INTRODUCTION

This Mechanical Feasibility Study will address the current mechanical system and try and suggest an alternative approach for a mechanical system design. The Grand Oaks assisted living facility, although different in aesthetics and overall purpose of care; is associated with and owned by, Sibley Memorial Hospital. In the year 2000, the existing building finished construction and began operation. Sibley Memorial Hospital has a central plant facility that serves the Hospital, Skilled Nursing Facility, and Existing Assisted Living Facility. The existing facility receives cold water for cooling, as well as medium pressure steam for heating hot water, and domestic hot water, via underground extension lines from the central plant. Essentially, the existing facility is not paying to produce cold water for cooling or hot water, for heating hot water and domestic hot water. They are charged a marginal fee for the energy they consume, but the building does not have onsite capabilities to produce cold or hot water for cooling and heating. With that said, it is no wonder they have relatively low electric bills. So, when trying to compare the needs and consumption of the existing facility and extrapolate a reasonable value for the energy needs of the new addition, there are some large assumptions that need to be made. Specifically, when trying to determine a demand charge associated with a building that is not currently built, (i.e., the new addition from which my Mechanical Feasibility Study addresses). This will be addressed in more detail later in this report.

EXISTING SYSTEM

The main air distribution of the Grand Oaks addition is achieved via four pipe fan coil units. All units have forward-curved 3-speed centrifugal fans sized at medium speed to minimize fan noise within the space. The FCU in living areas are exposed floor-mounted types with stack-style vertical cabinets. Air is 100% re-circulated. FCU are of the two-coil, four pipe style, suitable for chilled water and heating hot water service, with chilled water supply and return piping, and hot water supply and return piping. The ventilation requirement is provided by either wall or ceiling mounted supply air registers connected to a ducted 100% outside air ventilation distribution system. Exhausted air is removed through ceiling mounted registers located in toilet rooms. A centralized energy recovery air-handling unit serves both the supply and return air to increase the efficiency of the system. Chilled water is provided via an air-cooled roof-mounted chiller. The chiller is a hermetic helical rotary machine, featuring multiple air-cooled condenser fans, modulating compressor unloading, and independent refrigerant circuits. Hot watered is supplied via two instantaneous steam-fired domestic hot water heaters that receive medium pressure steam from Sibley's Boiler Plant.

ISSUES WITH CURRENT SYSTEM

The main concern with this system is the roof mounted air-to-water chiller that has a nominal cooling capacity of 140 tons and a maximum input power of 182 kw. Given that the chiller has multi-stages of air cooled condensing fans, and independent refrigerant circuits, certainly helps with the system efficiency. But it is still a unit that has the potential to consume large amounts of electricity and add to the life-cycle operating cost of the building. Electricity is becoming more of a volatile commodity of which, the Baltimore/Washington area will realize in the not to distant future.

ELECTRICITY RATES

In an article found in the Washington Post(referenced in Appendix B): "Customers in the Baltimore/Washington area receiving utility service from either Potomac Electric Power Company(Pepco) or Baltimore Gas and Electric (BGE), are expected to see large increases in utility rates effective the summer of 2006. In an article from the Washington times, the Maryland Public Service Commission was quoted at saying customers could expect rate increases in the range of 37-72% increases over current utility rates. The reason for this large rate increase is by in large to a two part problem. In 1999, Maryland deregulated its electric utilities requiring them to segregate their supply and distribution services. In 1993, law makers put a cap on utility rates and set them 6.5% below the current 1993 utility rates. Since then utility company rates have continued to rise due to inflation and the stresses placed on generation plants to meet demands. The overall volatility of the price of energy is further escalated due to the "War Against Terror" and struggles with Western Oil production, and the horrific Hurricanes that swept through the Southern United States in the Summer of 2005. The hurricanes severely damaged the Gulf Coast infrastructure, of which about 1/3 of the nations energy runs through. When taking into consideration energy on a global and national level, as well was at the local sector, electricity rates could not help but be affected."

