Exploratory Meeting – District Thermal

Welcome

June 9, 2020

Agenda

Noon	Convene NYSERDA, NYC MOS, NYC DDC, NYC EDC, NYSDPS, Con Edison, National Grid, NYPA
15 minutes duration	Welcome and Purpose **Janet Joseph and Susanne DesRoches**
30 minutes duration	NYSERDA: Aspirations, and Upcoming District Thermal Solicitation **Donovan Gordon and Dana Levy**
30 minutes duration	NYC: Tools, Resources, and Market Outlook **Nick Patane and Alex Posner**
15 minutes duration	DDC Case Study **Alex Posner**
15 minutes duration	National Grid Case Study Overview of Pilot **Owen Brady-Traczyk**
15 minutes duration	Con Edison Aspirations and Intentions for a District Geothermal Study **Christine Cummings and Nickolas Hellen**
60 minutes duration	**Group Discussion**: Market Challenges and Opportunities to Work Together to Resolve
3:00 pm	Adjourn

Purpose: Seeking to understand District Thermal market potential, trends, aspirations, opportunities to collaborate:

- Market Potential: Insights from screening analysis conducted for NYC Mayor's Office
- Customers: Characteristics of sweet spot customers, methods for targeted outreach
- Solution Providers: Identifying competent solution providers and attracting them to focus on NY
- Cost: Business models, bundling with other infrastructure construction, drivers of early adoption
- Availability: Applicability/limitations of available technology
- Institutional Hurdles: What are issues regarding franchise areas, rights-of-way, permitting, other

NEW YORK STATE OF OPPORTUNITY. NYSERDA

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

NYSERDA: District-style Heat Pumps

Program Intentions

Donovan Gordon

Dana Levy

June 9, 2020

Big Picture

Carbon Neutral Buildings Roadmap (thru 2050)

- Buildings
- DER
- Building-Electric Grid

Building Electrification Roadmap (thru 2030)

- Heating, Cooling, Hot Water
- Other End Uses
- Manage System Peaks

Heat Pumps

- Joint Management w/Utilities
- LMI Solutions
- Single-building Solution
- District Configuration
- Education/Outreach
- Cooperative Marketing
- Workforce Development

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Who's Who at NYSERDA

Carbon Neutral Buildings Roadmap

- Greg Hale

Building Electrification Roadmap

- Vanessa Ulmer

Heat Pumps … Donovan Gordon

- Joint Management w/Utilities … Wendy MacPherson
- LMI Solutions … Scott Smith/Mary Chick/(Michael DiRamio)
- Single-building Solution … (Courtney Moriarta/Michael Reed)
- District Configuration … Dana Levy/Andre Davis
- Education/Outreach … Scott Smith/Mary Chick
- Cooperative Marketing … Scott Smith/Mary Chick
- Workforce Development … Scott Smith/Kerry Hogan/(Adele Ferranti)

Investment Plan & Budget

- Filed: May 15, 2020
- Approved: May 28, 2020
- $15 Million for Clean Thermal Districts
  - $14 Million for Incentives to Customers
  - $1 Million for Helper Agents, Tools, Etc.

http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?Mattercaseno=16-00681

Solicitation Framework ($14 Million)

- Competitive, Quarterly Due Dates throughout 2021 / 2022 / 2023 until funds exhausted
- Three Facets, All Open Concurrently
  - Scoping
  - Design
  - Construction

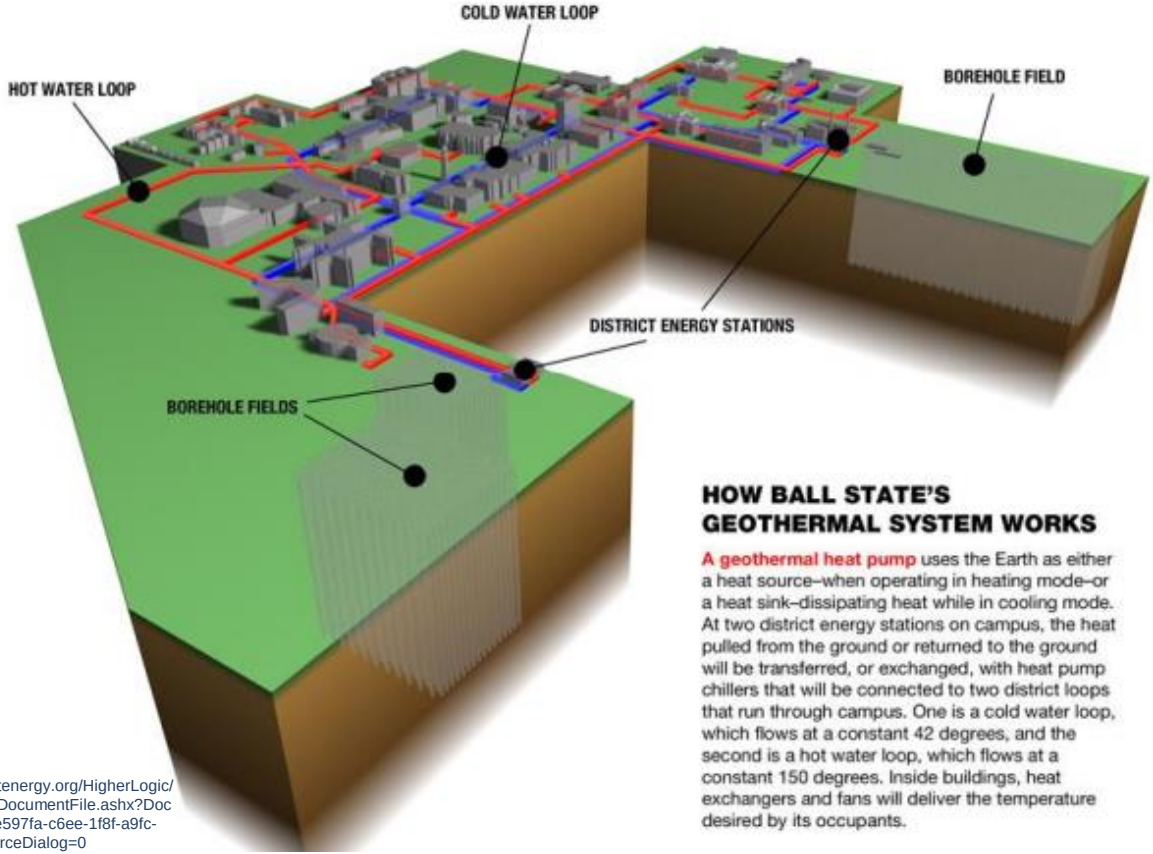
Timing of $14 Million Solicitation

- June/July: Gather Market Insights
  - Assistance from Int'l District Energy Association (IDEA)
  - Assistance from Underground Energy LLC (Mark Worthington)
- August: Vet Solicitation Strawman
- September/October: Issue Solicitation

Theory of Change

- Single-building Solutions, or District Solutions
  - When to Prefer which Approach?
- Nearly any Project will yield some Learning, but…
  - Seeking most-impactful Learning. How to Define? How to Acquire?
- Precursor to District Energy
  - Teaming: Tackle One Variable at a Time – Practice doing District Thermal in NYS Marketplace before assembling a multi-technology Team?
  - All Under One Roof: Pursue Integrated Projects with Solar+Storage etc. to Leverage Synergies which Improve Value?

District: Network serving Multiple Buildings



HOW BALL STATE'S GEOTHERMAL SYSTEM WORKS

A geothermal heat pump uses the Earth as either a heat source–when operating in heating mode–or a heat sink–dissipating heat while in cooling mode. At two district energy stations on campus, the heat pulled from the ground or returned to the ground will be transferred, or exchanged, with heat pump chillers that will be connected to two district loops that run through campus. One is a cold water loop, which flows at a constant 42 degrees, and the second is a hot water loop, which flows at a constant 150 degrees. Inside buildings, heat exchangers and fans will deliver the temperature desired by its occupants.

https://www.districtenergy.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=a9e597fa-c6ee-1f8f-a9fc-8ab2eebe937b&forceDialog=0

NEW YORK STATE OF OPPORTUNITY. NYSERDA

A “Portfolio” of Projects

- Diverse Examples – Lots of Variety of Learning
  - Upstate, Downstate
  - New Construction, Retrofits
  - Campuses, Downtown Core
  - Ground Loops, Treated Sewage, Watertable Depression Pump, Air Source
  - Novel Business Models
- Pathway to Economically-viable Replications
  - Example: Pioneering Project includes “Belt & Suspenders”
  - Example: First of Many with Repeat Customer
  - Example: Critical Mass Density for O&M Services

So-called 5th Generation District Thermal

	1 G	2 G	3 G	4 G	5 G
Piping Configuration	Pipe acts only as source District only provides heating	Pipe acts only as source District only provides heating	Pipe acts only as source District only provides heating	Two different pipes (one as source, other as sink) District provides heating and cooling	Single "ambient temperature" pipe can simultaneously act as source or sink for various buildings, thus enabling "prosumers" District provides heating and cooling
Temperature of Supply Pipe	400 °F	250 °F	190 °F	140 °F for heating 45 °F for cooling	60 °F
Fluid in Supply Pipe	Steam	Pressurized Hot Water	Water	Water	Water

Can use this supply of high-grade-heat via an in-building radiator to directly achieve comfort space heating, benefit is simplified mechanical infrastructure within each end-use building

Need to use an in-building heat pump to boost this supply of low-grade heat in order to achieve comfort space heating, but achieve system benefits via lower "thermal leakage" heat loss during distribution (narrower "delta T" between water in the distribution pipe and abutting soils of the trench)

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Marketplace Actors

- Dedicated NYSERDA webpage nyserda.ny.gov/district-thermal-systems
- Opt-in List of Solution Providers
- Virtual Expositions (Customers can meet Vendors)

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Continuing this Collaboration

All Rowing in Same Direction to extent Practicable:

- Recurring Calls in Small Groups?
- Another all-hands Webex?
- Who is Missing from the Dialog?

