Renewable Energy Ordinance Framework – Geothermal

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DVRPC's Renewable Energy Ordinance Frameworks were developed by DVRPC's Alternative Energy Ordinance Working Group (AEOWG). The AEOWG brings together leadership from counties and municipalities in the Greater Philadelphia region to support the safe and sound development of small-scale renewable energy systems, including solar photovoltaic, small wind (<100kW), and geothermal. This working group is convened by DVRPC's Office of Energy and Climate Change Initiatives as a component of its effort to reduce energy consumption and greenhouse gas emissions in the region. This work is in line with DVRPC's Long-Range Plan, *Connections: The Regional Plan for a Sustainable Future*, which identifies "Build an Energy Efficient Economy" as one of the four key strategies critical to realizing a sustainable future for our region.

These Renewable Energy Ordinance Frameworks are intended to serve as a resource for municipalities as they develop and update ordinances to govern the siting of small-scale renewable energy systems in their community. Municipalities in the DVRPC region are increasingly faced with the task of regulating the installation of small-scale renewable energy systems. As energy costs rise, and state and federal incentives reduce the initial cost of these systems, residents and businesses–some driven by environmental awareness–are becoming increasingly enabled to install renewable energy systems. However, many municipalities in the region do not have in place ordinances to approve, modify, or reject these renewable energy systems. As a result, residents and businesses often face the use-variance process, which must be performed on a case-by-case basis, resulting in considerable time delays, increased project costs, and increased strain on limited municipal resources. Inconsistent and unpredictable land use regulations can create a significant barrier to the installation of renewable energy systems by both residents and businesses, and deter the renewable energy industry from doing business in the region. Further, use variances, if granted, can be construed as spot zoning, creating costly legal challenges and delay.

A handful of municipalities in the region have begun adopting ordinances to proactively regulate the installation of renewable energy systems in an attempt to balance the benefits of renewable energy with the goals expressed in their municipal planning documents. Zoning and other land use regulations play an important role in enabling renewable energy projects that are cost effective and compatible with existing land use.

The purpose of these frameworks is to provide clear, consistent guidance on how to construct renewable energy ordinances that are consistent with state laws; are not overly restrictive or contradictory to the nature of renewable energy systems; and promote safe and sound community development. These frameworks provide a menu of sample ordinance language options, both permissive and restrictive, to allow municipalities to build a customized ordinance that addresses their local issues.

The document is formatted for easy navigation. Text boxes include corresponding guidance that explains the breadth of barriers, benefits, and cautions for municipalities when regulating these types of renewable energy systems.

These frameworks will be updated regularly as municipalities in our region develop ordinances and more information about renewable energy systems becomes available. The language provided in these frameworks is not intended to be adopted wholly. Municipalities should consult their solicitor to understand the implications associated with ordinance adoption and the specific language to be provided in the ordinance.

Introduction: Renewable Energy Ordinance Framework - Geothermal

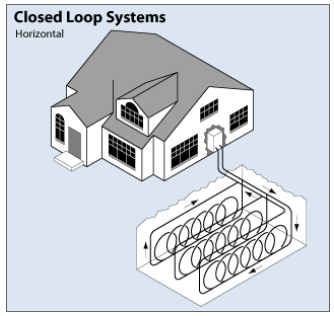
Legend:
Blue -- Ordinance framework
Black – Possible ordinance language (cited when possible)

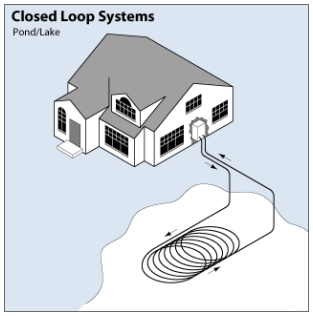
The Technology

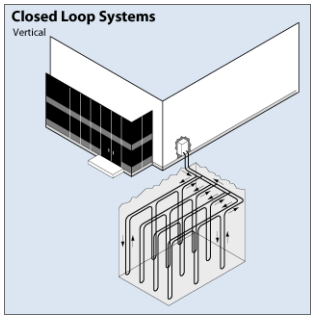
Geothermal energy is aptly named. The word geothermal translates into heat (thermal) from the earth (geo). Geothermal energy is a renewable, clean, and efficient energy source that can be produced in the DVRPC region. Geothermal energy can be used in several different ways, but in the DVRPC region, it is most commonly used on a distributed, small scale to improve the efficiency of heating and cooling buildings. Typically, geothermal energy in the region is derived from shallow-well heat pumps that utilize the constant temperature within the earth's upper crust. Ten feet below the earth's surface, the temperature remains a relatively constant 50 to 60 degrees Fahrenheit. In the summer, the ground temperature is cooler than the surface temperature; the opposite occurs in winter. Geothermal systems use this temperature differential to heat and cool buildings. The Greater Philadelphia region's climate of warm summer and cold winter temperatures makes the use of geothermal very attractive for our area.

