Thesis Proposal

Final Proposal for Spring Thesis Project

Ingleside at King Farm

Rockville, MD

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2008-2009 construction management option

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Executive Summary

Introduction:

A brief review of the project basics is provided in the introduction. It summarizes the building type, CM, owner, architect, contract type, delivery method, etc.

Analysis Descriptions:

Analysis Description 1-Building Envelope Performance:

Identified as a constructability issue in a previous submission, the exterior wall will be studied for opportunities to improve constructability, thermal performance, value. It addresses the critical issues associated with the energy crisis, high first costs, and changing roles. This analysis primarily covers a breadth in sustainability.

Analysis Description 2-Mechanical System Design:

The mechanical system design is being questioned for its feasibility of individual units at each residence so an analysis of the feasibility of switching to a centralized unit will be performed. It's believed that the opportunity exists to incorporate the site pond into the design as well. This analysis will primarily compare the cost and schedule impacts of the current system against the proposed system. An analysis of the achievable LEED credits will be performed. Analysis Description 2 will demonstrate a strong mechanical breadth.

Analysis Description 3-Construction Waste Management:

Analysis Description 3 is aimed at greening the project and project team while improving productivity through maintaining a clean site. This is believed to be assisted by developing an achievable and affordable construction waste management plan. An evaluation will be performed to compare the cost and schedule impacts of implementing the plan. It will also contribute to the LEED certification of the project.

Analysis Description 4-Water Efficient Landscaping:

In a last minute race to earn LEED certification, this analysis will attempt to replace the current landscape design with a more conservative one. It's believed that this type of activity could be implemented late in the construction process on many projects if they are on the verge of earning enough LEED points for certification. The site impacts, water consumption, and a cost comparison will be provided with this analysis.

Weight Matrix:

The weight matrix shows an estimate of how much time will be allotted toward the research, value engineering, constructability, or schedule reduction for each analysis description. In this case, it is respectively 25%, 38%, 26%, 11%.

Appendix 1-Breadth Studies:

Breadth studies demonstrate a student's competency and interest outside construction management. This is done through additional research or evaluation in at least two outside areas. As mentioned in the Analysis Descriptions, this thesis will demonstrate some form of breadth in several areas, but will focus primarily on Sustainability and Mechanical.

Introduction

Construction on Ingleside at King Farm started on 3/14/2007 and is expected to be substantially complete on 2/20/2009. Ingleside is a Continuing Care Retirement Community project located in Rockville, Maryland with a $97 million GMP contract. The project is delivered as a CM joint venture, Turner-Konover, and Turner is acting as the GC. Arthur Shuster and CSD People Architecture designed the seven story building, which is approximately 700,000 square feet. There are independent living units, assisted living units, skilled nursing units, and dementia units. This project is seeking LEED Certification and is owned by Ingleside Presbyterian Retirement Community, a non profit organization.

The organization is dedicated to providing a quality living atmosphere for senior citizens at an affordable price. The facility is located on an 11.5 acre site and it will consist of many amenities such as a site pond, gardens, pool, tennis courts, theater, bank, marketplace, etc. Another key feature is the heated garage beneath the building, which provides convenient parking for the senior residents.

The structural system consists primarily of a post-tensioned flat plate concrete floor system with a steel roof structure. Mechanically, it is split between a constant volume air system serving the common areas and primarily individual water source heatpump units that serve the residences. There are two separate electric services entering the building; backed by a 750KW emergency generator set. Main living and corridors are lit using compact fluorescent down lighting. Dining and roof gardens contain primarily incandescent decorative lighting and the other outdoor lighting and pool lighting are high intensity discharge (HID). Plumbing is relatively simple; each of the living units is served by PEX tubing and the food service area contains a grease recovery unit.

Throughout the first half of the architectural engineering senior thesis, a thorough understanding was gained of the above mentioned building elements. A study of the architectural, structural, mechanical, electrical, lighting, and plumbing systems taught the basics of how the project ticks. Detailed cost estimates and project schedules were developed in order to understand the cost impacts of system changes and magnitude of construction coordination required to build Ingleside at King Farm. Interviews with project team members and the owner tuned professional communication skills and educated on the positive and negative experiences gained throughout construction and the expectations for a successful project. Attending a PACE seminar related to current industry issues allowed for real application to the project, which clarified why certain project elements or activities were the way they were.

