Webinar 10 (Geo 101: Basics of Ground Coupling and Other Sources and Sinks for Heat Exchange) Q&A Report:

Question Asked	Answer Given
For buildings with constant electrical internal gains >5 watt/sqft is ground coupled still a viable option?	It depends. It depends on what the total building heating and cooling loads are, where the project is located, and whether the building is standalone or part of a community heat pump system. If for instance you are talking about a data center, there is an example from Sweden where a data center connects with a residential community to share heat energy. If there remains an imbalance for either cooling or heating in this location, a ground-coupled system might be a good solution for peak periods. For standalone buildings in warm regions, with warm earth temperatures this may not be a good solution.
At the start of the webinar you talked about a project in Sothern California. Is southern California's climate suitable for ground coupling with the mild winters? Is there a possibility to loose capacity over time?	Yes, Southern California has many climates: marine, mountains, desert, and valley. Provided that the designer properly accounts for the building loads, these systems can work quite well. Remember there are many other reasons ground-source heat pump systems are employed: No outdoor equipment to be corroded by marine air; no outdoor equipment to produce noise (complaining neighbors!), no cooling towers that use water and take up space, and as a trade-off for other building features within the energy compliance requirement (ASHRAE 90.1 or Title 24 in CA).
I noticed that solar re-heat of ground loops isn't part of this presentation. Do you know of anyone else who has used inexpensive HDPE solar thermal collectors to directly re-heat cold, heating dominant ground heat exchangers? We have three years of data from a pilot project that works well, and we would like to compare notes with others.	There are many topics and ideas to discuss relative to this technology and we are regularly challenged with the range and depth of information we included in these 1-hour sessions. As you may have noted in Webinar 10 we exceed the presentation time to include the 'open loop' options. I have done solar recharge on a small scale but I know others have looked at this on a larger scale and suggest you contact the members of TC6.8 to share and compare notes. Perhaps there could be a future seminar or paper session at the next Annual Meeting? I think the deadline for Toronto program submission may have passed.
Earlier in the presentation, energy piles were mentioned and the presenter mentioned there are design "resources available". Could the presenter(s) highlight these resources, including recommended design software?	Yes, I spoke with the Chair of the Task Force creating the Annex for C448 and he mentioned that there are some enhancements and modifications to input design variables into the GLD software. Some others are doing this. I suggest you contact tech support to see what they can tell you. There is also a design standard, "Thermopile Design, Installation, and Materials Standard" by the GSHP Association in the UK that you might want to purchase.
In previous webinars, there was discussion on creating list of design resources. Is there a preliminary list available? Or preliminary recommendation on geofield design software(s)? Preferably, a software that has ability to be configured to analyze energy piles.	See above. Yes, we did mention a resource list and ASHRAE is working on a website. I have in my notes to follow up with them next week.
How do you account for the differences in thermal conductivity and thickness of the grouting material?	The design software I have worked with allows inputs for borehole diameter, pipe material and diameter, grout conductivity and the average formation temperature, conductivity, and diffusivity.
We've been putting drains and/or sump pumps in below grade vaults to mitigate the inevitable water intrusion.	Thank you but if no one goes in the vault and checks on these things periodically there can be problems.
There are some areas where ground coupled is infeasible. The state of California actually published a document on feasibility throughout the state. I had a project outside Calexico where we were looking at it, and the ground temps were too high vs air source?	Yes, I know the document you are speaking about and believe it was PIER report out of the CEC. The document said that climate zone 15 down by the Sultan Sea is infeasible because there is high-temperature geothermal activity. You will see power generation plants in this part of CA. I agree; however, in that same climate zone (Rancho Mirage) we installed a ground loop system even though the deep earth temperature was 76 F because the owner of the building did not want the maintenance hassle of a cooling tower that results from sand storms that are frequent in that part of California.
Thanks over all for the quality discussion. Would like to see more on rivers as heat sink and source.	Thank you for the input. I have not had personal experience with rivers but we have accounted for them in the C448 section on surface water systems.
What is your take on DI water?	I am not sure what this question is in response to? System fill water? Sounds expensive and based on a quick look at the internet it could be problematic.

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Steve - have you had a lot of good experience with ground water systems you have designed and installed? We have gone away from it almost entirely because of contamination/fouling, decreases in the groundwater access from aquifer, etc. The more constant temps are very appealing on paper but harder to realize in practice unfortunately.	Gary responding, I'm afraid you have me confused with one of the two Steve's presenting in the webinar series. All of the issues you mentioned are considerations, but certainly there are successful "open loop" systems in operation. If you follow all the recommendations in the ASHRAE design guide we have referred to as the "Blue Book" you are less likely to have problems. The constant temperature is only one appeal of the ground water based systems; on larger scales such as what might be expected in a CHPS they can be much lower in first cost. Isolation heat exchangers become more viable in larger installations and they can alleviate many of the problems with dealing with ground water.
