Pratt Landing Geothermal Scoping Study

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Pratt Landing Geothermal Scoping Study

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Abstract

District thermal systems can offer greater efficiency and lower emissions than conventional heating, ventilation, and air conditioning (HVAC) systems. Initial challenges for installing district geothermal systems are often significant barriers to overcome. These include capital costs for design and installation, and uncertain regulatory pathways. Endurant explored the feasibility of incorporating a district thermal system at Pratt Landing (New Rochelle, NY) to determine technical, regulatory, and lifecycle cost viability as compared to a business-as-usual approach. Thermal exchange opportunities include sewer heat exchange and dedicated boreholes. Our results indicate that a geothermal district system offers significant savings around operational cost and emissions. The geothermal district system presents an installed cost premium compared installed cost for the business-as-usual option.

Keywords

building electrification, district thermal, district geothermal, geothermal heating and cooling, ground source heat pump, life-cycle cost analysis, Pratt Landing, sewer heat exchange

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Acronyms and Abbreviations

ASHP	Air source heat pump
BAU	Business as usual
BESS	Battery energy storage system
BTM	Behind-the-meter
CDG	Community distributed generation
CEP	Central energy plant
COP	Coefficient of performance
DBOOM	Design, build, own, operate, maintain
DER	Distributed energy resource
DHW	Domestic hot water
EPC	Engineer, procure, construct
ETS	Energy transfer station
EV	Electric vehicle
FTM	Front-of-the-meter
GLHE	Ground loop heat exchanger
GPM	Gallons per minute
GSHP	Ground source heat pump
HVAC	Heating, ventilation, and air conditioning
IRA	Inflation Reduction Act of 2022
ITC	Investment tax credit
kW	kilowatt
kWh	kilowatt-hour
NYSCHI	New York State Clean Heat Incentive
O&M	Operations and maintenance
PV	Photovoltaic
SHX	Sewer heat exchange
VDER	Value of distributed energy resources
VRF	Variable refrigerant flow
WSHP	Water source heat pump

Executive Summary

Pratt Landing is a 12.5-acre, mixed-use development located on the banks of Long Island Sound in New Rochelle, Westchester County. The developer, Twining Properties, is considering a district geothermal system to supply thermal energy to future tenants as an alternative to the business-as-usual (BAU) design. This study describes the methodology and results for assessing the technical and economic potential for developing and operating a geothermal system and a sewer heat exchange (SHX) system as compared to BAU.

ES.1 Methodology

Endurant proceeded with the following approach to develop the costs, benefits, and configurations for developing a district thermal solution for Pratt Landing.

1. Developed the BAU scenario, which included the following steps:
    - Modeled thermal loads.
    - Developed capital cost estimates for the heating, ventilation, and air conditioning (HVAC) systems.
    - Calculated utility and maintenance costs.
    - Established a 30-year lifecycle cost.
2. Developed a district geothermal conceptual design, which included the following steps:
    - Developed district configurations that will supply the thermal loads established in the previous step.
    - Estimated capital costs (and applicable incentives).
    - Calculated utility costs and maintenance costs.
    - Quantified avoided carbon emissions.
    - Conducted regulatory review for proposed district design.
    - Established a 30-year lifecycle cost.
3. Identified a commercial approach to project development.
4. Developed recommendations.

ES.2 Business-As-Usual

The team developed an hourly thermal energy model using IES Virtual Environment (VE) software based on schematic architecture design from Twining Properties. The exercise produced space heating, space cooling, and domestic hot water (DHW) loads for all buildings in the four blocks. The baseline HVAC equipment is assumed to be a variable refrigerant flow (VRF) system for space heating and cooling, and an electric boiler for DHW.

ES.3 Technologies Considered

Endurant assessed the use of sewer heat exchange (SHX), ground source heat pumps (GSHPs), and air source heat pumps (ASHPs) as an alternative to the BAU VRF design. Endurant considered district systems with mechanical equipment located in a central energy plant (centralized) or decentralized configurations, with mechanical equipment located throughout the district. In addition, Endurant assessed opportunities for solar photovoltaic (PV) and battery storage.

ES.4 Economic Analysis

This study compared capital costs, operating costs, and 30-year lifecycle costs (LCC) for each of the options and the BAU scenario. Table ES-1 summarizes each.

Table ES-1. Lifecycle Cost Comparison

	BAU	SHX Centralized	SHX Decentr.	Geo Centralized	Geo Decentr.
Annual Elec Use (kWh)	6,216,321	2,240,456	2,250,572	3,105,783	3,105,829
Installed Cost	$21,808,000	$33,578,000	$26,582,000	$32,229,000	$27,702,000
Year 1 Utility Cost	$1,550,000	$481,000	$665,000	$723,000	$859,000
Year 1 Maint. Cost	$105,000	$65,000	$65,000	$48,000	$48,000
30-year LCC	**$71,071,000**	**$49,540,000**	**$49,744,000**	**$56,233,000**	**$57,114,000**

ES.5 Recommendation

Endurant recommends that Twining Properties pursue an SHX solution to supply thermal demands across the Pratt Landing development. The SHX solution requires less electricity to operate, which results in lower utility costs and significantly reduced carbon emissions. The SHX option reduces CO_2 emissions by 66%, while the geothermal solution reduces CO_2 by 53% compared to the BAU baseline. In addition, the SHX solution uses existing infrastructure and eliminates the need to construct boreholes. The greatest challenge will be overcoming regulatory hurdles as there is little precedent for a district SHX system in the area.

If the regulatory hurdles prevent the SHX from adhering to the overall project timeline, Endurant recommends pursuing a hybrid geothermal system including GSHPs and ASHPs.

1 Project Background

Pratt Landing is a 12.5-acre mixed-use development located on the banks of Long Island Sound in New Rochelle, Westchester County. The planned 780,000 sq. ft. development is being built by Twining Properties, and will comprise retail stores, a large grocery store, 660 residential units, and conference and performing arts centers. The amenities planned include a waterfront esplanade overlooking Echo Bay (part of Long Island Sound). It will connect Main Street and downtown to the waterfront and connect the Echo Bay parks to each other. This will create a small-town center with places for people to walk and bike by the water's edge. The project is to be built out in four phases from 2022–2024.

Figure 1. Pratt Landing Illustration

The site offers a compelling opportunity for on-site thermal solutions, making it an ideal candidate for NYSERDA's PON 4614 feasibility study program. Twining Properties contracted Endurant Energy to bid into PON 4614 and conduct a detailed feasibility analysis for on-site geothermal heating and cooling solutions, in addition to assessing additional opportunities for deploying on-site energy solutions that would complement a geothermal system.

Endurant Energy has led the feasibility study for Pratt Landing and submitted periodic milestone reports to NYSERDA. This report represents the compilation of all feasibility work done for Pratt Landing into a cohesive document that highlights the end-to-end process followed for the feasibility study as well as key recommendations for Twining Properties.

2 Pratt Landing—Baseline Scenario

2.1 Thermal Energy Profile

Understanding a project's thermal load profile is imperative for identifying on-site distributed energy resource (DER) opportunities to meet space heating and cooling loads. This is particularly important while designing GSHP systems as they require annual balancing to prevent overheating or overcooling of the ground loop heat exchanger (GLHE).

A building's thermal profile is a function of building design, construction materials, location, occupancy profiles, and use type; therefore, the first step is to create an 8760 hourly energy model that reflects the expected thermal energy demands based on the criteria above. Pratt Landing has a mix of residential, commercial, and retail uses. Thermal loads were modeled for each building to arrive at the site's overall annual thermal energy usage.

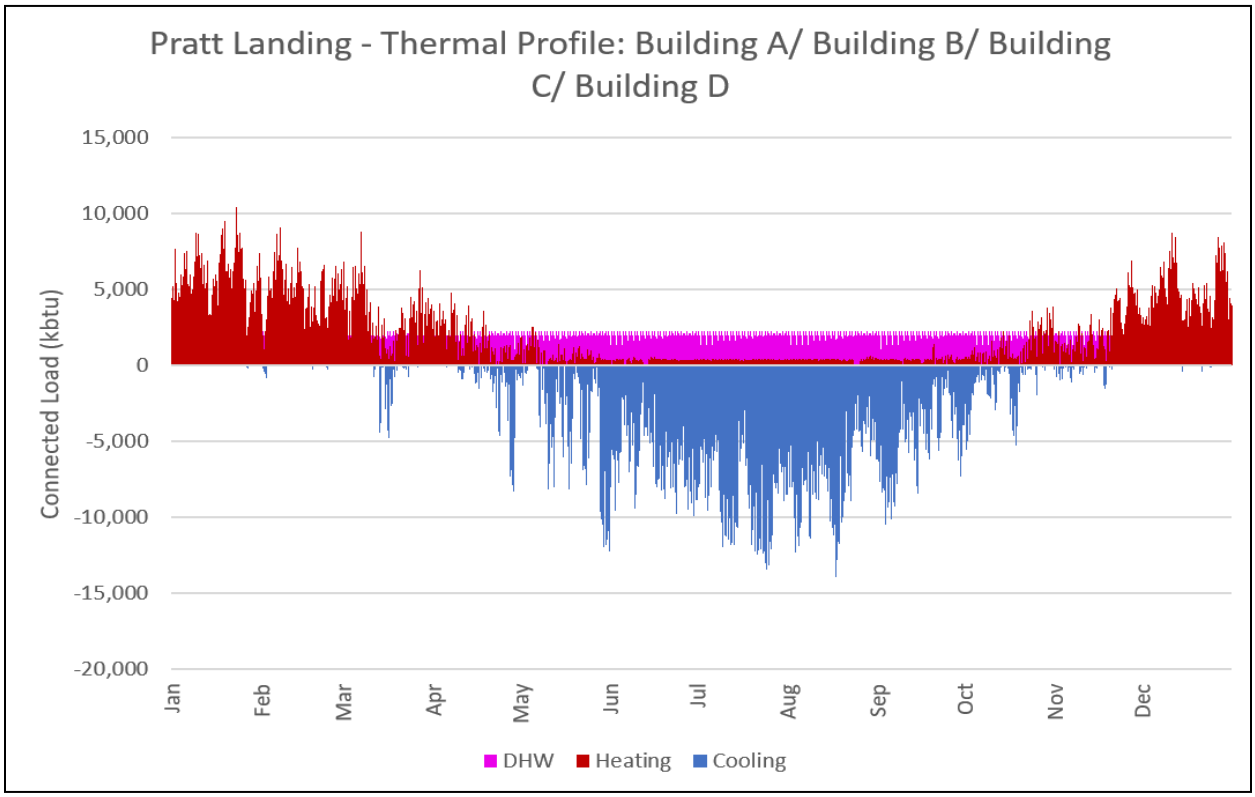
All buildings were modelled using IES VE 2019 energy modelling software based on the proposed schematic architectural design. Envelope thermal properties, all internal loads and schedules were modelled per ASHRAE 90.1. The interior parking/garage area and garage ramps were assumed to be unconditioned spaces. The thermal load profile of the entire development was used to identify simultaneous balanced thermal loads as well as non-concurrent unbalanced loads, which serves as a key input in evaluating technologies and configurations that would be appropriate for Pratt Landing.

The projected thermal profile for Pratt Landing is well balanced, both at the individual block and overall development level. The annual heating loads are summarized in Table 1 and graphically illustrated in Figure 2.

Table 1. Pratt Landing Annual Thermal Profile

	Block A	Block B	Block C	Block D	Combined
Annual Heating (kbtu)	3,147,384	5,750,120	3,431,389	2,687,521	15,016,413
Annual Cooling (kbtu)	3,3035,448	8,676,165	3,040,714	2,587,743	17,340,071
Annual DHW (kbtu)	1,598,169	5,370,360	1,834,172	1,705,342	10,508,043
Peak Heating (kbtu/hr)	2,292	4,267	2,073	1,795	10,427
Peak Cooling kbtu/hr (tons)	2,748 (229)	6,228 (519)	2,640 (220)	2,280 (190)	13,896 (1,158)

Figure 2. Annual Thermal Profile for Pratt Landing (Buildings A, B, C, and D Combined)



2.2 Baseline Capital and Operating Costs

In addition to estimating annual thermal loads, the building energy model also quantifies the input energy (electricity or natural gas) required to run equipment to provide the thermal loads. This is useful to estimate baseline utility costs associated with providing the projected space heating and cooling energy across the development. The baseline configuration assumes variable refrigerant flow (VRF) driven space heating and cooling, and electric boilers supplying DHW for all blocks. The 8760 profiles of the electric energy required to drive the baseline system were run through Endurant Energy's tariff engines, which simulate electric delivery and supply costs by mirroring how Con Edison would meter and bill for electricity and/or gas delivery. The tariff calculator is based on current, published tariff leaves and includes all applicable surcharges, riders and taxes that are typically applied to Con Edison bills. For this analysis, we assumed fully bundled Con Edison service (i.e., Con Edison rates for delivery and supply).

The rate class modeled for each solution depends on the metering configuration (e.g., a single master meter for the entire development versus distributed, building or unit-level meters), as well as the peak kilowatt (kW) demand for the solution. The total input electrical energy for the baseline VRF systems was divided by the number of residential apartment units to estimate electricity for a direct-meter setup. Each apartment is assumed to be on Con Edison's SC1 Rate 1 (Residential and Religious). Each commercial/retail space is assumed to be on Con Edison's SC9 Rate 1 (General-Large with peak-kilowatt demand less than 1,500 kW).

The modeled utility costs for each building and space-use are summarized in Table 2.

Table 2. Pratt Landing Baseline Utility Costs

	Building A	Building B	Building C	Building D
Total annual utility cost ($)	$ 270,283	$755,734	$ 281,977	$ 242,266
Electricity Unit Price Residential ($/kWh)	$0.249	$0.250	0.238	0.234
Electricity Unit Price Commercial ($/kWh)	$0.222	$0.284	$0.257	$0.270
Electricity Unit Price Retail ($/kWh)	$0.288	$0.322	$0.299	$0.298

In addition to utility costs, operations and maintenance costs associated with VRF systems were also estimated and included in the overall operating cost estimates. The total annual operating cost under the baseline scenario is summarized in Table 3.

Table 3. Pratt Landing Baseline Operating Costs

Business-as-Usual Scenario	
Electricity use (kWh)	6,216,321
Annual utility costs	$1,550,260
Annual maintenance costs	$105,284
Total operating cost	$1,655,543

Endurant Energy's Engineering, Procurement, and Construction (EPC) team worked with several reputed equipment manufacturers to develop budgetary estimates for baseline equipment. Multiple price quotes were used to ensure budgetary estimates are in-line with market pricing for the specified equipment. The estimated capital costs for the baseline VRF-driven system are summarized in Table 4.

Table 4. Pratt Landing Baseline Capital Costs

Business-as-Usual	Block A	Block B	Block C	Block D	Total
VRF HVAC Cost	$4,398,000	$10,429,000	$3,589,000	$3,392,000	**$21,808,000**

2.3 Baseline Lifecycle Cost Analysis

After estimating the capital and operating expenses associated with the baseline VRF system, Endurant conducted a 30-year life-cycle cost analysis (LCCA) as outlined in the Tables 5. The LCCA summarizes the initial capital expense and annual operational expense associated with the VRF-driven system. The LCCA considers capital costs, annual utility costs, and maintenance costs for the solution as well as 2.5% inflation rate, 3.0% escalation on utility costs, and 4.0% discount rate. Major equipment replacement is scheduled in year 15 and year 30 for the heating and cooling equipment.

Table 5. Baseline 30-Year Lifecycle Cost

Baseline 30-Year Lifecycle Cost Metric	Cost
VRF system installed cost (including in building distribution)	$21,808,000
Major equipment replacement costs (Year 15)	$4,513,000
Year 1 Maintenance Costs	$105,000
Year 1 Utility Cost	$1,550,000
30-year Life-Cycle Cost	**$71,071,000**

3 Pratt Landing—District Thermal Scenario

The baseline analysis and building energy models set the BAU case against which various alternative energy options are measured. Endurant Energy followed a comprehensive process to evaluate multiple technologies and design configurations that provide a sustainable and cost-effective alternative to Pratt Landing's baseline VRF-driven system.

3.1 Technologies Assessed

Endurant Energy assessed a variety of technologies that can optimally dispatch against the modeled thermal loads while achieving greater efficiencies and life-cycle value. We explored GSHP, ASHP, and wastewater heat recovery to meet the thermal demands. Additionally, we assessed the potential for solar PV and battery energy storage systems (BESS). This section will provide a brief description of each technology, its applicability at Pratt Landing and the intended benefits.

3.1.1 Wastewater Heat Recovery

Wastewater that is normally discarded into sewer lines can be diverted, separated into liquids and solids, and passed through a heat exchanger to extract or receive thermal energy. The average temperature of wastewater is 70°F, which provides an excellent opportunity for thermal exchange if adequate flow rates are available.

Table 6. Wastewater Heat Recovery—Key Considerations

Pros	Cons
• Electrically powered • Can work in parallel with GLHE • Highly efficient • Performance not directly dictated by ambient conditions • Low- to zero-carbon solution	• Dependent on location and flow through mains • Variable rates of heat production depending on flow • Available thermal energy may not cover load • Local municipality considerations if connecting into publicly owned sewer infrastructure

In most cases, heat recovery from wastewater is not able to supply peak thermal load requirements due to variable flowrates. However, in this instance municipal and city sewer lines exist underneath the Pratt Landing development site, and feed into the adjacent wastewater treatment plant. This makes it possible to consider a SHX solution that can satisfy peak thermal demands at the site.

A waste-water treatment plant of this size has an approximate 36,000 gallons-per-minute (GPM) flow rate at any given time, around 10 times the flow rate needed to satisfy all heating and cooling loads at Pratt Landing. The estimated SHX operations suggest that the total impact on the sewage temperature will only be approximately 1°F. This would indicate that there are no concerns with availability of flow. Nor should there be any impediment to any biological processes at the waste-water treatment plant by altering the sewage temperature.

An SHX solution avoids the need for drilling capitally intensive boreholes across the development. This technology therefore ranks high in the priority list of solutions to consider for Pratt Landing. The significant hurdle likely to be faced will be from municipal authorities, as the sewer mains are publicly owned, and access to them for thermal exchange would need to be approved.

3.1.2 Ground Source Heat Pump

GSHPs are one of the most efficient heating and cooling technologies commercially available. The technology relies on a water sourced heat pump (WSHP) containing a refrigeration loop that drives thermal exchange between a GLHE and a working fluid (glycol-water solution) contained within the GLHE. Ground temperatures remain more stable than air temperatures throughout the year. This dynamic allows the GSHP to treat the ground as a heat source in the winter and a heat sink in the summer.

A unique benefit to developing a GSHP solution is the ability to exploit simultaneous loads. For example, a simultaneous load would be when a building is cooling and producing domestic hot water at the same time. A water-based heat pump, unlike an ASHP, can reject the waste heat from the cooling process into the DHW circuit. Simultaneous loads at Pratt Landing are shown in Figure 2.

Table 7. GSHP—Key Considerations

Pros	Cons
• Most efficient heating and cooling technology (Full Load Co-efficient of Performance (COP) of 5-6) • Lowest operating cost compared to conventional equipment and other technologies assessed • Lower maintenance costs than conventional equipment • Ability to supply heating and cooling simultaneously • Low- to zero-carbon solution • Quieter operations than rooftop condensers	• Higher capital costs

Pratt Landing's annual load is well balanced, with the annual space cooling load higher than the space heating load. This suggests a cooling-dominant load profile which is preferred in a GSHP solution that uses the earth as a heat source/sink. In heating-dominant situations, the ground temperature runs the risk of, over time, falling below operationally permissible limits unless appropriate dispatch and temperature control strategies are implemented. Without these strategies, falling ground temperatures lower the temperature difference between the ground and the fluid circulating in the GLHE, which will eventually impede the performance of the GSHP. The second advantage is seen in the simultaneous cooling and DHW loads during the summer months. During this time, the heat of compression[1] generated by the pumps in providing the cooling load can be diverted to the DHW circuit (instead of rejecting to the GLHE if there were no concurrent balanced load), which in turn reduces the amount of heat extracted from the ground to meet the DHW load.

3.1.3 Air Source Heat Pumps

ASHPs provide a flexible solution for backup heating and cooling capacity. In lieu of a GLHE, ASHPs rely on ambient air as a source or sink for thermal energy. A refrigeration loop drives thermal exchange between the ambient air and working fluid. This solution performs best at moderate ambient conditions (i.e., fall and spring), while performance during summer and winter dwindles significantly.

Table 8. ASHP—Key Considerations

Pros	Cons
• Electrically powered • Good performance at moderate temperature (COP of 3-3.5 at 50°F) • Low- to zero-carbon solution	• Requires roof space • Reduced efficiency at extreme temperatures (<10°F) (COP of < 2.3 at 10°F)

Pratt Landing is a relatively dense urban development with space limitations to locate mechanical systems and GLHE. ASHPs are used as a complimentary technology to a GSHP system to handle unbalanced loads and peaks that exceed the GSHP capacity. Since they do not require GLHE, they are an ideal complement to a GSHP system.

3.1.4 Solar and Battery Energy Storage

Rooftop solar PV produces electricity from solar energy. It has been widely adopted across all building types due to its technical familiarity, relatively low costs, and ease of modular installation. In addition, utility programs allow for communities to access the value of solar PV via programs administered via their utility bill.

The benefits of solar PV are limited in two ways. First, solar PV requires area to place the panels, either on rooftops, parking structures, or unused land. This requirement can be a significant limitation in urban areas where space (including rooftops) is at a premium. Second, solar PV is an intermittent resource that only generates electricity as solar energy is available. The system will not generate energy during nighttime hours and is limited when clouds obstruct sunlight. Because solar PV's energy production is intermittent, a PV system by itself cannot adequately serve an individual building's electric needs—it would need to be paired with utility grid power or a BESS.

Table 9. Solar—Key Considerations

Pros	Cons
• Low capital cost • Able to deploy on otherwise unusable space (Rooftops, parking canopies, etc.) • Low maintenance	• Intermittent productions • Large space requirements

BESS is a versatile technology that is capable of charging and discharging electrical energy on demand. BESS technologies vary across their chemistry, though lithium ion is currently the most commercially viable chemistry being deployed across the globe.

Table 10. Battery Energy Storage Systems—Key Considerations

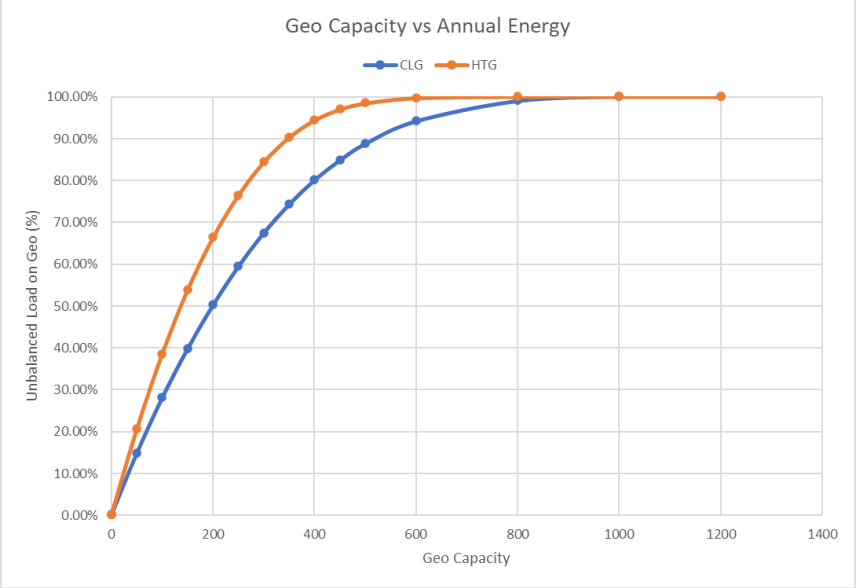
Pros	Cons
• Demand response capabilities • Ability to shift production to more valuable hours in the day • Value stacking revenue streams	• Cost is high and often requires incentives to make projects viable

Solar PV (with or without BESS) serves to provide on-site electrical energy as opposed to thermal (hot water and chilled water). These technologies can be integrated within the development to provide electrical energy to the heat pumps associated with on-site thermal energy equipment such as VRFs, heat pumps etc. Doing so will improve the renewable attributes of the project and lower utility costs. A detailed discussion on solar PV and BESS integration is presented in section 6.1.

3.2 Design Iterations

The thermal profile for Pratt Landing indicates a significant simultaneous load throughout the year, particularly during the summer months due to concurrent space cooling and DHW needs. To appropriately size the GSHP solution, the balanced simultaneous loads are excluded; the sizing is done based on the annual unbalanced load, in accordance with the principle of diminishing returns. This is illustrated in Figure 3.

Figure 3. Percent Unbalanced Load Supplied as Geothermal Capacity Increases



A 200-ton system can cover 50% of the unbalanced annual cooling load and ~65% of the unbalanced annual heating load. Doubling the system size to 400 tons does not double the amount of unbalanced annual load covered. This principle of diminishing returns, in addition to other considerations such as the impact on ground temperature over time and overall capital expense of the system are considered when sizing the GSHP system.

Several GLHE configurations were simulated for each building to determine the level of unbalanced load covered at different system sizes. This is summarized in Table 11.

Table 11. System Size Simulations

		Annual Geo Energy		Peak Geo Energy		
Building Loads	**Geo Size (tons)**	**CLG**	**HTG**	**CLG**	**HTG**	**Bore count at 500' depth**
A	20	28.93%	38.71%	9.35%	11.84%	16
	40	50.70%	66.01%	18.71%	23.68%	32
	60	66.93%	83.45%	28.06%	35.52%	44
	80	78.74%	93.33%	37.42%	47.36%	55
	220	100.00%	100.00%	100.00%	100.00%	95
B	50	29.17%	44.95%	10.67%	14.35%	37
	100	52.58%	74.35%	21.34%	28.70%	72
	150	70.66%	90.70%	32.00%	43.05%	100
	500	100.00%	100.00%	100.00%	100.00%	209
C	20	28.10%	36.45%	9.75%	12.62%	16
	40	49.90%	63.75%	19.50%	25.24%	32
	60	67.22%	82.51%	29.25%	37.86%	46
	80	80.07%	93.66%	39.00%	50.48%	60
	220	100.00%	100.00%	100.00%	100.00%	95
D	20	37.68%	42.82%	11.41%	14.40%	16
	30	51.93%	59.54%	17.12%	21.59%	24
	50	73.39%	83.02%	28.53%	35.99%	38
	80	90.84%	97.74%	45.65%	57.59%	55
	180	100.00%	100.00%	100.00%	100.00%	78
Combined	100	27.98%	38.41%	9.42%	12.27%	78
	200	50.10%	66.25%	18.83%	24.55%	165
	300	67.35%	84.29%	28.25%	36.82%	255
	400	79.98%	94.33%	37.66%	49.09%	330
	1100	100.00%	100.00%	100.00%	100.00%	427

While there are a variety of GLHE systems, Endurant focused on a closed loop borehole solution for this project to circumvent any regulatory concerns that are typically associated with open loop systems (such as aquifer contamination). The team explored vertically drilled boreholes to a depth of 500' which is appropriate for both State drilling regulations and the geological factors present at the site. GLHE sized for annually balanced thermal loads run the risk of evaporator temperatures falling below operationally permissible limits during the peak heating season. This is particularly prevalent in northern climates where undisturbed ground temperatures are low (~50^{o}F) and seasonal heating demands are high. In these cases, extracting heat from the ground to provide space heating could result in the ground temperature falling below 40^{o}F which will cause the water flowing through the evaporator to freeze. To avoid this, a larger GLHE would be needed to increase the surface area for heat exchange to meet the peak heating loads. In sites where space is constrained and/or drilling costs are high, this can often be prohibitive.