Once the project was understood, personal observations and ideas were documented. Theses observations and ideas were developed into observed problems or areas of opportunity to improve. The proposed analyses in the following sections are a product of time spent up front planning how to better a project through research, value engineering, constructability reviews, and schedule reductions. Ingleside at King Farm, like the architectural engineering senior thesis, is a great candidate to prove that proper planning can yield improved results in the long haul.

Analysis Descriptions

The following analysis descriptions have been introduced in the *Technical Analysis Method* section of *Technical Assignment 3-Alternative Methods Analysis*. They were presented as observed problems, or potential areas of opportunity. Each was provided with a description of the construction management activities stating how a technical analysis will be completed on the building systems and what research will be required to perform the analysis. Although some preliminary information was provided on these areas of opportunity in the previous assignment, this section will clearly reiterate the problem or opportunity and offer supporting research, potential solutions, analysis steps, anticipated time to complete each step, and an anticipated outcome.

Analysis Description I-Building Envelope Performance:

Breadths Covered:
Sustainability, Mechanical, Structural, Architectural, and Construction

Critical Issues Addressed:
Energy Crisis, High First Cost, and Changing Roles

Background:

Ingleside at King Farm's building envelope is an area that is believed to have significant room for performance improvement in the areas of energy efficiency and constructability. It is evident through an interview with one of the project managers that a viable design did not exist at the time the exterior wall was ready to be constructed, which resulted in the CM on the project, Turner-Konover, taking charge of the design completion. In turn, the building has been constructed using a somewhat "traditional" design and a building envelope that seems to lack much consideration of innovations in energy efficiency and schedule reduction.

Given the current energy crisis, owners are demonstrating a larger push for reductions in utility costs. Some owners are also concerned with carbon footprint. Reducing carbon footprints is another challenge facing the industry, which is intertwined with acquiring LEED certifications and developing sustainable projects. These challenges can be overcome for the industry through many opportunities in developing technologies.

Problem/Opportunity Statement:

Owners are concerned with rising energy costs and requesting to build projects that will provide immediate energy savings, but are faced with financing high first costs for innovative sustainable systems. Integrating photovoltaic panels, for example, into a building's design can replace direct energy costs for owners, but they won't reduce overall energy consumption and they have a high first cost. Localized cogeneration systems are approximately 80% to 85% efficient making them more efficient than buying power from the grid, which is typically less than 15% efficient; these systems also have a high first cost (Greenbuild Educational Session: Net Zero-Pearl River).

This area of the construction industry is being driven by rapidly increasing energy demands. Although there are power generation technologies that can alleviate some of the financial burden associated with rising energy demands, the technologies are expensive and may not be highly efficient. Continuous developments are being made as designers, builders, and owners educate themselves on these technologies. This inspires the opportunity to creatively think and use innovations in increasing efficiencies amongst the existing building systems and investigate areas where reductions can be made, but this is one of the major challenges facing the industry. How can energy costs be reduced while keeping payback periods short? It's best to first begin by designing more efficient systems into the project.

Proposed Solution:

A potential solution to the problem is to use an alternative construction method such as the prefabricated kama-EEBS wall system mentioned in Technical Assignment 3 and addresses the critical industry issue of Changing Roles since the CM took charge of design completion.. It creates a strong thermal break and can add up to 21 LEED credits to the project; a better solution than just adding additional insulation to the system. In order to investigate this solution, outside information sources include product literature and representatives from companies in attendance at Greenbuild 2008 and interviews with the CM on the Ingleside at King Farm project, Turner-Konover.

