

# The Washington County Regional Medical Center



Scott Earley

Construction  
Management

Consultant:  
Dr. David Riley

Penn State Senior Thesis April 14, 2009

## Presentation Outline



- Project Introduction
- Project Overview and Background
- **Analysis 1:** Developing the Previous Facilities
- **Analysis 2:** Redesign of the Deep Foundation System
- **Analysis 3:** Composite Precast Panel Unit Implementation
- Conclusions
- Q & A

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Project Introduction

Outline

**Project Introduction**

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Washington County Regional Medical Center



Location: 11116 Medical Campus Drive  
Hagerstown, MD 21742

Owner: Washington County Health System

Architect: Matthei & Colin Associates

Construction Manager: Gilbane Building Company

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Project Overview

Outline

**Project Introduction**

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion

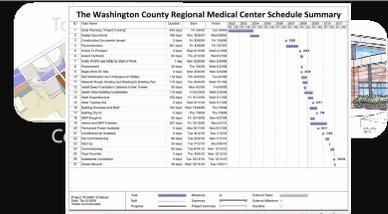


### Architecture

- 500,000 SF
- (275) Single Patient Rooms
- (53) Emergency Treatment Rooms
- (2) Trauma and (2) Cardiac Rooms
- Brick, Architectural Precast Concrete, and Curtain Wall

### Construction

- Budget
- Schedule
- Project Delivery Method



Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Project Overview

Outline

Project Introduction

Project Overview

Analysis 1: Developing the  
Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Structure



Mechanical

- (5) AHU's totaling 450,000 cfm
- (2) Chillers & (2) Cooling Towers

Electrical

- (3) Substations each at 4,000 amps, 480Y/277, 13.2kV

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1

### Developing the Previous Facility

*Construction Management Depth  
MAE Requirement*

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Problem:

Current financial times make it hard for owners to let old facilities to sit idle because of escalating costs. Old facilities become forgotten, vacant, and unused.

### Goals:

Generate additional income for the owner by developing former buildings with limited cost impacts. Show additional income can help repay bonds.

### MARKET ANALYSIS

Market	Construction Spending
Retail and Office Construction	-20%
Hotel Market (Typically Resorts)	-10%
K through 12	-0.6%
Higher Education	17%
Healthcare	2.6%
Religious	-8%
Public Construction	13%

Data courtesy of the publication Consulting-Specifying Engineer titled 2009 Economic Outlook and was published January 1, 2009

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

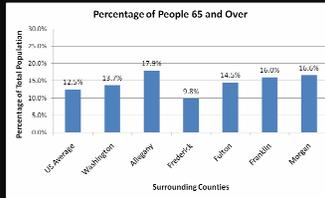
Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### MARKET ANALYSIS

Market	Construction Spending
Retail and Office Construction	-20%
Hotel Market (Typically Resorts)	-10%
K through 12	-0.6%
Higher Education	17%
Healthcare	2.6%
Religious	-8%
Public Construction	13%

Data courtesy of the publication Consulting-Specifying Engineer titled 2009 Economic Outlook and was published January 1, 2009

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

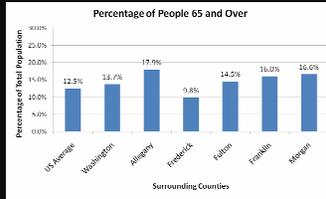
Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Data courtesy of the United States Census Bureau

## Complete Healthcare Services



Robinwood – Outpatient Facility



Old Hospital – Proposed Nursing Home



New Medical Center

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



NURSING HOME MARKET	
Findings	Semi-Private Rooms
2008 Average Rate	\$191
2007 Average Rate	\$189
2008 Maryland Average	\$218
Growth	1.1%
Capitalization Rate	12.75%

Data courtesy of The MetLife Market Survey of Nursing Home and Assisted Living Costs and The National Investment Center for the Seniors Housing and Care Industry

