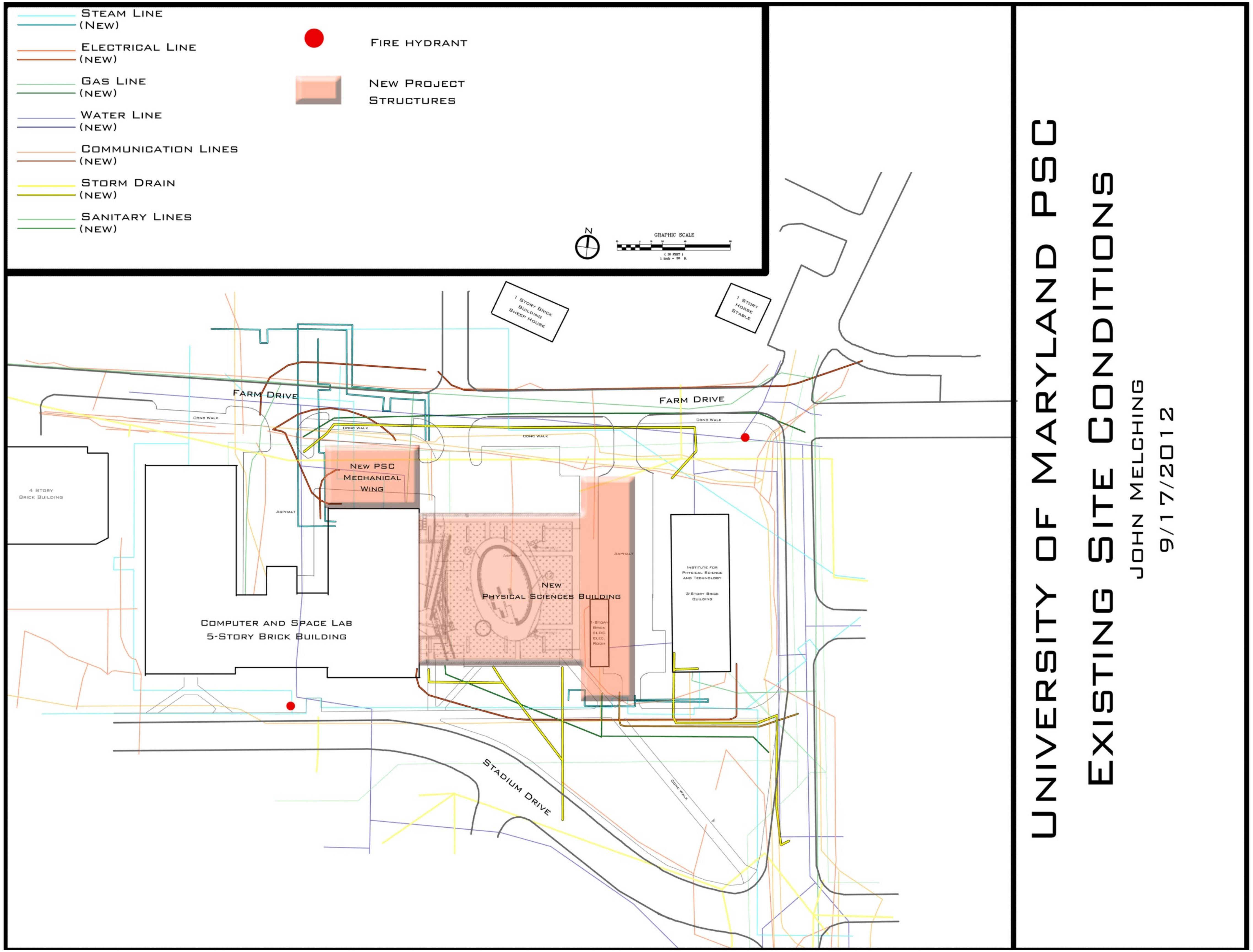
Date: 22-Sep-12

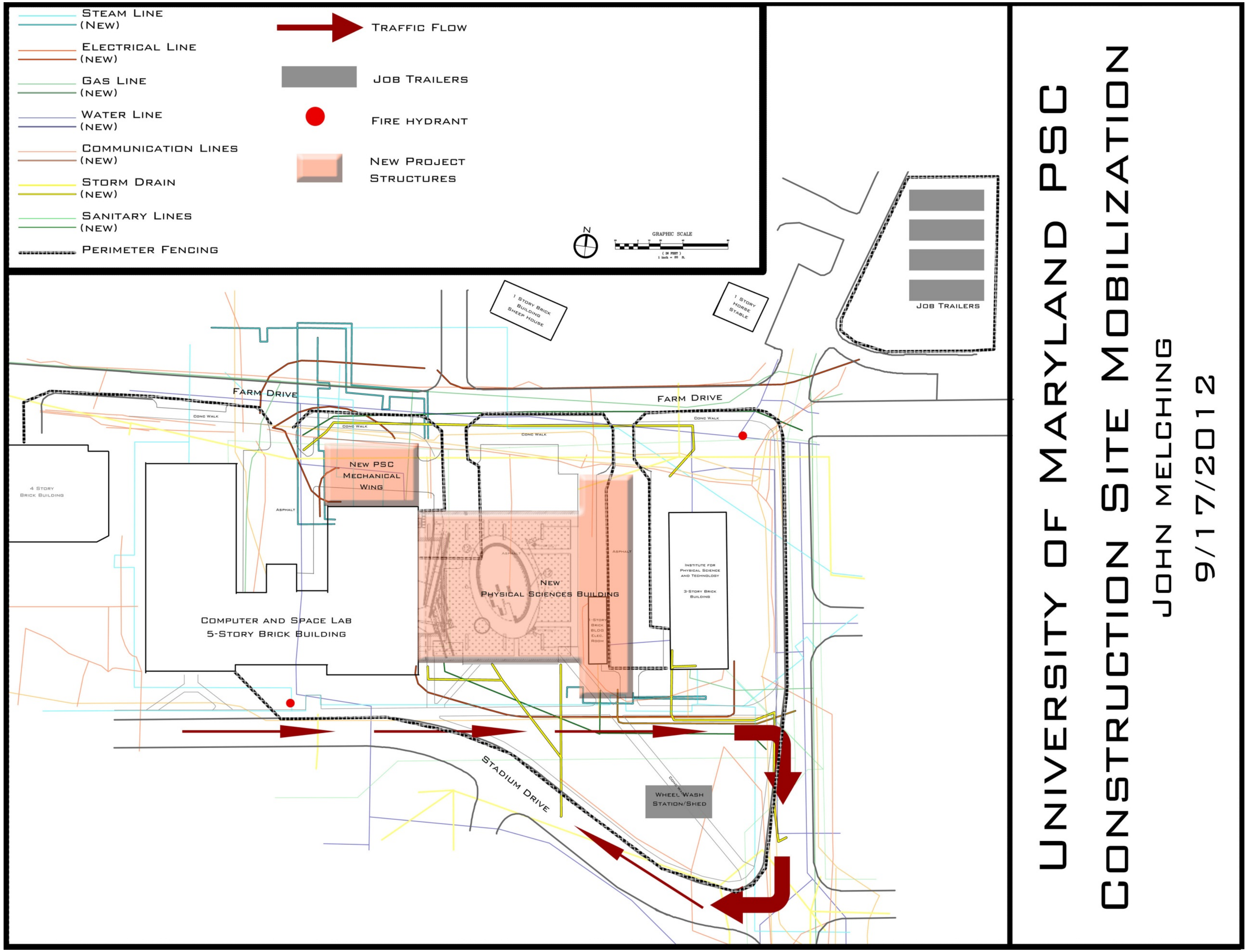
PSC - Assemblies

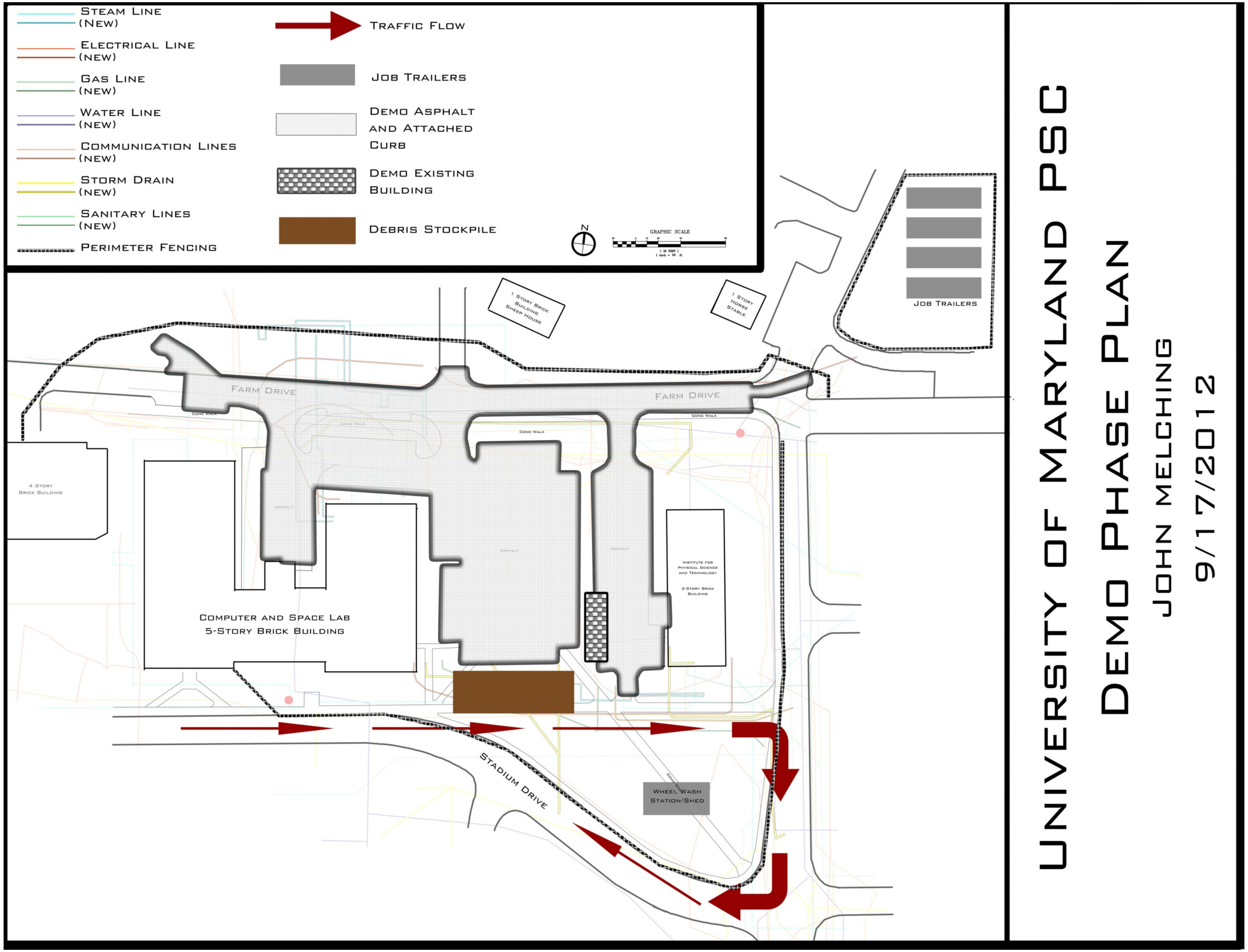
Prepared By:
John Melching
AmArch Inc

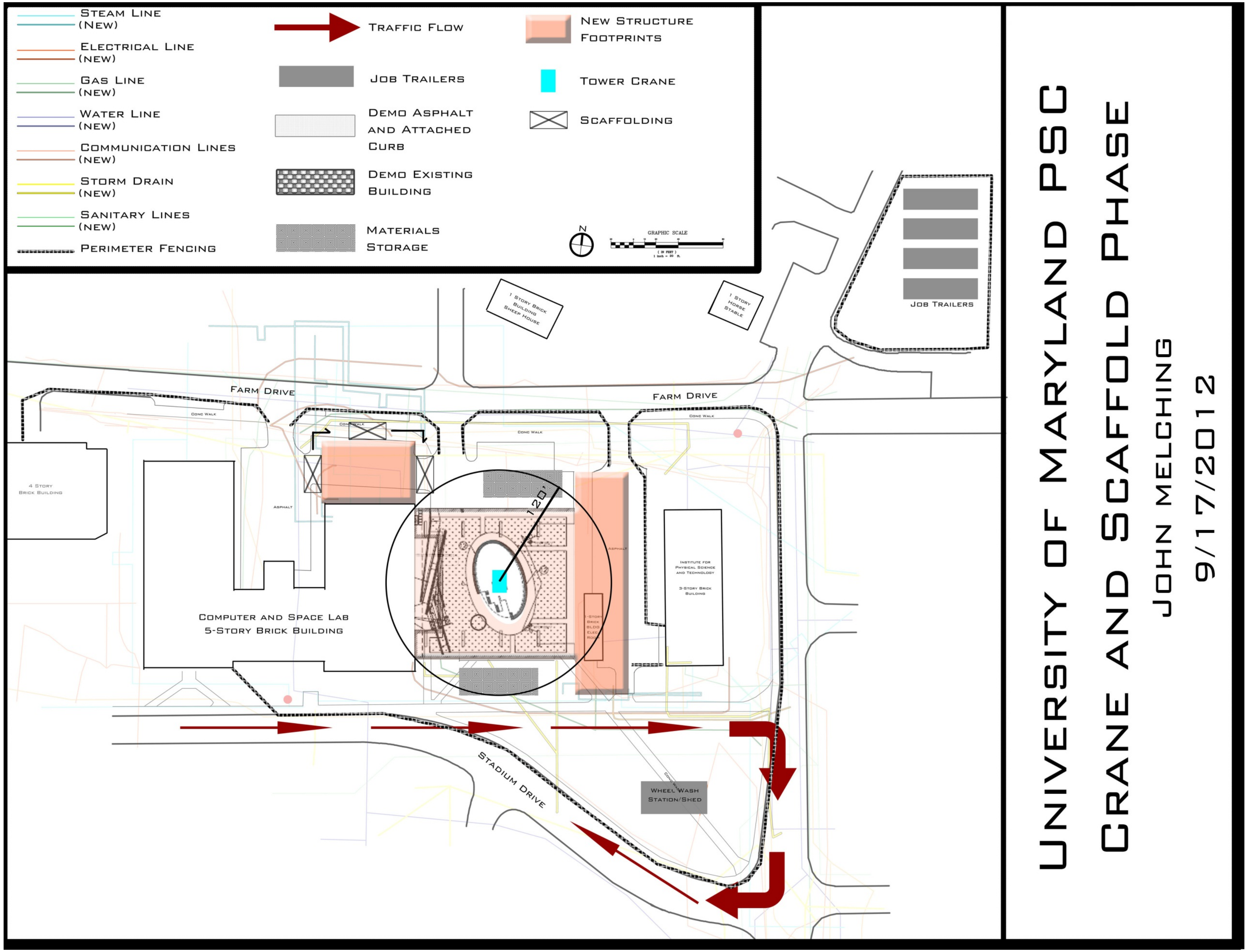
Assembly Number			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D Services							
D20202402020			Electric water heater, commercial, 100< F rise, 200 gal, 120 KW 490 GPH	6.00	Ea.	$31,264.65	$187,587.90
D30203301030			Pump, base mounted with motor, end-suction, 4" size, 7-1/2 HP, to 350 GPM	4.00	Ea.	$16,884.65	$67,538.60
D30203301040			Pump, base mounted with motor, end-suction, 5" size, 15 HP, to 1000 GPM	5.00	Ea.	$23,943.05	$119,715.25
D30203401020			Pump, base mounted with motor, double suction, 8" size, 75 HP, to 2500 GPM	4.00	Ea.	$50,034.20	$200,136.80
D30203401040			Pump, base mounted with motor, double suction, 10" size, 150 HP, to 4000 GPM	4.00	Ea.	$93,981.50	$375,926.00
