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CM Option
BCDC Expansion
Towson, Maryland
Consultant: D. Riley

I. Executive Summary

The following report contains detailed information regarding alternative systems and methods for the construction of the BCDC Expansion project. Included within this report are construction site logistics, temporary utilities, a detailed structural estimate, a general conditions estimate, a detailed project schedule and a cash flow curve.

The site layout for construction was broken down into four phases; excavation, foundation/garage construction, housing/administration construction and the finished phase. Each of these phases required changes in the site layout to maximize productivity and eliminate field conflicts.

Electrical and heating are two of the temporary utilities required for the construction of the BCDC Expansion. The structure will need to have electrical power for the tower crane and for the temporary lighting requirements. Heating systems are required to heat the areas of concrete pours to the required 50°C.

A detailed structural estimate was created within this report for an overall total of $8,757,223. This value was calculated by dividing the estimate into three categories; C.I.P. concrete, pre-cast concrete and structural steel. All unit prices for the structural estimate was gathered from R.S. Means 2004 and construction professionals.

The estimated general conditions cost for the three year BCDC project was $1,189,414. The general conditions cost for the construction manager is covered by the County. Monthly the County will pay approximately $50,539. All other GC cost were incorporated within the bids of each of the contractors.

Each of the estimates as well as the cash flow curve were based on the dates that were determined in the detailed schedule. The project started in March 2002 and should be completed in April 2005. These dates include all design, preconstruction, value engineering delays and construction activities.

The cash flow curve was also formulated to provide the owner with the estimated cost per month. The cost was relatively level for the entire project with a peak at the beginning of the project for the first three bid packages and at the end for retention payback. The typical monthly cost for the project was between $1,000,000 and $3,000,000.

II. Site Layout Planning

This section shows the phased construction of the BCDC Expansion project during the excavation, superstructure erection and project completion.

Phase 1: Excavation Site Plan

The excavation phase of the BCDC Expansion includes all utility relocation, demolition and excavation work. Below in figure 1 is a brief summarization of the dates in which this phase took place.

Activity	Approximate Start Date	Approximate Finish Date
Utility Relocation	June 10, 2002	August 02, 2002
Demolition	June 10, 2002	June 14, 2002
Excavation	June 07, 2002	September 26, 2002

Figure 1: Summarized Timetable for Excavation Phase

The excavation, foundation and garage portions of this project were fast-tracked for political reasons. The first three bid packages were released and bid in March 2002; several months before the 100% contract document were completed.

Upon completing the demolition and utility relocation of the items shown within the required excavated area of figure 3 the actual excavation began. First soldier piles were driven approximately 20 feet apart around the perimeter of the soon to be excavated area. The excavation was done in five foot increments. Every five feet the lagging system would be installed as the tiebacks were drilled and tensioned. Tiebacks were used for a majority of the retaining system excluding the southeast side of the site where there were existing buildings adjacent and temporary rakers were used. Since three levels of the BCDC are to be below grade the soldier pile and lagging system was engineered to become part of the permanent exterior walls once rebar and shotcrete were applied.

On the right is a photograph looking north of the actual excavation in progress. The overall layout of the site was efficient. There were two mobile cranes in use along with a team of loaders, dozers and backhoes. There was an occasional issue with entering/exiting the site due to the limited entrances/exits but there were no alternatives to improve this condition due to the elevation changes and the heavy traffic on the adjacent streets.

Figure 2: Excavation in progress Dec. 2002

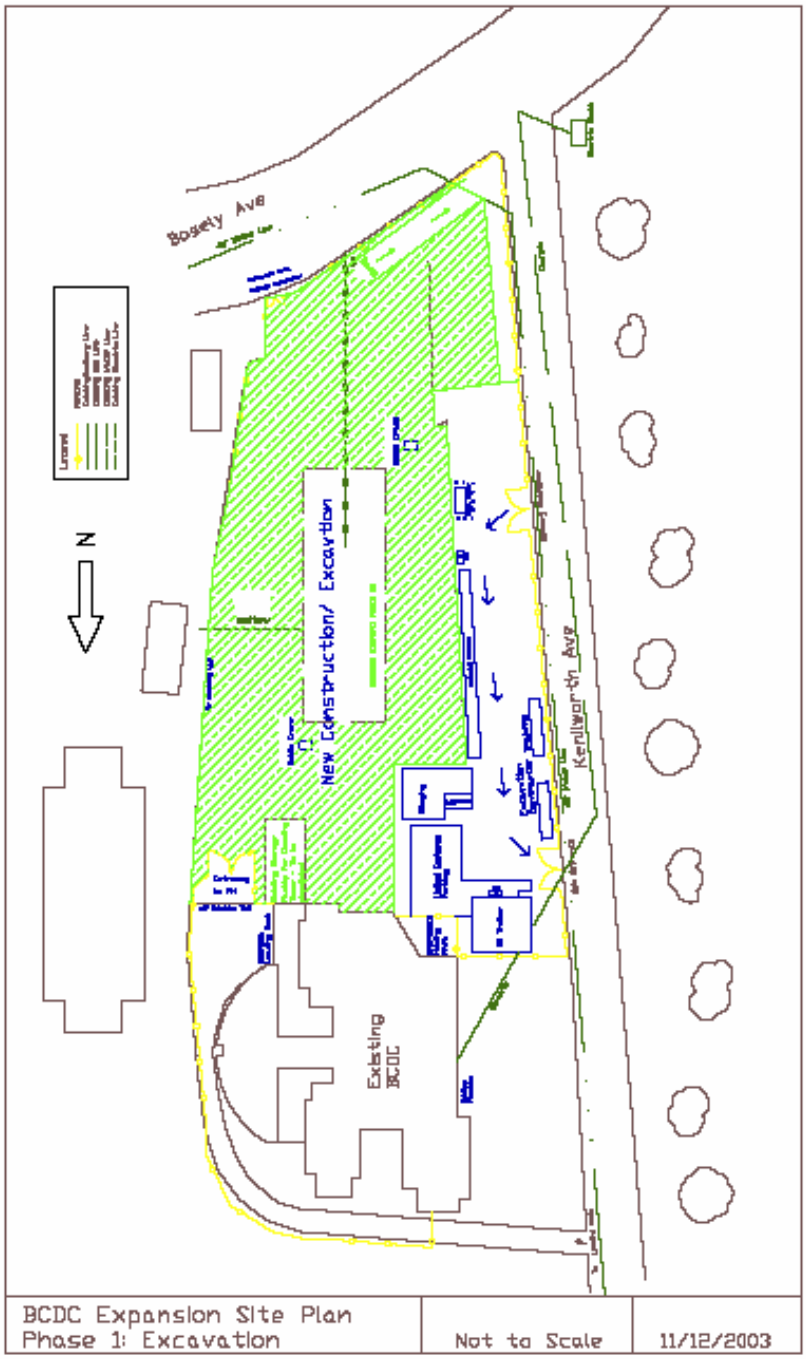

Figure 3: Phase 1 Site Plan (larger PDF file available on webpage)

Phase 2: Foundations & Garage Structure
Once the site work contractor had completed excavation the concrete contractor began pouring the concrete footings. The footings were excavated and poured from the south to the north side of the site. The footings on the south side of the site were poured first so that the garage concrete could be started immediately. The table below in figure 4 shows a timetable of this phase of the project.

Activity	Approximate Start Date	Approximate Finish Date
Foundations	September 20, 2002	October 17, 2002
Garage – Level 1	October 11, 2002	October 24, 2002
Garage – Level 2 & 2M	October 31, 2002	December 25, 2002
Garage – Level 3	December 24, 2002	January 07, 2003

Figure 4: Summarized Timetable for the Foundation/Garage Phase

Once the garage was under construction the project was slowed down by the owner for a value engineering process because several of the bids came in over the estimated value. This phase was also extended due to poor weather; primarily rain and snow.

The garage was divided into six sections for a concrete construction sequence. The sequence is shown on the next page in figure 6. In each section on each level the columns and walls were formed, reinforced and poured. Then the slabs were formed, reinforced and poured. The garage concrete bid package included that all MEP & security work within the garage was to be roughed-in by the concrete contractor. Thus there would be minimal coring issues later in the project.

There were not many problems with this phase of the construction. The concrete contractor was the only contractor on site and had unlimited space for storage and rebar staging. This was also the only activity the crane was being used for thus productivity was at its maximum potential.

Phase 3: Housing & Administration Structures
As the garage neared substantial completion the housing and administration areas began construction. The table in figure 5 shows a summarized timetable of the construction in this phase.