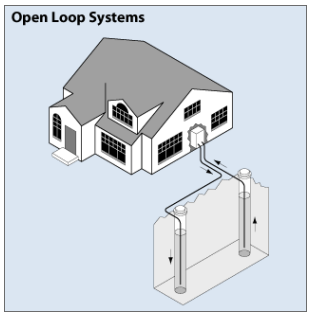
A geothermal heat pump system (GHPS) consists of narrow bore holes containing pipes drilled into the ground, a ground heat exchanger, a heat pumping unit, and ductwork in the building. In the winter, heat from the warmer ground is transferred through the heat exchanger into the building. In the summer, the heat from the warmer building is transferred into the ground via the underground pipe system. Some systems can use the heat removed from the building during the warmer months to heat water. No matter the season, the heat exchanger and fan run on electricity.

There are two configurations for geothermal heat pumps–open loop (groundwater) and closed loop (ground coupled) systems. These two configurations can be looped horizontally or vertically within the ground.









Closed Loop System

The horizontal closed loop system. In this system, two pipes are buried in a trench that is at least four feet deep and as narrow as two feet wide. The pipe can be looped (as seen in the illustration) to save space, or can be placed linearly in a longer, straight trench.

The vertical closed loop system. This system involves drilling multiple holes about 20 feet apart and 100 to 400 feet deep. Looped pipes are placed in the holes to circulate the water through wells. This option is commonly used where land area is limited or the soil is too shallow.

The closed loop pond/lake system. This system operates in the same method as the other closed loop systems, but it relies on the consistent higher water temperature instead of the ground temperature. The pipes are run into the body of water at a depth of at least eight feet to prevent freezing. The water is required to be of certain depth, volume, and quality.

Open loop systems

Open loop systems rely on a naturally occurring surface- or ground-water source. The water is pumped out of the well, used by the geothermal heat pump system, and then returned into the ground. This type of system requires a clean water supply and can be limited by natural and regulatory factors. There are two types of open loop systems: separate supply and reinjection wells (formerly, pump and dump); and standing column wells (SCW). Open loop systems typically offer higher efficiency and potentially lower capital expense, but require the same diligence as water wells in ensuring proper grouting to protect ground water against possible surface water contamination. Open loop systems utilize a heat

exchanger that separates ground water supply from the heat pump water loop. This heat exchanger further isolates the heat pump refrigerant from the ground water, thus insuring protection of this resource.

Standing Column Well (SCW): In the case of SCW, all water supplied by the well is returned to the aquifer via the same well. The net ground water withdrawal can be specified to be zero, i.e., no bleed design, or as much as 10 percent can be withdrawn as bleed water to address "gray water" considerations of the building. SCW systems, if properly designed, are no more onerous than a potable water well.

Open loop "pump and dump" systems: These systems require sufficient yield (three gpm/ton of HVAC) from the supply well and acceptance of that water by the reinjection well located a distance (100 feet) from the supply well. The issue with this type of open loop system is the removal of ground water from one point in the aquifer and the insertion of that water at another point, which may or may not ensure proper return to the aquifer. The perception of a system that demands large quantities of ground water for HVAC that is returned at a remote site leaves the possibility of dewatering the aquifer and impacting public water availability. For these reasons, open loop "pump and dump" systems have been prohibited in some areas. The same is NOT true of SCW systems, which are classed as an open loop system. Rather, SCW are designed to circulate ground water from a bore to and from a building heat exchanger. The return line in the well is designed to always remain below the surface of the water, so that air (oxygen) is eliminated as a possible source of changes to water chemistry.

Use of this Document

This framework provides guidance and example language for creating a permitting process and ensuring proper siting, installation, maintenance, and closure of a geothermal energy system. The language provided can be modified to become part of a municipality's drilling or well regulations, part of the General Codes, or part of the zoning ordinance. Since a handful of municipalities have placed their geothermal well regulations in their zoning ordinance, this framework has been formatted around the organizational structure of a typical a zoning ordinance. However, while including geothermal regulations in your zoning ordinance can be effective, it may not be the best place for this type of regulation, because geothermal wells are not truly a "use" to be regulated by zoning or land development. **Note: The language provided in this framework is not intended to be wholly adopted. Please consult with your municipal solicitor.**

For municipalities that choose to include the geothermal language into their drilling or well ordinance, ensure that there is no overlapping or conflicting language with the existing drill/well ordinance. Additionally, municipalities should also determine if their county has regulations concerning geothermal wells so that the two ordinances do not conflict. Municipalities concerned with any adverse impacts for geothermal wells–both their installation and the long-term operation and maintenance of these systems—can regulate these systems beyond current county requirements, but municipalities must meet all requirements in the county well-drilling regulations if they exist.

