TECHNICAL REPORT I

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Construction Management

Advisor – Ray Sowers

Cardinal Wuerl North Catholic High School

Cranberry Township, PA

Monday, September 16th, 2013

Executive Summary

Client Information

The owner of Cardinal Wuerl North Catholic High School is the Catholic Diocese of Pittsburgh. Their Chief Facilities Officer, Mike Arnold, functions as the owner representative between the architects/engineers, CM, and prime contractors. After a considerable amount of time in the construction industry of Pittsburgh, Mike joined the Diocese in 2011 and oversees the maintenance of 1,000 buildings in the area.

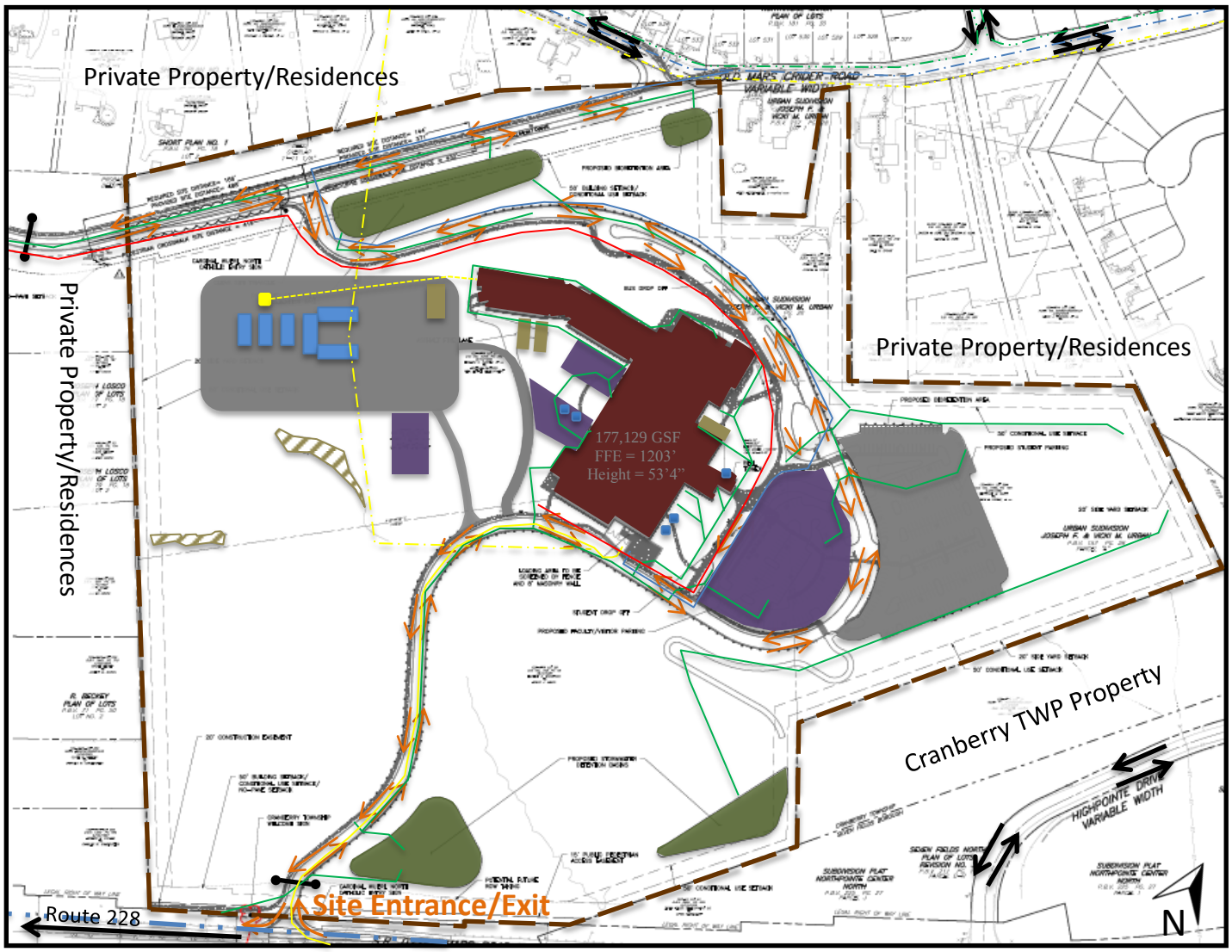
The primary reason for constructing a new school north of Pittsburgh was population growth in Cranberry Township. More and more students from Cranberry were enrolling at the original High School while enrollment in the current region had been steadily dropping for years. North Catholic High School was also becoming old & outdated, so the Diocese decided to move the school after years of planning and fundraising. The overall expectations for the project are as follows:

- *Cost* - $72,525,969.
- *Schedule* – Base building to be completed by Jan 31st, 2014. chapel to be completed by May 30th, 2014. The owner has accepted the schedule and expects the key structural, building envelope, and finishing sequences to be executed. At the current point in the project, the team is having issues with offsite road improvements due to resistance from neighbors (private residences).
- *QA/QC* – typical procedures are to be followed. Quality awards and extensive discussions at weekly job conferences are common.
- *Safety* – all contractors are to have a safety first culture and have an expectation of zero accidents (none yet). Safety is also stressed with quarterly corporate safety summits/jobsite walkthroughs.

Existing Conditions Site Plans & Local Conditions

Much of the existing conditions logistics issues were due to land acquisition from longtime land/home owners, removal of a house & debris from other demolished buildings, extensive tree removal & grading, wetlands mitigation and the removal of one overhead electrical wire. After receiving the Notice to Proceed on June 4th, 2012, three months of wetland mitigation, tree removal and grading delayed the turnover of the building pad to general contractor until September 1st, 2012. Two main problems were encountered in the subsurface investigation of the site. “Redbed” materials were commonplace and are dangerous naturally since they are prone to landslides and have a very low internal strength. In areas where this soil will affect the building pad or road conditions, it was over-excavated and filled with engineered soil. The condition of this soil also required temporary excavation safety such as temporary shoring and excavation rigging. Also, some groundwater was found throughout the site. The source of the water could be from some observable seeps, small streams and wet areas. These areas required extensive use of subsurface drainage measures such as rockfill drains.

Like most sites, the site went through various logistical changes throughout the project. For example, due to sequencing complications with the site contractor, material laydown areas and site entrance/exits changed several times. For about 12 months, the entrance/exit was located at Route 228. Once the site contractor began to finish that road, the entrance/exit changed from Route 228, to Hillmont Drive. Construction parking was readily available due to the vast amount of land the high school owned. Site security became an issue in the summer of 2013 after several thefts were reported on copper piping, saws, tools/equipment, etc. In addition to the locked gates at each entrance, a site security guard was added for all times out of regular work hours. The following construction phase site plan shows existing/temporary/new utility lines, material laydown areas, temporary facilities & parking, dumpsters, the building footprint, site traffic direction, and other useful information regarding navigating the site:



- Material Laydown
- Temporary Roads/Parking
- Temp. Offices
- Dumpsters
- Wetlands
- Stormwater Mgmt.
- Building Footprint
- Water Line
- Gas Line
- U/G Elec. Line
- Storm Line
- Existing Gas
- Existing Storm
- Existing Elec.
- Temp. Elec.
- Property Line
- Temp. Toilets
- Temp. Transformer
- Site Gate

Figure 1: Construction Site Plan (Property of Alec Hanley with approval to use CEC Drawing)

Building Systems Summary

BUILDING SYSTEMS SUMMARY			
Yes	No	Scope of Work	Description
X		Demolition	Removal of existing home
X		Structural Steel Frame	W10, W12, HSS columns; Moment bracing
X		Cast-In-Place Concrete	Foundations, SOG, SOD, traditional forms
	X	Precast Concrete	-
X		Mechanical System	VAV, chillers, AHUs, Nat. Gas Heating
X		Electrical System	3000 A MSWB, 71 Panelboards, emergency power
X		Masonry	Brick Veneer & some struct. CMU
	X	Curtain Wall	-
X		Support of Excavation	Shoring due to groundwater & redbed soil

Figure 2: CWNCHS Building Systems Summary Matrix

Construction – Cardinal Wuerl North Catholic High School is being delivered as a traditional design-bid-build project. Although construction experts were called in early in the design phases which created a hybrid Integrated Project Delivery environment. The owner chose a multiple prime (GC lead) with CM agency project structure based on his past experience with this delivery method. BIM is planned to be used on this project from the preconstruction phases all the way through the life of the building by the use of a facilities management model. Earthwork and site clearing were the focuses of construction early on in the project. The extensive tree clearing and excavating that needed to occur drove the project during Summer 2012. Temporary excavation support (shoring & rigging) was needed during excavation due to reported groundwater and the possibility of landslide due to excessive redbed soil. Onsite roadwork and earthwork changed caused for a change in entrance/exit several times. Parking was always available but material laydown areas and interior access points evolved on several instances also. Finally, the second floor in Area G was delivered as a core & shell package due to lack of enrollment to fill the extra space.