Activity	Approximate Start Date	Approximate Finish Date
C.I.P. Concrete - Housing	February 25, 2003	April 28, 2003
Structural Steel - Admin. Area	May 20, 2003	June 25, 2003
Pre-Cast – Housing Area	May 13, 2003	July 14, 2003

Figure 5: Summarized Timetable for Housing/Admin. Phase

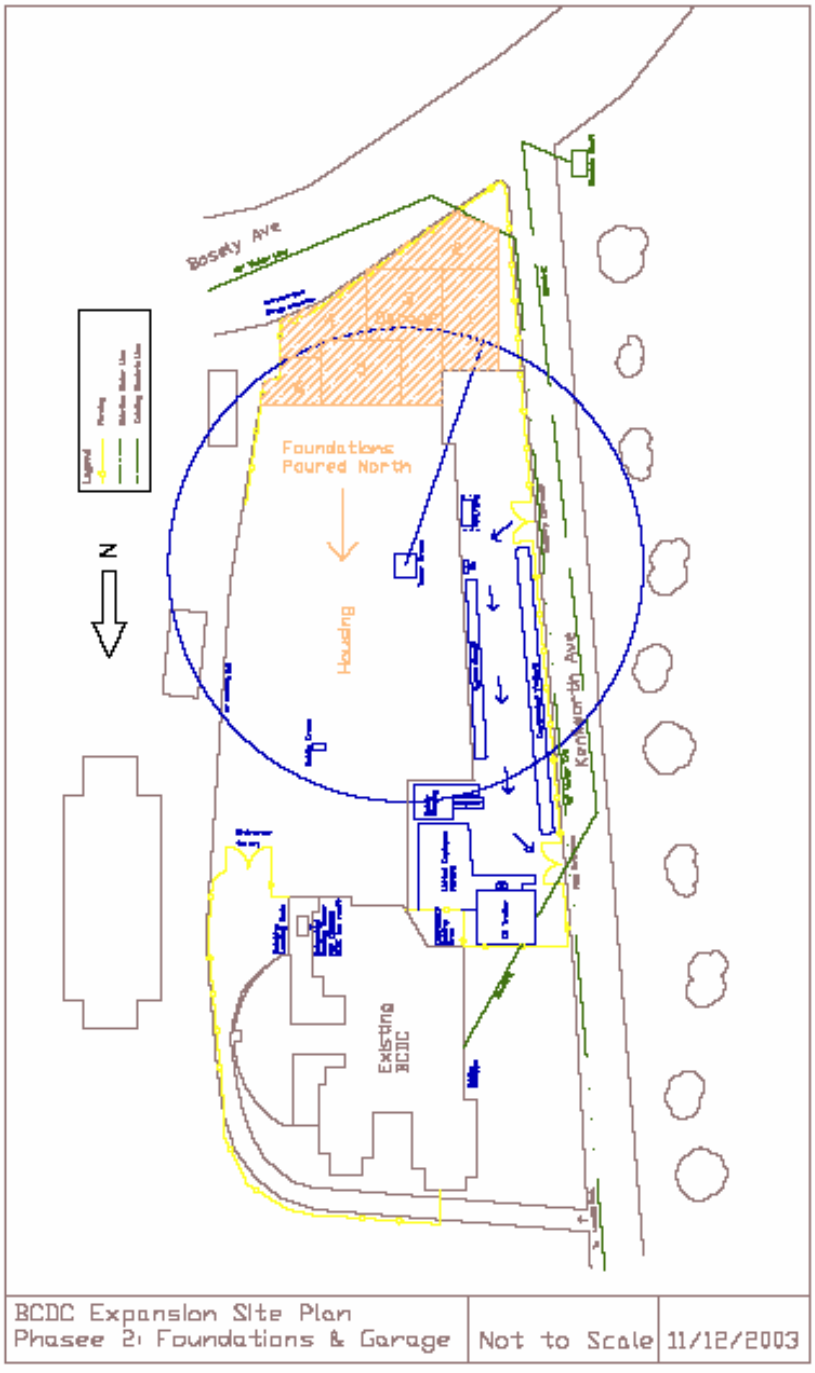

Figure 6: Phase 2 Site Plan (larger PDF file available on webpage)

The first level of the housing area is C.I.P. concrete and the above six levels are pre-cast modular units. Since the concrete contractor was first on site the housing structural sequence was set by the concrete sequence. This sequence is shown on the next page in figure 7. Construction began in the southwest corner and proceeded to the northeast corner of the structure. The tower crane was left in place until the pre-cast erection began at which point the pre-cast contractor provided a different erection method.

The pre-cast concrete modular units were erected at a plant in Telford, PA. The units were delivered to site daily as needed. One problem with this system is that there is to be no construction or deliveries to site before 7:30 a.m. or after 4:30 p.m. If the trucks arrived outside of those times they would have to wait to make the delivery. The County assisted in providing a delivery truck staging area one block away that the trucks could sit and wait to make their delivery.

Another future problem with the pre-cast units onsite will be erection. The limited site space will require a mini-deck crane to place the pre-cast units. Coordination between the concrete contractor and pre-cast contractor will be imperative to ensure the constructability/erectability of the pre-cast units.

The administration area composed of the structural steel was erected from the east to the west using the tower crane. The steel was delivered and staged on top of the finished garage. The steel package is relatively small so erection should proceed without conflict.

Phase 4: Finish Phase Site Plan
The final phase of the project is shown below in figure 8. This layout shows the access to the newly constructed building. This layout was in place for all interior installations. The MEP & security contractors (MEPS) stored all materials in the garage area. The sequence of the MEPS followed the same sequence shown in figure 7. Once demolition and the final clean up occurred the site was accessed regularly as shown in figure 8.

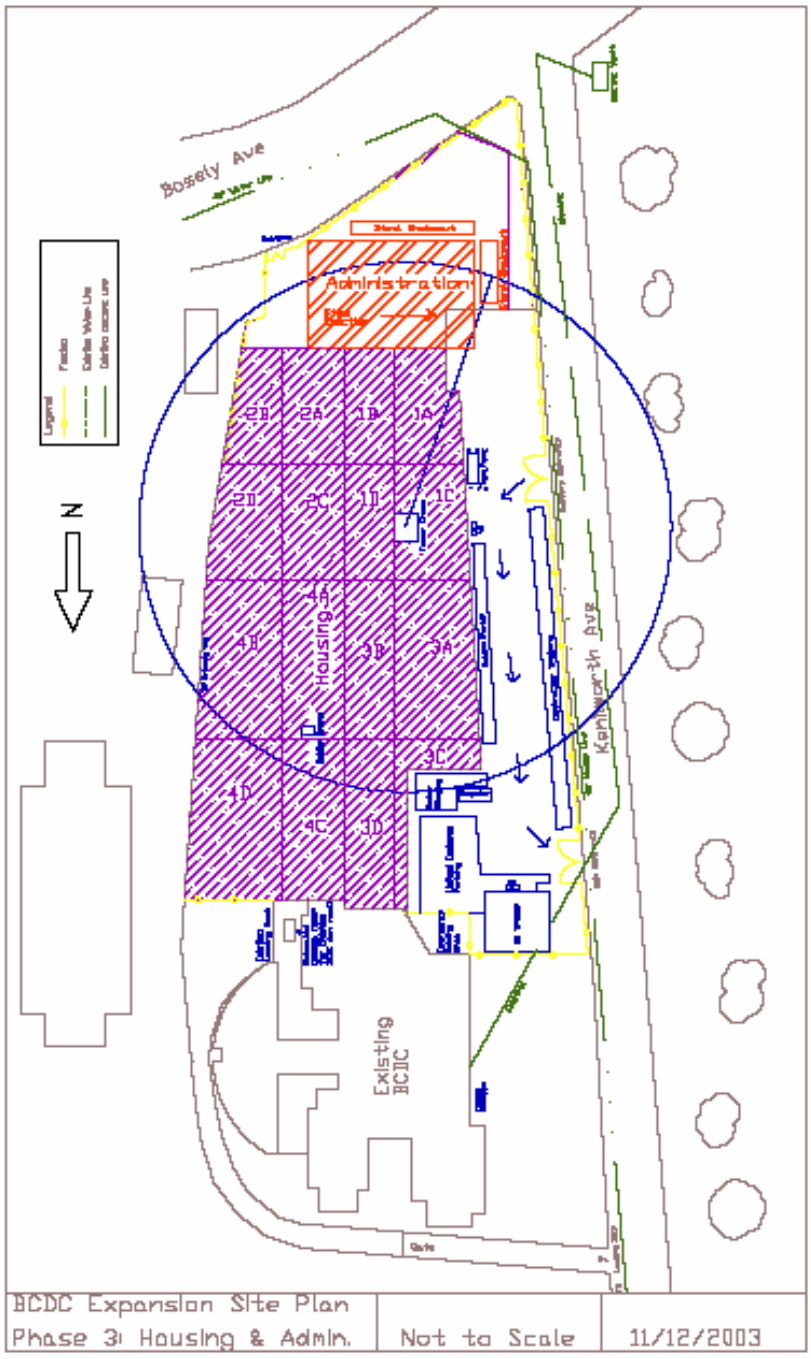

Figure 7: Phase 3 Site Plan (larger PDF file available on webpage)