There are no federal regulations regarding well construction and/or siting of wells and boreholes. As a result, many states have taken on this role; yet Pennsylvania is one of only two states in the country with no statewide regulations for construction of most wells or boreholes. Currently, well drilling is regulated at the county level in Chester County, Pennsylvania; Bucks County, Pennsylvania; and draft well-drilling regulations are in the works at Montgomery County. **Check to see if your county government has regulations for digging geothermal wells.** Well drilling is regulated in the State of New Jersey by The Bureau of Water Systems and Well Permitting at the New Jersey Department of Environmental Protection (NJDEP). Property owners must receive a permit from the state and use NJDEP-certified well drillers as well. See below for more information on county-level well-drilling regulations.

Example well and bore hole ordinances
County:

- **CHESTER COUNTY HEALTH DEPARTMENT RULES AND REGULATIONS CHAPTER 500. WATER, WELLS, NUISANCES, SEWAGE AND LIQUID WASTE:** http://www.chesco.org/health/lib/health/regs/501.pdf

Municipal:

- Edgmont Township (Delaware County)
- East Rockhill Township (Bucks County)

State of New Jersey:

- http://www.state.nj.us/dep/localgov/watersys_wellpermit.html
- http://www.nj.gov/dep/enforcement/advisories/2011-05.pdf

Resources:

Spring Creek Watershed Association (SCWA) Model Ordinance for Borehole and Well Drilling: The SCWA, located in State College, Pennsylvania, has developed two (draft) versions of well and borehole regulations. One draft {click here - Generic PMC} can be used in conjunction with the Property Maintenance Code implemented by municipalities with in-house code inspection services. A second draft {click here - Ordinance} can be adopted as a stand-alone ordinance by those municipalities that do not have a Property Maintenance Code in effect. http://scwatershed.com/component/content/article/39-well-drilling/84-spring-creek-watershed-model-ordinance-for-borehole-and-well-drilling.html

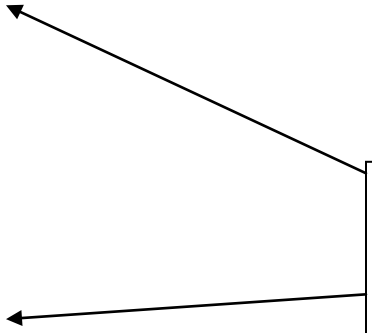
Pennsylvania Department of Conservation and Natural Resources (DCNR): Water Well Drilling and Abandonment
http://www.dcnr.state.pa.us/topogeo/groundwater/gw_privwells/index.htm

Section 1. Intent / Background

This section offers examples of how to phrase the intent and purpose of the ordinance. The inclusion of intent and purpose language is strongly encouraged in an renewable energy ordinance, as it explains the intent of creating provisions for the development of geothermal energy systems and clarifies a municipality's rationale for establishing the ordinance. It should also address why the regulations are being adopted and outline the goals of the ordinance, and perhaps refer to the correlating act to make the relevance of the ordinance apparent. An intent or purpose section highlights the benefits of geothermal energy systems and why they should be protected through the development of this ordinance. This section also serves to establish the rationale for the ordinance in case of a legal challenge.

- It is the purpose of this ordinance to protect the health, safety, and general welfare of the residents of (Municipality) by ensuring that the ground waters will not be polluted or contaminated. It is also the purpose of this ordinance to provide guidelines in the installation and operation of various geothermal systems that exist today in order to ensure the protections referenced.

- (Municipality) residents depend on ground water as a water supply source. Because geothermal systems are constructed in the ground or use ground water, these systems create a potential for water supply and quality degradation. Therefore, the Board of Supervisors finds that the installation, use, and maintenance of geothermal systems are matters of legitimate concern with respect to public health, safety, and welfare, and that the regulation of installation and maintenance of geothermal systems is warranted.



These examples do not prohibit open loop systems. A municipality may use this Intent/Background and prohibit open loop systems later in the ordinance if it deems that appropriate.

Section 2. Definitions

Any term used in the text of the ordinance must be defined. This section provides a selection of important terms and their definitions.

ANNULAR SPACE. The space between two (2) cylindrical objects, one of which surrounds the other, such as the space between a drill hole and a casing pipe.

AQUIFER. A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

ASTM. American Society for Testing and Materials.

BORING/BOREHOLE. A penetration of soil and/or rock that is augured, drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed which is generally cylindrical in shape and whose diameter is generally smaller than its depth of penetration.

