Making Geothermal a Reality at the NYCSCA St. John Village Campus Redevelopment Project

Pioneers in Sustainable Geothermal Solutions

- Geothermal consulting and design for nearly 30 years
- Specialize in the Ground Heat Exchangers (GHX), coordination with the MEP, civil, architect, and building energy modeler
- Experience in:
    - Campus and District Scale Systems
    - Open Loop
    - Closed Loop
    - Standing Column Wells
    - Energy Piles

Pioneers in Sustainable Geothermal Solutions

- Founding member, LI-GEO established in 2012.
- Founding and Charter member, NY-GEO established in 2014.
- Influential on NYC geothermal Local Law 32 of 2013 and Local Law 6 of 2016
- Member, NYSERDA's Renewable Heating and Cooling department advisory committee.
- IGSPHA geothermal design trainer.
- NYSERDA-certified GSHP rebate contractor.
- Committee member, joint ANSI/CSA C448 GSHP Design and Installation Standards.
- Member, Urban Green Advancing Electrification Advisory Committee.
- Advisor to Mayor's Office, NYC EDC, etc. regarding the viability of greater deployment of geothermal technologies within the five boroughs.

Our Services

- Subsurface Conditions Due Diligence
- Feasibility Study
- Environmental Due Diligence
- Thermal Conductivity Testing
- Geoexchange Modeling
- Ground Heat Exchanger (GHX) Design
- Filings and Notifications
- Construction Administration
- Field Inspection during Construction
- Start-Up and Commissioning Support
- Operation and Maintenance Support
- Troubleshoot Operating Systems

General Overview of Geothermal Energy

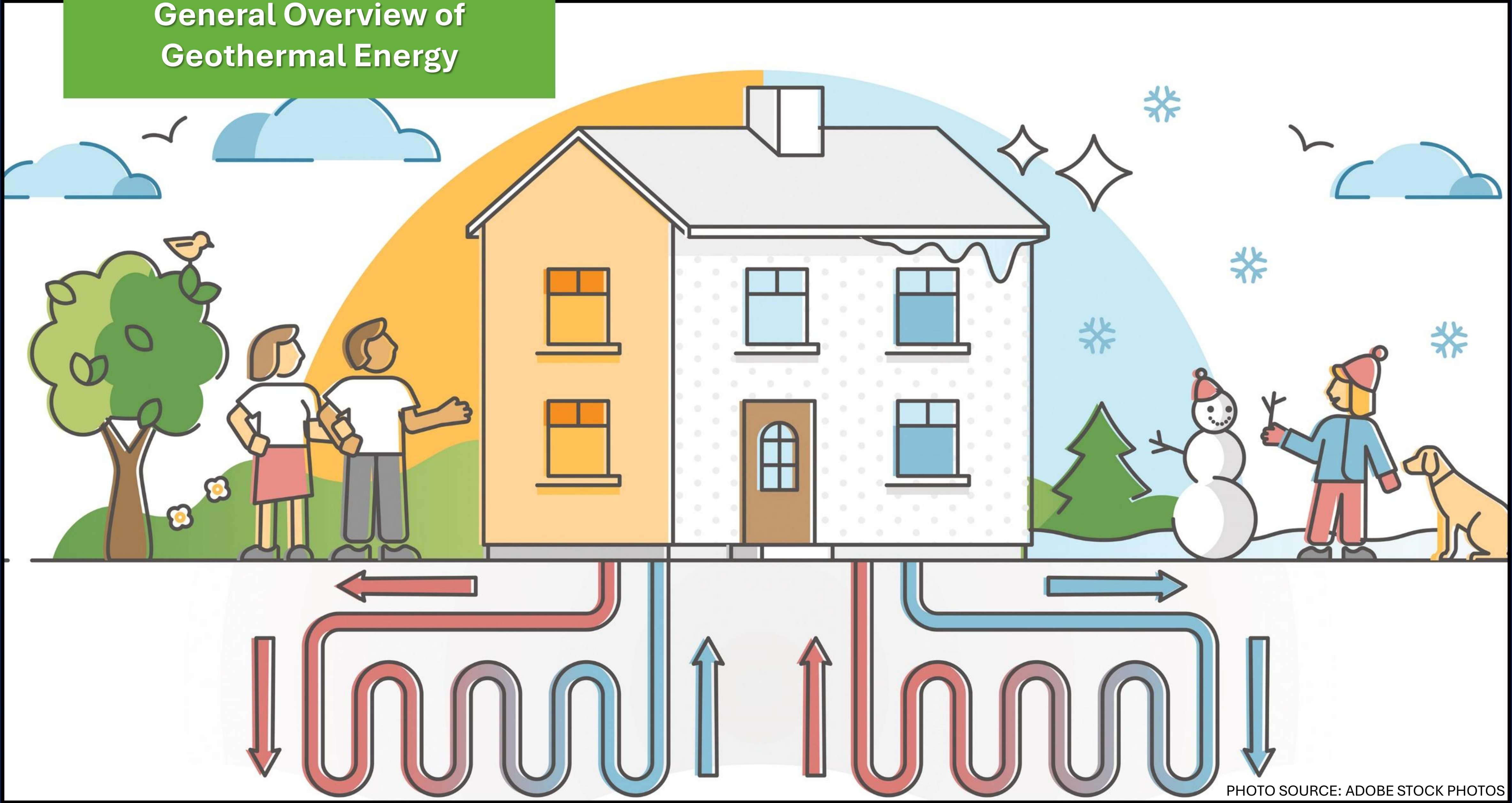
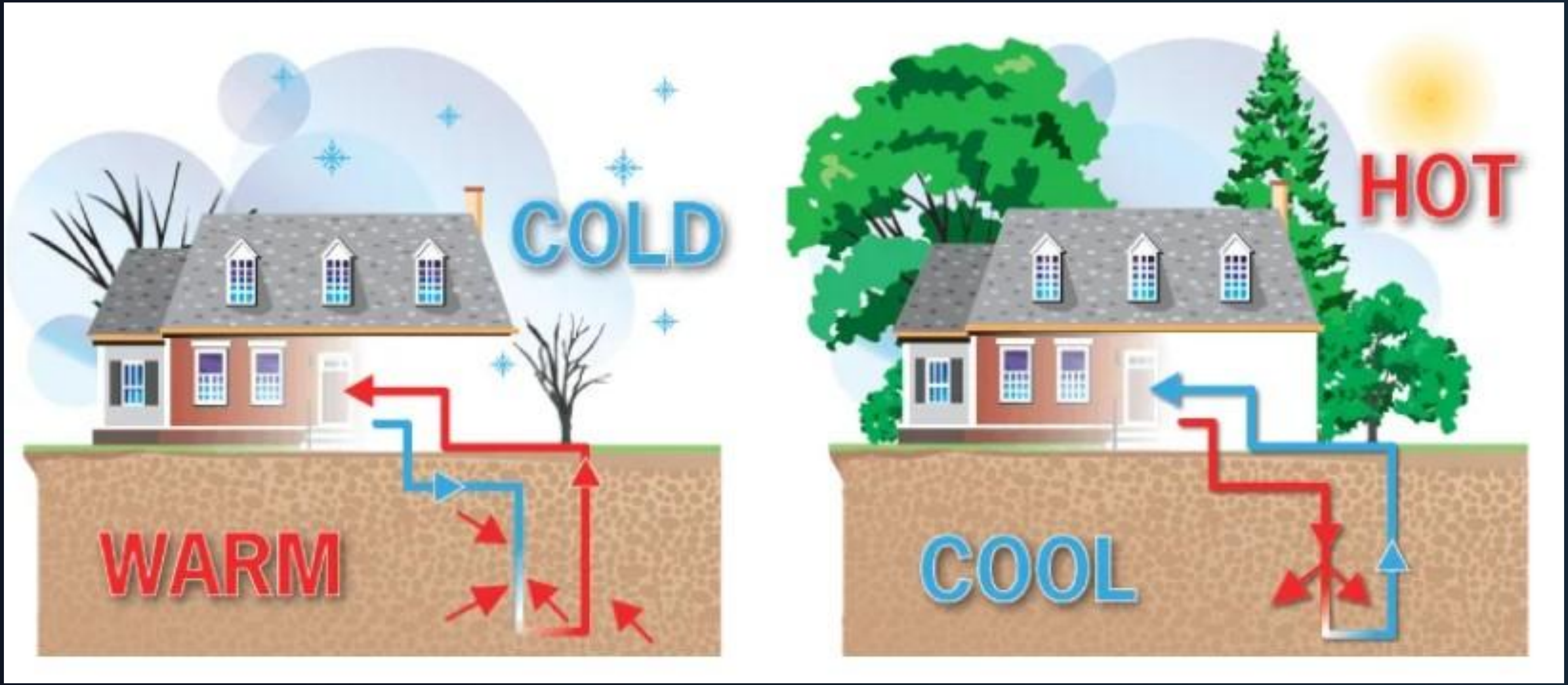


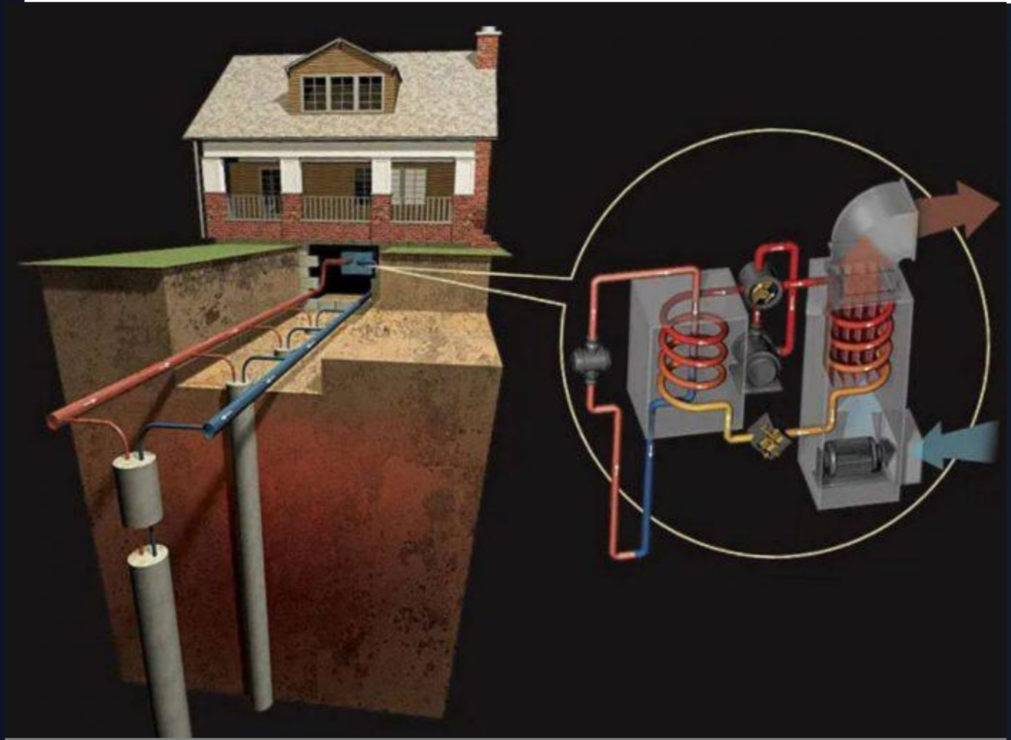
PHOTO SOURCE: ADOBE STOCK PHOTOS

What is Geothermal Energy?

- Geothermal energy is a form of renewable energy derived from the heat stored beneath the Earth's surface.