POSSIBLE SOLUTION

With all that said, I looked to a Mechanical System that could be implemented that would eliminate the chiller unit, while still operating along the same lines as the current fan-coil units. After talking with some individuals in the industry, I decided to explore the possibility of water-to-air heat pumps with a ground couple closed-loop. In this application, I will have a closed horizontal loop throughout the building that will have a variable rate pump and a 3-way diverting valve. If this horizontal loop falls outside the set point range of 40-70 degree F, the diverting valve opens, allowing a side stream straight pump to send the water/antifreeze solution down into the ground to recondition the loop. This ground loop will consist of a series "wells" made up of vertical bore holes filled with U-bed pipes. Well depth can range from 100-250 feet, I will

suggest using well depth of 160 feet. Long hair-pin shaped loops with U-bend pipes are put into the wells, then plugged or grouted, and connected to headers in a trench leading back to the building. It is my suggestion to place the series of vertical loops under the building foundation. All the drilling and pipe runs can be done prior to building construction, and by utilizing the space under the building, I am not affecting the ground area outside the building.

ADVANTAGES OF GEOTHERMAL SYSTEM

The main advantage of this system is the energy savings that it can provide when compared to the current mechanical system. As long as the horizontal loop is within its set point range, the side stream pump is not running, thereby saving energy. Given the nature of this building, assisted living; with residents having individual heat pumps in their bedrooms and living areas, this particular heat pump configuration is ideal. The heat pumps are completely independent of one another; one could be in cooling mode while the other is heating mode. So, the only electricity that is used while the horizontal loop is within its set range is to move BTUs throughout the building. Individual heat pumps are either taking BTUs out of the loop or putting BTUs into the loop. Another advantage of this system is that all the equipment is inside the building, unexposed to outside whether conditions. This closed loop system also uses limited amounts of water compared to an open loop system, which needs a large supply of clean, fresh water.

EQUIPMENT ELIMINATION

With this proposed installation if geothermal heat-pumps, several pieces of the current mechanical design can be eliminated.

- (1) Air- Cooled Helical Rotary Screw Chiller
- (2) Shell & Tube Steam-to-Water Converters
- (1) Duplex Condensate Receiver Pumpset
- (63) – 1 ton – 4 pipe fan coil units
- (26) – 2 ton – 4 pipe fan coil units
- (2) Heating Hot Water Pumps
- (1) Heating Hot Water Expansion Tank
- (1) Heating Hot Water System Bypass Water Filter
- (1) Heating Hot Water Filter
- (1) Cold Water Expansion Tank
- (1) Cold Water System Bypass Filter
- (1) Cold Water System Shot Feeder
- (650) ft - *approx(from rough take-off)* of Heating Hot Water Supply Piping
- (650) ft - *approx(from rough take-off)* of Heating Hot Water Return Piping

Immediately one can see that by stepping down to a 2-pipe closed loop system from that of a 4-pipe system simplifies the Mechanical Equipment needed. After assuming that these were the pieces of equipment that could be theoretically eliminated, I sought out to find a combination of heat pumps that would satisfy the load requirements for the building.

HEAT PUMP SIZING

Based on the load summary provided by the Mechanical Engineering Firm, there is a total load of 1008.9 MBH sensible cooling, 49.8 MBH latent cooling, and 582.4 MBH heating. So, if I sized the Geothermal Heat Pumps in accordance with this, seeing that the cooling load is the largest, I would need the capacity to handle 1058.7 MBH/12 = about an 89 ton system. Refer to the chart below for the Total Load Summary. I was not confident that this was the "magic" number I was looking for because I was uncertain as to what context, other than square footage that went into the making of this number. I then looked at the characteristics of the current fan-coil units, which are referenced in full detail in Appendix B. After doing this, I saw that again there was a need for a larger cooling capacity than heating capacity. The total MBH from the summation of the individual fan-coil units was 1238.6 MBH. Assuming that these units were sized correctly, I began to find water-to-air heat pumps with similar operating characteristics and the same MBH rating. After doing this I was able to quantify the energy associated with the fan-coil units operation to that of the heat pumps.