CASING. An impervious durable pipe placed in a well to prevent the walls from caving and to seal off surface drainage or undesirable water, gas, or other fluids and prevent their entering the well.

CLOSED-LOOP GEOTHERMAL SYSTEM. A type of geothermal heating and/or cooling system that utilizes a pressurized heat exchanger consisting of pipe, a circulating pump, and a water-source heat pump in which the heat transfer fluid is not exposed to the atmosphere. The heat transfer fluid is potable or beneficial reuse water and may have approved antifreeze added.

CONTRACTOR. Any individual, partnership, company, association, corporation, group, or entity employed, hired, contracted, or otherwise engaged by the Owner to perform defined services for compensation.

DECOMMISSIONING. The act of rendering a well or borehole to a condition where there is no pathway present for surface or subsurface contaminants to travel down to the water table.

DEP. New Jersey (NJ) or Pennsylvania (PA) Department of Environmental Protection.

DCNR. Pennsylvania Department of Conservation and Natural Resources.

DRILLING. Any act of penetrating soil or rock, such as boring, coring, washing, jetting, driving, or digging.

GEOTHERMAL SYSTEM. A system that uses a heat pump to extract heat from the earth in heating mode and/or reject heat into the earth in cooling mode. It is also called a geothermal heat pump system, a ground-coupled heat pump system, an earth-source heat pump system, and a GeoExchange system.

GROUND SOURCE HEAT PUMP. A geothermal heat pump that uses the earth itself as a heat source and heat sink. It is coupled to the ground by means of a closed-loop heat exchanger installed horizontally or vertically underground.

GROUNDWATER. Water within the earth below the water table within the zone of saturation. Groundwater includes both water under water table conditions and confined within deep aquifers.

GROUT. A high-solids fluid mixture of cement or bentonite and potable water of a consistency that can be pumped through a tremie pipe and placed as required. Various additives, such as sand or bentonite, may be included in the mixture to meet certain requirements.

HEAT PUMP. A mechanical device used for heating and/or cooling which operates by pumping heat from a cooler to a warmer location.

IGSHPA. The International Ground Source Heat Pump Association.

MONITORING WELLS. A well used to observe water levels and/or obtain samples of groundwater.

OPEN-LOOP GEOTHERMAL SYSTEM. A type of geothermal heating and/or cooling system that utilizes a water-supply well and a water pump to deliver ground water to a water-source heat pump. The discharge water from the water-source heat pump may be returned to the subsurface through a recharge well or infiltration bed, or may be discharged into a pond, lake, or stream. A spring may also be the source of the ground water supply.

OWNER. Any person vested with sole or partial, legal, or equitable ownership of the subject property.

PLUME. Areas of identified, delineated groundwater or soil contamination associated with any property considered to be a threat to the environment or human health, such as, but not limited to, a Superfund site.

POTABLE WATER. Water suitable for human consumption.

PUBLIC WATER SYSTEM. A system which provides water to the public for human consumption which has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. The term is either a community or noncommunity system and includes collection, treatment, storage, and distribution facilities under the control of the operator of the system and used in connection with the system. The term also includes a system which provides water for bottling or bulk hauling for human consumption.

RETURN WELL. A well designed and constructed for the return of water to the ground.

STANDING-COLUMN GEOTHERMAL SYSTEM. A type of open-loop geothermal heating and/or cooling system that circulates ground water from a water well through a heat exchanger and returns the discharge water from the water-source heat pump to the same water well that it was pumped from. The water withdrawal and return locations within the water well bore are separated as far as is possible. Some standing-column geothermal systems discharge some of the circulating ground water to enhance their heat transfer.

TEST WELLS. A well constructed for the purpose of obtaining information on groundwater or hydrogeologic conditions, including yield and quality.

TREMIE PIPE. A rigid or flexible pipe or a hose that carries the grouting materials to the bottom of the zone being grouted. The tremie pipe is withdrawn as the grout material fills the annular space outside the casing or fills the space between the loop pipes and the borehole wall. The end of the tremie pipe is kept submerged just below the surface of the grout material.

VERTICAL CLOSED-LOOP BOREHOLE. A borehole which is constructed to receive heat-exchanger loop pipes and grout material. Fill material may be used below a minimum depth of 20 feet below grade as the subsurface conditions warrant.

WATER-SOURCE HEAT PUMP. A heat pump that uses a water-to refrigerant heat exchanger to extract heat from the heat source.

WATER SUPPLY WELL. Any well that is constructed to remove or return water to the ground.

WATER TABLE. That surface in an unconfined groundwater body at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water.