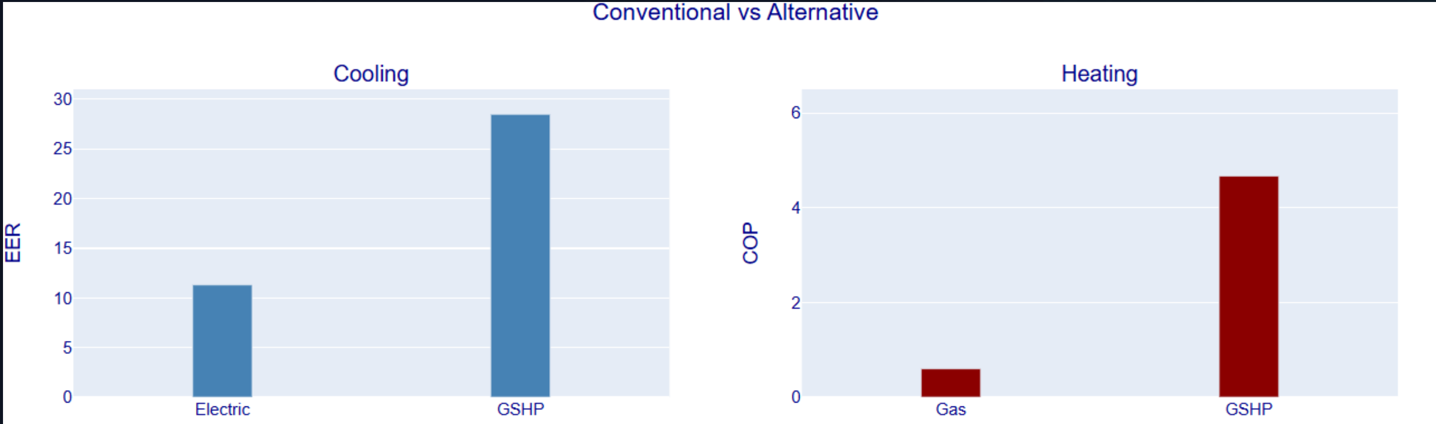


Geothermal: How It Works



Ground Source Heat Pump (GSHP) & Geothermal Boreholes

- A heat pump with a ground heat exchanger transfers heat between the ground and a building by circulating a Heat Transfer Fluid through underground loops, absorbing heat from the ground in winter and releasing heat into the ground in summer.
- Geothermal systems can reduce energy consumption by approximately 25% to 50% compared to air source heat pump systems.
- Ground Source Heat Pumps more than 20 year life expectancy.
- Geothermal underground infrastructure 25 - 50 year life expectancy minimum typical.



Standard vs. Geothermal Efficiency Comparison

Basic Geothermal Principles

Geoexchange Benefits

- Elimination of:
    - Conventional Mechanical Systems
    - Fossil Fuel Dependence and Price Fluctuations
    - Legionella Risk
- Reduction of:
    - Carbon Footprint
    - Maintenance
    - Noise & Vibrations
    - Mechanical Room Space
    - Roof Space
    - Eyesores

Cooling Towers

Boiler Plant

Chiller plant

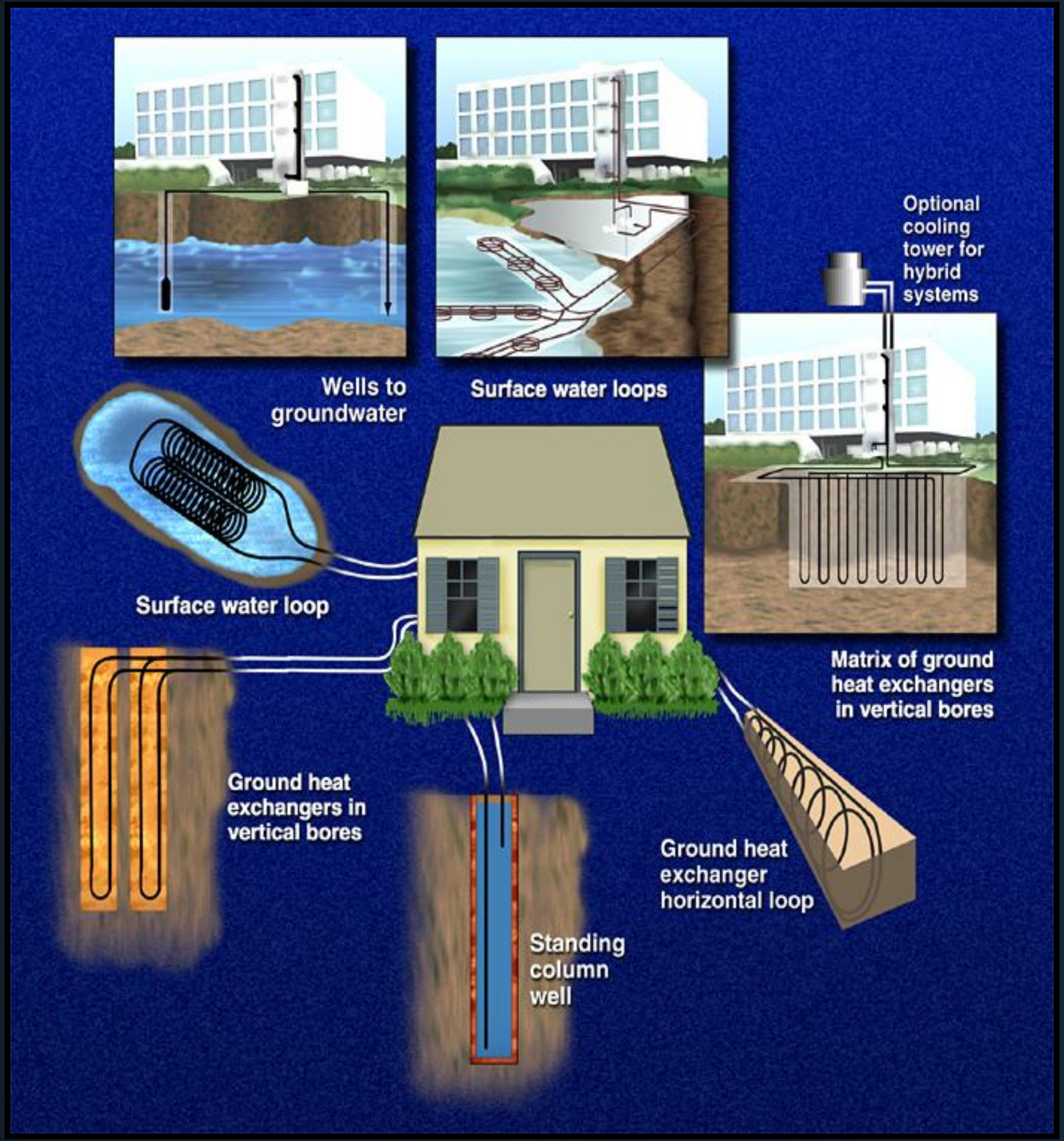
Geoexchange Technologies

Typical Designs:

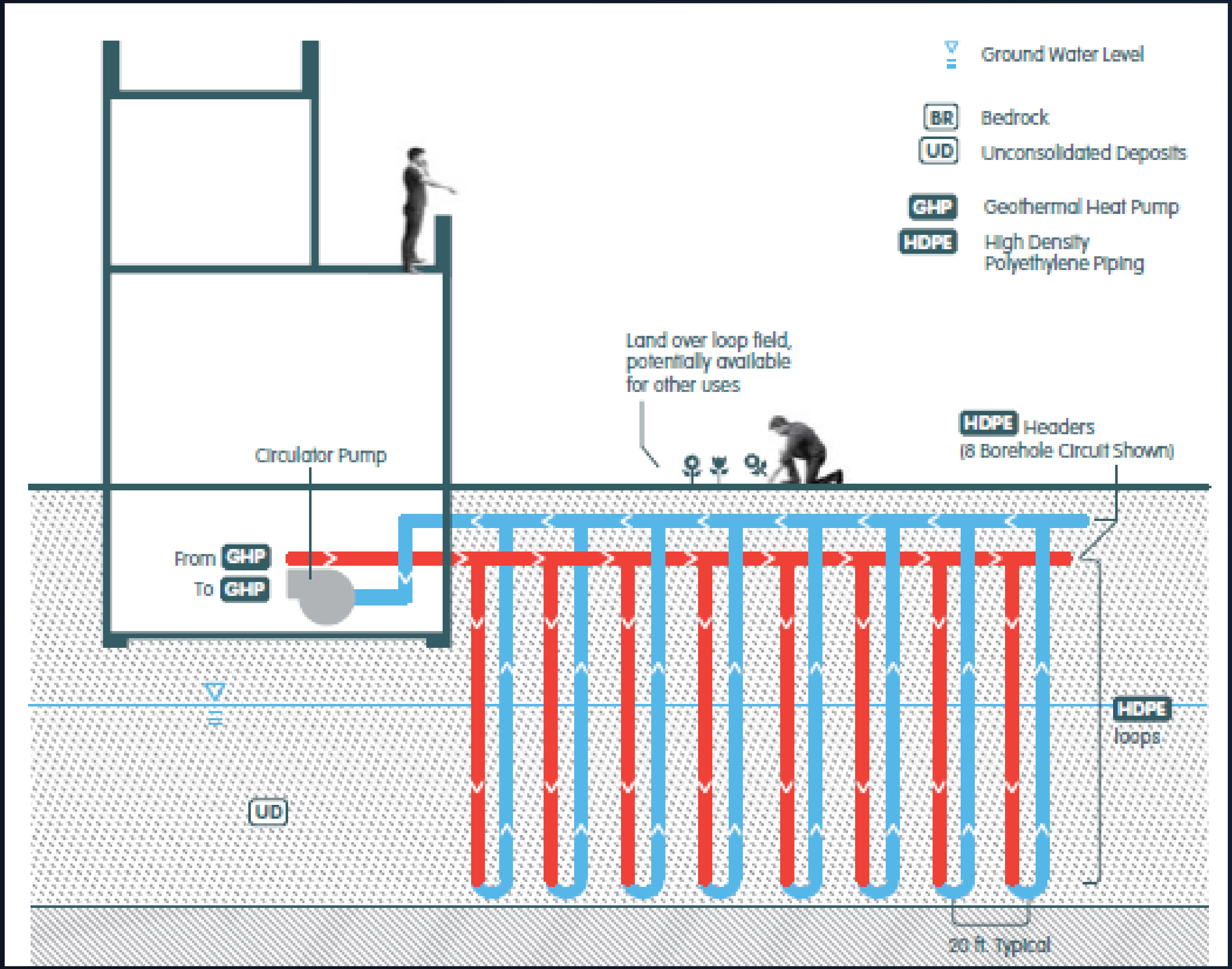
- Vertical Closed-Loop System
- Open-Loop System
- Hybrid Systems
- District-scale/Thermal Energy Networks

Less Common Design Alternatives:

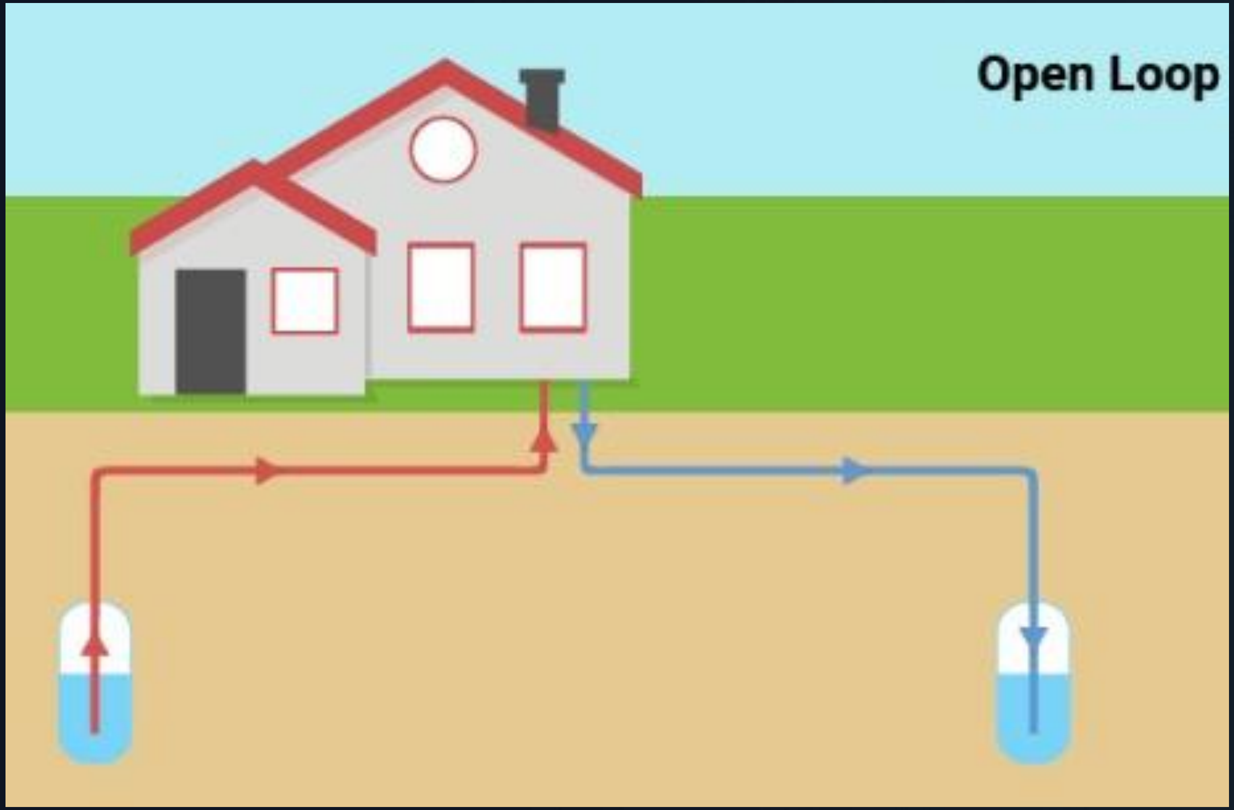
- Horizontal Closed-Loop
- Closed-Loop Surface Water
- Standing Column Well