## Complete Healthcare Services



Robinwood – Outpatient Facility



Old Hospital – Proposed Nursing Home



New Medical Center

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Quick Background

- 550,000 SF
- 7 stories
- (264) Beds



### Budget Establishment

BUDGET		
Item	Cost (\$/SF)	Total Cost
<b>Demolition</b>		
Demolition (All)	\$19.50	\$10,725,000.00
<b>Renovation</b>		
<b>Total Renovation Costs</b>		<b>\$28,830,250.13</b>
<b>Upgrades, Cleaning, Inspection</b>		
Mechanical	\$17.86	\$5,735,620.00
Electrical	\$8.06	\$1,152,880.00
Plumbing	\$4.96	\$436,480.00
Elevator Inspections, Repairs, and Upgrades		\$95,000.00
All Interior Work	\$18.45	\$10,147,500.00
<b>Total Renovation Costs</b>		<b>\$28,830,250.13</b>

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



DEVELOP TO SELL SUMMARY	
Total Design and Construction Costs	\$34,475,474
Net Development Return	\$94,238,703
Gross Residual Value	\$59,753,229
Sole Price	\$126,799,059
Land Value <sup>1</sup>	\$1,915,000
<b>Total Renovation Schedule</b>	<b>243</b>
DEVELOP TO RUN SUMMARY	
New Roofing	20
Upgrades, C	10
Mechanic	1
Electrical	22
Plumbing	13
Elevator Inspections, repairs, and Upgrades	5
All Interior Work	610
<b>Total Renovation Schedule</b>	<b>243</b>

### Development Options

- 1) Develop to Sell
- 2) Develop to Run

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Development Options

- 1) Develop to Sell
- 2) Develop to Run
- 3) Partially Develop to Run
- 4) Develop to Lease

#### PARTIALLY DEVELOP TO RUN SUMMARY

Sale Price @ 10 <sup>th</sup> year	\$74,264,614
Return on Investment	\$50,117,002
Internal Rate of Return	31%

#### DEVELOP TO LEASE SUMMARY

Sale Price @ 10 <sup>th</sup> year	\$69,925,736
Return on Investment	\$35,450,262
Internal Rate of Return	25%

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 1: Developing the Previous Facility

Outline

Project Introduction

Project Overview

**Analysis 1: Developing the Previous Facility**

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Conclusion and Recommendations

- Financial times may be tough; however, the right development may be a worthy investment
- Partially Develop to Run
  - Construction Costs Low
  - WCHS is capable of management
  - Help repay bonds on new medical center

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2

# Redesign of Deep Foundation System

*Structural Breadth*

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2: Redesign of Deep Foundation

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion

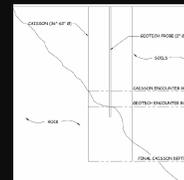


Problem:

Current deep foundation system, 150 caissons, has created multiple issues because of subsurface rock conditions and the inability for the entire caisson to rest on adequate bearing rock.

Goals:

Develop a more appropriate system that meets or exceeds all contract specifications while reducing costs.



Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2: Redesign of Deep Foundation

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

**Analysis 2: Redesign of Deep Foundation System**

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Initial Alternate Foundation Analysis

- Mat Foundation
- Piles
  - End Bearing
  - Friction
- Geopiers
- Minipiles

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2: Redesign of Deep Foundation

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

**Analysis 2: Redesign of Deep Foundation System**

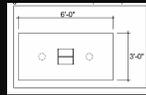
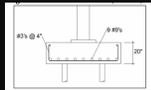
Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Minipile Deep Foundation System Design

- 250 kips per pile
- 5 inch diameter
- 10 foot rock socket



- 2 minipiles
- 4 minipiles
- 5 minipiles
- 6 minipiles
- 8 minipiles

Schedule Review

SCHEDULE COMPARISON				
Construction Time				
System	Quantity	Unit	Output (Unit/Day)	Total (Days)
Coissons			<b>% Reduction 48.3%</b>	103.0
Minipiles	532.0	Minipiles	11.0	53.2
			Difference	<b>49.8</b>
			<b>% Reduction</b>	<b>48.3%</b>

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2: Redesign of Deep Foundation