Structural Steel Frame – the primary structure of CWNCHS is its steel frame. By utilizing a system of W10, W12 & various HSS columns, the building reaches vertically and is either covered by a composite slab in a few areas or TPO/standing seam metal roofing. The frame utilizes shear walls in the stairways and elevator shafts as well as moment connections on beams throughout the structure for lateral strength. Mobile cranes were used since a lot of horizontal distance needed to be covered during the erection phase. Two mobile boom & jib cranes navigated the perimeter for 1.5 months in order to put the steel skeleton in place.

Cast-In-Place Concrete – perhaps the biggest undertaking on CWNCHS was the cast-in-place concrete. It took approximately 9 months to complete from the first pour in November 2012 to the last in August 2013. Since most of the school is on one level, a majority of the concrete flooring was poured on grade at 1203'0". Mascaro self performed all concrete which included footers, retaining walls, slab-on-grade, slab-on-deck, cast-in-place stairs, prefabricated steel pan stair cast-in-place concrete, etc. Where it was necessary, the primary formwork used was lumber. In a lot of places it was not needed due to the two courses of CMU on the footers, which shaped the outer edge of the cast-in-place slab on grade. Power buggies were used for all 1st level concrete placement while a concrete pump truck was necessary for composite slab-on-deck pours at higher elevations.

Mechanical System - Cardinal Wuerl North Catholic High School is cooled by eleven VAV rooftop air-handling units, two fan coil units, and thirteen split system air conditioners. The primary method of cooling the spaces throughout the building is by providing chilled water to the AHUs, utilizing the chilled water coil in the unit, and delivering conditioned air through overhead ducts at traditional grille, register & diffuser terminals. The aforementioned air-handlers range in size from 10-HP to 40-HP and serve the library, music suite, lower level, administration areas, athletic suite, academic wings, auditorium & gymnasium. All chilled water to these units is returned to the three B&G 1510 36 Model chilled water pumps located in Room A006 (MEP) and are rated at 450 GPM (25-HP; one of these CHWPs must be on standby at all times). From here, the 30% propylene glycol chilled water passes through a glycol fill station and recirculate through one of the two 350-ton chillers in the mechanical yard on the south side of the building. The majority of the chilled water supply feeds the rooftop AHUs but a small portion is delivered to the two fan-coil units for the purposes of providing conditioned air to the academic wing stairwells. Aside from the water-to-air system described, thirteen split system air conditioners are installed at roof level to serve MEP/MDF/machine rooms on lower level A, electrical/IDF rooms through Areas B, E, & F, and the auxiliary/storage rooms (D103/D104) in the auditorium. The SSACs used in CWNCHS supply either 240, 345, or 640 CFM and are necessary to provide constant volume air conditioning to these critical spaces.

The rooftop air-handling units also provide heated air through means of natural gas and deliver conditioned air through overhead ducts at traditional grille, register & diffuser terminals. The natural gas service enters North Catholic at the south end of the building in the chiller yard from a 3" pipe at 2-psig/8,702 cfh. The service feeds the ten air handling units and the three water heaters through branch piping from this single entrance. The natural gas is used as fuel for the AHU's at a max gas inlet pressure of 14

in-wg in each unit and the natural gas burner shall be fully modulating with a minimum turndown ratio of 10:1. Mechanical space is designated in the southeast corner of Area A.

The fire protection system enters at the mechanical yard (4” pipe) and splits off into 6 different branches to feed the entire building. This active fire protection system also utilizes CMU fire walls for extra protection.