				TOTAL LOAD			
Space Name	Mult	Area (sf)	Total Area (sf)	Cooling Sensible (MBH)	Cooling Latent (MBH)	Air Flow (cfm/rm)	Heating Load (MBH)
Stairwell	2	128	256	0	0	0	13.4
1st Floor	1	2028	577	20	3.4	800	7.8
2nd Floor	1	12564	12564	328.6	15.5	17501	219.3
3rd Floor	1	12564	12564	326.9	15.5	17329	169
4th Floor	1	11579	11579	333.4	15.4	17958	172.9
TOTAL FLOOR AREA			**37,540**	1008.9	49.8	53588.0	582.4

HEAT PUMPS		CHILLED WATER				HOT WATER HEATING COIL				POWER SUMMARY HP		POWER SUMMARY FCU	
DESG	NO. OF UNITS	TOTAL CAPACITY (MBH)		GEH/GEV MODEL NUMBER	kw/unit	MINIMUM CAPACITY (MBH)		GEH/GEV MODEL NUMBER	kw/unit	TOTAL FLA	TOTAL KW	MAX OPERATING POWER (kw)	TOTAL (kw)
HP-2-1 THRU HP-2-2	2	14	28	12	1.4	10	20	6	0.831	10	2.77	0.27	0.54
HP-3-1 THRU HP-3-9	9	23	207	24	3.2	14.6	131.4	12	1.385	102.6	28.4202	0.44	3.96
HP-4-1 THRU HP-4-5	5	26.4	132	24	3.2	14.6	73	12	1.385	57	15.789	0.44	2.2
HP-5-1 TRHU HP-5-16	16	7.6	121.6	6	0.8	9.8	156.8	9	0.9972	48	13.296	0.115	1.84
HP-6-1 THRU HP-6-28	28	10.7	299.6	9	1	9.8	274.4	9	0.9972	100.8	27.9216	0.2	5.6
HP-7-1 THRU HP-7-12	12	12.6	151.2	12	1.4	9.8	117.6	9	0.9972	60	16.62	0.2	2.4
HP-8-1 THRU HP-8-5	5	15.2	76	15	1.5	10.2	51	9	0.9972	27.5	7.6175	0.325	1.625
HP-9-1 THRU HP-9-12	12	18.6	223.2	18	2	12.2	146.4	9	0.9972	85.2	23.6004	0.472	5.664
Subtotals	89		1238.6				970.6			491.1	136.0347		23.829
ERU-1		CHILLED WATER				HOT WATER HEATING COIL				POWER SUMMARY			
DESG	NO. OF UNITS	TOTAL CAPACITY (MBH)			kw/unit	MINIMUM CAPACITY (MBH)		EXWA MODEL NUMBER	kw/unit	TOTAL FLA	TOTAL KW		
HP-1-ERU-1 THRU HP-2-E	2	SIZED BASED ON HTG LOAD				246.3	492.6	240	12.42	-	24.84		
									Total	**491.1**	**160.8747**		

The main power consumption for a fain coil unit comes from the motor, which operates a blower, that is responsible for pulling air through the unit so that it can be conditioned by either the heating coils or cooling coils, depending on the need of the space. These units themselves are not consuming large amounts of electricity to produce the heating and cooling requirements, the Mechanical Equipment that is supplying the chilled water or hot water is where the real energy consumption takes place. So when addressing the energy consumption of the fan coil units, I assumed that the kw rating on the motor was at maximum efficiency, therefore that was the kw I used to find their power consumption. Since there is no direct efficiency factor associated with the FCU, the efficiency of the equipment serving these units will be taken into consideration when that equipment kw are quantified.

The main power consumption for the heat pumps actually does occur at the unit itself. Some of the instrumental pieces of the heat pump are: a reciprocating compressor, Coaxial Water-to-Refrigerant Coil, Expansion Valve and Reversing Valve, Blower Motor, Air-to-Refrigerant Coil. The Expansion valve plays an important role in monitoring the refrigerant flow through the circuitry to achieve desired heating or cooling. The expansion valve device allows the exact amount of refrigerant required to meet the coil load demands, which increases the efficiency of the unit. (www.trane.com)

As it can be seen by the rather lengthy list, the heat pumps are slightly more complex than the fan coil units. But with all these components working in unison, the efficiency is quite high. For the purpose of this study, I have used an E.E.R for the heat pumps of, 14.8, which corresponds to the average E.E.R. for the different heat pumps I selected to take the place of the fan coil units.

