

APPENDIX T

Green Building Practices

DEPOT HILL

DISTRICT GEOTHERMAL

REPORT

Prepared for:

**Depot Hill Farm
Amenia, NY**

Prepared by:

**Crawford & Associates Engineering P.C.
551 Warren Street
Hudson, New York 12534**



C & A # 2773.0

November 13, 2007

- Executive Summary

The purpose of this report is to provide an analysis for the residential geothermal systems at Depot Hill. The topics covered in this analysis will be:

- Typical residential geothermal heating and cooling system.
- District geothermal wells versus individual wells.
 - Payback period for district well systems.
 - Feasibility of both types of well systems

This report will also describe the qualifications of constructing energy star certified residential buildings and the appliances installed within these residences.

- Project Description

The Depot Hill project is located in Amenia, NY. It will be an equestrian themed residential development consisting of four neighborhoods with community center. 138 residential units are slated to be built with each unit ranging from 2000 to 3000 square feet. The residential units are to have energy star certified appliances and geothermal heating and cooling equipment.

- Typical Residential Geothermal Systems

Typical residential geothermal systems consist of a closed loop, and a ground source heat pump. The benefits of these systems are as follows:

- Equipment to provide both heating and cooling
- One system provides both heating and cooling, ability to produce domestic hot water

- District Geothermal Loop vs. Independent Residential Geothermal Loop

Due to space requirements, the best suited loop to be installed is a vertical loop since they require minimal square footage per borehole. The following are examples of a district system vs. independent well fields:

- District well field: 160,000 square feet
- Independent well fields: 1,400 square feet

Advantages to having a district well field system are cost related. By installing a district system, the contractors installing the wells and loops could provide cost breaks for quantity of materials and labor. The vault operation would be dependent on the existing load, and increased as more residential units are constructed in the future. All district piping would be installed at one time, and

could also be put in place as other utilities are being installed. Connections to residential units are made at the time of unit construction.

Independent well systems have several disadvantages. Each residential unit would be required to have the loop fields installed in conjunction with other trades involved in the building. Space requirements come into play, as well as existing utilities could influence the movement of large machinery. Costs to install independent well fields could fluctuate depending on the date and costs of materials. Most importantly, thermal conductivity tests would be required per each residential unit, or groups of units, in order to properly size the loop field.

- Payback Period

Payback period was calculated using comparison of costs for dedicated, district geothermal wells and costs for independent residential geothermal wells. Differences in costs came from the costs per borehole and installation of piping, as well as the construction costs for the geothermal equipment. A payback period of 3 to 5 years was determined using current costs.

- New York State Energy Star Requirements

To earn the ENERGY STAR rating, a home must meet guidelines for energy efficiency set by the U.S. Environmental Protection Agency. These homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code (IRC), and include additional energy-saving features that typically make them 20–30% more efficient than standard homes. ENERGY STAR qualified homes can include a variety of 'tried-and-true' energy-efficient features that contribute to improved home quality and homeowner comfort, and to lower energy demand and reduced air pollution:

- Efficient Products
 - ENERGY STAR qualified homes may also be equipped with ENERGY STAR qualified products that use 10 to 40 percent less energy than standard appliances.
- Efficient Heating and Cooling Equipment
 - In addition to using less energy to operate, energy-efficient heating and cooling systems can be quieter, reduce indoor humidity, and improve the overall comfort of the home.
- Tight Construction and Ducts
 - Sealing holes and cracks in the home's "envelope" and in heating and cooling duct systems helps reduce drafts, moisture, dust, pollen, and noise.
 - A tightly sealed home improves comfort and indoor air quality while reducing utility and maintenance.
- Effective Insulation

- Properly installed and inspected insulation in floors, walls, and attics ensures even temperatures throughout the house, reduced energy use, and increased comfort
- High-Performance Windows
 - Energy-efficient windows employ advanced technologies, such as protective coatings and improved frames, to help keep heat in during winter and out during summer.
 - These windows also block damaging ultraviolet sunlight that can discolor carpets and furnishings.
- Third Party Verification
 - Raters conduct onsite testing and inspections to verify the energy efficiency measures, as well as insulation, air tightness, and duct sealing details

What constitutes an energy star appliance is the energy consumption. The following are descriptions of the different type of energy star appliances.

- Electrical appliances such as refrigerators, dishwashers, and clothes washers are energy star certified when they consume 10 to 40 percent less energy than standard appliances.
- Clothes washers and dishwashers use less water than standard appliances
- Hot water heaters usually account for 15 percent of a home's energy use.
 - Energy Star water heaters use 10 to 50 percent less energy than standard appliances.
- Energy Star lighting fixtures and bulbs reduce energy consumption by 75 percent.
 - Bulbs come with a 2 year warranty.