The DEC has water wells logged on-line since the year 2000. It's for drinking water wells - not closed loop geothermal but good for finding out about depth to rock and a few other properties.	Agreed, one of the first places to look for preliminary info.
I have a client that is opposed to using a vertical drilled system because they said that when they piloted a geo-exchange heat pump system, they hit salt water at 400-500 ft. Correct me if I'm wrong, but if the system is closed loop and properly grouted, this shouldn't be an issue, right?	You are not wrong. The system is a sealed loop within a borehole so often the regulators will require a grout with cement or other admixtures to make sure the seal does not breakdown.
what kind of issues have you ran into with connecting into aquifer ground water (dependent upon project experience); would assume there would be special permitting requirements if this would even be allowed. FYI; I live in the Midwest where a lot of water is in an underground aquifer.	Certainly there are permitting issues and they are going to vary from state-to-state and even within states. But many systems have been installed. In the Northeast they have been predominantly standing column wells. In the pacific Northwest a number of installations that are open loop systems were installed as early as the 1950's, see https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.524.8987&rep=rep1&type=pdf for some examples. In California open loop systems are rarely pursued because there are two permits required: one for the well (through the county) and one for the reinjection well (or other method of discharge) which is regulated by our Sate Regional Water Quality Control Board.
have you ever used Wastewater has a heat sink? assume there would be maximum allowed temperatures	We will be discussing wastewater in Webinar 14, however its use as a heat sink only we are not aware of. Maximum temperatures certainly could be an issue, but as long as the volume of the wastewater flow is high enough to support the heat rejection with limited temperature increases, it should be possible. As with many of the concepts we have been discussing, it's all about balance.
what is the ASHRAE "Blue Book"? What text are you referring to?	Geothermal Heating and Cooling: Design of Ground-Source Heat Pump Systems by Kavanaugh and Rafferty.
With regards to energy modelling, how was your experience? was integrated with the building mechanical system? lessons learnt? pros and cons?	Building loads are the starting point for any good design regardless of mechanical system.
Are there shallow thermal conductivity maps available in the New York area? - for prefeasibility planning...	As we discussed in the webinar, information on "shallow" soils will likely be available from both agricultural agencies and the USGS. From the soils, some information on thermal properties can be inferred, we will discuss this a bit more in Webinar #12. I do not know of any source for NYS (or elsewhere) that provides thermal conductivity directly. Any design that relies heavily on the soil thermal properties should confirm them, as is commonly done with vertical ground-coupled systems, see Section 3.6 of the "Blue Book", and if you do not know what that reference is see the answer to that question above.
In the Florida example shown, was the heat delivered to each circuit provided by a common GSHP? In that case, how long the circuits can be to ensure that the water/HTF delivery temperature for each home at the farthest end of a given loop is not too much lower than the first one in the loop? If booster heat pumps are added on to each of the homes, does the temperature lift for the individual booster heat pumps be higher at the farthest end home in the loop than the first one?	There was no example shared from Florida.
For irregular grid, or any grid, Isn’t there a modeling utility to calculate ground heat transfer performance?	My experience has been that the size of the ground loop is input in by grid (7x4 for example) into the design software. So if you have an irregular grid some creativity is required to estimate what the capacity of the ground loop is. Thus the comment about "engineering judgement."

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Any direction on soil conditions as relates to potential dielectric corrosion?	Dielectric unions are designed to stop galvanic corrosion between dissimilar metals. Soils are not normally an issue in dielectric unions. I expect what you are referring to is cathodic protection of buried piping, in which the soil resistivity plays a role. These issues are discussed in both the ASHRAE District Cooling and District Heating Guides, in each case the discussion is in Chapter 4. There is also a discussion in Chapter 12 of the 2020 ASHRAE Handbook.
Are earthquakes a threat to these systems?	This was answered during Q&A.
You might also mention another architecture of open loop systems that are reversible with each/every well having both an injection valve and pump that allow you capture/harness waste heat and “waste cold” and even create both out of season. Known as ATES or Aquifer Thermal Energy Storage, more info can be found here on the Federal website at this link: https://wbdg.org/continuing-education/dod-courses/dod10	Comment, thank you!
When you design an open loop lake water system , what type of filtration you specify? How do you monitor for foreign objects coming into the system.	The example shared in the Webinar today used the following filtration product. https://www.thecarycompany.com/6-bag-filter-vessel-size-2. Through trial and error, the maintenance staff converged on an 800 micron filter for their location.
Should deep bore wells be drilled more slowly to keep wells from following sloped strata and conflicting?	That is a question for an experienced driller.
How often are municipal water systems used as sinks for community heat pump systems?	That is a very good question. I recall several years ago there was a product out there where this idea was proposed. What happens in many cases is that the AHJ requires the water that passes through the heat exchange system to go back through the water treatment plant before sending it to consumers (as was the case with the project I shared). With some creativity and double-wall heat exchangers this might be circumvented and could be come more widely accepted. See https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.524.8987&rep=rep1&type=pdf for some example of where municipal water supplies have been used.