Another thing to consider by comparing the current mechanical system to that of the geothermal heat pump system I propose is the Energy Recover Air Handling Unit, denoted ERU-1, that provides the outdoor air requirements for the building. This unit is located on the roof and works by mixing outside/supply air with return/exhaust air, whereby it can save energy by not conditioning 100% outside air. The unit still needs chilled water and hot water to service its cooling coils and heating coils. I did not look into an air handling unit that uses only one water source. Instead I made some assumptions based on the chilled water cooling coil needs and the hot water heating coil needs. The cooling coil has a total capacity of providing 300 MBH, while the heating coil has a minimum capacity of providing 400 MBH, (please refer to Appendix B for a schedule of this piece of equipment). So, I sized two water-to-water heat pumps that could satisfy the 400 MBH requirement of the heating coil. I found that a Trane model EXWA-240 could provide 246.3 MBH, so I assume that two of these units would satisfy the 400 MBH requirement of the ERU-1. Because I sized this unit for heating, the efficiency rating is based on C.O.P. rather than E.E.R. I assumed the kw associated with these particular heat pump units already took into consideration the efficiency of the heat pump.

POWER COMPARISON OF TWO SYSTEMS

After I found the number of heat pumps needed to satisfy the MBH needs that the current system specifies, I could begin to compare the power consumption of current system; with all of its associate equipment, to that of the geothermal heat pumps I propose implementing. One thing to note: I am still maintaining the chilled water pumps that have the capacity to push 360 GPM. I mentioned earlier that for the horizontal loop, I would need a variable rate pump, and a side stream straight pump for when I need to call on the ground for either heat sinking or heat extracting purposes. For the sake of simplification, I am assuming that that these two cold water pumps have the capacity needed to push the fluid through my closed loop system. That is the reason that I am only considering the power that the hot water pumps consume in the Current System Comparison.

Mechanical System Power Comparison												
Current System							Proposed System					
Design	Equipment	EER	ton	kw	MBH	kw based on EER	kw based on EER	MBH	kw	EER	Equipment	Design
CH-1	Air-Cooled helical Rotary Screw Chiller	10.3	140	181	1680	163.1068	24.84	400	24.84	5.8 - C.O.P	Energy Recovery Air Handling Unit - Heat Pumps	ERU - HP
CONV-1	Steam Converter				2200							
CONV-2	Steam Converter				2200							
CR-1	Duplex Steam Condensate Reciever Pumpset	1		1.119	0	1.119						
FCU	4-Pipe Fan Coil Units	1		23.829	1238.6	23.829	83.6891892	1238.6	91.99	14.8	2-Pipe Water-to-Air Heat Pumps	H.P.
P-HW1	Htg Hot Water Pump	1		5.595	0	5.95						
P-HW2	Htg Hot Water Pump	1		5.595	0	5.95						
	Htg Hot Water Expansion Tank											
	Htg Hot Water System Bypass Water Filter											
	Htg Hot Water System Shot Feeder											
	Cold Water Expansion Tank											
	Cold Water System Bypass Water Filter											
	Cold Water System Shot Feeder											
TOTALS				217.14	7318.6	**199.9548**	**108.529189**	1638.6	116.83			
						-163.1068						
				Winter Months		**36.848**						