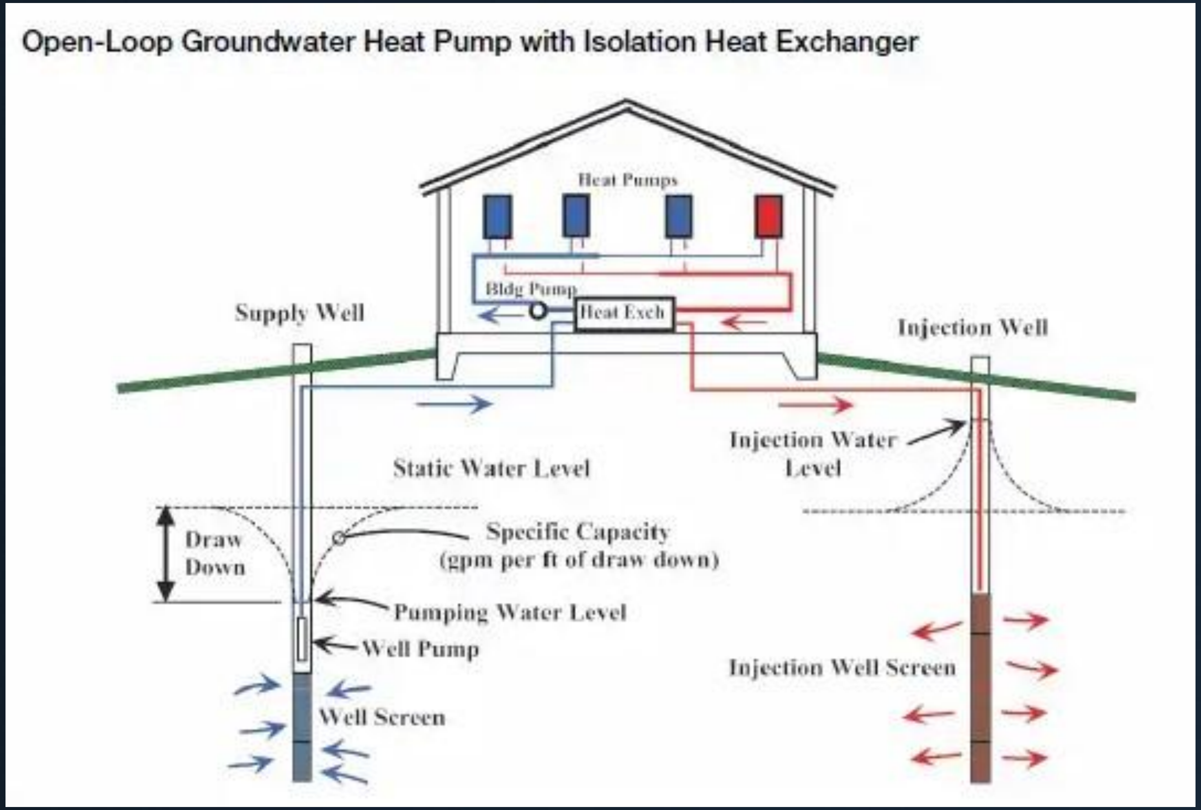


Typical Closed Loop System



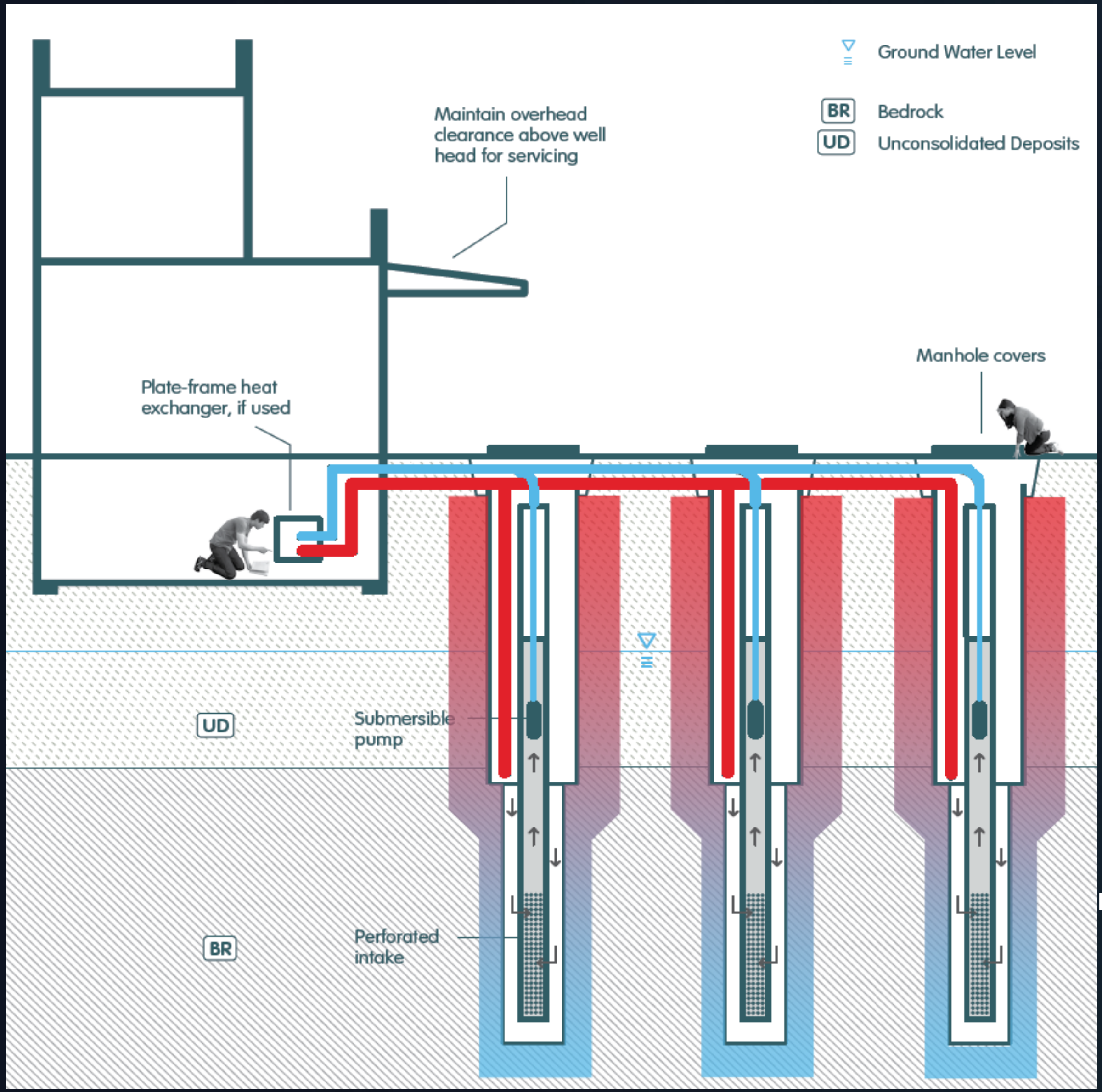
Typical Open Loop System



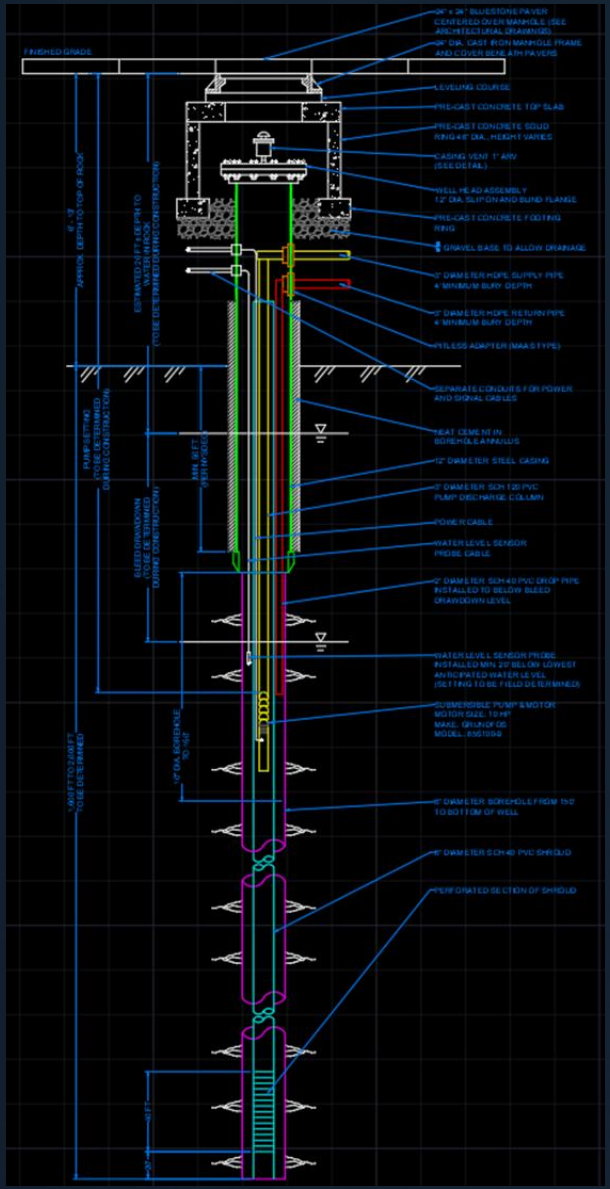


Source: Appalachian Heating

Typical Standing Column Well System



ng



Source: PWGC

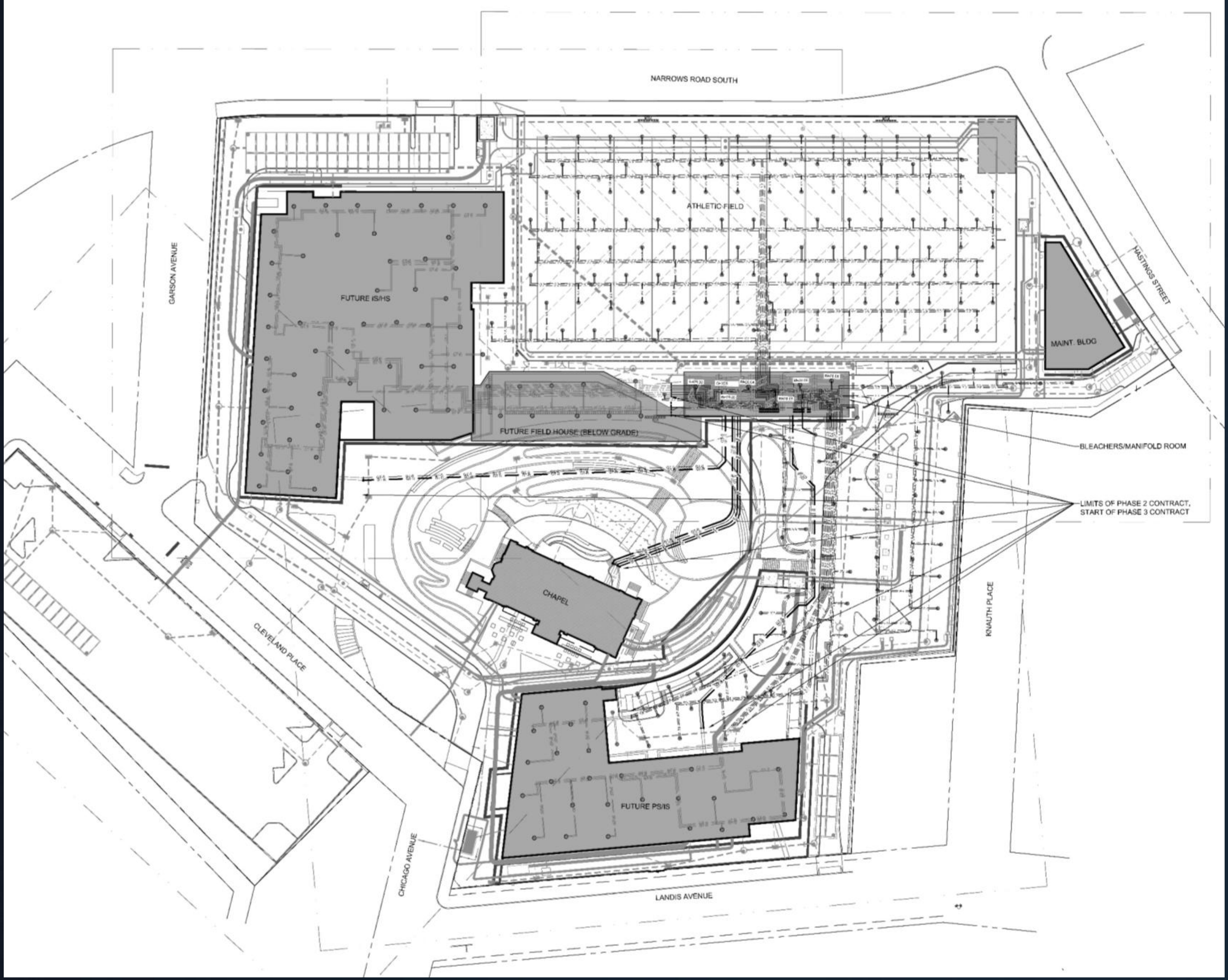
St. John Villa Campus Redevelopment Project

- Redevelopment of the former St. John Villa campus at 57 Cleveland Place in the Arrochar section of Staten Island to include a new primary/intermediate school, two separate intermediate/high schools, an athletic field with bleachers, renovated Chapel Building, a maintenance building, three parking lots, and landscaped areas.
- Design team led by architect Pei Cobb Fried & Partners
- Geothermal system design led by P.W. Grosser Consulting
- Key design consultants include:
  - Loring Consulting Engineers - mechanical design; heat pump sizing
  - SOCOTEC - energy modeling
  - Shenoy Engineering, PC - domestic hot water, plumbing, and electrical design

St. John Villa Campus Redevelopment Project

St. John Villa Campus Geothermal System Layout

Geothermal System Summary
- 276 Vertical Closed Loop Boreholes
- Average of 10 boreholes on each circuit run to manifold
- Combined manifold, plus separate circulation pumps, air/dirt separators, expansion tanks located under Bleachers
- Supply and return mains run to each of the PS/IS, IS/HS and Chapel Buildings
- GSHPs located in each building’s mechanical room

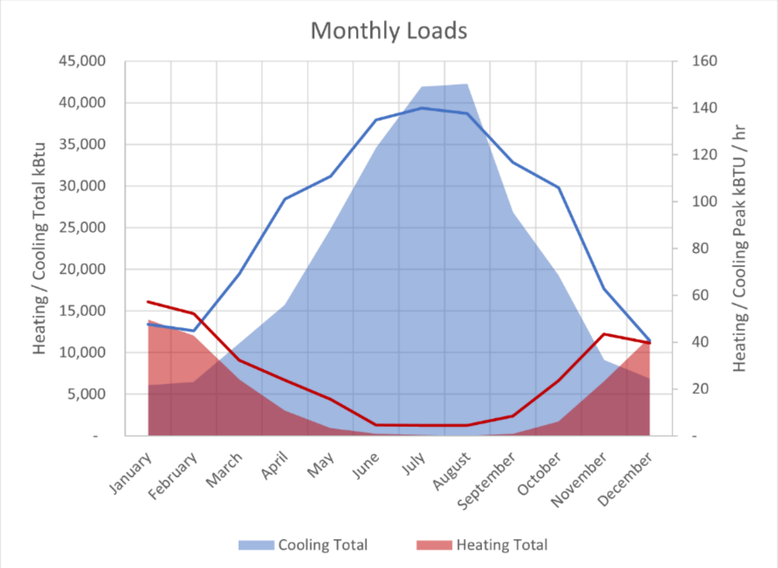


Feasibility Study

- Provide client with conceptual design and scoping out a project. Evaluate if the site is suitable for a geothermal system.
- The goal is to determine the project's viability and outline the basic system parameters for field testing and a full-scale geothermal system.

Components

- Site Assessment
- Subsurface Conditions
- Design Heating & Cooling Loads
- Field Testing/ Thermal Conductivity
- Geothermal System Layout
- Construction Logistics
- Permitting Requirements
- Environmental Considerations
- Incentives (tax credits, utility rebates)
- Cost Analysis

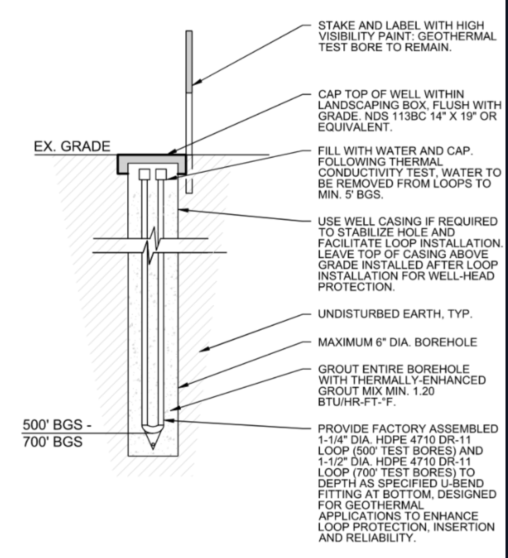


Cooling & Heating Loads

Test Bore Installation

Field Testing Program – Closed Loop System

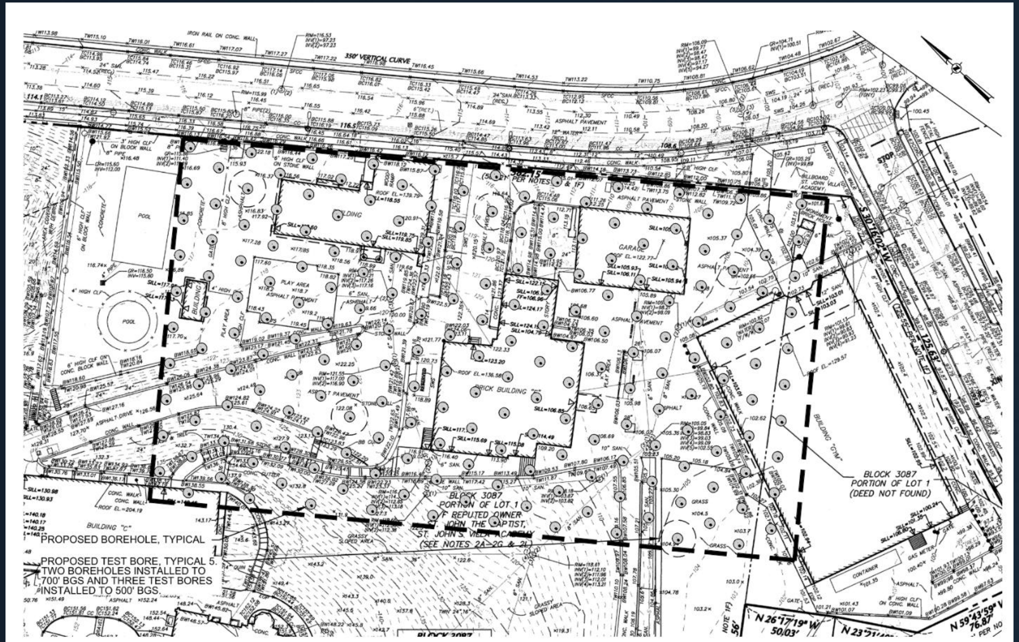
- American Well and Pump Co. - Driller
- Five test bores – 2 to 700’ BGS, 3 to 500’ BGS
- Install test loops and provide FTC test on each bore
- Different test loop depths and drilling techniques (air rotary vs mud rotary) employed to optimize full-scale system design
- Test loops to be incorporated into full-scale system



GEOTHERMAL TEST WELL DETAIL
(TYP. OF 5)
SCALE: NOT TO SCALE

Formation Description	Depth (ft)
Brown clay/grey clay	0'-40'
Small gravel, silty sand	40'-140'
