UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Allerton Park and Retreat Center

515 Old Timber Road
Monticello, IL 61856

March 15, 2010

Mr. Suhail Barot
Student Sustainability Committee

Subject: Renewable Energy Grant/Zero-Interest Loan Proposal
Green Allerton Park—Geothermal Project

Dear Mr. Barot:

Allerton Park and Retreat Center (APRC) thanks the Student sustainability Committee (SSC) for the opportunity to submit a proposal for a grant or zero-interest loan[1] in the amount of $25,000. The SSC would join with the Park and the State of Illinois' portion of the American Recovery and Reinvestment Act (ARRA) to install four geothermal systems in four buildings at the Park.

As an attachment, please find the full proposal for this project for the committee's review. Should you have any questions or require further information, please contact me by email at bschleic@illinois.edu or by phone 217-333-3287 x 204. If I am unavailable, please contact Jim Gortner, Associate Director of the Park, email Gortner@illinois.edu and phone 218-333-3287 x 111.

Sincerely,

Barbara A. Schleicher

Barbara Schleicher
Grant Writer and Landscape Designer

[1] A loan request in dependent on approval from Associate Provost Keith Marshall's office because of the current debt load the Allerton Park in trying to pay back.

Allerton Park and Retreat Center
Green Allerton—Geothermal Project
SSC Grant/Zero Interest Proposal

I. **Detailed Project Description**

A. Project Goals

This project is another component of the Green Allerton strategic goal: reducing the Park's and the University's dependence on fossil fuels. We propose to install four ground source heat pumps with horizontal closed loop systems in and around four buildings at the Park. This renewable energy source that is available in the earth at Allerton Park will replace natural gas and electric resistance heating and cooling systems in the Visitor Center, Evergreen Lodge, Gatehouse and House in the Woods. This will result in the reduction of over 815,000 tons of CO_2 emissions.

B. Definition of Sustainability and the Relationship of the Project to this definition

The Green Allerton Initiative is a comprehensive approach to sustainable operations of the Park's facilities. We are attempting to operate our facilities in a manner that will meet our current needs while preserving the environment so that these needs can be not only in the present, but in the indefinite future.

Geothermal energy represents an enormous, underused power source that provides clean, renewable energy in virtually unlimited supply. The constant temperature of the Earth creates underground sources of heat, hot water and steam which become fuel to produce geothermal energy[1]. Ground source heating and cooling can be installed anywhere in the United States using a geothermal heat pump, a highly efficient energy technology that takes advantage of the constant heat stored in the Earth or in ground water into a building during the winter and transfer it out of the structure and back into the ground during the summer.

C. Feasibility Evaluation

The following is the criteria that the Park staff used in the development of this project. This was done in order to determine the feasibility of such a project and to ensure the success of installing an alternative energy system. All of the points listed had to have positive results or the project would not have been proposed to funding sources.

1. Evaluation of energy expenses and CO2 emissions by structure and areas to conserve

[1] U.S. Environmental Protection Agency. "Geothermal Energy" Region 1: EPA New England. http://www.epa.gov/regional/eco/energy/re_geothermal.html

2. Evaluation of alternative energy options for the selected structures and historical nature of the buildings and landscape
3. Consultation with geothermal industry experts and software for proper area selection, sizing for systems and loop fields, cost estimates and EPA approved equipment, piping, materials and supplies.
4. Evaluation of the landscape and Park hydrology for the installation of the closed loop fields
5. Assessment and/or training needs of the Park staff for installation, controlling and maintenance of the systems
6. Sought appropriate funding partners for the development and installation of the project
7. Sought authorization from appropriate university units for the installation of these systems at the Park.

D. Design Details

Appendix A contains the following system design information for each of the buildings where the geothermal system will be installed:

- Scope of work
- Project Specifics
- Horizontal Trench specifications and calculations

In addition, information is provided regarding the sources for the calculations, project cost estimates and staff technical accreditations.

E. Longevity and/or Permanence of Project Results within the University

This ground source heating and cooling systems will be replacing 25-30 year old forced air or resistant heating and cooling systems. We are intending to install GEOMAX 2 two stage geothermal heat pumps. The manufacturer of the ground source heat pump systems (GSHP) stated that the life expectancy of the closed loop systems' piping and material is 50 years. The heat pump's life-expectancy is 8 years with the actual average time is 12-15 years with proper inspections and maintenance[2]. The anticipated savings would continue throughout this life cycle. This type of project (similar building square footage and available land) could be replicated on campus and an example of alternative energy source for local communities.

