State of Maine
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Water Quality
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SUPPLEMENTAL GEOTHERMAL WELL INFORMATION FORM

Facility Name or Well Identifying Information

Well Owner / Address: _____

Facility Name or Well Identifier: _____

GPS Location of the Well(s) _____

Town or City: _____ County:_____

Professional Information

Drilling Contractor: _____

Contact Name/Phone Number: _____

System Design Company: _____

Address: _____

Project Manager / Phone Number:_____ CGD #:_____

Is a Professional Engineer (P.E.) required to design the system either by state statute (see Attachment A) Yes/No____;

or by Municipal Code Enforcement Officer determination? Yes/No ____

If a P.E. is required, please provide the following:

Engineering Firm: _____

Address: _____

Project P.E. / Phone Number:_____ ME Stamp #:_____

Geologist / Hydrogeologist: _____ Phone Number:_____

Geothermal Well System Information

Is the well(s) located on a Mapped Significant Sand and Gravel Aquifer? _____ Yes_____ No ____ Unknown

Is the well(s) located on a Source Water Protection Area for a Public Water Supply? ____ Yes _____ No ____

Unknown How many Geothermal Wells are going to be installed at the facility? Number: _____

What type of Geothermal System is going to be installed (Please Check One)?

Closed Loop _____ Closed Loop (Direct Exchange) _____ "Open Hole" _____ Other_____

If other is selected, Please describe how the system works:

_____

How many "heat Pump" units are going to be installed at the facility? Number:_____

What is the maximum heating capacity of each individual "heat pump" units in BTU's? _____

What is the maximum cooling capacity of each individual "heat pump" in tons?_____

NOTE: Refer to Attachment A for a brief description of the most common types of geothermal systems mentioned above.

Remember that even if proper safeguards are put in place, if a system failure causes a direct discharge to a water of the state, **the owner will likely be liable for clean up and remediation costs** from their geothermal well system. Any failure contributing to a release of a pollutant to a water of the state must be reported to the MEDEP.

A documented release of pollutants from a geothermal well system is a violation of Maine State Law, Title 38 M.R.S., § 413 which prohibits the unlicensed discharge of wastes to waters of the State. Additionally, the release of carrier oil from a heat pump compressor violates Maine State Law, Title 38 M.S.R., § 543 which prohibits the discharge of oil into or upon any waters of the state (i.e., surface water and groundwater). As such the release must be remediated to the MEDEP's satisfaction in accordance with Maine State Law, Title 38 M.S.R., § 548.

Well drilling logs for each of the wells must be submitted with the registration form. The well drilling logs must include (but not be limited to), depth of well, depth to bedrock, depth of water bearing fractures, amount of casing installed, estimated GPM, etc… If geophysical analysis is conducted on the wells after installation, a copy of the geophysical report must also be submitted.

"Closed Loop" Geothermal Systems

Does the "Closed Loop "geothermal system use food grade propylene glycol as a heat exchange fluid?

Yes _____ No_____

If yes, what brand name of propylene glycol is used (CAS No.)? _____

If No, what type of heat exchange fluid is used?_____

Are the geothermal wells grouted in to help prevent and contain a direct discharge of the heat exchange fluid to a water of the state in the event of a piping failure?

Yes _____ No_____

If No, what type preventative measures are in place to prevent a release in the event of a system failure?

_____

"Direct Exchange" Geothermal Systems

Are the geothermal wells grouted in to help prevent and contain a direct discharge of the refrigerant and carrier oil to a water of the state in the event of a piping failure?

Yes _____ No_____

If No, what type preventative measures are in place to prevent a release in the event of a failure?

_____

Does the geothermal system incorporate cathodic protection to protect the integrity of the system piping?

Yes _____ No_____

If No, what type preventative measures are in place to prevent a release in the event of a piping failure?

_____

“Open Hole” Geothermal Systems and Discharge Information

Does the geothermal system design incorporate a heat exchanger to separate the well loop from the building loop?

NOTE: a heat exchanger is a separate piece of equipment than the “heat pump” itself to prevent well water from circulating through the “heat pump”.

Yes _____ No_____

If No, by what means does the system prevent contamination in the event of a heat pump failure discharging refrigerant and carrier oil? _____

Is the Geothermal Well System going to discharge "bleed water"? _____Yes _____No
If yes, where is the "bleed water" going to be discharged?

Municipal Sewer_____ Dry Well_____ Septic System_____ Municipal Storm Sewer_____ Other_____

If other is selected, please describe where the “bleed water” will be discharged.

_____

If the Geothermal Well System is going to discharge “bleed water” what is the source of the additional water to compensate for the loss of the "bleed water" from the system?

Public Water Supply_____ Private Well(s)_____ Aquifer Recharge_____ Not Applicable_____ Other_____

If other is selected, please describe where the additional water is derived:

_____

All geothermal well systems that are NOT discharging to the municipal sewer system and are discharging “bleed water” or any other by-product at the site to a system other than the original well(s) must complete and submit the following laboratory analysis PRIOR to using the system. Additionally, if the source of the water to compensate the loss of the “Bleed Water” is a source other than a public water supply, each water source must also be sampled. All currently registered geothermal systems discharging on-site must complete and submit the following laboratory analysis to maintain their registration.