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

**Analysis 2: Redesign of Deep Foundation System**

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Budget Review

COST COMPARISON				
System	Labor (\$)	Material (\$)	Equipment (\$)	Total
Caissons				853,573.62
			<b>% Reduction</b>	<b>22.3%</b>
Minipiles	\$520,383.27	\$203,568.88	\$585,336.19	\$1,440,217.16
			<b>Difference</b>	<b>\$413,356.46</b>
			<b>% Reduction</b>	<b>22.3%</b>

### Schedule Review

SCHEDULE COMPARISON				
Construction Time				
System	Quantity	Unit	Output (Unit/Day)	Total (Days)
Caissons				103.0
			<b>% Reduction</b>	<b>48.3%</b>
Minipiles	532.0	Minipiles	11.0	53.2
			<b>Difference</b>	<b>49.8</b>
			<b>% Reduction</b>	<b>48.3%</b>

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Analysis 2: Redesign of Deep Foundation

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

**Analysis 2: Redesign of Deep Foundation System**

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



### Conclusion and Recommendations

- Minipile foundation provides a shorter schedule and cost reduction
- Fits much better with WCHS goals and plans
- Safer for construction workers

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

Analysis 3

Composite Precast Panel Unit Implementation

Mechanical Breadth

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



Problem:

The masonry work starts in the winter and can be a long labor intensive activity and, with rising energy costs and other labor and material costs, composite precast implementation worth investigation.

Goals:

Simplify the construction of the exterior brick façade by reducing the schedule and thereby, shortening the critical path. Also, enhance the thermal properties of the wall system and reduce the size of the AHU's

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



#### Metal Stud Crete®



2" Thick Concrete Insulation  
Light Gauge Framing

#### Meeting the Goals

Achieving the brick look with The Scott System®



- LEED
- Mesh contains 30%-80% recycled content
  - Locally extracted materials
  - Lighter = Less transportation

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



#### SCHEDULE COMPARISON

SCHEDULE COMPARISON				
Lead Times				
System	Quantity	Unit	Output (Unit/Day)	Total (Days)
Brick	12927.0SF			70.0
<b>Lead Time % Increase</b>			<b>48.3%</b>	
<b>Construction Time % Reduction</b>			<b>81.4%</b>	
Construction Time				
System	Quantity	Unit	Output (Unit/Day)	Total (Days)
Brick	12927.0SF		190.0	68.0
Metal Stud Crete®	6093.0LF		450.0	13.5
Metal Stud Crete®	12927.0SF		853.0	15.2
Difference				68.4
% Reduction				81.4%

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



SCHEDULE COMPARISON					
Lead Times	System	Quantity	Unit	Output (Unit/Day)	Total (Days)
	Brick	12927.0SF			70.0
		<b>Lead Time % Increase</b>		<b>48.3%</b>	
		<b>Construction Time % Reduction</b>		<b>81.4%</b>	
Construction Time					
System	Quantity	Unit	Output (Unit/Day)	Total (Days)	
Brick	12927.0SF		190.0	68.0	
Metal Stud	6093.0LF		450.0	13.5	
Metal Stud Crete®	12927.0SF		853.0	15.2	
				<b>Difference</b>	<b>68.4</b>
				<b>% Reduction</b>	<b>81.4%</b>

COST COMPARISON					
Bare Costs	System	Quantity	Unit	Cost (\$/Unit)	Total Cost
	Brick	12927.0SF		\$35.00	\$452,445.00
		<b>Bare Costs % Increase</b>		<b>28.6%</b>	
		<b>Total Costs % Savings</b>		<b>48.4%</b>	
Related Costs					
Item	Quantity	Unit	Cost (\$/Unit)	Total Cost	
Crane (15 Days)	120	Chrs.	\$350.00	\$42,000.00	
<b>Sub-Totals</b>				<b>\$42,000.00</b>	
Less:					
Scaffold	1500	SFCA	\$252.00	\$378,000.00	
Exterior Framing	6093	LF	\$21.00	\$127,953.00	
<b>Total Savings</b>				<b>\$463,952.71</b>	
				<b>% Savings</b>	<b>48.4%</b>