F. Project Governance

The following staff will be involved in the project administration, financing and installation:

[2] "GEOMAX2 Two Stage Geothermal Heat Pump" brochure HT Series Vertical Comfort-Aire by Heat Controller, Inc. www.heatcontroller.com

Keith Marshall, Associate Provost for Enrollment Management
Campus supervisor of APRC, approval of financial agreement, in particular any loans

Jim Gortner, Associate Director at APRC
On-site supervisor, management of budget and expenditures and authorizes construction projects

Richard Burton, Assistant Manager of Facilities
Technical consultant and geothermal project manager

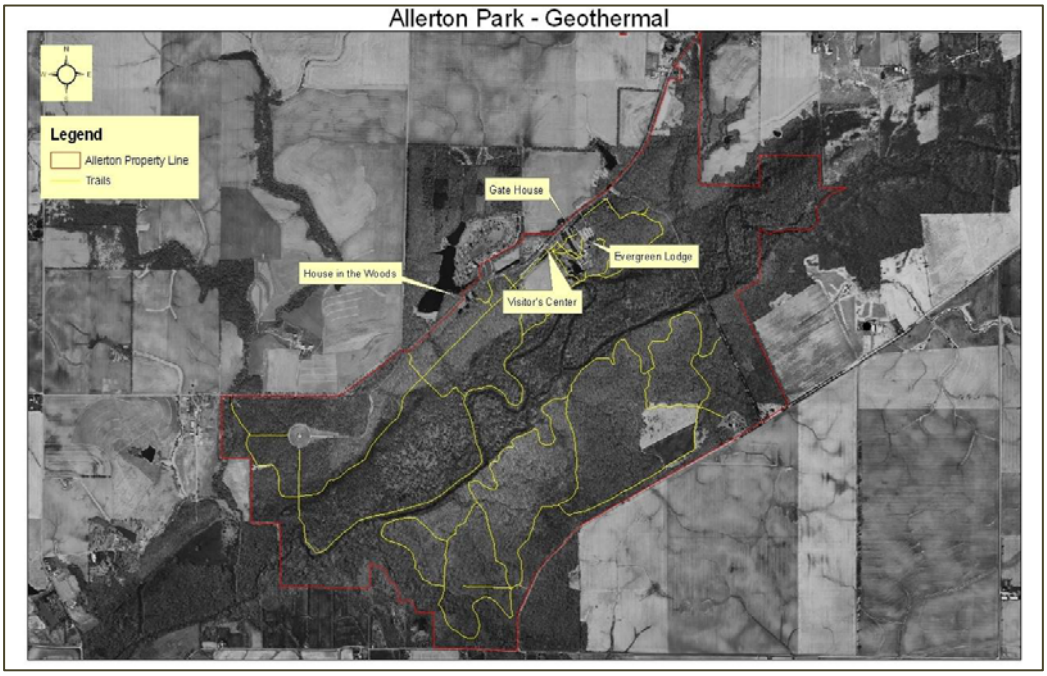
Derek Peterson, Grounds Foreman
Supervision of trenching and landscape preparations

Tim Tracy, Business Operations Specialist
Accountant for geothermal project

Barbara Schleicher, Grant Writer and Landscape Designer
Grant coordinator, Staff consultant for landscape and historic preservation and supervisor of student intern assistants(3)

G. *Location*

The project will be located about 25 miles west of the Urbana campus of the University of Illinois in Piatt County. Allerton Park and Retreat Center (APRC) was gifted to the University in 1946 and has been a wonderful resource for research, educational opportunities and public recreation. The first aerial photo below illustrates the locations of the four building that would have the proposed geothermal systems within the Park. Following this photo are the aerial photos of each site building and where the horizontal closed loop field would be located. A photo of each structure can be found in Appendix A.



H. University co-ordination and support

The following University units were contacted regarding this project:

- Facility and Services—Sustainability Engineer, Tom Abram
- Facility and Services—Planning and Design Division, Melvyn Skvarla, Matt Edmondson
- Department of Urban Planning—Brian Deal

A letter of project acknowledgement and support is forthcoming from Facility and Services. According to Melvyn Skvarla, Helen Coleman, head of the University's Facility and Services, Planning and Design Division will send the letter directly to the SSC. Appendix B is a copy of an email from Tom Abrams indicating the support and the forthcoming letter.

II. **Budget and Fundraising**

A. Detailed Budget

The expense information provided below was received from the geothermal consulting technician for the project. Staff member, Richard Burton is an Accredited Installer and a member of the International Ground Source Heat Pump Association (IGSPA). Copies of his estimates can be provided.

Expenses (proposed)

	Evergreen Lodge	**Gate House**	**House in the Woods**	**Visitor Center**	**All Units**
Equipment (incld. freight)	$6,121	$7,573	$7,504	$11,634	
Loop field material	1,147	1,768	974	1,674	
Interior piping	400	2,200	2,200	2,200	
Labor	6,600	6,600	6,600	6,600	
Trencher Rental					2,400
Special tools					6,500
Signage					1,096
Subtotals	$14,268	$18,141	$17,278	$23,417	$9,996
Grand Total					**$83,100**

B. Funding Sources

Financially, Allerton Park would not be able to fund this entire geothermal project alone. Staff had targeted their grant seeking efforts to those entities that would be strong supporters of their energy conservation goals for this project and could provided adequate financial assistance for a portion of the total project cost.

After applying to several foundations and government entities for financial assistance, the following groups proved to be viable organizations for financial assistance. All of these sources of funding are crucial to success of the project; without each organization full participation the project would not succeed.