This issue is alleviated by adding propylene glycol to the solution. The glycol-water GHLE solution has a lower freezing point, which allows for much lower evaporator temperatures. As a result, the same sized GHLE can now serve a larger peak heating load since more heat can be extracted from the ground without causing the evaporator fluid to freeze. Glycol therefore serves to lower the overall size of GLHE needed to serve peak heating loads and is a preferred approach in northern climates and projects where space is scarce and drilling costs are high. Our analysis suggests that a ~20% propylene glycol solution can reduce the GLHE size by up to, and in some cases more than, 50%.

Conversely, addition of glycol results in a decrease in the specific heat of the GLHE solution. This means that for the same amount of heat transfer to/from the fluid, flow must increase (added pumping energy). Additionally, since the glycol solution's temperature can fall lower than pure water, the system must work to supply the same condenser temperature to satisfy heating loads by extracting heat from a GLHE with a cooler working fluid temperature. The compressor must work harder to accomplish this. The addition of glycol therefore negatively impacts the overall operational performance of the system.

The ultimate benefit of adding glycol is dependent on the interplay between lower capital costs and increased inefficiencies in operating performance. Our team tested each sizing run assuming a 17.7% glycol GLHE solution. However, since the efficacy of adding glycol to the evaporator solution is highly dependent on project site conditions and location, our team recommends testing the runs without glycol as well to determine the overall benefits (or additional costs) imposed by the addition of glycol.

The process of determining the appropriate size for a GSHP system is iterative and involves studying the impact of several variables such as system cost, percent of unbalanced load coverage, operational efficiencies, and the project's overall goals and objective related to energy and sustainability. Our design team's experience suggests that a hybrid system sized to support 60% of annual load through GSHP and 40% of annual load through supplemental ASHPs is likely to be the most optimal sizing in context of all variables.

3.2.1 Distributed Energy Resource Options for Pratt Landing

Based on the geo-optimization exercise presented in Table 6, a 1,100-ton system will supply the full site's annual and peak heating and cooling loads. However, constructing a GLHE to support a 1,100-ton GSHP system is the costliest configuration. An SHX system offers a more cost-effective alternative to a GSHP system with GHLE as the SHX has the potential to supply all the site's thermal loads.

An alternative to the SHX solution is a hybrid system that includes both GSHP and ASHP. This results in a 150-ton GSHP system would supply 60% of the thermal loads while the ASHPs would supply the remaining 40%. A 150-ton GLHE will require 120 bores drilled 500 ft. deep and spaced 20 ft. on center. The borefield area would require 48,000 sq. ft., – roughly 1.1 acres.

Each solution (i.e., 1,100-ton SHX or 150-ton GSHP with supplemental ASHPs) can be configured in several ways. The subsequent sections describe the various configurations that were evaluated for Pratt Landing.

3.3 System Configuration

The layout of Pratt Landing was evaluated for several configurations that could serve the heating and cooling loads across the four blocks. For each scenario, we evaluated both the GSHP configuration and the SHX configuration.

3.3.1 Central Plant

One design option for a district thermal system is to locate the major equipment in a central mechanical space (central plant). A thermal distribution system connects the buildings to the central plant, which supplies the heating and cooling energy to the connected buildings. This design requires either existing space or new space to house plant equipment, which we believe could be made available.

The GLHE will ideally be located as close to the central plant as possible. This will reduce trenching and lateral piping costs. The GLHE will be coupled to the central plant via a source loop. Additional heating assets, such as wastewater or surface water heat exchange, can easily be coupled into the source loop as well.

The central plant option assumes a 4-pipe distribution (hot water and chilled water supplies and returns) configuration will connect each building to the central plant. This requires a greater investment in trenching and lateral piping than a decentralized plant concept and presents an increased chance for thermal loss/gain in the distribution network. Thermal losses/gains can be minimized with insulation. The pros and cons of a central plant concept are summarized in Table 12.

Table 12. Central Energy Plant—Key Considerations

Pros	Cons
• Economies of scale on plant equipment • More efficient dispatch of plant assets • Reduced maintenance (fewer compressors to service) • Greatest opportunity for simultaneous load	• Requires greater existing space allocation or new building • 4-pipe distribution: • Increased investment cost for site trenching and lateral piping • Increased investment cost at building level • Increased opportunity for thermal losses in distribution

The indicative layouts for each option under a centralized solution are shown in Figures 4 and 5.

Figure 4. Centralized GSHP/ASHP Hybrid Concept (Borefield Layoutis Indicative)

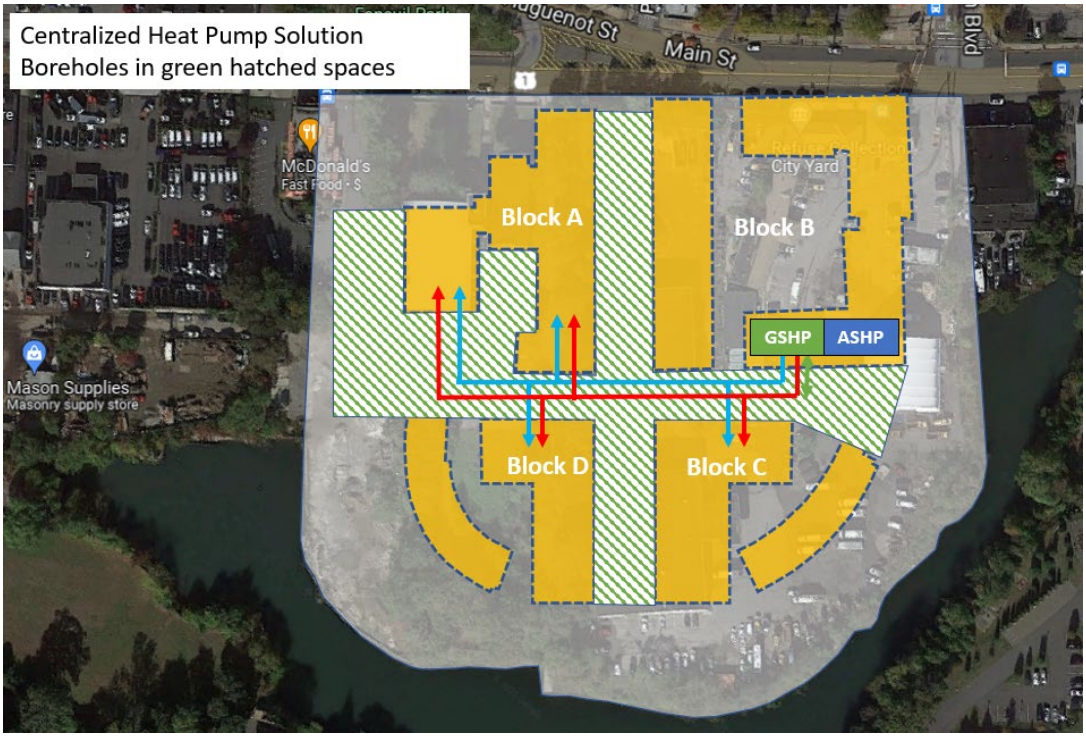
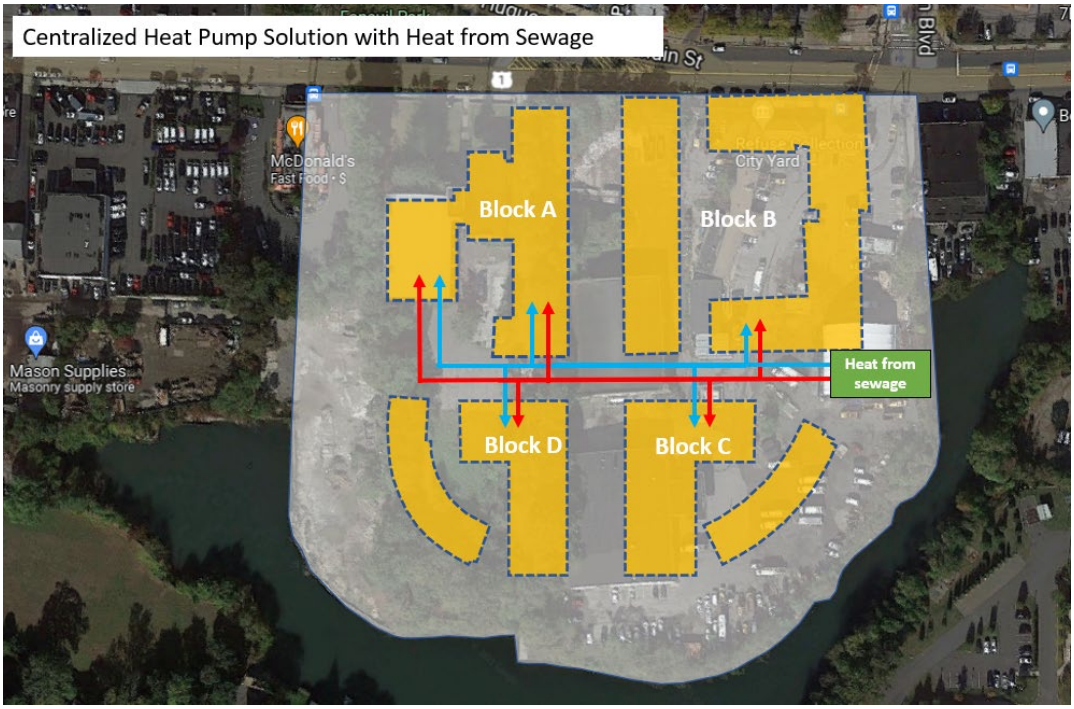


Figure 5. Centralized SHX Solution



3.3.2 Decentralized Configuration

The alternative design option for a district thermal system is to locate heat pump equipment in mechanical spaces within each building. GSHPs would supply thermal loads to the building and would be connected to the GLHE (and/or wastewater heat exchangers) via a source loop.

The GLHE will ideally be located as close to the source/energy loop as possible. A 2-pipe distribution system will thermally connect the buildings and GLHE. The 2-pipe supply/return design will reduce investment in lateral piping and trenching as compared to the 4-pipe central plant design. The moderate temperature of the loop will minimize the potential for thermal losses and will not require additional insulation. The pros and cons of a decentralized solution are summarized in Table 13.

Table 13. Decentralized Heat Pumps—Key Considerations

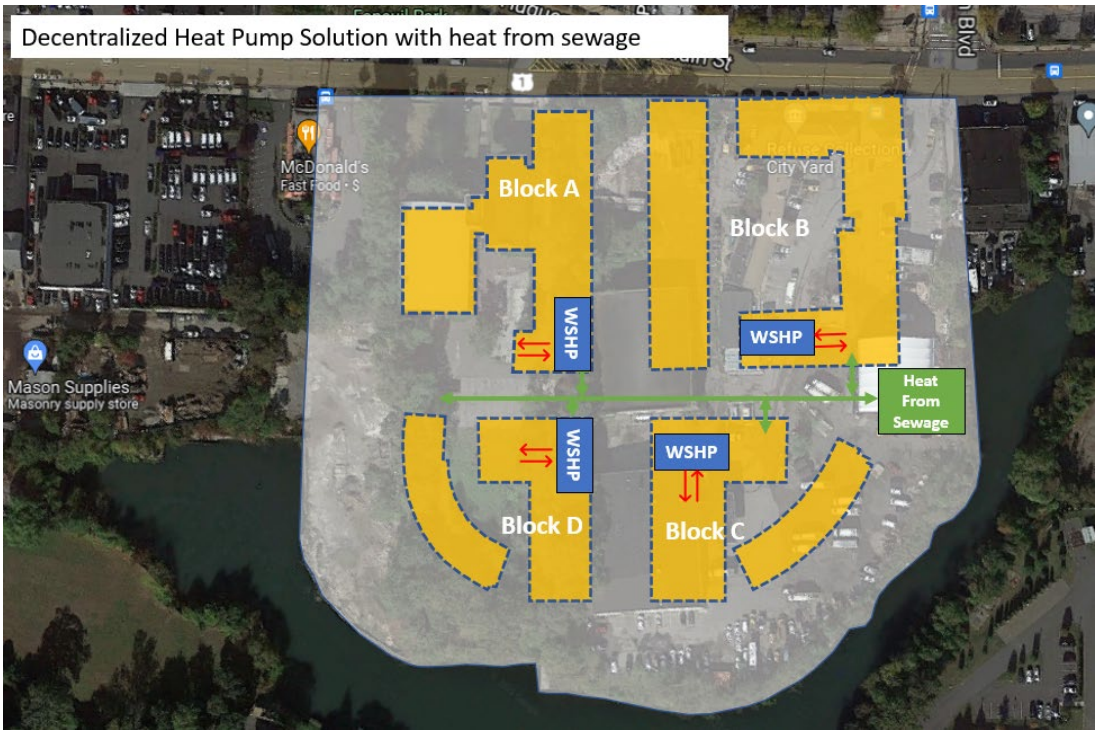
Pros	Cons

• 2-pipe distribution:
  ○ Reduced investment cost for site trenching and lateral piping
  ○ Reduced investment cost at building level
• Flexibility at building level:
  ○ Utilize 2-pipe and/or 4-pipe distribution to spaces
  ○ Supplemental assets can be localized (ASHP)
	• Less opportunity for “true” simultaneous load
	• Larger investment in equipment:
	  ○ Less opportunity for economies of scale
	  ○ Redundancy/resiliency requirements localized
	• Increased potential for maintenance (more compressors)

The indicative layouts for each option under a decentralized solution are shown in Figures 6 and 7.

Figure 6. Decentralized GSHP/ASHP Configuration (Borefield Layout is Indicative)

Figure 7. Decentralized SHX Configuration



3.4 Potential Incentives

While geothermal heating and cooling technologies offer a compelling on-site solution that offers operating cost savings and sustainable on-site energy, a significant hurdle in their deployment is high upfront capital expenses. These projects benefit from incentives that serve to lower the upfront costs. There are four incentive programs applicable to the proposed SHX or GSHP/ASHP solution at Pratt Landing.

Potential incentives may vary depending on a variety of factors. Each incentive program outlined in this section does require certain qualifying criteria that may apply to either the applicant or project. Once qualifying criteria are met, most incentive programs require a technical third-party review to verify the methodology and assumptions behind an incentive application. Additionally, incentive funds can be exhausted or sunset.

3.4.1 New York State Clean Heat Incentive

The NYSCHI[2] is a state-wide incentive program administered through the New York State Joint Utilities.[3] The program has a variety of incentive categories that encompass small- to large-scale energy projects and numerous heat pump-based technologies. This is a performance-based incentive that compensates
the project based on energy savings generated against a standard New York State code compliant energy baseline for HVAC. The formula for determining the incentive value is below.

$$\{\boldsymbol{Modeled\ Code\ Compliant\ Heating\ \&Cooling\ (MMBtu)} - \boldsymbol{(Modeled\ GSHX\ Energy\ Heating\ \&Cooling\ (MMBtu)}\}\ \boldsymbol{x}\ \$\boldsymbol{Incentive\ Value}$$

Pratt Landing will qualify for Category 4: Custom Incentives. This category pays $200 per MMBtu of energy savings generated, in addition to a 30% bonus for projects located in gas constrained regions such as Westchester County. Within Category 4, the Category 4A– Heat Pump + Envelope allows for additional incentives if the dominant load is reduced by 5% by implementing eligible measures including:

- Window replacements
- Window film
- Wall insulation
- Continuous insulation
- Window walls
- Curtain walls

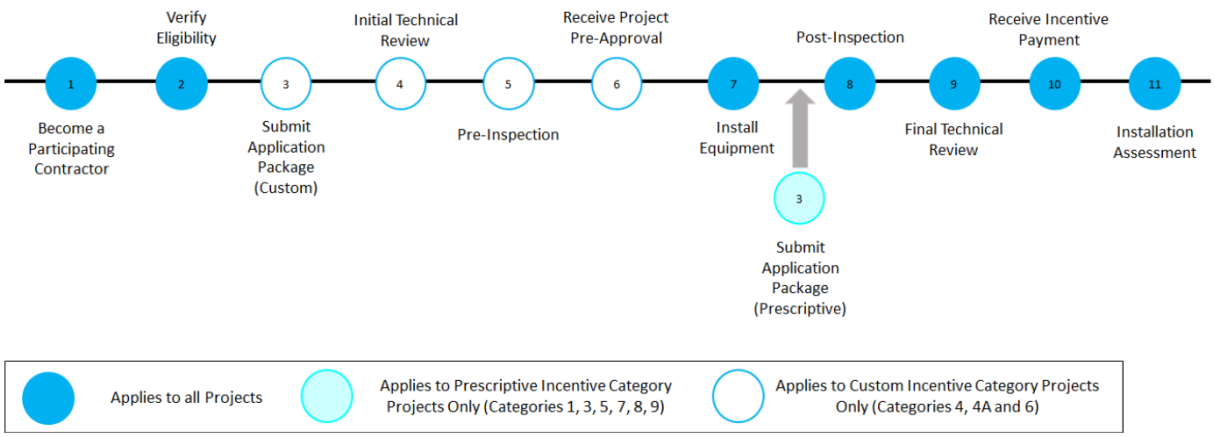
- Exterior façade
- Air leakage sealing
- Air barrier continuity
- Roof insulation[4]

The applicability of any additional incentives from Category 4A to Pratt Landing will depend on the eventual envelope design parameters.

The application for these incentives, followed by Con Edison's review and incentive approval, must be completed prior to the installation. The application requires the following elements:

1. Completed Program Application
    - Cutsheets for proposed equipment
    - Cost estimate for proposed work
    - Load calculations
    - Detailed Scope of Work
        - Description of baseline
            - Describe the extent of the work
            - Specify type of heat pump technology
            - Provide design capacity
            - Specify what percentage of the design heating/cooling load heat pumps will meet
            - Specify whether supplemental heating is required
        - Why addition electrification is non-feasible
        - Document a controls strategy that prioritizes heat pump dispatch
2. Approved Department of Buildings Permit Submission
3. Savings Analysis

Figure 8. Application and Approvals Timeline for New York State Clean Heat Incentive



3.4.2 NYSERDA PON 4337 – New Construction Housing Program

NYSERDA's New Construction Housing Program (PON 4337) provides support for highly-efficient new construction multi-family buildings. Pratt Landing would qualify for this program based on the reduction in input energy needed for the SHX and GSHP/ASHP solutions compared to the baseline VRF system.

Under PON 4337 there are four incentive tiers and two categories: Market Rate and Low-Moderate income (LMI). Incentive values increase with successive tiers, and LMI category projects receive higher payments than Market Rate. Our analysis indicates Pratt Landing would qualify as a Tier 4 Market Rate development. Additionally, Pratt Landing may be eligible for increased incentives for projects located in Westchester County. Incentives are paid out in three milestones as defined in Table 14.

Table 14. PON 4337 Incentive Milestone Payment Schedule

Milestone 1 Proposed Design	Milestone 2 Open Wall	Milestone 3 As Built
• 30%	• 30%	• 40%
• lProposed design meeting eligibility thresholds • Deliverable: Contracts between engineer and project, LMI Qualifications, Energy Models, Design Documents, Workbooks	• 30% completion of various measures: exterior insulation, insulated concrete form, exterior insulation and finishing systems, interior insulation only, exterior insulation with interior insulation, prefabricated exterior wall assembly and modular construction • Deliverable: Multifamily Workbook, checklists, multifamily high-rise measurement and verifications, photo documentation	• Project Completion • Deliverables: Multifamily workbook or equivalent, photo documentation as required, as-built energy modelling files, ASHRAE path calculator or approved equivalent, proof of review by Multifamily Review Organization, HVAC functional testing checklist, testing and verification worksheets

PON 4337 also contains an additional incentive for commercial space paid out at a rate up to $2/sq.ft., with a cap of $250,000 per project. This incentive can be layered on top of residential incentives.

3.4.3 Federal Accelerated Depreciation Schedules

Geothermal assets are eligible for accelerated methods of depreciation such as Bonus Depreciation and Modified Accelerated Cost-Recovery System (MACRS). Under the federal MACRS program, companies may recover investments in qualified property (including geothermal ground source heat pumps) via depreciation deductions on an accelerated schedule. When MACRS is elected, one of the two types of

systems apply: the General Depreciation System (GDS) or the Alternative Depreciation Systems (ADS), which determines the depreciation method and recovery periods used. GDS is generally used unless ADS is required by law. Under GDS, property is depreciated over 3, 5, 7, 10, 15, 20, 25, 27.5, and 39 years depending on the property class as defined by the IRS. Bonus depreciation of 100% in the first year is available for qualified property placed in service between September 27, 2017, and January 1, 2023.[5]

3.4.4 Federal Business Energy Investment Tax Credit

The Federal Business Energy Investment Tax Credit (ITC) is a tax credit that may be claimed for qualifying investments in renewable technologies. The ITC has been extended on numerous occasions. Currently, the ITC rate for qualifying geothermal heat pumps is set at 10%.[6] It is due to expire at the end of 2023.

The value of the ITC may be monetized via a reduction in federal taxes owed by the project owner. Real estate developers or project owners that have an effective tax rate of 0% or near 0% will not be able to monetize this benefit. Alternatively, there are tax equity investors who may be able monetize this tax credit via an equity partnership role in the project. Endurant EaaS can partner with tax equity investors to monetize the ITC benefit on behalf of the project using EaaS.

This incentive applies only to GSHP equipment and downstream distribution equipment receiving at least 75% of the annual thermal energy from the GHSP system. For example, a fan coil unit delivering heat that is at least 75% derived from the GSHP on an annual basis would be eligible for the ITC. The ITC must be monetized within one year of initial operations and cannot be monetized before the equipment becomes operational.

It should be noted that any federal tax incentives monetized through a tax equity partner are complex to structure, are not guaranteed, and require transaction costs that erode the net value of the ITC and/or accelerate depreciation.

3.4.5 Summary of Incentive Value for Pratt Landing

The maximum total estimated incentive value applicable to Pratt Landing from each of the programs identified above is summarized in Table 15.

Table 15. Summary of Incentives for Pratt Landing

Program	Block A	Block B	Block C	Block D	All Blocks
NYSCHI	$1,110,000	$2,655,000	$1,220,000	$1,010,000	$6,005,000
PON 4337	$375,000	$603,000	$264,000	$192,000	$1,433,000
ITC	$887,000	$2,103,000	$723,800	$684,000	$4,398,000
Total	**$2,372,000**	**$5,361,000**	**$2,208,000**	**$1,895,000**	**$11,836,000**

Incentive estimates represent an estimated value based on present conditions, and are subject to change based on the following:

- Exhausted program funds or program sunsetting
- Third-party technical review
- Change in project design that impacts eligibility

3.5 Capital Costs

Capital costs for each system design are estimated in Tables 16 and 17 by block. Each design is compared to the BAU HVAC design.

Table 16. Capital Cost Summary—Centralized Design

	Block A	Block B	Block C	Block D	Total
BAU HVAC	$6,066,040	$14,385,440	$4,950,440	$4,679,160	$30,081,080
SHX Design	$8,869,109	$21,032,839	$7,237,999	$6,841,363	$43,981,311
GSHP Design	$8,525,023	$20,216,847	$6,957,194	$6,575,945	$42,275,009

Table 17. Capital Cost Summary—Decentralized Design

	Block A	Block B	Block C	Block D	Total
BAU HVAC	$6,066,040	$14,385,440	$4,950,440	$4,679,160	$30,081,080
SHX Design	$7,591,548	$18,003,137	$6,195,393	$5,855,890	$37,645,968
GSHP Design	$6,564,473	$15,567,459	$5,357,206	$5,063,636	$32,552,774

3.6 Operating Costs

Each configuration was modeled to generate an 8760 electric-energy profile of the input energy required to drive the thermal system. The 8760 profiles are run through Endurant Energy's tariff engines, which simulate electric delivery and supply costs by mirroring how Con Edison would meter and bill for electricity and/or gas delivery. The tariff calculator is based on current, published tariff leaves and includes all applicable surcharges, riders, and taxes that are typically applied to Con Edison bills. For this analysis, we assumed fully bundled Con Edison service (i.e., Con Edison rates for delivery and supply).

The rate class modeled for each solution depends on the metering configuration (e.g., a single master meter for the heat pumps versus distributed, building, or unit-level meters), as well as the peak-kilowatt demand for the solution. The baseline configuration assumes VRF-driven heating, cooling, and DHW for all blocks. The total input energy for the baseline VRF systems was divided by the number of residential apartment units to estimate electricity for a direct-meter setup. Each apartment is assumed to be on Con Edison's Service Class 1 (SC1) Rate 1 (Residential and Religious). Each commercial/retail space is assumed to be on Con Edison's SC9 Rate 1 (General-Large with peak-kilowatt demand less than 1,500 kW).

In addition to utility costs, equipment maintenance costs are also included in the total operating costs for each configuration.

3.6.1 Centralized Plant Operating Costs

The operating costs for the centralized solutions are summarized in Table 18. Under a centralized configuration, all mechanical equipment associated with the technical solution is assumed to be on a single, commercial electric account. Based on the peak-kilowatt demand needed to drive the system(s), both SHX and GSHP/ASHP will qualify for Con Edison's SC9 Rate 1 (General-Large with peak-kilowatt demand less than 1,500 kW).

Table 18. Operating Cost Summary—Centralized Design

	BAU	SHX	GSHP/ASHP
Electricity use	6,216,321 kWh	2,240,456 kWh	3,105,783 kWh
Annual utility costs	$1,550,260	$480,831	$723,422
Annual maintenance costs	$105,284	$65,100	$48,000
Total operating cost	$1,655,543	$545,931	$771,422
Operational savings (Year 1)	N/A	$1,109,612	$884,121

A centralized plant's inherent advantage is that it will be billed as one large commercial account, as opposed to unit-level billing. Unit-level billing will result in the accumulation of each meter's fixed charges such as customer charge, taxes, and demand charges, which will result in a higher annual utility cost estimate. This is avoided when all usage is aggregated and billed under one account.