PURPOSE OF THIS STUDY

Ultimately, the goal of this feasibility study is see if there is an energy savings among the two systems. So based on the MBH and EER(which tells me the amount of electricity required by an air conditioning unit to provide the desired cooling level in BTUs. The higher an EER, the more energy efficient a unit is.), I was able to associate a kw rating with a specific piece of equipment. Because the chiller is a very important piece of equipment in this comparison, I wanted to be as accurate as possible when determining the kw it consumes. From the documents and working drawings that I have, no specific manufacturer was specified as the provider of the Chiller unit. I found a model from TRANE that served the specified cooling requirements of 140 ton capacity; which has a standard high efficiency E.E.R rating of 10.3. The addition utilizes a medium pressure steam service that is receives from Sibley Memorial Hospital's Central Plant. After talking with Dave Bracket, a Mechanical Engineer at Leach Wallace, I learned that the steam this building receives, as well as the existing building, is excess steam. The central plant does not change its boiler operations based on these buildings, the boilers are going to produce the same amount of steam whether these building exist of not. That, in and of itself, makes a dollar-to-dollar energy savings comparison hard because they are not operating with the same cost of production. I thought about trying to convert the steam consumption into a kw number, and then associate a marginal price with that kw rating. But I wanted to keep the comparison as realistic

as possible, so I decided to completely exclude the energy associated with generating the steam, and see how the numbers worked.

As one can see looking at the numbers, the Current Mechanical System with a the chiller unit and all associated equipment has a total kw consumption based on E.E.R. of 199.95 kw, and the heat pump system I propose has a kw consumption of 108.53 kw. Keep in mind, this is a "Feasibility Study", so I am not saying these are the exact numbers these two installations have associated with them, but I feel that I am making conservative assumptions and decisions, and these are the numbers I was able to generate based on my assumptions.

ENERGY COMPARISON

Now that I have the "magic" KW numbers, I can compare the annual electrical bills of the two systems, the current vs. the proposed, and see if there is a savings with the geothermal heat pump units. As I mentioned before, this building has yet to be constructed, so there are no previous electric bills that I can use to find kwh usage, or a kw demand. So, when making the comparison, I assumed that all systems were running 24 hours a day. This building will receive electrical service from PEPCO (Potomac Electric and Power Company), and will be classified under the rate structure of, Time Metered General Service-Low Voltage Schedule "GT-LV". Refer to Appendix B for this particular Rate Schedule.

TARIFF AGREEMENT

-*see following page*

From the tariff agreement for PEPCO, service DC-GT LV:

Rating Periods
Weekdays - (Excluding Holidays)

On-Peak Period		12:00 noon to 8:00 p.m. (8)
Intermediate Period		8:00 am to 12:00 noon
	and	8:00 pm to 12:00 midnight (8)
Off-Peak		12:00 midnight to 8:00 a.m (8)
Saturdays, Sundays and Holidays		
Off-Peak Period		All Hours

For a 7 day week	
On-Peak	40hrs
Intermediate	40hrs
Off-Peak	88hrs

Billing Demands - (270kw) for Existing Building
On-Peak (Summer Billing Months Only) - The billing demand shall be the maximum thirty (30) minute demand recorded during the on-peak period of the billing month (**202.5**)

Maximum (All Months) - The billing demand shall be the maximum thirty (30) minute demand recorded during the billing month **(202.5)**

ASSUMPTIONS WITH ENERGY COMPARISONS

Because the Addition has not yet been built, I could not look to past electrical bills to find a reasonable Demand Charge, so I looked at what the past electrical bills of the existing building, and saw that they had a demand charge of 270kw. As was mentioned previously, the existing building receives all chilled water for cooling and all steam for heating from Sibley Memorial Hospital's Central Plant. So, they are not locally (on-site) seeing an electrical charge for producing chilled water and hot water. So, I am going to use 75% of that kw demand charge for this building, this is where the 202.5 kw number comes from in the figure above. I am assuming that because I am using a geothermal system, the demand charge will be lower because the heat pumps can move BTUs throughout the building. Also the fact that the ground temperature is a relatively constant temperature, there is not a large energy use associated with producing the horizontal loop temperature. With the air cooled chiller, there could be a temperature differential

of outside air to a conditioned chilled water temperature of 35 degrees F, but for the purpose of keeping the comparisons the same; I used the same demand for each electric bill.