Organization	**Amount**	**Fund Type**
ARRA—UI F&S*	$23,000	Grant
SSC	25,000	Zero-Interest Loan
Allerton Park**	34,100	In-kind (labor)
Friends of Allerton Park	1,000	Signage
Total	**$83,100**	

***** These funds were part of the University's grant request to the State of Illinois's Department of Commerce and Economic Opportunities (DCEO) for the American Recovery and Reinvestment Funds (ARRA). The original grant request was for $23,000 but DCEO said it may be cut to $18,710. APRC staff has been working with Tom Abram with these negotiations.

III. **Timeline**

The follow timeline for installation is dependent on when funds would be released from the various funding partners and weather conditions. Overall, the Park Staff has projected the entire project to be completed by August of 2011. It is project that the installation could take up to 6 weeks to install from trenching to equipment testing.

2010

1. May15 thru June 30: First geothermal system site installation
2. June 30 thru mid-August: Second geothermal system site installation
3. Mid August thru September 30: Third geothermal system site installation
4. October thru mid November: Fourth geothermal system site installation

IV. **Energy, Environmental, Social and Economic Impact**

A. Energy created and Cost Savings

Using a Heating and Cooling load calculation software, Richard Burton, the staff technical consultant, prepared a report on each building and related loop field design. The following table illustrates the projected energy that could be created by the Geothermal Ground Source Hat Pump Systems (GSHP) that would be installed at the four buildings at the Park. This energy is sufficient to power the GSHP systems.

Table: Annual Energy Created by GSHP Systems in Four Buildings at the Park (Units in BTU/hr[3]

Buildings	Heating Season	Cooling Season
Evergreen Lodge	51,100	66,000
Gate House	48,100	61,900
House in the Woods	48,100	61,900
Visitor Center	68,000	84,800
Total	215,300	274,600

Ground source heat pumps are generally cheaper to operate than other traditional heating systems. A ground source heat pump (GSHP) system uses electricity to pump heat to and from the ground to heat and cool a building. The ground acts as either a heat source for heating or a heat sink for cooling. The system includes an electric water pump,

[3] Heating and Cooling load was performed on building using Wright-Soft load calc software manual J. Wrightsoft Corporation 131 Hartwell Avenue Lexington, MA 02421

to pump the water used in the **closed loop system** to transfer heat to and from the ground, and a type of compressor called a heat pump.

Three of the structures (Visitor Center, Gate House, and the House in the Woods) would be converting from nature gas, forced air systems to the geothermal system. As a result of this conversion, these heating and cooling systems expected electricity use would increase. See the following table. The Evergreen Lodge is currently heated and cooled with resistance heat and Central Air conditioning. This buildings electrical use will significantly decrease.

Table: Comparison of Electrical Demand in Park Buildings Converting to Geothermal Systems

Building	**Natural Gas-Central A/C**	**Resistance Heat-Central A/C**	**Geothermal**
House in the Woods	3,412 KW/h		9,944 KW/h
Gate House	6,088KW/h		16,279 KW/h
Visitor Center	8,363 KW/h		13,397 KW/h
Evergreen Lodge		42,618 KW/h	16,601 KW/h

Source: Allerton Park Assistant Properties Manager. This report is for the yearly demand of heating and cooling for the properties

Geothermal energy heating uses a renewable source by tapping into the free heat from the sun that has been absorbed into the ground so enabling this type of system to give back more energy in the form of heat than the equivalent amount of electric energy they consume to operate[4]. For example, in heating mode a highly efficient ground source heat pump can extract energy from the ground and transfer it to your home at a ratio of 1:4 or more. This would mean that for every 1 KW/h of electrical energy that you use to drive the heat pump, around 4KW/h of thermal energy will be produced for use in your building. This ratio is given as the 'coefficient of performance' (COP) for heat pumps that are working in the heating mode. The COP is calculated by dividing the input KW/h into the output KW/h. In the cooling mode (inversion cycle) the ratio is called the 'energy efficient ratio (EER). The higher the COP and EER ratios, the more efficient the system.

According to the Energy STAR system, qualified heating and cooling equipment installed as a part of a GSHP system must meet of exceed the efficiency standards outlined in the table below. The COP and the EER of the building in the Park are included in the Table.

Table: Energy Star Efficiency Standards and the Proposed Units Ratings

GSHP System Type	**Energy Star Minimum Equipment Efficiency**	
	Heating (COP)	**Cooling (EER)**
Closed Loop system	3.6	16.2
Visitor Center	3.9	18.1
Gate House	3.8	16.8
House in the Woods	3.8	16.8
Evergreen Lodge	3.8	16.8

[4] www.home-heating-systems-and-solutions.com/thermal-energy-heating.html#ans004

Sources:
http://www.effciencyvermont.com/pages/Residential/Home_Heating/heating_systems/GSHP
International Ground Source Heat Pump Association load calculation manual.

Converting the current heating and cooling systems with GSHP systems and closed loop field would provide a significant cost savings to the Park. Based on 2008-2009 Ameren Utility bills the estimate annual savings for all four buildings would be over $18,500. The GSHP system would pay for themselves in less than 5 years.