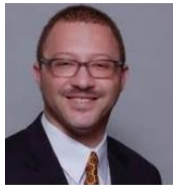
Contacts

Donovan Gordon

(212) 971-5342 x3119 Donovan.Gordon@nyserda.ny.gov

Dana Levy

(518) 862-1090 x3377 Dana.Levy@nyserda.ny.gov



Andre Davis

(212) 971-5342 x3078 Andre.Davis@nyserda.ny.gov

NEW YORK STATE OF OPPORTUNITY. NYSERDA

DDC Case Study

Alex Posner

New York City Department of Design & Construction

Experience with Geothermal Systems

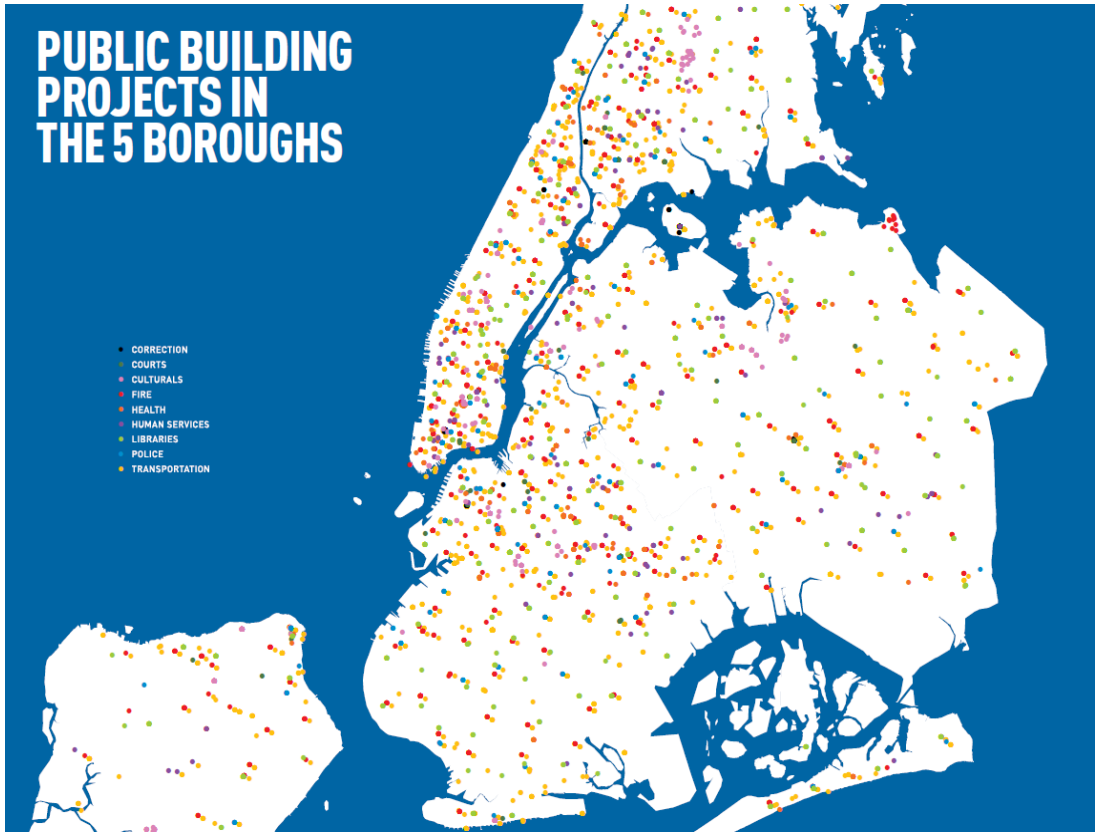
Margaret Castillo, FAIA
Chief Architect

Alex Posner, PG
Project Director\Office of Sustainability

Mayor's Office of Sustainability & NYSERDA
June 09, 2020

NYC DDC Department of Design and Construction

New York City Department of Design and Construction




Copyright 2005 Geology.com

Glacial Advance in North America

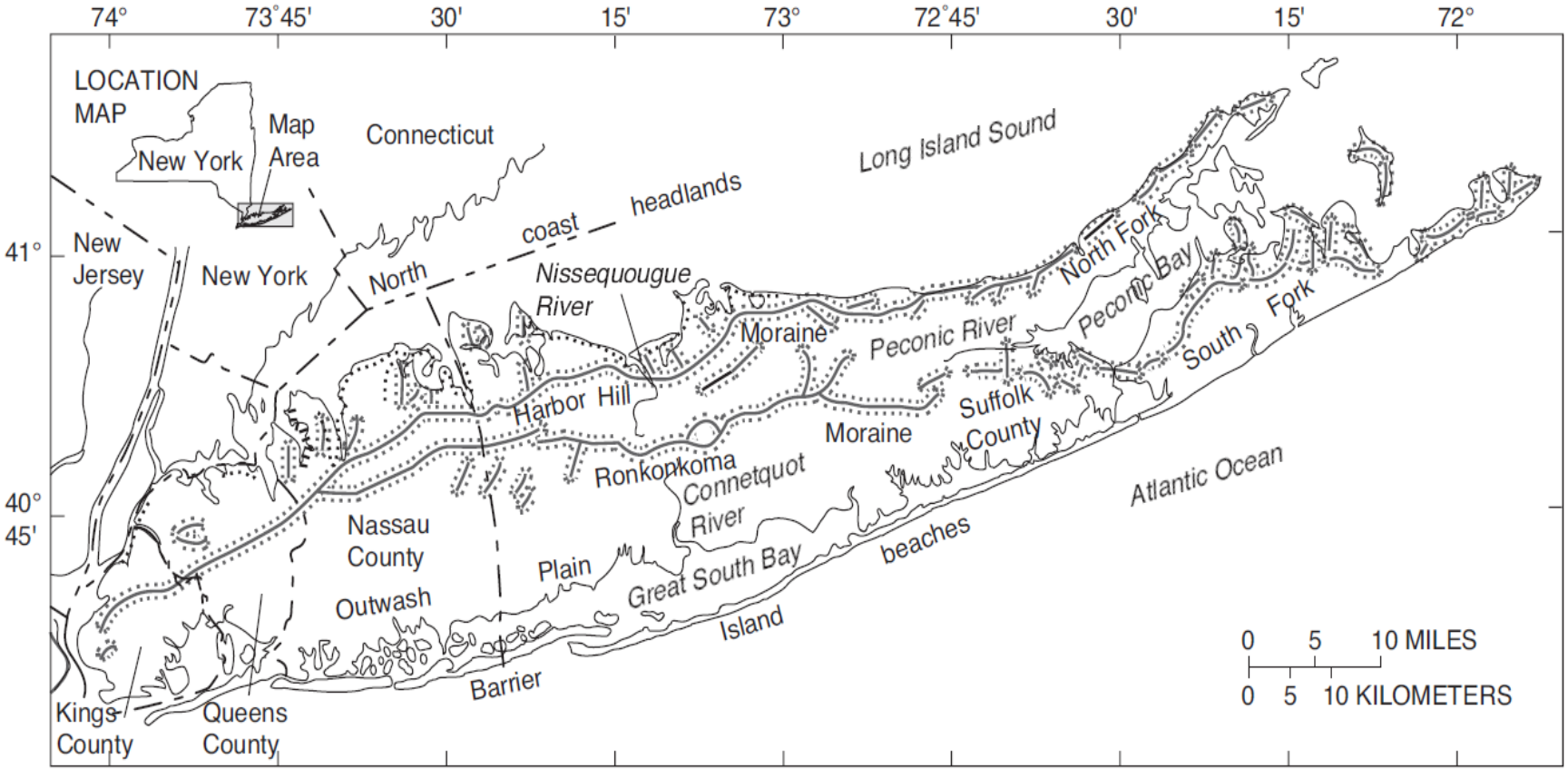
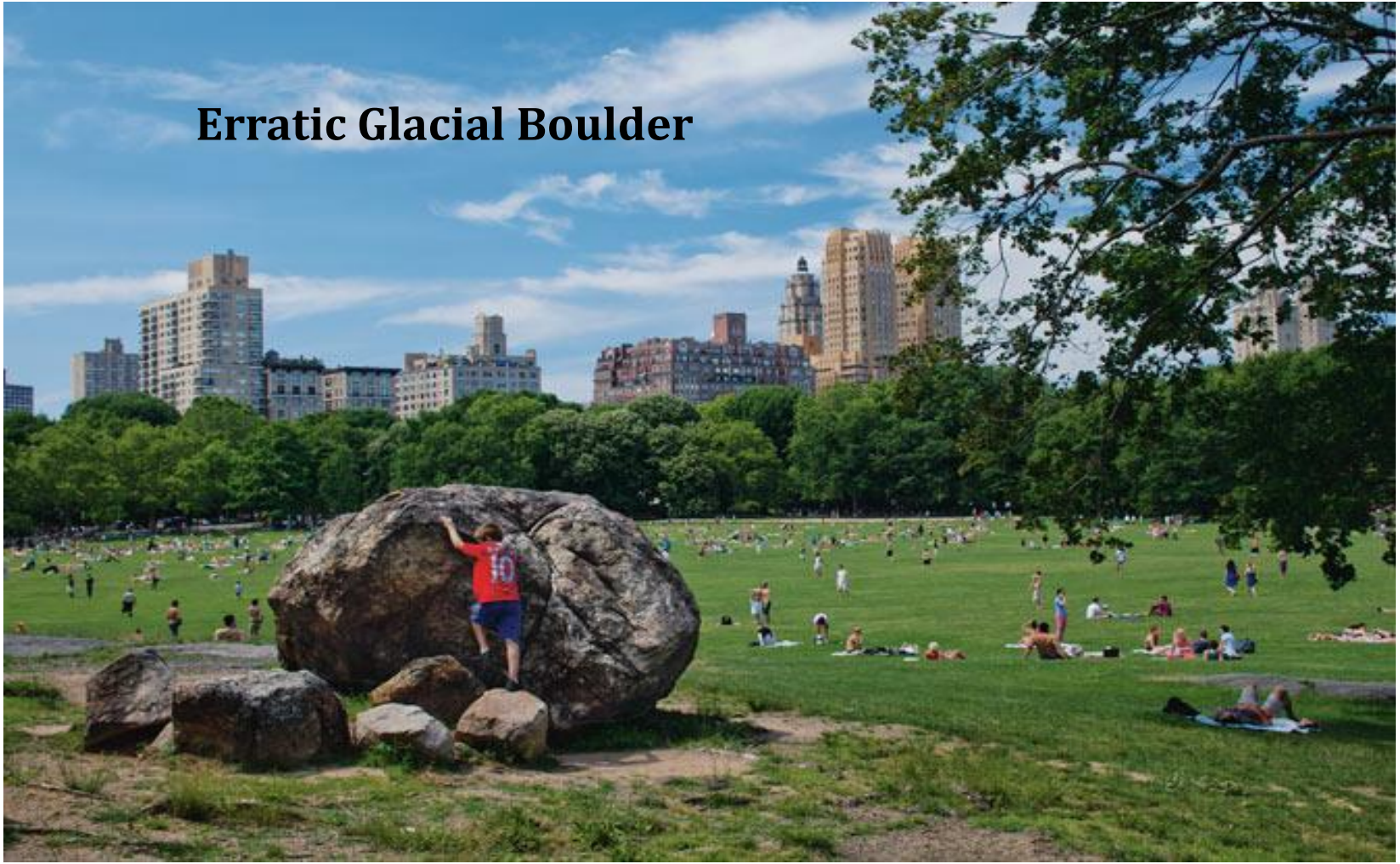