Small gravel, sand, little red clay	140'-160'
Small gravel, silty sand, streak of clay	160'-260'
Small gravel, grey clay	260'-280'
Red clay	280'-320'
Multicolored clay	320'-340'
Weathered rock	340'-357'
Rock: schist, gneiss and serpentinite rock mix	357'-705'

Bore produced 30 gpm water at 660 ft; 60 gpm at 680 ft.



BASEMAP REFERENCE: SURVEY PROVIDED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING, LANDSCAPE ARCHITECTURE AND GEOLOGY, D.P.C. DATED 10/12/2018

PROPOSED TEST BORE
EXISTING SURVEY REFERENCE

Ground Loop Design Modeling

Formation Thermal Conductivity Test Report

Date	February 11-13, 2009
Location	Staten Island, NY
Undisturbed Formation Temperature	Approx. 54-55°F

Borehole Data – As Provided by Aquifer Drilling & Testing, Inc.

Borehole Diameter	8 3/4 inches, 0-191 ft 6 inches, 191-499 ft

Note: Six inch steel casing installed to 191 ft.

Drill Log

Reddish brown fine sand	0'-149'
Granite gneiss	149'-159'
Clay	159'-165'
Granite gneiss	165'-181'
Clay	181'-183'
Grey serpentinite	183'-360'
Schist	360'-499'

Note: Water flow observed of approximately 15 gpm at 207 ft, 100 gpm at 270 ft.

U-bend Size	1 1/4 inch HDPE
U-Bend Length	498 ft
Grout Type	GeoPro TG Select
Grout Solids	400 lb sand per 50 lb bentonite
Grouted Portion	Entire bore

Test Data

Test Duration	48.4 hrs.
Average Voltage	241.2 V
Average Power	8,177 W
Total Heat Input Rate	27,908 Btu/hr
Calculated Circulator Flow Rate	9.0 gpm
Standard Deviation of Power	0.25%
Maximum Variation in Power	1.50%

Est. Average Heat Capacity (Btu/ft^3 °F)	Thermal Conductivity (Btu/hr-ft-°F)	Est. Thermal Diffusivity (ft^2/day)
37.4	1.75	1.12

Formation Thermal Conductivity Test Report

Date	February 9-11, 2009
Location	Staten Island, NY
Undisturbed Formation Temperature	Approx. 54-55.5°F

Borehole Data – As Provided by Aquifer Drilling & Testing, Inc.

Borehole Diameter	8 3/4 inches, 0-191 ft 6 inches, 191-498 ft

Note: Six inch steel casing installed to 191 ft.

Drill Log

Reddish brown fine sand	0'-157'
Pink granite gneiss	157'-225'
Green serpentinite	225'-305'
Pink granite gneiss	305'-385'
Grey schist	385'-498'

Note: Water flow observed of approximately 15 gpm at 365 ft.

U-bend Size	1 1/4 inch HDPE
U-Bend Length	498 ft
Grout Type	GeoPro TG Select
Grout Solids	400 lb sand per 50 lb bentonite
Grouted Portion	Entire bore

Test Data

Test Duration	47.0 hrs.
Average Voltage	240.9 V
Average Power	8,175 W
Total Heat Input Rate	27,902 Btu/hr
Calculated Circulator Flow Rate	8.88 gpm
Standard Deviation of Power	0.19%
Maximum Variation in Power	1.60%

Est. Average Heat Capacity (Btu/ft^3 °F)	Thermal Conductivity (Btu/hr-ft-°F)	Est. Thermal Diffusivity (ft^2/day)
36.8	1.82	1.19

Ground Loop Design Modeling

Input Parameters (Cont.)