Another assumption that I am making is that the chiller is operating at full capacity to produce chilled water, so the kw I use in the electric bill is the one documented in the Mechanical System Power Comparison Chart. Also, the FCU operation explained previously allowed me to make the assumption that the kw consumed by a FCU is soley from the motor, so if the unit is on, its using the specified number of kw. The FCU does not influence the chilled water loop or the heating hot water loop temperature, it is only running that water through heating or cooling coils, depending on the service need.

For the heat pumps: Given the fact that I am using a ground-couple closed loop system to produce my horizontal loop temperature a diversity factor of 60% will be applied to the kw rating that I calculated. This is because I am not using fossil fuels or electricity to charge my loop, I am using the ground as a heat exchanger; and the fact that the heat pumps have the ability to take BTU's from or put BTU's into the loop, de-rating the kw makes sense.

Based on these assumptions and the rate structure of Time Metered General Service – Low Voltage Schedule "GT-LV", I developed a monthly energy bill for the Current Mechanical System, and one for my Proposed Mechanical System. From these two comparisons one can see the cost savings of using the heat pump system that I propose verses the current system.

CURRENT SYSTEM ELECTRIC BILL

Potomac Electric Power Company
District of Columbia
Standard Offer Service Rates
Effective February 8, 2005 Through May 31, 2006

TIME METERED GENERAL SERVICE - LOW VOLTAGE SCHEDULE "GT-LV"

CURRENT SYSTEM

Enter the kw for the desired system	199.954796	Billing Months of June-October		kw	Billing Months of November-May		kw
Generation				199.9547961			36.848
Kilowatt hour Charge							
	On Peak	$0.08682	per kwh	$694.40	$0.06889	per kwh	$101.54
	Intermediate	$0.06632	per kwh	$530.44	$0.07239	per kwh	$106.70
	Off Peak	$0.05645	per kwh	$993.30	$0.05757	per kwh	$186.68
Kilowatt Charge							
	On Peak	$0.84507	per kw	$171.13			
	Maximum	$0.30248	per kw	$61.25	$0.30248	per kw	$61.25
Transmission							
All kwh		$0.00111	per kwh	$37.29	$0.00111	per kwh	$6.87
Kilowatt Charge							
	On peak	$0.71000	per kw	$141.97			
	Maximum	$0.59000	per kw	$119.48	$0.59000	per kw	$119.48
Distribution							
Customer Charge		$20.93000	per month	$20.93000	$20.93000	per month	$20.93000
All kwh		$0.01029	per kwh	$345.67	$0.01029	per kwh	$63.70
Kilowatte Charge							
	Maximum	$4.80000	per kw	$972.00	$4.80000	per kw	$972.00
Delivery Tax		$0.00770	per kwh	$258.66	$0.00770	per kwh	$47.67
Public Space Occupancy Surcharge		$0.00154	per kwh	$51.73	$0.00159	per kwh	$9.84
Reliability Enegy Trust Fund		$0.00065	per kwh	$21.84	$0.00065	per kwh	$4.02
Generation Procurement credit		$0.00002	per kwh	$0.67	$0.00002	per kwh	$0.12
Sub-total				**$4,420.74**			**$1,700.80**
	Subtracting out the cost that are only added once to the monthly bill			-$171.13 -$61.25 -$141.97 -$119.48 -$20.93000 -$972.00			-$61.25 -$119.48 -$20.93000 -$972.00
Billing for average 7 day week less demand and peak charges				$2,933.99			$527.14
Billing for 1 month less demand and peak charges				$11,735.97			$2,108.57
Billing for 1 month of electrical service				**$13,222.72**			**$3,282.22**

PROPOSED SYSTEM ELECTRIC BILL

Potomac Electric Power Company
District of Columbia
Standard Offer Service Rates
Effective February 8, 2005 Through May 31, 2006

TIME METERED GENERAL SERVICE - LOW VOLTAGE SCHEDULE "GT-LV"