B. Environmental Impact

Based on Ameren utility bills between October, 2008 and October, 2009, the four buildings that are the sites for the proposed GSHP systems used annually 18,701 therms of natural gas fuel. In addition, these same structures annually used over 60,480 KW/h of electricity in the processes of heating and cooling. This represents a CO2 emission of greater than 96 metric tons spewed into the atmosphere. This would be equivalent to the annual gas emissions of 18.4 passenger vehicles or the CO2 emissions of 10,821 gallons of gasoline consumed[5]. The proposed GSHP systems would generate annually 56,221 KW/h of electricity or 40.4 metric tons of CO2 emissions. Overall, the new systems would represent a 42% decrease in metric tons of CO2 emitted into the atmosphere.

At three of the sites, the closed loop field will be located in areas that are primarily planted with a mix of Kentucky Blue Grass and other turf-like vegetation. Some trenching would be dug under parking lots and sidewalks. The Evergreen Lodge loop field will be dug partially under the main parking lot and under several mature Eastern White (*Pinus strobes*) pine trees. Trenching can be accomplished without disturbing the root systems of these trees. The roots systems are usually within the first 12-18" of soil. The depth of the trenches at this site is 8 feet. See the following table for trench numbers, depth and length.

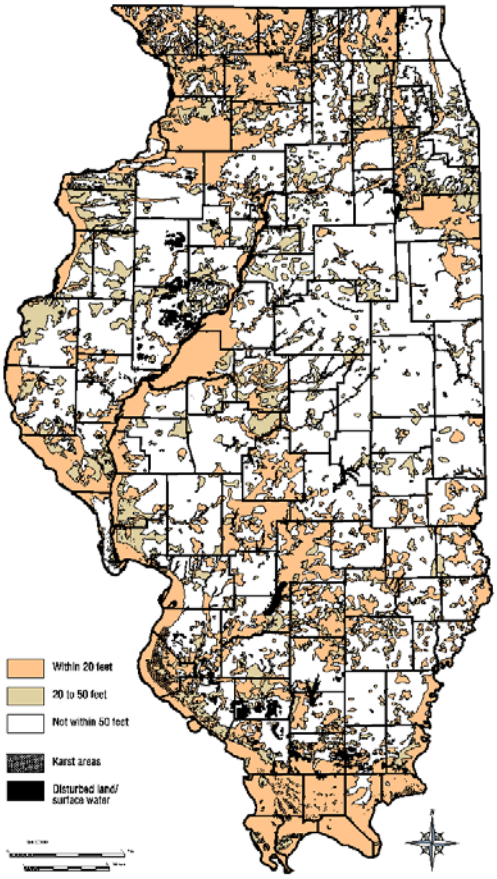
Table: Trench Number, Depth and Length by Project Site

	Number	Depth by feet	Length by feet
Visitor Center	7	7	224
Gate House	5	7	317
Evergreen Lodge	6	8	156
House in the Woods	5	7	237

None of the GSPH sites and loop fields is located on the floodplain of the Sangamon River or its tributaries. After conferring with a January 2006 Illinois Groundwater Protection Program Report, the closed aquifer is greater than 50 feet below

[5] US EPA Greenhouse Gas Equivalencies Calculator. www.epa.gov/climatechange/emissions/int_calculator.html.

the surface in Piatt County[6]. See the map below. The Mahomet aquifer the source of water to Allerton Park is about 197 feet below the surface. The Illinois Water Survey has been contacted to determine where the water table exists at all the sites. Preliminary digging (up to 7') has not shown any evidence of a high water table at the sites.



The only know endanger species of wildlife that exists in the park is the Massasauga Rattlesnake (*Sistrurus catenatus*). It's habitat is wet prairies, flood plains, marshes and bogs. None of the four sites has this eco-type in its surrounding environment[7].

C. Social Impact

The positive social impact would be in the education of the public (visitors and students) regarding the geothermal project and its financial benefits to the Park, the reduction of greenhouse gases, and benefits of converting a natural gas fueled heating and cooling systems to an alternative energy found in abundance in the earth. A potential

[6] Illinois EPA Interagency Coordinating Committee on Ground Water. "Illinois Groundwater Protection Program Report: Biennial Comprehensive Status and Self Assessment Report". January 2006. IEPA/BOW/06-001

[7] Illinois Natural History Survey. Illinois Herpetology Species. www.inhs.illinois.edu/animals_plants/herps/species/si_catenet/html

negative impact would be an increase in electrical use due to insufficient ground temperatures.

D. Economic Impact

A positive economic impact would be the need to save a maintenance job to monitor and maintain the systems. Any negative effect due to the size of the unit would be negligible.

V. Outreach and Education

Allerton Park and Retreat Center, although not physically on the University campus has made strident efforts to included students in the various aspects of the planning, design and operations of the Park. The Scholar program works in cooperation with the Departments of Architecture, Landscape Architecture and Natural Resources and Environmental Sciences. Each summer the Park employees 3-5 interns in various operations of the part including: horticulture, design and park maintenance.

The actual installation of the system will be conducted in the summer of 2009 in which the summer interns will be involved in the project as well as the construction of storage structure.