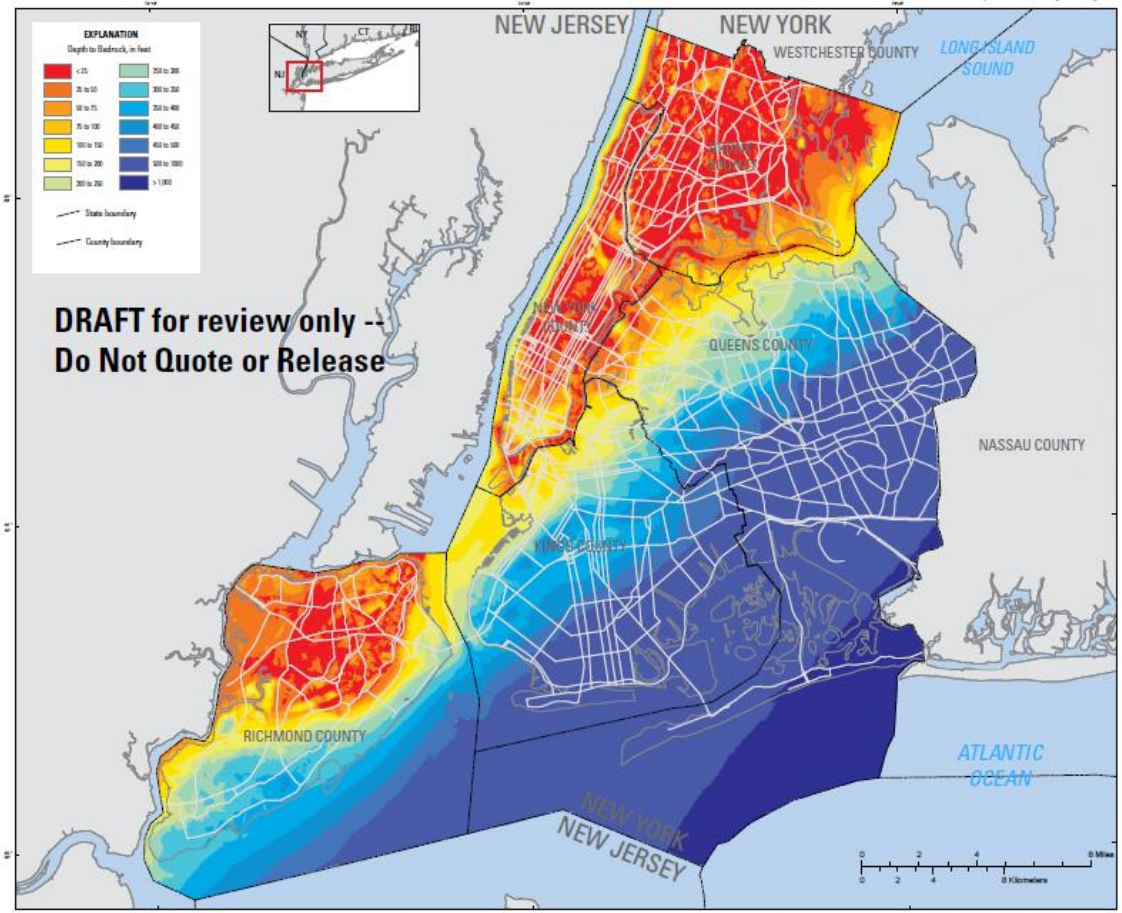
Figure 1. Location and physiographic features of Long Island, N.Y. (Modified from McClymonds and Franke, 1972, fig. 2.)


Erratic Glacial Boulder

Prepared in cooperation with the
NEW YORK CITY DEPARTMENT OF DESIGN AND CONSTRUCTION

USGS U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP XXXX



DRAFT for review only --
Do Not Quote or Release

Depth to Bedrock Within the Five Boroughs of New York City, New York

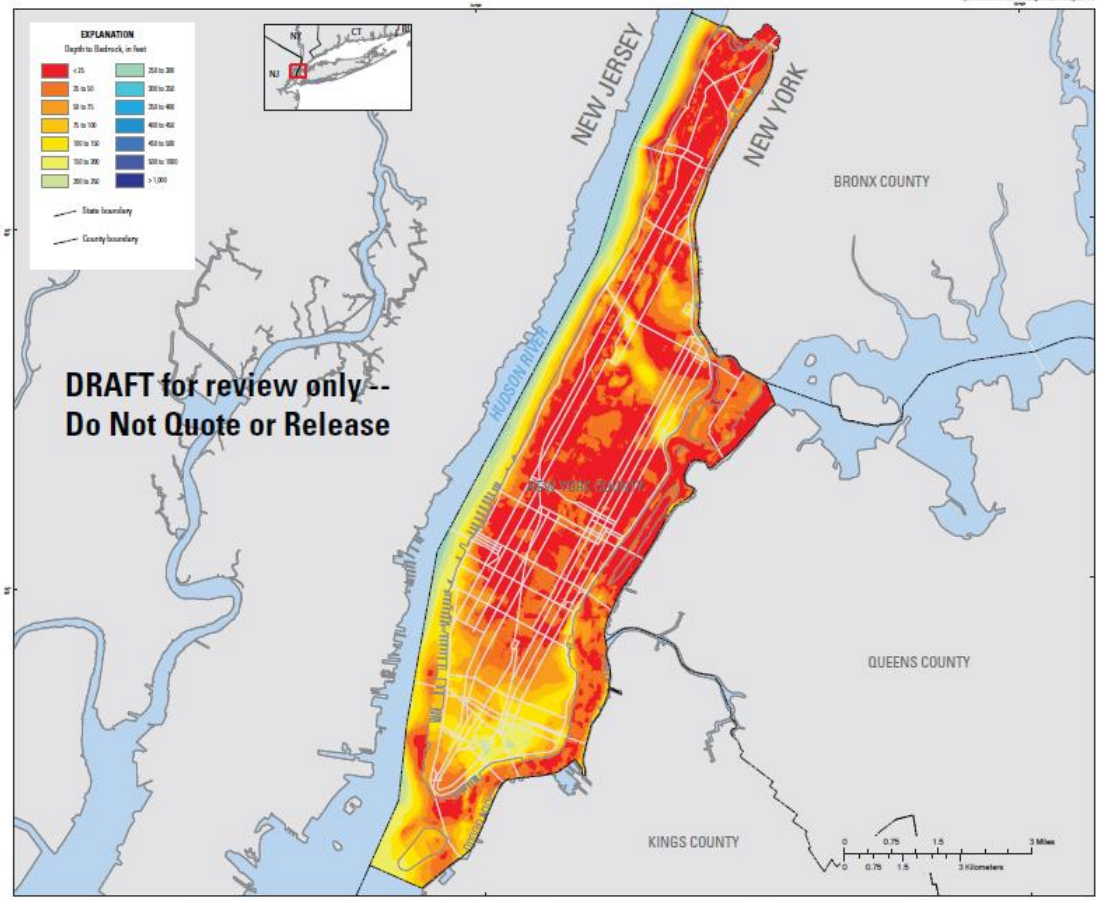
By
Frederick Stumm, Michael Como, Michael Noll, Anthony Chu, and Jason Finkelstein

2015

Prepared in cooperation with the
NEW YORK CITY DEPARTMENT OF DESIGN AND CONSTRUCTION

USGS U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP XXXX
Depth to Bedrock Within New York County—SHEET 7 of 7