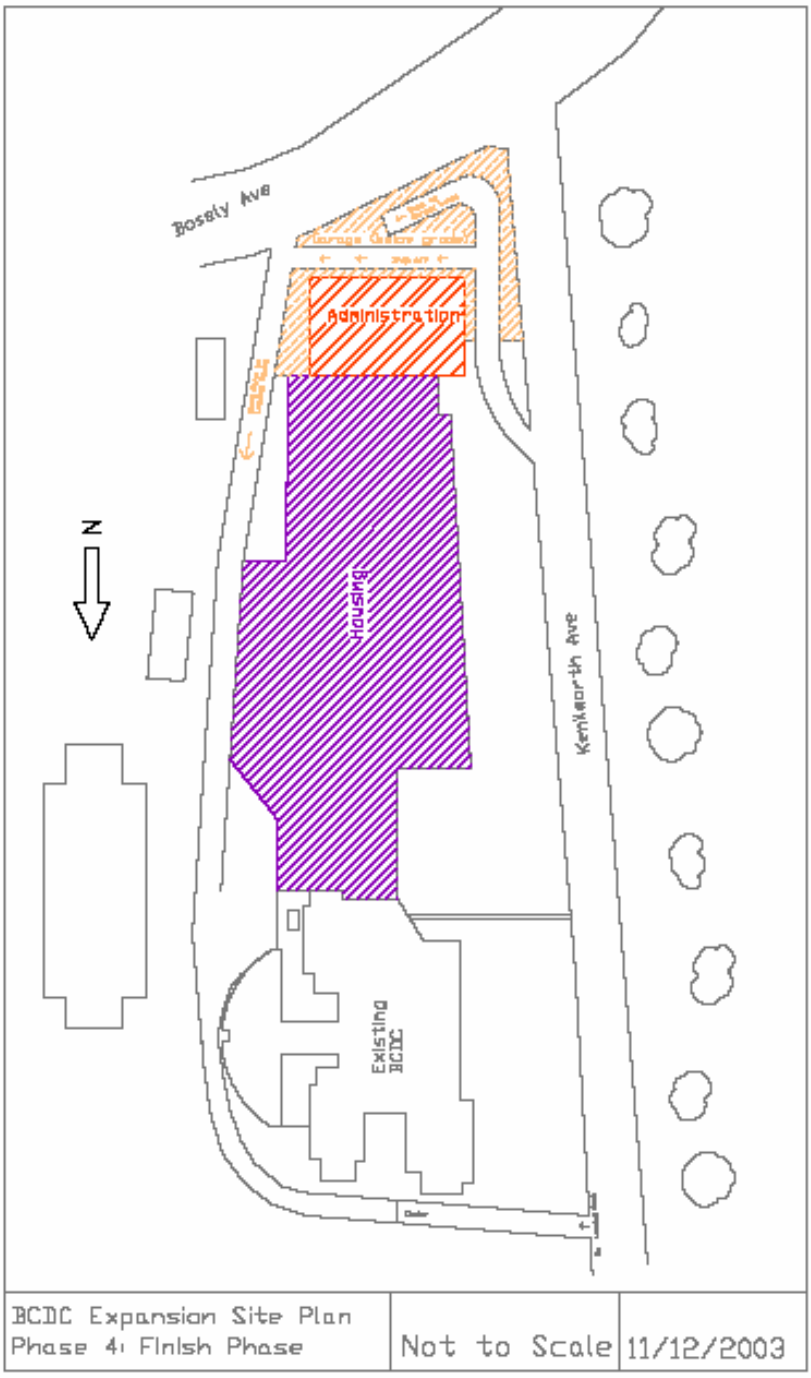

Figure 8: Phase 4 Site Plan (larger PDF file available on webpage)

III. Temporary Utilities

In order to perform various construction activities there are different requirements for temporary utilities such as electrical power, lighting, ventilation, heating and cooling. These requirements are typically detailed in specification section 1500. The temporary utilities were installed early in the project within bid packages #1-3. For the BCDC project two main concerns were the electrical service for the erection of the structure and proper heating for the concrete elements.

Electrical Power/Lighting
The erection of the structure required electrical power mainly for the temporary lighting and the tower crane. The temporary electrical power was supplied by an electrical vault located across from the site. The power supplied was a 1200A, 120/280V, 3 phase temporary distribution panel. The distribution panel was located as close to the crane as possible for minimal wiring. The tower crane itself required electrical power for operation but the specification also required a temporary lighting system that fulfilled security and protection requirements without the operation of the full system.

Heating
The structure was mainly composed of CIP concrete and pre-cast concrete. Concrete is required to be poured and cured at a minimum of 50°C. The temperature requirements will be achieved by using vented, self-contained, liquid-propane-gas or fuel heaters with individual space thermostatic control.

The CIP concrete within the garage was poured in the winter below 50°C. The concrete was specially design with admixtures for these conditions and poured in insulated formwork to ensure the concrete quality. The adjustments due to the temperature were not an issue because the weather was expected and measures were taken within the bid to cover the extra cost.

Concrete is just one element that requires a minimal temperature at time if application. Many of the finishes and grout within the interior structure will also require heating.

IV. Detailed Structural System Estimate

A detailed structural estimate was performed for the BCDC expansion using R.S. Means Building Construction 2004. The estimate was divided into three main categories C.I.P.

concrete, pre-cast concrete and structural steel. All calculations do not include overhead or profit.

C.I.P. concrete
The C.I.P concrete estimate includes the foundations, garage concrete, level one housing concrete and the slab on grade. The following assumptions were made for this portion of the structural estimate:

1) Foundations
    a. Excavate Footings- Assume concrete and excavation CY the same; $37.50/ CY added to the labor for each footing
    b. Concrete strength was 3000psi
    c. Poured in Earth – no cost formwork
    d. Reinforcing was assumed to be 0.052 ton per footing. This added $27.88/ CY to the material unit price per footing and $15.44/CY to the labor unit price per footing.
    e. Direct Chute, over 5 CY - add $10.35/CY for labor cost per footing and $0.54/CY for equipment per footing
    f. Strap beams were not accounted for
2) Garage
    a. Each type of shear wall has the same dimensions
    b. All elevations of all walls equal on every floor
    c. Columns all 10 feet – column sizes to fit unit prices given in Means
    d. Elevated slab assume reinforcing 0.043 ton/ 1 SF of slab
3) Housing- Level 1
    a. Columns assumed to be 14 feet
    b. All beams and transfer girders assumed to be one averaged size
4) Slab on Grade
    a. Assume average depth of slab 1-‘6”, cost as 15” thick
    b. Formwork is negligible
    c. Reinforcing, welded wire fabric – 4 x 4, 61lb/CSF

The cost difference between the estimated value and the contract value is in the concrete accessories that were not included in the estimate. The cost of box-out labor, dovetails, embeds and filler compose a relatively large portion of the CIP concrete bid package but are not accounted for in the estimate. There was also rough-in work within the concrete bid package that will account for some of the cost difference.

C.I. P. Concrete

Foundations

Description	Number	Quanity Ea.	Units	Total Quanity	Labor U/P	Labor Cost	Materials U/P	Materials Cost	Equipment U/P	Equipment Cost	Total Cost
4'-0" x 4'-0" 1'-2"	3	0.69	CY	2.07	63.29	131.01	100.38	207.79	0.54	1.12	$339.91
6'-0" x 6'-0" x 1'-8"	11	2.22	CY	24.42	63.29	1545.54	100.38	2451.28	0.54	13.19	$4,010.01
6'-0" x 12'-0" x 3'-2"	5	8.44	CY	42.20	63.29	2670.84	100.38	4236.04	0.54	22.79	$6,929.66
7'-0" x 7'-0" x 2'-0"	13	3.63	CY	47.19	63.29	2986.66	100.38	4736.93	0.54	25.48	$7,749.07
7'-0" x 10'-0" x 2'-8"	4	6.91	CY	27.64	63.29	1749.34	100.38	2774.50	0.54	14.93	$4,538.76
7'-6" x 7'-6" x 2'-2"	5	4.51	CY	22.55	63.29	1427.19	100.38	2263.57	0.54	12.18	$3,702.94
8'-0" x 8'-0" x 2'-2"	14	5.14	CY	71.96	63.29	4554.35	100.38	7223.34	0.54	38.86	$11,816.55
8'-6" x 8'-6"x 2'-4"	12	6.24	CY	74.88	63.29	4739.16	100.38	7516.45	0.54	40.44	$12,296.04
9'-0" x 9'-0" x 2'-6"	22	7.50	CY	165.00	63.29	10442.85	100.38	16562.70	0.54	89.10	$27,094.65
10'-0" x 10'-0" x 2'-0"	2	7.41	CY	14.82	63.29	937.96	100.38	1487.63	0.54	8.00	$2,433.59
10'-6" x 10'-6" x 2'-10"	10	11.57	CY	115.70	63.29	7322.65	100.38	11613.97	0.54	62.48	$18,999.10
11'-0" x 11'-0" x 2'-0"	2	8.96	CY	17.92	63.29	1134.16	100.38	1798.81	0.54	9.68	$2,942.64
11'-0" x 11'-0" x 2'-10"	6	12.70	CY	76.20	63.29	4822.70	100.38	7648.96	0.54	41.15	$12,512.80
11'-6" x 11'-6" x 3'-0"	7	14.69	CY	102.83	63.29	6508.11	100.38	10322.08	0.54	55.53	$16,885.71
12'-0" x 12'-0" x 3'-2"	12	16.89	CY	202.68	63.29	12827.62	100.38	20345.02	0.54	109.45	$33,282.08
13'-0" x 13'-0" x 3'-4"	2	20.86	CY	41.72	63.29	2640.46	100.38	4187.85	0.54	22.53	$6,850.84
15'-0" x 15'-0" x 3'-8"	4	30.56	CY	122.24	63.29	7736.57	100.38	12270.45	0.54	66.01	$20,073.03
12'-6" x 12'-6" x 3'-2"	9	18.33	CY	164.97	63.29	10440.95	100.38	16559.69	0.54	89.08	$27,089.72
14'-0" x 14'-0" x 3'-6"	6	25.41	CY	152.46	63.29	9649.19	100.38	15303.93	0.54	82.33	$25,035.46
17'-0" x 17'-0" x 4'-2"	10	44.60	CY	446.00	63.29	28227.34	100.38	44769.48	0.54	240.84	$73,237.66
											$317,820.24