Electrical System – the underground electrical utility service enters the building at the south side in the mechanical yard into the utility transformer. The primary service power then travels to an exterior current trasnformer cabinet and inside the building to the main switchboard (3,000 Amps). Power is distributed from here to the 41-208/120V & 30-480/277V panelboards. EMT conduit runs the length of the building from here, feeding power to the entire complex. Classrooms utilize pendant linear fluorescent lighting while the auditorium utilized 6” pendant LED downlights. There is also a diesel generator in the mechanical yard of the building which serves emergency power and has an optional standby power. Branch electrical and IDF rooms are located in many areas throughout the school. The main electrical rooms are located in the southeast corner of lower Level A.

Masonry – CMUs were used to construct shear walls in the staircases & elevators. They were also used in areas such as the locker rooms, kitchen, MEP rooms etc. as the finished wall material. A brick veneer is used on almost 65% of the exterior. Traditional scaffolding was used on most elevations other than the Area E north elevation. A hydraulic scaffolding lift was used here since it was the largest & simplest scope of brick veneer work for efficiency’s sake.

Support of Excavation – metioned in construction systems above.

Project Delivery Method

Cardinal Wuerl North Catholic High School is considered a design-bid-build project but according to the owner, the Diocese used a hybrid delivery method that incorporated aspects of Integrated Project Delivery while competitively bidding prequalified bidders. Due to his own experience with a variety of delivery systems, Mike Arnold chose the multiple prime, general contractor lead w/ CM Agency structure. He has a wealth of experience in the Pittsburgh area and was selective based on past project performance quality and professionalism.

The general contractor was selected based on qualifications, staff & fee structure. Their responsibility as the lead prime on the project was to ensure maintenance of the schedule. As of this moment, Cardinal Wuerl North Catholic High School is scheduled to be complete on time.

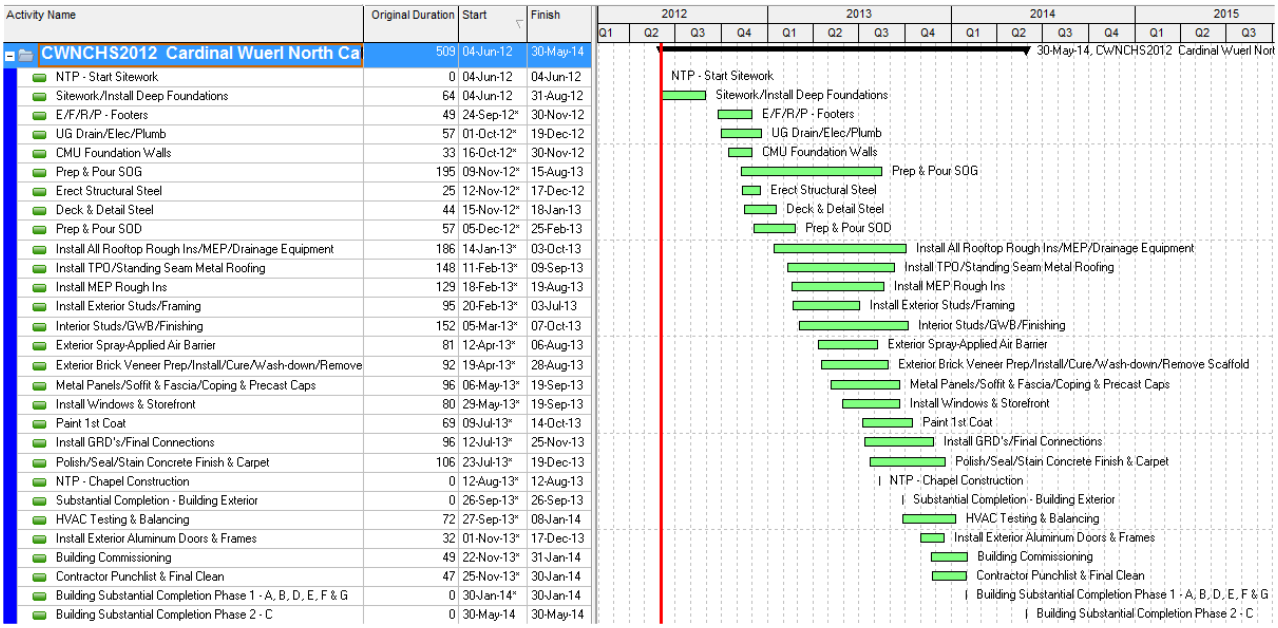
GMP contracts are in use between the Diocese-architect, Diocese-CM & Diocese-primes. The contracts being utilized (A132-2009. A232-2009 & B132-2009) are in place to ensure that the CM is on the team solely for advising and quality control. Mascaro Construction has lump sum contracts with all of their subcontractors, such as, Cost, D-M, Phoenix Roofing, RAM & SS&E.