DRAFT for review only --
Do Not Quote or Release

Depth to Bedrock Within the Five Boroughs of New York City, New York

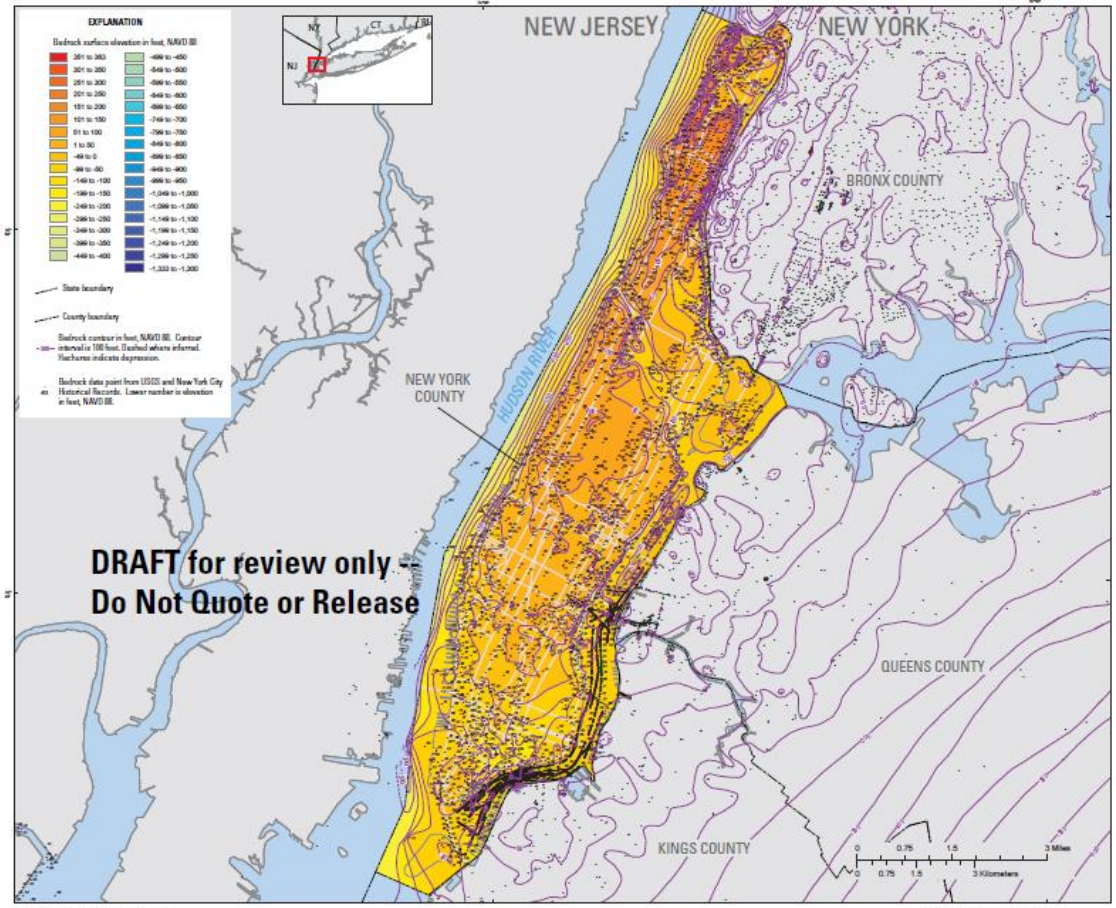
By
Frederick Stumm, Michael Como, Michael Noll, Anthony Chu, and Jason Finkelstein

2015

Prepared in cooperation with the
NEW YORK CITY DEPARTMENT OF DESIGN AND CONSTRUCTION

USGS U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP XXXX
Bedrock Surface Elevation of New York County—SHEET 1 of 1



DRAFT for review only --
Do Not Quote or Release

Bedrock Surface Elevation of the Five Boroughs of New York City, New York

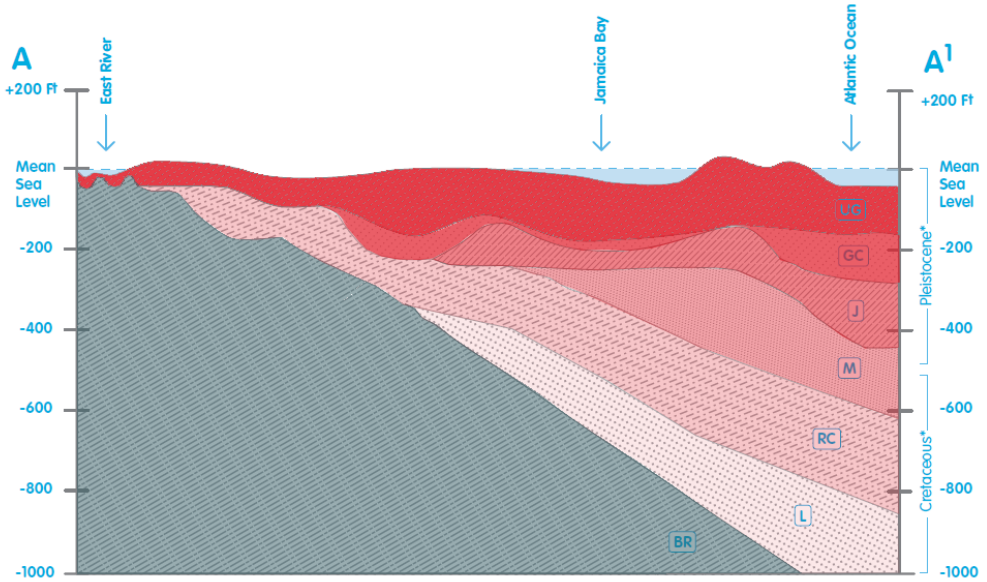
By
Frederick Stumm, Michael Noll, Michael Como, Anthony Chu, and Jason Finkelstein

2015

Aquifers in Brooklyn and Queens

* Section A above refers to Cross section below

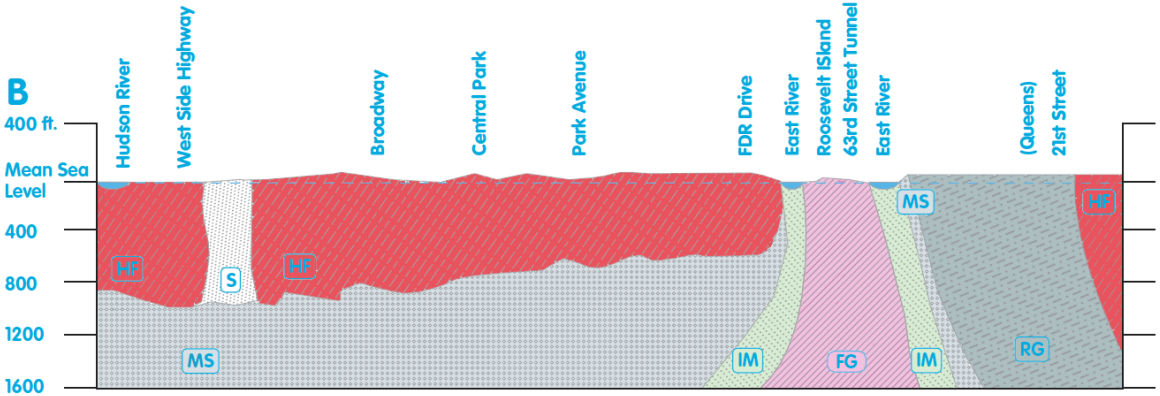
UG Upper Glacial aquifer
GC Gardiners clay
J Jameco aquifer
M Magothy aquifer
RC Raritan clay
L Lloyd aquifer
BR Bedrock



Bedrock Formations in Manhattan and Queens

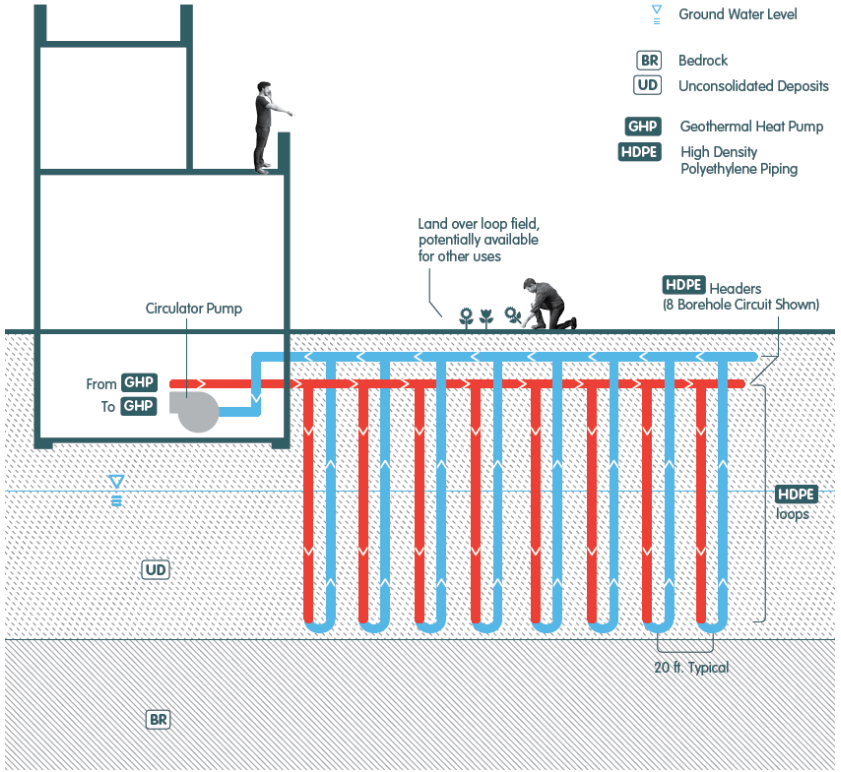
* Section B above refers to Cross Section below

FG Fordham Gneiss
IM Inwood Marble
RG Ravenswood Granodiorite
MS Manhattan Schist
HF Hartland Formation
S Serpentinite



