STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISSION

Docket No. DG 22-045

Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty

Winter 2022-2023 and Summer 2023 Cost of Gas

DIRECT TESTIMONY

OF

JOHN C. MURPHY, CCM, CHMM

and

JAMES M. WIECK, P.G.

December 30, 2022

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LIST OF ATTACHMENTS

ATTACHMENT A	OPINION OF PROBABLE COSTS

I. INTRODUCTION

Q. Please state your name, title, and business address.

A. JCM – My name is John C. Murphy. I am a Certified Construction Manager, Senior Principal, and the Chief Operating Officer of GZA GeoEnvironmental, Inc. ("GZA"), 5 Commerce Park North, Suite 201, Bedford, NH 03110.

JMW – My name is James M. Wieck. I am a Professional Geologist, Hydrogeologist and an Associate Principal at GZA, 5 Commerce Park North, Suite 201, Bedford, NH 03110.

Q. On whose behalf are you submitting this testimony?

A. We are testifying on behalf of Liberty Utilities (EnergyNorth Natural Gas) Corp. ("Liberty").

Q. Please describe your educational and professional background.

A. See Attachments JCM/JMW-1 and JCM/JMW-2 for our CVs.

Q. Please describe your duties at GZA.

JCM –In my current role at GZA, I serve as Chief Operating Officer for the firm. I am also responsible for management, oversight, and technical review for a variety of environmental, energy, building, heavy construction, demolition, and facility closures projects throughout the United States.

A.

JMW – In my role at GZA, I serve as an Associate Principal for the firm. I am also responsible for the management, oversight, and technical review for a variety of environmental site investigation, remediation, and water supply projects principally within New Hampshire.

Q. Have you previously testified in regulatory proceedings before this Commission?

A. No, we have not.

Q. Have you testified in other regulatory or judicial jurisdictions?

A. No, we have not.

A. ?

II. PURPOSE OF TESTIMONY AND EXECUTIVE SUMMARY

Q. What is the purpose of your testimony?

A. The purpose of our testimony is to (1) provide a brief history of the gas holder house structure (the "Gas Holder") and the site on which it sits at One Gas Street, Concord, New Hampshire (the "Gas Holder Site"); (2) explain the nature of the contaminants that have been, and that remain, at the Gas Golder Site; (3) explain the Remedial Action Plan ("RAP") that has been approved by the New Hampshire Department of Environmental Services ("NHDES") to address the contamination at the Gas Holder Site; (4) describe the remedial efforts Liberty has taken at the site to date and that GZA expects will be taken in the future; (5) explain the role that the Gas Holder is currently serving within the scope of the RAP and the role that it could play in the future; (6) explain what would happen with regard to the RAP if the Gas Holder was demolished; (7) describe key

elements of the agreement between Liberty and the New Hampshire Preservation Alliance (NHPA); and (8) describe the Owner's Estimate prepared by GZA and the role it plays in this proceeding.

Q. Are you sponsoring any required schedules or Exhibits? – if applicable

A. Attached in Exhibit A is GZA's Opinion of Probable Costs associated with anticipated activities if the Gas Holder was demolished.

III.

Q. What is the basis of your knowledge of the Gas Holder and the Gas Holder Site?

A. Liberty and its immediate predecessor, National Grid, have retained GZA to advise Liberty on aspects of assessing the contamination at the Gas Holder Site. We have personally been working with Liberty and National Grid on the Gas Holder Site since 2008.

GZA essentially acts as Liberty's prime contractor for environmental issues related to the Gas Holder Site, working closely with Liberty. In that role, we have conducted examinations of the contamination on and beneath the Gas Holder Site. We developed strategies to remedy the contamination. We prepared the necessary reports and filings to obtain NHDES approval of our proposed remediations, culminating in NHDES approving the current RAP in 2015, and we have been executing that remediation program in recent years. The remediation has included removing contaminated soils that were at or near the surface, removing the contents of subsurface structures formerly used to manufacture coal gas at the site including potentially mobile sources of contamination,

monitoring of water quality below surface, and will ultimately involve installing a "cap" over the entire Gas Holder Site., which we describe below.

Q. Please provide a brief history of the "Gas Holder" and the Gas Holder Site.

Beginning in the 1850s, decades before natural gas pipelines reached Concord in the early 1950s, Liberty's predecessor companies manufactured gas from coal at the Gas Holder Site. Various buildings on the Gas Holder Site played specific roles in the manufacturing process which, simply stated, consisted of heating the coal to create a flammable gas. The manufactured gas was captured and moved to the Gas Holder.

The Gas Holder, constructed in 1888, is a round brick building that is 88 feet in diameter, rises approximately 72 feet above grade, and extends approximately 25 feet below grade. Inside the Gas Holder is a large metal tank with an open bottom, similar to an upside-down cup, that would rise and fall with the amount of gas injected into tank. As gas was injected into the tank, the tank rose, riding on rails on the inside walls of the Gas Holder. The weight of the tank provided sufficient pressure to push the gas out of the Gas Holder through a pipeline distribution system to reach customers in the Concord area, similar to the current distribution system. Liberty has been replacing cast iron pipes throughout Concord that were installed to deliver manufactured gas from the Gas Holder and continue to deliver natural gas today. As the gas left the Gas Holder, the dome would drop, until more gas was injected from the manufacturing process.

Thus, the Gas Holder functioned both as a storage tank and as a pressure regulator.

Q. What is the nature of the contaminants that have been, and that remain, present at the Gas Golder Site?

A. The byproducts of the manufactured gas process include a heavy, thick, tar-like substance, called a non-aqueous phase liquid (or NAPL) and other residues from the processing of the coal gas. The residues contain a large number of regulated contaminants, which are toxic to humans and to other organisms. Many of the contaminants can be transported in air and water. As groundwater flows past the manufactured gas byproduct contamination in soil, the water picks up some of the contaminants, which are dissolved in the water as it flows away from the site and toward rivers (the Merrimack River in the case of the contaminants at the Gas Holder Site) and other water sources where the water comes into contact with people, other animals, and plants. Certain contaminants can move into the atmosphere from soil or groundwater under certain conditions.

Q. Please explain the RAP that has been approved by NHDES to address the contamination at the Gas Holder Site.

A. Remediation of the MGP byproducts usually involves one or both of two methods. If the soil is heavily contaminated and/or it can be removed relatively easily, the contaminated soil can be removed, treated, then returned to the site or disposed of at an appropriate facility. If the soil is less heavily contaminated and/or it would be very difficult or expensive to remove, as in the case with the Gas Holder Site the remediation can consist of constructing barriers or caps that prevent contact with contaminated soils and limit

groundwater from becoming contaminated or of constructing wells to remove mobile tar-like MGP byproducts and/or contaminated water.

The specifics of a particular site determine which of the above methods, or which combination of these methods, are employed to remedy the contamination. For the Gas Holder Site, we recommended a remediation plan that consists of (1) removing localized and readily accessible "hot spots" of contaminated soil, (2) removing the contents of historic subsurface structures to prevent further contamination of the subsurface, (3) installing of a series of monitoring and removal wells that can both monitor the level of groundwater contamination and remove tar-like MGP byproducts, (4) constructing a cap over the entire site to prevent contact with contaminated soil and limit the infiltration of water through the soil, which will limit the contamination that could be carried off site toward the Merrimack River, and (5) implementing deed restrictions on excavation to control excavation within areas of contaminated soil thereby limiting the potential for exposure to contaminated soil and groundwater.

NHDES approved this approach to remedy the contamination at the Gas Holder Site

Q. Has Liberty Taken any of these remedial steps?

A. Yes. Liberty has completed the first step – removal of hot spots at the Gas Holder Site. Over the past few years, Liberty remediated the identified historical subsurface structures and removed areas of contaminated soil. This soil was in areas where the manufacturing process occurred and where the contaminated residue was stored, which locations were

away from the Gas Holder itself. Liberty has completed the removal of known shallow hot spots that we believe are appropriate for removal.