Staffing Plan

The GC/CM have representatives onsite 5 days/week. Jesse Campayno (CM) can speak directly with Mascaro's VP of Building Operations, Ron Cortes, if necessary, but he will typically communicate with Jon Machen or John West when Mr. West is at the jobsite. Jesse Campayno's foreman Dan Doyle is onsite full time and is in charge of day-to-day QA/QC operations.

Jon Machen is the onsite Project Manager who delegates to the superintendent Tim Hanna, the two project engineers (Nick Depperman & Billy Charles), the administrators (Melanie West & Michelle McCrea), and the BIM/Cost Control departments of Mascaro's corporate office when necessary. Tim Hanna delegates to Mascaro's subcontractors and his two foremen, Paul Hess & Danny Long. They are in charge of all carpentry, general labor & cast-in-place concrete.

Project Schedule Summary



Activity Name	Original Duration	Start	Finish
CWNCHS2012 Cardinal Wuerl North Ca	509	04-Jun-12	30-May-14
NTP - Start Sitework	0	04-Jun-12	04-Jun-12
Sitework/Install Deep Foundations	64	04-Jun-12	31-Aug-12
E/F/R/P - Footers	49	24-Sep-12*	30-Nov-12
UG Drain/Elec/Plumb	57	01-Oct-12*	19-Dec-12
CMU Foundation Walls	33	16-Oct-12*	30-Nov-12
Prep & Pour SOG	195	09-Nov-12*	15-Aug-13
Erect Structural Steel	25	12-Nov-12*	17-Dec-12
Deck & Detail Steel	44	15-Nov-12*	18-Jan-13
Prep & Pour SOD	57	05-Dec-12*	25-Feb-13
Install All Rooftop Rough Ins/MEP/Drainage Equipment	186	14-Jan-13*	03-Oct-13
Install TPO/Standing Seam Metal Roofing	148	11-Feb-13*	09-Sep-13
Install MEP Rough Ins	129	18-Feb-13*	19-Aug-13
Install Exterior Studs/Framing	95	20-Feb-13*	03-Jul-13
Interior Studs/GWB/Finishing	152	05-Mar-13*	07-Oct-13
Exterior Spray-Applied Air Barrier	81	12-Apr-13*	06-Aug-13
Exterior Brick Veneer Prep/Install/Cure/Wash-down/Remove	92	19-Apr-13*	28-Aug-13
Metal Panels/Soffit & Fascia/Coping & Precast Caps	96	06-May-13*	19-Sep-13
Install Windows & Storefront	80	29-May-13*	19-Sep-13
Paint 1st Coat	69	09-Jul-13*	14-Oct-13
Install GRD's/Final Connections	96	12-Jul-13*	25-Nov-13
Polish/Seal/Stain Concrete Finish & Carpet	106	23-Jul-13*	19-Dec-13
NTP - Chapel Construction	0	12-Aug-13*	12-Aug-13
Substantial Completion - Building Exterior	0	26-Sep-13*	26-Sep-13
HVAC Testing & Balancing	72	27-Sep-13*	08-Jan-14
Install Exterior Aluminum Doors & Frames	32	01-Nov-13*	17-Dec-13
Building Commissioning	49	22-Nov-13*	31-Jan-14
Contractor Punchlist & Final Clean	47	25-Nov-13*	30-Jan-14
Building Substantial Completion Phase 1 - A, B, D, E, F & G	0	30-Jan-14*	30-Jan-14
Building Substantial Completion Phase 2 - C	0	30-May-14	30-May-14

Figure 3: CWNCHS Summary Schedule (Property of Alec Hanley)

CWNCHSs site was turned over to Allegheny Excavating, INC. on June 4th, 2012 in order to begin earthwork. Due to the addition of a several caissons, the building pad turnover to the GC was delayed one month. Regardless of the late start, foundation work began on 9/24/2012 and did so in a very quick fashion. The month that was lost from the original schedule was completely recovered by June 2013.

Completion of superstructure frame & detailing took slightly over 2 months and made way for roof/building enclosure work. The building exterior is slotted to finish at the end of September 2013, giving the project team 4 months to finish the building interior.