Garage

Description	Number	Quanity Ea.	Units	Total Quanity	Labor U/P	Labor Cost	Materials U/P	Materials Cost	Equipment U/P	Equipment Cost	Total Cost
Shear Walls											
SW-1 13' x 10' x 10"	24	4.01	CY	96.24	164	15783.36	126	12126.24	18.65	1794.876	29704.48
SW-2 24' x 10' x 10"	4	7.41	CY	29.64	164	4860.96	126	3734.64	18.65	552.786	9148.39
SW-4 40' x 10' x 8"	3	9.88	CY	29.64	241	7143.24	158	4683.12	25.5	755.82	12582.18
SW-5 50' x 10' x 10"	5	15.44	CY	77.20	164	12660.8	126	9727.2	18.65	1439.78	23827.78
SW-6 32' x 10' x 10"	3	9.88	CY	29.64	164	4860.96	126	3734.64	18.65	552.786	9148.39
SW-7 56' x 10' x 10"	5	17.28	CY	86.40	164	14169.6	126	10886.4	18.65	1611.36	26667.36
SW-8 36' x 10' x 10"	5	11.12	CY	55.60	164	9118.4	126	7005.6	18.65	1036.94	17160.94

Figure 9a: C.I.P Structural Estimate (pg 1)

SW-9 60' x 10' x 10"	5	18.52	CY	92.60	164	15186.4	126	11667.6	18.65	1726.99		28580.99
SW-10 26' x 10' x 10"	5	8.02	CY	40.10	164	6576.4	126	5052.6	18.65	747.865		12376.87
SW-11 16' x 10' x 10"	24	4.94	CY	118.56	164	19443.8	126	14938.56	18.65	2211.144		36593.54
SW-12 4' x 10' x 10"	3	1.24	CY	3.72	164	610.08	126	468.72	18.65	69.378		1148.18
Add 10% for gang forms						11041.4		84025.32				19443.94
Columns												
12" x 24"	6	0.74	CY	4.44	655	2908.2	310	1376.4	73.5	326.34		4610.94
20" x 20"	20	1.03	CY	20.60	655	13493	310	6386	73.5	1514.1		21393.10
24" x 24"	134	1.48	CY	198.32	410	81311.2	197	39069.04	46	9122.72		129502.96
20" Φ	9	0.81	CY	7.29	276	2012.04	295	2150.55	31	225.99		4386.58
24" Φ	18	1.16	CY	20.88	245	5115.6	293	6117.84	27.5	574.2		11807.64
Elevated Slabs												
Level 2 28,892 SF x 9" slab	1	802.6	CY	802.60	3.75	3009.75	2.55	2046.63	0.28	224.728		5281.11
Level 2M 28,339 SF x 9" slab	1	787.2	CY	787.20	3.75	2952	2.55	2007.36	0.28	220.416		5179.78
Level 3 28,339 SF x 9" slab	1	787.2	CY	787.20	3.75	2952	2.55	2007.36	0.28	220.416		5179.78
Reinforcing for slabs	3	500	Ton	1500.00	410	615000	605	907500				1522500.00
												$1,538,140.66

Housing					Labor		Materials		Equipment		
Description	Number	Quantity Ea.	Units	Total Quantity	U/P	Cost	U/P	Cost	U/P	Cost	Total Cost
Housing Shear Walls											
HSW-1 38' x 18' x 8"	1	16.89	CY	16.89	241	4070.49	158	2668.62	25.5	430.695	7169.805
HSW-2 38' x 20' x 10"	1	23.46	CY	23.46	164	3847.44	126	2955.96	18.65	437.529	7240.929
HSW-3 18' x 14' x 10"	1	7.78	CY	7.78	164	1275.92	126	980.28	18.65	145.097	2401.297
HSW-4 26' x 19' x 10"	1	15.24	CY	15.24	164	2499.36	126	1920.24	18.65	284.226	4703.826
HSW-5 20' x 15' x 8"	1	7.41	CY	7.41	241	1785.81	158	1170.78	25.5	188.955	3145.545
HSW-6 40' x 16.5 x 8"	1	16.30	CY	16.30	241	3928.3	158	2575.4	25.5	415.65	6919.35
HSW-7 10' x 14' x 10"	1	4.32	CY	4.32	164	708.48	126	544.32	18.65	80.568	1333.368
HSW-8 80' x 20.2 x 8"	1	39.90	CY	39.90	241	9615.9	158	6304.2	25.5	1017.45	16937.55
HSW-9 5' x 19' x 10"	1	2.94	CY	2.94	164	482.16	126	370.44	18.65	54.831	907.431
HSW-10 40' x 14' x 8"	1	13.83	CY	13.83	241	3333.03	158	2185.14	25.5	352.665	5870.835
HSW-11 54' x 14' x 10"	1	23.33	CY	23.33	164	3826.12	126	2939.58	18.65	435.1045	7200.8045
HSW-12 16' x 13.5' x 12"	1	8.00	CY	8.00	164	1312	126	1008	18.65	149.2	2469.2
HSW-13 16' x 15' x 12"	1	8.88	CY	8.88	164	1456.32	126	1118.88	18.65	165.612	2740.812
HSW-14 80' x 19' x 8"	1	37.53	CY	37.53	241	9044.73	158	5929.74	25.5	957.015	15931.485
HSW-15 100' x 18' x 8"	1	44.44	CY	44.44	241	10710	158	7021.52	25.5	1133.22	18864.78

Figure 9b: CIP Structural Estimate (pg 2)

HSW-16 28' x 19' x 8"	1	13.14	CY	13.14	241	3166.74	158	2076.12	25.5	335.07					5577.93
HSW-17 142' x 14' x 10"	1	61.36	CY	61.36	164	10063	126	7731.36	18.65	1144.364					18938.764
HSW-18 50' x 18' x 8"	1	22.22	CY	22.22	241	5355.02	158	3510.76	25.5	566.61					9432.39
HSW-19 8' x 14' x 8"	1	2.77	CY	2.77	241	667.57	158	437.66	25.5	70.635					1175.865
HSW-20 16' x 18' x 8"	1	7.12	CY	7.12	241	1715.92	158	1124.96	25.5	181.56					3022.44
HSW-21 8' x 19' x 8"	1	3.75	CY	3.75	241	903.75	158	592.5	25.5	95.625					1591.875
Add 10% for Gang forms						79768.1		55166.46							13493.46
Columns															
8" x 16"	1	0.46	CY	0.46	655	301.3	310	142.6	73.5	33.81					477.71
14" x 14"	4	0.71	CY	2.84	655	1860.2	310	880.4	73.5	208.74					2949.34
16" x 16"	42	0.92	CY	38.64	410	15842.4	197	7612.08	46	1777.44					25231.92
16" x 22"	1	1.27	CY	1.27	410	520.7	197	250.19	46	58.42					829.31
16" x 24"	17	1.38	CY	23.46	375	8797.5	258	6052.68	42	985.32					15835.5
16" x 36"	2	2.07	CY	4.14	375	1552.5	258	1068.12	42	173.88					2794.5
20" x 20"	8	1.44	CY	11.52	375	4320	258	2972.16	42	483.84					7776
24" x 24"	21	2.07	CY	43.47	375	16301.3	258	11215.26	42	1825.74					29342.25
24" x 28"	13	2.42	CY	31.46	375	11797.5	258	8116.68	42	1321.32					21235.5
24" x 32"	4	2.77	CY	11.08	375	4155	258	2858.64	42	465.36					7479
8" Φ	6	0.18	CY	1.08	435	469.8	315	340.2	49	52.92					862.92
12" Φ	2	0.41	CY	0.82	435	356.7	315	258.3	49	40.18					655.18
16" Φ	18	0.72	CY	12.96	345	4471.2	320	4147.2	39	505.44					9123.84
22" Φ	12	1.37	CY	16.44	276	4537.44	295	4849.8	31	509.64					9896.88
24" Φ	2	1.63	CY	3.26	245	798.7	293	955.18	27.5	89.65					1843.53
32" Φ	2	2.9	CY	5.80	177	1026.6	253	1467.4	19.9	115.42					2609.42
Beams															
12" x 24" x 30"	113	2.22	CY	250.86	425	106616	233	58450.38	48	12041.28					177107.16
Transfer Girders															
28" x 44" x 40"	66	12.88	CY	850.08	355	301778	214	181917.1	40	34003.2					517698.72
															$990,818.42

SOG

					Labor		Materials		Equipment		
Description	Number	Quantity Ea.	Units	Total Quantity	U/P	Cost	U/P	Cost	U/P	Cost	Total Cost
SOG, w/o forms or reinforcing, over 10,000 SF					0.86		3.64		0.01		
Reinforcing					22		20				
77,672 GSF, 15" thick	1	43151.11	CY	43151.11	22.86	98643.4	23.64	102009.2	0.01	43.1511	$200,695.77

TOTAL	$3,047,475.09

Figure 9c: CIP Structural Estimate (pg3)

Pre-cast Concrete
The housing area of the BCDC Expansion is composed of pre-cast concrete modular units. These units are supplied by OldCastle Pre-Cast Modular Units. To calculate an accurate estimate for the pre-cast I contacted the BCDC project manager from OldCastle and requested an approximate cell/dormitory unit price. These were the numbers used to estimate the cost of pre-cast for the structural estimate.