Liberty has also implemented the second step which includes removal of mobile tar-like MGP byproducts from four wells and groundwater monitoring. A total of 37 groundwater monitoring wells are currently monitored routinely under a Groundwater Management Permit issued by the NHDES. Water level and contaminant concentrations are monitored to evaluate the fate of the contaminants and manage their presence in groundwater, as wells as evaluate the long-term effectiveness of the remedies included in the RAP. This second remedial step is not complete because the wells continue to monitor and continue to remove small quantities of mobile tar-like MGP byproducts. We expect this monitoring and removal processes will be in place for many years, as is typical of manufactured gas sites.

The third and fourth remedial steps, have not been implemented. These steps will include the construction of a soil cap over the site. The cap design and restrictions on excavation will be selected based on the future use of the site, which has yet to be determined.

Most relevant to this testimony is that the Gas Holder itself can serve as an appropriate cap for its 88-foot diameter footprint because it will both restrict access to subsurface contamination and prevent rainwater and snow melt from penetrating the soil beneath that footprint. Thus, so long as the Gas Holder stands, it will serve as a cap over its 88-foot diameter and Liberty will have to construct the cap over the rest of the site. If the Gas

Holder is demolished, then the Company will have to extend the cap to also cover the 88-foot diameter circle where the Gas Holder now stands.

Q. Why has Liberty not yet installed the cap over the Gas Holder Site?

A. The cap has not been installed for two basic reasons. First, the other remedial steps (removal of contaminated hot spots of soil and installation of monitoring and removal wells) had to be completed prior to installing a cap. Once the cap is installed, every effort is made not to make new penetrations for additional wells or removal of more soil, so these first step had to be implemented before it would be appropriate to install the cap.

Second as agreed to by NHDES, the ultimate use of the Gas Holder Site will dictate the precise details of how and where the cap will be installed. The Gas Holder Site has a significant slope, from its highest point on its northwest border adjacent to South Main Street to its lowest point on the southeastern border along the railroad tracks. The cap should not be installed until the final contours of that slope are known, and those final contours cannot be determined until Liberty knows the long-term use of the property. For example, if the Gas Holder Site were to have the Gas Holder but also have a parking lot or picnic area, Liberty would have to determine the location of the new parking lot, the location of any new underground utilities, and whether and how the Gas Holder Site will be graded to accommodate the changes. Liberty would also have to wait until that grading work was complete before installing the cap.

The final use of the Gas Holder Site is still unknown. Several developers looked at the site and indicated high level plans of what they would do, but none made any firm

commitments and they have not shown any interest in several years. Recently, of course, the NHPA and Liberty have invested in the initial stabilization of the Gas Holder with the intent to develop long term plans for use of the Gas Holder Site that includes preservation of the Gas Holder. Given this uncertainty as to the future of the Gas Holder Site, Liberty has not yet moved forward with the cap. NHDES has been aware of these events and has allowed Liberty to continue to hold off on the design and construction of the cap until at least 2026 to provide time for Liberty and NHPA to raise funds for further repairs to the Gas Holder and determine the future site use.

Q. What role does the Gas Holder play within the scope of the RAP and what role could it play in the future?

A. As mentioned above, the Gas Holder is currently serving as a cap over its footprint. Going forward, if the Gas Holder remans standing and its roof remains sound, it can continue to serve as a cap over its footprint indefinitely. NHDES is aware of the plan to keep the Gas Holder standing and of Liberty's intent to have the Gas Holder be the "cap" over its footprint, and NH DES indicated it approves that approach.

Q. What would happen with regard to the RAP if the Gas Holder was demolished?

A. If the Gas Holder was to be demolished, then the same remedial steps of the RAP would apply to the 88-foot circle. That is, Liberty would have to investigate the soils within that 88-foot circle, remove any accessible shallow soil hot spots, install wells to measure, monitor, and remove any potentially mobile tar-like MGP byproducts found, and also construct a cap.

Q. Does NHDES have a preference as to whether the Gas Holder remains standing?

A. No. In conversations with NHDES, it is our understanding that NHDES would consider Liberty to be in compliance with the RAP if the Gas Holder remained standing, so long as the roof was sound and doing its job of preventing water from entering the 88-foot circle, or if the Gas Holder came down and Liberty did the appropriate investigation and remediation of any contamination found in that 88-foot circle.

Q. Are you aware of the Emergency Stabilization License Agreement ("Agreement") signed by Liberty and the New Hampshire Preservation Alliance (NHPA)?

A. Yes, we were involved in reviewing and providing advice on the technical aspects of the Agreement.

Q. What are the key provisions of the Agreement from your perspective?

A. We understand the Agreement to (1) authorize NHPA and is contractors to enter the Gas Holder Site to perform construction work to stabilize the Gas Holder; (2) impose standards on the contractors' work on the Gas Holder; (3) allow for Liberty to monitor the work, which monitoring was performed by GZA; and, most important to this testimony, (4) provide for Liberty to contribute toward the costs of stabilizing the Gas Holder the amount Liberty would otherwise have spent to demolish the Gas Holder and conduct the above-described investigation and remediation of the soil beneath the Gas Holder.

Q. How does the Agreement determine the amount that Liberty will contribute toward the stabilization of the Gas Holder?

A. The Agreement calls for Liberty to prepare an Owner's Estimate of the costs Liberty would incur to demolish the structure, investigate the soil beneath the Gas Holder, and take the remediation steps that we think would likely be necessary if the Gas Holder had to be demolished.

Q. Has that Owner's Estimate been prepared?

A. Yes. GZA prepared the Owner's estimate, which is Attachment A.

Q. How was the Owner's Estimate Prepared?

A. We first prepared an overall approach to demolition and capping of the Gas Holder. This process included assessing the presence of potentially hazardous building materials used in the construction of the Gas Holder. We then prepared a bid package for submission to demolition contractors. Our bid package provided extensive details of the work to be performed in demolition of the Gas Holder, to ensure the bidders recognized both logistical and management complexity of such a project. In 2021 we sent the bid package to a number of contractors whom we know are qualified to perform the work. We received three bids in response. The lowest responsible bid, adjusted for inflation through use of a contingency, was used in the final Owner's Estimate.

We next estimated the type and extent of work that would be involved in the investigation into possible contamination beneath the Gas Holder. We assumed that we would follow the same approach that has governed all our work at the Gas Holder Site

and that is embodied in the RAP – investigation into the extent of contamination, removal of any contaminated soil that would be accessible, installation of monitoring and recovery wells, and installation of a cap. This approach was reviewed and discussed with NHDES on several occasions in both March and December of 2021.

The investigative steps that would be taken are clear as they are what the RAP currently requires and is consistent with the investigative work we have done on the rest of the Gas Holder Site. Those investigative steps would include 1) assessment of the condition of the Gas Holder foundation for potential paths contamination could take from the Gas House to the subsurface, 2) excavation of test pits within the foundation of the Gas House, 3) drilling of soil borings and installation of monitoring wells beneath the Gas Holder. GZA estimated the cost to complete investigation to be $329,375. The cost of the investigation reflects the technical difficulties of accessing and working within the foundation of the Gas Holder with heavy equipment.

The costs to remediate contamination found beneath the Gas Holder are less certain and are somewhat speculative because, of course, we do not know for sure what will be found if we have to perform this investigation. Therefore, we relied on our experience with this and other manufactured gas sites and we made professional judgments of the likelihood of finding contamination beneath the Gas Holder and of the likely extent of that contamination based on the degree of contamination downslope from the Gas Holder and the construction details of the Gas Holder reviewed in historical site documents. This process included receiving input from a third-party consultant hired by NHPA (Haley &

Aldrich) which was considered when to developing GZA's estimated range of potential costs to remediate contamination found beneath the Gas Holder. The range of cost estimated by GZA was prepared for planning purposes and is based on our experience at the Site. GZA agrees with Haley & Aldrich, as presented in their December 20, 2022 memorandum to NHPA, that actual costs for remediation are uncertain and could vary significantly from the range estimated by GZA for planning purposes.