Upon receipt and review of the analytical results, the MEDEP will determine if the discharge to the environment is deminimus and authorized by rule, if additional testing is required, or if a waste discharge license is needed and a treatment system required to be installed.

All of the geothermal wells and water supply sources (community public water supply excluded) in the system must be sampled for the following analytical parameters to ensure the on-site discharge meets applicable drinking water standards. A representative raw water sample from each well must be collected and preserved in accordance with analytical test methods.

If a state certified geologist / hydrogeologist can demonstrate that all of the wells in the geothermal system exhibit similar stratigraphy, geology, and hydraulic characteristics, only one representative well will need to be sampled. All wells that penetrate unique geologic strata, are not hydraulically interconnected, or exhibit individual characteristics will also need to be sampled.

"Open Hole" Geothermal Systems and Discharge Information Continued

Sampling and analysis must be conducted in accordance with: a) methods approved by 40 Code of Federal Regulations (CFR) Part 136, b) alternative methods approved by the Department in accordance with the procedures in 40 CFR Part 136, or c) as otherwise specified by the Department. Samples that are sent out for analysis shall be analyzed by a laboratory certified by the State of Maine's Department of Health and Human Services.

SUBSTANCE	MEG	EPA HEALTH ADVISORY	EPA MCL
Arsenic	10		10
Lead	10		15
Manganese	300		
Sodium	20000	20	
Chloride		250	
Uranium	30		30
Extractable Petroleum Hydrocarbons	Various		
Volatile Petroleum Hydrocarbons	Various		
Volatile Organic Compounds EPA Method 8260	Various		Various

Table Notes:

All concentrations shown are in parts per billion (ppb) unless otherwise noted in the body of the table for a specific parameter.

MEG – Maximum Exposure Guidelines; Maine CDC MEG's for drinking water; updated December 2016.

EPA – U.S Environmental Protection Agency

MCL – Maximum Contaminant Level

Consideration to site conditions and geology may warrant additional laboratory analysis. If existing sources of contamination are present in the area

(i.e., gasoline stations, landfills, etc….) the analysis should be adjusted to identify any potential compounds associated with the source.

Under certain conditions, systems without a heat exchanger installed to separate the well loop suffer material deterioration resulting in the discharge of copper and lead to the environment. For such designs, the Department advises analysis of the discharge from each heat pump unit at a point prior to returning to the well or disposal field, for the following parameters 90-120 days after start up of the system.

Substance	MEG	EPA HEALTH ADVISORY	EPA MCL
Copper	500 ppb		1,300 ppb
Lead	10 ppb		15 ppb

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SUPPLEMENTAL GEOTHERMAL WELL INFORMATION

ATTACHMENT A

Geothermal & Ground Water Heat Pump Wells

Geothermal & ground water heat pump wells are heating and/or cooling systems that exchange thermal energy from an underground source. The wells that are typically associated with geothermal systems are regulated by Maine Department of Environmental Protection (MEDEP) under the Underground Injection Control (UIC) Program, "*Rules to Control the Subsurface Discharge of Pollutants*", 06-096 C.M.R. Chapter 543.

Geothermal systems utilize the earth's relatively constant temperatures just below its surface with an average range of 45° to 65°F. In the heating season, a fluid or refrigerant in the loop collects heat from the earth and transfers that heat to the building. The system then uses electrically driven compressors and heat exchangers to concentrate the heat and release it into the building. In the cooling season, most geothermal systems can be modified to run in reverse and remove heat from the building, transferring it to the well(s).

There are three main types of geothermal systems, "Closed Loop" systems, "Direct Exchange systems, and "Open Hole" systems. Variations of closed-loop systems are based on the configuration of the pipe, the type of antifreeze solution (if used) and the amount of heating and cooling required. "Open Hole" systems vary according to the use and disposal of groundwater.

"Closed Loop" geothermal systems:

Closed loop geothermal systems rely on the contained circulation of heat exchange fluids through an underground loop of pipes. The subsurface loops consist of thin walled polyethylene pipe, installed either vertically in borings (wells) or horizontally in trenches, and typically containing an antifreeze solution. The subsurface loop acts as a heat exchanger, transferring thermal energy to the ground and subsequently circulating to an indoor heat pump where it releases thermal energy to the building via the heat pump refrigerant.

The risk of groundwater contamination from closed-loop geothermal systems is relatively low. However, the potential exists for a leak or rupture to occur that would allow the antifreeze to escape to a water of the state. If the fluid is a polluting substance such as a methanol or ethylene glycol, the system owner may be liable for remediating the release. As such, the MEDEP recommends using biodegradable heat exchange fluid mixtures such as food grade propylene glycol. All other thermal exchange fluids must be approved in writing by the MEDEP prior to use. Additionally, the MEDEP recommends grouting the wells to help prevent a direct release of heat exchange fluid to a water of the state in the event of a piping failure.