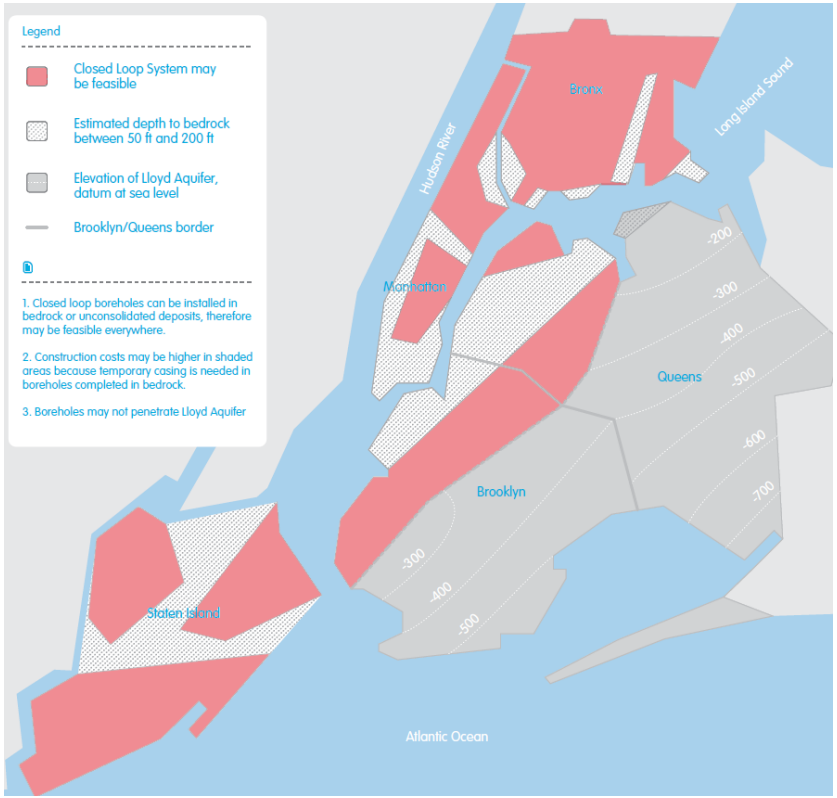
Closed Loop

- System uses anti-freeze or water solution within HDPE loops for heat transfer
- Pumps needed to circulate fluid



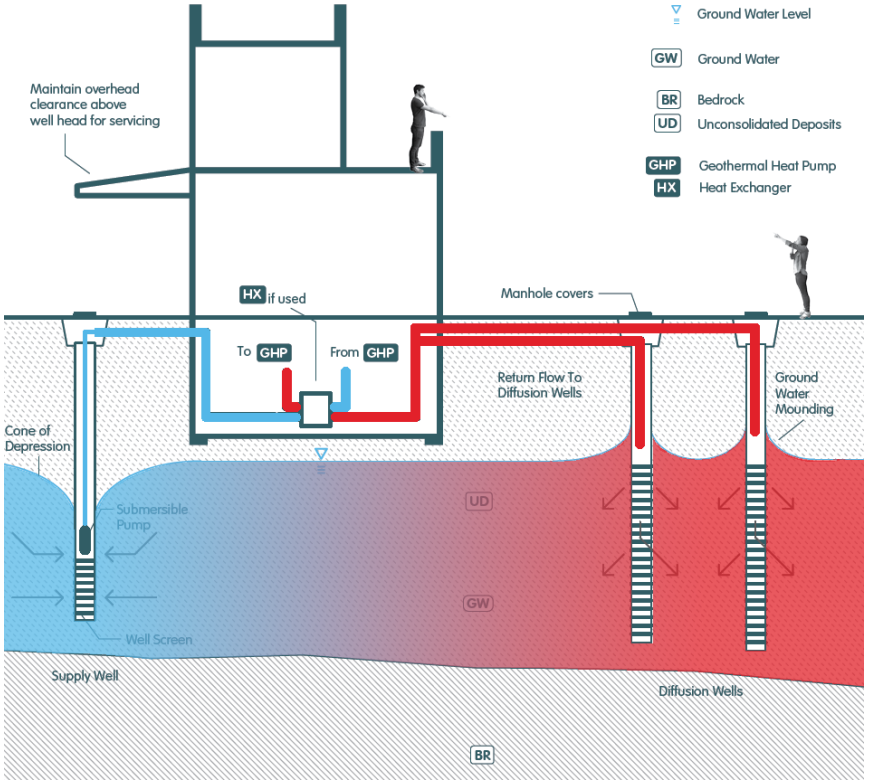
Areas for Closed Loop

- Can be installed anywhere, but more costly to drill into bedrock
- Lowest maintenance of each system, but requires most space



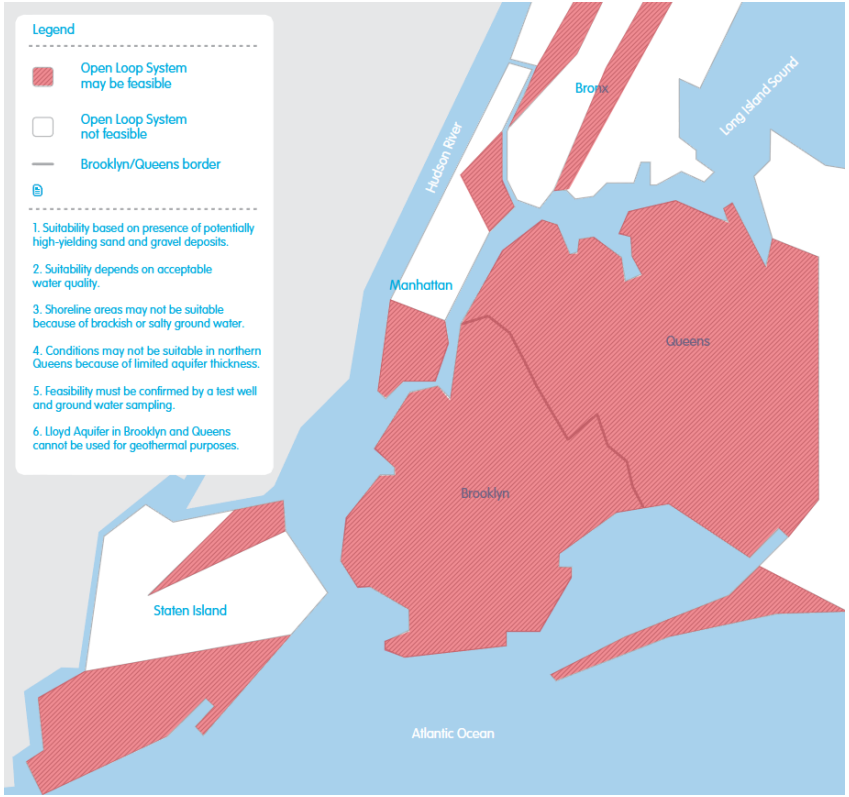
Open Loop

- Uses ground water in an aquifer for heat exchange
- Requires one or more supply and diffusion wells



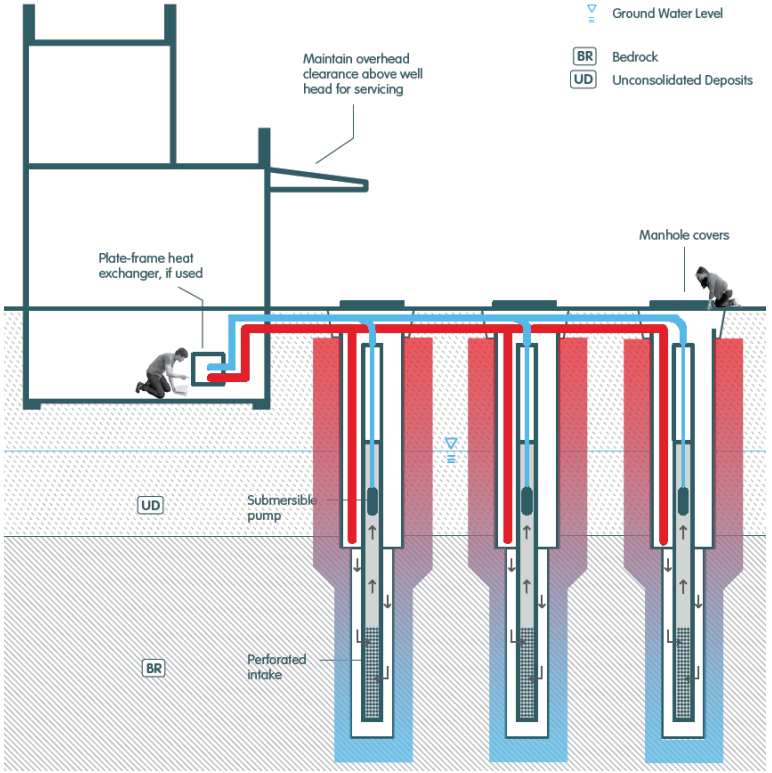
Areas for Open Loop

- Most common in Brooklyn and Queens because of prolific aquifers



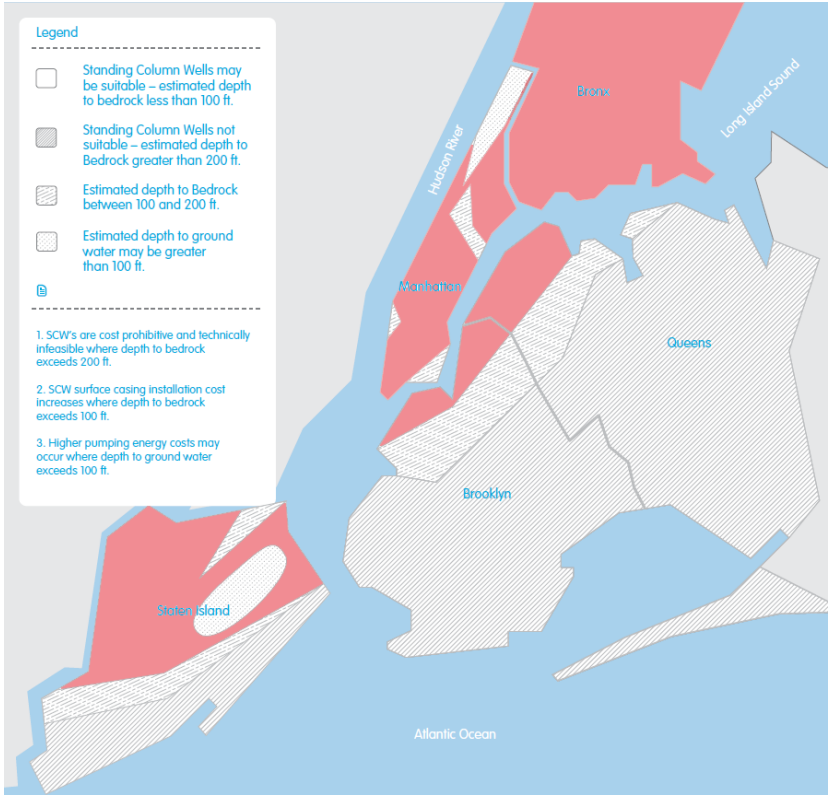
Standing Column Wells

- System combines supply & diffusion wells into one unit
- Heat exchange with bedrock rather than ground water
- Each well approximately 1,500 ft. deep