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MEMORANDUM

TO: APA _____
BKN _____

FROM: JRT

RE: Depot Hill
District Geothermal Systems
C&A #2773.0

DATE: November 13, 2007

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Due to space requirements, the best suited loop to be installed is a vertical loop since they require minimal square footage per borehole. The following are examples of a district system vs. independent well fields:

- District well fields: 19,250 square feet for entire development
 - Neighborhood 1: 5,750 square feet
 - Neighborhood 2: 4,750 square feet
 - Neighborhood 3: 2,750 square feet
 - Neighborhood 4: 6,000 square feet
- Independent Residential well fields: 750 to 1,250 square feet

Advantages to having a district well field system are essentially cost related. By installing a district system, the contractors installing the wells and loops could provide cost breaks for quantity of materials and labor. The vault operation would be dependent on the existing load, and increased as more residential units are constructed in the future. All district piping would be installed at one time, and could also be put in place as other utilities are being installed. Connections to residential units are made at the time of unit construction.

Initial Capital Investment is the major economic driving force behind any district heating and cooling systems. Economic benefits of a district system can be found in:

- Operating Personnel: reduction of trained operating personnel necessary for district operation.
- Insurance: Property and liability insurance are reduced with the elimination of boilers and fire risk.
- Usable Space: residential units will have more usable space with the reduction of mechanical equipment and spaces.
- Equipment Maintenance
- Higher Thermal Efficiency: reduction of emissions from residential units due to higher thermal efficiencies achieved with the central plant.

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- Payback Period

Payback period was calculated using comparison of costs for dedicated, district geothermal wells and costs for independent residential geothermal wells. Differences in costs came from the costs per borehole and installation of piping, as well as the construction costs for the geothermal equipment. A payback period of 3 to 5 years was determined using current costs for a district heating and cooling system. For the residential application having independent wells per unit, a payback period of 4 to 6

years, per unit is estimated. Please note that for this analysis, current energy prices were used, along with the grants and refunds applicable for the Hudson Valley Area. The rising costs of the geothermal equipment can not be determined for the next 3 years.

District Residential System Installation Cost:

	Initial Cost	Sys Life	Main Cost	SQFT
District Residential Loop =	\$672,750	50 + YRS	"0" if no leaks	156,975
Heatpumps & Ductwork	\$2,511,600			
Grant Reductions	(\$598,000)			
Cost of Conventional Sys=	(\$2,063,100)			
Annual Savings =				\$235,990
TOTAL =	\$523,250			

Dollars per sqft additional	\$1.46	Annual Savings per sqft =	\$0.66
		Years Payback	3

Independent Residential System Installation Cost:

	Initial Cost	Sys Life	Main Cost	SQFT
Individual Residential Loop =	\$971,750	50 + YRS	"0" if no leaks	156,975
Heatpumps & Ductwork	\$2,511,600			
Grant Reductions	\$598,000			
Cost of Conventional Sys=	\$2,063,100			
Annual Savings =				\$235,990
TOTAL =	\$822,250			

Dollars per sqft additional	\$2.29	Annual Savings per sqft =	\$0.66
		Years Payback	4

- New York State Energy Star Requirements

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- Efficient Products
 - ENERGY STAR qualified homes may also be equipped with ENERGY STAR qualified products that use 10 to 40 percent less energy than standard appliances.
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- Tight Construction and Ducts
 - Sealing holes and cracks in the home's "envelope" and in heating and cooling duct systems helps reduce drafts, moisture, dust, pollen, and noise.
 - A tightly sealed home improves comfort and indoor air quality while reducing utility and maintenance.
- Effective Insulation
 - Properly installed and inspected insulation in floors, walls, and attics ensures even temperatures throughout the house, reduced energy use, and increased comfort
- High-Performance Windows
 - Energy-efficient windows employ advanced technologies, such as protective coatings and improved frames, to help keep heat in during winter and out during summer.
 - These windows also block damaging ultraviolet sunlight that can discolor carpets and furnishings.
- Third Party Verification
 - Raters conduct onsite testing and inspections to verify the energy efficiency measures, as well as insulation, air tightness, and duct sealing details

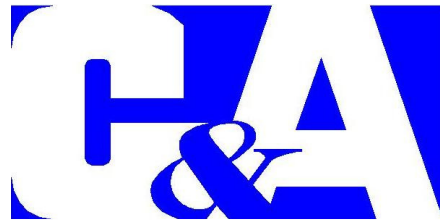
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- Energy Star lighting fixtures and bulbs reduce energy consumption by 75 percent.
 - Bulbs come with a 2 year warranty.

**DEPOT HILL FARM
LEED CERTIFICATION
FEASIBILITY REPORT**

Prepared by:

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Hudson, New York 12534**



C & A # 2773.0

December 4, 2007

LEED CERTIFICATION FEASIBILITY REPORT

Depot Hill Farms

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Report Summary

The purpose of this report is to discuss the Depot Hill Farm Development concept and the feasibility of LEED Certification. The project as described in the DEIS document proposes to construct and development a conservation based community, preserving existing agricultural lands, wetlands, and the existing Keane Stud farm. The goal of this project is to attract families who wish to live within a working farm community committed to protecting open spaces and the environment. Depot Hill Farm's 138 homes will be clustered on just 60.7 of the farm's 481.44 acres, less than 13% of the farm's total acreage.

The families of Depot Hill Farm and the Town of Amenia community will be able to participate in equestrian programs, utilizing state-of-the-art facilities and providing instruction and riding opportunities. These facilities include indoor and outdoor arenas, associated barns, a cross-country course and riding/hiking trails.