WELL. Any excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is for the location, acquisition, monitoring, or artificial recharge of groundwater. This includes, but is not limited to, test wells, test borings, and monitoring wells, in addition to wells to be utilized as individual or semipublic water supplies.

WELL DRILLER. An individual or company that is permitted or licensed by the State of Pennsylvania to drill wells in Pennsylvania.

WELL SEAL. An approved device or method used to protect a well casing or water system from the entrance of any external pollutant at the point of entrance into the casing of a pipe, electric conduit, or water level measuring device.

ZONE OF SATURATION. The zone below the water table in which all interstices are filled with ground water.

Section 3. Applicability

Most ordinances concerning geothermal systems do not include an applicability section.

Section 4. General Regulations

The general regulations are general guidelines or added requirements that must be integrated into the local review process used by your municipality. The standards that follow may be used in addition to existing special use permits and site plan review standards, or they may be used to create a stand-alone set of review standards that substitute for any existing review standards. For Pennsylvania municipalities, these regulations can be placed in the municipality's building permit regulations as amendments to Pennsylvania's Uniform Construction Code (as authorized by section 35.P.S. Section 7210.503 Changes in Uniform Construction Code). Approval standards may be imposed upon specific types of geothermal wells (i.e., open loop, pond applications), imposed upon specific districts, or be generally applied to all geothermal wells. This section is organized into subheadings (such as Permitting, Location of Geothermal Systems, etc.). You should organize your regulations to fit best with your current regulations.

Permitting

A. It shall be unlawful to install a new geothermal well or modify an existing geothermal well without a valid permit.

B. Prior to constructing a new geothermal well or modifying an existing geothermal well, the property owner shall file all appropriate applications with the municipality, county, or other regulating agency and pay all applicable fees.

You should check with your county government to determine if your county has regulations concerning geothermal wells and your ordinance should not conflict with your county ordinance.

C. The application to construct or alter a geothermal well must be filed on behalf of the current owner or equitable owner.

D. The Municipality shall approve or deny the application within ___ working days of receipt of a complete application and fee. The Municipality must field verify the location of the proposed geothermal wells and all applicable isolation distances. When (Municipality) has found an application to be incomplete, or (Municipality) is unable to verify the information submitted, the applicant shall be notified in writing that additional information or clarification is required. (Municipality's) time for acting upon a

You should fill in the number of business days with which your municipality is comfortable. The Uniform Construction Code generally requires municipal approval of building permit applications for one- and two-family dwellings and utility and miscellaneous use structures to be issued within 15 business days, or within 5 business days when the application is prepared by a licensed design professional; all other construction permits must be issued within 30 days.

permit shall be extended ____ days beyond the date of receipt of the supplementary or amendatory information.

E. Any relocation of the proposed geothermal well site from the permitted location must be submitted in writing and approved by (Municipality).

F. If geothermal well construction is not completed in ___ years of the permit issuance date, the approval to construct shall expire.

Three years is a common length of time for construction.

G. All geothermal well applications must be completed and include the following information:

1. Applicant name and signature, address, and telephone number.
2. Site address, subdivision name, and lot number.
3. Driller name, (State licensing agency) number, and telephone number.
4. Tax parcel number.
5. Description of construction.
6. Plot plan to include:
    a. Property lines, lot dimensions, slope direction, adjacent streets, and reference to North.
    b. Marked distances from the proposed geothermal well to any existing and proposed water supplies, buildings, driveways, parking areas, two (2) non-parallel property lines, retention areas, surface waters, chemical/fuel storage areas, and any other feature that requires an isolation distance as defined in this ordinance.

Standing Column Well (SCW) Regulations

- Standing column wells should be dug to potable water well standards.

- Isolation distances should be used.

- **Design and installation of SCW systems.**
  The standing column well geothermal system, including heat pump exchanger, piping, and all other related systems shall be installed by a geothermal well installation contractor who is certified in the proper installation methods as specified by the manufacturer.

A municipality can use its current municipal or county potable water well standards to regulate the drilling of SCW wells.

A municipality should incorporate isolation distances for the SCW wells. These can be the ones provided by a potable water well ordinance or the ones supplied in this document. See pg. 18 for a listing of recommended /common isolation distances.

The **wells** for a SCW system can be regulated with a municipal or county potable water well ordinance. The **mechanical systems** (heat exchanger, piping, etc.) could be regulated through the language provided here.

Open Loop Systems

OPEN LOOP SYSTEMS PROHIBITED.

- Open loop systems are prohibited.
- Only closed loop systems or standing column well systems are allowed. Separate supply and reinjection wells are prohibited.