Pattern	
Vertical Grid Arrangement:	1 x 3
Borehole Number:	3
Borehole Separation:	20.0 ft
Bores Per Circuit	1
Fixed Length Mode	On
Grid File	None
File:	

Modeling Time Period	
Prediction Time:	20.0 years
Long Term Soil Temperatures:	
Cooling:	52.5 °F
Heating:	52.5 °F

Default Heat Pumps

Manufacturer: - Default Generic

Series: Generic High Efficiency

Design Heat Pump Inlet Load Temperatures:

	Cooling (WB)	*Heating (DB)*
Water to Air:	67 °F	70 °F
Water to Water:	55 °F	100 °F

Optional Hybrid Loads	Cooling	Heating
Geo Peak (%)	100%	100%
Geo Total (%)	100%	100%
Hybrid Peak (%)	0%	0%
Hybrid Total (%)	0%	0%

Extra kW	
Pump Power	0.0 kW
Cooling Tower Pump:	0.0 kW
Cooling Tower Fan:	0.0 kW
Additional Power	0.0 kW

Loads File

2023-05-30 - Club Cabin Loading.zon

Final Design Modeling post TCT

Ground Loop Design
Borehole Design Project Report - 5/30/2023

GLD Software Gaia Geothermal

Project Name:	Discovery Land - Club Cabin
Designer Name:	Michael Scanlon, PE
Date:	5/30/2023
Project Start Date:	5/30/2023
Client Name:	Discovery Land Co.
Address Line 1:	
Address Line 2:	
City:	
State:	
Zip:	
Phone:	
Fax:	
Email:	

Calculation Results

Design Method: *Monthly*	COOLING	HEATING
Total Bore Length (ft):	900.0	900.0
Borehole Number:	3	3
Borehole Length (ft):	300.0	300.0
Ground Temperature Change (°F):	N/A	N/A
Peak Unit Inlet (°F):	79.1	36.4
Peak Unit Outlet (°F):	88.3	32.7
Total Unit Capacity (kBtu/Hr):	76.0	50.4
Peak Load (kBtu/Hr):	76.0	50.4
Peak Demand (kW):	3.3	3.3
Heat Pump EER/COP:	22.6	4.4
Seasonal Heat Pump EER/COP:	31.4	4.5
Avg. Annual Power (kWh):	1.95E+3	4.79E+3
System Flow Rate (gpm):	19.0	12.6

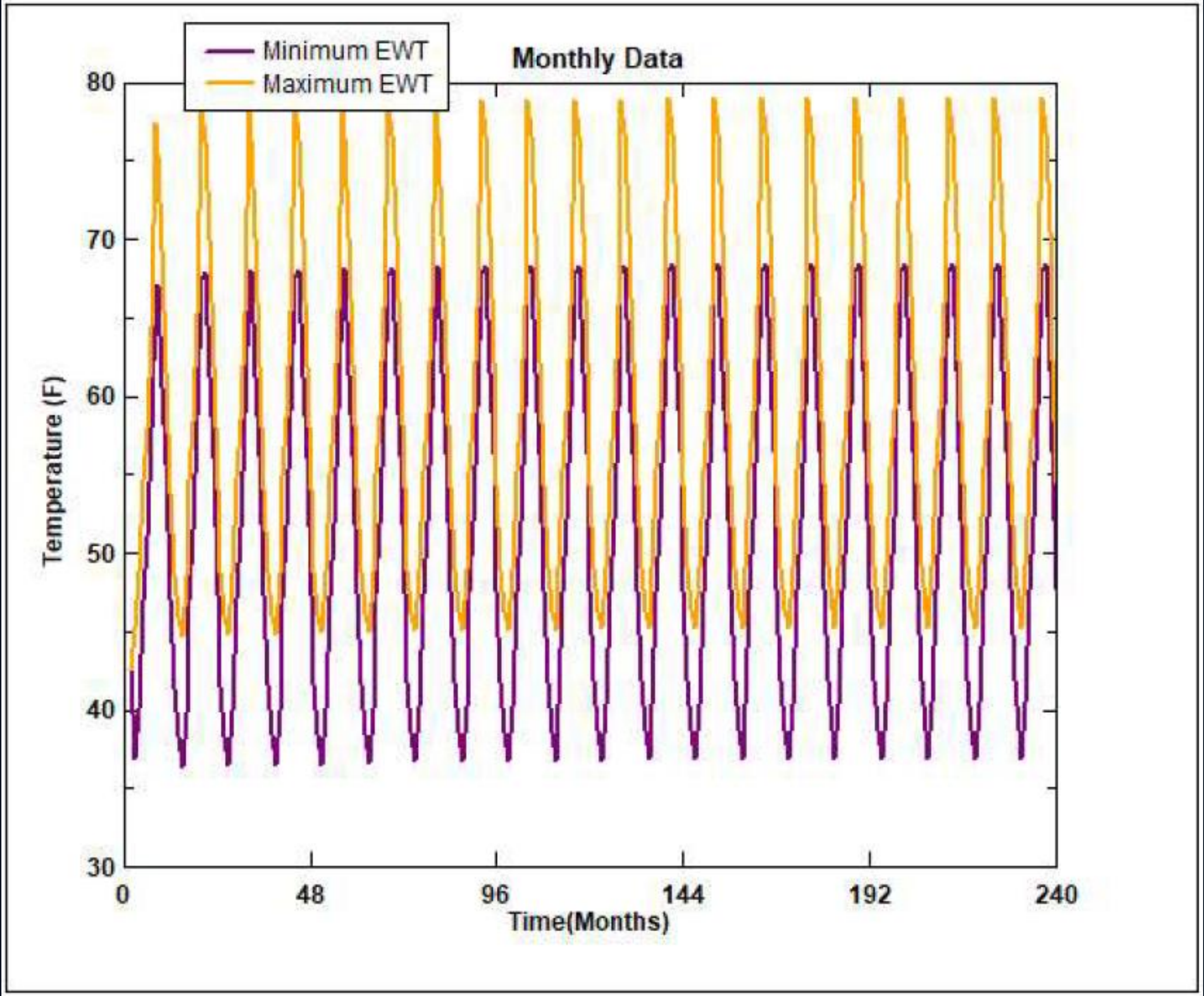
Input Parameters

Fluid	
Flow Rate	3.0 gpm/ton
Fluid:	17.7% Propylene Glycol
Specific Heat (Cp):	0.94 Btu/(°F*lbm)
Density (rho):	64.0 lb/ft^3

Soil	
Ground Temperature:	52.5 °F
Thermal Conductivity:	1.43 Btu/(h*ft*°F)
Thermal Diffusivity:	1.01 ft^2/day

Piping	
Pipe Type:	1 1/4 in. (32 mm) - SDR11
Flow Type:	Turbulent
Pipe Resistance:	0.104 h*ft*°F/Btu
U-Tube Configuration:	Single
Radial Pipe Placement:	Average
Borehole Diameter:	6.00 in
Grout Thermal Conductivity:	1.20 Btu/(h*ft*°F)
Borehole Thermal Resistance:	0.208 h*ft*°F/Btu

Ground Loop Design Modeling



Ground Loop Design

Piping Report - 5/30/2023

GLD Software Gaia Geothermal

System Summary

Total Pipe Length (ft):	1808.0
Total Circuit Pipe Length (ft):	1800.0
Modules | Manifolds | Pre-Manifold:	1 | 1 | 0
Number of Circuits:	3
Includes Balancing Valves	No
SystemFluid Type:	Propylene Glycol
System Fluid Volume (Gallons):	138.3
Antifreeze Percentage (%)	17.7% by Weight
Freeze Point Protection (°F):	20
Minimum Design Temperature (°F):	32

Operational Performance - PEAK LOAD Mode

System Flow Rate (gpm):	19.0	
System Pressure Drop (ft.hd.):	6.8	
Max GHX Module Pressure Drop (ft.hd.):	6.8	
Reynolds Number Range for Circuits:	3933	<--> 3936

Power Performance

Total Circulation Pump Power (hP):	0.04
Pumping Power Score:	0.6

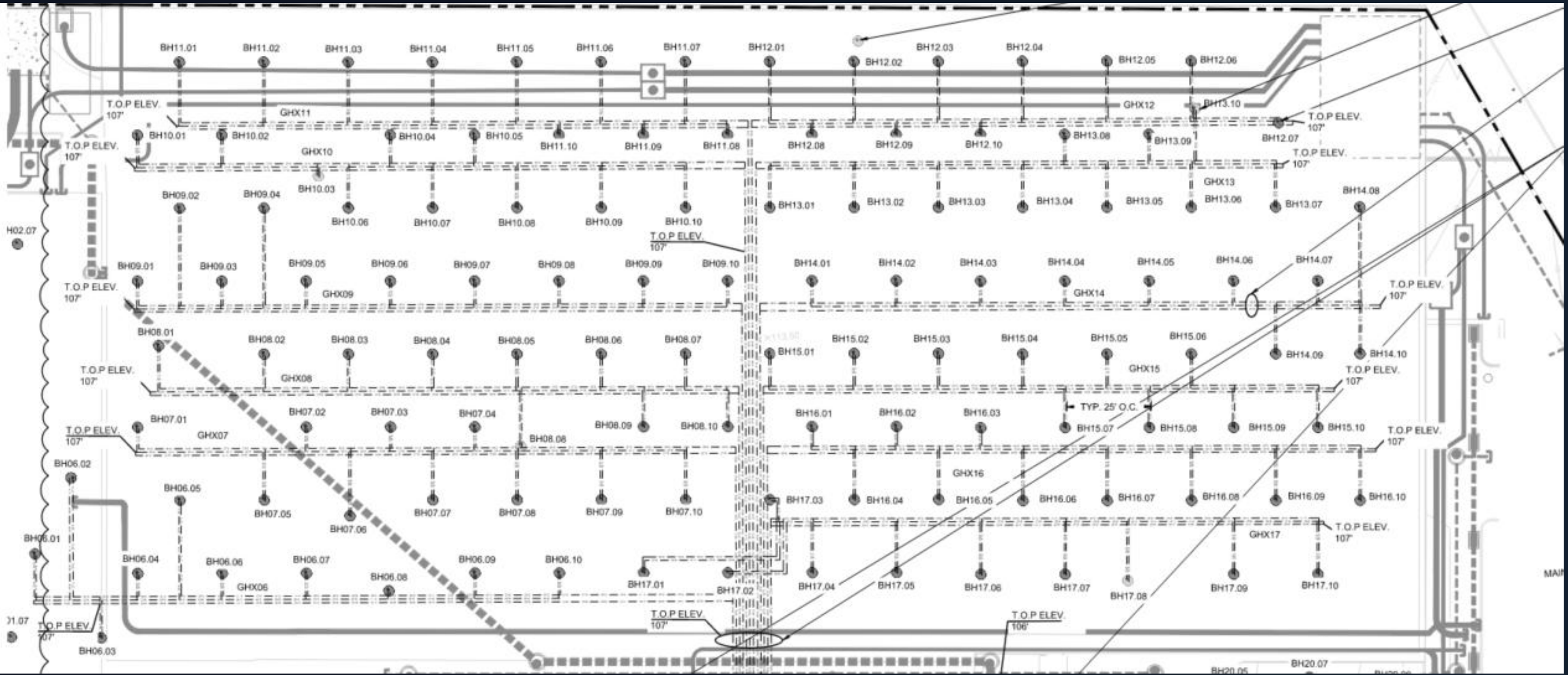
Purging Performance (Fluid:Water)