I've seen some ground source systems (slinky in a lake) where the lake ended up getting too hot and had algae issues. What can you do to mitigate?	It sounds like a thermal energy analysis was not performed for this location. Without any more detail it's hard to provide input but perhaps an aerator or water feature might be added to help with heat rejection, insert an fluid cooler in line prior to the lake), or perhaps look at something in the building you can do to recover or dump heat before the source water goes to the lake.
RE: #9. Controls contractor. Please remember that there are generally more than one controls contractor involved. You may have a BAS overlay that has to work with the manufacturers proprietary application system. The BAS can only provide what the manufacturer lets them have access to.	Comment, thank you.
According to the blue book and other references, HVAC systems with large auxiliary power requirements, such as a chilled-water VAV system with high fan and pump pressure requirements, are not recommended for GSHP applications. Why would this applicable for heating dominated buildings in northern climates; the auxiliary equipments add heat that would be beneficial to balance the ground between summer and winter?	There are two things to consider here: energy and heat. If the heat can be recovered by the operations and help provide balance to the ground loop; ok. But, what is the cost of doing that? It is important to understand what the Owner's Project Requirements are for any project and I suggest that the life cycle costs, which properly account for maintenance, operation, and first cost is the best place to evaluate varying systems and their impact on the ground loop size.
Thanks a lot for the presentation. Regarding the school getting its water from the neighboring body of water, what would be the main environmental concerns to consider and how challenging is to address them?	LOL! That would have been another 10 minutes to discuss in the Webinar today. I had to meet with the Division of Drinking Water to explain what we wanted to do and get their sign-off before the civil engineer on the project would allow it (even though this is what the school district, water board, and energy provider wanted). With the support of some very smart people and the heat pump manufacturer (who wrote a letter of support and explanation about how oil or refrigerant leaks into the source water system would behave and could be addressed at the water treatment plant) the project was approved for direct use (or exchange). At the end of the day the school district decided they did not want to do a direct exchange of the water because of perceived issues with refrigerant leaks into the raw water. So we added the double-wall heat exchanger and took the energy efficiency penalty because they thought politically doing a direct connection would be poorly received by the towns people.

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Do boreholes under a building need access for servicing?	If everything is done correctly (installation, pressure test, flushing and purging) - no. BUT, you must be thoughtful about how these loops are circuited and provide a way to isolate each circuit from the main system should a problem develop.
There are about three dozin 35 stadning coliumns in NY City alone - wwish to note, they are commercial including St Patrick Cathedral . Gary suggested they are only residential - in NYC there are systems upto 60 ton s and, in MA 1,000 tons, and in NH 650 tons- a SCW bore can provide 40 tons - define advantage for commercial	What I "suggested" depends on who's making the interpretation. I may have said the installations have primarily been residential scale, which I believe is true. I did not say it was a concept that could not be used on other scales and I'm well aware of some of the larger installations. We had a lot of material to cover and delineating the history and current status of installations for every type of system we discussed was not possible.
I will typically specify at least 1" ball valve connections at plate heat exchangers handling raw well water for the purpose of high volume air purging of the well side of the plate frame exchangers. This process works very well for the purging of soft iron deoosits and saves major labor for heat exchanger tear down and power washing of the plates.	Comment, thank you!
About 1977-1978 The National Ground Water Association produced a two manual NY wide applicability study for NYSERDA. Each manual was the size of the NY yellow pages detailing county by county bedrock and unconsolidated aquifers. This was prior to the widespread use of closed loop systems but was a major effort for the promotion of Open Systems and where they might be applied. From Jeff Persons	Comment, thank you!
Does the design guide cover soil heat absorbtivity and heat saturation	see above.
Yes, the soil can typically only absorb so much heat before it becomes saturated	see above.
On large CHPS with vertical wells, any understanding or awareness of ground thermocline long-term temperature rises as a result of concentrated high load draw from static ground temperatures ?	Any large application of a ground water based system will require the consultation of a hydrogeologist, see the "Blue Book".
In seismic active areas, and areas where ground liquefaction a potential problem, how do you take that situation into account in design to prevent breaks in the lines?	Similar to question answered earlier during Q&A.
Comment: Surface water systems in marine environments, marine organisms and sea weed/ algae growth becomes a fouling problem.	Comment, thank you!
This is my first time hearing about this webinar series. Is there a way to get a replay of the prior webinars to this series?	Yes, you can go back into the listing and register for each previous Webinar. With that you will gain access to the video and PowerPoint presentations. You will not be able to obtain PDHs.
Does removing heat from the sewage cause problems in the waster treatment plant?	see similar question and response above.
What would be the downside of using a larger heat pump for the building side?	No downside provided that the energy analysis accounts for this. Typically larger pieces of equipment are less energy efficient. Larger systems also often rely of moving air to transfer heat rather than water, the later being far more efficient.