OPEN LOOP GEOTHERMAL SYSTEMS (permitted)

a. Best Management Practices shall be used to prevent aquifer contamination. Return wells shall be drilled into the same aquifer as the withdraw well to prevent introduction of contaminants from one aquifer to another. If this is not possible, the water quality of both the withdraw well and return well shall be tested and the withdraw well aquifer cannot be of lesser quality (as determined by the Municipality) than the return well aquifer. To prevent thermal degradation, the withdraw and return wells must be a minimum of 50 feet apart. All other isolation distances must also be adhered to.

b. Only [insert state agency here] approved well drillers using [insert state agency here] approved well drilling rigs shall drill the withdraw and return flow wells for this type of system.

c. Return flow wells shall be designed and screen lengths doubled. Extended pump testing of 12 to 24 hours shall be done to determine the hydraulic characteristics of the well, and a blind flange shall be installed to allow for emergency surface discharge of water. Any emergency surface discharge shall conform to applicable state regulations

d. Surface discharge of water from an open loop system to a surface water body may require a National Pollutant Discharge Elimination System (NPDES) permit. The person

Many municipalities in this region prohibit open loop systems. They do this with the goal of protecting water resources. Experts argue that if designed and installed properly, open loop systems pose no threat to water quality or aquifer quantities. Each municipality should decide if it is comfortable with allowing open loop systems. If a municipality chooses to allow open loop systems, then additional regulations should be added to regulate open loop systems.

If you do allow open loop geothermal systems, these are recommended regulations.

In Pennsylvania, this would be PA DCNR. http://www.dcnr.state.pa.us/topogeo/groundwater/LicensedDrillers/LicensedDrillerReport.aspx

requesting a geothermal permit from the Department is required to submit proof of an NPDES permit or exemption with any application.

e. An EPA reporting requirement exists for injection of water to a return well for groundwater heat pump systems.
f. Under no circumstances may additives of any kind be placed in this type of geothermal system to enhance heat transfer or reduce freezing points of the circulating water.

Location of Geothermal System

- **Minimum isolation (setback) distance.** Wells and boreholes regulated by this ordinance shall be located using the minimum isolation (setback) distances to existing or potential sources of pollution listed in Table 1. For closed loop geothermal wells and boreholes which due to infeasibility cannot conform to the requirements of Table 1 (on the following page), an appeal to the pertinent municipal official can be made detailing the infeasibility and the proposed location. Upon review, the municipal official may reduce the required set back distances.

Municipalities can choose if they want to include isolation distances in their ordinance. If so, we have presented recommended isolation distances on the following page (Table 1). Municipalities can also reference the isolation distances defined in Pennsylvania Code Title 25 Environmental Resources, Section 73.13 Minimum Horizontal Isolation Distances . Not every distance may be applicable in each municipality, so choose those that are appropriate for your community.

Table 1

Setback From	Borehole and Geothermal Supply and Geothermal Return Well (feet)
Delineated wetlands, flood plains, lakes, ponds, or other surface waters	10-25 feet
Storm drains, retention basins, stabilization ponds, or stormwater management facilities	at least 10 feet
Preparation area or storage area of hazardous spray materials, fertilizers of chemicals, or salt piles	300 feet 100-150 feet (if borehole is cased and grouted inside and out)
Gravity sewer lines and drains carrying domestic sewage or industrial waste	5-15 feet or according to easement
Existing water and forced sewer buried utilities and/or utility trenches	at least 15 feet or outside easement
Septic tanks, aerobic tanks, or holding tanks	at least 25 feet
Subsurface sewage disposal systems, elevated sand mounds, or other sewage disposal fields	25-50 feet
Sewage seepage pits and cesspools	at least 25 feet
Farm silos, barnyards, privies, and fuel tanks	at least 25 feet
Spray irrigation sites, sewage sludge, and septage disposal sites	at least 25 feet
Dedicated public right-of-way and property lines	at least 10 feet
Building foundations (except for buildings enclosing water wells and/or water well pumps and any other source of pollution as approved)	at least 10 feet
Identified NPL Site (Superfund) plume area	at least 300 feet
Any other source or potential source of pollution	

Source: Bucks County Department of Health Rules and Regulations Governing all Wells and their Construction Specifications; Edgmont, PA (Delaware County) Ordinance; Spring Creek Watershed Association (State College, PA) Model Ordinance.

Municipalities can also reference the isolation distances defined in Pennsylvania Code Title 25 Environmental Resources, Section 73.13 Minimum Horizontal Isolation Distances .

•All geothermal systems in areas underlain by _____ (geological formation (e.g., carbonate bedrock, etc.)) must be vertical loop systems. If the closed loop geothermal borehole penetrates bedrock, it must be grouted from a depth of fifteen feet (15') into the bedrock to the top of the borehole. Outside the _____ (geological formation) areas, either a vertical or horizontal closed loop geothermal system may be used, subject, however, to the review and approval of the plans for same by the _____(municipal engineer, zoning officer, etc.).