Research Steps:

1. Educate self on thermal resistance and performance of current building envelope design; including windows and walls. (2 days to complete)
2. Research innovative materials and prefabricated building envelope systems and educate self on thermal resistance and performance of the alternative systems and windows to ensure that performance exceeds current design. (2 days to complete)
3. Evaluate cost and schedule associated with current building envelope design. (1 day to complete)
4. Compare energy efficiency of current design to alternative systems using standard R-Value comparison, hand calculations, and/or COMcheck program (http://www.energycodes.gov/comcheck/). (2 days to complete)
5. Compare material cost of current design to alternative systems. (3 days to complete)
6. Compare labor costs, duration of construction, and constructability of current design to alternative systems including an evaluation of structural impacts. (3 days to complete)
7. Evaluate additional impacts on schedule for alternative systems in terms of design time and procurement. (1 day to complete)
8. Evaluate current design for LEED credits achieved and compare to anticipated credits achievable with alternative systems. (1 days to complete)
9. Review proposed alternative with CM for industry acceptance and viability. (5 days to complete)
10. Develop a score card to compare the current design to alternative systems and propose an alternative system. (1 day to complete)

Research Goals:

- To prove that upgrading the building envelope to a more thermally efficient design is a feasible alternative to reducing operational costs by solely integrating localized power generation features into Ingleside at King Farm.
- To educate designers, engineers, CM's, and owners about the opportunity to incorporate affordable and sustainable technologies into their projects.
- To uncover opportunities to save costs in other areas of Ingleside at King Farm, such as a reduction mechanical equipment sizes.
- To show the benefit of immediate cost savings to owners and long term economical and environmental benefits to society through a reduction in energy consumption.

Expected Outcome/Conclusions:

An innovative prefabricated building envelope system will cost more per square foot and require more attention to detail during procurement than the currently designed building envelope, but this cost will be offset by labor savings and schedule reduction. The thermal performance of the proposed system will meet code requirements and exceed the performance of the currently designed system, while allowing the exterior face of the envelope to maintain its currently designed appearance.

As mentioned, improving the building envelope performance will address the challenges associated with the energy crisis critical industry issue. Designing with higher efficiency in mind is a way to significantly and truly reduce operational costs to owners; building system performance must first be improved before attempting to rely on localized power generation and an improved building envelope performance will still help reduce Ingleside at King Farm's carbon footprint. This research will be advantageous to the CM on the project in the event that they are tasked with leading the design completion on future projects with a similar design because it potentially offers a quick and direct replacement of existing system with minimal structural impacts. One concern with using a prefabricated system is that it will increase lead time and require more attention to detail during the procurement of the system. On the positive side, it is anticipated to improve constructability, require much less installation time, and prove to be an achievable value engineering idea by potentially adding LEED points.

Analysis Description II-Mechanical System Design:

Breadths Covered:

Sustainability, Mechanical, Structural, Construction, and Acoustics

Background:

Cooling towers present a multitude of design, construction, and financial challenges to a project such as aesthetics, self weight added to the structure, noise, adequate space to place the units, lead time, first cost, and maintenance cost. Previous experiences taught that startup and commissioning of cooling towers can be timely and costly, especially if controls programs are not properly functioning. Another area of Ingleside that relies heavily on equipment is the residences. Each one contains its own water source heatpump for localized individual control. Eliminating reliance on mechanical equipment can prevent major headaches on a project. If the cooling towers could be removed from the design, it would reduce first cost for equipment by $100,000, or more, based on a preliminary cost estimate (Advantage-Making Water Work www.advantageengineering.com).

Problem/Opportunity Statement:

A major challenge to owners is acquiring sufficient funds to build their project. Mechanical equipment adds significant cost to a project in terms of designing, purchasing, installation, and commissioning. Relying on delivery of equipment also presents risks of delaying progress on a project. There is a large quantity of individual pieces of mechanical equipment for Ingleside that creates staging challenges and each piece requires protection until it is installed.

Proposed Solution:

One solution to these problems is to utilize the site pond as a pond loop in conjunction with the mechanical system as a water source for a geothermal system, which could eliminate the cooling towers, or reduce the amount of cooling towers. The second solution is to investigate opportunities for switching to a centralized distribution system to save labor and equipment cost of individual heatpumps.