Consequently, we consider this to be a conservative assessment of the necessary investigative steps and the remediation efforts to address the contamination that could be found beneath the Gas Holder, and of the costs to perform those tasks.

Q. What are the estimated costs for these investigative and remedial steps?

A. We estimate those costs to include approximately $329,375 to perform required tasks to complete the subsurface investigation required by NH DES. As noted above the degree to which the presence of the Gas Holder has impacted the subsurface beneath the Gas Holder cannot be fully known, consequently we estimated a likely range of remediation costs, which is from $531,606 to 1,219,492. These costs do not include the cost of demolition and cap construction which are estimated at $788,750 and $41,875, respectively.

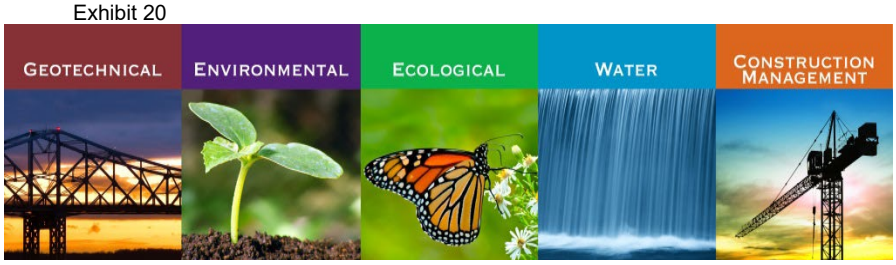
Q. What is the total amount of the Owner's Estimate?

A. Combining the figures described above, we estimate that Liberty would have to spend $1,691,606 to $2,379,492 to demolish the Gas Holder, investigate the area beneath the Gas Holder, remediate the contamination that may be discovered, and associated costs.

For planning purposes GZA has recommended Liberty use $2,035,549, which is the total of the estimated demolition, investigation, and cap construction ($1,128,750) plus the midpoint of the estimated range of potential remediation ($906,799),

Q. Does this conclude your prefilled direct testimony?

A. Yes.



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CALCULATION OF BASIS OF MAXIMUM OWNER CONTRIBUTION

1888 GAS HOLDER HOUSE DEMOLITION ALTERNATIVE

Manufactured Gas Plant

Concord, New Hampshire

December 27, 2022
File No. 04.0029644.03

PREPARED FOR:

Liberty™

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1.0 INTRODUCTION

GZA GeoEnvironmental, Inc. is pleased to present this letter report providing our opinion of probable costs (OPC) for known and potential regulatory required environmental services related to the demolition of the 1888 Holder House at the former Concord Coal Gas Site[1] (Site), should demolition of the structure become necessary. GZA's OPC was prepared to provide a basis for the calculation of the Maximum Owner Contribution to the repair of the Holder House under the Emergency Stabilization License Agreement (Agreement) between The New Hampshire Preservation Alliance (NHPA) and Liberty Utilities (Energy North Natural Gas) Corp. (Liberty Utilities).

Liberty Utilities desires to contribute to the total cost of stabilizing and preserving the Holder House an amount no greater than the aggregate estimated cost of demolishing the Holder House and gas holder, performing an environmental investigation beneath the area currently made inaccessible by the Holder House, removing or managing contamination found beneath the Holder House that would be made accessible by the demolition process, and installing a cap over the Holder House footprint. The work must be consistent with the objectives and remedial alternatives described in the Remedial Action Plan[2] (RAP) prepared for the Site or any RAP amendment required by the New Hampshire Department of Environmental Services (NHDES), and the funds spent on a plan that will ensure the long-term viability of the building's service as a cap as required by the RAP. The Agreement between Liberty Utilities and NHPA outlines a detailed phased stabilization plan, NHDES, and NH Public Utilities Commission approval requirements and further defines use of this OPC in defining the Maximum Owner Contribution. As outlined in the Agreement, during development of the OPC by GZA, Haley & Aldrich of Bedford, New Hampshire was retained jointly by Liberty Utilities and NHPA to review the approach and estimates presented herein.

The tasks included in the OPC described in this letter report were selected to be consistent with the RAP for the Site, which was conditionally approved by the NHDES in their letter[3] dated May 29, 2015, and additional guidance provided by NHDES in their letter[4] dated February 24, 2014. The tasks included in the OPC are consistent with GZA's understanding of Site conditions as described in GZA's conceptual Site model (CSM) and reflect our understanding of historical Site use, Site, and vicinity hydrogeology, and identified potential receptors to manufactured gas plant (MGP) byproduct contamination associated with the Site. A copy of GZA's CSM for the Site is included in the year 2021 annual summary report[5] (ASR) prepared by GZA for the Site, including the results of recent monitoring. GZA's ASR for 2021 is available on the NHDES online OneStop website. General descriptions of the tasks included in this OPC were reviewed by NHDES during a meeting with Liberty Utilities, NHPA, and GZA on Thursday, September 30, 2021. NHDES commented during the meeting[6] that the alternatives presented seemed appropriate based on what was currently known.

[1] Site address One Gas Street, Concord, New Hampshire. NHDES Site Number 198904063, Project RSN #1479.

[2] RAP prepared by GZA titled "*Report, Remedial Action Plan, Former Concord MGP Gas Street Site, Concord, New Hampshire, NHDES Site No. 198904063, Project RSN # 1479*," dated April 1, 2015.

[3] Letter by NHDES titled "*Concord – Former Concord Manufactured Gas Plant (MGP) Site, Gas Street, DES Site #198904063, Project #1479, Remedial Action Plan, prepared by GZA GeoEnvironmental, Inc. (GZA), and dated April 1, 2015*."

[4] Letter by NHDES titled "*Concord – Former Concord Coal Gas Site/Manufactured Gas Plant, DES Site #198904063, Project #1479, Letter Regarding Brick Gas Holder House Status, prepared by GZA GeoEnvironmental, Inc., and dated January 29, 2014*."

[5] Report by GZA titled "*Annual Summary Report – Monitoring Year 2021, Former Concord Coal Gas Site, One Gas Street, Concord, New Hampshire, Groundwater Management Permit No. GWP-198904063-C-002, NHDES Site No. 198904063, Project RSN #147*," dated March 1, 2022.

[6] Refer to memorandum by GZA titled "*Meeting Minutes – Concord, Gas St. – 1888 Holder House, Conceptual Investigation and Remediation Scope Discussion*," dated December 6, 2021.

The following sections summarize background information and describe the known and potential tasks on which our OPC is based, including primary assumptions. This letter report and GZA's OPC are subject to the Limitations included in **Appendix A**.

2.0 BACKGROUND

2.1 HOLDER HOUSE HISTORICAL SUMMARY & CONDITION

The vacant, approximately 2.4-acre Site is located at the South Main Street/Gas Street intersection in Concord, New Hampshire. The terrain is generally open with some overgrown brush and a few mature trees and moderately slopes downward from South Main Street in an easterly direction toward existing rail lines. Grassed areas are mowed regularly to maintain a neat appearance. The Site is enclosed by a series of chain-link fences and locked gates to mitigate trespassing. The only structure remaining from the former MGP facility is the Holder House, that stands in the northwest corner of the Site, approximately 15 feet east of South Main Street (**Figure 1**).

The circular Holder House structure was constructed in 1888 and houses an approximately 80-foot-diameter riveted iron plate gas holder (tank) that was once connected to the City of Concord's gas distribution system. The iron plate holder consists of a circular top and sidewall that is approximately 24 feet in height. The holder sits within the approximately 24 feet deep Holder House foundation and is open to the foundation at the bottom. The Holder House is approximately 88 feet in diameter and has 27-foot-high brick masonry walls. The conical roof is constructed using heavy timbers and is covered with slate shingles.