Pre-Cast Concrete Modular Units

Description	Quanity	Unit	Unit Price	Total
Cells	84	Each	38,750	3,255,000
Dormitories	92	Each	46,000	4,232,000
				$7,487,000

TOTAL	**$7,487,000**

Figure 10: Pre-cast Structural Estimate

The cost will not match the pre-cast bid package exactly because the BP includes embeds and attached fixtures. This contract was also design/build so the overhead and profit will drive the contracted value higher.

Structural Steel
The structural steel estimate included the steel columns, beams, metal decking in the administration area and the roof joist within the administration portion of the structure. The following assumptions were made:

1) Columns
   a. Assumed the T.O.S for level 3 was 406’ at all locations
2) Beams
   a. Drawings with beam dimensions not available assumed tonnage of the calculated columns and beams were equal.
3) Metal Decking
   a. Assumed metal decking SF equivalent to GSF for administration and housing
4) Roof Joist
   a. Roof foist are space evenly every 12’

The difference between the actual cost of the steel contract and the estimated cost shown in figure 11 can be accounted for by the miscellaneous metals that were included within the steel bid package but not this estimate.

Steel

Columns

Description	Number	Length	lb/ft	Quanity	Units
W 8 x 24	13	12	24	1.87	Ton
W 8 x 31	1	12	31	0.19	Ton
W10 x 33	2	30	33	0.99	Ton
W10 x 33	3	24.5	33	1.21	Ton
W10 x 33	5	12.5	33	1.03	Ton
W10 x 39	4	24.5	39	1.91	Ton
W10 x 45	1	30	45	0.68	Ton
W10 x 45	1	24.5	45	0.55	Ton
W10 x 49	1	30	49	0.74	Ton
W10 x 49	7	42.5	49	7.29	Ton
W10 x 54	1	30	54	0.81	Ton
W10 x 54	2	42.5	54	2.30	Ton
W10 x 60	1	24.5	60	0.74	Ton
W10 x 60	2	30	60	1.80	Ton
W10 x 60	2	42.5	60	2.55	Ton
W10 x 68	1	30	68	1.02	Ton
W10 x 77	2	42.5	77	3.27	Ton
W10 x 77	3	30	77	3.47	Ton
W10 x 88	1	42.5	88	1.87	Ton
W10 x 88	2	30	88	2.64	Ton
W10 x 100	1	30	100	1.50	Ton
W10 x 112	1	30	112	1.68	Ton
				40.09	Ton

Beams

40.09	Ton
80.18	Ton

Office 1-2 Stories

		Labor		Materials		Equipment		
Total Quanity	Units	U/P	Cost	U/P	Cost	U/P	Cost	Total Cost
80.18	Ton	284	22771.12	1,275	102229.5	145	11626.1	**$136,626.72**

Metal Decking

		Labor		Materials		Equipment		
Total Quanity	Units	U/P	Cost	U/P	Cost	U/P	Cost	Total Cost
Open Type Galvanied, 18 Gauge, long span 6" deep								
255,981	SF	0.06	15358.86	3.99	1021364	0.04	10239.24	**$1,046,962.29**

Roof Joist

		Labor		Materials		Equipment		
Total Quanity	Units	U/P	Cost	U/P	Cost	U/P	Cost	Total Cost
Open Web Joist 18K5, 7.7 lb/L, Span 30' Min								
97,360	LF	1.46	142145.6	3.23	314472.8	0.78	75940.8	**$532,669.20**

TOTAL $1,716,148.21

Figure 11: Structural Steel Estimate

Summary
The following table in figure 12 summarizes the total structural cost for the BCDC Expansion.

Description	Cost
C.I.P. Concrete	$3,047,475.09
Pre-cast Concrete	$7,487,000.00
Structural Steel	$1, 716,148.21
TOTAL	**$12,250,623**

Figure 12: Summary of Structural Estimate

The structural estimate is approximately 22% of the construction hard cost. This is relatively low for a typical contract. The structural estimate may not reflect the true cost of the structural system due to the all the unique details that make up the system. There is very little repetition in any of the structural elements which makes it difficult to account for all of the cost associated with the structure. An economical analysis of the benefits of a repetitive design may be investigated further at a later date.

V. General Conditions Estimate
The general condition costs incurred by Gilbane for the construction of the BCDC Expansion were paid for by Baltimore County. The following assumptions were made to perform the general conditions estimate found below in figure 13:

General Assumptions

1) R.S. Means Building Construction Cost Data 2003 was used for all value in the GC estimate
2) The project lasted a total of 35 months
3) Work was performed 5 days a week for 8 hours a day
4) Assumed 4 weeks in each month

Staffing Assumptions

1) Only on-site staff will be paid for
2) The cost per week for the part time staff was modified based on the time spent on site as stated in technical assignment #2.
3) Overtime is not paid for

R.O.S. = Staff cost/Fee = $783,300/$2,718,185 = 0.29

A typical return on staff should be about 0.80. This R.O.S. shows weather a project is staffed properly based on the profit a company is receiving. An R.O.S. over 1 means that the overhead is too high and no profit is being made. If the R.O.S. is too low a project is understaffed. At the BCDC project there were not enough employees on the job hence, the 0.29 R.O.S. Just recently two additional employees were added to the job to cover the overflow of work.

Temporary Facilities

1) Gilbane has three trailers approximately 50' x 10'
2) There is one dumpster used onsite

Utilities

1) All water is supplied by the existing detention center until 8/2003 when the indoor plumbing facilities were connected to the trailer
2) Temporary lighting accounts for the total CSF of the new structure
3) Temporary heating is only within the housing structure to meet the curing requirements for the grout between the pre-cast modular units
4) Chemical toilets paid for within the GC cost till 9/2003 and BP #16 became contractually responsible

Clean-up

1) Clean up is paid for in the GC cost till 9/2003 when BP#16 takes over

Typically the overall value of the general conditions cost is 6 to 7% of the contract sum. The BCDC GC cost is 1.65% of the total contract sum. However, the County has assigned a majority of the general condition cost to the various contractors on the project. The general trades contractor, BP #16 is responsible for most of this cost. This is why the general conditions cost estimate shown above is relatively low for a $72 million project.

General Conditions Cost Estimate

Code	Description	Quantity	Units	Labor		Materials		Equipment		Total Cost
				U/P	Cost	U/P	Cost	U/P	Cost	
CM MANAGEMENT & SUPERVISION										
	Regional Operations Manager - Off Site	0	week							0
	Project Executive	116	week	425	49300					49300
	Project Manager	124	week	1,500	186000					186000
	Project Superintendent	144	week	1,400	201600					201600
	Project Engineer	128	week	920	117760					117760
	Project Engineer	132	week	920	121440					121440
	Office Engineer	80	week	710	56800					56800
	MEP Engineer	80	week	630	50400					50400
										783300
DESIGN, ENGINEERING & SAFETY										
	Professional Surveying	5.3	acre	247	1309.1	16	84.8			1394
	Blue Printing	45	set			150	6750			6750
	Engineering Equipment	1	job							400
	Safety Training	1	job							2000
										10544
OFFICE										
	Job Telephone/ Fax	35	month			204	7140			7140
	Postage	35	month			50	1750			1750
	Office Supplies	35	month			83.5	2922.5			2923
	Furniture & Equipment	35	month			139	4865			4865
	Water Cooler	35	month			120	4200			4200
	Copy machine (1)	35	month			500	17500			17500
										38378
ON-SITE BUILDINGS										
	Trailer Transportation - 3	50	mile			1.53	76.5			77
	Trailer Setup - 3	3	ea	300	900					900
	Trailer Rental (50'x10') - (3/35mo)	35	mo			266	9310			9310
										10287

Figure 13a: General Conditions Estimate (pg1)