D30301154600			Packaged chiller, water cooled, with fan coil unit, schools and colleges, 60,000 SF, 230.00 ton	8.00	S.F.	$12.31	$98.48
D30301401030			Chiller, centrifugal, water cooled, packaged hermetic, standard controls, 1000 ton	2.00	Ea.	$530,007.50	$1,060,015.00
D30401161040			AHU, rooftop, cool/heat coils, VAV, filters, 20,000 CFM	7.00	Ea.	$146,565.00	$1,025,955.00
D30401341040			VAV terminal, cooling, hot water reheat, with actuator / controls, 800 CFM	220.00	Ea.	$6,259.80	$1,377,156.00
D30406101040			Plate heat exchanger, 1800 GPM	3.00	Ea.	$178,100.00	$534,300.00
D50102400280			Switchgear installation, incl switchboard, panels & circuit breaker, 800 A	1.00	Ea.	$24,690.80	$24,690.80
D50102400400			Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A	2.00	Ea.	$55,356.10	$110,712.20
D50902101200			Generator sets, w/battery, charger, muffler and transfer switch, diesel engine with fuel tank, 750 kW	2.00	kW	$275.35	$550.70
D Services Subtotal							**$5,084,382.73**
E Equipment & Furnishings							
E10301100120			Architectural equipment, auto equipment, compressors, electric, 5 HP, dual controls	1.00	Ea.	$3,684.68	$3,684.68
E Equipment & Furnishings Su							**$3,684.68**

Appendix D: Existing Conditions and Construction Plans


Steam Line (New)
Electrical Line (New)
Gas Line (New)
Water Line (New)
Communication Lines (New)
Storm Drain (New)
Sanitary Lines (New)
Fire Hydrant
New Project Structures
N
Graphic Scale
Farm Drive
Farm Drive
Stadium Drive
1 Story Brick Building Sheep House
1 Story Horse Stable
4 Story Brick Building
New PSC Mechanical Wing
Computer and Space Lab 5-Story Brick Building
New Physical Sciences Building
Institute for Physical Science and Technology 3-Story Brick Building
Asphalt
Conc Walk
University of Maryland PSC
Existing Site Conditions
John Melching
9/17/2012


Steam Line (New)
Electrical Line (New)
Gas Line (New)
Water Line (New)
Communication Lines (New)
Storm Drain (New)
Sanitary Lines (New)
Perimeter Fencing