The gasholder was originally designed to travel up and down inside the Holder House as gas was pumped into the holder and then out into the gas distribution network. As such, there were no interior roof or wall supporting elements that would interfere with its operation. Historical drawings depicting the construction of the gas Holder House are included on **Figure 2**. Although not depicted on historical drawings of the 1888 Holder House, a brick central pillar is located within the foundation of the Holder House. The holder was supported by the pillar when the gas pressure within the holder is not sufficient to lift the holder and is currently resting on the pillar.

Reportedly, the gas holder and Holder House are the last surviving, intact holder and holder house of its type in the United States.[7] The Holder House is included in the Library of Congress collection of Historic American Building Survey/Historic American Engineering Record, and during 2018 was included in the National Register of Historic Places.

Stabilization elements anticipated to have been constructed during the 1990s consist of a center platform supported by four-spoke beams that extended to the interior wall line, where they engage the building's foundation. The platform is also supported by the central brick pillar. A shoring system of modular scaffolding was erected from the platform to the roof to partially support the cupola until a permanent solution could be implemented in 2010, the platform and shoring were updated to allow safer access to the cupola for window repairs.

A tree fell onto the north side of the conical roof of the Holder House during a storm in June 2013. Liberty Utilities designed temporary repairs to the roof in 2013 and installed temporary roof repairs in during 2014. A combination interior/exterior shoring system was erected, and temporary repairs were made to the roof to stabilize the structure. Completion of the repairs was technically challenging and costly due to the presence of the holder and

[7] Hatheway, A., W., 2012, Remediation of Former Manufactured Gas Plants and Other Coal-Tar Sites, CRC Press, Boca Raton, FL, p. 444.

lack of a structure within the Holder House from which to access and repair the roof. The overall condition of the roof was observed as part of the repair work, and deterioration of the roof and related critical structural elements due to the passage of time and historic weathering, in addition to the impact by the tree, was identified as a significant impediment to permanent repair.

Since completion of the temporary repairs in 2014, Liberty Utilities and the City have been working to identify a developer that would fully repair the Holder House as part of the future use of the Site, and thereby maintain the barrier function provided by the Holder House. Although several developers have expressed interest and performed preliminary development studies, no development is planned at this time.

In late 2021, a stabilization Agreement between Liberty Utilities and NHPA was finalized, and design, planning, and procurement activities commenced. The first phase of stabilization efforts began when a historic preservation contractor, Yankee Steeplejack Company, Inc., of Harvard, Massachusetts, mobilized to the Site in early March 2022. Stabilization work was well underway at the time this letter report was prepared.

2.2 HOLDER HOUSE FUNCTION

When operating, the foundation of the Holder House contained water, used to create a gas-tight seal, and the holder rose and fell depending on the pressure exerted on the holder by the coal gas. The production of gas at the Site was discontinued in the 1950s and residual MGP byproducts removed from the interior of the Holder House foundation during the 1990s. Relative to the management of historic MGP byproduct contamination at the Site, the Holder House currently provides a physical barrier to the contamination and prevents potential contaminant transport due to the infiltration of precipitation.

As noted by the NHDES in their May 29, 2015, letter approving the RAP, " *we believe that maintaining (restoring) the gas holder building would provide a physical barrier to prevent infiltration of precipitation into the foundation of the structure and deeper subsurface soils. This would limit the amount of MGP-related residual contaminants that could be released to the environment. As indicated in the referenced letter, the Department remains concerned that the roof must be restored to not only provide the environmental protections but also to prevent further deterioration of the roof and building structure*."

The NHDES also noted that "*In the event that the holder structure was to be razed, the potential for infiltration of precipitation into the foundation would be unrestricted. This condition would increase the potential for both dissolved-phase contaminants and NAPL to be released to the environment. In the absence of the physical containment afforded by the gas holder, the Department would likely need to require that the RAP include a remedial element to remove or treat MGP-contaminated soils that may be present beneath the gas holder and would then likely be accessible."*

GZA's and NHDES' opinions regarding the role of the Holder House as a cap relative to the remedial strategy for the Site are also described in GZA's letter[8] dated January 29, 2014, and NHDES's letter[9] dated February 24, 2014.

[8] Letter by GZA titled "*Brick Gas Holder House Status, Former Concord Coal Gas Site/Manufactured Gas Plant (site), One Gas Street, Concord, New Hampshire, DES Site # 198904063, Project RSN # 1479*."

[9] Letter by NHDES titled "*Concord – Former Concord Coal Gas Site/Manufactured Gas Plant, DES Site #198904063, Project #1479, Letter Regarding Brick Gas Holder House Status, prepared by GZA GeoEnvironmental, Inc., and dated January 29, 2014*."

2.3 STATUS OF SITE REMEDIATION

The remedial alternatives selected to address historic MGP byproduct contamination at the Site, as described in the RAP, include:

1. Excavation and inspection of certain subsurface structures to identify and remove readily accessible and potentially mobile MGP byproduct source material.
2. Excavation of known areas of solid tar and tar-saturated soils within the upper 2 feet below ground surface to limit the potential for direct contact with MGP byproduct contamination.
3. Construction of an engineered cap (Cap) to limit the long-term potential for workers to come in direct contact with Site contaminants. Also, designed, to the extent practicable, to limit infiltration of precipitation and the resulting and leaching of contaminants from Site soils to groundwater.
4. Periodic recovery of dense nonaqueous phase liquid (DNAPL), where practicable, from existing monitoring wells.

As documented in GZA's ASR for 2021, known subsurface structures and readily accessible sources of solid tar and tar-saturated soils at the Site have been excavated, and recovery of DNAPL is ongoing. The construction of the Cap remains to be completed along with certain follow-up activities related to work completed during 2020, as described in NHDES' letter[10] dated April 28, 2020.

An important part of the intent of the engineered Cap is to accommodate redevelopment of the Site. Consequently, the design of the Cap has been deferred pending determination of the future use of the Site, so that the Cap can be designed to accommodate the future Site use. Despite efforts by the Liberty Utilities and City of Concord, a developer/future use of the Site has not been identified. Access to the Site remains restricted by chain-link fence and locked gates. The security fence has been recently upgraded and reinforced by Liberty Utilities.

As described in the RAP, the lateral and vertical distribution of MGP byproduct contamination beneath the Site and vicinity and physical constraints related to the historic development of the Site vicinity, including transportation infrastructure, in the absence of potential receptors, make the remediation of residual soil contamination beneath the Site impractical. However, potentially mobile nonaqueous phase liquid (NAPL) represents a source of further contamination of the subsurface and is the focus of the remedial efforts at the Site. The known and potential tasks included in the OPC were selected to be consistent with the overall remedial approach for the Site, which was implemented in consideration of these conditions.

3.0 REQUIRED TASKS (DEMOLITION AND INVESTIGATION)

3.1 HOLDER HOUSE DEMOLITION

The OPC includes the complete demolition and removal of the above-ground elements of the Holder House and capping in place the below-ground portions of the structure. The top of the foundation wall would be left in place and would stand above the ground surface. For this option, GZA worked with Select Demolition, Inc. of

[10] Letter by NHDES titled "*Concord – Former Concord Manufactured Gas Plant (MGP) Site, 1 Gas Street, DES Site #198904063, Project #1479, 2020 Annual Summary Report, as prepared by GZA GeoEnvironmental, Inc., and dated February 19, 2021*."

Salem, New Hampshire and Leighton A. White, Inc. of Milford, New Hampshire to develop a demolition approach that includes the following tasks and assumptions:

- **Demolition Planning** – Preparation of a workplan expanding on the task descriptions included herein for review and approval by the City of Concord and NHDES and obtaining demolition permits (Concord Demolition Review Committee approval required).