General Conditions Cost Estimate

Code	Description	Quantity	Units	Labor		Materials		Equipment		Total Cost
				U/P	Cost	U/P	Cost	U/P	Cost	
SITE FACILITIES										
	Temp. Roads- 4" gravel	6600	SY	1.75	11550	2.94	19404			30954
	Parking	2400	SY	1.75	4200	2.94	7056			11256
	Project Signs	1	job							1000
	Layout & Batterboards	1	day	520	520	50	50			570
										43780
PROTECTION										
	Security Fence for Inmates	300	LF	5.23	1569	4	1200			2769
	Perimeter Fences- Chain link 6' high over 1000'	900	LF	3.69	3321	1.64	1476			4797
	Fire Protection	35	month			35	1225			1225
	Winter Protection	171,430	SF	0.53	90857.9	0.38	65143.4			156001
										162023
INSTALL UTILITIES TRAILER										
	Temp. Power Hookup	1	job							200
	Temp. Lighting	35	month			40	1400			1400
	Install Heating System	1	job							100
	Telephone/Telex Setup	1	job							100
										1800
TEMPORARY UTILITIES										
	Lighting: lamps, wiring and outlets	5000	CSF/floor	8.85	44250	2.11	10550			54800
	Power Bills	35	month			207	7245			7245
	Heat	4000	CSF/ floor	4.3	17200	7.85	31400			48600
	Water Bills	35	month			62	2170			2170
	Chemical Toilet (2/15 mo)	30	each/mo			150	4500			4500
										117315

Figure 13b: General Conditions Estimate (pg2)

General Conditions Cost Estimate

Code	Description	Quantity	Units	Labor U/P	Labor Cost	Materials U/P	Materials Cost	Equipment U/P	Equipment Cost	Total Cost
	TESTING & INSPECTION		Contracted within each bid package or self performed by BOC							
	CLEANUP - From 5/2002 to 9/2003									
	Rubbish Removal	16	mo	155	2480					2480
	Periodic Cleanup	350	MSF	18.5	6475	1.7	595	1.25	437.5	7508
	Final Cleanup	1	job							12000
										21988
	OVERALL GC ESTIMATE SUM									$1,189,414

Figure 13c: General Conditions Estimate (pg3)

VI. Project Schedule

The following is a detailed project schedule for the BCDC Expansion project. The project starts March 8, 2002 and is to be completed May 02, 2002.

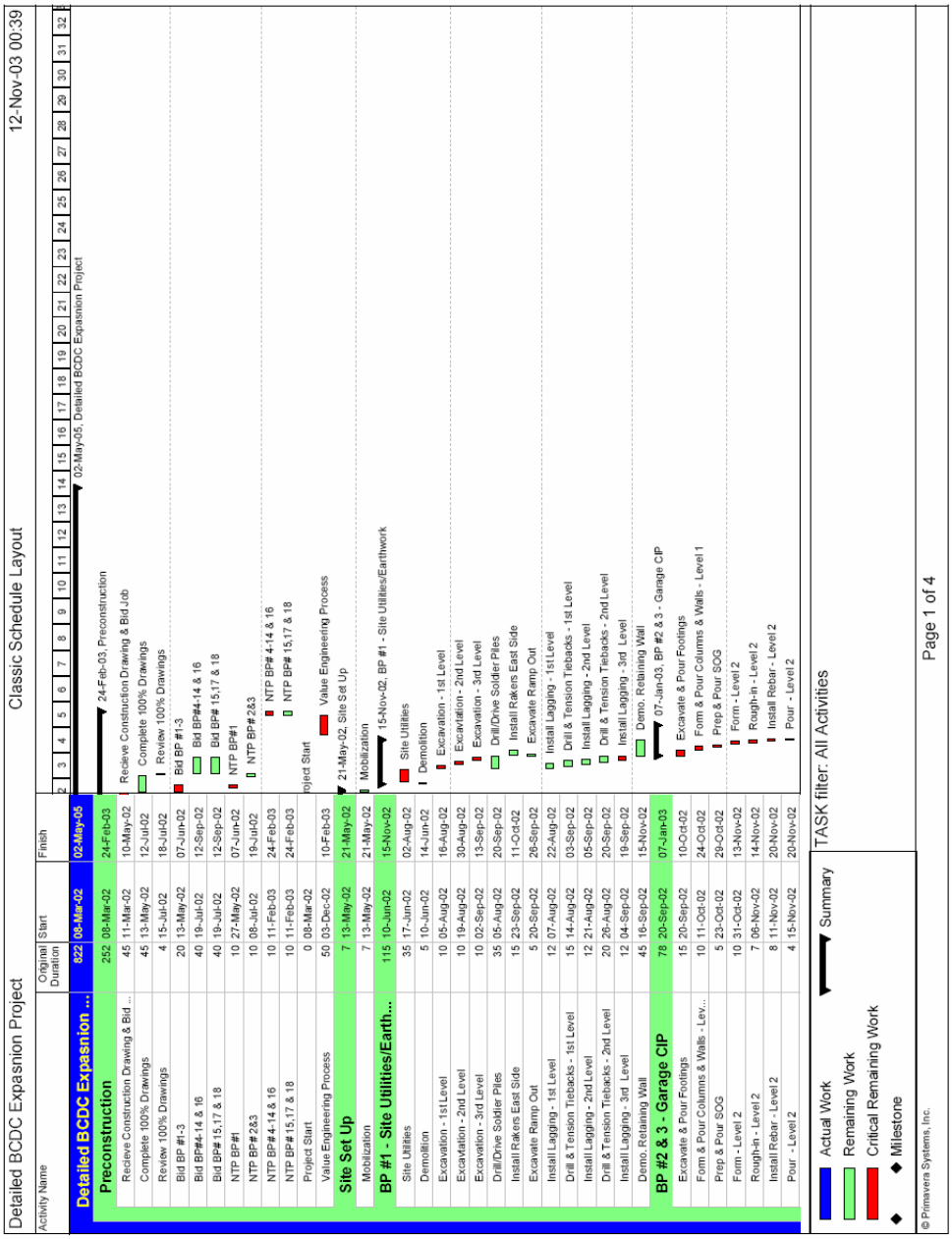

Figure 14a: Project Schedule (pg1, larger PDF file available on website)

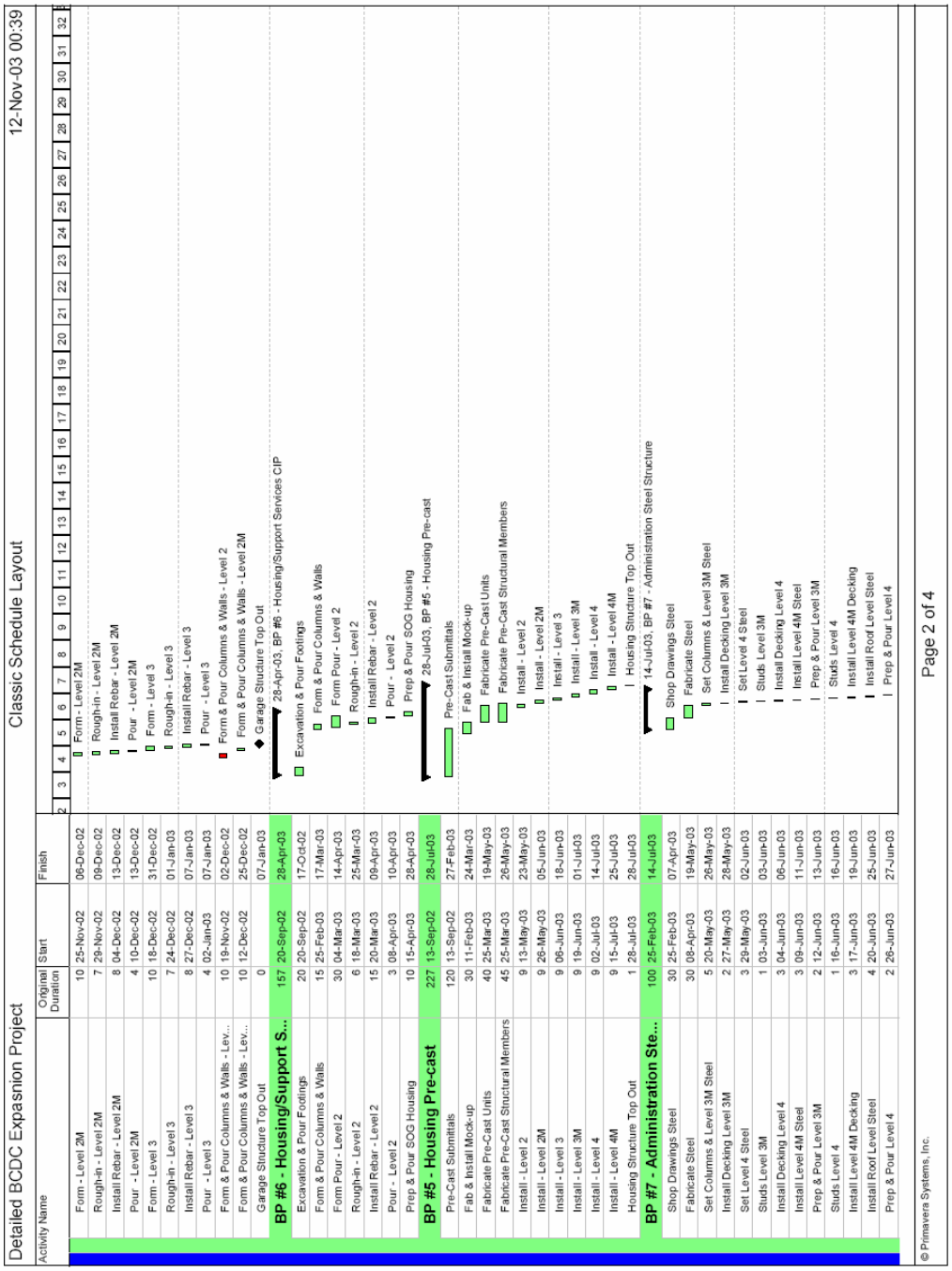

Figure 14b: Project Schedule (pg2, larger PDF file available on website)