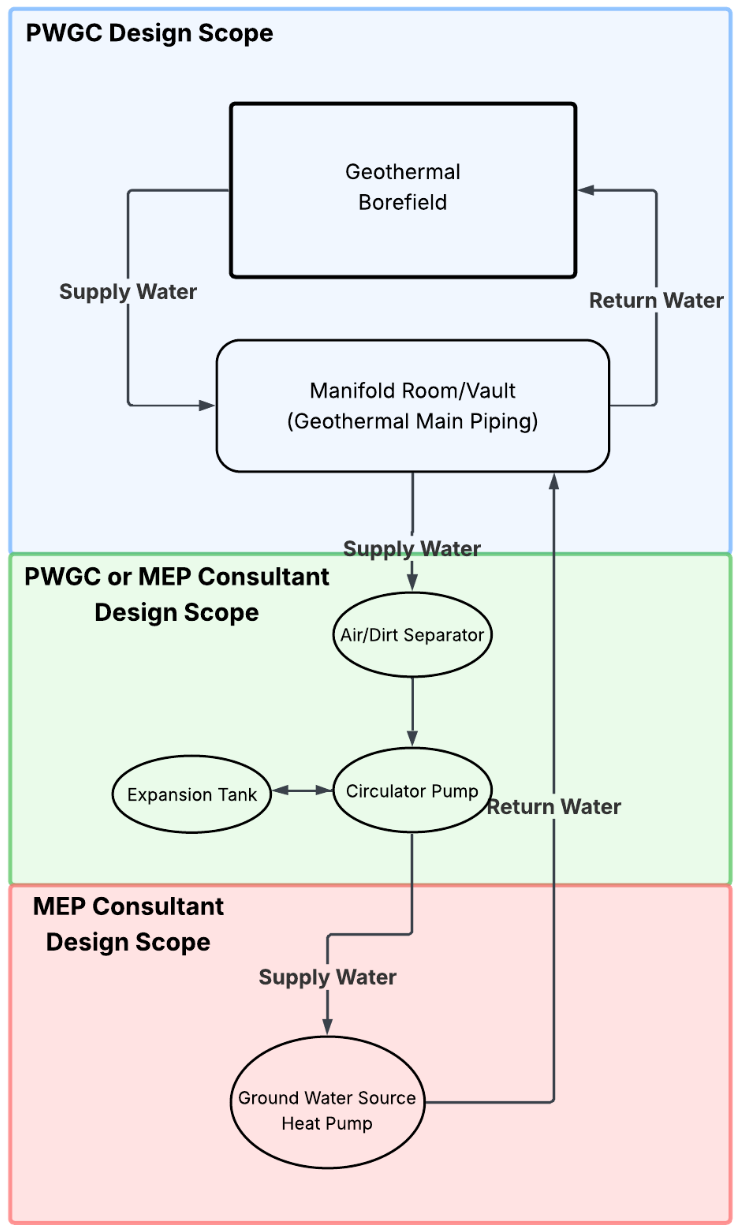
Purging Flow Rate (gpm):	29.8
Purging Pressure Drop (ft.hd.):	12.0
Required Purge Pump Power (hP):	0.15

Design/Construction Scope

PWGC
- Geothermal borefield layout
- Test bore subcontracting/ oversight
- Manifold layout
- Construction oversight
- Ground loop design modeling

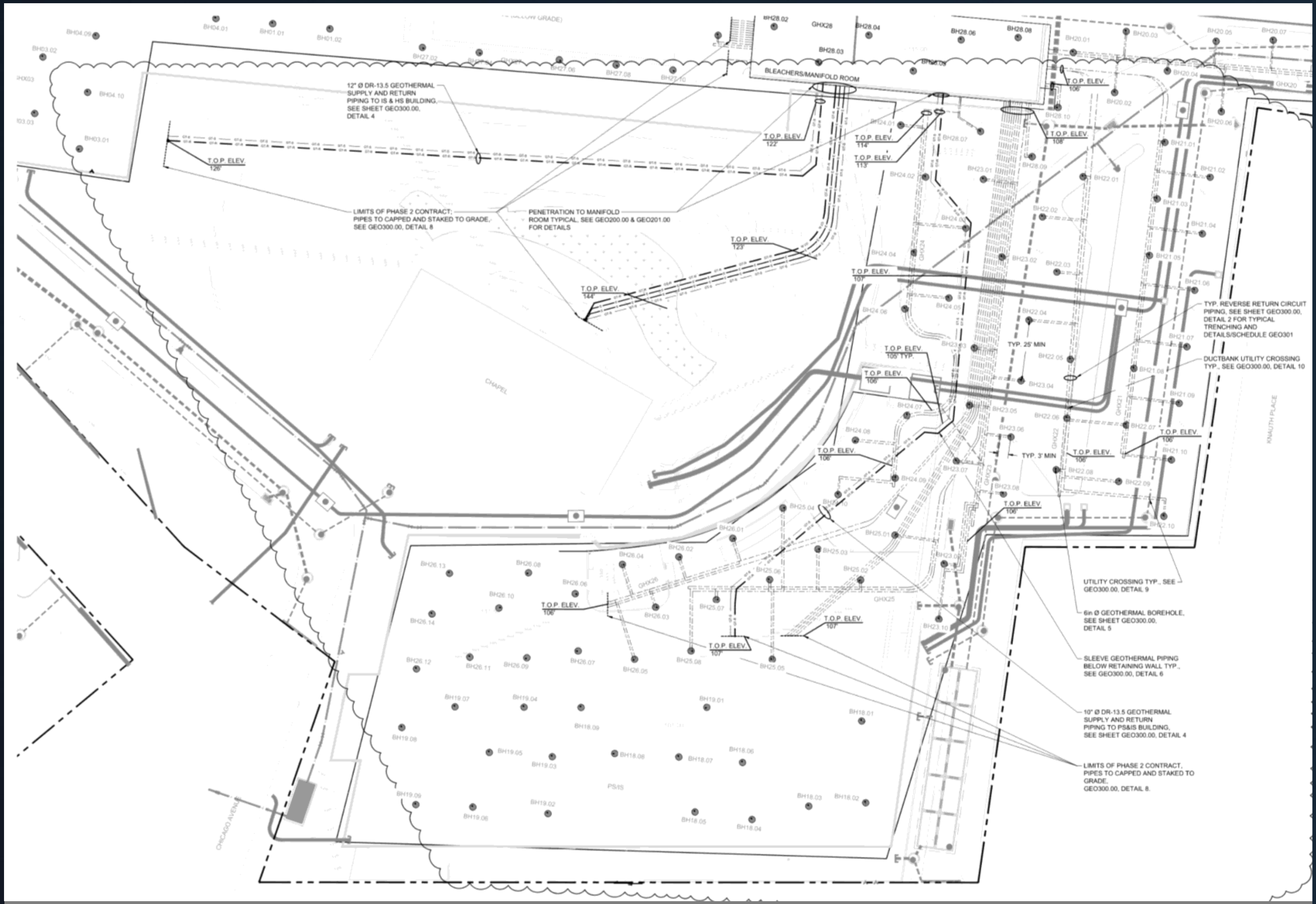
MEP Consultant
- Heating & cooling loads
- Supply/return piping from manifold
- Geothermal subcontracting
- GSHPs selection
- HVAC design
- Construction oversight





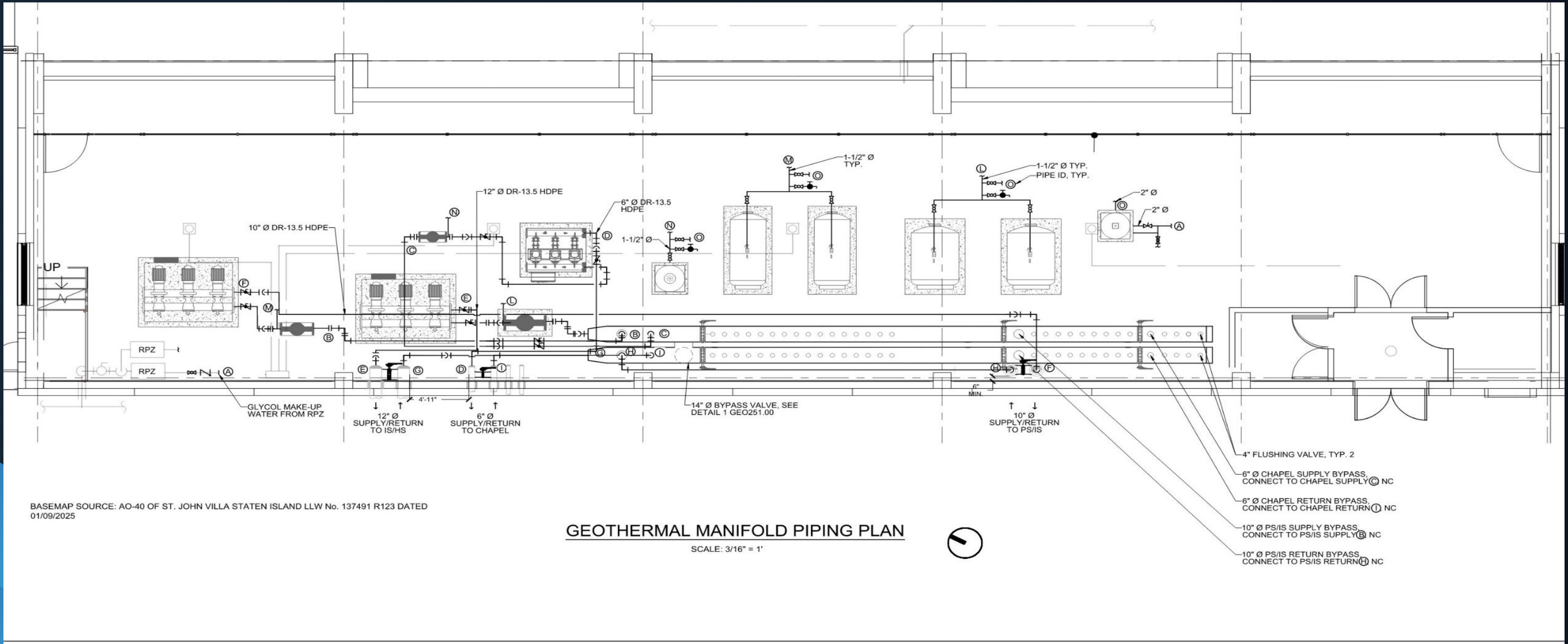
Design Considerations

- Accurate load profile & system sizing
- Subsurface utility mapping (GPR) & conflict avoidance
- Optimized borefield placement
    - Minimize land usage
    - Preserve open space
    - Avoid future construction/ landscaping conflicts
- Vertical or angled boreholes for compact footprint/expanded ground access
- Mechanical room integration
- Domestic Hot Water inclusion
- Zoning & site topography constraints
- Phasing & construction logistics