- **Mobilization and Site Preparation** – GZA's OPC for this task assumes/includes:

  - Site access through the Gas Street entrance gate.
  - Identified asbestos and hazardous materials removed based on limited hazardous building material assessment[11] by GZA dated March 19, 2021.
  - Standing water in gasholder water removed (assumed 30,000 gallons based on gauging from top of holder) with waste profile based on sampling results included in GZA's 2020 ASR[12].
  - Utilities cut/disconnected within Site limits, including removal of existing Holder House perimeter lighting system. Excludes active gas lines that transect the Site (not connected to Holder House).

- **Demolition of Holder House –** Demolition of the structure of the Holder House above the top of the foundation wall and demolition of the central brick pillar. GZA's OPC for this task assumes/includes:

  - Demolition and holder removal performed using conventional demolition equipment.
  - Demolition performed over two months.
  - Salvage retained by contractor ($10,000 allowance included for preservation of certain building components).

- **Cap Construction and Site Restoration –** Includes construction of an engineered cap throughout the footprint of the Holder House. GZA's OPC for this task assumes/includes:

  - Construction of a minimum 2-foot-thick low permeability soil cap with marker barrier.
  - Restoration will include grading, loam, and seed of disturbed areas.
  - Long-term monitoring of the cap is included with ongoing Site management and is not included in the OPC.

3.2 HOLDER HOUSE FOOTPRINT SUBSURFACE INVESTIGATION

Consistent with the RAP, which includes managing residual soil contamination using administrative controls and an engineered Cap, the required subsurface investigation is focused on the identification of potentially mobile NAPL[13]. The investigation includes the following primary tasks:

[11] Report by GZA titled "*Limited Hazardous Building Materials Assessment, Holder House, 1 Gas Street, Concord, New Hampshire*."

[12] Report by GZA titled "*Annual Summary Report – Monitoring Year 2020, Former Concord Coal Gas Site, One Gas Street, Concord, New Hampshire, Groundwater Management Permit No. GWP-198904063-C-002, NHDES Site No. 198904063, Project RSN #1479*," dated February 19, 2021.

[13] Including dense NAPL (DNAPL) and light NAPL (LNAPL).

- **Site Investigation Workplan** – Preparation of a workplan/RAP addendum expanding on the task descriptions included herein for review and approval by NHDES.
- **Holder House Foundation Condition Assessment** – Observation and documentation of the physical condition of the surface of the Holder House foundation following removal of holder and dewatering of foundation. The objective of this task is to identify and document potential penetrations of the foundation that could have allowed MGP byproducts to move into the subsurface. Potential penetrations may include piping and structural components that extend through the foundation, as well as substantial cracks in the foundation. The assessment will focus on the portion of the foundation that is anticipated to have historically contained liquid (NAPL and or water). The observations will be used to select locations for excavation of test pits and/or drilling of soil borings. GZA's OPC for this task assumes/includes:
  - The observations will be completed by two persons over two 8-hour days on the Site.
  - Entry into the foundation via a ladder utilizing fall protection.
  - Photographic documentation, measurement, and visual characterization of each potential penetration identified.
  - Observations will be sufficient to prepare a plan documenting the conditions for submittal to NHDES.
- **Test Pit Excavation –** Excavation of test pits through the foundation to make visual observations of underlying soils. Test pits will be excavated at locations selected based on the foundation condition assessment using a mini excavator placed in the foundation using a crane. GZA's OPC for this task assumes/includes:
  - Construction of a gravel access/tracking pad for excavator (access from South Main St.).
  - Placement of up to 500 cubic yards of ¾-inch stone fill within the foundation to construct a level working platform for a mini excavator (Includes 10 days of min excavator subcontractor services and two days of crane subcontractor services).
  - The test pits will be completed by two persons over four 8-hour days on Site.
  - Two days of concrete cutting/breaking and crane subcontractor services.
  - A maximum concrete thickness of 12-inches (based on Historical information from similar holder houses).
  - Documentation of the location of the test pits and soil conditions encountered sufficient to prepare a plan documenting the conditions for submittal to NHDES.
- **Foundation Backfill** – The foundation will be backfilled to grade to enable entry into the footprint of the Holder House by a track-mounted drill rig. GZA's OPC for this task assumes/includes:
  - Placement of approximately clean masonry debris and imported fill within the foundation of the Holder House. Fill would be brought to within approximately 2 feet of the current Site grade adjacent to South Main Street to allow for construction of a low-permeability cap as described in **Section 3.1**.
- **Boring and Monitoring Well Construction** – Drilling and construction of seven overburden and three bedrock monitoring wells within the footprint of the Holder House. GZA's OPC for this task assumes/includes:
  - Depth to bedrock, based on existing Site borings, of 35 feet below grade.

- Overburden borings extend to bedrock (*i.e.*, 35 feet below grade).
- Bedrock borings drilled 15 feet into bedrock.
- Borings and monitoring well construction can be completed in 11 days using a track-mounted drill rig.
- Monitoring wells will be constructed using 2-inch internal diameter PVC screen and riser sections and will be consistent with the requirements of Env-Or 610.04 (Groundwater Monitoring Wells).
- Soil samples will be collected at 5-foot intervals using a 2-foot-long splits spoon soil sampler.
- Visual examination of soil samples.
- Completion of a reference point level elevation survey and location of wells using taped measurements from Site features on the existing Site plan.

- **NAPL Gauging** – Monthly gauging of monitoring wells constructed within the footprint of the Holder House using an oil/water interface probe to identify NAPL. This task also includes collection of two rounds of groundwater samples for laboratory analysis of MGP-related groundwater contaminants. GZA's OPC for this task assumes/includes:

  - Each monthly gauging round can be completed in four hours on Site.
  - Laboratory analysis of samples from five wells during each of two sampling rounds performed coincident with two of the gauging rounds. Each sampling round can be completed in eight hours on Site.
  - Laboratory analysis for volatile organic compounds (VOCs), semi-VOCs, total petroleum hydrocarbons, Resource Conservation and Recovery Act (RCRA), eight metals, and total cyanide.

- **Summary Report** – Preparation of a summary report describing the investigation tasks, including the work performed and results. The report will be prepared to meet, as applicable, the requirements of Env- Or 606.03 (Site Investigation Report).

4.0 POTENTIALLY REQUIRED TASKS (SUBSURFACE REMEDIATION) – NOT CURRENTLY REQUIRED BY NHDES

Consistent with the RAP, which includes managing residual soil contamination using administrative controls and an engineered cap, the potentially required tasks are theoretical and are focused on the potential removal of mobile NAPL from the subsurface if encountered during test pit operations described in **Task 3.2**. The remediation approach included in the OPC has been designed to address the removal of potentially mobile NAPL:

- **Workplan/RAP Addendum** – Preparation of a workplan/RAP addendum expanding on the task descriptions included herein for review and approval by NHDES.

- **Limited Foundation Floor Removal and Soil Excavation** – Prior to backfilling operations, removal of a portion of the floor and limited excavation of impacted soils below the floor slab. To maintain the stability of the roadbed of South Main Street and associated utilities, the permitter foundation wall of the Holder House foundation must remain in place. The theoretical excavation of soil from beneath the foundation assumes that the permitter foundation wall remains in place along with the floor slab at the base of the foundation walls to maintain the stability of the foundation walls. GZA's opinion of probable cost for this task assumes/includes:

- Excavation from the center of the foundation to a radial distance of approximately 20 feet (*i.e.*, a circular area with an area of 1,200 square feet).
- Excavation to a depth of approximately 5 feet within the center of the excavation.
- Excavation of soil using a mini-excavator and skid steer, placed within the foundation using a crane.
- Removal of up to 275 cubic yards of impacted soils using 3,000 lb. soil bags.
- Stockpiling and management of impacted soil on the Site.
- Off-Site transport and disposal of up to 415 Tons of impacted soil to Clean Earth (ESMI), Loudon, New Hampshire.
- Replace excavated soil with compacted structural fill.