3.6.2 Decentralized Plant Operating Costs

The operating costs for the decentralized solutions are summarized in Table 19. Under a decentralized configuration, each unit will be fitted with a WSHP. The GSHP/ASHP solution will require an ASHP located at each building to supplement the unit level WSHPs; this is not required for the SHX solution.

The decentralized configuration will involve unit-level billing. As such, the total input energy is amortized over the total number of units. Each apartment unit is assumed to be on Con Edison's SC9 Rate 1 (Residential and Religious) service, while each commercial/retail unit is assumed to be on Con Edison's SC9 Rate 1 (General-large with peak-kilowatt demand under 1,500 kW) service.

Table 19. Operating Cost Summary—Decentralized Design

	BAU	SHX	GSHP/ASHP
Electricity use	6,216,321 kWh	2,250,572 kWh	3,105,829 kWh
Annual utility costs	$1,550,260	$665,194	$859,169
Annual maintenance costs	$105,284	$65,100	$48,000
Total operating cost	$1,655,543	$730,294	$907,169
Operational savings (Year 1)	N/A	$925,249	$748,374

While both the centralized and decentralized GSHP and SHX configurations offer significant operational cost savings compared to the base case, the centralized configuration offers the greater savings of the two.

The mechanical capacity and borehole requirements for the district systems are approximately equivalent to the total capacity and borehole requirements for four unitary geothermal systems. This is mainly due to the fact that most of the building space is scheduled for similar use. Therefore, there is little load diversity between buildings and the peak loads that were modelled are estimated to occur at the same time. When designing a district system for buildings with highly diverse load profiles, the aggregate peak demand will be lower than the sum of the individual peak demand of each building (since they occur at different times).

For Pratt Landing, the analysis indicates that the decrease in total GSHP system capacity between five unitary systems and the proposed district is estimated to be less than 1%. However, it should be noted that a district system configuration is recommended for several reasons. First, a district system introduces redundancy so that any single building is not totally reliant on a single, unitary system. In the unlikely event that a borefield section fails, the building is still connected to the larger district and impacts from any single failure are less severe for any individual building. In addition, actual building thermal energy demands will vary from what has been modelled based on fluctuations in occupancy, thermostat setpoints, and variation in actual loads. The modelling methodology used in this report does not account for these fluctuations. However, it is anticipated that the actual efficiency gains from coincident loads within the district will be greater than what can be demonstrated using estimated, modelled hourly load profiles.

3.7 GSHP/SHX Lifecycle Cost Analysis

Endurant conducted a 30-year LCCA for each design alternative as outlined in the Tables 20, 21, 22 and 23 below. The LCCA summarizes the initial capital expense and annual operational expense associated with each scenario. The LCCA considers capital costs, annual utility costs, and maintenance costs for the solution as well as 2.5% inflation rate, 3.0% escalation on utility costs, and 4.0% discount rate. Major equipment replacement is scheduled in year 15 and year 30 for the heating and cooling equipment. Finally, the benefit of upfront incentives is considered while calculating the lifecycle cost of each solution. For the purposes of this analysis, we have excluded ITC in the incentive stack. The ability of SHX to qualify for ITC remains an open item. In addition, the construction schedule for these buildings is not likely to align with the requirement to have the systems at mechanical completion by the end of 2023 when the current ITC for geothermal expires. It may be extended, as it has historically, but any extensions are not available at the time of publishing this report.

Table 20. Life Cycle Cost Analysis—Centralized SHX Solution

Total Conditioned Area (Sq. Ft.)	752,027
SHX Installed cost (including in building distribution)	$33,578,000
Major equipment replacement costs (Year 20)	$2,578,096
Year 1 Maintenance Costs	$65,000
Year 1 Utility Cost	$481,000
30-year Life-Cycle Cost	**$49,539,696**

Table 21. Life Cycle Cost Analysis—Centralized GSHP/ASHP Solution

Total Conditioned Area (Sq. Ft.)	752,027
GSHP/ASHP Installed cost (including in building distribution)	$32,229,000
Major equipment replacement costs (Year 20)	$5,491,000
Year 1 Maintenance costs	$48,000
Year 1 Utility cost	$723,000
30-year Life-Cycle Cost	**$56,232,777**

Table 22. Life Cycle Cost Analysis—Decentralized SHX Solution

Total Conditioned Area (Sq. Ft.)	752,027
SHX Installed Cost (including in building distribution)	$26,582,000
Major equipment replacement costs (Year 20)	$5,823,000
Year 1 Maintenance Costs	$65,000
Year 1 Utility Cost	$665,000
30-year Life-Cycle Cost	**$49,743,634**

Table 23. Life Cycle Cost Analysis—Decentralized GSHP/ASHP Solution

Total Conditioned Area (Sq. Ft.)	752,027
GSHP/ASHP Installed Cost (including in building distribution)	$27,702,000
Major equipment replacement costs (Year 20)	$8,009,000
Year 1 Maintenance Costs	$48,000
Year 1 Utility Cost	$859,000
30-year Life-Cycle Cost	**$57,113,675**

4 Regulatory Review

A district scale geothermal heating and cooling project is a relatively new concept; as such, there is a lack of precedent in New Rochelle to follow in terms of rules, regulations, and requirements of various stakeholders. Endurant Energy worked with a team of internal experts and external consultants to conduct a comprehensive review of the regulatory landscape for district scale thermal solutions. The regulatory review identified approximately 30 different agencies, stakeholders, and Authorities Having Jurisdiction (AHJs) from whom various permits, approvals and general support need to be sought.

The SHX solution will require adherence to City requirements around system design and connections to the sewer mains, maintaining sewer temperatures and right of way restrictions. Further, any interaction with the sewer system will require coordination and approval from city officials.

Other pertinent regulatory considerations relate to tenant sub-metering, maintaining standards of heat delivered to tenants and monetizing tax benefits efficiently. These regulatory hurdles can be overcome through effective contractual arrangements.

Recommended contractual arrangement include:

- **Third-Party Energy Services**. An energy services agreement with Endurant as the geothermal system operator will be required if Endurant owns and operates the geothermal system. Any arrangements with a third-party energy services provider should require performance and compliance consistent with developer obligations to tenants and requirements that may be imposed by the New York Public Service Commission or other government agencies in relation to provision of heat to tenants.
- **Submetering and Tenant Leases.** If the project plans to submeter heating services so that individual tenants control their usage and pay for their heat services on an individual basis, submetering arrangements should be approved by the Public Service Commission prior to entering leases with any tenants. Leases should then be drafted with language clearly allocating financial responsibility for billed to the tenant.
- **Submeter Billing.** The developer or a third-party energy service provider operating the system will be required to use an approved form of bill and maintain billing service and dispute mechanisms as required by New York State's submetering regulations. The developer or third-party energy service provider may desire to contract with a third-party billing provider to comply with these requirements. Such arrangements must provide compliance with any applicable landlord-tenant laws.

- **Tax Optimization**. The geothermal system is a depreciable asset that provides opportunities for tax-advantaged financing. The form of ownership for those assets can be separated from the project and its phases to exploit tax advantages. A separate geothermal financing structure potentially improves the financial return of the overall project; however, this must be weighed against the additional complexity and legal risk in the event of a failure to meet obligations for any reasons or a legal dispute.

A detailed report of the regulatory analysis conducted for district geothermal system feasibility in New Rochelle is provided in the appendix.

5 Financial and Carbon Savings Comparison

The SHX and GSHP/ASHP solutions under both centralized and decentralized system designs are compared against the baseline VRF-driven system. The comparisons of capital and operating costs savings are summarized in Tables 24, 25, 26 and 27.

5.1 System Costs Comparison

Table 24. Capital Cost Summary—Baseline Versus Centralized SHX/GSHP Design

	Block A	Block B	Block C	Block D	Total
BAU HVAC	$4,398,000	$10,429,000	$3,589,000	$3,392,000	$21,808,000
SHX Design	$7,079,000	$16,789,000	$5,777,000	$5,461,000	$35,106,000
GSHP Design	$6,499,000	$15,413,000	$5,304,000	$5,013,000	$32,229,000

Table 25. Capital Cost Summary—Baseline Versus Decentralized SHX/GSHP Design

	Block A	Block B	Block C	Block D	Total
BAU HVAC	$4,398,000	$10,429,000	$3,589,000	$3,392,000	$21,808,000
SHX Design	$5,360,000	$12,712,000	$4,375,000	$4,135,000	$26,582,000
GSHP Design	$5,586,000	$13,248,000	$4,559,000	$4,309,000	$27,702,000

Table 26. Operating Cost Summary—Centralized Configuration

	BAU	SHX	GSHP/ASHP
Electricity use (kWh)	6,216,321	2,240,456	3,105,783
Annual utility costs	$1,550,000	$481,000	$723,000
Annual maintenance costs	$105,000	$65,000	$48,000
Total operating cost	$1,655,000	$546,000	$771,000
Operational savings (Year 1)	**N/A**	**$1,110,000**	**$884,000**

Table 27. Operating Cost Summary—Decentralized Configuration

	BAU	SHX	GSHP/ASHP
Electricity use (kWh)	6,216,321	2,250,572	3,105,829
Annual utility costs	$1,550,000	$665,000	$859,000
Annual maintenance costs	$105,000	$65,000	$48,000
Total operating cost	$1,656,000	$730,000	$907,000
Operational savings (Year 1)	**N/A**	**$925,000**	**$748,000**

5.2 System Carbon Savings Comparison

The baseline HVAC system for Pratt Landing is an all-electric VRF. As such, the carbon emissions associated with HVAC operations is dependent on the fuel-mix of the local electric grid. Both the SHX and GSHP/ASHP solutions require less electricity to supply the district's thermal demands. To estimate carbon emissions, the same carbon intensity factor used in Local Law 97 (0.2890 kg/kWh of CO_2) was assumed.

Table 28 below summarizes the reduction in tons of CO_2 per year for the SHX and GSHP/ASHP solutions when compared to the baseline VRF system.

Table 28. Summary of Annual CO_2 Reductions

	BAU	SHX	GSHP/ASHP
Electricity use (kWh)	6,216,321	2,240,456	3,105,783
Annual CO_2 emissions (tons)	1,913	647	897
Annual CO_2 reduction (tons)	**-**	**1,266**	**1,016**

6 Endurant Energy's Commercial Offering

The proposed onsite DER thermal opportunity at Pratt Landing is an ideal candidate for Endurant's Energy-as-a-Service (EaaS) offering. EaaS is a comprehensive solution that Endurant offers clients for the development, construction, ownership, and maintenance of bespoke energy solutions for specific sites, delivered through an energy services agreement. It may include a wide array of services and products and is tailored to meet the specific needs of each project.

Developing DER systems enhances reliability and energy flexibility and will position the development to better adapt to future changes in the energy landscape. As Twining Properties' EaaS partner, Endurant will develop a solution that will serve as a platform for long term value creation.

6.1 Endurant's EaaS Offering

Endurant's EaaS offering includes DBOOOM (Design, Build, Own, Optimize, Operate, Maintain) services across the following technologies:

- Ground source and air source heat pumps
- Solar PV/ solar thermal
- Battery energy storage systems (BESS)
- EV charging
- Fuel cells
- Combined heat and power (CHP)
- Demand management
- Energy supply contracts
- Efficiency upgrades

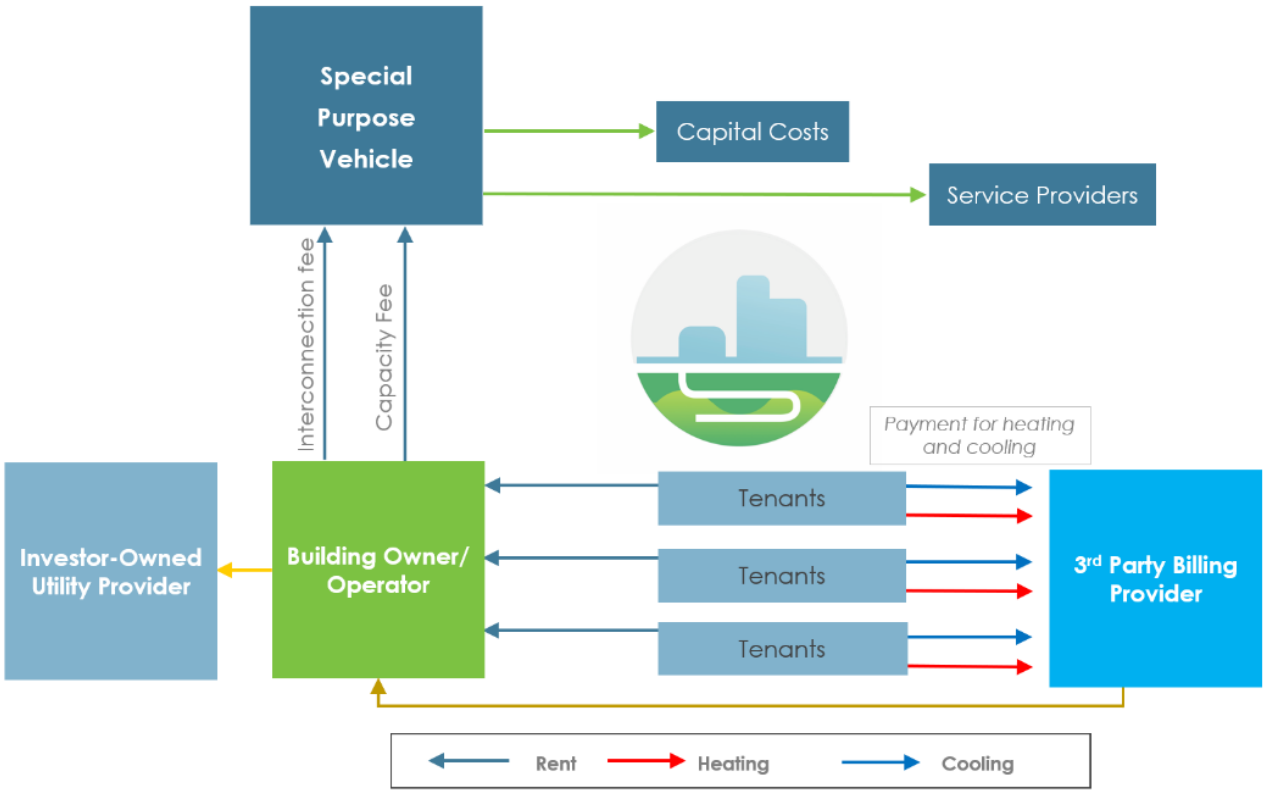
For the proposed thermal solution (either SHX or GSHP/ASHP), Endurant's EaaS will encompass the following services:

- Detailed design
- Installation
- Commissioning
- Operations/ optimization and maintenance
- Decommissioning
- Project financing

All phases are presently owned by the same entity but will be subdivided into separate tax lots within separate special purpose vehicles upon commissioning.

Figure 9 illustrates the overarching relationships and responsibilities in the EaaS business model.

Figure 9. EaaS Commercial Structure



Endurant will set up a Special Purpose Vehicle (SPV) that will develop, finance, build, own, optimize and operate the proposed SHX or GSHP/ASHP system. A core component of the EaaS model is to simplify counter-party relationships. In our proposed structure, the SPV will contract directly with the building owner/operator for Energy Services, namely heating and cooling energy from the system. From the building owner's perspective, this relationship would be like their relationship with Con Edison in the BAU case, i.e., a payment in exchange for the heating energy (either gas or electricity).

The annual capacity fee includes a "turnkey" service to the building- including provision of energy as well as timely maintenance. There are unique advantages to the EaaS business model proposed here:

1. The building owner receives the benefit of installing GSHP without the risk of financing and owning the asset.
2. Endurant can wrap several value-added benefits into the EaaS, such as:
    - Hedged electric supply pricing, if determined to be necessary for the project.
    - Monetization of tax-based benefits such as the ITC and depreciation, which serves to improve project economics for all stakeholders involved.

- Electric supply can be sourced from fully renewable sources, which will help position the project as 100% green and renewable.

The EaaS business model's fundamental tenet is to maximize value to all stakeholders, as summarized in Table 29 below.

Table 29. EaaS Benefits Summary

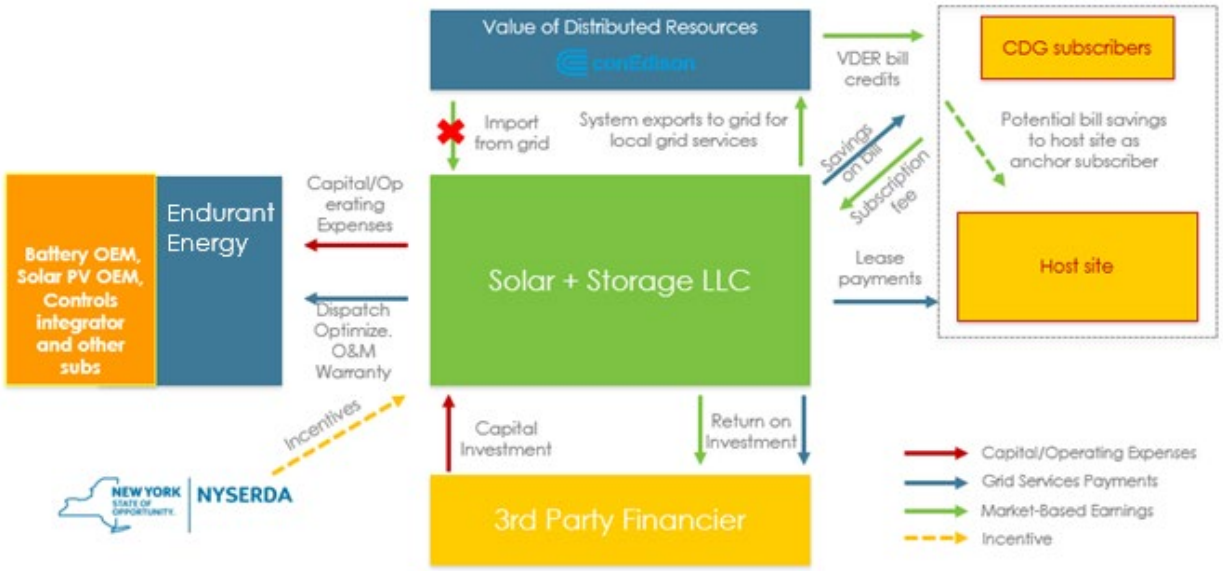
Stakeholder	Benefits of EaaS business model
Developer	• Lower utility/operational costs incurred to provide heating and cooling to tenants • Low risk since the developer is not responsible for financing and owning a complex DER project on their balance sheet • Improves the brand value and marketability of future development projects
Tenants	• Lower utility costs
Endurant	• Directly in-line with our mandate to deploy capital and own DER projects • Builds on our expertise in GSHP design, construction, and financing
Community	• More efficient thermal energy means more carbon emission reductions • Eliminate on-site emissions completely • Serves as a proof-of-concept for the scalability of this model to other parts of the community

6.2 Front-of-the-Meter Community Solar PV and Storage

New York State has an established program called Value of Distributed Energy Resources (VDER) that allows solar PV (optionally paired with BESS) systems to connect directly to the distribution grid in front of the customer meter (FTM). An asset enrolled in the VDER program generates a monetary credit for each kWh of electricity injected into the grid. The VDER program has several sub-options that dictate how that monetary credit can be applied to a variety of customer bills.

Community Distributed Generation (CDG) is one such version of the VDER program, which allows commercial and residential customers to "subscribe" to the output of an FTM VDER asset and see a portion of those monetary credits as savings on their bill. FTM assets deployed under the CDG VDER program offer landowners the opportunity to generate stable lease payments for use of their land (or rooftops) by third-party asset developers, as well as the opportunity for Con Edison customers to subscribe to the renewable energy generated by the asset. As per the rules of the CDG VDER program, up to 40% of the total monetary credit may be allocated to a large commercial account, with the remaining 60% reserved for mass-market (residential and small business) customers. Figure 10 summarizes the third-party funded business model for the FTM CDG VDER asset.

Figure 10. Third-Party Funded FTM CDG VDER Commercial Structure



Under this business model, all credits appear as savings (or bill reductions) on each allocated subscribers' bill. The project then recovers 90%-95% of this credit as a fee (this is the primary revenue to the solar PV + BESS asset owner), leaving the remainder as savings on the subscribers' bills.

Twining Properties would receive a lease payment from the third-party asset owner for use of their rooftops and ground space. Furthermore, the proposed SHX or GSHP/ASHP solution's primary Con Edison account can be designated as a subscriber to the solar PV + BESS project, thereby seeing approximately 5%-10% reduction in electricity bills. FTM VDER projects offer the following advantages:

1. They are technically independent of the proposed thermal solution and can therefore be pursued in parallel; however, they create *virtual* financial benefits and enhance overall value to Twining Properties in the following ways:
    - Offers stable and predictable cash flows in the form of lease payments, which can serve to further reduce the operating expenses associated with the thermal solution.
    - Provide savings to the Pratt Landing community without any out-of-pocket costs.
    - Enhance renewable energy attributes and overall marketability of the Pratt Landing development.
2. Excess or unused credits may be shared with the wider New Rochelle community outside of Pratt Landing.

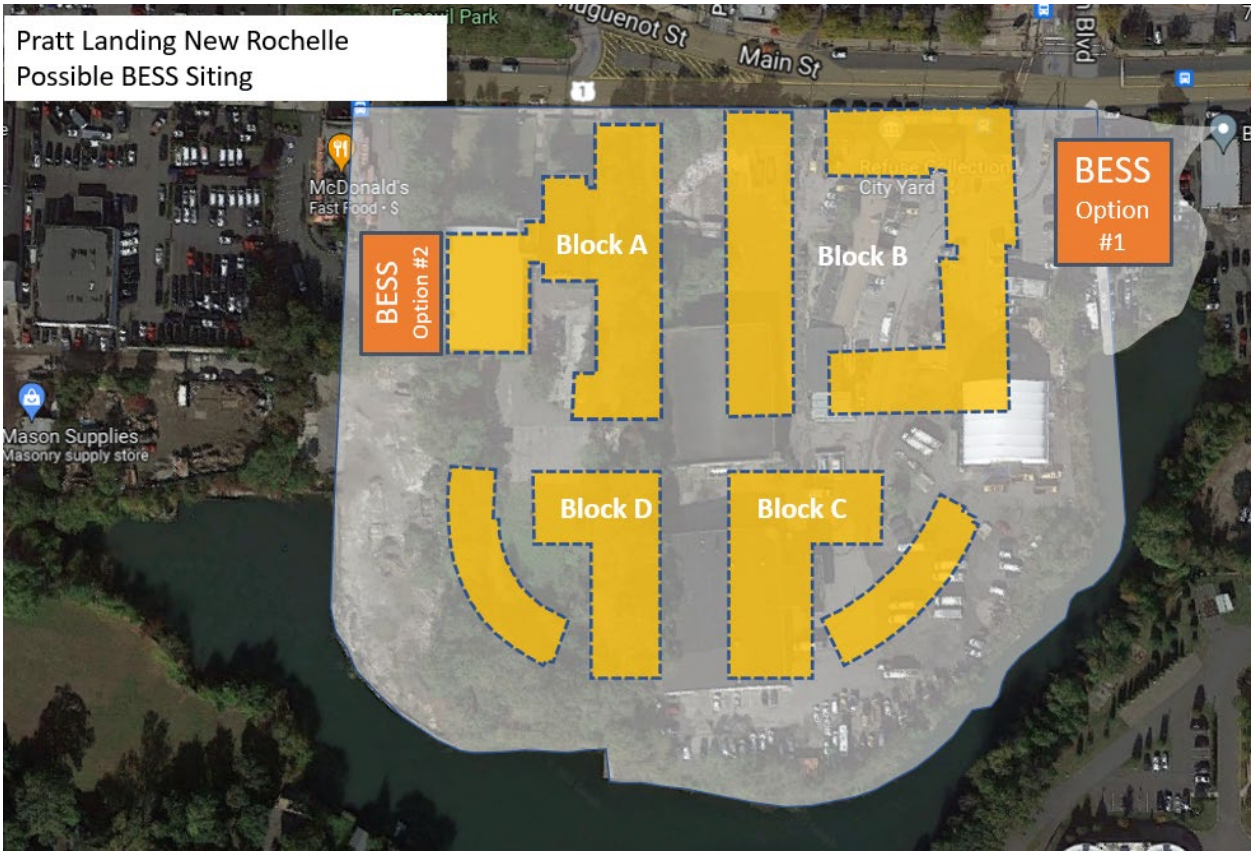
Pratt Landing's design does not allow for extensive solar PV installations outside of available rooftop space. Rooftop solar PV potential was simulated across blocks A, B, C, and D using Helioscope, a specialist solar PV planning tool. Approximate roof dimensions were used to estimate total solar PV potential at max roof area coverage. This simulation suggests that covering all available roof space with solar panels will result in a total installed nameplate capacity of ~900 kWdc. Figure 11 shows the solar PV buildout assuming maximum roof coverage.

Figure 11. Illustrative Rooftop Solar Assuming Max Rooftop Coverage

There are uncertainties in the roof space availability due to the space required for locating other equipment and maintaining serviceability. Therefore, it is appropriate to assume that approximately 50% of the roof will be available for solar PV deployment. At 50% roof coverage, the solar PV potential is approximately 450 kWdc - 500 kWdc across the development.

Pratt Landing was reviewed from both a technical and financial perspective to determine the feasibility of installing a BESS at the site. Through conversations with Twining Properties, two potential locations were identified for a BESS installation. These are shown in Figure 12.