It is envisioned, that the publicity for this project and grant award would be in three phases: grant receipt notification, project progress and the completed project.

Grant receipt notification

- Press release to local media, UI Environmental Council, other appropriate news sources
- Allerton Advisory Council
- Local state government representatives, departments

Project progress

- Allerton Park Project Sign—a temporary sign that informs visitors about the project, its importance and any additional funding sources
- Allerton Park Website –Featured item on the website www.allerton.uiuc.edu
- Local state government representatives, departments
- Local news media, etc

Completed project

- Park informational sign—project design, intent, Green Allerton energy Conservation plan, funders. The park receives about 150,000 visitors annually for special events, visits to the formal gardens and walking the 14 miles of trails.
- Invite University and local colleges classes to participate in studies, monitoring, etc of the project and in the Green Allerton EC plan
- Local news media, etc
- Allerton Quarterly newsletter

- Local state government representatives, departments
- Green Allerton Park plan and literature
- Where ever the SSC would suggest we publicize our project, research, etc.

This project will be available to the public and especially university classes for study and tours. In the past, we have had classes from the Department of Architecture and Landscape Architecture visits the various energy efficient facilities that are on site and include suggestions for additional designs. It is hoped that information on this project would be highlighted in the University's energy efficiency program, B.L.U.E. Program.

Allerton Park and Retreat Center has over 150,000 visitors annually. It is important to note to visitors that we are part of the University. It is equally important to demonstrate that the University and the staff of the Park are aware of their roles as educators and innovators in natural areas conservation awareness and energy conservation, not only on campus but to all the units.

The intent of all this publicity would be to explain that Allerton Park is part of the University of Illinois, perhaps not physically on campus but in our united effort to be a more energy efficient public institutions of education and research. This type of information and the fact the SSC was instrumental in the funding of the Green Allerton Alternative Energy/Conservation Project would be conveyed to the public, students, and staff through the avenues of communication listed above. Should the SSC require any specific language to be included in such publicity, we would be more than willing to comply. Finally, we would encourage the SSC to consider using the completed project as an educational resource for energy saving projects that can be accomplished with the funds generated with the student fees.

Appendix A—Project Design Information

Evergreen Lodge

The current property is heated with electric baseboard heaters and a very old central a/c system.

Scope of work

The existing air handler, condensing unit, and electric baseboard heaters will be removed.

A 6 ton geothermal heat pump will be installed in the attic of the building and reconnected to the existing duct work.

Water piping and a circulating pump system will be installed in the attic of the building. The interior piping will be connected to the loop field in the attic.

The loop field will consist of 6 trenches 156' in length each terminated at the header trench and then connected to the building with a separate trench for the supply return piping.

Project Specifics

Proposed start time would be June 17th and completed by July 17th.
Electrical demand will decrease by 25,589 KWH
Annual operating costs for geothermal heat pump system = $1,328.26
Annual operating costs for resistance heat w/ central a/c = $3,375.22
Conservative estimated savings of $2,046.96
Annual CO2 emissions for geothermal heat pump system = 9 tons
Annual CO2 emissions for resistance heat w/ central a/c = 24 tons

Horizontal Trench 1

Earth Temperature Data Location

This location closely approximates the soil conditions and climate in your area which results in very comparable properties of the earth under load from the GSHP.

City	Urbana	Mean Earth Temperature (T_M)	53 °F
State	Illinois	Annual Swing (A_S)	26 °F
Country	United States	Days to Minimum (T_0)	35 days

Soil Details

The thermal properties of your soil are based on the soil's composition and have a direct impact on the scale of your loopfield.

Thermal Conductivity	0.51 Btu/hr ft °F	Thermal Diffusivity	0.33 ft^2/day

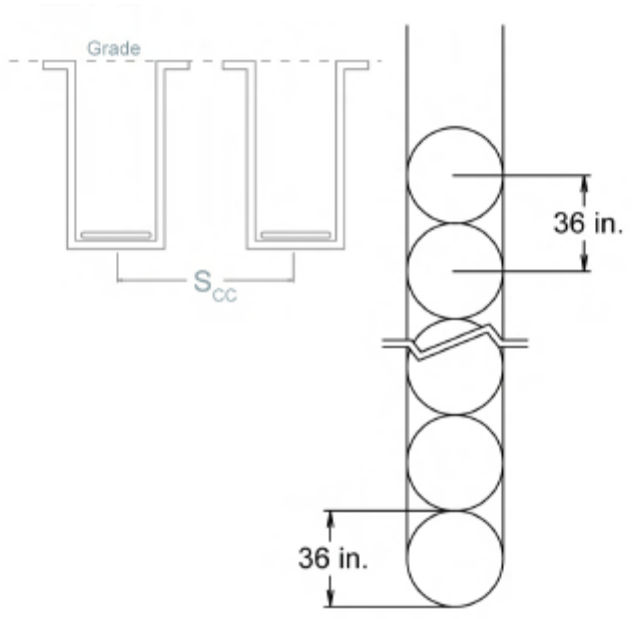
Piping Details

The loopfield is designed for optimal performance based on the pipe configuration chosen.