Given that no soil quality data are available from beneath the footprint of the Holder House, the extent of excavation that may be needed is not known. Additionally, the depth to bedrock beneath the Holder House is not known and may be as little as five feet. As part of the review conducted by Haley & Aldrich the uncertainty of the soil volume requiring excavation, management, and off-site disposal was reviewed with GZA. Haley & Aldrich calculated a potential excavation soil volume of 788 cubic yards. In consideration of the uncertainty regarding the volume of soil that may be appropriate to excavate, GZA has presented a range of costs in the OPC presented in Appendix B using the above-assumed excavation volume (275 cubic yards) and the Haley & Aldrich excavation volume estimates as the ends of the range for estimating purposes.

GZA acknowledges that Haley & Aldrich subsequently estimated a range of potential cost higher than the range estimated for planning purposes by GZA, as described in their December 20, 2022 memorandum to NHPA. GZA agrees with Haley & Aldrich that actual costs for remediation are uncertain and could be higher than the range estimated by GZA for planning purposes. Consequently, we consider our estimated range to be conservative and appropriate for planning purposes in the absence of data delineating any contamination that may be present within the footprint of the Holder House.

- **NAPL Recovery Well Construction** – Construction of five 4-inch internal diameter NAPL recovery wells. GZA's opinion of probable cost for this task assumes/includes:
  - Well construction following backfilling of the folder to within approximately 2 feet of the final grade to allow for construction of a low-permeability cap as described in **Section 3.1**.
  - Depth to bedrock, based on existing Site borings, of 35 feet below grade.
  - NAPL recovery wells extend to bedrock (i.e., 35 feet below grade).
  - Well construction can be completed in 7 days using a track-mounted drill rig.
- **Product Recovery** – Manual gauging and recovery of NAPL from the product recovery wells; and
  - Monthly gauging and recovery for up to five years.
  - Each monitoring well within the footprint of the Holder House. Monthly gauging and recovery round can be completed in four hours on Site.
  - Disposal of product with existing product recovered from Site.

- Annual reporting would be included within the Annual Summary Report prepared for the Site under the existing Site groundwater Management Permit.

- **Remedial Completion Report** – Preparation of a report summarizing the soil excavation and NAPL product recovery measures implemented at the Site meeting the requirements of Env-Or 606.17 (Remedial Action Implementation Report).

5.0 GENERAL ASSUMPTIONS

GZA's opinions of probable cost for the known Required Tasks described in **Section 2.0** and Potentially Required Tasks described in **Section 3.0** are based on the following general assumptions:

- Permitting and approvals would not require project to meet State or federal historic preservation guidelines requirements or be controlled by federal historic preservation statutes;
- Project management by GZA is included in each task;
- Staffing and travel from GZA's Bedford, New Hampshire office;
- Use of personal protective equipment (PPE) and air quality monitoring under Site-Specific Health and Safety Plans (HASPs);
- All costs presented in the OPC are in 2022 dollars, including all overhead and profit. No provision for cost escalation or adjustment are included; and
- GZA's OPC should be considered a Class 3 Estimate as defined by the American Association of Cost Engineers Cost Estimate Classification System and is subject to limitations included in **Appendix A**.

6.0 OPINION OF PROBABLE COSTS

GZA's OPC for decommissioning and performing related subsurface investigation within the footprint of the 1888 Holder House is $1,128,750 and is detailed in Appendix B.

GZA's OPC for decommissioning and performing related subsurface investigation and remediation of potentially mobile NAPL within the footprint of the 1888 Holder House is between $1,691,606 and $ 2,379,492 as detailed in Appendix B. Some degree of subsurface contamination is likely, but the extent cannot be known based on the available data. Consequently, we recommend using the midpoint of this range ($2,035,549) for planning purposes.

GZA's OPC is based on review of local cost data (contractor quotations) for demolition, excavation, monitoring/recovery well construction, and waste transportation and disposal services; industry cost averages; RSMeans 2022 Cost works Data; and our experience with oversight of demolition, subsurface investigation, and remediation projects. The OPC includes a 25-percent cost contingency for overruns that regularly occur during construction but cannot be ascertained when an operation is being reviewed.

7.0 PREPARER'S STATEMENT AND QUALIFICATIONS

The demolition plan and the associated sections of this OPC has been prepared under the direction of Mr. John C. Murphy, CCM, CHMM. Mr. Murphy is a Certified Construction Manager and Certified Hazardous Materials Manager with over 34 years of experience in remediation, demolition, and facility decommissioning projects throughout the United States; Mr. Murphy is a Senior Principal at GZA, and in this capacity, he is

responsible for overall management and oversight of a variety of projects and personnel. His experience includes construction management, cost estimating, schedule control, and design in the environmental, building, demolition, and heavy construction industries.

The subsurface investigation and remediation sections of this OPC have been prepared under the direction of Mr. James M. Wieck, P.G. Mr. Wieck has over 30 years of experience in hydrogeologic and contaminated Site investigation and remediation and has been involved with the investigation and remediation of the Site since 2009. Mr. Wieck is an Associate Principal at GZA; in this capacity, he is responsible for overall management and oversight of a variety of projects and personnel. Both Mr. Murphy and Mr. Wieck have been involved with the remediation of the Site since 2012, and their resumes are included in **Appendix C**.

James. M. Wieck, P.G.
Associate Principal

John C. Murphy CCM, CHMM
Senior Principal

JMW/JCM:jlb
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Figures

GENERAL NOTES

1. BASE PLAN PROVIDED BY NATIONAL GRID AS PREPARED BY PAULUS SOKOLOWSKI AND SARTOR, LLC (PS&S) FROM THE SOURCES LISTED UNDER NOTES 2, 4, AND 5.
2. FIGURE REPRODUCED FROM PLANS ENTITLED "PLANT PROPERTY PLAN OF THE CONCORD GAS COMPANY, CONCORD, NH", PREPARED BY K. RICHTER, DATED 01/01/1932, "EXPLORATION LOCATION AND SITE FEATURES PLAN", PREPARED BY SANBORN, HEAD & ASSOCIATES (SHA), DATED JUNE 03, AND CONCORD, NH TAX ASSESSMENT MAPS 26 & 27 OBTAINED FROM THE CONCORD, NH TAX ASSESSORS OFFICE 3/17/04, "PLANS OF PROPOSED US ROUTE 3/WATER ST., WATER ST. BRIDGE, HALL ST., RELOCATED GULF ST., SO. MAIN ST.", BY NHDOT, DATED 2/28/97, AND FORMER UTILITLY PLANS OBTAINED FROM THE CONCORD, NH ENGINEERING DEPARTMENT, "ABUTTING AND DOWN GRADIENT PROPERTIES", LISTED IN NHDES DATABASE, PREPARED BY GEI CONSULTANTS, DATED 06/2005.
3. THE LOCATION OF THE SITE, SITE FEATURES, PROPERTY LINES, BUILDING FOOTPRINTS AND EXPLORATION LOCATIONS ARE APPROXIMATE.
4. PROPERTY BOUNDARIES ARE CREATED FROM PLAN ENTITLED "PROPERTIES LOCATED WITHIN A 1,000–FOOT RADIUS OF THE SITE", DRAWN BY GEI, DATED 06/2005. CERTAIN LOTS WERE HAND–DRAWN BY GEI USING PROPERTY DATA FROM THE CITY OF CONCORD.
5. BASE MAP DEVELOPED FROM GOOGLE PROFESSIONAL IMAGE FILE. DIGITAL AERIAL ORTHOPHOTOGRAPHY WAS COLLECTED FOR THE GAS HOLDER SITE IN OCTOBER 2015.