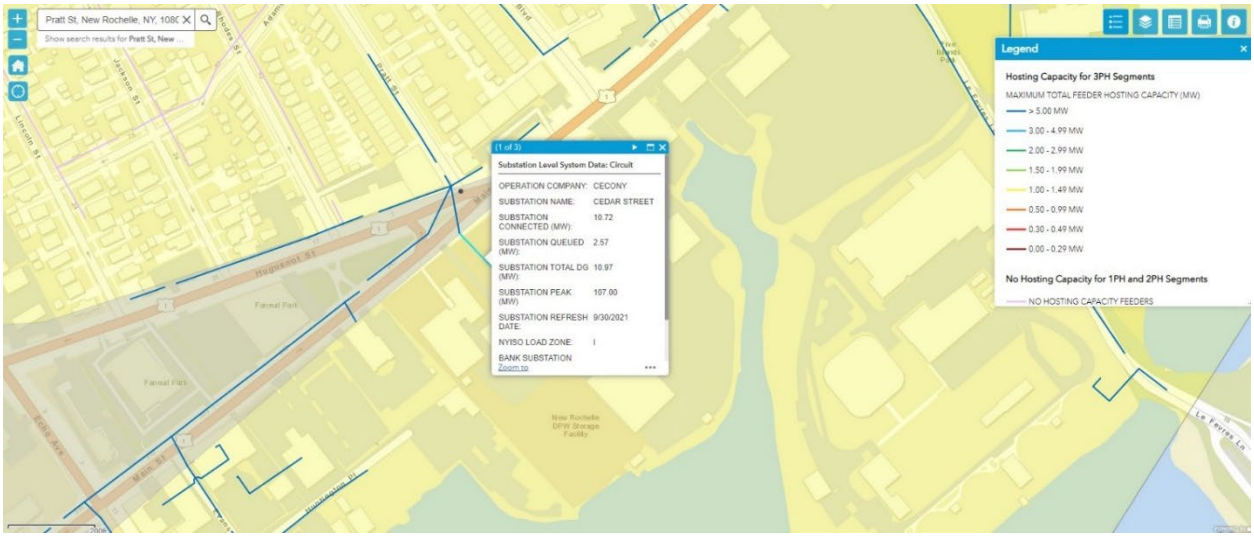
Figure 12. Potential BESS Locations



To maximize the size of the BESS (up to 5 MW/20 MWh under the current regulations for FTM VDER assets) we require approximately 6,000 sq ft. Based on initial conversations and the identified locations for a BESS, there appears to be sufficient space to site this.

Additionally, Con Edison's distribution network was reviewed to evaluate if the grid would be able to accommodate new power from a potential BESS. Results were very positive. The site is served by the Cedar Substation and the local feeder has a hosting capacity of 8.9 MW on the 13kV line. Simultaneously, only 2.57 MW is queued to be connected to the system, and there's 10.97 MW of total DG. Altogether, this indicates that few substation upgrades (therefore costs) would be needed to install a battery system.

Figure 13. Hosting Capacity Map



Pratt Landing therefore has a distinct opportunity to develop 5 MW/20 MWh of BESS paired with up to 500 kW of solar PV; the BESS will charge using all available solar energy and supplement directly from the distribution grid during off-peak hours; this energy will be injected back into the grid during hours of grid congestion to generate revenue. The project will generate above market lease offers and leave subscribers with approximately 5%–10% of the total value as on-bill savings.

The total VDER credits generated is driven by the New York Independent System Operator (NYISO) energy and capacity prices. Based on historical NYISO Zone I energy and capacity pricing, as well as the published VDER rates for other time and location specific values (e.g., local demand reduction will be in the range of $120,000–$140,000 per year.[7]

7 Conclusion

Endurant Energy recommends that Twining Properties pursue an SHX solution to provide annual thermal leads across the Pratt Landing development. The SHX solution offers several distinct advantages over the GSHP/ASHP hybrid solution. They are as follows:

1. The SHX solution requires less input electric-energy, which will result in greater utility cost reduction and carbon emission savings compared to the baseline.
2. The solution takes advantage of existing infrastructure, which can significantly streamline the overall development and construction timeline.

However, developing the SHX solution will require close coordination with municipal entities due to the interaction with municipal-owned infrastructure. While this may present regulatory hurdles, it is believed that the inherent benefits and novelty of the SHX solution will be apparent to municipal counterparties and encourage them to view the proposal favorably.

If the regulatory hurdles resulting from the SHX solution prove to be insurmountable, the 150-ton GSHP paired with complimentary ASHPs is a viable alternative to meet Pratt Landing's annual thermal loads. Despite higher capital and operational costs compared to the SHX solution, the GSHP/ASHP solution will generate operational cost and carbon emission reductions against the BAU case.

Endurant also recommends that Twining Properties consider a parallel Solar PV + BESS FTM VDER project. This project will be technically independent of the SHX (or GSHP/ASHP) solution but can be financed collectively by Endurant with the thermal system to generate the most efficient economic results for all stakeholders.

Endurant found that comparing the SHX and GSHP systems to an all-electric baseline system shows a clear value to future occupants. Improved efficiency from the SHX or GSHP configurations resulted in lower lifecycle costs. If the baseline HVAC system relied on cheaper natural gas-fired systems, lifecycle cost savings from the SHX or GSHP systems would not have been as significant.

Appendix A. Energy Model Assumptions

A.1 Building A

Envelope	• Roof assembly U- 0.032 • External wall steel-framed assembly U- 0.064 • Window assembly U- 0.420; SHGC=0.400 • Opaque door U- 0.500 • Ground floor unheated U=F(0.52) • Window to wall area ratio 27.0%
Occupancy	• Occupancy per ASHRAE 90.1 space-by-space method
Interior Lighting Power Density	• Lighting power density per ASHRAE 90.1 space-by-space method • Residential living units and townhouses 1.00 W/sq. ft. • Overall LPD 0.96 W/sq. ft.
Exterior Lighting	• 0.02 W/sq. ft. of building area: 3,220 W
Miscellaneous Loads	• Receptacle plug load per ASHRAE 90.1 space-by-space method • Residential living units and townhouses 0.5 W/sq. ft. • Overall 0.44 W/sq. ft. • Three elevators 20 kW each

HVAC Systems	• Residential Spaces
	  ○ Residential tower living units
	  ▪ VRF cooling [COP 3.0]
	  ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0]
	  ○ Residential tower DOAS Unit
	  ▪ DX cooling [EER 9.8] - Buildings A, C, and D
	  ▪ DX cooling [EER 9.5] - Building B
	  ▪ ERV 50% sensible, 50% latent effectiveness, 0.54 kW motor
	  ○ Residential townhouses
	  ▪ VRF cooling [COP 3.0]
	  ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0]
	  ○ Commercial/common spaces
	  ▪ VRF Cooling [COP 3.4]
	  ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0]
	  ○ Retail spaces
	  ▪ VRF Cooling [COP 3.2]
	  ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0]
	  ○ Unconditioned interior parking garage.

A.2 Building B

Envelope	▪ Roof assembly U- 0.032 ▪ External wall steel-framed assembly U- 0.064 ▪ Window assembly U- 0.420; SHGC=0.400 ▪ Opaque door U- 0.500 ▪ Ground floor unheated U=F(0.52) ▪ Window to wall area ratio 29.6%
Occupancy	▪ Occupancy per ASHRAE 90.1 space-by-space method
Interior Lighting Power Density	▪ Lighting power density per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 1.00 W/sq. ft. ▪ Overall lighting power density 0.84 W/sq. ft.
Exterior Lighting	▪ 0.02 W/sq. ft. of building area: 7,717 Watts
Miscellaneous Loads	▪ Receptacle loader per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 0.5 W/sq. ft. ▪ Overall building 0.44 W/sq. ft. ▪ Eight elevators 20kW each
HVAC Systems	▪ Residential Spaces o Residential tower living units ▪ VRF Cooling [COP 3.0] ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0] o Residential tower DOAS Unit ▪ DX cooling [EER 9.8] - Buildings A, C, and D ▪ DX cooling [EER 9.5] - Building B ▪ ERV 50% sensible, 50% latent effectiveness, 0.54 kW motor o Residential townhouses ▪ DX cooling [EER 9.3] o Commercial/common spaces ▪ VRF Cooling [COP 3.4] ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0] o Retail spaces ▪ VRF Cooling [COP 3.2] ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0] o Unconditioned interior parking garage.

A.3 Building C

▪ Envelope	▪ Roof assembly U- 0.032 ▪ External wall steel-framed assembly U- 0.064 ▪ Window assembly U- 0.420; SHGC=0.400 ▪ Opaque door U- 0.500 ▪ Ground floor unheated U=F(0.52) ▪ Window to wall area ratio: 30.0%
▪ Occupancy	▪ Occupancy per ASHRAE 90.1 space-by-space method
▪ Interior Lighting Power Density	▪ Lighting power density per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 1.00 W/sq. ft. ▪ Overall lighting power density 0.78 W/sq. ft.
▪ Exterior Lighting	▪ 0.02 W/sq. ft. of building area: 2,646 Watts
▪ Miscellaneous Loads	▪ Receptacle plug load per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 0.5 W/sq. ft. ▪ Overall building 0.42 W/sq. ft. ▪ Two elevators 20kW each
▪ HVAC Systems	▪ Residential Spaces o Residential tower living units ▪ VRF Cooling [COP 3.0] ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0] o Residential tower DOAS Unit ▪ AAHP cooling (EER 9.3) and heating (COP 3.2) ▪ No air-side energy recovery ▪ ERV 50% sensible, 50% latent effectiveness, 0.54 kW motor o Residential townhouses ▪ VRF Cooling [COP 3.4] o VRF heating efficiency varies based on ambient air temperature [average COP 3.0] Commercial/Common Spaces ▪ VRF Cooling [COP 3.2] ▪ VRF Heating efficiency varies based on ambient air temperature [average COP 3.0] o Retail Spaces ▪ VRF cooling [COP 2.9] ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0] ▪ Unconditioned interior parking garage.

A.4 Building D

Envelope	▪ Roof assembly U- 0.032 ▪ External wall steel-framed assembly U- 0.064 ▪ Window assembly U- 0.420; SHGC=0.400 ▪ Opaque Door U- 0.500 ▪ Ground floor unheated U=F(0.52) ▪ Window to wall area ratio: 29.4%
Occupancy	▪ Occupancy per ASHRAE 90.1 space-by-space method
Interior Lighting Power Density	▪ Lighting power density per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 1.00 W/sq. ft. ▪ Overall lighting power density 0.98 W/sq. ft.
Exterior Lighting	▪ 0.02 W/sq. ft. of building area: 2,459
Miscellaneous Loads	▪ Receptable plug load per ASHRAE 90.1 space-by-space method ▪ Residential living units and townhouses 0.5 W/sq. ft. ▪ Overall building 0.48 W/sq. ft. ▪ Two elevators 20kW each
HVAC Systems	▪ Residential Spaces o Residential tower living units ▪ VRF cooling [COP 3.0] ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0] o Residential tower DOAS Unit ▪ DX cooling [EER 9.8] - Buildings A, C, and D ▪ DX cooling [EER 9.5] - Building B ▪ ERV 50% sensible, 50% latent effectiveness, 0.54 kW motor o Residential townhouses ▪ VRF cooling [COP 3.0] ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0] o Commercial/common spaces ▪ VRF cooling [COP 3.4] ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0] o Retail spaces ▪ VRF cooling [COP 3.2] ▪ VRF heating efficiency varies based on ambient air temperature [average COP 3.0] ▪ Unconditioned interior parking garage.

Appendix B. Regulatory Roadmap

B.1 Significant Project Design Features with Regulatory Implications

Located on the banks of the Long Island Sound in New Rochelle, New York, Pratt Landing is a 12.5-acre mixed-use and residential brownfield redevelopment. It comprises seven buildings, including retail stores, a large grocery store, 650 residential units, and conference and performing arts centers, The project will be built in four phases.

The United States Army sold the property to the City of New Rochelle, subject to certain deed restrictions, one of which required preservation of the Armory on the site. The Armory is a historic site protected by the State Historic Preservation Office.

Pratt Landing offers excellent potential for a water sourced heat exchange system using Echo Bay as a thermal source. This will require assessment of water behavior in Echo Bay, including water patterns, depth temperatures, and marine habitat.

Any use of Echo Bay or the wetlands as a thermal source would require special environmental and wetland permit approvals by DEC to ensure that any construction in or near wetlands or transitional areas does not harm marine habitat or dredge up any contamination from past uses of the property. Contamination of the site is potentially significant, and remediation of different levels is proposed.

Because the site is adjacent to Echo Bay, a navigable State-owned waterway, the Army Corps of Engineers has jurisdiction to approve development that could impact the water. The project proposes to slightly expand the landmass into the waterway, which requires approval. Any use of the waterway for geothermal equipment would require Army Corps approval as well.

Although Echo Bay is not a significant navigation waterway, neighboring residents across from the development share the waterway and may object to the project on the grounds it impacts their access for small boats, potentially complicating the review process. Access to the waterway for maintaining coastal infrastructure may also be a factor. In the southern part of the waterway, adjoining properties have rights that extend into the waterway or have docks that likely enjoy easement rights. These rights cannot be impaired by a geothermal system.

Complicating matters, the City of New Rochelle filled a portion of land without obtaining approvals or permits years ago, which the Pratt Landing development will be taking over. Rectifying the land use may require adjustments to property boundaries and easements.

The Office of General Services and Department of State may also have jurisdiction to approve aspects of the project because the developer is negotiating to change the use of the property and potentially adjusting property boundaries and easements from current configurations.

Alternative heat source options include three acres of community space, which could host geothermal bore holes, exploiting the sewage system, and integration with the New Rochelle Waste Treatment Plant, which is adjacent to the plot. The development will include underground parking, which could offer potential for loops based in the foundation.

The thermal resource will be connected to a community heat pump system, enabling efficient thermal load sharing. This could take the form of a centralized or decentralized district system.

One variation of importance is exploiting sewage pipes as a thermal source using a return loop for sewage. This variation could slightly lower the temperature of sewage entering the Westchester County process facility directly across the Echo Bay canal. Flow rates and upper/lower temperature ranges of sewage entering pipes, and potential lower temperatures of sewage, may pose concerns for the Westchester County Department of Environmental Facilities. If thermal sewage technologies are unfamiliar to reviewing agencies, this could cause delay in permit review.

Another variation under consideration is a diversion of Echo Bay water passed through a thermal heat exchanger in a manmade hole. The diversion and hole would be built inland and fish would be protected by the water passing through gravel and grates. The water would be pumped back to the bay. In coordination with the Army Corps, DEC will review proposed systems involving the Echo Bay for impact on the marine habitat, including disturbing existing soil contaminants, any changes in water temperatures, and any changes to the shoreline. Any pumps employed in such a proposal may also be scrutinized for noise.

Another possible variation to reduce impacts on Echo Bay and its habitat could involve slant drilling and installation of thermal loops without disturbing surface features.

Figure B-1. Technologies Assessed under Scoping Study

Geothermal Bore Holes	Heat Exchange with Echo Bay	Air Source Heat Pumps (ASHP)	Sewage Heat Exchange	Heat Exchange with New Rochelle WWTP
Using the 3 acres of available space	Pratt Landing is located next to Echo Bay of Long Island Sound. We will extensively research using Echo Bay as a thermal production option.	Throughout the 7 buildings there is a lot of opportunity to use ASHP to help the development reach all-electric	There is a sewage line located directly underneath the site which could be tapped into during project construction for heat exchange use.	Located next door to Pratt landing is the New Rochelle WWTP. This presents an affordable and highly effective opportunity for heat exchange.

The project will also consider BESS and solar PV connected to EV charging.

The parties are exploring heating as a service through this project, and the ownership of the district geothermal system may be structured based on economic and tax considerations. Endurant will consider retaining ownership of the geothermal infrastructure in this case.

The developer is considering integrating geothermal into the project development depending on the outcome of Endurant's evaluation. Accordingly, no permit applications for the geothermal system have commenced.

Although most of the project will be contained within the development, easements may be required to be procured to cross a public road and other utility infrastructure. The regulatory hurdles to assess and navigate include:

- Using a water sourced heat exchange system for Pratt Landing using Echo Bay.
- Exploring regulations to connect a heating system to New Rochelle wastewater treatment plant.
- Additional interconnection requirements to include solar + storage on the project.
- Metering and billing structures for the different building use-types.
- Staying within regulatory rules for billing all forms of housing.

Because the development includes an existing armory building, the site development, including geothermal integration, may be required to comply with preservation specifications and the developer must obtain additional approvals by the New York State Historic Preservation Office.

B.2 Description of Regulatory Approach to Alternative 3: Decentralized Building-Level Thermal Systems with Isolated Loads

An alternative configuration comprising several smaller individual systems could be employed among individual buildings. However, because this project is under common ownership at the time of development, and there are no current plans to break ownership into multiple properties, there are no advantages to separate systems. If division of the property into separately owned buildings were undertaken in the future, a common system management agreement could be adopted cost effectively. Under these circumstances, separate systems will likely achieve sub-optimal results compared to a district system.

B.3 Applicable Laws and Regulations

Laws and regulations are organized as federal, state, and local. However, administration of laws is often shared at multiple levels of government, with primary responsibility delegated to lower levels of government. Accordingly, laws appear in this section based on the primary level of administration.

B.3.1 Federal

B.3.1.1 Clean Water Act

The Clean Water Act establishes two types of permitting schemes: the National Pollutant Discharge Elimination System (NPDES) permit and Section 404 permits (also referred to as "dredge and fill" permits).

The CWA allows states to assume primary enforcement and administration of permit programs if authorized by the EPA. Additionally, the CWA defines the powers that states possess in regulating water, which include the authority to issue pollution discharge permits in conformance with or stricter than federal minimum technology-based and water quality-based control requirements, authority to provide for public participation in the permit issuance process, authority to develop a pre-treatment program to regulate indirect discharges of pollutants into municipal treatments works, and the authority to adopt state water quality standards.[8] Importantly, the CWA also grants states the power to "veto" a federal permit or license by refusing to certify that the construction and operation of the permitted projects would not violate the state's water quality standards under CWA Section 401.[9]

In New York, the New York Department of Environmental Conservation (DEC) is responsible for administering the State Pollution Discharge Elimination (SPDES) program, certifying federal projects under CWA Section 401, and promulgating state water quality standards. However, DEC has not been delegated authority to implement CWA Section 404 for dredge and fill permits, which is the responsibility of the US Army Corps of Engineers (the Corps). Potential permitting requirements pursuant to New York State's SPDES program are discussed in the State requirements section.

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including adjacent wetlands. Pursuant to Section 404, discharge of dredged or fill material into waters of the U.S. is prohibited unless the action is exempted or is authorized by a permit issued by the U.S. Army Corps of Engineers.

"Waters of the United States" includes the following: 1. navigable waters of the U.S.; 2. Wetlands; 3. tributaries to navigable waters of the U.S., including adjacent wetlands, lakes and ponds; 4. interstate waters and their tributaries, including adjacent wetlands; and 5. all other waters of the U.S. where the use, degradation, or destruction of these waters could affect interstate foreign commerce.[10] Section 404 defines the landward limit of jurisdiction as the high tide line in tidal waters and the ordinary high-water mark as the limit in non-tidal waters.[11] However, when adjacent wetlands are present, the limit of jurisdiction extends to the limit of the wetland.[12] The eastern edge of Pratt Landing is adjacent to Echo Bay, with two fingers of Echo Bay extending into the western and eastern halves of the property. Echo Bay is a sheltered inlet off the Long Island Sound and is a navigable water subject to the Corps' jurisdiction. According to the National Wetlands Inventory Map, Echo Bay is an "Estuarine and Marine Deepwater" habitat classified as a E1UBL by the National Wetlands Inventory Map, consisting of deep-water tidal habitats and adjacent tidal wetlands.

Further investigation may be required to determine the presence of adjacent wetlands, and the resulting scope of the Corps' jurisdiction. There are no definitive maps of federally regulated wetlands or waterways, and therefore it is often not possible to determine the Corps' jurisdiction based solely on an in-office review.[13] Often, a site inspection is the only definitive means of determining the presence/absence and extent of wetlands; a wetlands delineation may be required to ascertain the full scope of the Corps' jurisdiction.[14]

Section 404 permitting requirements are associated with a wide variety of activities, ranging from those with large, complex impacts on the aquatic environmental to those having minimal impacts.[15] The term fill material means material placed in waters of the U.S. where the material has the effect of replacing any portion of a water of the U.S. with dry land; or changing the bottom elevation of any portion of a water of the U.S..[16] Discharge of fill material includes fill that is necessary for the construction of any structure or impoundment requiring rock, sand, dirt, or other material for its construction.[17] According to Corps regulations, the term "discharge of dredged material" means any addition of material that is excavated or dredged from waters of the U.S., including any redeposit of dredged material other than incidental fallback.[18]

Given the wide range of activities regulated under Section 404, it is likely that any system design utilizing the Echo Bay or adjacent wetlands would require a Section 404 permit. While excavation or dredging alone may not trigger Section 404 requirements, any redeposit of dredged material (other than incidental fallback) or backfilling during construction within the Corps' jurisdiction would be considered a discharge requiring a permit. Additionally, because "discharge of fill material" is defined broadly to include "the building of any structure, infrastructure or impoundment requiring rock, sand, dirt, or other material for its construction,"[19] the installation of a loop system using the Echo Bay as a heat exchange may constitute a "discharge of fill material" pursuant to Section 404. Furthermore, if a wet well is installed below the high tide line, or within adjacent wetlands areas, a Section 404 will likely be required.

Determinations as to alternatives minimizing adverse impacts will depend on site conditions and geothermal system design. To that end, it is the applicant's burden to provide sufficient information showing that steps have been taken to consider and evaluate project alternatives that avoid impacts to aquatic environment (such as a fully land-based geothermal system that does not utilize the Echo Bay and/or adjacent wetlands), that there are no practicable alternatives to the proposed project, and that steps have been taken to minimize unavoidable impacts. For projects either avoiding or having minor impacts, the stringency of the review may be modified based on the "significance and complexity of the discharge activity."[20]

In light of available alternative designs that do not utilize the Echo Bay and/or adjacent wetlands, the Corps may ultimately be precluded from issuing a 404 permit under the EPA regulations. However, where a proposed project would only have minor impacts, a detailed alternative analysis may not be required.[21] Pre-application consultation with the Corps would assist in determining the scope of the alternative analysis required for the geothermal system.

B.3.1.2 Rivers and Harbors Act

The Rivers and Harbors Act requires authorization from the Secretary of the Army, acting through the Corps, for the construction of any structure in or over any navigable water of the U.S..[22] Pursuant to Section 10, it is unlawful to build any pier, wharf, structure or "works" in a "navigable water" without authorization from the Corps.

Under the Rivers and Harbors Act, navigable waters include "those waters that are subject to the ebb and flow of the tide and/or presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce." Pursuant to Corps regulations, jurisdiction under the Rivers and Harbors Act reaches laterally to the ordinary high-water mark in freshwater areas or mean high water mark in tidal areas, and accordingly, wetlands are generally not within the Rivers and Harbors Act's navigable waters jurisdiction.[23] However, if work conducted in a wetland would ultimately impact a navigable water, a Section 10 permit will be required.[24]

Obtaining a Section 10 permit requires compliance with EPA Section 404(b)(1) Guidelines, Corps regulations, NEPA, ESA, National Historic Preservation Act, and Coastal Zone Management Act.[25] Generally, the review process for Section 10 permits and CWA Section 404 permits is the same.

The term "structure" includes any permanent mooring structure, power transmission line, permanently moored floating vessel, piling, or any other obstacle or obstruction. Additionally, "work" includes any dredging or disposal of dredged material, excavation, filling, or other modification of a navigable water of the U.S..[26]

A Section 10 permit would likely be required for any type of geothermal system involving Echo Bay, as it is navigable water subject to Corps' jurisdiction. Unlike Section 404 requirements pursuant to the Clean Water Act, Section 10 would not be triggered by systems impacting adjacent wetlands so long as it would not ultimately impact the navigability of the water. However, any construction-related activating, such as excavation or filling in Echo Bay, or activities located along the shoreline landward to the mean high-water mark, would require a Section 10 permit.

B.3.1.3 National Environmental Policy Act – Environmental Review for Federal Issuance of Permit

When a federal agency proposes to undertake an action or grant a permit, the National Environmental Policy Act (NEPA) requires the agency to assess the effects of its action on the human environment.[27] Pursuant NEPA, federal agencies must identify and evaluate impacts of "major Federal actions significantly affecting the quality of the human environment."[28]

Under NEPA, any federal action that significantly affects the quality of the human environment requires the preparation of an Environmental Impact Statement (EIS).[29] The EIS must include all significant environmental effects associated not only with the proposed action, but also with every reasonable alternative to that action.[30] Importantly, while NEPA requires a federal agency to consider and quantify environmental impacts associated with a proposed project, it does not require that agencies modify their behavior based on the findings of their review.[31] In other words, NEPA does not require that agencies take one type of action or another based on the adverse environmental impacts. [32] However, in accordance with the Administrative Procedure Act, the sufficiency of an EIS may be subject to a citizen's challenge under NEPA.[33]

The Council on Environmental Quality regulations list four categories of "Major federal action" which include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[34]

Consequently, Corps permitting authorization of the Pratt Landing project are subject to the provisions of NEPA.

Because NEPA applies, whether because the geothermal component requires federal action or due to non-geothermal aspects of the project, the application of NEPA to this project will require review of the geothermal elements' potential impact on the environment. The design of the geothermal system should therefore aim to minimize impacts on wetlands and waterways.

B.3.1.4 National Historic Preservation Act

Under the National Historic Preservation Act, federal agencies conducting, funding, or licensing a project must consider the impact of the project on structures or properties included in the National Register of Historic Places prior issuing a permit for a project.

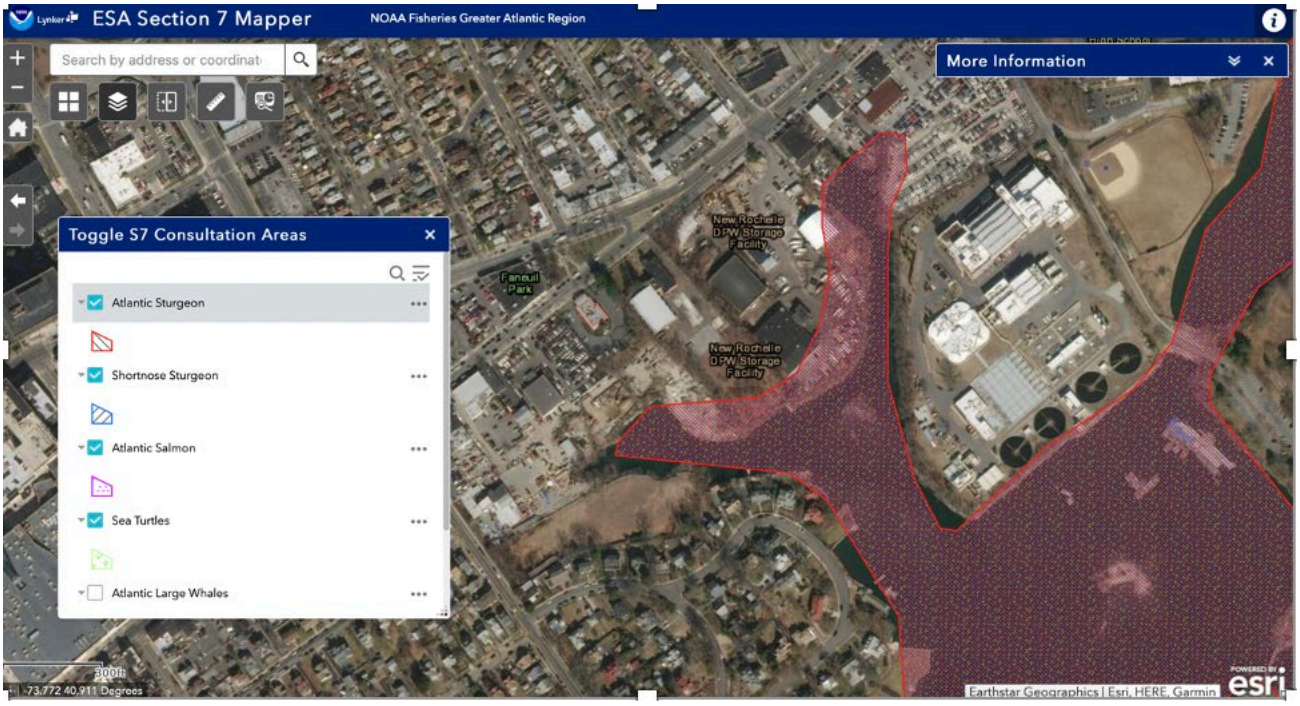
Further, under Section 106 of the National Historic Preservation Act, federal agencies "must make a reasonable, good faith effort to identify historic properties," "determine whether identified properties are eligible for listing on the National Register," "assess the effects of the undertaking on any eligible historic properties found," "determine whether the effect will be adverse," and "avoid or mitigate any adverse effects.[35] This entails consultation with the New York State Historic Preservation Office and, in certain circumstances, with the Advisory Council on Historic Preservation.[36]

State Historic preservation officers are provided the opportunity to review and comment on all individual permit activities and the Advisory Council on Historic Preservation may review certain proposed activities that require a federal permit.[37]

The Section 106 review encourages, but does not mandate, preservation of historic properties. Instead, a Section 106 review ensures that preservation values are factored into federal agency planning and decision-making and allows the public to hold the federal agency publicly accountable for decisions that affect historic properties.