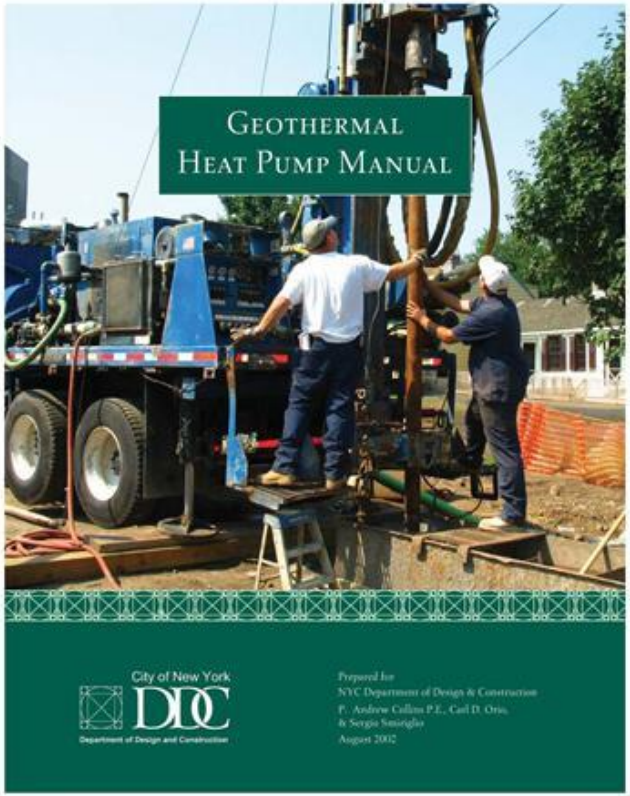
Areas for Standing Column Well

- Most common in Manhattan and areas with shallow depth to bedrock, i.e. Bronx
- Ground water presence increases thermal capacity

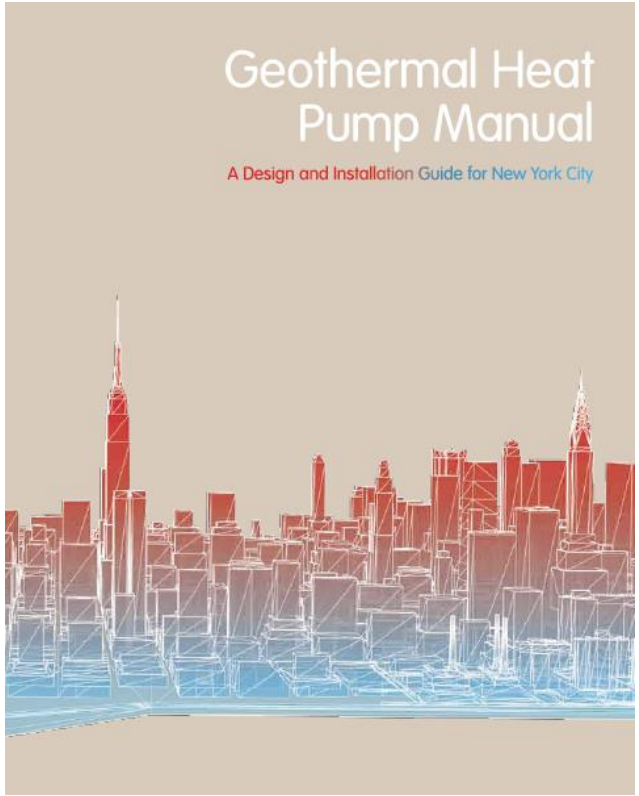


Geothermal Heat Pump Manual

2002



2012



Geothermal Tool

About | Glossary | Assumptions

Geothermal Pre-feasibility Tool

Welcome to the New York City Geothermal Pre-feasibility Tool. Use this tool to identify areas where ground source, or geothermal heat pump systems may be an option for retrofitting buildings' heating and cooling systems. View instructions for using this tool on our Help page.

In One New York: The Plan for a Strong and Just City, the City committed to reducing greenhouse gas (GHG) emissions 80% by 2050. Reducing emissions in buildings, the largest source of GHG emissions in New York City, is key to reaching this goal. Geothermal heat pump systems are a promising way to reduce emissions from buildings and tap into a cleaner future grid.

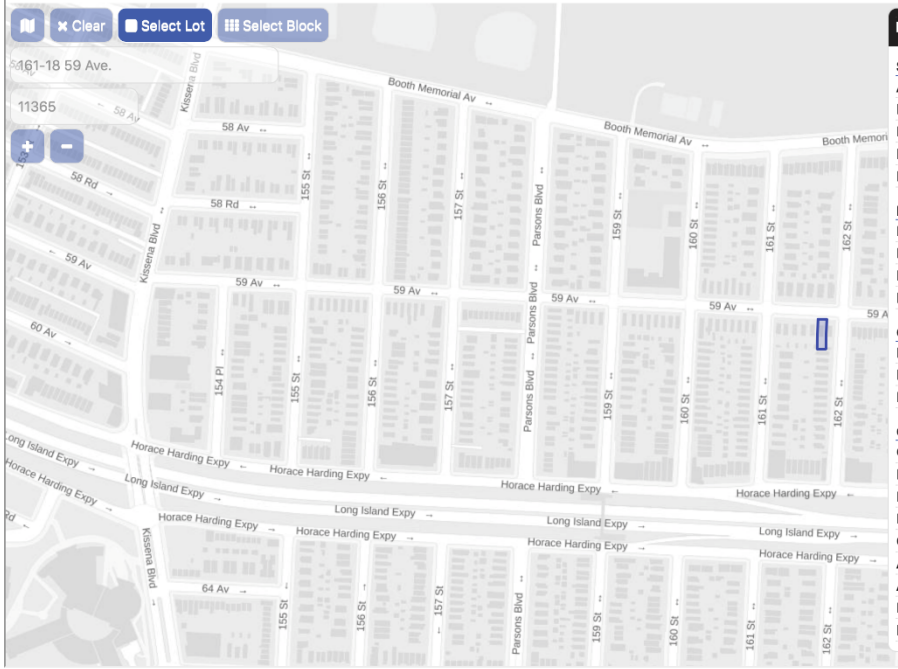
Success of geothermal heat pump systems is dependent on a number of key variables, so building owners should still conduct a full feasibility study before installing them.

This tool was brought to you by the New York City Mayor's Office of Sustainability and the New York City Department of Design and Construction, pursuant to New York City Local Law 6 of 2016.

Explore Feasibility

Geothermal Tool

About | Glossary | Assumptions | Resources | Help



Feasibility

Selection		
Address	161-18 59 AVENUE	
Borough	Queens	
Block	6739	
Lot(s)	44	
BBL(s)	4067390044	

Building**		* Fields marked with an '*' can be edited
Lot Area* (SqFt)	3,010	Lot Area
Building Area* (SqFt)	1,440	Building Area
Building Footprint* (SqFt)	770	Building Footprint
Building Type*	Other: SF1	

Calculation	
Depth To Bedrock (Ft ±25 Ft)	494
Depth To Water (Ft ±25 Ft)	24
Lloyd Aquifer (Present/Not Present)	Present

Geothermal System	Standing Column Well	Closed Loop	Open Loop***
Geological and Technical Suitability (Yes/No)	No	Yes	Yes
Potential Capacity (Tons)		13	9
Full System Feasible (Yes/No)	No	Yes	Yes
Hybrid System Feasible (Yes/No)	No	N/A	N/A
Carbon Footprint Reduction (Tons CO2e)		3	3
Annual Cost of Carbon ($)	0	356	355
Annual Potential Savings with Geothermal System ($)	0	571	566
Projected Incremental Payback with Carbon Credit (Years)		7	6
Projected Incremental Payback without Carbon Credit (Years)		12	9

Geothermal Tool

About | Glossary | Assumptions | Resources | Help

Map / Legend

Choose a background map and solution overlay.