This language can be adapted for municipalities that have specific geological concerns.

A municipality may require more stringent licensing or certification standards than this. Some certifications that can be used as a means of qualifying include:
-IGSHPA Accredited; and
-Keystone HELP Program Accredited;
- State and federal geothermal funding sources usually require a certified installer. You can research the current programs and use those licensing/certification standards.

Geothermal System Standards

•Only an insert your state agency here-licensed well driller or an IGSHPA-accredited geothermal system installer shall conduct the drilling of a geothermal well. In all cases, the well drilling rig must also be approved by insert your state agency here.

The IGSHPA method for regulating installation

•The geothermal system must be installed, maintained, and decommissioned in standards conforming to IGSHPA Closed-Loop/Geothermal Heat Pump Systems Design and Installation Standards, as same may be amended and updated from time to time.

There are three ways to include installation, materials used, maintenance, and decommissioning standards into your ordinance: 1) rely completely on accepted international standards (the IGSHPA), 2) define your own standards, or 3) use manufacturers' specifications, or a combination of methods.

This method is the simplest to write and is quite thorough. Every year the IGSHPA updates its standards to conform to the latest accepted technologies and techniques. The drawback to this method is the lack of control by the municipality. The standards may change without the municipality being aware of it, or include aspects that the municipality does not want. For example, the IGSHPA also includes standards that require installation be done by an IGSHPA-accredited contractor. We recommend that the municipality visits the IGSHPA website and fully reviews the Closed-Loop/Geothermal Heat Pump Systems Design and Installation Standards before adopting this language. The 2011 manual can be found at the following link:
http://www.igshpa.okstate.edu/pdf_files/publications/IGSHPA2011StandardsSec.pdf
To ensure that you have the latest version, we would recommend an internet search.

For the purpose of this document, we will present installation, materials, maintenance, and decommissioning standards that may be used in an ordinance. Some of these options are taken from IGSHPA standards, while some are taken from county regulations in the region. You should read the materials presented and decide what works best for your community.

Some of this language is quite detailed. Installing geothermal systems, and the materials required for such installation, is quite complex. They should be treated as such in an ordinance. It may be possible to simplify this language, but a municipality should do so only with the guidance of a qualified engineer or other professional.

•Closed-Loop Geothermal Boreholes shall be located, drilled, and finished in a manner that will protect the borehole structure from damage from surface activities or other natural occurrences so that the quality of the local groundwater cannot be affected.

•The well contractor shall be responsible for ensuring that the borehole is drilled in the permitted location. Deviation from the permitted location must receive prior written approval from this Department. The well contractor shall be responsible for drilling the borehole and the final backfilling after the pipe loop has been installed.

•For a trench system, a minimum of six inches of sand or screenings is to be added to the bottom of the trench to prevent the loop piping from rubbing on stones.

•Pipe loops must be in intimate contact with soil or grout to minimize air pockets. Three to five percent of the piping should extend up from the bore holes or trenches to compensate for relaxation or stretching.

•The pipe loop is to be installed by a contractor who is certified in the proper method of heat fusion specified by the pipe manufacturer. The well contractor shall be responsible for ensuring

that the pipe loop is installed in accordance with the specifications of the ground source heat pump.

•All pipe and heat fused material shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D 3035, or D 2447, as specified in the PPI handbook of Polyethylene Pipe HVAC Applications.

•Copper piping is not acceptable for heat transfer use system manufacturer.

•Casings are not required. Casings may be necessary to hold the borehole open during the drilling process. Casings may be left in the borehole at the discretion of the well contractor. When a casing is used, grouting the annular space is required.

If the casings are left in the borehole, it is important that the casings are grouted.

•Backfilling shall be according to the specifications of the ground source heat pump equipment manufacturer. When sand is the specified backfill material, the borehole shall be constructed in the same manner as a water supply well. A casing is required to be used and the annular space is required to be grouted.

•The minimum required backfilling material for boreholes is bentonite. Bentonite grout shall be pure, with at least 20 percent solids by weight when mixed with water. Hydration of the bentonite must be delayed until the bentonite has been placed down the well. It is recommended that the vertical bore holes are grouted from the bottom of the well to the top using an appropriate grout with thermal transfer properties. If the borehole penetrates bedrock, it must be grouted from a depth of fifteen (15) feet into the bedrock to the top of the borehole.

Grouting is extremely important to protect water quality. This is the most important aspect of any geothermal regulation. If installed correctly, a bentonite grout will protect water quality, but using a grout with thermal transfer properties will also help the system function more efficiently.