LEGEND

BOSTON AND MAINE RAILROAD

APPROXIMATE SITE BOUNDARY

N

0 10 20 40 60
SCALE: 1"=20'

1888 GAS HOLDER HOUSE DEMOLITION ALTERNATIVE CALCUATION OF BASIS OF MAXIMUM OWNER CONTRBUTION GAS STREET SITE CONCORD, NEW HAMPSHIRE

DES SITE #198904063, PROJECT RSN #1479
SITE LAYOUT / FEATURES

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
5 COMMERCE PARK NORTH, SUITE 201
BEDFORD, NEW HAMPSHIRE 03110
(603) 623-3600

PREPARED FOR: Liberty Utilities

PROJ MGR:	JMW	REVIEWED BY:	SRL	CHECKED BY:	JMW
DESIGNED BY:	JMW	DRAWN BY:	MR	SCALE:	1" = 20'
DATE:	MARCH 2022	PROJECT NO.	04.0029644.03	REVISION NO.	

FIGURE 1
SHEET NO.

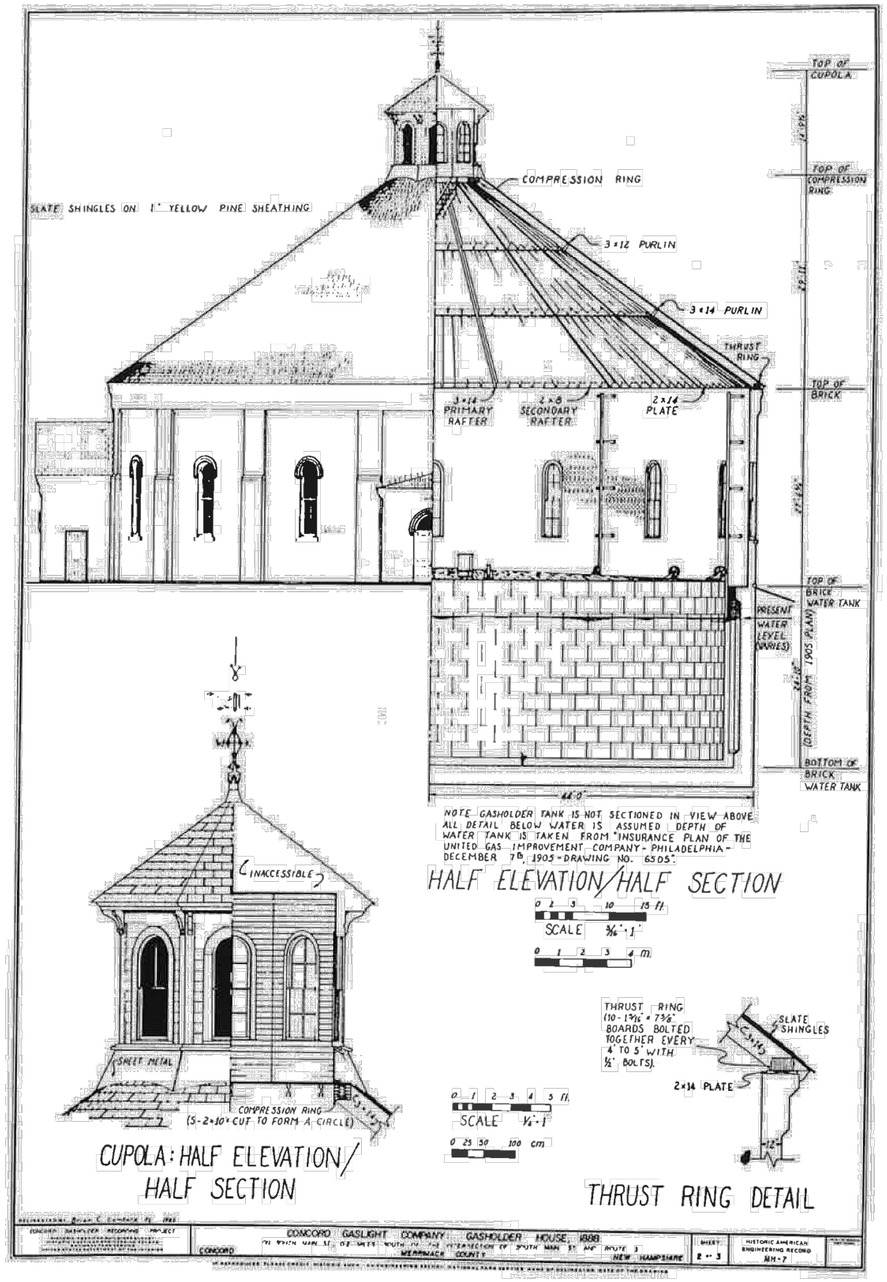


Figure 4. *Elevation and section drawings of 1888 gasholder house.* HAER, drawing by Brian Lombard, 1982.

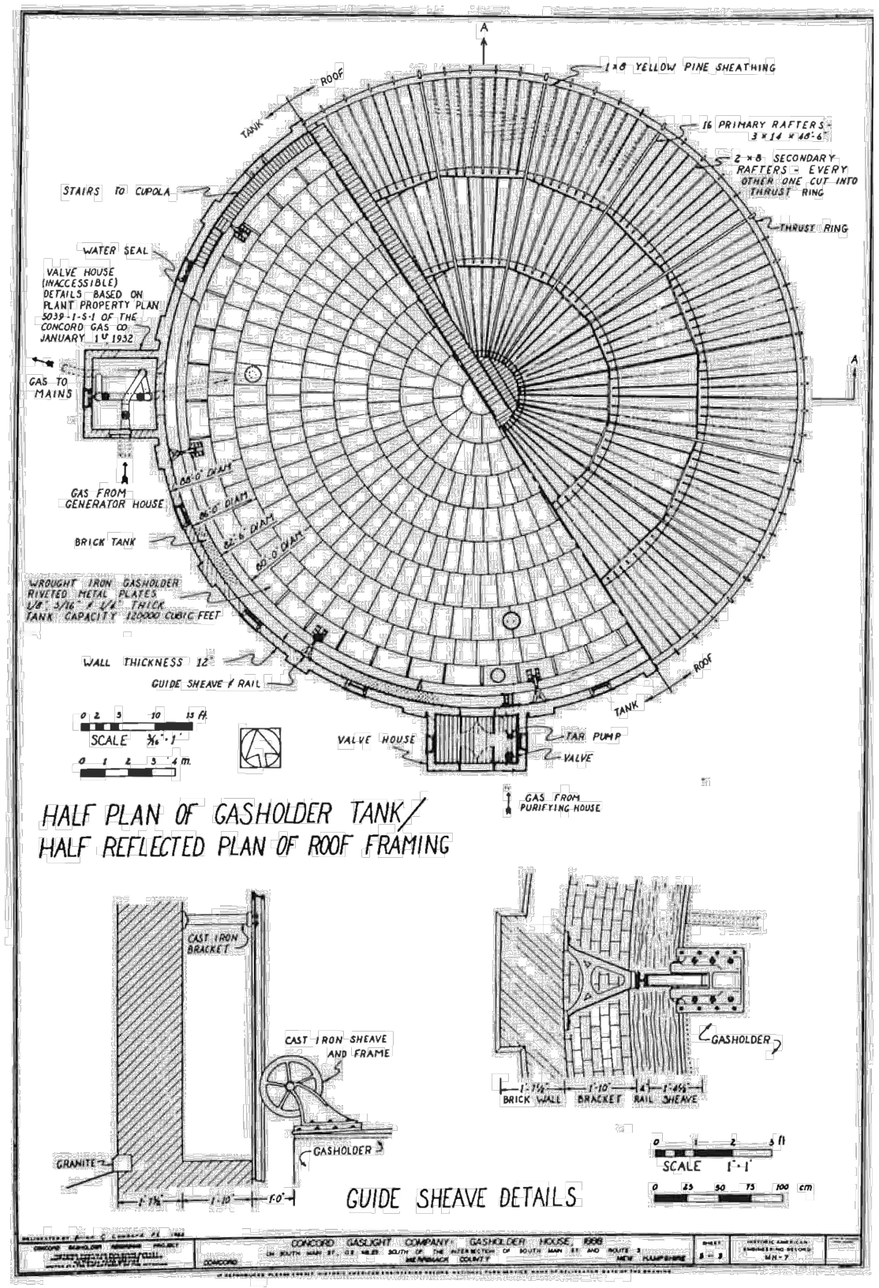
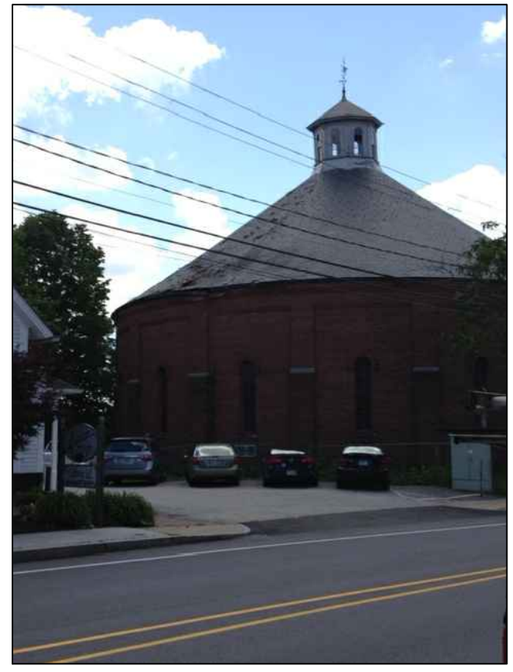