Borefield Layout Overlay With GPR Results

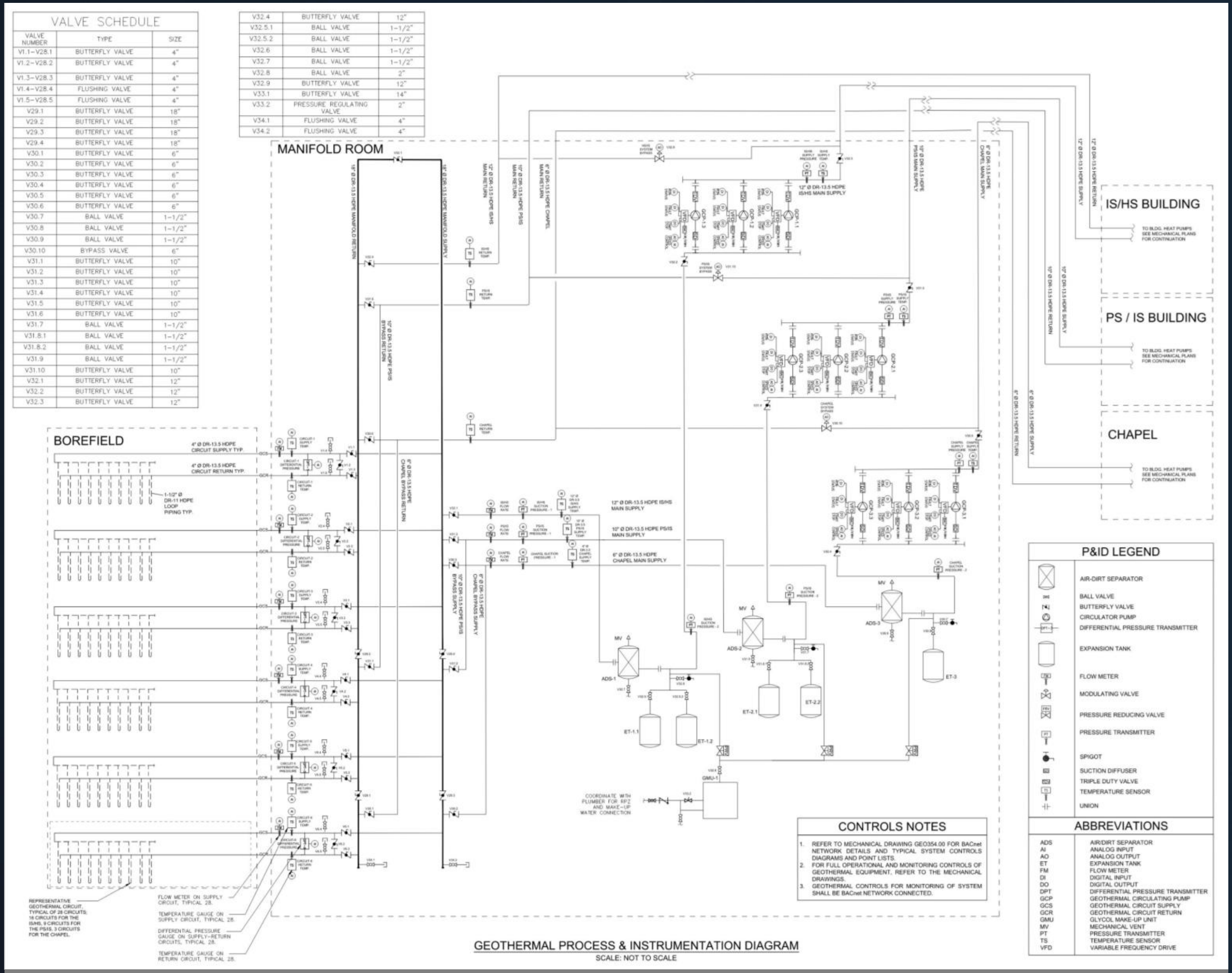
Geothermal to GSHPs



Geothermal Manifold Room

Geothermal to GSHPs

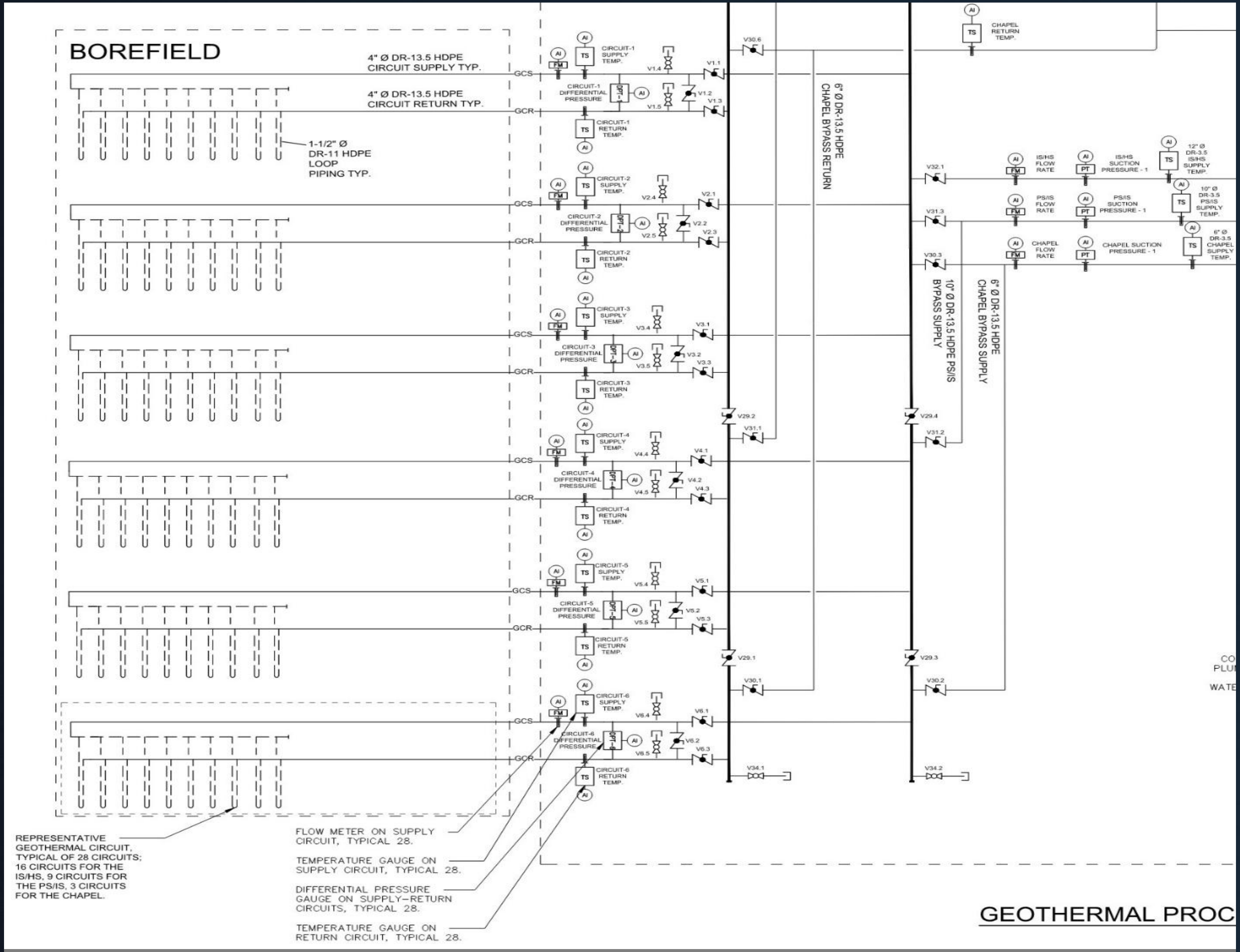
1. Geothermal supply/return piping connect into main piping via centralized manifold
2. The manifold is equipped with isolation valves, bypass valves, and energy metering for flow rate and temperature monitoring
3. Supply main routes through air/dirt separator, expansion tank, glycol fill station, and circulation pumps
4. Circulation pumps distribute supply water effectively to GSHPs in each building
5. Supply water exchanges heat as needed for heating or cooling for GSHPs
6. Return (used) water is sent back to manifold
7. Return water is then distributed evenly to boreholes



Geothermal P&ID

Geothermal Controls

- Maintain entering-water temperature (EWT) to heat pumps within safe range.
- Deliver required flow with minimal pumping energy.
- Enable monitoring, trending, and BMS integration
- Actuated bypass valve to stabilize ΔP and maintain min flow during low load
- Isolation valves per header/branch; normally open
- Pressure maintenance: diaphragm expansion tanks
- Lead/lag primary pumps
- VFD control to maintain setpoints



Installation

Rock Drill Bit

HDPE Loop Piping

Grout Materials and Piping

Drill Rig and Support Vehicles

Overburden Drill Bit

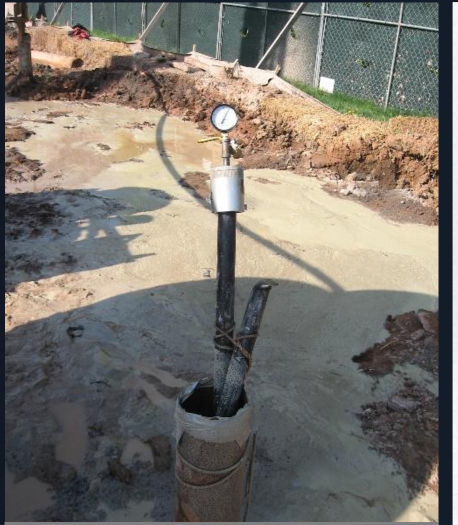
Installation

Drilling In Progress

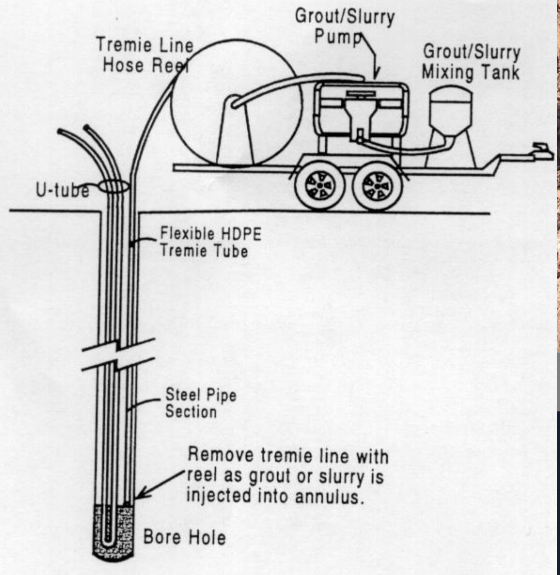
Grouting Equipment

Completed Loops

Grouting Process – Tremie Pipe Hose Reel



Grouted Loop/Pressure Test



Installation

Typical Site Conditions

Drilling Process

Grouting

Manifold Vault

Installation

Borehole Casing Cut Down to Trench Bottom

Protective Lip Installed on Casing

Horizontal Piping Assembly

Horizontal Pipe Fittings Pre-assembled

Trench Backfilling in Lifts

Installation

Supply and Return Lines

Interior Penetrations for Supply and Return Lines from Manifold Vault

Utility Crossings

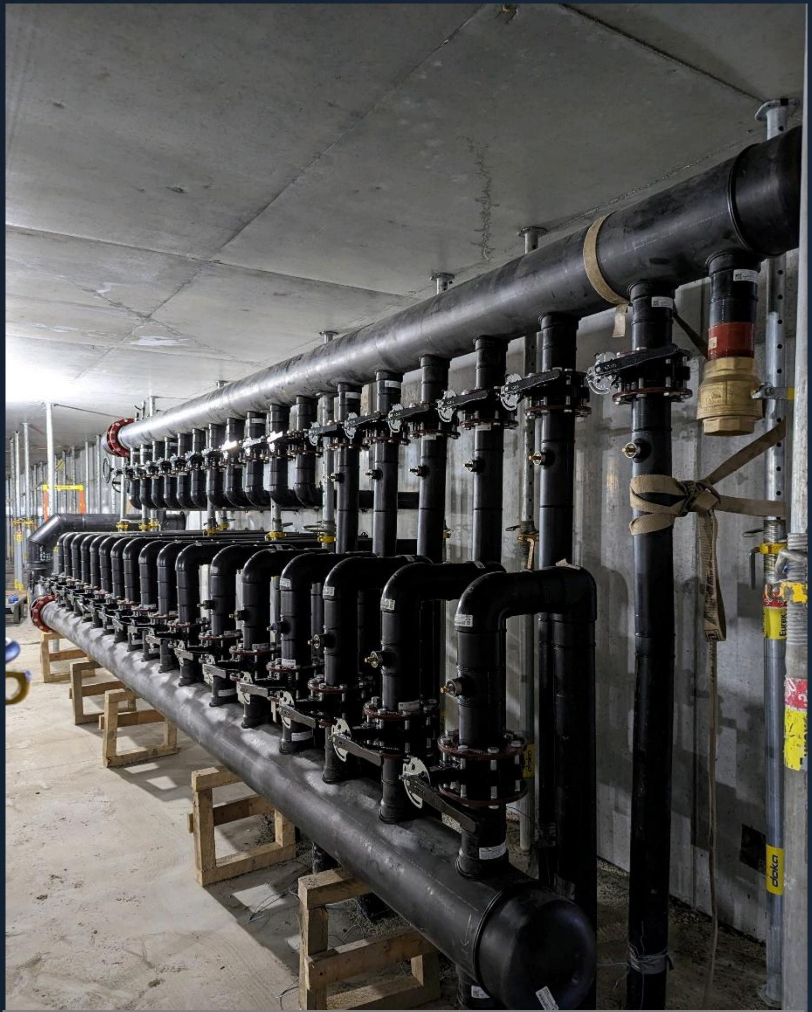
Supply and Return Line Penetrations Sealed and Fitted with Butterfly Valves