View

- (•) Map
- ( ) Satellite

Geothermal System

- (•) None
- ( ) Standing Column Well
- ( ) Closed Loop
- ( ) Open Loop

Range of Payback Period

Feasibility

Selection	
Address	161-18 59 AVENUE
Borough	Queens
Block	6739
Lot(s)	44
BBL(s)	4067390044

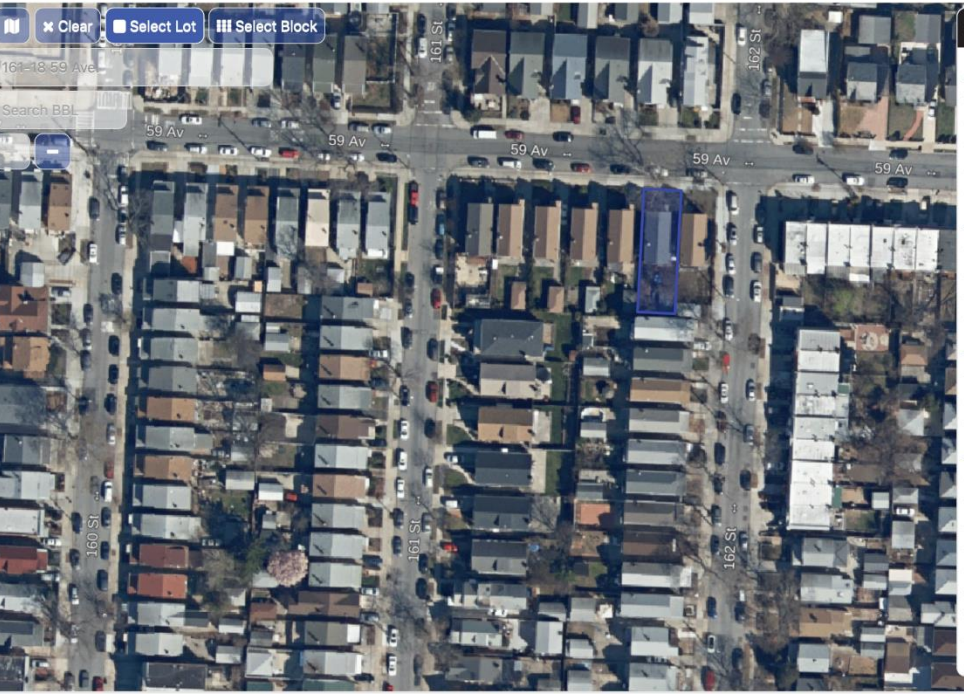
Building**		* Fields marked with an '*' can be edited
Lot Area* (SqFt)	3,010	Lot Area
Building Area* (SqFt)	1,440	Building Area
Building Footprint* (SqFt)	770	Building Footprint
Building Type*	Other: SF1	

Calculation	
Depth To Bedrock (Ft ±25 Ft)	494
Depth To Water (Ft ±25 Ft)	24
Lloyd Aquifer (Present/Not Present)	Present

Geothermal System	Standing Column Well	Closed Loop	Open Loop***
Geological and Technical Suitability (Yes/No)	No	Yes	Yes
Potential Capacity (Tons)		13	9
Full System Feasible (Yes/No)	No	Yes	Yes
Hybrid System Feasible (Yes/No)	No	N/A	N/A
Carbon Footprint Reduction (Tons CO2e)		3	3
Annual Cost of Carbon ($)	0	356	355
Annual Potential Savings with Geothermal System ($)	0	571	566
Projected Incremental Payback with Carbon Credit (Years)		7	6
Projected Incremental Payback without Carbon Credit (Years)		12	9

Geothermal Tool

About | Glossary | Assumptions | Resources | Help



Feasibility

Selection

Address	161-18 59 AVENUE
Borough	Queens
Block	6739
Lot(s)	44
BBL(s)	4067390044

Building**

		* Fields marked with an '*' can be edited
Lot Area* (SqFt)	3,010	Lot Area
Building Area* (SqFt)	1,440	Building Area
Building Footprint* (SqFt)	770	Building Footprint
Building Type*	Other: SF1	

Calculation

Depth To Bedrock (Ft ±25 Ft)	494
Depth To Water (Ft ±25 Ft)	24
Lloyd Aquifer (Present/Not Present)	Present

Geothermal System	Standing Column Well	Closed Loop	Open Loop***
Geological and Technical Suitability (Yes/No)	No	Yes	Yes
Potential Capacity (Tons)		13	9
Full System Feasible (Yes/No)	No	Yes	Yes
Hybrid System Feasible (Yes/No)	No	N/A	N/A
Carbon Footprint Reduction (Tons CO2e)		3	3
Annual Cost of Carbon ($)	0	356	355
Annual Potential Savings with Geothermal System ($)	0	571	566
Projected Incremental Payback with Carbon Credit (Years)		7	6
Projected Incremental Payback without Carbon Credit (Years)		12	9

Current NYC DDC Projects Using Geothermal

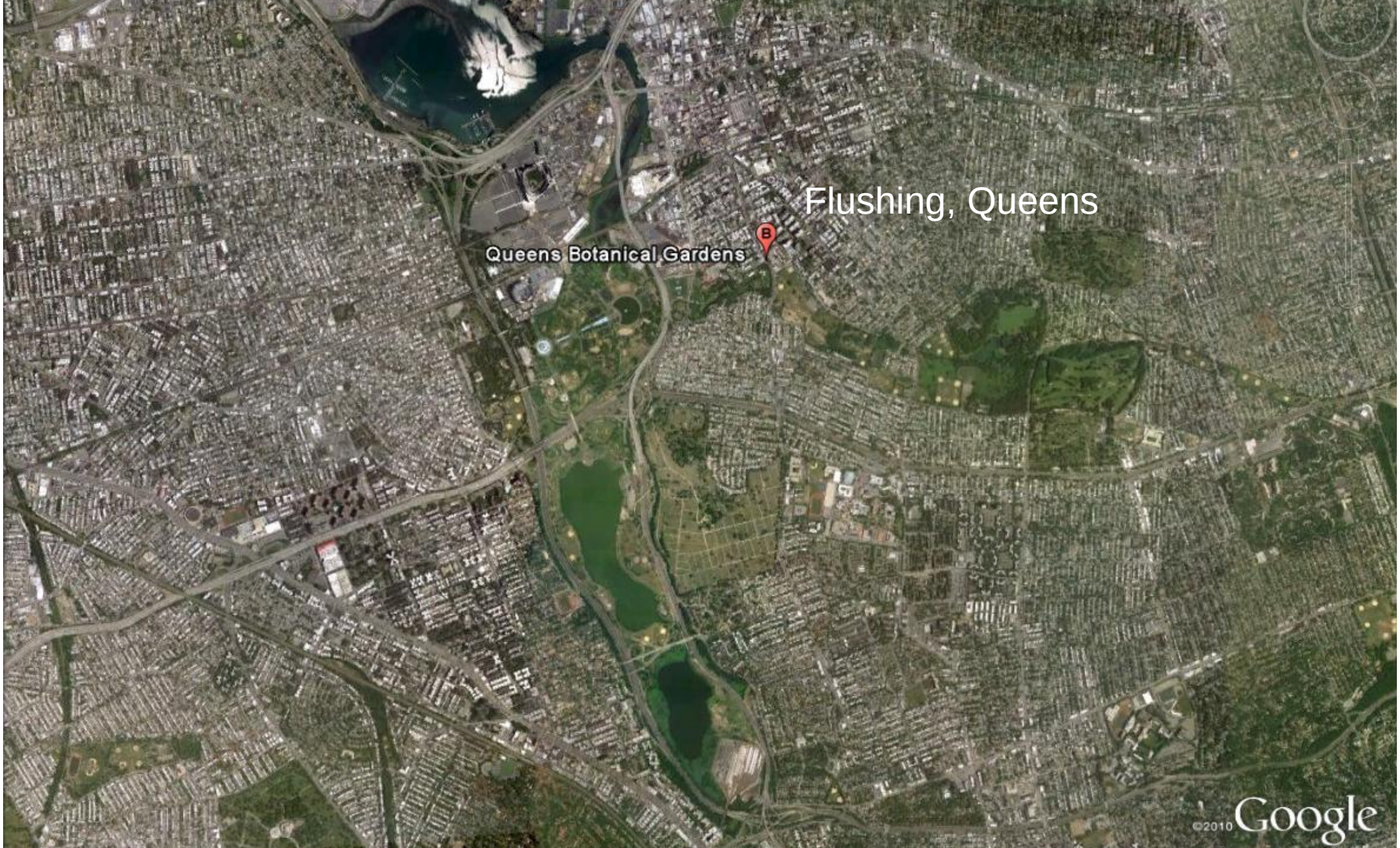
- Queens Botanical Garden
- Brooklyn Childrens Museum
- Bronx Zoo - Lion House\Madagascar Exhibit
- Weeksville Heritage Center
- Staten Island Museum (Renovation of Building A), Snug Harbor, Staten Island
- FDNY Rescue Company 2
- Washington Square Park
- Bronx River Boathouse

Queens Botanical Garden
Heating and Cooling Loads
(Open Loop)

- 16,000 sq. ft. building, 2 levels
- 8 Heat Pumps - Only 5 or 6 are actually used
- Heating Loads = 378,100 BTU/h
- Cooling Load – 37 tons
- 1 Supply Well 305 ft. deep
- 2 Diffusion Wells 305 ft. deep

Queens Botanical Garden

Administration Building


Flushing, Queens
Queens Botanical Gardens
©2010 Google


Queens Botanical Garden
©2010 Google


Administration Building
Supply Well
Rooftop
Photovoltaics
East Diffusion Well
West Diffusion Well


West Diffusion Well

Lion House at the Bronx Zoo (Standing Column)

- Total Building Area – 40,000 sq. ft.
- Heating & Cooling Capacity – 1,057,000 BTU/h, 56 tons cooling
- 5 Standing Column Wells 1,500 ft. deep
- Operating Flow Rate = 108 gpm per well
- Number of heat pumps – 6 units