Presently, there are no structures on site are listed in the National Register. However, the Naval Armory is currently listed on the New York State Registry. Additionally, according to the New York Cultural Resource Information System (CRIS) online GIS tool, the Pratt is located in an archeologic sensitive area. Consequently, the Corps must account for its historic status in issuing any permit and will likely condition approval on adoption of measures to mitigate the impact of development on its historic features. Additionally, the Corps will likely need to consult with NY SHPO to determine whether an archaeological survey is required.

Figure B-2. Regulatory Road Map



B.3.1.5 Endangered Species Act

The Endangered Species Act requires federal agencies to consult with the US Fish and Wildlife Service (for land and freshwater) and the National Oceanic Atmospheric Administration (NOAA) (for marine species) if an activity that requires federal authorization may affect endangered or threatened species or critical habitat.

According to the US Fish and Wildlife's online mapping tool, there are presently no listed species present at Pratt landing (on land). However, according to NOAA's ESA S7 Mapper, the Echo Bay serves as habitat to the following listed species: Atlantic sturgeon, shortnose sturgeon, Atlantic salmon, and sea turtles. Additionally, DEC's environmental mapper also designates portions of the Echo Bay as anadromous fish concentration areas. Given the potential presence of sea turtles and anadromous fish, consultation with NOAA will be required to confirm whether listed species are present in the Echo Bay, and to ascertain potential adverse impacts posed by the geothermal system.

Section 7 of the ESA prohibits a federal agency from engaging in any action that is likely to jeopardize the continued existence of endangered or threatened species or that destroys or adversely affects the designated critical habitat of such species.[38] To that end, Section 7 of the Endangered Species Act requires federal agencies with jurisdiction to (a) actively pursue species conservation; (b) ensure no jeopardy to a listed species; and (c) insure that areas designated under the act as "critical habitat" are not destroyed or adversely modified.

Additionally, Section 7 requires federal agencies, before they initiate, fund, or authorize any action that could affect endangered species must first submit a written request to the US Fish and Wildlife Service and/or the National Marine Fisheries Service for a list of species and of formally designated critical habitat that may be present in any areas potentially affected, either directly or indirectly, by the proposed action.[39] If, after consultation, the agency determines a listed species "may be present," the formal consultation process results in a biological opinion prepared by either agency stating whether the permit action is likely to jeopardize the continued existence of the listed species or adversely modify designated critical habitat.[40] Formal consultation pursuant Section 7 under the Endangered Species Act is not required if the agency determines that an action will not affect listed species or designated critical habitat.[41]

If the biological opinion determines that the proposed action may jeopardize the continued existence of a species and/or may destroy critical habitat, the agency will issue a "jeopardy opinion."[42] If a jeopardy conclusion is found, the jeopardy opinion must discuss "any reasonable and prudent alternatives" to the proposed action that will minimize or avoid the action's adverse effects.[43] If the biological opinion concludes that jeopardy would occur, and that there are not reasonable alternatives, the federal agency is required to deny a permit, decline funding or other action pursuant to the EPA Section 404(b)(1) Guidelines.

B.3.1.6 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires federal agencies taking action on projects with a potential impact on fish and wildlife to consult with U.S. Fish and Wildlife Service (and in some instances, with NOAA fisheries), and the head of the fish and wildlife agency in the state where the project is located, regarding the fish and wildlife impacts of permitting the project and on measure to mitigate those impacts.[44]

As part of the consultation, Fish and Wildlife Service must prepare a report that describes those impacts and makes recommendations for mitigating the damage to fish and wildlife resources, called a Wildlife Coordination Act Report.[45] In the report, Fish and Wildlife Service must (a) develop recommendations based on surveys and investigations to determine the potential impacts to wildlife resources; (b) describe the damages to wildlife attributable to the project; and (c) develop mitigation measures to prevent these damages and to improve wildlife resources.[46] The report must be included in a final Environmental Impact Statement for the project, and must be given "full consideration" by the federal permitting agency. However, the federal permitting agency is not required to adopt the Fish and Wildlife Service recommendations.[47]

B.3.2 State

B.3.2.1 New York State Dept. of Environmental Conservation Water Quality Certificate under Section 401 of the Clean Water Act

Pursuant Section 401 of the Clean Water Act, a federal agency may not issue a permit unless the state either certifies that the proposed activity will not violate state water quality standard or waives its certification authority. If the state denies a Section 401 water quality certification, the activity cannot proceed.[48] States can also impose significant conditions on the permit or project through the Section 401-certification process that can reduce the impacts of the activity.[49] Generally, a developer will apply to federal agency and DEC, which administers New York State's environmental laws and administers CWA water quality certification permits, at the same time so the reviews can occur concurrently.

Accordingly, the Corps cannot issue a Section 404 water discharge permit until DEC issues a water quality certificate or waives the requirement.

B.3.3 State Pollutant Discharge Elimination System Permit

The federal Clean Water Act establishes a permitting scheme that regulates the discharge of pollutants into the waters of the U.S., known as the National Pollution Discharge Elimination System (NPDES) permit program.[50] NPDES requires all facilities that discharge pollutants, including heat, into surface water from a point source obtain a permit before discharging.[51] NPDES permits incorporate both water quality standards and technology-based effluent limitations to protect water quality.

The Clean Water Act authorizes EPA to delegate enforcement authority to the states and allows states to administer their own State Pollution Discharge Elimination (SPDES) Programs upon approval from the EPA. New York State's SPDES program has been approved by the EPA for the control of surface wastewater and stormwater discharges in accordance with the Clean Water Act. Notably, New York State law is also broader in scope and stricter than the federal NPDES program and requires a SPDES Permit for point source discharges of pollutants into all waters of the State including both surface waters and ground waters.

The Clean Water Act also directs states to adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters.[52] State water quality standards define the maximum allowable levels of chemical pollutants and are used as the regulatory targets for permitting, compliance, enforcement, monitoring, and assessing the quality of the State's waters. Pursuant to the CWA, "water quality standard(s) shall consist of designated uses of the navigable waters involved and the water quality criteria for such waters based on such uses."[53]

Additionally, EPA regulations require states to include in their water quality standards an antidegradation policy.[54]

Accordingly, effluent standards set in NPDES/SPDES permits must ensure that state water quality standards will be achieved for the receiving waters.[55] These effluent limitations are based either on technology-based standards prescribed by the EPA,[56] or on water-quality-based standards in instances when applicable technology standards would still cause an exceedance of state water quality standards for the receiving waterbody.[57] SPDES permits may also impose additional conditions such as temperature monitoring and reporting, as well as limitations on how much heat may be discharged from the system depending on the receiving waterbody's classification.

B.3.4 State Discharge and General Water Quality Standards Application to Geothermal

The NPDES/SPDES discharge requirements and the New York State water quality standards both potentially regulate geothermal systems. These regimes, both of which flow from the Clean Water Act, can be applied separately—and potentially together—depending on the circumstances of the geothermal design and regulatory decisions by DEC.

Under the SPDES program, a discharge includes thermal discharges.[58] Separately, under New York State's general water quality standards, thermal discharges are defined as "a discharge that results or would result in a temperature change of the receiving water."[59] Pursuant to DEC's criteria governing thermal discharges, "[a]ll thermal discharges to the waters of the State shall assure the protection and propagation of a balanced, indigenous populations of shellfish, fish, and wildlife in and on the body of water."[60]

While open-loop systems clearly are regulated under both regimes through issuance of a SPDES permit that authorizes the effluent discharge in accordance with general water quality requirements, for closed-loop systems DEC would apply general water quality standards, but it is unclear whether they would require a SPDES permit as part of its regulatory approach.

More specifically, geothermal systems that discharge heat or cooling or water treatment chemicals into surface waters of the State, must obtain a SPDES permit. While this is typically more applicable to open-loop systems, all systems are subject to New York State's water quality standards and best use criterion set forth at 6 NYCRR Parts 649-758, including criteria for thermal discharges.[61]

Under all approaches that DEC might adopt, DEC can require meeting technological standards for the geothermal activity in order to mitigate thermal impacts on the receiving water body, which could include criteria for mixing zones.

B.3.5 SPDES for Geothermal Systems

The specific requirements of a SPDES permit will depend on whether the geothermal system discharges to groundwater or surface water, the classification of the receiving water body and whether the system discharges heat or some type of water or heat treatment chemicals.[62] Generally, geothermal systems that discharge heat, or cooling or water treatment chemicals into waters of the State must obtain a SPDES permit. Open-loop residential systems with a design flow greater than 1,000 gallons per day or that use water treatment chemicals, as well as all commercial open-loop systems, require a SPDES permit. Additionally, depending on the circumstances, DEC may require a SPDES permit for closed-loop systems if the system "discharges" heat, or otherwise changes the temperature, of a receiving waterbody.

B.3.6 SPDES Permits for Construction and Stormwater Pollution

A SPDES permit might also be required for construction-related activities. Section 402 of the CWA requires permits for stormwater discharges from construction activities, which would include geothermal drilling operations, that disturb one or more acres of land. In New York, a SPDES General Permit for Stormwater Discharges from Construction activity is required for construction activities involving soil disturbances of one or more acres based on a common plan, and soil disturbances of less than one acre that could potentially contribute to a violation of a water quality standard or pollutants to surface waters.[63] To qualify for the permit, permit applicants are required to develop a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the requirements in the General Permit to prevent discharges of construction-related pollutants to surface waters.[64]

B.3.7 State Water Quality Standards of General Application

Beyond the requirements under the SPDES program, New York State water quality standards always apply to geothermal and other activities even if operations are not subject to the SPDES permitting requirements, such that geothermal or other activities must not cause or contribute to any violation of water quality standards.[65] Review by DEC is required to determine whether the system would violate State water quality standards or whether a SPDES permit is required.

New York State's water quality standards establish classifications and designated uses for all waters in the State including groundwater.[66] Best usage of the classes of waters include fish, shellfish and wildlife propagation and survival, fishing, drinking water supply, and primary and secondary contact recreation.[67] DEC regulations also contain general conditions applying to all water classifications including criteria governing thermal discharges.[68] Pursuant DEC regulations, thermal discharges are defined as "a discharge that results or would result in a temperature change of the receiving water."[69] DEC's thermal discharge criteria include general and waterbody-specific standards for thermal discharges, mixing zone criteria, and additional limitations on thermal discharges that may ultimately impact system design.

Under the New York State Waterbody Classification System, Echo Bay currently has a "Classification SB" designation. The best use of Echo Bay has been identified as "swimming and other recreation, and fishing." Accordingly, any geothermal system designs utilizing the Echo Bay, even if closed-loop,

will require consultation with DEC to confirm that the system will not violate applicable water quality standards. DEC may require a thermal impact analysis to confirm compliance with DEC thermal criteria, as well as an Essential Fish Habitat (EFH) assessment to evaluate the impact of the project on local aquatic life.[70]

At the time of review, DEC may also impose additional conditions appropriate to the system, which may require the applicant to provide biological information on the water body and an analysis of available technology or operational measures that can be employed to minimize any adverse impacts caused by the thermal discharge.

B.3.8 Protection of Waters Permit

In New York State, a Protection of Waters permit is required for "excavation or placement of fill" in navigable waters below the mean highwater level, including adjacent and contiguous marshes and wetlands.

Because Echo Bay is a State-owned navigable waterbody, any excavation and/or installation of a river loop system will likely require a Protection of Waters permit. Additionally, similarly to CWA Section 404 and Rivers and Harbors Act Section 10 permits, depending on the impacts to Echo Bay, DEC may require the applicant to demonstrate that there are no alternative designs or locations that might avoid or minimize impacts to protect the watercourse.[71]

Review time frames, procedures, and requirements for public notice for applications are different for minor and major projects. The thresholds for minor projects in navigable waters include fill of less than 100 cubic yards, maintenance dredging occurring at least once every 10 years, and excavation of an area of 5,000 square feet or less.[72] For minor projects, DEC must make a permit decision within 45 days of determining the application is complete.[73] Major projects are subject to public notice followed by a comment period and may require a public hearing. The major projects process may require up to seven months based on statutory procedural requirements.[74]

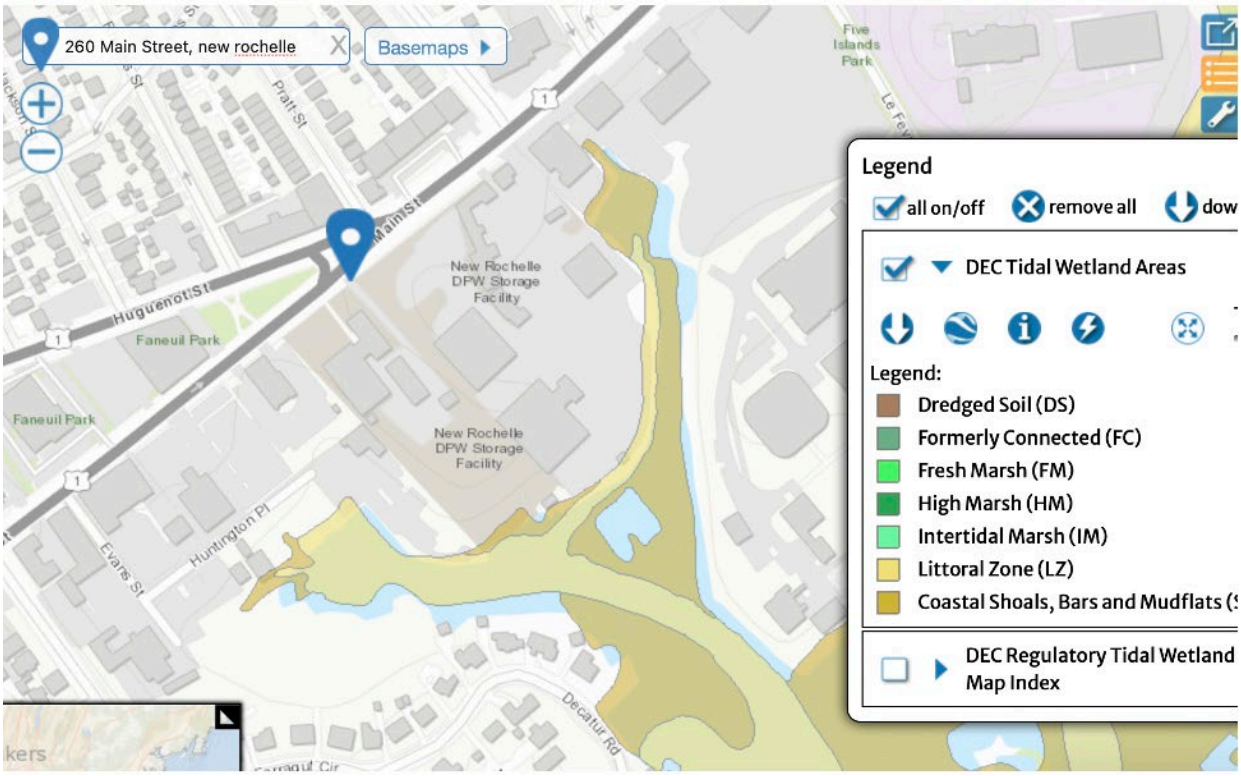
B.3.5 Tidal Wetlands Permit

DEC regulates all tidal wetlands and adjacent areas pursuant the Tidal Wetlands Act of 1973 (TWA). The TWA requires the DEC to establish a map of all tidal wetlands in the state, and to promulgate regulations for the use and development of tidal wetlands and their adjacent areas.[75] It also prohibits most activities that would change, alter, or otherwise affect the character of a tidal wetland unless the activity is authorized under a permit or otherwise authorized by DEC.[76]

Tidal wetlands are defined as "those areas which border on or lie beneath tidal waters, such as, but not limited to, banks, bogs, salt marsh, swamps, meadows, flats or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters…"[77] All tidal wetlands within the State have been mapped and classified by DEC, and the maps are on file at the office of each county clerk and at DEC's regional offices. Each tidal wetland is classified as either a coastal fresh marsh; an intertidal marsh; a coastal shoal, bar or flat; a littoral zone; or a high marsh or salt meadow.[78] In addition to mapped tidal wetlands, DEC also regulates activities occurring within "adjacent areas." Adjacent areas run landward to the nearest of one of several upland points enumerated pursuant Section 661.4(b)(1) and may extend up to 300 feet inland from a wetland (or 150 feet inland in New York City).

According to the New York State Tidal Wetlands Map, almost the entire shoreline of the property is mapped either as Tidal Wetland SM (Coastal Shoals, Bars, and Mudflats) or Wetland LZ (Littoral Zone). The online mapping tool is a digital rendition of the official 1974 wetlands inventory maps of New York State; however, the map is unable to indicate the exact boundaries of wetlands present at the site. The tidal wetland boundary line will need to be determined through a field inspection and may differ from the boundary line depicted on the map. DEC recommends applicants contact their regional DEC office to request a jurisdiction determination to establish the limits of the wetlands and adjacent areas, on-site.

Figure B-3. Pratt Landing as Shown on the Tidal Wetlands Map



Under Title 4 of the Tidal Wetlands Act, once an area is designated a wetland and mapped, almost any activity in that area requires a permit. Regulated activities include "any form of draining, dredging, excavation and removal… of soil, mud, sand, shells, gravel or other aggregate from any tidal wetland; any form of dumping, filling or deposition… of any soil, stones, sands, gravel, mud or fill of any kind; the erection of any structures or roads, the driving of any pilings or placing of any obstructions whether or not changing the ebb and flow of the tide."[79]

DEC imposes different restrictions on activities depending on the category of wetlands present on site. DEC regulations list specific types of uses, designates compatibility with each class of wetland, and specifies the type of permit or authorization required before an activity may be undertaken in each class.[80] Depending on the designation of a specific use, the applicant may also be required to provide additional application materials such as a more detailed analysis demonstrating the potential impacts of a project, showing that the project will not have undue adverse impacts on present or potential wetland values.

Pursuant to 6 N.Y.C.R.R.R 661.5, dredging, filling, disposal, or dredged material, and certain installations of electric, gas, sewer, water, or other utilities are all "presumptively incompatible uses" requiring a permit. Additionally, any type of regulated activity not listed in 661.5, requires a permit. As such, any components of the geothermal system installed within the tidal wetlands and/or adjacent areas present at Pratt Landing will likely require a permit.

Importantly, proposed activities must meet permit issuance standards and comply with the use guidelines set forth in 6 NYCRRR 661.5. DEC regulations also impose additional restrictions on the use and development of tidal wetlands and adjacent areas include minimum lot sizes and setbacks, maximum lot coverage (both of buildings and of impervious surfaces), septic systems and drainage. 6 N.Y.C.R.R. § 661.6(a). However, DEC may grant variants to these restrictions in certain instances.[81]

The Tidal Wetlands Permit issuance standards require applications to avoid or minimize impacts to wetlands. Additionally, applications are subject to review under SEQR, and the State Historic Preservation Act.[82]

B.3.6 Lands Now or Formerly Underwater

In New York State, most navigable waters—and the beds of navigable waters—owned by the State are held in trust by the New York State Office of General Services (OGS). Pursuant to the NY Public Lands Law, "no wharf, dock, pier, jetty, platform, breakwater, mooring or other structure shall be constructed, erected, anchored, suspended, placed … on or above state-owned lands underwater unless a lease, easement, permit or other license" is obtained from OGS. Because Echo Bay is owned by the State, authorization from OGS will be required for installation of a river loop system.[83]

All application materials required for permits for activities affecting waterways (i.e. water protection permit, tidal wetlands permit, Section 404 permit) should be forwarded to OGS, which will then review the application to determine if a license, easement, or permit is required.[84] The applicant will then need to apply for the appropriate approval. OGS encourages applicants to request a pre-application conference with the OGS Bureau of Land Management to determine applicable requirements.[85]

Prior to approving a grant, easement, permit, or license to interest in lands underwater, OGS must ascertain the probable effects of the proposed structure on the public interest in State-owned lands underwater in consultation with the DEC, DOS, and Office of Parks, Recreation and Historic Preservation (OPRHP).[86] In making this determination, OGS must consider several factors including the

environmental impacts, and "consistency with the public interest for purposes of fishing, bathing, access to navigable waters and the need of the owners of private property to safeguard their property." Generally, the State discourages non-water dependent uses of public lands (uses that could take place on the adjoining upland lands).[87] Depending on the geothermal system's impacts on Echo Bay, OGS could deny authorization
in light of land-based alternatives.

B.3.7 State Environmental Quality Review Act

The New York State Environmental Quality Review Act (SEQRA) requires State and local agencies to consider environmental factors in the planning, review, and decision-making processes regarding permits, zoning changes, or government funding. SEQRA review is triggered by State projects that require some form of discretionary State or local government approval.[88]

The SEQRA review process requires agencies to determine whether actions they directly undertake, fund, or approve may have a "significant impact" on the environment ("a determination of significance"), and if so, to prepare, or require to be prepared, an EIS that assesses the potential impacts of the proposed actions, as well as ways to avoid or mitigate those impacts.[89] The lead agency responsible for authorizing the project issues a "negative declaration" if it determines that the proposed action will not result in a significant environmental impact. This ends the SEQRA review process and can result in subsequent litigation brought by project opponents.[90] A positive declaration triggers the procedural mandates that lead to the preparation of a Final EIS, which will be the basis of the final decision to fund or approve the project.[91]

An action is subject to review under SEQRA if any State or local agency has authority to issue a discretionary permit, license, or other type of approval for that action, as well as if an agency funds or directly undertakes a project. Consequently, any State or local approvals such as issuing a permit, will trigger the provisions of SEQRA. Additionally, any funding by NYSERDA for subsequent phases of the project would likely constitute an agency action subject to SEQRA.

Once there is an "agency action" the agency must determine whether the action is subject to SEQRA. Type II actions, which are actions determined to not have a significant effect on the environment, and are not subject to the SEQRA review process.[92] However, if the action does not fall within one of these exclusionary categories, then it is subject to SEQRA and the agency will need to determine whether it is a Type I action or an unlisted action, which will trigger different procedural requirements.

To reach a determination of significance, the agency must prepare an Environmental Assessment Form (EAF), either a short or full EAF, depending on the action.

The short form EAF, which is used for unlisted actions deemed to have a significant effect, requires the lead agency to consider whether the proposed action would cause "an increase in the use of energy" and whether it "fails to incorporate reasonably available energy conservation or renewable energy opportunities."[93] The Full EAF also requires applicants for commercial and industrial projects to provide information about the proposed action's new or additional demand for energy, including information about the anticipated sources of energy.[94]

If the agency issues a positive declaration, the preparation of an EIS is required, which involves the preparation of a Draft Environmental Impact Statement (DEIS) that is then circulated for public review and comment.[95] In addition to "analyzing the significant adverse impacts and evaluating all reasonable alternatives," the DEIS should include an "assessment of impacts only where relevant and significant" including "impacts of the proposed action on the use and conservation of energy" and "measures to avoid or reduce both an action's impacts on climate change and associated impacts due to the effects of climate change…"[96]

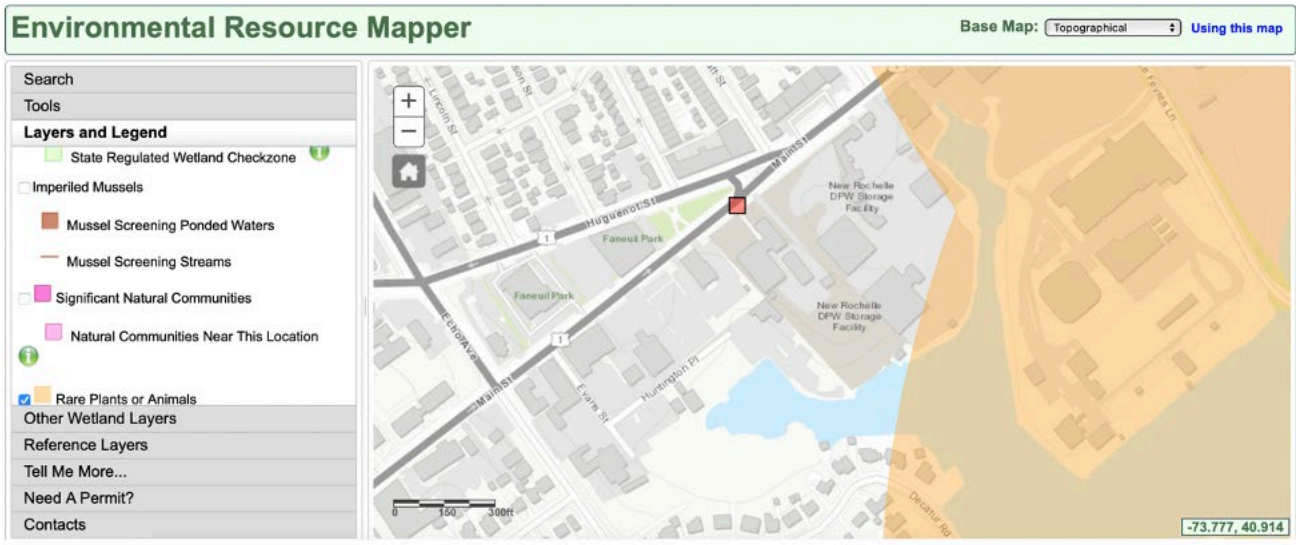
B.3.8 Listed Species Regulation

Animals and plants listed under New York State regulations as endangered, threatened, special concern, or rare are protected under New York State Law. As previously explained, DEC utilizes its authority under the SEQRA to assess potential environmental impacts of a proposed project, including impacts to endangered and threatened animals, and to make recommendations to project proponents on how to avoid or reduce those impacts.[97] However, when a project component cannot fully avoid adverse impacts to a listed species, an incidental take permit may be required for the "taking" of a threatened or endangered species.[98]

Permitting requirements apply only to animals listed as endangered or threatened as defined in Part 182, and an incidental take permit is not required for activities affecting species of special concern.[99] Additionally, to trigger the permitting requirements, a proposed activity must either be likely to result in the taking of a listed animal or involve an adverse modification of occupied habitat.[100]

However, as previously noted, according to NOAA's ESA S7 Mapper, Echo Bay serves as habitat to the following listed species: Atlantic sturgeon, shortnose Sturgeon, Atlantic salmon, and sea turtles. Additionally, DEC's environmental mapper also designates portions of the Echo Bay as anadromous fish concentration areas. Accordingly, potential impacts to habitat will need to be identified and evaluated as part of the SEQRA review process.