- The IGSHPA recommendation that the heat exchanger be isolated and tested to 150 percent of design pressure or 300 percent of system operating pressure shall be followed. No leaks shall occur within a 30-minute period.
- Only water or other fluid specifically approved by the municipality may be used as a circulating fluid for geothermal systems.

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A municipality may not wish to require testing of the system to IGSHPA standards. However, as a best management practice, it is recommended that the system is tested.

Manufacturer's specifications for regulating installation

- The pipe loop is to be installed by a geothermal well installation contractor who is certified in the proper method of heat fusion specified by the pipe manufacturer. The geothermal well installation contractor shall be responsible for ensuring that the pipe loop is installed in accordance with the specifications of the ground source heat pump system manufacturer and the pipe manufacturer, and that the borehole is properly backfilled. Backfilling shall be according to the specifications of the ground source heat pump equipment manufacturer. When sand is the specified backfill material, the borehole shall be constructed in the same manner as a water supply well. A casing is required to be used and the annular space is required to be grouted.

This language is standard in ordinances that reflect the use of technology. While it may be the safest from a legal standpoint, it does take a measure of control away from a municipality.

Maintenance of Geothermal System

- Geothermal piping systems shall be tested hydrostatically at one and one half times the maximum system design pressure, but not less than 100 psi (689 kPa). The duration of each test shall be not less than 15 minutes. All geothermal systems must be checked by a licensed geothermal contractor every year from the certification system date. Results shall be submitted to the Municipality. A pressure monitoring system

This language may be seen as too onerous. Requiring testing every year and a monitor to be placed on the system will be costly for the homeowner, but may be appropriate for a cautious community. A municipality can change the testing interval from every year to a longer period of time, such as every five years.

the system to be shut down if there is a pressure drop of the geothermal system fluid that would indicate an external leak in the system.

•All geothermal systems shall be property maintained in accordance with manufacturer's specifications, the installer's specifications, and any applicable Federal, State and local laws.

This language is standard in ordinances that reflect the use of technology. While it may be the safest from a legal standpoint, it does take a measure of control away from a municipality.

<u>Maintenance of Ground Source Heat Pump</u>.

1. All ground source heat pump systems shall be properly maintained in accordance with the manufacturer's specifications, the installer's specifications, and any applicable DEP or *federal* regulations.

This language is more stringent than just referring to the manufacturer's specifications and puts more responsibility on the homeowner.

2. A person who owns a lot upon which a ground source heat pump system is installed, and any person who occupies a structure which is served by a ground source heat pump system, shall be responsible for maintaining the ground source heat pump system.

3. If a ground source heat pump system malfunctions, the person responsible for the maintenance of the ground source heat pump system shall take all action necessary to repair, modify, or alter the ground source heat pump system to eliminate the malfunction.

4. Any ground source heat pump system leaks or releases shall be reported by the applicant (and subsequent owners) to the Municipality within 24 hours of the discovery of same, and the applicant (and subsequent owners of the property) covenants and agrees to take all appropriate action to minimize any fluid release to the ground and to promptly repair any system leak.

Sixty to 90 days is a typical timeframe for repair or replacement for malfunctions.

5. In the event of the proposed discontinuance of the use of the ground source heat pump system, a system closure plan will be prepared and submitted to the Municipality for its approval.

Abandonment of Geothermal System

•A geothermal system shall be abandoned in a manner acceptable to the Municipality and shall comply with the laws, rules, and regulations applicable to the abandonment of water wells. Any and all heat transfer fluid must be removed by displacement with grout in a manner acceptable to the Municipality. The top of the borehole must be uncovered and capped with grout in a manner acceptable to the Municipality.

Compliance with Other Regulations

•If any provision of this section conflicts with any applicable state or federal law, rule, or regulation which is more strict or which is determined to preempt a provision of this section, the applicable state or federal requirement shall control.

Section 5. Penalties

We recommend the use of standard language, but the language should be very specific for each municipality.

Section 6. Severability

•If any sentence, clause, section, or other part of this ordinance is, for any reason, found to be unconstitutional, illegal, or invalid, such unconstitutionality, illegality, or invalidity shall not affect or impair any remaining provisions, sentences, clauses, sections, or other parts of this ordinance. It is hereby declared as the intent of (Municipality) that this ordinance would have been adopted had such unconstitutional, illegal, or invalid sentence, clause, section, or part thereof not been included herein.

Section 7. Effective Date

•This ordinance shall become effective 30 days from the date of enactment.

Sections 5, 6, and 7 may be unnecessary if the municipality is including geothermal language in an existing ordinance. The municipality can, and should, use its normal standard language for this section, if possible.