The project site is in the Town of Amenia, Dutchess County, New York. The Town is also the terminal point for the Metro-North Railroad Harlem Line with direct service to Grand Central Terminal in New York City. Amenia is served by New York State(NYS) Route 22, the primary north-south route, and New York State Routes 44 and 343, the primary east-west routes. Depot Hill Road is located east of NYS Route 22 on Old Route 22. The location of the site gives accessibility to the commercial and business areas of Amenia.

Project Description

Currently, the USGBC (United States Green Building Council) has two programs in pilot for Residential LEED applications. These pilot programs are the LEED for Neighborhood Development and The LEED for Homes Rating System. The goal of both programs is to promote the green building practices of residential units and neighborhoods alike.

The Depot Hill Farm development will incorporate an existing stud farm with new construction. 138 residential units will be constructed in four neighborhoods. An equestrian center will be the focal point of this community, for it will also serve as the community center for the development's residents. It is the intent of the project owner to construct all residential units to Energy Star homes standards.

Review of the project's scope and design against the LEED pilot programs rating systems has produced positive results. LEED Certification is feasible for this project for both the LEED for Homes and LEED Neighborhood Development rating systems.

LEED for Homes

LEED for Homes applies only to new construction of single family homes. LEED for Homes is intended to promote sustainable practices in the home building industry. It is the intent of this report to also calculate the possible points and certification level that Depot Hill could achieve, based upon the project information available at the present time.

The LEED for Homes rating system is comprised of eight different categories that measure overall performance of an individual home:

- Innovation and Design Process (ID)
 - Design methods, unique regionally credits, and future criteria not addressed.
- Location and Linkages (LL)
 - Placement of homes in socially and environmentally responsible ways in relation to the larger community.
- Sustainable Sites (SS)
 - Use of entire property in order to minimize impact of project on site.
- Water Efficiency (WE)
 - Water conservation practices, indoor and outdoor, built into the home.
- Energy and Atmosphere (EA)
 - Energy efficiency of building envelope, heating and cooling systems.
- Materials and Resources (MR)
 - Utilization of environmentally preferable materials and minimization of construction waste.
- Indoor Environmental Quality (IEQ)
 - Improvement of indoor air quality through means of reducing possible air pollution and fresh air exchange.
- Awareness and Education (AE)
 - Education of homeowner about operation and maintenance of the green features of the LEED Home.

LEED for Neighborhood Development

LEED for Neighborhood Development is designed to certify development projects that perform well in regards to smart growth, new urbanism, and green building. The principal goal of this program is to improve land use patterns, neighborhood design, and technology throughout the United States.

The LEED for Neighborhood Development is comprised of four different categories that measure overall performance of a home:

- Smart Location and Linkage (SLL)
 - Encourages development near existing communities and infrastructure in order to reduce multiple environmental impacts and

- preserve agricultural resources, promote open spaces, and enhance water quality.
- Neighborhood Pattern and Design (NPD)
 - Promotes and foster communities to be physically connected.
 - Conserve land by promoting livability, transportation efficiency, and walk ability.
 - Green construction & Technology (GCT)
 - Reduce pollution from construction activities.
 - Reduce water consumption
 - Encourage green building practices and energy efficient buildings.
 - Innovation & Design Process (ID)
 - Supports and encourages the planning and design integration required by LEED for Neighborhood Development Rating System.

Energy Star Homes

To earn the ENERGY STAR rating, a home must meet guidelines for energy efficiency set by the U.S. Environmental Protection Agency. These homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code (IRC), and include additional energy-saving features that typically make them 20–30% more efficient than standard homes. ENERGY STAR qualified homes can include a variety of 'tried-and-true' energy-efficient features that contribute to improved home quality and homeowner comfort, and to lower energy demand and reduced air pollution:

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Conclusion and Findings

Becoming a LEED Certified Home or Neighborhood Development is a voluntary decision grounded in accepted energy and environmental principles that are balanced between established practices and the emerging concepts. The Depot Hill Farm project has the ability to achieve certification in both. Please note that in order to obtain certification in either program, residential units must perform to Energy Star Home levels. A level of Silver Certification is intended for either LEED programs.

Per design and intent, the residential units would be awarded a Certified Level for LEED Homes. A Silver or Gold Certification could be obtained by:

- Installation and implementation of grey water reuse systems.
- Exceeding Energy Star home performance
- Renewable energy options
- Disposal of cardboard and other wastes from construction
- Choice of insulation and windows

In regards to the LEED Neighborhood Development and The Depot Hill Project, the above mentioned project should easily be LEED Certified. This estimate is based upon the minimal requirements for LEED Neighborhood Development certification. Further improvements to the development's design will award additional points. A Silver Certification could be obtained by:

- District heating and cooling systems.
- 40% or more of square footage of project's buildings LEED certified
- Exceed ENERGY STAR for Homes
- Promote bicycle and transportation efficiency
- On site renewable energy sources
- Storm water management
- Reduced automobile dependency
- Transportation demand management