Bronx Zoo Lion House

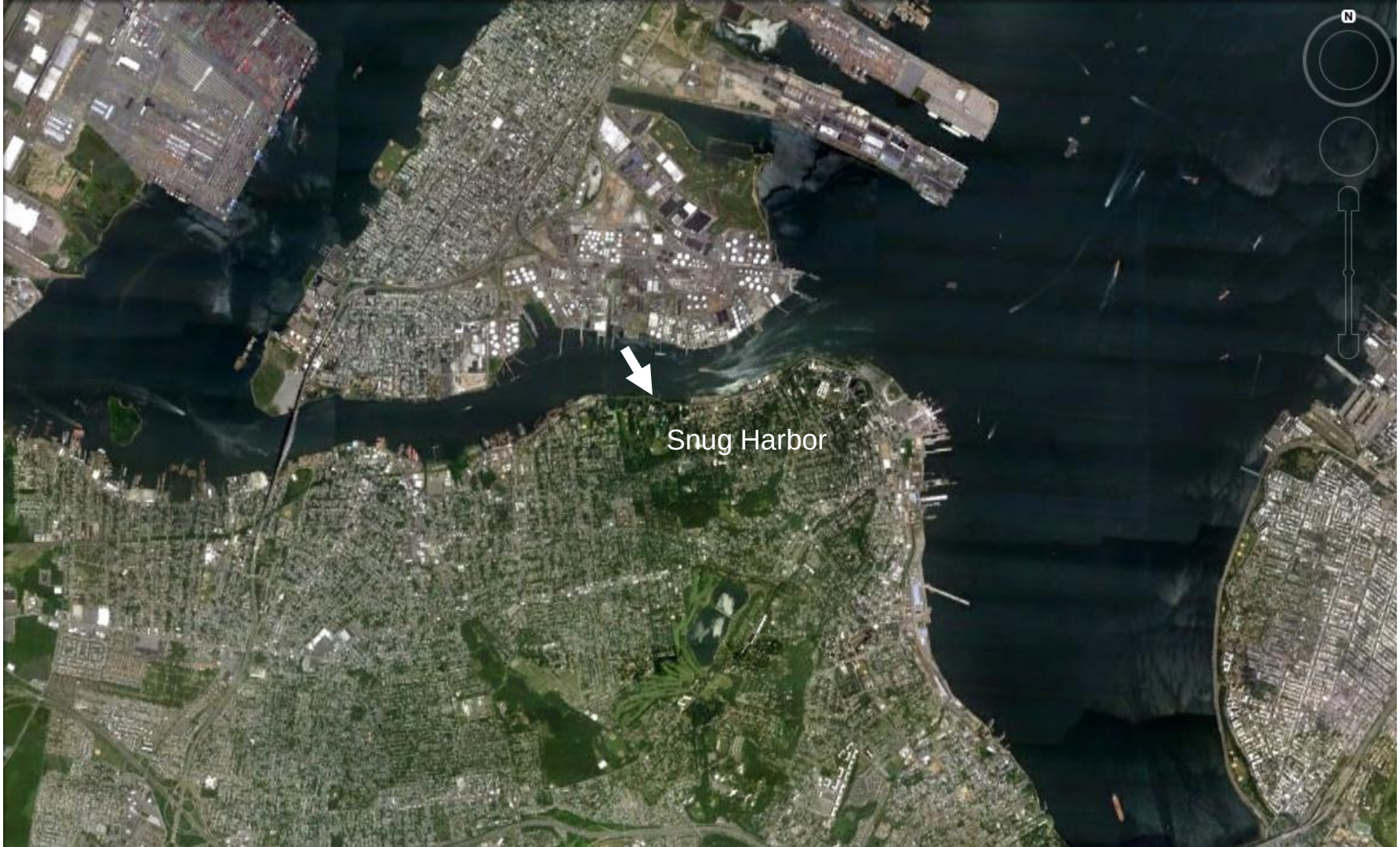
Standing Column Wells


W
W
W
W
W
©2010 Google

Snug Harbor Museum
Heating and Cooling Loads
(Closed Loop)

- 16,800 sq. ft. building, 2 levels
- Heating Load 1,114,400 Btu/h, cooling load – 91.5 tons
- Loop Field – 32 boreholes at 500 ft. depths

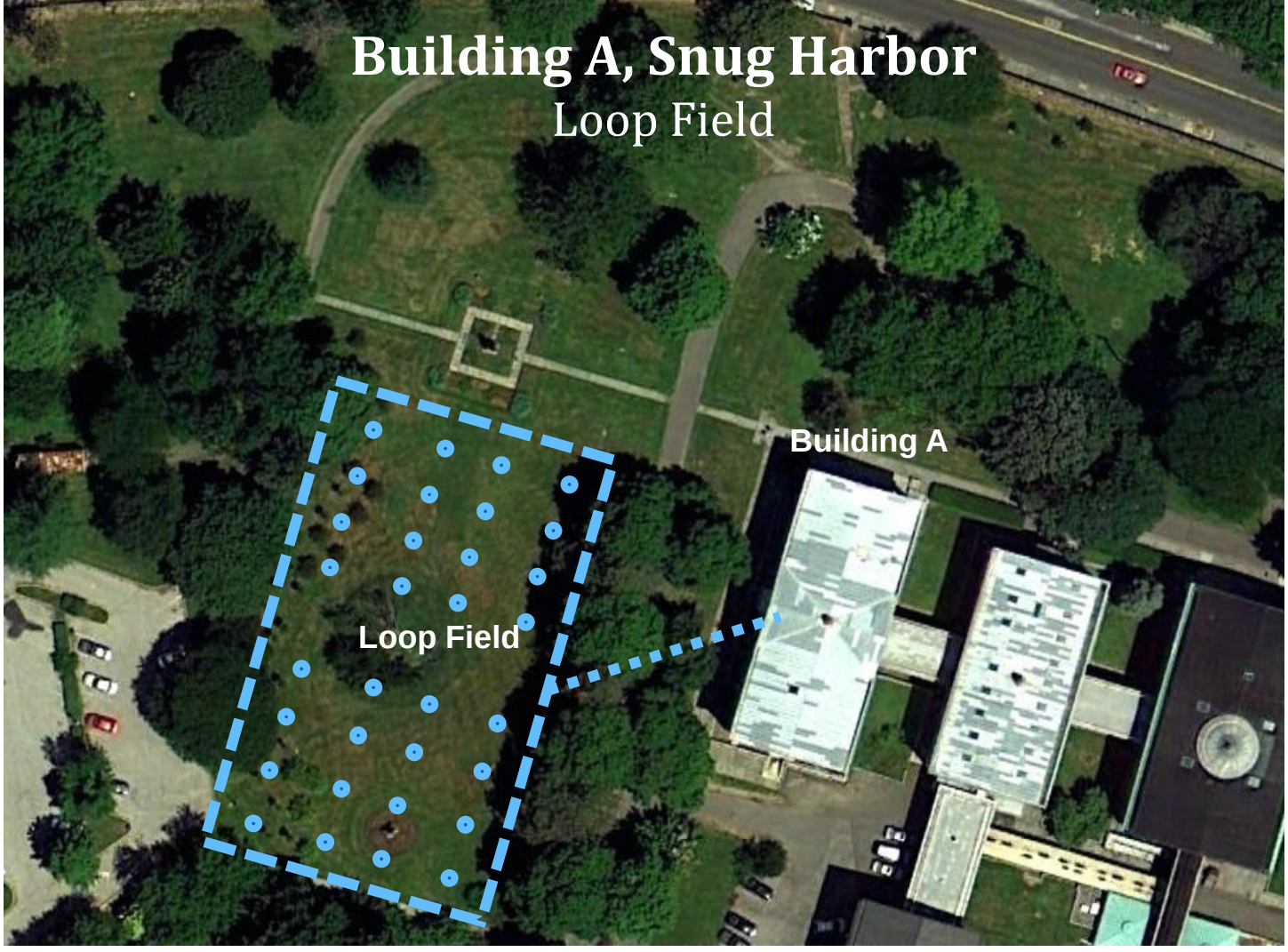
  (8 groups of 4 boreholes)
- 5 heat pump units


Snug Harbor

Staten Island Museum (Building A) at Snug Harbor

Building A, Snug Harbor

Loop Field



Snug Harbor, Staten Island

National Grid Case Study Overview of Pilot

Owen Brady-Traczyk

Please see document at NYSDPS website Case 16-G-0058 dated 4/3/2020 titled National Grid Geothermal Gas REV Demo Final Report (23 MB document):

http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2511B9E5-F94E-451E-BD27-BB9535BEA596}

Please see youtube video: https://youtu.be/W74xbFB0XVw

District Geothermal Pilot

June 9, 2020

nationalgrid

Riverhead, NY Geothermal Pilot – Overview

Test and learn pilot approved in 2016 rate case

- 55+ retirement community with homes located 1000'-1500' from gas network
- 10 homes connected to a 30-ton common loop field beginning in Dec 2017
  - No central pumping
  - Replaced kerosene and propane heating systems
- Energy efficiency upgrades were made in some homes, typically based on the vintage of the home
- Close coordination with NYSERDA & PSE&G-LI for installation, system impacts, EM&V and incentives
- All system costs paid for by the project
  - Participants paid $21.66/month, which is the minimum gas customer charge for LI

Riverhead, NY Geothermal Pilot – Results

Project was successful and utility ownership merits further investigation

- Load diversity resulted in a peak load that was 80% of nominal load
  - Shared loop capacity could have been reduced by 20% compared to individual loops
- Met year-round heating and cooling needs for these customers
- Could potentially be a viable alternative to expanding gas infrastructure
- Customers experienced positive qualitative benefits
  - Improved indoor air quality
  - Reduced equipment noise
  - More consistent temperature in the home
- Customers saved 43% compared with previous heating and cooling systems

Con Edison Aspirations and Intentions for a District Geothermal Study

Christine Cummings and Nickolas Hellen

Con Edison District Energy Study and Pilot

- Agreement reached in Case 19-G-0066
  - Milestones over the three years
  - Dovetails with other initiatives the company is pursuing
  - Collaboration with the Mayor’s Office of Sustainability
- Part of the Company’s overall commitment to the cleaner energy future

Framework for the Study/Pilots

- Examine the feasibility of deploying geothermal district energy systems in the Company's service territory as an alternative to replacing cast iron/unprotected steel
- Benchmarking
- All else equal, focus on LMI or environmental justice
- At least two locations (one in NYC and one in Westchester).

Progress

- Company is doing its own analysis using customer and company infrastructure information
- Viewed as an opportunity for the company
- Next steps are to hire consulting engineer to size the loops
- Working internally to leverage existing skill set
  - Customer Engagement
  - Engineering
  - Construction
  - Project Management
  - Energy Efficiency

Group Discussion

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Exploratory Meeting – District Thermal

Adjourn

June 9, 2020