Pipe Configuration	36" Slinky	Pipe Diameter (D_p)	0.75 in

GHEX Summary

Heating is dominant



Top View

EWT_{MIN}	30.0 °F
EWT_{MAX}	90.0 °F
Number of Trenches	6
Flow Paths per Trench	1
Number of Flow Paths	6
C-C Spacing (S_{CC})	11 ft
Average Depth (d_{AVG})	8.0 ft
Horizontal Spacing (S_H)	1.00 ft
Total Pipe Length	4,678 ft
Pipe Length per Trench	780 ft
Trench Depth	8.00 ft
Trench Length	156 ft
System Run Fraction	0.670

Appendix A

Gate House

The current property is heated by a hot water boiler & cooled by two central a/c units.

Scope of work

The existing air handlers, condensing units, hot water boiler and the base board heaters will all be removed.

A 5 ton geothermal heat pump will be installed in the basement of the house. Duct work for the supply and return air and floor registers will be installed for the first floor of the house and a trunk line will be installed to the attic. The existing duct work in the attic will be connected to the new trunk line.

Water piping and a circulating pump system will be installed in the building between the basement and the two heat pumps. The interior piping will be connected to the loop field in the basement.

The loop field will consist of 5 trenches 317' in length each terminated at the header trench and then connected to the building with a separate trench for the supply/return piping.

Project Specifics

Proposed start time would be May 16th and completed by June 16th.
Electrical demand will increase by 10,191 KWH
Annual operating costs for geothermal heat pump system = $1,302.49
Annual operating costs for natural gas boiler w/central a/c = $2,446.94
Conservative estimated savings of $1,144.45
Annual CO@ emissions for geothermal heat pump system = 9
Annual CO@ emissions for natural gas boiler w/central a/c = 13

Horizontal Trench 1

Earth Temperature Data Location

This location closely approximates the soil conditions and climate in your area which results in very comparable properties of the earth under load from the GSHP.

City	Urbana	Mean Earth Temperature (T_M)	53 °F
State	Illinois	Annual Swing (A_S)	26 °F
Country	United States	Days to Minimum (T_0)	35 days

Soil Details

The thermal properties of your soil are based on the soil's composition and have a direct impact on the scale of your loopfield.

Thermal Conductivity	0.51 Btu/hr ft °F	Thermal Diffusivity	0.33 ft^2/day

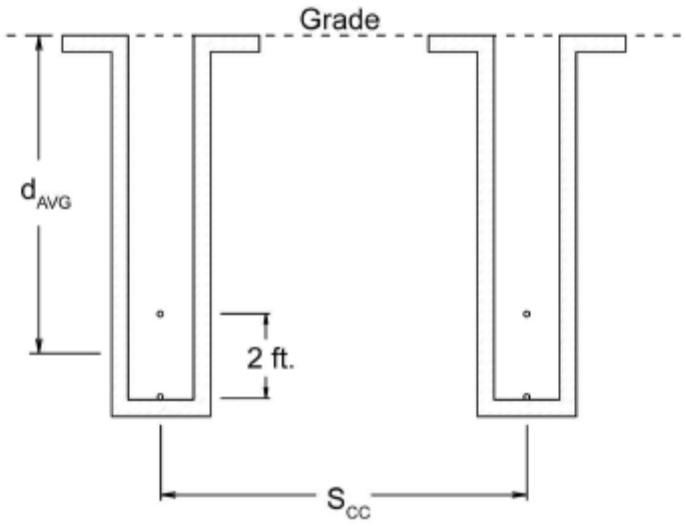
Piping Details

The loopfield is designed for optimal performance based on the pipe configuration chosen.

Pipe Configuration	2 Pipe Standing	Pipe Diameter (D_p)	0.75 in

GHEX Summary

Heating is dominant



EWT_{MIN}	30.0 °F
EWT_{MAX}	90.0 °F
Number of Trenches	5
Flow Paths per Trench	1
Number of Flow Paths	5
C-C Spacing (S_{CC})	11 ft
Average Depth (d_{AVG})	6.0 ft
Horizontal Spacing (S_H)	1.00 ft
Total Pipe Length	3,167 ft
Pipe Length per Trench	633 ft
Trench Depth	7.00 ft
Trench Length	317 ft
System Run Fraction	0.760

Appendix A

Visitors Center

The current property is heated by our new wood burning boiler and supplemented with a very old and inefficient natural gas boiler and is cooled by 2 very old central air conditioning systems. One end of the building is a greenhouse and the other end is used for an information center, public restrooms, office space, and meeting space. The plan is to replace the two central ac systems with energy star rated 2 stage geothermal heat pumps.

Scope of work

The existing air handlers and condensing units will be removed.

A 4 ton geothermal heat pump and a 3 ton geothermal heat pump will be installed and reconnected to the existing duct work.

Water piping and a circulating pump system will be installed in the building between the basement and the two heat pumps. The interior piping will be connected to the loop field in the basement.

The loop field will consist of 7 trenches 224' in length each terminated at the header trench and then connected to the building with a separate trench for the supply return piping. We will be using a step-down step-up reverse-return header.