Research Steps:

1. Research typical mechanical systems used in this building type to determine benefits, advantages, and disadvantages of current mechanical system design. (1 day to complete)
2. Estimate cost of current mechanical system and identify potential areas for reduction in cost such as switching to a pond loop system and eliminating cooling towers and/or switching to centralized system. (2 days to complete)
3. Interview mechanical engineer to determine viability of eliminating cooling towers to use a pond loop system and viability of using centralized system. (3 days to complete)
4. Estimate cost of pond loop system and cost savings of centralized system if systems are viable and compare to current design. (2 days to complete)
5. Compare labor costs, duration of construction, and constructability of current design to using pond loop system and centralized system. (3 days to complete)
6. Evaluate schedule reductions in terms of equipment procurement and schedule reductions associated with less equipment installation for using a centralized system. (2 days to complete)
7. Compare site impacts of staging for current system and proposed system. (2 days to complete)
8. Evaluate current design for LEED credits achieved and compare to anticipated credits achievable with switching to pond loop system and centralized system; including such tasks as a calculation of energy savings in terms of removing cooling towers from the mechanical system design. (1 day to complete)
9. Develop a score card to compare the current design to pond loop system and centralized system to present the best option. (1 day to complete)

Expected Outcome/Conclusions:

An enlarged site pond is expected to provide added benefits in terms of aesthetics of the property and also help lower ambient temperatures surrounding the building due to the effects of natural evaporative cooling. A pond loop system is likely to increase design and sitework costs, but will add value by cutting equipment costs of the cooling towers and also result in an overall energy savings to the owner. Immediate payback, or savings, is anticipated. LEED credits will be earned for innovation if a site pond can be integrated into the mechanical system. Design time may be increase along with schedule delays if the project team is not experienced with a pond loop system, but this will be overcome by reduced startup and commissioning. Additional anticipated effects on the project include improved constructability and reduced costs for the roof structure due to a reduced roof load and eliminating the use of the crane to erect or place the cooling towers. More indirect benefits include a reduction in sound isolation and lower maintenance and lifecycle costs due to a closed loop system.

After evaluating the use of the individual heatpump units, it is believed that they may prove to be a more energy efficient system switching to the centralized system. It's also suspected that there will be a higher first cost associated with the heatpump units. Replacing equipment more equipment with ductwork associated with a more centralized system may not be the best option and will not likely result in much energy savings to the owner.

Analysis Description III-Construction Waste Management:

Breadths Covered:

Sustainability and Construction

Background:

A site visit to Ingleside at King Farm revealed an issue with construction waste management on this project from a volume and logistical standpoint. It was stated that there was no construction waste management plan in place and that everything was being tossed into one type of dumpster. On a project that's pursuing LEED certification, this seems to be counterproductive when building a sustainable project is the goal. One of the superintendents expressed that the amount of construction waste inherently created is a recurring issue on many projects throughout his career.

Problem/Opportunity Statement:

The issue noticeably impacted site safety in some areas and efficient use of space to complete work. Construction waste, as presented in a previously submitted photo, can cause tripping hazards, can block trash chutes, and can crowd potential material staging or storage areas. Piles of trash were found in a couple different locations throughout the site, so it did not just appear to be a coincidence.

A large footprint like the Ingleside at King Farm project may result in trash being set low on the priority list and set aside to worry about later, which allows a project team to maintain focus on the critical path. Managing waste, though, is not just an item that can be left for a punchlist at the end of a project, or left for a laborer to clean up at the end of the day. Although managing waste may not be on the critical path and may be the least of a contractor's concerns, maintaining a clean and safe site through the proper planning and reduction in waste generation should be a task that everyone is motivated to do. Long term side effects of neglecting waste management will add significant expense to construction projects as the world adopts more environmentally responsible practices in other industries. Designers, CM's, and builders can take the lead in long term waste reductions by following responsible practices that can even be taught to owners, but not all take this lead.

CM's and builders may view a construction waste management plan as a hindrance, but don't always realize the potentially positive results while wrapped up in the middle of deadlines, change orders, inspections, etc. Goals and procedures for managing waste are not always laid out up front and construction companies are not obligated to provide additional services that are not in the drawings, specifications, or other front end documents.

Proposed Solution:

Carefully planning construction waste management into the project seems to be the obvious solution to the problem. Adding a few lines of text to the drawings, specifications, and/or front end documents could help set the tone for a whole project. This would be accompanied by a construction waste management plan including clearly defined leaders for implementing the plan. Part of the plan would be request minimal packaging for items shipped to the site. The plan would also include suggestions for greening the project team.