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion

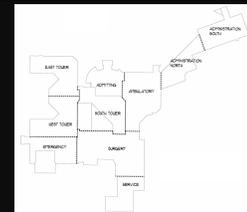


Original Sequencing

SEQUENCING ORDER	
#	Area
1	South Tower
2	West Tower
3	East Tower
4	Service Building
5	Admin (or Link) North
6	Admin (or Link) South
7	Admitting
8	Ambulatory
9	Emergency
10	Surgery

New Sequencing

SEQUENCING ORDER	
#	Area
1	South Tower
2	West Tower
3	East Tower
4	Emergency
5	Service Building
6	Surgery
7	Ambulatory
8	Admitting
9	Admin (or Link) South
10	Admin (or Link) North



Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



#### THERMAL ANALYSIS

Summer Heat Gain ( $T_o = 89, T_i =$

Reduction in Heat Gain				
System	Area (SF)	U-Value	$\Delta T$ (°F)	(BTU/Hr)
Brick Cavity Wall	12927.0	0.325	17	71421.68
Metal Stud Crete®	12927.0	0.300	17	65927.70
			Difference	137349.38
			<b>Reduction in Heat Gain</b>	<b>7.69%</b>

#### THERMAL ANALYSIS

Winter Heat Loss ( $T_o = 11, T_i =$

Reduction in Heat Loss				
System	Area (SF)	U-Value	$\Delta T$ (°F)	(BTU/Hr)
Brick Cavity Wall	12927.0	0.325	58	243673.95
Metal Stud Crete®	12927.0	0.300	58	224929.80
			Difference	468603.75
			<b>Reduction in Heat Loss</b>	<b>7.69%</b>

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

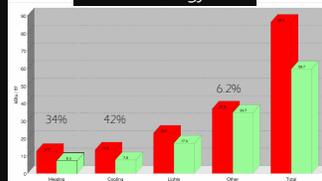
Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

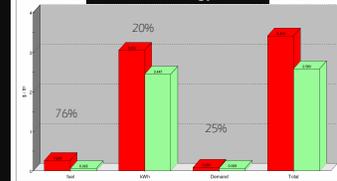
Conclusion



#### Annual Energy Use



#### Annual Energy Cost



Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Analysis 3: Composite Precast Panel Units

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

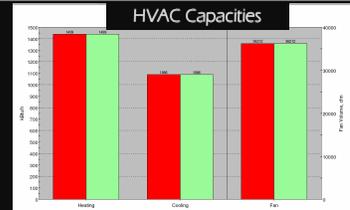
Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



#### Conclusion and Recommendations

- Composite wall system is faster and, including all factors, cheaper.
- Lead time is longer.
- Energy costs are lower.
- Demand is not reduced enough to re-size units.



Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

### Conclusion

#### Completing the Picture

Outline

Project Introduction

Project Overview

Analysis 1: Developing the Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



PARTIALLY DEVELOP TO RUN W/ SAVINGS SUMMARY	
Sale Price @ 10 <sup>th</sup> year	\$74,264,614
Return on Investment	\$50,865,041
Internal Rate of Return	34%

COMPARISON		
	PDTR	PDTRwS
Sale Price @ 10 <sup>th</sup> year	\$74,264,614	\$74,264,614
Return on Investment	\$50,117,002	\$50,865,041
Internal Rate of Return	31%	34%

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

## Conclusion

Outline

Project Introduction

Project Overview

Analysis 1: Developing the  
Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



# Thesis Conclusion

## Development

With the proper development, an owner can contribute to their income by developing their previous facility.

## Deep Foundation Redesign with Minipiles

22% reduction in cost and 48% reduction in schedule.

## Composite Precast Implementation

48% reduction in cost and 81% reduction in schedule. 7.69% reduction in summer heat gain and winter heat loss.