Project Specifics

Proposed start time would be April15th and completed by May 15th.
Electrical demand will increase by 5,034KWH per season.
Annual operating costs for geothermal heat pumps = $1,072.22
Annual operating costs for natural gas boiler w/ central a/c = $1,932.61
Conservative estimated savings of $860.39
Annual CO2 emissions for geothermal heat pump system 7.5 tons
Annual CO2 emissions for natural gas boiler w/ central a/c = 11.5 tons

Horizontal Trench 1

Earth Temperature Data Location

This location closely approximates the soil conditions and climate in your area which results in very comparable properties of the earth under load from the GSHP.

City	Urbana	Mean Earth Temperature (T_M)	53 °F
State	Illinois	Annual Swing (A_S)	26 °F
Country	United States	Days to Minimum (T_0)	35 days

Soil Details

The thermal properties of your soil are based on the soil's composition and have a direct impact on the scale of your loopfield.

Thermal Conductivity	0.51 Btu/hr ft °F	Thermal Diffusivity	0.33 ft^2/day

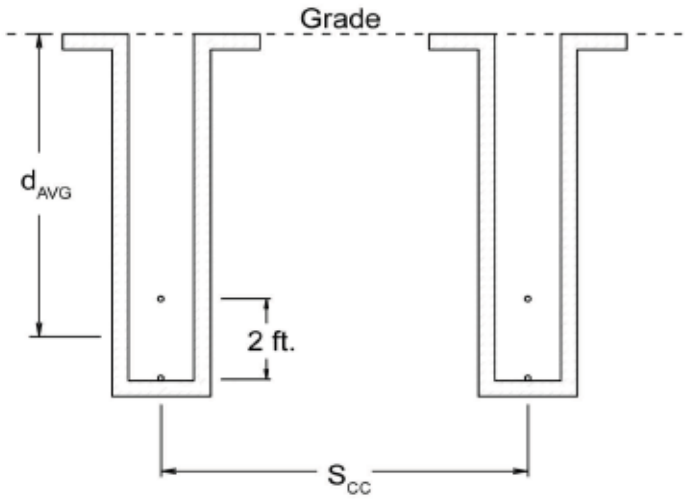
Piping Details

The loopfield is designed for optimal performance based on the pipe configuration chosen.

Pipe Configuration	2 Pipe Standing	Pipe Diameter (D_p)	0.75 in

GHEX Summary

Heating is dominant



EWT_{MIN}	30.0 °F
EWT_{MAX}	90.0 °F
Number of Trenches	7
Flow Paths per Trench	1
Number of Flow Paths	7
C-C Spacing (S_{CC})	11 ft
Average Depth (d_{AVG})	6.0 ft
Horizontal Spacing (S_H)	1.00 ft
Total Pipe Length	3,139 ft
Pipe Length per Trench	448 ft
Trench Depth	7.00 ft
Trench Length	224 ft
System Run Fraction	0.514

Appendix A

House In The Woods

The current building is heated by a 95% natural gas furnace with w/central a/c.

Scope of work

The existing furnace and condensing unit will be removed.

A 5 ton geothermal heat pump will be installed and connected to the existing duct work.

Water piping and a circulating pump system will be installed in the building. The interior piping will be connected to the loop field in the basement.

The loop field will consist of 5 trenches 237' in length each terminated at the header trench and then connected to the building with a separate trench for the supply/return piping.

Project Specifics

Proposed start time would be July 18th and completed by August 18th.
Electrical demand would increase by 6,532 KWH
Annual operating costs for geothermal heat pump system = $795.77
Annual operating costs for natural gas furnace w/central a/c = $1,610.26
Conservative estimated savings of $814.49
Annual CO2 emissions for geothermal heat pump system = 6 tons
Annual CO2 emissions for natural gas furnace w/central a/c = 9 tons.

Horizontal Trench 1

Earth Temperature Data Location

This location closely approximates the soil conditions and climate in your area which results in very comparable properties of the earth under load from the GSHP.

City	Urbana	Mean Earth Temperature (T_M)	53 °F
State	Illinois	Annual Swing (A_S)	26 °F
Country	United States	Days to Minimum (T_0)	35 days

Soil Details

The thermal properties of your soil are based on the soil's composition and have a direct impact on the scale of your loopfield.

Thermal Conductivity	0.51 Btu/hr ft °F	Thermal Diffusivity	0.33 ft^2/day

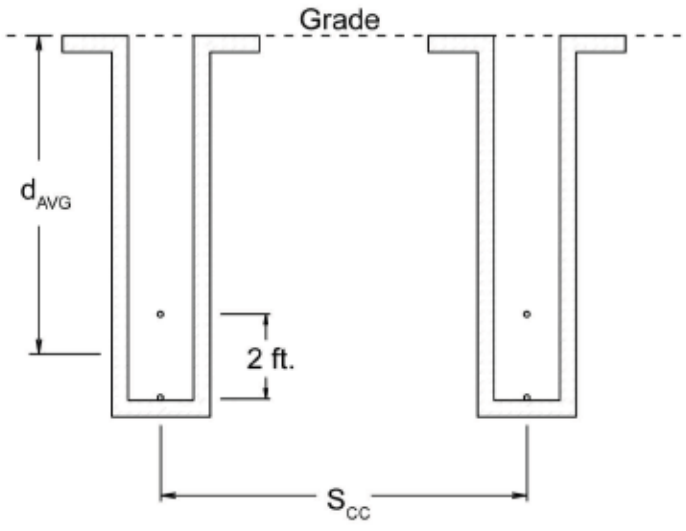
Piping Details

The loopfield is designed for optimal performance based on the pipe configuration chosen.