Research Steps:

1. Interview CM to determine safety concerns, schedule impacts, and staging area impacts of excess trash on site and also determine how the trash is left to build up. (1 day to complete)
2. Research current trends, average waste percentages, and execution methods in construction waste management. (2 days to complete)
3. Estimate amount of trash generated for project without waste management plan. (2 days to complete)
4. Investigate options for reducing waste such as requesting minimal packaging from vendors and suppliers and investigate opportunities to purchase items with recycled content and/or reclaimed materials from other projects. (5 days to complete)
5. Evaluate site impacts of implementing a construction waste management plan by developing a new site plan showing locations of additional dumpsters and logistics of implementing a construction waste management plan on the floor plan. (1 day to complete)
6. Estimate cost of implementing construction waste management plan in terms of additional dumpsters, labor, and tipping fees. (1 day to complete)
7. Evaluate anticipated schedule reductions of implementing a construction waste management plan through interviewing the CM. (2 days to complete)
8. Calculate tonnage of trash saved from landfill and present cost savings on tipping fees. (1 day to complete)

9. Evaluate anticipated LEED credits that would be earned in terms of construction waste management and recycled content to determine value added to the project. (1 day to complete)
10. Develop prototype construction waste management plan including informational brochure to communicate a construction waste management plan to designers and builders. (2 days to complete)

Expected Outcome/Conclusions:

Implementing a construction waste management plan is expected to earn acceptance by the project team and spark creative thinking. The change in thinking will result in a successful reduction in construction delays, safety concerns, and tipping fees. If implemented in the beginning, perceived hindrances by builders can be overcome by maintaining a positive flow of trash removal, which will help create a positive construction atmosphere, increase team morale, improve productivity, and promote efficiency by maintaining the appearance of a well organized project. Although hard to quantify the full value of the program, the benefits to the CM and builders include creating a positive image in the owner's eye during inspections, invitations to bid on future projects, long term reductions in operations costs, an environmental marketing advantage, and overall environmental stewardship. This proposed plan is also anticipated to earn the project additional LEED credits.

Moreover, it is anticipated that a clear and affordable construction waste management plan will improve site safety. The reduction or elimination in site clutter will improve productivity by reducing loss time due to unworkable areas of the site. If the plan is well developed and achievable, it may uncover significant cost and time savings that could potentially be passed on to the owner. Additional environmental benefits due to reduced landfill waste are also anticipated; existing U.S. landfills have less than 20 years of capacity remaining.

Analysis Description IV-Water Efficient Landscaping:

Breadths Covered:

Sustainability, Mechanical, Construction, and Architecture

Background:

Ingleside at King Farm is pursuing LEED certification, which is being tracked in part by the owner's son. Recent correspondence, with him uncovered a concern with the current design not being able to achieve the LEED certification. Since the idea to pursue LEED certification for Ingleside at King Farm was thought of after design had already begun, it will be more difficult to achieve the foreseen credits. In order to achieve many of the available LEED credits, considerations must be made during the design phase. In this case, water efficient landscaping is something that might be possible to implement late in the game.

Problem/Opportunity Statement:

The plants called for in the drawings are believed to be large consumers of water and costly to maintain. In an effort to offset the lack of early LEED planning, water efficient landscaping can be investigated since a change in the landscape design will not likely have adverse affects on the currently designed building systems.

Conservation is ever growing in terms of water usage. Wasted water also consumes unnecessary energy, takes away from the local water tables, and costs owners in utilities. An opportunity to reduce overall water consumption in a project is present in low flush toilets, waterless urinals, and low flow shower heads, but is sometimes overlooked in designing the landscaping around the building in an effort to create curb appeal. Introducing foreign species of plants to the landscape design can bring a "taste of the tropics" to a project, for example, but introducing a tropical species to a project in the D.C. Metropolitan area calls for consideration of the required care for that species.

Proposed Solution:

The proposed solution is simple for this analysis. It involves evaluating the current landscape design to determine areas where curb appeal and water reduction can be balanced. Utilizing more native flora and fauna from local nurseries and growers should be the focus with this analysis, which will contribute to the LEED certification.