Figure B-4. Pratt Landing as Shown on DEC's Environmental Resource Mapper



B.3.9 Coastal Zone Management Act

Under the New York State Coastal Management Program, actions by federal or state agencies affecting New York's coast, including permitting decisions, must be consistent with the State's coastal policies. Depending on whether a project has a significant potential impact on coastal areas, a full review may be required as a precondition to determine whether the project is consistent with State policies. The New York Department of State makes costal policy determinations for the State.

In developing the Coastal Management Plan, New York State also passed the Waterfront Revitalization of Coastal Areas and Inland Waterways Act, which established a State-wide approach for encouraging development of the coastal area while protecting natural resources.[101] The law establishes boundaries for the State's Coastal Area by adopting a map that defines the area in which the Coastal Management Plan policies apply and provides a set of policies that address significant coastal issues. It also offers local

governments the opportunity to participate in the State's Coastal Management Plan, on a voluntary basis, by preparing and adopting local waterfront revitalization programs (LWRP) providing more detailed implementation of the State's Coastal Management Plan (CMP) through use of existing municipal powers such as zoning and site plan review.[102]

An LWRP is a "locally prepared, land and water use plan and strategy for a community's natural, public, working, or developed waterfront through which critical issues are addressed".[103] Once developed, LWRPs become amendments to the State's coastal management program, and "in effect become the policies and standards of the local government, the State of New York, and the federal government." Additionally, State agencies' action must be consistent with the approved LWRP to the maximum extent practicable.[104]

A coastal management plan for the Long Island Sound was adopted in 1999 by the New York Department of State, Division of Coastal Resources and Waterfront Revitalization to balance ecological protection and restoration with appropriate economic development strategies. The plan enumerates 50 recommendations and 13 policies across four perspectives: the developed coast, the natural coast, the public coast, and the working coast.[105] Overall, the focus of the CMP is to improve water quality within the upland watershed, harbor, and nearshore waters. [106] The City of New Rochelle's LWRP has not yet been finalized,[107] and so the Long Island Sound CMP is the official CMP for waterfront development within the City of New Rochelle.[108] Accordingly, the project will need to be reviewed for consistency with the policies of the Long Island Sound CMP to obtain any federal, State, or local approvals.

At the State level, consistency review of State agency actions is undertaken congruently with the SEQRA process. At the federal level, a Federal Consistency Assessment Form is submitted to the Department of States Division of Coastal Resources.[109]

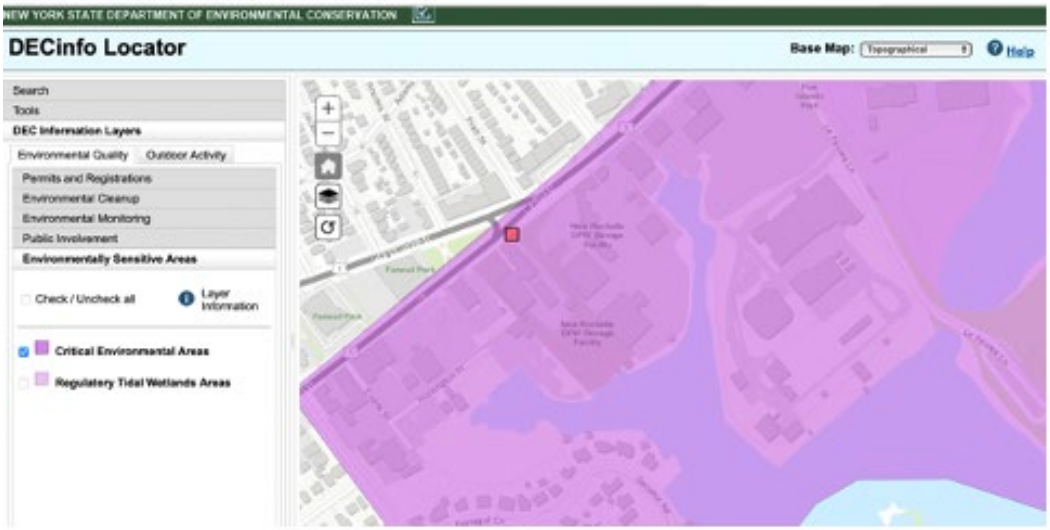
Generally, the Department's full consistency review of a proposed activity and a consistency certification for it, coordinated with other federal, State and certain municipalities takes between 30 and 90 days, but may take up to six months. The public notice and comment period is normally 30, but not less than 15, days. By federal regulation, the Department of State has six months to complete its review of a consistency certification and make a decision.

B.3.10 Critical Environmental Areas

Critical Environmental Areas (CEA) are areas in the State that have been designated by a local or State agency to recognize a specific geographic area with one or more of the following characteristics: a feature that is a benefit or threat to human health; an exception or unique natural setting; exception or unique social, historic, archaeological, recreation or educational values; or an inherent ecological geological or hydrological sensitivity to change that may be adversely affected by any physical disturbance.[110] Following designation, the potential impact of any Type I or Unlisted Action on the environmental characteristics of the CEA must be evaluated during the SEQR process.[111]

The Long Island Sound was designated by Westchester County as a Critical Environmental Area in January 1990.[112] As shown by the DECinfo mapping tool, the entirety of the Pratt Landing site is located within the boundaries of the CEA. The designation relates to several factors including: a shoreline that exhibits many areas of tidal marsh; the occurrence of several areas of scenic and historic interest; and the inclusion of many areas of important environmental features. Accordingly, potential impacts on the CEA will need to be evaluated as part of the SEQRA review process.

Figure B-5 DECinfo Locator



B.3.11 Office of Renewable Energy Siting Approval

Geothermal systems equal to or greater than 25 MW_{th} planned capacity are subject to the permitting requirements of the Office of Renewable Energy Siting (ORES).[113] A 25 MW_{th}-equivalent geothermal system would support a small community of approximately 2,000 homes.[114] ORES regulations provide for an application process similar to Article 10 of the Public Service Law for siting major electric generating facilities, as well as uniform standards and conditions for all proposed projects. Applicants are required to work with the municipal authorities where the proposed facility is to be located, obtain several environmental approvals from ORES prior to applying, and file an application including exhibits addressing areas of impacts on land use, public health, safety and security, noise and vibration, cultural resources, endangered and threatened species, visual impacts, water quality, and wetlands. Applications are also subject to a comment period and public hearing procedures.

Under Section 94-C governing ORES decisions, the siting agency has 60 days to review an application and determine whether it complies with applicable requirements.

To determine that an application is complete, the record must contain proof the applicant consulted with the host municipalities and communities. Applicants are required to work with host municipalities in which the proposed facility is to be located, obtain several environmental approvals from ORES prior to applying, and file an application including exhibits addressing areas of impacts on land use, public health, safety and security, noise and vibration, cultural resources, endangered and threatened species, visual impacts, water quality, and wetlands.

During the Section 94-C comment period, the host municipality is to file a statement "indicating whether the proposed facility is designed to be sited, constructed and operated in compliance with applicable local laws and regulations, if any, concerning the environment, or public health and safety."[115] Following the public comment period, the agency may set the matter for an adjudicatory hearing to hear arguments or to rule on the application.

Under Section 94-C, ORES is required to issue a permit within 12 months of the application being deemed complete. ORES may issue a permit only if it finds that any significant adverse environmental impacts have been avoided or minimized, that a review of applicable local zoning

laws has been completed, and that the application complies with applicable laws and regulations. Under Section 94-C, in making its determination of compliance, ORES may elect to not apply local law and ordinances in favor of a uniform set of standards and conditions set out in the Regulations Implementing Section 94-C. However, the present regulations do not provide specific guidelines for geothermal energy systems.

B.3.12 Drilling Permits

New York State imposes different requirements for geothermal wells drilled less than 500 feet and wells over 500 feet, based on permitting regimes that were designed for non-geothermal systems, but adapted for these purposes.

Wells that are less than 500 feet deep are regulated by the DEC Division of Water. The Division of Water requires the submission of driller and pump installer registration and certification, and preliminary notice and well completion reports for open loop or standing column systems.[116] Completion reports are waived for closed loop geothermal systems with boreholes drilled up to 500 feet deep.[117]

The DEC Division of Mineral Resources regulates the drilling, construction, operation, and plugging of geothermal wells deeper than 500 feet.[118] Wells deeper than 500 feet impose additional requirements, which are set out in Table B-1.. Among these requirements, detailed information regarding well locations, depth, use, casing material, cementing procedures, drilling fluid, and cutting disposal methods, as well as completion of an Environmental Assessment Form, which will be used by DEC to evaluate the environmental impacts of the well, and to decide whether any "special permit conditions, a Supplemental Environmental Impact State, or any additional DEC permits are required."[119] DEC also imposes reporting requirements throughout the permitting and drilling process, and a separate permit must be obtained before a well may be permanently plugged and abandoned by the well owner.[120]

Importantly, prior to obtaining a well-drilling permit for a well that may produce brine, saltwater, or other polluting fluids in sufficient quantities to harm the surrounding environment, the well owner must obtain a permit for the safe and proper disposal of such produced fluids.[121] Depending on the applicable method of disposal, DEC may require the well owner to obtain additional permits for discharge and/or disposal.

DEC also mandates minimum standards for all wells pursuant to the division's Casing and Cementing Practices to protect groundwater by preventing the migration of fluids.[122] However, DEC imposes stricter permitting conditions for wells that will be drilled through primary and principal aquifers, as well as for wells where subsurface conditions are unknown or where high pressures are expected.[123]

The Division of Mineral Resources will also consult with the New York State OPRHP to determine whether the proposed location of a well is within a State-listed historic area, which would require additional permissions.[124] If applicable, OPRHP will review the project and ensure the well will not negatively impact cultural resources.[125] The permit application process takes approximately six to eight weeks, but may take longer depending on the project. Additionally, filing fees for the application materials vary depending on the depth of the well.[126] Drilling permit requirements and restrictions under both regimes are summarized in Table B.1.

Table B-1. Requirements for Closed Ground Source Loops[127]

Under 500 Feet	500+ Feet
Driller and pump installer certification and registration with DECDEC	
	DECDEC Requirements for 500+ Feet:
	Organizational Report (Form 85-15-12)
	Application for permit to drill well (Form 85-12-5)
	Environmental Assessment (Form 85-16-5)
	Financial Security Worksheet (Form 85-11-2) and deposit of required financial security starting at $2,500 per well over 500 feet
	Certified site plan
	Casing and cementing plan
	Drilling progress reports
	Periodic drilling drift correction[128]
	Well drilling and completion report (Form 85-15-7)
	Annual reports of status and use of well
	Incident reports of leakage or condition posing risk to environment or the health, safety, welfare, or property of any person
	Permit to plug and abandon
Municipalities may impose additional requirements for wells of any depth	

B.3.13 New York State Historic Preservation Office

New York's State Historic Preservation Office (SHPO) within the New York State OPRHP helps communities identify, evaluate, preserve, and revitalize their historic, archeological, and cultural resources. SHPO administers programs authorized by both the National Historic Preservation Act of 1966 and the New York State Historic Preservation Act of 1980.

These programs, including the Statewide Historic Resources Survey, the New York State and National Registers of Historic Places, the federal historic rehabilitation tax credit, the Certified Local Government program, the state historic preservation grants program, state and federal environmental review, and a wide range of technical assistance, are provided through a network of teams assigned to territories across the State.

In carrying out these responsibilities, SHPO conducts project review, specifies conditions for modification of sites subject to their jurisdiction, and approves or assists other agencies in approving plans for modifications to historic sites. Project sponsors are required, to the fullest extent practicable consistent with other provisions of the law, avoid or mitigate adverse impacts to such properties, to fully explore all feasible and prudent alternatives, and give due consideration to feasible and prudent plans that will avoid or mitigate adverse impacts.[129] Accordingly, geothermal elements should be designed and constructed, including drilling, to avoid impacting historic features.

The Naval Armory located on-site is currently listed on the New York State Registry. Additionally, according to the New York Cultural Resource Information System (CRIS) online GIS tool, Pratt landing is located in an archaeological sensitive area. Archaeological sensitive areas are buffer areas that are a specified distance around archaeological sites inventoried by SHPO that may contain archaeological resources. Furthermore, the Armory portion of the property is located on land that was formerly the confluence of a stream flowing from the north Crystal Lake (now filled) into the Sound.[130] The confluence of streams has been found to be extremely sensitive for prehistoric cultural resources.

As part of the SEQRA review process, SHPO will need to be consulted to determine whether the geothermal system will have an adverse impact on the Armory and may ultimately condition approval on the adoption of measures to mitigate the impact of development on its historic features. Additionally, because the project is located in an archaeological sensitive area, SHPO may require phased archaeological surveys to determine whether archaeological resources may be present on site, and the extent of the potential impacts posed by the project.

It is worth noting that a Phase 1A Literature Review and Sensitivity Analysis had previously been conducted in 2012, which surveyed 9.4 acres of the site (the City Yard parcel and the Armory parcel).[131] Based on the Phase 1A, a Phase 1B Archaeological Field Reconnaissance Survey was completed on 1.58

acres in the southwest portion of the Armory property, which found a low potential for historical resources and concluded no further investigation was required.[132] These surveys should be consulted as part of the review process, and SHPO may require additional surveys be conducted.

B.3.14 Uniform Heat Standards for Multi-Unit Residential Buildings

New York State establishes statewide standards for the provision of heat in multi-unit buildings. Heating facilities must be capable of maintaining a temperature of 68 °F.

Heat must be supplied from October 1 through May 31 to tenants in multiple dwellings. If the outdoor temperature falls below 55°F between the hours of 6 a.m. to 10 p.m., each apartment must be heated to a temperature of at least 68°F. If the outdoor temperature falls below 40°F between the hours of 6 a.m. to 10 p.m., each apartment must be heated to a temperature of at least 55°F. *[133]*

B.3.15 Utilities Regulation

The New York State Public Service Law governs utilities and delegates the regulation of utilities to the New York Public Service Commission. The scope of the Public Service Law covers electricity, natural gas, water, and telecommunications, but does not cover geothermal or the provision of heat generally.[134] As a result, utilities are presently not permitted to own or operate geothermal assets. Also, because geothermal falls outside the scope of the law, private providers of heat services are not presently regulated under the Public Service Law.

Beyond the omission of geothermal from the Public Service Law, common law principles suggest that geothermal heat services provided on a competitive basis by a company that does not possess a monopoly or otherwise exert market power would not be deemed a utility or regulated as a utility. The historical genesis of utility regulation is rooted in concerns over market power during the early 1900s as a variant of anti-trust legislation. The modern approach to defining a utility for purposes of determining whether an energy provider is deemed and regulated as a utility has been refined by the courts deciding whether third-party power providers entering into power purchase agreements with energy users, a situation analogous to the provision of geothermal services. Multiple factors are considered in determining whether the activity constitutes provision of utility services. They include:

- The nature of the transaction and relationship between the parties, in particular whether it is an arm's length transaction between willing buyer and willing seller.
- Whether the services are for public or private use, determined in part by whether the provision of energy is in front or behind the meter.

- Whether the service provided is an indispensable service that generally requires public regulation; if the service is structured so that the end user has alternative grid-supplied options in addition to the service, it may be deemed non-essential or not requiring regulation.
- The presence of market power or monopoly.
- Ability to serve all members of the public.
- Ability to discriminate against members of the public.
- Actual or potential competition with other entities that are regulated in the public interest.[135]

Although no single factor is determinative, if a geothermal provider contracts on a one-to-one basis with a building or commercial user, and the building retains backup utility service for heating as an alternative option, it is unlikely that such an arrangement would be deemed as requiring regulation as a utility under common law principles.

B.3.16 HEFPA and Submetering Regulations for Electric Heat

Notwithstanding the provision of geothermal services as an unregulated utility, a building or service provider that provides electricity and/or electric heat to residents on a submeter basis must comply with the Home Energy Fair Practices Act (HEFPA) part of the Public Service Law §§30-53, and the DPS Residential Electrical Submetering regulations,[136] pursuant to the New York Public Service Law.[137] Importantly, for purposes of submetering, electric heat services include heat services provided by electric heat pumps.[138]

HEFPA and its regulations subject covered parties to the same standards as utilities for consumer initiation and termination of service, billing and deposits, disputes over service and charges, and standards for quality of service. The submetering regulations further require that buildings apply to the New York Public Service Commission for permission to submeter, which approval may be conditioned upon requirements set by the Commission. These conditions include rate caps, and violation of Commission conditions or failure to adhere to regulations can result in reductions in rate caps,[139] sanctions and termination of authority to submeter. [140]

For existing buildings that seek to convert from a master meter to a submeter, in order to approve the application, the Commission must make a positive determination that the proposed submetering is in the public interest and consistent with the provision of safe and adequate electric service to residents.[141] This requirement applies to rental buildings, condominiums and cooperative buildings.

For conversion of rental buildings, the application requires notice to all residents, publication for public comment, and the Commission may consider all supplemental information submitted, including public comments.[142] Conversion of an existing building is therefore a far more cumbersome process involving actual tenants with pre-existing contractual and statutory rights that must be adjusted if submetering is to be permitted.

For buildings that are mixed rental and condominium, such as where sponsors retain ownership of certain units that are rentals, the regulations do not specify which regime is followed. The answer should follow whether the sponsor remains obligated to pay the submeter bill under the lease, or whether that can be passed to tenants. Contract, landlord-tenant, rent control and other laws would be relevant to what would be permissible.

Applications for submetering must include a plan for complying with HEFPA, demonstration that submetering will comply with equipment, energy efficiency, income-based housing assistance, rate cap, and other requirements.[143]

The process is complex, requires months to complete, and the public interest finding is a relatively high standard to meet. However, submetering that supports meeting State and local climate targets by enabling geothermal technologies could be deemed to be in the public interest, provided all other requirements are also satisfied.

B.3.17 Non-Electric Heat and Cooling

While HEFPA regulates electric heat submeters, non-electric heat and cooling fall outside of HEFPA and the submetering regulations. The absence of a specific regulatory regime means other non-energy regimes at the State and local level may set default rules without providing a clear path towards submetering residential units for these services. As described in the following section, these include municipal landlord-tenant laws.

Non-electric heating is allocated as a responsibility of the landlord in State and municipal law and leases, whereas cooling generally is omitted from both. This may enable bifurcated business models that more easily support cooling as a service to be offered, the provision of electric heat under HEFPA, but non-electric heat facing barriers under local law.

Proposals to submeter geothermal will likely require the submetering regulations for electricity and electric heat be adapted to incorporate geothermal or new regulations developed for geothermal.

B.3.18 Other Consumer/Tenant Protection Laws

Regardless of whether heat services are billed as electric heat or therms, contract law, consumer protection laws, tort laws, and other laws and regulation governing the marketing of heat services would apply.

In the context of building contracting geothermal heat services and on-selling them to tenants, local landlord-tenant laws would apply to protect tenant-consumers, which would necessarily expand the range of regulatory stakeholders to include municipal regulatory authorities regulating buildings and protecting tenants. Thus, New York State's Division of Homes and Community Renewal, as well as municipal tenant advocates could become actively involved, including the Westchester County Housing and Community Development. Other non-government tenancy advocacy groups will also likely become active to influence government decision making processes.

The New York State construction code requires buildings to provide a means to heat residential units, but does not allocate in the specific responsibility for the cost of operation of those units or fuel:

> §27-740 Heating requirements. All habitable or occupiable rooms or spaces, and all other rooms or spaces … shall be provided with means of heating in accordance with the requirements of this subchapter and reference standard RS 12-1….[144]

As noted in the prior section, in the absence of a regulatory regime like HEFPA for non-electric heating, municipal landlord tenant laws may allocate the responsibility for heating to landlords. Similarly, for existing buildings, incumbent leases will allocate the responsibility to landlords.

Absent a municipal law allocating responsibility for heating cost to landlords, navigating incumbent rights contained in leases raises contract law issues and, although HEFPA would not apply, municipal regulators may require a process similar or more onerous to that of HEFPA.

Assuming a building provider is permitted to separately provide and bill for heat, failure to provide adequate heat according to standards set in municipal regulations protecting tenants could result in violations and penalties under these laws. In turn, this could trigger contractual violations between the building owner and a third-party heat provider.

B.3.19 Affordable Housing

If a building is deemed affordable housing under federal law, New York State and local municipal regulations set maximum amounts that can be charged in multi-unit residential buildings. In determining housing affordability, all housing costs must be included in the calculation. In rental units, housing costs include rent and any tenant paid utilities. In ownership units, costs include the mortgage payment (principal and interest), property taxes and homeowner insurance, and any common charges or homeowner's association fees for condominiums or cooperatives.

The U.S. Department of Housing and Urban Development (HUD) sets income limits annually for a variety of housing programs known as the Area Median Income (AMI) for each Metropolitan Statistical Area (MSA). MSAs are typically large cities or counties. Westchester County Housing and Community Development uses the AMI standard to set eligibility requirements for its funding programs for both rental and ownership housing. Affordability is broadly defined as a household paying no more than 30% of their monthly gross income towards their housing costs. The number of persons in the household determines the specific amount that may be charged for housing costs to stay within the affordability thresholds.

In addition, HUD annually publishes HOME Program Rent Limits for each MSA based on affordability for households with incomes at or below 50% AMI or up to 60% AMI.

For rental units, because both rent and utilities are included in the calculation, an arrangement between a building owner and third-party heat providers must be governed by contractual arrangements to ensure that affordability compliance thresholds are met.

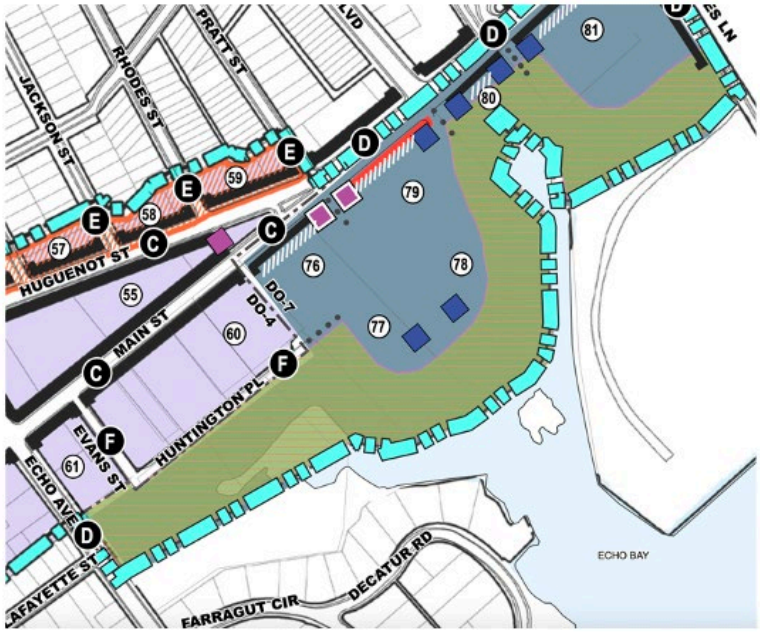
B.4 Local Permitting

The City of New Rochelle has not developed permitting guidelines for geothermal systems, however various local laws and regulations could apply to the geothermal aspects of the project. Additionally, New Rochelle's local climate and energy policies suggest that a district geothermal system may be well received by local regulators.

B.5 Zoning

New Rochelle is currently in the process of amending its zoning standards and zoning map to add a Waterfront Overlay Zone (DO-7). According to the draft amendments, Pratt landing will be zoned as a DO-7 Waterfront District with a Waterfront Activation Area along the entire shoreline of the property[145]. Accordingly, the existing zoning regulations, as well as those included in the new overlay district will be applicable to Pratt Landing.[146]

Figure B-6. Waterfront Overlay Zone DO-7 Map



A waterfront activation area is "a general area along the waterfront … within which the continuous publicly accessible space physically and visually connects the adjacent areas to the water front."[147] Under the proposed amendments, the Waterfront Activation Area must contain civic space that provides continuous public access along the waterfront, as well as integrate a combination of waterfront boardwalk, pedestrian trails, other civic spaces, and public frontages with nearby sidewalks and parkland.[148] Additionally, all properties are required to provide a minimum 30 foot wide area that includes shoreline restoration and beneficially improves landscaping areas planted with native species and a continuous public trail along the water's edge.[149]

While the new zoning changes may not directly impact the geothermal system, system designs should be informed by the current plans for the waterfront activation area, and the system will need to be designed such that it does not interfere with public access to Echo Bay or any shoreline restoration.

B.5.1 New Rochelle Sustainability Plan and Comprehensive Plan

A district geothermal system at the Pratt Landing site would align with New Rochelle's local climate and energy policies.

In 2010, New Rochelle created the City's first sustainability plan (known as GreeNR) to, among other sustainability initiatives, establish priorities to reduce energy consumption and the City's carbon footprint. Specifically, GreeNR provides for the reduction of "local energy consumption and greenhouse gas emissions while transitioning to renewable sources of energy and adapting to probable climate changes" and sets goals in furtherance of this objective, which include:

- Reducing annual per capita energy consumption by at least 20%, from 125 MMbtus to 100 MMbtus.
- Reducing annual per capita Co2-equivalent emissions by at least 20%, from 9.0 metric tons to 7.2 metric tons.[150]

GreenNR also requires that "relevant municipal actions such as Comprehensive Plan updates, zoning amendments, development agreements, and environmental assessments be reviewed for consistency with GreenNR's objectives."[151]

Additionally, in 2016, the City of New Rochelle partnered with the Land Use Law Center at Pace Law School and the planning firm BFJ to update the city's comprehensive plan. Among other key concepts, the updated plan, or "EnvisionNR", was framed to incorporate the goals of New Rochelle's GreeNR. To that end, the comprehensive plan recommends exploring renewable energy and district energy systems such as microgrids.