PROPOSED SYSTEM

Enter the kw for the desired system	108.5	Billing Months of June-October		kw	Billing Months of November-May		kw
Generation				65.1			65.1
Kilowatt hour Charge							
	On Peak	$0.08682	per kwh	$226.08	$0.06889	per kwh	$179.39
	Intermediate	$0.06632	per kwh	$172.70	$0.07239	per kwh	$188.50
	Off Peak	$0.05645	per kwh	$323.39	$0.05757	per kwh	$329.81
Kilowatt Charge							
	On Peak	$0.84507	per kw	$171.13			
	Maximum	$0.30248	per kw	$61.25	$0.30248	per kw	$61.25
Transmission							
All kwh		$0.00111	per kwh	$12.14	$0.00111	per kwh	$12.14
Kilowatt Charge							
	On peak	$0.71000	per kw	$46.22			
	Maximum	$0.59000	per kw	$119.48	$0.59000	per kw	$119.48
Distribution							
Customer Charge		$20.93000	per month	$20.93000	$20.93000	per month	$20.93000
All kwh		$0.01029	per kwh	$112.54	$0.01029	per kwh	$112.54
Kilowatte Charge							
	Maximum	$4.80000	per kw	$972.00	$4.80000	per kw	$972.00
Delivery Tax		$0.00770	per kwh	$84.21	$0.00770	per kwh	$84.21
Public Space Occupancy Surcharge		$0.00154	per kwh	$16.84	$0.00159	per kwh	$17.39
Reliability Enegy Trust Fund		$0.00065	per kwh	$7.11	$0.00065	per kwh	$7.11
Generation Procurement credit		$0.00002	per kwh	$0.22	$0.00002	per kwh	$0.22
Sub-total				**$2,346.24**			**$2,104.97**
	Subtracting out the cost that are only added once to the monthly bill			-$171.13			-$61.25
				-$61.25			-$119.48
				-$46.22			-$20.93000
				-$119.48			-$972.00
				-$20.93000			
				-$972.00			
Billing for average 7 day week less demand and peak charges				$955.23			$931.31
Billing for 1 month less demand and peak charges				$3,820.92			$3,725.24
Billing for 1 month of electrical service				**$5,211.93**			**$4,898.90**

CONCLUSION

The purpose of this "Feasibility Study" was to look at the energy savings that might be realized by installing a 2-pipe geothermal heat pump system in place of the Current System, which utilizes 4-pipe fan coil units that receive chilled water supply from a roof-top air cooled chilling unit, and heating hot water supply from two medium pressure steam-to-water converters. The theory behind the geothermal system makes it something of interest to study. The ability to use the relatively constant temperature of the ground as a source of energy makes a strong case when looking at the energy savings a system of this type could afford. As noted, several assumptions had to be made, but with the support and reasons that I gave for making these assumptions, I feel that they are sound, and at times conservative. The final design that I propose will make use of (89) water-to-air heat pumps that are of the size of 1-2 tons, and (2) 20 ton water-to-water heat pumps that satisfy the needs of the Energy Recovery Air Handling Unit. The ground loop will consist of 200 vertically drilled wells, assuming 1-ton capacity per well, spaced 12-feet apart and located under the building foundation. Each well will be filled with U-bent Polyethylene pipe and then back filled with a grouting material. The 2-pipe horizontal loop will be housed on the fourth floor with vertical pipe risers supplying the subsequent lower floors where the various heat pumps are located in individual tenant suites. The current design for condensate return piping will be maintained, and heat pumps will be outfitted with a condensate pipe connection. To avoid any mold or bacteria build up during summer months, when there may be a constant moisture condition present in the condensate pan, the heat pumps will have 13 watt - ultraviolet light that turns on for 15 minutes a day, thereby killing any mold or bacteria spores.

After comparing the two energy bills, it can be seen that the Geothermal System that I propose has the potential to save around $3900/month during the summer billing rate structure, while in the winter month, it could cost around $1600/month more to operate. The geothermal heat-pump design is likely to have a higher initial cost than the current system, but with the suggested energy savings this high initial cost could be offset by annual energy savings afforded by my proposed system. The cost analysis for this system can be found in the Construction Management Report found in the pages to follow. The implications of my proposed mechanical system offer the opportunity to explore a different electrical distribution method to the Assisted Living Facility Addition. With the elimination of the roof top chiller, I eliminate a major piece of equipment that previously influenced the electrical distribution system.