Research Steps:

1. Develop spreadsheet with space to compare currently specified and proposed species, quantities, unit price, planting methods, and water consumption for currently specified landscaping. (2 days to complete)
2. Research weather for location to determine average rainfall during normal season and average rainfall during droughts. (1 day to complete)
3. Research native flora and fauna for opportunities to reduce or replace some of the currently specified large water consuming species in the spreadsheet. (2 days to complete)
4. Develop multiple proposed landscaping schemes with sketches, renderings, and/or photographs. (3 days to complete)
5. Evaluate site impacts of staging and schedule sequencing of each landscaping scheme. (1 day to complete)
6. Compare material cost of currently specified design to alternative landscaping schemes. (1 day to complete)
7. Compare labor costs, duration of construction, and constructability of current design to alternative landscaping schemes. (1 day to complete)
8. Estimate anticipated schedule reductions for alternative landscaping in terms of procurement. (2 days to complete)
9. Evaluate alternative landscaping schemes for anticipated LEED credits achieved in terms of water reduction and efficiency. (1 day to complete)
10. Develop a score card to show added value and compare the curb appeal of current design to alternative landscaping schemes based on basic principles of landscape design; color, form, line, scale, and texture. (1 day to complete)
11. Review alternative landscaping schemes with landscape architect and owner for acceptance and propose the best option. (5 days to complete)

Expected Outcome/Conclusions:

Residents of an area often enjoy state parks for the native flora and fauna, which offer a natural curb appeal. A building that is designed to blend into a neighborhood in a native sense can offer a "taste of home" that also has a natural curb appeal. Water efficient landscaping is expected to sustain a healthy site and living condition for the residents, which also aligns with the goals of the owner. The use of more native flora and fauna will require little to no fertilizers or chemical pest control to maintain root structure and physical appearance, which will attract native bird species, butterflies, and other desirable insects acting as natural pest control. A reduction in water usage will save operations and maintenance costs to the owner. The new design will require less procurement time and result in a lower first cost for the owner. As the expected outcomes of the other analysis topics, this proposed design is anticipated to earn the project additional LEED credits.

Incorporating a water efficient landscaping plan is also anticipated to improve constructability since most alternatives will include native species, which should not require extensive labor to plant. It may accelerate the schedule since native species will be easier to acquire and will have shorter lead times due to procurement of local plants. Saving the owner first cost, saving lifecycle costs, and adding LEED credits to the project adds value to the project.

Weight Matrix

The weight matrix below is designed to provide an anticipated percentage of workload in each analysis area to maintain focus with the senior thesis project.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Building Envelope Performance	5%	10%	5%	5%	**25%**
Mechanical System Design	5%	10%	18%	2%	**35%**
Construction Waste Management	10%	10%	-	2%	**22%**
Water Efficient Landscaping	5%	8%	3%	2%	**18%**
Total	**25%**	**38%**	**26%**	**11%**	**100%**

Appendix 1 - Breadth Studies

Breadth is covered in all of the analyses in some form, but some of the analyses require additional investigation to fully demonstrate breadth. In particular, two breadths will be further addressed in order to maintain focus; Sustainability and Mechanical System Design. The focus on sustainability will be addressed in each of the analyses and the mechanical system design will be addressed primarily in *Analysis Description II*.

Sustainability:

The first area of breadth will be the overall sustainability of the project, a sustainable architecture breadth. It will focus on schedule and budget impacts of implementing additional or alternative features, materials, and construction methods into Ingleside at King Farm in order to acquire some of the LEED credits that are not currently attainable. Some additional or alternative features include, but are not limited to, an improvement in material selection, a reduction in energy consumption, and a consideration of life cycles.

This breadth will suggest the appropriate phase of the project that such features should be considered in order to be successfully implemented. In addition, the breadth will offer suggestions on greening the project team to allow a smooth and sustainable design and construction process. Each of the *Analysis Descriptions* are already leaning toward developing a more sustainable Ingleside, which not only aligns with the goals of the owner, but allows for integration of the various Analysis Descriptions.