Pipe Configuration	2 Pipe Standing	Pipe Diameter (D_p)	0.75 in

GHEX Summary

Heating is dominant



EWT_{MIN}	30.0 °F
EWT_{MAX}	90.0 °F
Number of Trenches	5
Flow Paths per Trench	1
Number of Flow Paths	5
C-C Spacing (S_{CC})	11 ft
Average Depth (d_{AVG})	6.0 ft
Horizontal Spacing (S_H)	1.00 ft
Total Pipe Length	2,368 ft
Pipe Length per Trench	474 ft
Trench Depth	7.00 ft
Trench Length	237 ft
System Run Fraction	0.552

Appendix A --Sources and Credentials

References

Heating/Cooling load was performed on building using Wright-Soft load calc software manual J (1-800-225-8697**). Wrightsoft Corporation** | 131 Hartwell Avenue | Lexington, MA 02421 | 800 225-8697

Design of the system and loop field was performed using Loop Link software from **Geo-Connections, Inc** (1-866-995-4449) 302 E Warehouse St | PO Box 255 | Elkton, SD 57026.

Pricing for all equipment was received from Rogers Supply (217-356-0166). They are the local distributor for Heat Controller, Inc. and Comfort-Aire geothermal equipment. **Rogers Supply** *350 N Walnut, 61820* Toll Free: 800.252.0406 Phone: 217.356.0166 Emergency: 217.202.1669 Fax: 217.356.1768 **Heat Controller, Inc.** 1900 Wellworth Ave Jackson, Michigan 49203 Phone: (517) 787-2100 Fax: (517) 787-9341

Pricing for HDPE piping was obtained from **ISCO industries**. P.O. Box 4545 926 Baxter Avenue Louisville, KY 40204 (502) 583-6591 fax (502) 584-9713 (800) 345-4726

Richard Burton is an Accredited Installer and a member of The International Ground Source Heat Pump Association (IGSPA) he has completed a three day training course on the design, installation and heat fusion procedures in Chicago, IL on 2-17-2008. Membership ID 24586-0209 Accreditation ID 18919-0209. **International Ground Source Heat Pump Association (IGSHPA)** 374 Cordell South Stillwater, OK 74078 Phone: (405) 744-5175 Fax: (405) 744-5283 Email: igshpa@okstate.edu

Appendix B

-----Original Message-----

From: Abram, Tom J (Facilities & Services) [mailto:tabram@fs.uiuc.edu]

Sent: Thursday, March 11, 2010 2:14 PM

To: Schleicher, Barbara A

Subject: RE: Geothermal- Ground Source Heat Pump Questionnaire

I met with Kent Reifsteck and Robert Halverson of Engineering and Melvyn Skvarla. I helped draft a letter of support that will be sent to Helen Coleman (through Melyvn) for approval. It will include support from several individuals from within F&S (including myself). Melyvn would know the current status of the letter.

Thanks!

Tom

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Facilities & Services

Physical Plant Service Building
1501 South Oak Street
Champaign, IL 61820

March 16, 2010

Mr. Suhail Barot, Chair
Student Sustainability Committee
University of Illinois at Urbana-Champaign

Dear Student Sustainability Committee:

Facilities and Services has reviewed the Allerton Park proposal to the UIUC Student Sustainability Committee (SSC) to provide funding for the partial support of four (4) geothermal heat pumps for four (4) buildings at the Allerton Park and Retreat Center. We believe this would be an appropriate application for geothermal, particularly due to the buildings' exclusion from a central thermal system.

This project has also been included in the campus' full request to the Large Customer Energy Efficiency Program, administered by the Illinois Department of Commerce and Economic Opportunity and funded by the American Recovery and Reinvestment Act. It has been selected to receive funding from DCEO and if it proceeds, we anticipate a funding level of $23,000.

At this time, Facilities & Services Engineering Division has not performed any technical analysis and therefore, we cannot comment on specific information regarding cost, system size, payback, utility placement, or other siting issues. However, the general concept is solid, the technology is proven, and in our opinion, the project would be beneficial to Allerton Park and the University as a whole.

Sincerely,

Helen J. Coleman, Director
Facilities and Services Planning Division

Cc: Ms. Jill Maxey, Associate Director
Mr. Kent Reifsteck
Mr. Robert Halverson
Mr. Tom Abram
Mr. Melvyn A. Skvarla
Mr. James Gortner

telephone 217-333-0697 • *fax* 217-333-4294