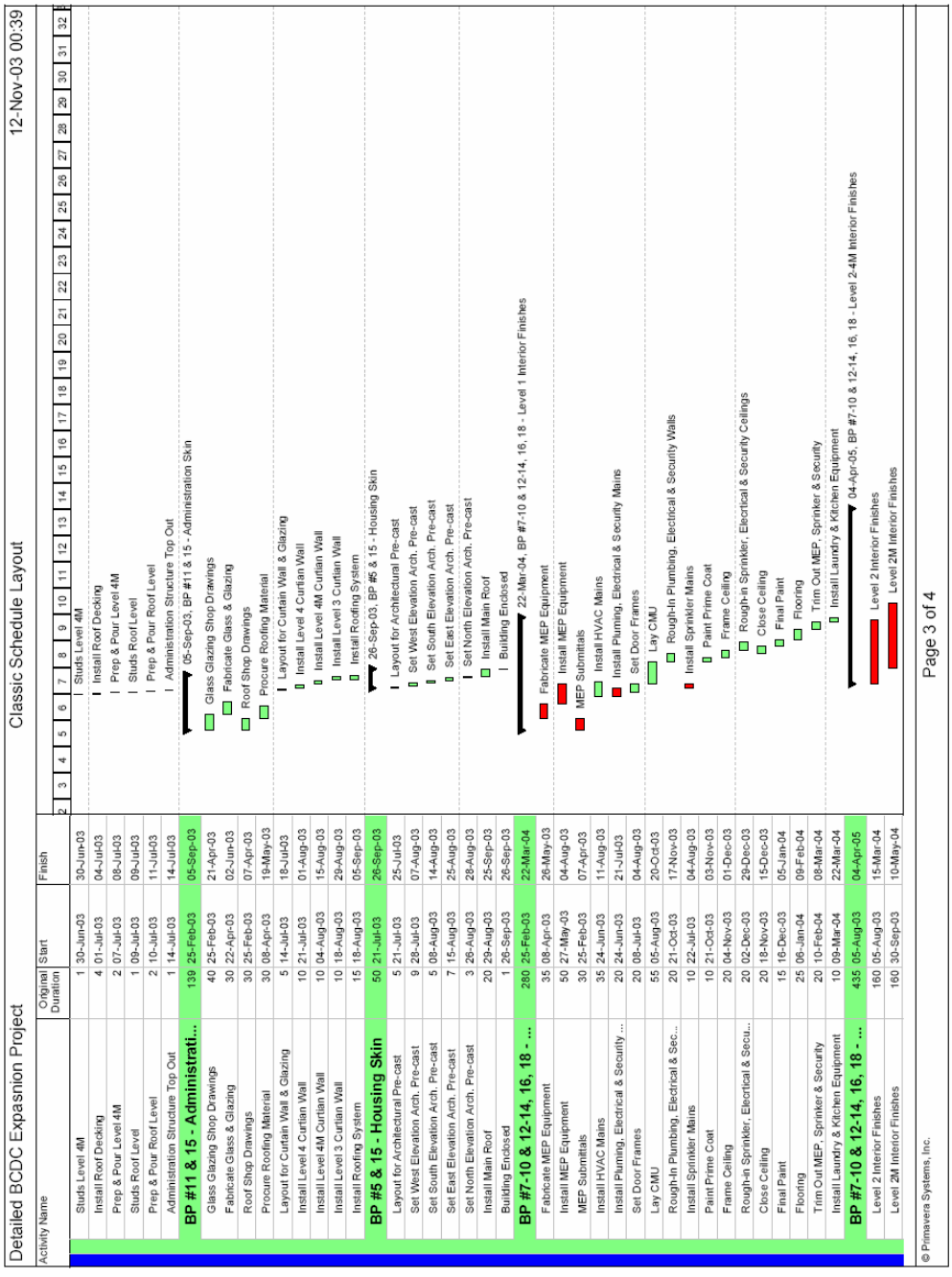

Figure 14c: Project Schedule (pg3, larger PDF file available on website)

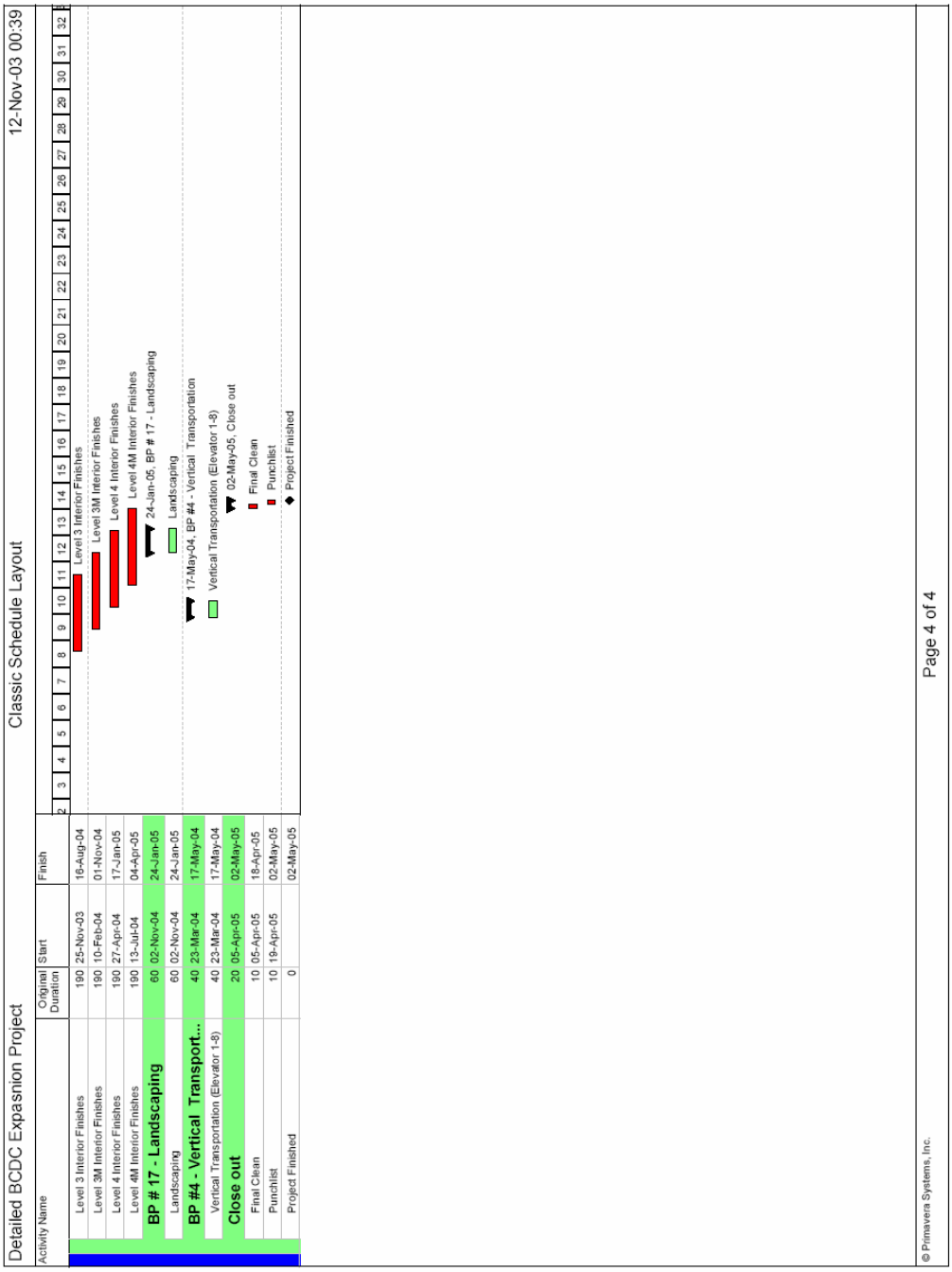

Figure 14d: Project Schedule (pg4, larger PDF file available on website)

The detailed schedule in figure 15 was then summarized to show the schedule for each contractor of the project. These dates were then used for the cash flow.