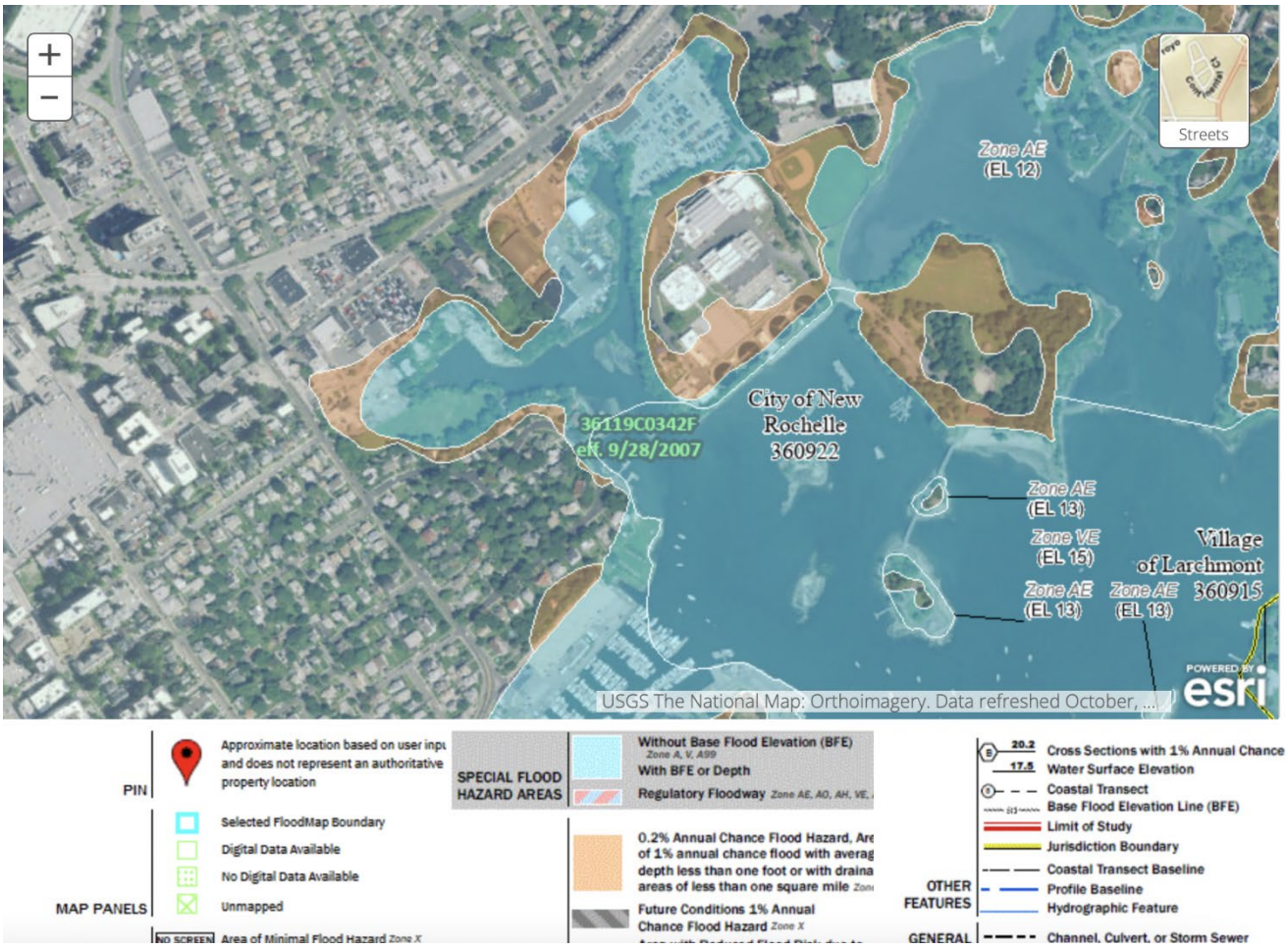
While not directly mentioned, a district geothermal system would align with the policies enumerated in GreeNR and EnvisioNR.

B.5.2 Special Flood Hazard Areas

In New York, local municipalities that participate in the National Flood Insurance Program regulate development in Special Flood Hazard Areas (SFHA).[152] Accordingly, all development, including buildings and other structures, mining, dredging, filling, paving, excavation, drilling, or storage of equipment or materials is subject to construction regulations if it occurs within a SFHA.[153]

According to FEMA's Flood Insurance Rates Maps (FIRMs) Panel 36119C0342F, portions of the Pratt Landing site include areas with a 1% annual chance of flood designated as "Zone AE", as well as areas with the 0.2% annual chance of flood designated as "Zone X."

Figure B-7. Pratt Landing on FEMA's Flood Insurance Rates Maps



Pursuant to Article IV of New Rochelle's local code, a floodplain development permit is required from the Building Official of the City of New Rochelle for all construction and other development undertaken in areas of special flood hazard.[154] Areas of special flood hazard include areas subject to a one-percent-or-greater chance of flooding in any given year designated as Zone AE.

Article IV also contains general standards for construction in areas of special flood hazard, as well as specific standards based on zone and structure. For instance, all new structures in areas of special flood hazard shall be anchored to prevent flotation, collapse, or lateral movement during the base flood. Additionally, "new construction and substantial improvements to structures shall be constructed with materials and utility equipment resistant to food damage…. using methods and practices that minimize flood damage."[155]

Article IV also provides that "new and replacement electrical equipment, heating, ventilating, air conditioning, plumbing connections, and other service equipment shall be located two feet above the base flood elevation or one foot above the highest flood elevation of record, whichever is higher. Electrical wiring and outlets, switches, junction boxes and panels shall be elevated two feet above the base flood elevation unless they conform to the appropriate provisions of the electrical part of the Building Code of New York State or the Resident code of New York State for location of such items in wet locations."[156]

B.5.3 Wetland setbacks

Pursuant Section 331-19 of New Rochelle's local code, "[n]o building or structure… shall be constructed within 75 feet of the boundary of any tidal or freshwater wetlands, other than boardwalks, shoreline promenades, bulkheads, piers, docks, marinas… or other similar water-dependent structures…"[157] Consequently, an area variance from the Planning Board may be required to install any component of the geothermal system within 75ft of the tidal wetland boundary.

In determining whether to grant an area variance, the Board must balance the benefit to the applicant if the variance is granted against the detriment to the health, safety and welfare of the neighborhood or community by granting such variance. In doing so, the Board must consider: "(1) Whether an undesirable change will be produced in that character of the neighbourhood or a detriment to nearby properties will be created by the granting of the area variance; (2) Whether the benefit sought by the applicant can be

achieved by some method feasible for the applicant to pursue, other than an area variance; (3) Whether the requested area variance is substantial; (4) Whether the proposed variance will have an adverse effect or impact on the physical or environmental conditions in the neighbourhood or district; and (5) Whether the alleged difficulty was self-created."[158]

B.5.4 Use of Sewer System as Thermal Source/Sink

A variation of the geothermal system design proposes to exploit the project's sewage stream as a source and sink for heat. The proposed system would divert sewage through a bypass pipe that is coupled with a heat exchange unit. Sewage would return to the main line and travel outward to the edge of the property where it passes to the municipal sewage lines.

Westchester County Department of Environmental Facilities administers the sewer regulations. Westchester County owns the treatment facility connected to the project by a direct sewer effluent pipe. Discharges of industrial waste or injurious waste substances into the sewer require prior authorization from the Commissioner of Public Works of Westchester County. [159]

Additionally, the New Rochelle Bureau of Sewers and Drains will review proposed use of sewer as thermal source as part of the municipal permitting process.

Based on the proposed system, the following is assumed:

- The system would be entirely closed without possible discharge into the environment.
- The sewage stream would not be changed by addition or removal of any of its original components, including changes in bio-chemical oxygen demand (BOD), total suspended solids (TSS), pH, fecal or total coliform bacteria, phosphate and phosphorus compounds, fats, oils, and greases of animal or vegetable origin, and the sewage stream would conform to these requirements.
- The only change in the diverted and return sewage stream would be changes in temperature.
- System cleaning and maintenance uses ordinary water and mild degreasing agents and would not introduce any substances that would be prohibited.
- System operation would not involve any significant additional water use.
- System operation would not change the concentration of viscosity of waste streams.
- System design and connections to the sewer system will confirm with all applicable codes, include DEC regulations, for materials and system design of sewage systems.

Regulations for sewers are primarily municipal law governing sewer use, building and construction codes, which, where appropriate draw upon or be supplemented by county, DEC, New York State Plumbing Codes, and U.S. Environmental Protection Agency requirements.

B.5.5 City Approval for Sewer Work

The City of New Rochelle's Commissioner of Public Work must approve any work connected to municipal sewer systems. According to city code, "No person, firm or corporation shall make or cause to be made any connection into a sanitary sewer, stormwater drain, in an easement or right-of-way across private property, said sanitary sewer, stormwater drain forming a part of the sewer, drainage or water distribution system, respectively, of the City of New Rochelle, without first obtaining from the Commissioner [of Public Works of the City of New Rochelle] a written permit for street opening."

B.5.6 Right of Way

If the sewage thermal exchange unit is entirely located on the project premises and serviced without going beyond the project premises, no easements or other property rights of way would be required for the thermal exchange unit, beyond those required for the conventional sewer system. By confining the thermal exchange system in this manner, the project confines the approval required to meet ordinary design and right of way requirements.

B.5.7 Temperature of Discharge

Municipal regulations specify a default range for the temperatures of outflow in the public sewer system, which can be varied by the sewer authority if such temperatures could harm the sewer system, treatment process, or otherwise have an adverse effect. Temperatures are regulated at the point of entering the municipal system pipes and at the sewage treatment plant.

Westchester County regulations state the following:

- Sewage streams reaching the publicly owned treatment works may not exceed 104 degrees Fahrenheit (104° F) (40° C).[160]
- County regulations do not set a minimum temperature however, as a prudential matter, waste streams should be above freezing so as not to be ice.
- County regulations do not specify default temperatures for entry into the sewer system pipe, however the county may specify additional requirements as a condition of permit.

Together these requirements would confine the use of sewage streams as a heat source and sink to outflow that enters the public sewer within the range of above 0° C (32° F) and below (150° F) (65° C). The sewer authority may specify a narrower range of temperature as part of the review process.

B.5.8 System Construction

The construction of sewage systems must be built to contain waste and prevent it from polluting the environment. Accordingly, connections between the diversion and main line connected to the sewer must conform to regular DEC requirements for sewer construction and be made watertight so that no leakage into or out of such connections shall occur. Westchester County sewer construction requirements would apply to the heat exchange component of the project's proposed sewer system.

The system design and materials will be reviewed as part of the ordinary permitting process. Although there are no specific geothermal requirements, lack of familiarity with these systems will potentially require additional time for review.

B.6 Relevant Precedents

The City of New Rochelle has no prior experience with district geothermal systems.

B.7 Authorities with Jurisdiction

Table B-2. Matrix of Relevant Authorities with Jurisdiction

AHJ	Permit or Approval Required	Description	Estimated Time of Approval	Risks	Fees
Federal					
US Army Corps of Engineers	Approvals for activities affecting navigable waterways Clean Water Act Section 404 Dredge and Fill Permit Rivers and Harbours Act Section 10 Permit	Navigable waterway, adjacent wetlands are within Corps jurisdiction and require Corps to delineate protected wetland to determine full scope of jurisdiction All Corps approvals require compliance with EPA Regulations, Corps Regulations, National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, Section 401 of Clean Water Act, and the Coastal Zone Management Act. Coordinates closely with DEC and other agencies.	Concurrent with DEC 60 days to 1+ years, depending on complexity.	Issues relating to impairment of habitat, navigation, and other primarily river and wetlands issues; public opposition. Available alternative designs could prevent approval of river system.	$10-$100; Corps will determine applicable permitting fees upon review. Costs of NEPA review are project specific but could range from $5,000 to over $500,000.
US EPA	Supervisory over Corps and DEC: CZMA Clean Water Act SDWA Endangered Species Act NEPA	Can block CWA Section 404 permits if it finds project has unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.	Follows Corps review unless complications.	Corps and DEC issue permits after incomplete or unsupported findings.	

Table B-2 continued

AHJ	Permit or Approval Required	Description	Estimated Time of Approval	Risks	Fees
Federal (continued)					
NOAA	Consultation - Endangered Species Act	Corps to consult if presence of any endangered species and if project jeopardize their existence or adversely impacts critical habitat. Echo Bay is listed as habitat for certain federally listed anadromous fish and sea turtles.	Subsumed within Corps review.	Can require thermal discharges be equipped with best technology available to avoid impact on wetlands.	
Housing and Urban Development	Regulation and potential enforcement	Compliance with affordable housing rules.	Follows State process unless complications.	Public complaint or lawsuit.	
State					
DEC Environmental Conservation	Permits and approvals	CWA 401 Water Quality Certification. SPDES Permit for water discharge, thermal extraction, potential drinking water pollution. Division of Water Approval or Division of Mineral Resource approves wells less than 500 feet or over 500 feet. Protection of Waters Permit. Tidal Wetlands Permit. Listed species protection, incidental takings. DEC requirements for sewer construction.	Concurrent with Corps review	Issues relating to impairment of habitat and other primarily river and wetlands issues	Tidal Wetlands Permit: $200 for minor projects; $900 for major projects. SPDES: permit-specific annual fees; $110-$330.

Table B-2 continued

AHJ	Permit or Approval Required	Description	Estimated Time of Approval	Risks	Fees
State (continued)					
Department of State, Division of Coastal Resources.	Approval.	Coastal Management Program verification of consistency with state policies to protect coastal areas from degradation and to revitalize coastal areas. Different review procedures apply at the federal, state, and municipal levels.	60 days – 6 months for federal consistency review.	Issues relating to impairment of habitat and other primarily river and wetlands issues; public opposition.	
NYS Office of General Services.	lease, easement, permit or license.	Construction on or above state-owned lands underwater.	Concurrent with Corps review	The state generally discourages non-water dependent uses of public lands.	TBD upon receipt of application.
State Historic Preservation Office.	Approval.	Protected historical or cultural resources.	30 days	Design decisions	
NYSDOT Transportation	Road closure, Easement.	Approval to encroach upon or work in road or railroad track.	Weeks	No significant risks	
Office of Renewable Energy Siting.	Approval for projects over 25 $MW_{th.}$	ORES approval if geothermal system is greater or equal to 25 $MW_{th.}$	Up to 12 months	No significant risks provided consultation with City government and compliance with laws.	
Public Service Commission	Home Energy Fair Practices Act (HEFPA) and submetering approvals.	Approval of submetering applications.	6 months to 1 year	Pricing and ability to comply with submetering service requirements. Submetering regulations not designed for non-electric services.	
Department of Public Service	Submetering and notices	Approval of submetering under Residential Electrical Submetering Regulations, notice of historical artefacts on project site.	6 months to 1 year	Pricing and ability to comply with submetering service requirements. Submetering regulations not designed for non-electric services.	
New York State Homes and Community Renewal.	Regulation	Provision and cost of heat, compliance with affordable housing rules.	None unless complaint	Pricing and public opposition.	

Table B-2 continued

AHJ	Permit or Approval Required	Description	Estimated Time of Approval	Risks	Fees
Local					
New Rochelle Building Department	Building Permit or Mechanical Permit – Heat Devices or Heating Floodplain Development Permit	Geothermal reviewed in building or mechanical permit application.	Months	Design, communications	Floodplain Permit: $36.75
New Rochelle Public Works	Road closure, Easement, Street opening permit for sewer connection	Road closure, right of way to encroach or temporary work.	Weeks	No significant risks	
Harbourmaster	Consultation, potentially approval	Use of navigable waterways.	Subsumed within Corps review.	Impediments to navigation.	
Westchester County Department of Health	Approval	Impact on water and sewer system. Provision of heating services.	Subsumed within project permitting. None unless complaints.	Design Reliability of heating services.	
Westchester County Department of Environmental Facilities	Approval	Connect to water or sewer systems – temperature control and impact on system operation.	Subsumed within local project permitting.	Design	
Westchester County Department of Environmental Planning	Approvals – sewer pumps	Sewer system design, prohibition of pumping stations unless no design alternative.	Subsumed within project permitting.	Design	
Westchester County Housing and Community Development	Rent regulation and tenant rights enforcement	Provision and cost of heat, compliance with affordable housing rules.	None unless opposition.	Public opposition, compliance with regulations.	
Courts	Adjudication	Landlord-tenant disputes over provision of heat and cost.	None unless opposition, then months to years.	Public opposition, force change of business model.	

B.8 Non-Governmental Stakeholder Approvals or Consents

Table B-3. Matrix of Stakeholders Requiring Coordination

Stakeholder	Approval or Consent Required	Description	Estimated Time of Approval	Risks
Project Development Investors	Agreement by all investors to commonly managed elements of project.	Development is presently controlled by a single developer. If subdivided, a common management agreement for the geothermal and other elements of the development among uniquely-owned buildings would be necessary or desirable.	Months. Agreement should be developed once geothermal system and other infrastructure is finalized and prior to subdivision and accepting third-party investors.	Acceptance of investors prior to resolution of common agreement presents several risks, including: Failure to disclose material terms resulting in investor liability. Incomplete agreement or delay in agreement could result in delay, cost and/or deadlock.
Electric and Gas Utility	Submetering	Coordinate submetering for electric heat under HEFPA.	6 months to year	See NY Public Service Commission
All Utilities Electricity Gas Water Sewer Cable Telephone	Right of Way Franchise	Encroachment or access across utility infrastructure. Confirm no interference with utility franchise agreements. Agreement on compensation, maintenance, decommissioning, and liability.	Weeks to months	Negotiations in absence of default regulations could require time to negotiation consent and agreement on liability and compensation.
Electrical Utility	Electric load	Electrical approval and expansion to accommodate equipment like heat pumps and exchangers.	Weeks	No significant risks
NGO/Community	Participation in public hearings and consultation		Not quantifiable	Public opposition

B.9 Anticipated Challenges and Risks

B.9.1 Use of Long Island Sound as a Thermal Source/Sink

The Long Island Sound, including Echo Bay, is a navigable waterway subject to the jurisdiction of the U.S. Army Corps of Engineers. Additionally, portions of the site located along the shoreline and extending inland are listed as federal wetlands in the National Wetlands Inventory (NWI) and are located within a 100-year flood plain, both of which are indicative of the presence of adjacent wetlands.

As such, any system design using the river or adjacent wetlands, as well as any construction related activity involving excavation, drilling, trenching, and/or backfilling within the protected area, including the area extending to the ordinary high-water mark and/or any adjacent wetlands would likely be a regulated activity under Clean Water Act Section 404.

Given the wide range of activities regulated under 404, the likely best way to avoid the permitting requirements would be to avoid construction above the ordinary high-water line as well as adjacent wetlands. However, because it is unclear to what extent jurisdictional wetlands are present on-site, a wetlands delineation is likely required to ascertain the full scope of Army Corp jurisdiction and to inform system-designs that could potentially avoid Section 404 permitting requirements.

The permitting review process for Clean Water Act Section 404 and Rivers and Harbors Act Section 10 may ultimately impact the feasibility of using a river loop system. Availability of practicable non-river alternatives that do not have an adverse impact on the environment would preclude issuing a permit for a river system. Further, due to the use of the Sound as a navigable channel, the Corps may be less inclined to view favourably a system that could potentially impede on navigation.

Any system design necessitating a Section 404 permit could potentially cause development delays from a timing perspective. The developers of the site are already several months into the process for obtaining three nationwide permits from the Army Corps (as well as a Tidal Wetlands permit from DEC). Additionally, shoreline plans for the site have already been developed in accordance with local, DEC, and Corps requirements. All designs for the system should be compatible with the existing shoreline plans for the site and resulting permitting delays should be considered when assessing the ultimate design of the system.

B.9.2 Endangered Species Act Mitigation Measures

Formal consultation pursuant Section 7 under the Endangered Species Act is not required if the agency determines that an action will not affect listed species or designated critical habitat.[161]

Accordingly, system designs that avoid impacts to species habitat will likely avoid the need for a formal consultation.

B.9.3 Drilling – Brine Production

The project subsurface contains groundwater that may contain brine. A well drilling permit for a well that may produce brine, saltwater, or other polluting fluids in sufficient quantities to harm the surrounding environment must obtain a permit for the safe and proper disposal of such produced fluids.[162] Depending on the applicable method of disposal, DEC may require the well owner to obtain additional permits for discharge and/or disposal.

B.9.4 Lack of Municipal Regulatory Regime for District Geothermal Systems

In New York State, few municipalities have developed permitting guidelines for geothermal systems, and no municipality has developed guidelines for multi-property district systems,

Without a permitting regime and standards for equipment, developers and municipal officials are left to navigate the various zoning, building, mechanical, environmental, and other regulations that may apply to geothermal systems but were not designed specifically for these systems.

This ad hoc approach in the absence of a dedicated geothermal permitting regime increases costs, uncertainty, and risks, and delays the approval process. For project designs in which multiple stakeholders—property owners, utilities, and government agencies—must consent or grant approval, lack of a permitting regime and standards risks the inability of stakeholders to reach decisions or consensus, resulting in deadlock and bureaucratic paralysis. Application of zoning and other regulations not designed for geothermal systems, such as setback requirements, may even block geothermal projects altogether in dense urban and peri-urban areas where small lot sizes are common.

To address this challenge, project developers should start educating municipal permitting authorities and elected officials about the benefits of the geothermal features of the project and the measures to mitigate any potential risks to the environment or other subsurface infrastructure as early as possible. This educational effort should commence as soon as the developer has approved a proposed geothermal design and the assessment of mitigation measures is completed. The project developer should also be prepared to engage with environmental and community groups interested in the project.

B.9.5 Rights of Way and Approvals

Developers must obtain either fee simple ownership or easements in order to drill and install a shared ground loop across multiple properties. Crossing property lines, streets, railroad tracks, existing utility infrastructure all will require the grant of an easement and approval by the owner or authority responsible for their operation.

The costs of acquiring rights of way can be expensive and time-consuming. Each utility that has installed infrastructure in the subsurface should be consulted as part of the approval process to ensure that proposed designs and implementation will not disturb their operations. To safely install geothermal piping in the subsurface without interfering with other utilities will likely require site visits to individual properties by these other utilities. The costs and risk of damage incurred by these utilities will likely generate resistance to granting their approval.

Granting easements over a property limits the property owner's ability to use its own property, and can adversely affect private property rights, or diminish private property values. Compensating the grant of an easement and its impact on the servient property can be difficult to value,[163] potentially resulting in deadlock in negotiations.

Without government intervention, geothermal developers must negotiate with property owners and affected utilities to grant approval, which may be conditioned upon agreement on compensation, maintenance, decommissioning, and indemnification for liability.

The costs of obtaining rights of way have been well documented for roads, pipelines,[164] telecommunications, railroads, subways and intracity surface rail, and other types of infrastructure that necessarily crosses property lines. These costs may include a one-time acquisition fee, annual fees, excessive or escalating fees,[165] and the time and cost of organizational staff and legal professionals to procure rights.

In New York State, investor-owned electric and gas utilities resolve rights of way issues by entering into franchise agreements with municipalities.

B.9.7 Drilling Regulatory Restrictions

New York State imposes different requirements for geothermal wells drilled less than 500 feet and wells over 500 feet. Permitting requirements for wells over 500 feet in depth are considerably more rigorous and costly.

The different permitting regimes effectively limit geothermal system design to shallower depths for many developers of residential and individual building systems. Consequently, more wells must be drilled than would be required if deeper wells were employed to support the same system capacity. The greater number of wells increases overall costs due to greater drilling time, materials requirements, particularly costly well casing, expanded site restoration area, and increased production of cuttings and water.

The decision whether to drill beyond 500-foot depth requires a benefit-cost analysis of the potential additional thermal capacity and more efficient use of limited land weighed against the costs of compliance with the regulatory regime.

The project developer has elected to limit drilling to 500 feet in order to avoid the significant costs of compliance with additional regulation, foregoing a more energy efficient design.

B.9.8 Drilling Barrier Cost and Liability

Geothermal drilling operations may encounter several complicating conditions that have significant safety and regulatory consequences. Heightened operating complexities combined with traditional legal liability rules and regulatory requirements drive increasing costs for labor due to enhanced safety precautions and specialized equipment, slower work progress, more stringent permitting requirements, and higher insurance premiums.

Drilling in areas with excessive groundwater will complicate the drilling process. Saltwater produced from boring cannot be reinjected and must be removed from the site.

B.9.9 Business Model

Geothermal development can follow one or more of several business models that exhibit differing technical economies relative to transactional diseconomies. Utilizing the continuum of business models set out in the NYSERDA-sponsored Pace Energy and Climate Center *Overcoming Legal and Regulatory Barriers to District Geothermal in New York State* (2021), the present project is classified as a "Single Property—Single Owner—Multiple Users" business model.

In this model, a single-property owner hosts a geothermal system on a single property that serves multiple users or tenants. This presents the simplest of property rights and permitting arrangements but allows the system operator to increase revenues by serving multiple tenants. College campus geothermal systems fall under this model. This model is advantaged by simple and low-cost legal and administrative arrangements.

If Endurant retains ownership of the geothermal component of the project, this project also may follow a "Single Property—Build-Own-Operate-Transfer (BOOT)" business model.

A variant of the single property model is for an energy service provider to build, own, and operate the geothermal system on a single property owned by a third-party, and to eventually transfer ownership and operation of the system at a contractually specified point in time to the property owner. These build-own-operate-transfer or "BOOT" arrangements are commonly used to finance capital intensive infrastructure projects.

B.9.10 Submetering and Tenant Billing

If the project plans to submeter heating services so that individual tenants control their usage and pay for their heat services on an individual basis, the developer or a third-party energy services provider must apply with the Public Service Commission for approval of submetering tenant units. Public Service Commission submetering regulations require compliance with metering, billing, dispute resolution, and other requirements.

Obtaining submetering approval for a new development is far less complex a process than submetering a building with existing tenants. If submetering is introduced to an existing tenant relationship, this will require additional public hearing and amendment of leases.

Presently, New York State submetering regulations apply to electricity and electric heating services. No regulatory arrangement exists for billing heating services measured in thermal units.

Accordingly, to simplify submetering arrangements, the project should introduce submetering prior to entering into agreements with any prospective tenants and, preferably prior to advertising rental units. Further, the project should measure and bill heat services as electric heat following established guidelines to conform to the current regulations as closely as possible. If the project proposes to measure and bill services on a submeter basis, it should at the earliest possible time consult the New York Public Service Commission and the DPS for guidance as this request will raise novel issues likely requiring adaptation of existing rules.