Traffic Flow
Job Trailers
Fire Hydrant
New Project Structures
N
GRAPHIC SCALE
1 Story Brick Building Sheep House
1 Story Horse Stable
Job Trailers
Farm Drive
Farm Drive
Conc Walk
4 Story Brick Building
New PSC Mechanical Wing
Asphalt
Computer and Space Lab 5-Story Brick Building
New Physical Sciences Building
Institute for Physical Science and Technology 3-Story Brick Building
Stadium Drive
Wheel Wash Station/Shed
University of Maryland PSC
Construction Site Mobilization
John Melching
9/17/2012


Steam Line (New)
Electrical Line (New)
Gas Line (New)
Water Line (New)
Communication Lines (New)
Storm Drain (New)
Sanitary Lines (New)
Perimeter Fencing
Traffic Flow
Job Trailers
Demo Asphalt and Attached Curb
Demo Existing Building
Debris Stockpile
N
GRAPHIC SCALE
20
0
10
20
40
80
(IN FEET)
1 inch = 20 ft.
1 Story Brick Building Sheep House
1 Story Horse Stable
Job Trailers
Farm Drive
Farm Drive
Conc Walk
Conc Walk
Conc Walk
Asphalt
Asphalt
Asphalt
4 Story Brick Building
Computer and Space Lab 5-Story Brick Building
Institute for Physical Science and Technology
3-Story Brick Building
Stadium Drive
Wheel Wash Station/Shed
University of Maryland PSC
Demo Phase Plan
John Melching
9/17/2012


Steam Line (New)
Electrical Line (New)
Gas Line (New)
Water Line (New)
Communication Lines (New)
Storm Drain (New)
Sanitary Lines (New)
Perimeter Fencing
Traffic Flow
Job Trailers
Demo Asphalt and Attached Curb
Demo Existing Building
Materials Storage
New Structure Footprints
Tower Crane
Scaffolding
N
GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.
1 Story Brick Building Sheep House
1 Story Horse Stable
Job Trailers
Farm Drive
Farm Drive
Conc Walk
4 Story Brick Building
Asphalt
120'
Computer and Space Lab
5-Story Brick Building
Institute for Physical Science and Technology
3-Story Brick Building
Wheel Wash Station/Shed
Stadium Drive
University of Maryland PSC
Crane and Scaffold Phase
John Melching
9/17/2012