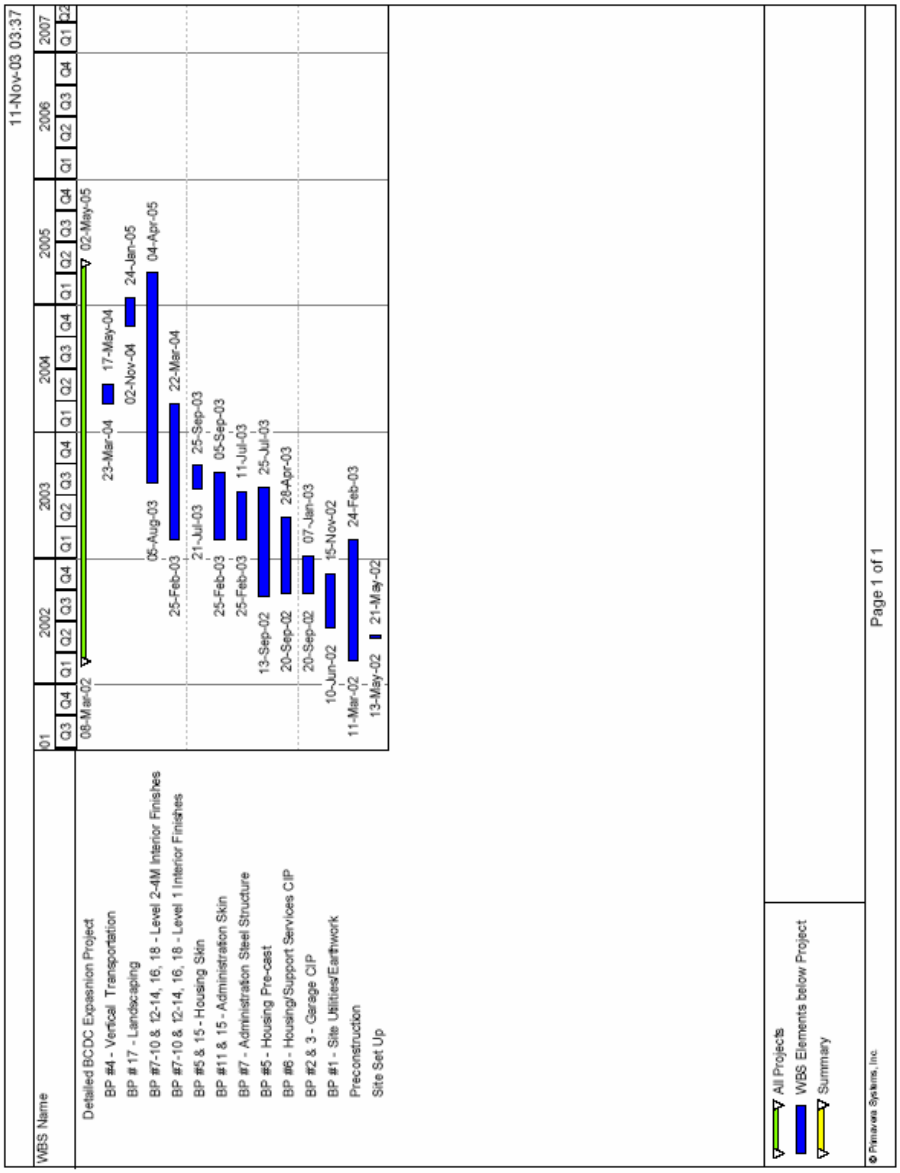

Figure 15: BP Breakdown Schedule (larger PDF file available on website)

VII. Cash Flow

The cash flow schedule for the owner was created using the price of each bid package and the bid package/contractor schedule shown in figure 15. The actual cash flow schedule is located in Appendices C. Once a cash flow schedule was created for each contractor a monthly anticipated cost was calculated and formatted into a cash flow curve shown in figure 16.

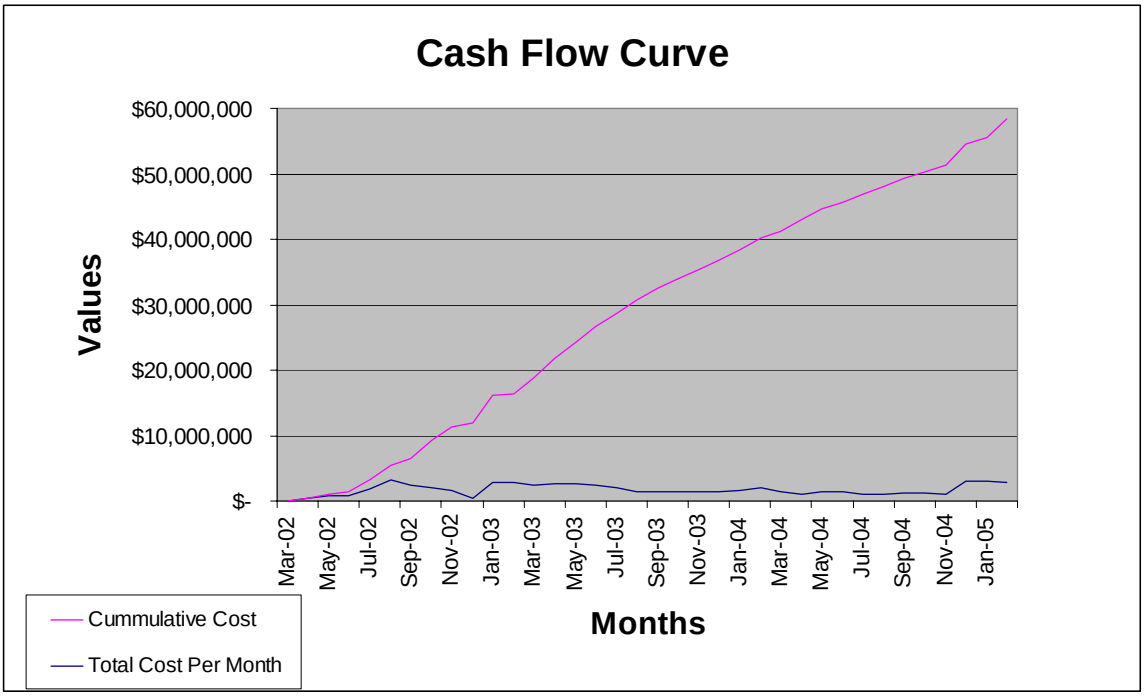

Figure 16: Cash Flow Curve

This cash flow curve will assist the County in forecasting a financing plan. The cost is fairly level throughout the project with a peak at the beginning of the project for the fast-tracked bid packages 1-3 and a peak at the end at the end for the retention payback. A blow up of the cost per month (S curve) is shown below in figure 17.

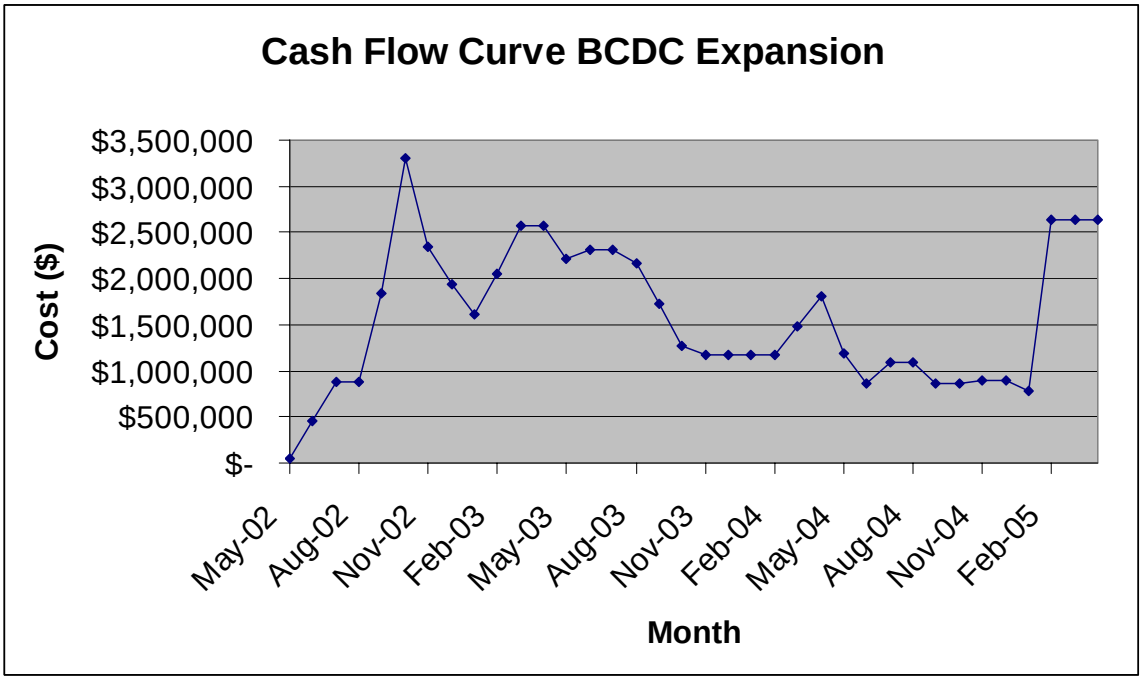

Figure 17: Enlarged Total Cost per Month (S curve)

VIII. Appendices

A. Larger Site Plans (figure 3a-d)
B. Larger Schedule (figure 14a-d)
C. Cost Schedule