B.9.11 American Innovation and Manufacturing Act of 2020

The American Innovation and Manufacturing Act of 2020 (AIM Act) directs the EPA to promulgate regulations that will reduce U.S. hydrofluorocarbon (HFC) production and consumption by approximately 85% by 2035.[166] Specifically, the Act directs the EPA to: phase down the production and consumption of 18 HFCs listed in the Act through an allowance allocation and trading program, establish requirements for the management of listed HFCs and HFCs substitutes, and facilitate the transition to next-generation technologies by restricting the use of listed HFCs in a specific sector or subsectors.[167]

The phase-down requirements of the AIM Act are directed towards companies that produce and/or import bulk HFCs, as well as companies that use HFCs in the following six applications: propellants in metered dose inhalers, defence sprays, structural composite preformed polyurethane foam for marine use and trailer use, etching of semiconductor material or wafers and the cleaning of chemical deposition chambers within the semiconductor manufacturing sector, mission-critical military end uses, and onboard aerospace fire suppression.[168]

The AIM Act also grants EPA authority to restrict either fully, partially, or on a graduated schedule, the use of HFCs in specific sectors or subsectors. EPA may do so by initiating its own rulemaking procedures either on its own accord or a person may petition EPA to promulgate a rule restricting use of HFCs in a particular sector or subsectors.[169] On October 8, 2020, the EPA announced that it is granting or partially granting 11 petitions that were filed under the AIM Act to restrict the use of HFCs in the refrigeration and air conditioning, aerosols, and foam sectors. EPA will have two years to promulgate regulations (through public comment and rulemaking procedures) addressing these petitions.

B.9.12 New York State Law — SNAP Rules 20 and 21

Prior to the passage of the AIM act, relying on its authority to regulate ozone depleting substances under the Title VI of the Clean Air Act, in 2015 EPA attempted to restrict the use of HFCs through the Clean Air Act's Significant New Alternative Policy (SNAP) program by promulgating SNAP Rules 20 and 21. The rules removed HFCs from the list of acceptable substitutes for ozone depleting substances, and specifically listed HFCs as unacceptable in certain end-use applications such as refrigerators and certain air-conditioners. EPA was responding to recent science demonstrating that HFCs measurably contribute to the breakdown of the ozone layer both directly and indirectly as a catalyst due to their high global warming potential.[170] However, upon judicial review the D.C. Court of Appeals held EPA exceeded its authority under the SNAP program in requiring manufacturers that had already replaced ozone-depleting substances with HFCs at a time when they were listed as safe substitutes, as they were prior to the 2015 reclassification deemed non-ozone-depleting substances under Section 612 of the Clean Air Act. The court vacated the EPA's 2015 reclassification of HFCs and remanded to the EPA to determine if it possesses authority to conclude that a manufacturer's past decision to replace an ozone-depleting substance with HFCs is no longer lawful.[171]

In response, several states acted on their own to adopt SNAP Rules 20 and 21 reimposing EPA's restrictions on HFCs. For example, in 2018, California passed the California Cooling Act adopting SNAP 20 and 21 into their own state regulations. Other states including New York have followed California's lead by enacting similar restrictions on HFCs. Additionally, in 2020, New York promulgated regulations adopting SNAP 20 and 21.

DEC regulations ban the sale, installation, and commercial use of certain HFC refrigerants in new or retrofitted food refrigeration equipment, large air conditioning equipment (chillers), and vending machines, as well as place prohibitions on substances used as aerosol propellants and foam-blowing agents in new consumer products.[172] The regulations do not require currently functioning equipment to be replaced or altered, but Part 494 requirements may apply at the end of its useful life.

B.9.13 Implications for Geothermal

The potential for evolving regulations to impact maintenance costs and replacement of regulated refrigerants at the end of life of equipment or those refrigerants should be considered when making investment decisions concerning technology selection today.

Although EPA has already authorized a number of refrigerants with lower global warming potentials for air-conditioner end-uses under the SNAP program[173] pursuant to its expanded authority under AIM, regulatory requirements are fast evolving as some states such as California are taking further action to impose restrictions on refrigerants based on its GWP level.[174]

Further complicating matters, many next-generation refrigerants pose other environmental and regulatory risks, such as increased level of flammability compared to those commonly in use today.[175] Further, these refrigerants cannot be used as "drop-in" replacements for equipment that is currently in use until equipment manufacturers develop systems that can accommodate these new refrigerants and State building codes are developed that specify acceptable uses.[176]

Given the uncertainty concerning rapidly evolving regulations governing HFCs and the issues surrounding safe and effective HFC substitutes, hydronic or other systems that eliminate the use of refrigerants altogether might prove to be an economic choice today when the full life cycle of technology options and the risks posed by uncertain regulation are considered.

B.9.14 Summary of Recommendations to Overcome

B.9.14.1 Preliminary Commercial Terms/Contractual Relationships and Recommendations

Certain of these challenges can be addressed through contractual arrangements between the developer and other stakeholders. Recommended contractual arrangement include:

- **Third-Party Energy Services.** An energy services agreement with Endurant as the geothermal system operator will be required if Endurant owns and operates the geothermal system. Any arrangements with a third-party energy services provider should require performance and compliance consistent with developer obligations to tenants and requirements that may be imposed by the New York Public Service Commission or other government agencies in relation to provision of heat to tenants.
- **Submetering and Tenant Leases.** If the project plans to submeter heating services so that individual tenants control their usage and pay for their heat services on an individual basis, submetering arrangements should be approved by the Public Service Commission prior to entering into leases with any tenants. Leases should then be drafted with language clearly allocating financial responsibility billed to the tenant.

- **Submeter Billing.** The developer or a third-party energy service provider operating the system will be required to use an approved form of bill-and-maintain billing service and dispute mechanisms as required by New York State's submetering regulations. The developer or third-party energy service provider may desire to contract with a third-party billing provider in order to comply with these requirements. Such arrangements must provide compliance with any applicable landlord-tenant laws.
- **Tax Optimization**. The geothermal system is a depreciable asset that provides opportunities for tax-advantaged financing. The form of ownership for those assets can be separated from the project and its phases in order to exploit tax advantages. A separate geothermal financing structure potentially improves the financial return of the overall project; however, this must be weighed against the additional complexity and legal risk in the event of a failure to meet obligations for any reasons or a legal dispute.

Endnotes

[1] Heat of compression refers to the portion of input electrical energy to the compressor that gets released as thermal energy due to mechanical inefficiency. With hermetically sealed compressors, this thermal energy is absorbed on the condenser side and can be used as thermal input for spaces that require heating. In cooling mode, thermal energy is being removed from conditioned spaces and rejected to the GLHE. The amount of thermal energy rejected to the GLHE is actually 20-30% more than is removed from conditioned spaces due to the heat of compression factor. The same happens in heating mode. Due to the heat of compression factor from the heat pump, only 70-80% of the thermal energy required by the conditioned spaces is extracted from the GLHE.

[2] New York State Clean Heat State-wide Heat Pump Program Manual - Version 5, October 2021 NYS-Clean-Heat-Program-Manual.pdf

[3] The Joint Utilities of New York is a regulatory framework developed to support coordination amongst utilities in response to NYS's Climate leadership and Community Protection Act. https://jointutilitiesofny.org/

[4] New York State Clean Heat Statewide Heat Pump Program Manual - Version 5, Section 2.1., October 2021 NYS-Clean-Heat-Program-Manual.pdf

[5] The Tax Cuts and Jobs Act of 2017

[6] 26 U.S. Code § 48 - Energy credit

[7] Endurant Energy develops VDER credit estimates using an in-house calculator that builds off the NYSERDA Value Stack Calculator logic for estimating VDER revenue from energy, capacity, demand reduction, community credits and environmental value delivered to the local grid.

[8] Clean Water Act, 33 U.S.C. §§ 1251-1387; Colburn T. Cherney & Karen M. Wardzinski, State & Federal Roles Under the Clean Water Act, 1 Nat. Resources & Env. 19, 19-20 (1986).

[9] Jason Bressler, Blocking Interstate Natural Gas Pipelines: How to Curb Climate Change While Strengthening the Nation's Energy System, 44 Colum. J. of Env. Law 137, 140 (2019).

[10] U.S. Army Corps of Engineers, New England District, Are You Planning Work in a Waterway or Wetland?, https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/WorkInWaterway2014.pdf (last accessed Oct. 12, 2021).

[11] U.S. Army Corps of Engineers, New England District, Are You Planning Work in a Waterway or Wetland?, https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/WorkInWaterway2014.pdf (last accessed Oct. 12, 2021).

[12] U.S. Army Corps of Engineers, New England District, Are You Planning Work in a Waterway or Wetland?, https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/WorkInWaterway2014.pdf (last accessed Oct. 12, 2021).

[13] U.S. Army Corps of Engineers, Wetlands- What You Should Know Before You Buy or Build (May 2019), https://www.lrb.usace.army.mil/Portals/45/docs/regulatory/DistrictInfo/FactSheets/NY-Wetlands_What_You_Should_Know_Revised_13MAY2019.pdf?ver=2019-05-13-150727-513.

[14] U.S. Army Corps of Engineers, Wetlands- What You Should Know Before You Buy or Build (May 2019), https://www.lrb.usace.army.mil/Portals/45/docs/regulatory/DistrictInfo/FactSheets/NY-Wetlands_What_You_Should_Know_Revised_13MAY2019.pdf?ver=2019-05-13-150727-513.

[15] U.S. Dep't of Army & U.S. Env. Protection Agency, Memorandum of Agreement concern Mitigation Sequence for Wetlands in Alaska under Section 404 of the Clean Water Act at 7 (June 15, 2018), https://www.environmentallawandpolicy.com/wp-content/uploads/sites/452/2018/07/MOA.pdf.

[16] According to Corp regulations, fill material includes "rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from minors or other excavation activities, and materials used to create any structure or infrastructure in the water of the United States. 33 C.F.R. § 323.2(e)(2).

[17] U.S. Army Corps of Engineers, New England District, Are You Planning Work in a Waterway or Wetland?, https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/WorkInWaterway2014.pdf (last accessed Oct. 12, 2021).

[18] 33 C.F.R. § 323.2(d)(1); The term includes any addition, including redeposit other than incidental fallback, of dredged material, including excavated material, into waters of the United States which is incidental to any activity, including mechanized land clearing, ditching, channelization or other excavation. 33 C.F.R. § 323.2(d)(2).

[19] 33 C.F.R. § 323.1.

[20] Environmental Law Institute, The Federal Wetland Permitting Program: Avoidance and Minimization Requirements (Mar. 2008), https://www.lrl.usace.army.mil/Portals/64/docs/regulatory/Permitting/ELI.pdf

[21] According to Army Corp guidance, "minor impacts are associated with activities that generally would have little potential to degrade the aquatic environment and include one, and frequently more, of the following characteristics: are located in aquatic resources of limited natural function; are small in size and cause little direct impact; have little potential for secondary or cumulative impacts; or cause only temporary impacts." US EPA, Regulatory Guidance Letter 93-02, Guidance on Flexibility of the 404(b)(1) Guidelines and Mitigation Banking (Aug. 23, 1993), https://www.nap.usace.army.mil/Portals/39/docs/regulatory/rgls/rgl93-02.pdf

[22] William Funk, 4 Environmental Law Practice Guide § 19.04 (Matthew Bender LexisNexis 2021).

[23] Ibid.

[24] Ibid.

[25] California State Water Resources Control Board, Supplemental Information for USACE Permitting Requirements, Appendix E (2015), https://www.waterboards.ca.gov/waterrights/water_issues/programs//bay_delta/california_waterfix/exhibits/exhibit3/docs/RDEIRS/Ap_E_SuppInfo.pdf

[26] William Funk, 4 Environmental Law Practice Guide § 19.04 (Matthew Bender LexisNexis 2021).

[27] Kenneth M. Bogdan & Albert I. Herson, 5 California Environmental Law & Land Use Practice § 68.06 (Matthew Bender LexisNexis 2021).

[28] Nina M. Hart & Linda Tsang, Cong. Rsch. Serv., IF11549, The Legal Framework of the National Environmental Policy Act (2021), https://sgp.fas.org/crs/misc/IF11549.pdf

[29] Ibid.

[30] 40 C.F.R. § 1502.14. (2020).

[31] Steven M Siros, et al., Pipeline Projects, The evolving Role of Greenhouse Gas Emissions Analyses Under NEPA, 41 Energy L. J. 47, 52 (2020).

[32] Sierra Club v. FERC, 867 F.3d 1357 (D.C. Cir. 2017).

[33] Jason Bressler, Blocking Interstate Natural Gas Pipelines: How to Curb Climate Change While Strengthening the Nation's Energy System, 44 Colum. J. of Env. Law 137, 158 (2019).

[34] 40 C.F.R. § 1508.18.

[35] Antonio Rossmann & Roger B. Moore, 5 California Environmental Law & Land Use Practice § 71.30 (Matthew Bender LexisNexis 2021)

[36] See generally 33 C.F.R. § 325, app. C, § 2(a) and 36 C.F.R. §§ 800.5, 800.10.

[37] Consensus Building Institute, Navigating the Clean Water Act § 404 Application Process: Information to Assist Permit Applicants 5 (Feb. 2018), https://www.cbi.org/assets/news/EPA_TSD_Final.pdf

[38] Thomas J. Schoenbaum & Richard B. Stewart, The Role of Mitigation and Conservation Measures in Achieving Compliance with Environmental Regulatory Statutes: Lessons From Section 316 of the Clean Water Act, 8 N.Y.U. Envtl. L.J. 237, 258 (2000).

[39] Melissa Samet, American Rivers Nat'l. Wildlife Fed'n., A Citizen's Guide to the Corps of Engineers 148-150 (2009), https://biotech.law.lsu.edu/blog/A-Citizens-Guide-to-the-Corps-of-Engineers-Permitting-D.pdf

[40] Kenneth M. Bogdan & Albert I. Herson, 5 California Environmental Law & Land Use Practice § 68.06 (Matthew Bender LexisNexis 2021).

[41] U.S. Envtl. Protection Agency, Office of Water, Memorandum on Endangered Species Act Section 7(a)(2) Consultation for State and Tribal Clean Water Act Section 404 Program Approvals, https://www.oregon.gov/dsl/WW/Documents/ESAconsultationpolicyfor404-20200827.pdf

[42] Melissa Samet, American Rivers Nat'l. Wildlife Fed'n., A Citizen's Guide to the Corps of Engineers 148-150 (2009), https://biotech.law.lsu.edu/blog/A-Citizens-Guide-to-the-Corps-of-Engineers-Permitting-D.pdf

[43] Ibid.

[44] Ibid.

[45] Ibid.

[46] Ibid.

[47] Ibid.

[48] Ibid.

[49] Ibid.

[50] Ken Krich et al., Biomethane from Dairy Waste: A Sourcebook for the Production and Utilization of Renewable Natural Gas in California, USDA Rural Devel., at 135 (July 2005).

[51] Ibid.

[52] Ohio Envtl. Protection Agency, Water Quality Standards Program, https://www.epa.ohio.gov/dsw/wqs/index (last accessed Oct. 13, 2021).

[53] 33 U.S.C. § 1313(c)(2)(A); NYS Dep't of Envtl. Conservation, Division of Environmental Planning and Protection, Clean Water Act Section 401 Certification for Commercial Vessel and Large Recreation Vessel General Permit (Nov. 3, 2008, https://www.nwf.org/Regional-Centers/~/media/PDFs/Regional/Great-Lakes/DEC_VGP_401_Certification_final.ashx

[54] NYS Dep't of Envtl. Conservation, Division of Environmental Planning and Protection, Clean Water Act Section 401 Certification for Commercial Vessel and Large Recreation Vessel General Permit (Nov. 3, 2008, https://www.nwf.org/Regional-Centers/~/media/PDFs/Regional/Great-Lakes/DEC_VGP_401_Certification_final.ashx

[55] Knauf Shaw LLP, Clean Water Regulation at 8, https://www.nyenvlaw.com/wp-content/uploads/2015/05/Chapter-4-Clean-Water-Regulation.pdf (last accessed Sept. 27, 2021).

[56] Technology based standards are "performance standards" developed by the EPA within a specific industrial category aimed at determining what levels of discharge pollutant by pollutant, can be achieved using the most cost-effective set of available pollution prevention and control techniques applicable to those types of facilities. Each subcategory of dischargers within an industrial category are required to meet these end of pipe limits, regardless of the condition of the water into which they discharge. Technology standards differ based on the type of pollutant and whether the discharge is new or existing at the time the standards is established. EPA, Watershed Academy Web, Introduction to the Clean Water Act, https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=2734&object_id=2738 (last accessed Oct. 12, 2021).

[57] Since meeting the technology standards does not guarantee that a discharge will not create or contribute to exceedance of the state's ambient water quality standards for the receiving waterbody, regulators must examine the impact of a discharge on water quality even though the discharge will be restricted by the applicable technology limit. If the regulator determines that exceedance is possible even with the applicable technological requirements in place, a more stringent effluent limit (a water quality based effluent limit) must be incorporated into the permit. New York Water Environment Association, Regulatory Overview and Legal Responsibilities, in Handbook on Wastewater Management at 4-56 (Jan. 2013), https://efc.syr.edu/wp-content/uploads/2015/03/Chapter4-web.pdf

[58] Nat. Assoc. of State Dep't of Ag. Res. Found., Nat. Cen. For Ag. Law Res. & Info., State Environmental Laws Affecting New York Agriculture 6, https://efotg.sc.egov.usda.gov/references/public/NY/NewYork.pdf

[59] 6 N.Y.C.R.R. § 700.1.

[60] 6 N.Y.C.R.R. § 704.1.

[61] 6 N.Y.C.R.R. Parts 649-758.

[62] Heat is considered a pollutant pursuant to 6 N.Y.C.R.R. Part 704.

[63] DEC, Permit No. GP-0-20-001, SPDES General Permit for Stormwater Discharges from Construction Activity (January 28, 2020), https://www.dec.ny.gov/docs/water_pdf/constgp020001.pdf

[64] Stormwater Permit for Construction Activity, DEC, https://www.dec.ny.gov/chemical/43133.html (Accessed September 28, 2021).

[65] Nat'l. Assoc. of State Dep't. of Ag. Rsch. Found., Nat'l. Center for Ag. Law Rsch. & Info., State Environmental Laws Affecting New York Agriculture, https://efotg.sc.egov.usda.gov/references/public/NY/NewYork.pdf

[66] New York Water Environment Association, Regulatory Overview and Legal Responsibilities, in Handbook on Wastewater Management at 4-56 (Jan. 2013), https://efc.syr.edu/wp-content/uploads/2015/03/Chapter4-web.pdf

[67] NYS Dept of Envtl. Conservation, Division of Environmental Planning and Protection, Clean Water Act Section 401 Certification for Commercial Vessel and Large Recreation Vessel General Permit (Nov. 3, 2008, https://www.nwf.org/Regional-Centers/~/media/PDFs/Regional/Great-Lakes/DEC_VGP_401_Certification_final.ashx

[68] Nat'l. Assoc. of State Dept. of Ag. Rsch. Found., Nat'l. Center for Ag. Law Rsch. & Info., State Environmental Laws Affecting New York Agriculture, https://efotg.sc.egov.usda.gov/references/public/NY/NewYork.pdf

[69] 6 N.Y.C.R.R. 700.1

[70] NYC Office of Sustainability, Geothermal Pre-Screening Tool at 6 (January 2018), https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/RIVERWATER-ASSESSMENT-FINAL-RPT.pdf

[71] Protection of Waters: Application Procedures, https://www.dec.ny.gov/permits/6333.html (last accessed Sept. 28, 2021).

[72] 6 N.Y.C.R.R. Part 621. Excavation or Fill in Navigable Waters, DEC, https://www.dec.ny.gov/permits/6548.html (last accessed Sept. 28, 2021).

[73] Getting an Environmental Permit, DEC, https://www.dec.ny.gov/permits/6230.html (last accessed Sept. 28, 2021).

[74] Ibid.

[75] N.Y. Env't. Conserv. Law § 25–0201; N.Y. Env't. Conserv. Law § 25–0302.

[76] N.Y. Env't. Conserv. Law § 25–0401(1)

[77] N.Y. Env't. Conserv. Law § 25-0103)

[78] 6 N.Y.C.R.R. § 661.2.

[79] N.Y. Env't. Conserv. Law § 25–0401(2)

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[113] Pursuant to the Accelerated Renewable Energy Growth & Community Benefit Act, S. 7508-B, A. 9508, 2020-21 Reg. Sess. (N.Y. 2020), the Office of Renewable Energy Siting is responsible for siting and permitting new major renewable energy facilities in New York State, which are defined as "any renewable energy system, as such term is defined in section sixty-six-p of the public service law… with a nameplate generating capacity of twenty-five thousand kilowatts or more". Section 66-p of the Public Service Law defines renewable energy systems as "systems that generate electricity or thermal energy through use of the following technologies: solar thermal, photovoltaics, on land and offshore wind, hydroelectric, geothermal electric, geothermal ground source heat, tidal energy, wave energy, ocean thermal, and fuel cells which do not utilize a fossil fuel resource in the process of generating electricity."

[114] A 25 MWth system based on 2.93 kWth per heating ton (3.517/(12,000 BTU/10,000 BTU)) would support 1,700 homes using 5-ton systems and 2,130 homes using 4-ton systems. See Kilowatts to Refrigeration Tons Conversion, RapidTables, available at https://www.rapidtables.com/convert/power/kw-to-ton.html (accessed April 14, 2021).

[115] New York Consolidated Executive Laws, Executive Law Section 94-C(5)(c)(ii).

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[128] DEC Division of Minerals requires that drillers demonstrate that wells do not drift beneath adjacent properties for which the applicant has not received permission from the property owner, by performing angular deviation and directional surveys at 100 ft. intervals during drilling using a gyroscope or other approved method. NYC Department of Design & Construction, Office of Sustainable Design, Geothermal Heat Pump Systems Manual: A Design and Installation Guide for New York City Projects (2012), p. 127.

[129] 9 N.Y.C.R.R. § 428.1

[130] Echo Bay Center Waterfront Redevelopment, Draft Environmental Impact Statement, Appendix 10 Phase 1A literature Review & Sensitivity Analysis (2013), https://www.newrochelleny.com/DocumentCenter/View/2609/DEIS-SECTION-IV-ENVIRONMENTAL-ANALYSES-W-GRAPHICS?bidId=

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[133] New York State Multiple Dwelling Law § 79; New York State Multiple Residence Law § 173.

[134] Section 5(1)(b)-(c) of the Public Service Law.

[135] See, e.g., SZ Enterprises, LLC D/B/A Eagle Point Solar v. Iowa Utilities Board, 850 N.W.2d 441 (Iowa 2014).

[136] Title 16 Department of Public Service, Chapter II Electric Utilities, Part 96.

[137] Public Service Law, §4, 53, 65 and 66.

[138] Title 16 Department of Public Service, Chapter II Electric Utilities, Part 96.1.

[139] Ibid, Part 96.2(b)(2).

[140] Ibid, Part 96.8.

[141] Ibid, Part 96.3(a)(3), 96.4(c).

[142] Ibid, Part 96.3.

[143] Ibid, Part 96.5.

[144] 2006 New York Code - Heating Requirements, §27-740.

[145] City of New Rochelle, 2021 DOZ Amendments Supplemental Draft Generic Environmental Impact Statement, Appendix A-4 Zoning Code Update Draft Proposed Revision (May 19, 2021), https://www.newrochelleny.com/DocumentCenter/View/14232/Appendix-A-4-DOZ-Draft-Zoning-Amendments_-5-19-2021

[146] Pratt Landing is currently zoned as a Planned Waterfront Development District (PWD-5). PWD-5 is a mixed-use district intended to "encourage mixed-use water-dependent and water related [uses], possibly including residential and commercial development, to preserve view of the water and smaller harbor area… and to encourage, whenever possible, public access to and enjoyment of the waterfront."

[147] City of New Rochelle, 2021 DOZ Amendments Supplemental Draft Generic Environmental Impact Statement, Appendix A-4 Zoning Code Update Draft Proposed Revision (May 19, 2021), https://www.newrochelleny.com/DocumentCenter/View/14232/Appendix-A-4-DOZ-Draft-Zoning-Amendments_-5-19-2021

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[150] City of New Rochelle, GreeNR, The City of New Rochelle Sustainability Plan 2010-2030 (2010), https://www.newrochelleny.com/DocumentCenter/View/2054/GreeNR?bidId=

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[153] Ibid.

[154] City of New Rochelle, NY, The Code pt. II art. 4 § 111-33.

[155] Ibid, The Code pt. II art. 4 § 111-34.

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[159] City of New Rochelle, NY, The Code pt. II art. 3 § 281-45.

[160] Westchester County, Rules & Regulations of the Department of Environmental Facilities, County Environmental Facilities Act, Section 824.91.

[161] David P. Ross, U.S. Env. Protection Agency, Office of Water, Memorandum on Endangered Species Action Section 7(a)(2) Consultation for State and tribal Clean Water Act Section 404 Program Approvals (2020) https://www.oregon.gov/dsl/WW/Documents/ESAconsultationpolicyfor404-20200827.pdf

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[163] Oxana Šnajberg, Valuation of Real Estate with Easement, Procedia Economics & Finance 25 at 420-27 (2015).

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[165] Lisa Gonzales, All Aboard for Reformed Railroad Right-of-Way Crossing Rules, Community Networks (Feb. 19, 2019), available at https://muninetworks.org/content/all-aboard-reformed-minnesota-railroad-right-way-crossing-rules (accessed March 7, 2021).

[166] 42 U.S.C. §7675.

[167] 86 Fed. Reg. 55,116 (2021).

[168] EPA, Final Rule – Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the American Innovation and Manufacturing (AIM) Act (Sept. 2021), https://www.epa.gov/system/files/documents/2021-09/hfc-allocation-final-rule-faq-sept2021.pdf

[169] EPA, EPA Acts on Petitions to Cut Climate-Damaging HFCs, Will Begin AIM Act Rulemaking Process (Oct. 8, 2021), https://www.epa.gov/newsreleases/epa-acts-petitions-cut-climate-damaging-hfcs-will-begin-aim-act-rulemaking-process

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[171] Mexichem Fluor, Inc. v. Environmental Protection Agency, 866 F.3d. 451 (D.C. Cir. 2017).

[172] 6 N.Y.C.R.R. Part 494.

[173] Specifically, SNAP rule 23 lists R-452B, R-454A, R-454B, R-454C and R-457A as acceptable substitutes, subject to use conditions, for use in residential and light commercial air condition and heat pumps for new equipment; and R-32 as acceptable subject to use conditions, for use in residential and light commercial AC and heat pumps (other than self-contained room air conditioners) for new equipment. EPA, Snap Regulations, https://www.epa.gov/snap/snap-regulations (Accessed Dec. 15, 2021).

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