"Direct Exchange" geothermal systems:

Another type of closed-loop system is the direct exchange (DX) geothermal system. DX systems are more common for smaller residential applications where a large thermal exchange system is not needed as in a commercial application (i.e., schools, office buildings, warehouses, etc.) Typical DX systems utilize copper piping placed in a series of vertical wells. The copper piping is subsequently charged with refrigerant and carrier oil that is circulated to the compressor in the building

Since a DX system requires several times the amount of refrigerant and carrier oil that is circulated through the copper piping, the potential exists for a leak or rupture to occur that allows the refrigerant and carrier oil to escape. If a release of refrigerant and carrier oil occurs, the system owner may be liable for remediating the release. As such, the MEDEP recommends grouting the wells to prevent a direct refrigerant release to a water of the state in the event of a piping failure. Additionally, the MEDEP recommends the installation of a cathodic protection system to protect the integrity of the copper piping of the system and provide an additional safeguard to help prevent a release of refrigerant and carrier oil.

“Open Hole” geothermal systems:

Open hole geothermal systems generally consist of a series of vertical standing column wells that are typically six to eight inches in diameter and range from 400 to 1,500 feet in depth. Each well in the system is fitted with a four to six inch diameter poly vinyl chloride (PVC) sleeve with a series of one inch diameter holes drilled in the lower section (Porter Shroud). The Porter Shroud allows the submersible well pump in each well to be located near the top of the well and still draw the warmer and more stable water from the bottom of the well. Water is then pumped from the well(s) and circulated through a heat pump where thermal exchange occurs with the refrigerant and carrier oil in the compressor. The water is subsequently discharged back into the well on the exterior of the Porter Shroud. In order to keep a stable thermal exchange in the well system during peak heating and cooling times, “bleed water” is discharged from the system and water is added from an external source. The addition of water treatment chemicals to the open hole geothermal system is prohibited.

Discharges to the same aquifer and horizon with no addition of new pollutants and no increases in ambient conditions does not constitute a discharge of pollutants and therefore does not require a Maine waste discharge license.

There are two issues with open hole systems that can cause a release of pollutants to a water of the state:

1.) If the ground water in the wells is corrosive or contains suspended solids that are abrasive, the heat exchange coils in the heat pump can fail, causing a discharge of refrigerant and carrier oil to the well system. This type of release has been documented in Maine. If a release of refrigerant and carrier oil from the compressor occurs, the system owner may be liable for remediating the release from the system. As such, the MEDEP recommends that a heat exchange system be installed to separate the well water loop from the building loop to significantly reduce the potential of a release. The MEDEP recognizes that there is a potential of a release in the event that the heat exchanger fails, but greatly reduces the potential of a discharge is greatly reduced.

2.) The deep aquifer well(s) utilized in the system may contain elevated background concentrations of pollutants. In this case, the water may return to the well field from which it originates as it does not cause or contribute to a violation of ambient water quality standards. However, if the geothermal system is going to discharge “bleed water” to an on-site location (i.e., leach field) it is likely that ambient conditions in the shallow aquifer are not similar. As such, a representative sample from each well in the system that will be discharging “bleed water” to a water of the state must be submitted to a state certified laboratory for the list of parameters on the “Supplemental Geothermal Well Information Form”. Additionally, if the source of the water that compensates for the loss of “bleed water” in the geothermal system is an onsite well, then it must also be sampled prior to use to ensure water quality standards are not violated. If elevated concentrations of pollutants are identified in any of the wells and bleed water will be discharged on-site, the facility will need to install a water treatment system and obtain a waste discharge license from the MEDEP.

Professional Engineer Requirements and Exemptions:

In accordance with State Board of Licensure for Professional Engineers rules, "*Engineers*”, 32 M.S.R., Chapter 19, all commercial geothermal designs must be designed by a Professional Engineer unless the project meets specific exemptions in state statute. It should be noted, the municipal Code Enforcement Officer (CEO) has the authority to require a P.E. to design the system even if state statute exempts it.

The geothermal systems exempted from P.E. requirements in 32, M.S.R., Chapter 19 include (but are not limited to):

Section 1255 (8)A: Detached one-family or 2-family residences;

Section 1255 (8)B: Farm buildings with an overall floor plan not exceeding 3,000 square feet;

Section 1255 (8)E: Revisions to existing heating, ventilation and air conditioning systems and design of new heating, ventilation and air conditioning systems if the work has no impact on the building’s compliance with the National Fire Protection Association Life Safety Code adopted by the Department of Public Safety, Office of the State Fire Marshal requirements and the project does not include more than one heating, ventilation and air conditioning unit with a maximum cooling capacity of 5 tons or heating capacity of 200,000 BTUs.

A complete listing of the exemptions can be found here: http://www.mainelegislature.org/legis/statutes/32/title32sec1255.html

It is the responsibility of the applicant to determine if a P.E. is required to design the geothermal system for the intended use and application of the system. The applicant should consult a qualified professional If the need for a P.E. is in question.