Final System Flush, Purge, and Pressure Testing

Installation

Interior Manifold

Interior Manifold



Interior Manifold

Example Projects

Obama Presidential Center – Presidential Library and Athletic Building (~500 Tons)

St. John's Villa Academy – IS/HS, PS/IS, and Chapel Buildings (Campus System ~900 Tons)

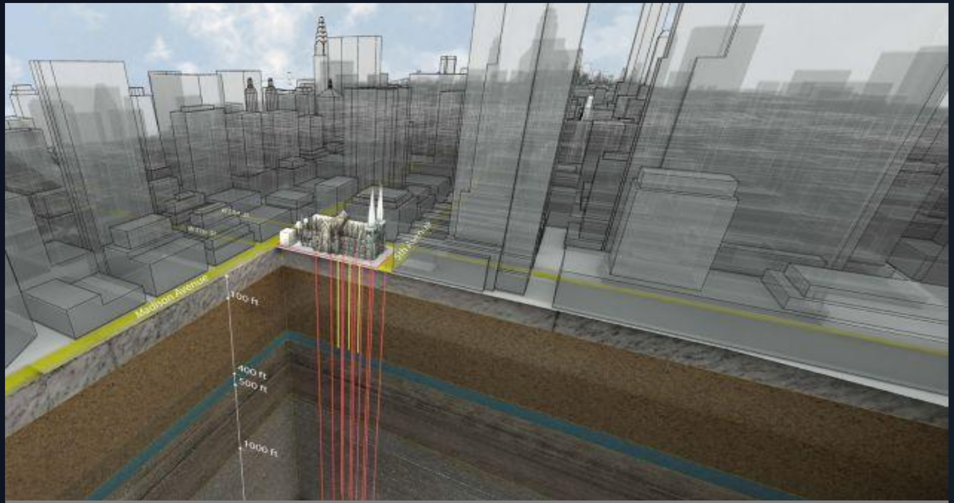
Wyandanch Rising (Campus Study)

Mastercard Headquarters (~600 Tons)

Columbia University – Geochemistry Building (~175 Tons)

SUNY Farmingdale College – Computer Science Building (~150 Tons)

Example Projects



St. Patrick's Cathedral (~200 Tons)

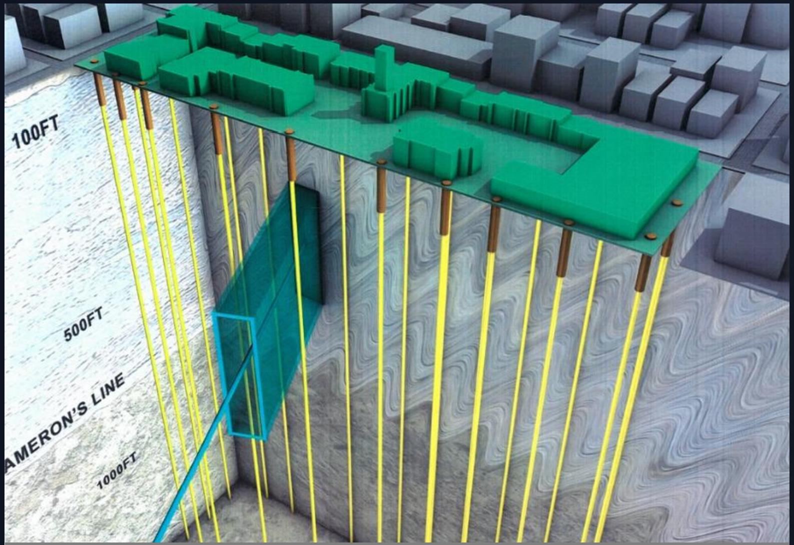
Amneal Pharmaceuticals (Open Loop ~1,200 Tons)


Cornell/Roosevelt Island

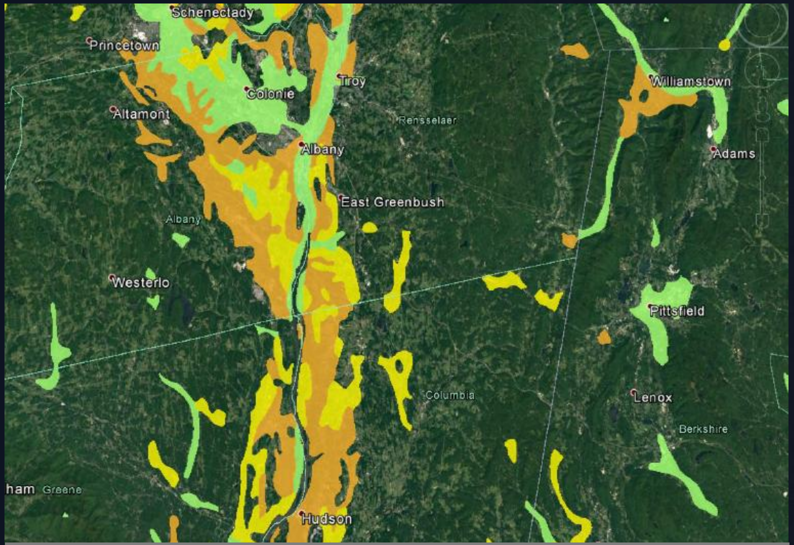
Glen Cove Hospital (Campus System 10+ Buildings)


Brooklyn Navy Yard – Open Loop

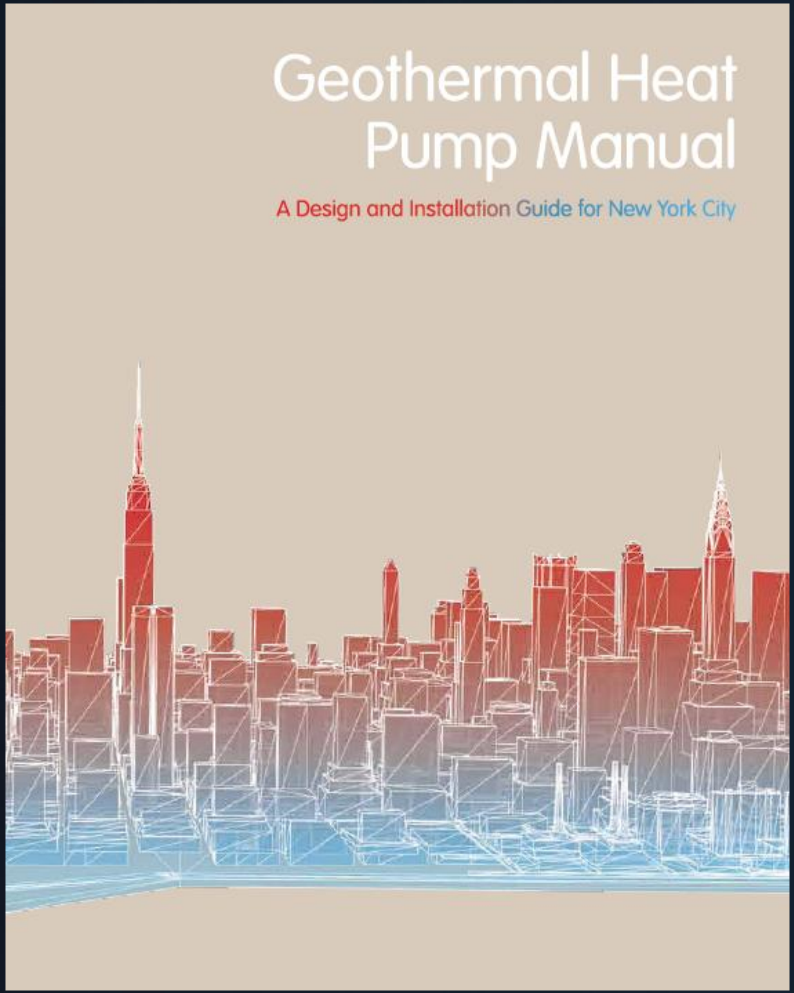
Specialty Geothermal Services

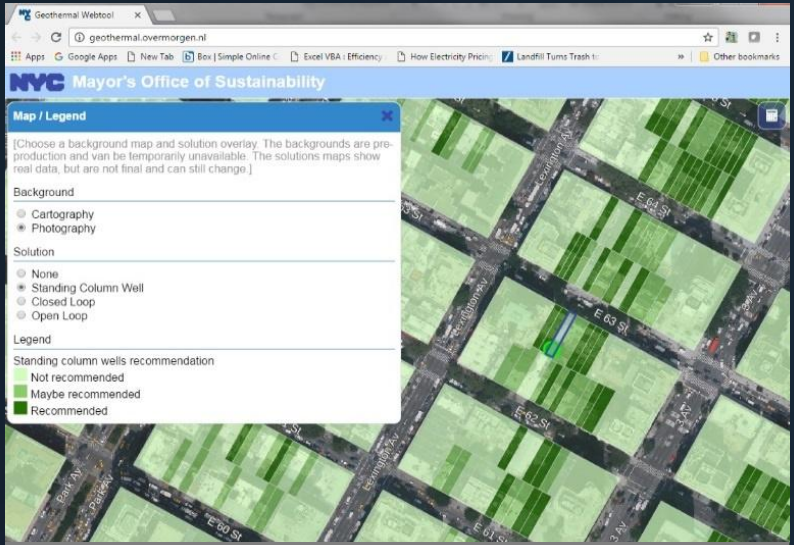


General Theological Seminary

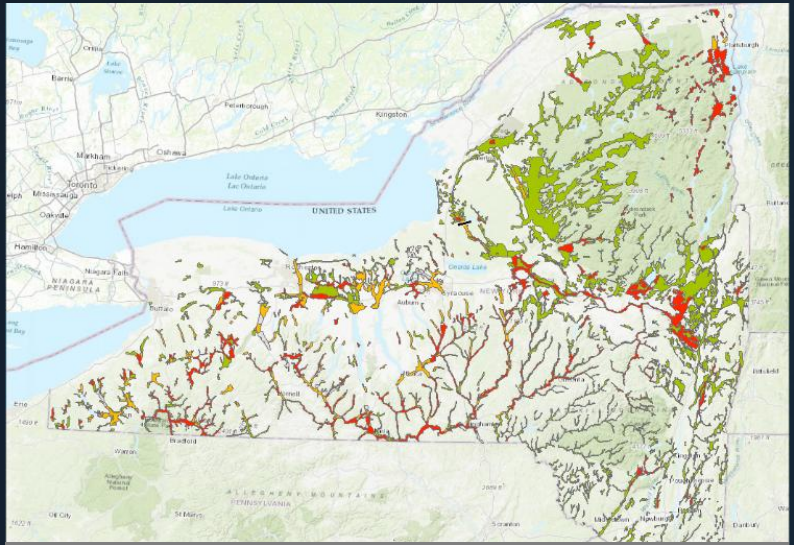


Google(X) 10-State Geologic/GIS Mapping





NYC Geothermal Feasibility Screening Tool



ATES Geothermal Screening Tool

Geothermal Snapshot

High Efficiency

- Up to 600% efficiency, even during cold winters (U.S. DOE)

Long Lifespan

- Heat Pumps: 20+ years
- Underground Infrastructure: 25–50 years

Energy Cost Savings

- Reduce energy consumption by 25–50% compared to air source systems

Sustainable & Low Maintenance

- Eliminates need for boilers/chillers; reduces carbon emissions.

Supports State & Local Climate Goals

- Aids compliance with NY natural gas ban and electrification mandates

Financial Incentives

- Direct Pay for non-taxed entities
- Federal Tax Credit (ITC – Section 48)
- 30% through 2032 (drops in later years)
- Bonus credits for domestic content

New York State Tax Credit

- 35% of qualified expenditures (max $5,000 per system)

Utility Rebates

- Con Edison: Up to 50% of project cost, capped at $100K
- PSEG Long Island: 50% rebate on thermal conductivity testing (up to $40K)

Why PWGC?

- Proven track record, regulatory insight, and integrated design with MEP/civil/architect teams

Pioneers in Sustainable Geothermal Solutions

Paul Boyce, PE
paulb@pwgrosser.com

Michael Scanlon, PE
mscanlon@pwgrosser.com

Erik Dee-Olsen, PE
edee-olsen@pwgrosser.com

631.589.6353
pwgc.info@pwgrosser.com

PWGC
ENVIRONMENTAL ENGINEERING & CONSULTING