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009

Outline

Project Introduction

Project Overview

Analysis 1: Developing the  
Previous Facility

Analysis 2: Redesign of Deep Foundation System

Analysis 3: Composite Precast Panel Unit Implementation

Conclusion



# Questions?



## Acknowledgments

- Washington County Health System
- Gilbane Building Company – especially Matt Sarver, Gary Orton, and Fred Neighoff
- Penn State AE faculty– especially Dr. Riley and Dr. Horman
  - Fellow AE students
  - Karen Borst and Foster Earley
  - Ryan and Todd Earley
  - Tom, Julie, and Megan Ramsey
- “Hawks 4 Life” – David Miller and Steve Lump
- Thomas Chirdon, Dominic Manno, and Christopher Conrad

Scott Earley

Construction Management

The Washington County Regional Medical Center

Consultant: Dr. Riley

April 14, 2009



### Minipiles vs. Caissons Costs

CAISSONS						
Item and Quantity	Unit	Quantity (CY)	Labor (\$)	Material (\$)	Equipment (\$)	Total
Earth Auger	222.33		\$15,758.07	\$2,875.13	\$17,810.05	\$30,243.25
Rock Auger	3.06		\$1,005.97	\$187.81	\$1,201.07	\$2,414.85
Rock Down	447.11		\$922,479.75	\$116,398.59	\$1,474,857.86	\$3,513,676.20
Rebar	105.16		\$102.24	\$500.54	\$0.00	\$602.78
<b>Total</b>	<b>1242.65</b>		<b>\$1,078,366.03</b>	<b>\$119,753.54</b>	<b>\$1,794,868.01</b>	<b>\$3,892,987.58</b>
<b>Minipiles</b>						
Item	Quantity (CY)	Labor (\$)	Material (\$)	Equipment (\$)	Total	
CAISSONS	5038.22	\$33,370.70	\$6,730.28	\$0.00	\$40,100.98	
Minipiles	10.00	\$4,410.00	\$4,000.00	\$0.00	\$8,410.00	
<b>Total</b>	<b>5048.22</b>	<b>\$37,780.70</b>	<b>\$10,730.28</b>	<b>\$0.00</b>	<b>\$48,510.98</b>	
<b>Grand Total</b>	<b>1242.65</b>	<b>\$1,116,146.73</b>	<b>\$130,483.82</b>	<b>\$1,794,868.01</b>	<b>\$4,341,508.56</b>	

### Minipiles vs. Caissons Costs

MINIPILES						
Item and Quantity	Unit	Quantity (CY)	Labor (\$)	Material (\$)	Equipment (\$)	Total
Minipiles	10.00		\$4,410.00	\$4,000.00	\$0.00	\$8,410.00
Earth Auger	69.09		\$4,112.77	\$958.17	\$4,045.13	\$9,116.07
Rock Auger	1.00		\$205.45	\$45.30	\$255.00	\$505.75
Rock Down	272.4		\$512,531.37	\$57,055.25	\$512,230.04	\$1,121,816.66
Rebar	105.16		\$102.24	\$500.54	\$0.00	\$602.78
<b>Total</b>	<b>468.74</b>		<b>\$521,361.53</b>	<b>\$61,609.16</b>	<b>\$516,285.13</b>	<b>\$1,149,255.82</b>
<b>Minipiles</b>						
Item	Quantity (CY)	Labor (\$)	Material (\$)	Equipment (\$)	Total	
CAISSONS	5038.22	\$33,370.70	\$6,730.28	\$0.00	\$40,100.98	
Minipiles	10.00	\$4,410.00	\$4,000.00	\$0.00	\$8,410.00	
<b>Total</b>	<b>5048.22</b>	<b>\$37,780.70</b>	<b>\$10,730.28</b>	<b>\$0.00</b>	<b>\$48,510.98</b>	
<b>Grand Total</b>	<b>1242.65</b>	<b>\$1,154,927.43</b>	<b>\$141,214.10</b>	<b>\$1,794,868.01</b>	<b>\$4,390,028.54</b>	

### Thermal Wall Comparison Analysis

THERMAL ANALYSIS					
Component	Thermal Conductivity	Area (sq ft)	U-Value	Q-Value	Notes
Concrete	1.0	100	0.15	150	
Insulation	0.02	100	0.02	20	
Soil	0.25	100	0.25	250	
Water	0.33	100	0.33	330	
Grout	0.78	100	0.78	780	
Rebar	0.10	100	0.10	100	
Formwork	0.10	100	0.10	100	
Other	0.10	100	0.10	100	
<b>Total U-Value</b>			<b>0.85</b>	<b>850</b>	