Perhaps the most critical scheduling item outside of the late start was the late design & construction of the chapel. This design had been in the original plan but the funds for it were not available until the beginning of Summer 2013. Once they were available, Astorino went into the design phase and prepared 100% completed drawings by mid-July. One month later Mascaro broke ground on August 12th, 2013. While the main building is scheduled to finish on track or ahead of schedule (1/31/14), the chapel will be completed by May 30th, 2014.

Project Cost Evaluation

ACTUAL BUILDING COSTS		
	Construction Cost	**Cost/SF**
Actual Building Construction Costs (CC)	$43,027,573.00	$242.92
Total Project Cost (TC)	$72,525,969.00	$13.91
MEP/FP Systems Total Cost	$8,860,010.00	$49.99
Structural Systems Cost	$6,017,485.00	$33.97

Figure 4: Actual Building Construction Costs

Square Foot Estimate	
Appraisal Information	
Gross Floor Area	177,129
Perimeter	3,136'
Story Height A-Low/High Roof, B, F/G-2 stories	15'0"
Story Height D-Stage	53'8"
Story Height D-Low Roof	12'8"
Story Height A-Gym, D-Auditorium	35'0"
Story Height E	22'0"
Average Story Height (based on perimeter LF)	20'1"
Exterior Wall Construction Chosen	Face Brick w/ Block Back-up
Frame	Steel
Estimate Breakdown	
Interpolated Construction Cost	$162.92/SF
Perimeter Adjustment	$1.09/100 LF(354 LF) = $3.86/SF additional
Story Height Adjustment	$1.83/ft(8.083 ft) = $14.80/SF additional
Adjusted Base Cost/SF	$181.58/SF
Building Estimate	
Building Cost Estimate	$181.58/SF*177,29 SF = $32,163,083.82
Common Additives	
Auditorium Seating, Veneer back w/ padded seat	$335/seat*1,000 seats = $335,000
Classroom Seating, movable chair & desk	$171/set*20 sets/class*27 classrooms = $92,340
Sound System, Amplifier	$1,975/each*100~ = $197,500
Lockers, single tier	$355/opening*1,100 = $390,500
Kitchen Equipment	$20,000
Bleachers, telescoping to 15 tier	$187/seat*1,500 seats = $280,500
Clock System	$28,000
Elevators	$68,900/each*2 elevators = $137,800
Total Additives	$1,481,640
Final Total Cost	**$33,644,723.82**

Figure 5: CWNCHS Square Foot Estimate

The actual building construction costs and CC/SF are reported (excluding sitework, site acquisition/permitting, etc.) as $43,027,573.00 and $242.92/SF respectively. This is based around the building GSF of 177,129. Total project cost is reported at $72,525,969.00,

$13.91/SF. The large drop in cost/SF can be attributed the extent of land that was acquired (71 acres).

At the request of the owner, the MEP/FP system costs are not listed individually, but the combined cost is $8,860,010.00 and $49.99/SF. The structural system cost was reported from the GC as $6,017,485.00 and $33.97.

The square foot estimate was produced by the following parameters and RS Means figures:

- 177,129 GSF
- 20'1" average story height (average of CWNCHS heights compared to % of perimeter; RS Means average = 12')
- 3,136' perimeter (RS Means interpolated value = 2,782')

The CC/SF cost given by RS Means for face brick w/ concrete block back up (no exterior studs/sheathing provided) at the interpolated value for 177,129 GSF is $162,92/SF. After using their provided formulas for adjustments, it was shown that the final CC/SF was $181.58/SF. Additives such as telescoping bleachers, clock system, elevators, flagpoles, kitchen equipment, lockers, auditorium/classroom seating & sound system were added in an attempt to get the estimate figure closer to the actual building construction cost.

The $9 million difference in price between the estimate and the actual number can be attributed to a lot of ideas. First of all, the building pad and perimeter of this building are very large in comparison to other schools that RS Means would evaluate. It is also a private school, which tend to be more expensive. CWNCHS did not always take the low bidder either. Also, RS Means did not provide the proper wall construction. Finally, there wasn't much repetitive work that occurred which most likely drove down production rates and drove costs up & MEP costs were very high due to the length their branches needed to travel from the southeast corner of the building.