Problem/Opportunity Statement:

Sustainability is sometimes viewed as a gimmick or a fad that ends up leaving owners wondering what happened with their project and leaving them with less money in their wallets. It's closed minded thinking that sparks these ideas, which are not always generated explicitly from an owner's point of view. Designers and contractors often don't take the time to learn about sustainable practices and can easily fall into a closed minded mentality. Seeing the other side of the fence, like the more than 30,000 attendees and 1,400 exhibitors at Greenbuild, one can quickly be enlightened and understanding why sustainability is not a fad. Nature has practiced the concept since its existence and is capable of healing itself under natural circumstances. Many areas of the earth have evolved into unnatural habitats and daily human population has grown exponentially along with human consumption. Some believe that this unnaturalness and exponential growth has caused an environmental condition in which earth is not capable of healing before its resources are spent, so human nature has forced us to seek other resources. Seeking other resources is only a short term solution, but each resource that's harvested from the earth has an impact in some way. No one is really certain where the line must be drawn before earth can't sustain human existence as it is known in today's day in age.

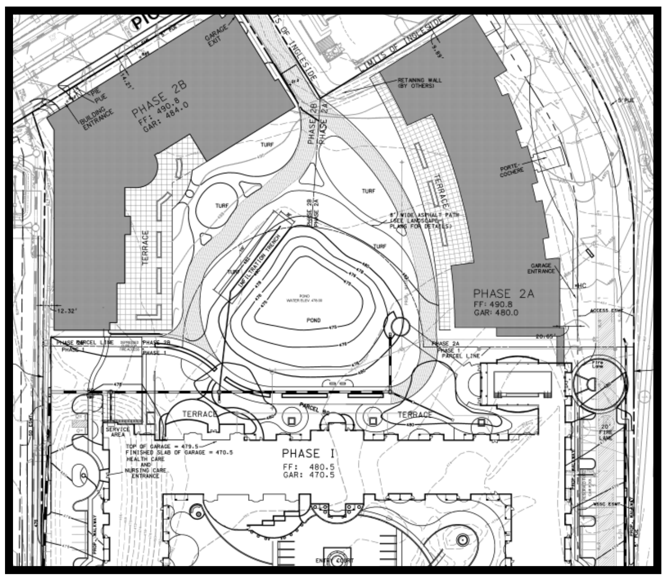
We are certain that there are many types of crisis in the world and many of them relate to the economic status of the countries we live in. The fundamentals of economics are all about supply and demand, which has to do with the quantity of resources available to manufacture products that consumers desire. Desires will soon be unanswered if there is not a concerted effort to take advantage of every opportunity possible to reduce or eliminate wasted resources and increase efficiency. The United States Green Building Council has been tossing around the idea of restorative projects, or buildings that replenishes as many resources as they harvest, which may also be known as carbon neutral. A breadth study of some of Ingleside at King Farms's systems will be step toward neutrality.

Mechanical System Design:

Evaluating the mechanical system design will also require a significant amount of additional work to demonstrate breadth. Part of the goal in this area is to be able to incorporate the site pond into the mechanical system as a water source for a geothermal heatpump system. Ingleside at King Farm is built on a large and fairly open site with plans of constructing a site pond to be used for rainwater retention and resident enjoyment. This presents a great opportunity to utilize the body of water for mechanical purposes.

Problem/Opportunity Statement:

Again, the sustainability theme arises in demonstrating this mechanical breadth, but more importantly, it addresses opportunities for improving the mechanical system design. As alluded to, the "concept" of sustainability encompasses many ideas of environmental protection in the form of energy reduction and energy efficiency. Ingleside at King Farm's large site is potentially underutilized since there are no current plans to build Phase 2A or Phase 2B of the project, which makes the use of land rather inefficient while the owner awaits a positive swing in the housing market. The image to the right shows the site pond centered between Phase 1 at the bottom and Phases 2A and 2B at the top. This is a good location, but it is anticipated that incorporating a water source geothermal heatpump system into the mechanical design will require a larger body of water to satisfy heating and cooling loads produced by Ingleside on design days, therefore; the pond must cover a larger area and/or be excavated deeper.



Additionally, the system design consists of localized heatpump units at each residence. Compared to a centralized system, this is labor intensive and costly in terms of equipment. Individual localized units at each residence may prove to be more energy efficient since most of the thermal energy conversions take place at the unit, which results in less heat gain or heat loss in distribution piping; this would require a mechanical engineer to be compare the gains and losses of a centralized system. Although, the localized units may be more energy efficient, a centralized system could prove to save energy if connected to the pond loop system.