Figure 8. *Roof plan and details of guide sheaves.* HAER, drawing by Brian Lombard, 1982.



GENERAL NOTES

1. DRAWINGS TAKEN FROM "THE CONCORD (NEW HAMPSHIRE) GASHOLDER: LAST SURVIVOR FROM THE GAS-MAKING ERA," BY WILLIAM L. TAYLOR.
2. PHOTOGRAPHS TAKEN BY GZA DURING JUNE 2013.

1888 GAS HOLDER HOUSE DEMOLITION ALTERNATIVE CALCULATION OF BASIS OF MAXIMUM OWNER CONTRIBUTION
GAS STREET SITE
CONCORD, NEW HAMPSHIRE

DES SITE #198904063, PROJECT RSN #1479
HOLDER HOUSE FEATURES

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
5 COMMERCE PARK NORTH, SUITE 201
BEDFORD, NEW HAMPSHIRE 03110
(603) 623-3600

PREPARED FOR:
Liberty Utilities

PROJ MGR: JMW	REVIEWED BY: SRL	CHECKED BY: JMW	FIGURE 2
DESIGNED BY: JMW	DRAWN BY: MA	SCALE: NOT TO SCALE	
DATE MARCH 2022	PROJECT NO. 04.0029644.03	REVISION NO.	SHEET NO.

Appendix A - Limitations

USE OF REPORT

1. GeoEnvironmental, Inc. (GZA) prepared this Report on behalf of, and for the exclusive use of our Client at the stated time for the stated purpose(s) and location(s) identified in the Report. Use of this Report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Report and/or proposal, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work.

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services at the same time, under similar conditions, and at the same or a similar property. No warranty, expressed or implied, is made.

BASIS OF OPINION OF COST

4. GZA's opinion of cost is based on limited data which may not be sufficient to identify each and every condition existing at the site which may constitute noncompliance with applicable governmental statutes, rules, and regulations or constitute a release of oil or hazardous materials and/or may require remediation.

5. The costs on which the preliminary opinion of cost is based are limited to those conditions which were described in the Report.

6. Observations described in the Report were made under the conditions stated therein. Where access to portions of a structure or site was unavailable or limited, GZA renders no opinion as to the condition of those portions of the site or structure.

7. The conclusions presented in the Report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of described services or the time and budgetary constraints imposed by the Client.

COST ASSUMPTIONS

8. While the preliminary opinion of cost represents our professional judgment in this matter, actual conditions encountered during remediation may result in higher or lower costs.

9. The preliminary opinion of cost includes only those cost items identified, and should not be assumed to include other costs such as legal, administrative, permitting or others. The preliminary opinion of cost also does not include any costs with respect to third-party claims, fines, penalties, or other charges which may be assessed against any responsible party because of either the existence of present conditions or the future existence or discovery of any such conditions.

10. The Report contains approximate cost opinions for purposes of evaluating alternative remedial programs. These estimates involve approximate quantity evaluations. Actual quantities and unit costs may vary. A preliminary cost opinion of this nature is likely to vary substantially from Contractors' Bid Prices and is not to be considered the equivalent of nor as reliable as Contractors' Bid Prices. Prices for similar work undertaken in the future will be subject to variations

in market pricing, which are not within GZA's control. Detailed quantity and cost estimating should be performed by professional, experienced cost estimators to determine actual cost.

RELIANCE ON INFORMATION PROVIDED BY OTHERS

11. In preparing the Report, GZA may have relied on certain information provided by the Client, state and local officials, and other parties referenced therein available to GZA at the time of the evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

CODES AND REGULATIONS

12. GZA used reasonable care in identifying and interpreting codes and regulations which are relevant to the costs estimated. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

13. Governmental agencies' interpretations, requirements, and enforcement policies vary from region to region, district office to district office, from state to state, and between federal and state agencies. In addition, statutes, rules, standards, and regulations may be legislatively changed and inter-agency and intra-agency policies may be changed from present practices. GZA has used its experience and judgment in making assumptions as to how anticipated changes in regulatory policies may affect remediation costs.

ADDITIONAL SERVICES

14. It is recommended that GZA be retained to provide engineering services during any final design, construction and/or implementation of any remedial measures recommended in this report. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

Appendix B – Opinion of Probable Cost

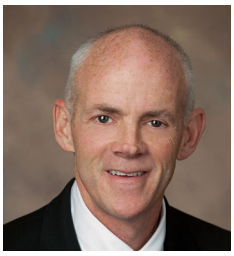
Summary of Opinion of Probable Costs

Former Concord Coal Gas Site
One Gas Street, Concord, New Hampshire
NHDES Site No. 198904063
(December 27, 2022)

TASK		SUB-TASK Number	Name	Opinion of Probable Cost Required	Required and Potential
1	**Demolition**				
		1.1	Work Plan, Mobilization, and Site Preparation	$35,500	$35,500
		1.2	Temporary Facilities and Controls	$31,000	$31,000
		1.3	Erosion and Sedimentation Controls	$11,000	$11,000
		1.4	Asbestos Removal	$39,500	$39,500
		1.5	Hazardous Materials Removal	$4,500	$4,500
		1.6	Dewater Interior of Foundation	$60,000	$85,000
		1.7	Demolition of Holder House to Top of Foundation	$158,000	$158,000
		1.8	Backfill and Restoration	$246,500	$246,500
		1.9	Demobilization	$20,000	$20,000
			Task Contingency (25%)	*$151,500*	*$157,750*
			Demolition Subtotal	***$757,500***	***$788,750***
2	**Cap Construction** *Required by NHDES*				
		2.1	Clay Cap Construction	$33,500	$33,500
			Task Contingency (25%)	*$8,375*	*$8,375*
			Cap Construction Subtotal	***$41,875***	***$41,875***
3	**Investigation** *Required by NHDES*				
		3.1	Work Plan	$7,500	$7,500
		3.2	Visual Inspection of Foundation	$11,000	$11,000
		3.3	Test Pit Excavation	$60,000	$60,000
		3.4	Work Platform	$39,500	$39,500
		3.5	Boring and Monitoring Well Construction	$93,000	$93,000
		3.6	Groundwater Sampling and NAPL Gauging	$27,500	$27,500
		3.7	Investigation Report	$25,000	$25,000
			Task Contingency (25%)	$65,875	$65,875
			Investigation Subtotal	***$329,375***	***$329,375***
4	**Remediation** *May be required by NHDES (Speculative)*				
		4.1	RAP Addendum/Workplan	-	$20,000
		4.2	NAPL Recovery Well Construction	-	$38,000
		4.3	NAPL Gauging and Recovery (*5-Years*)	-	$47,285
		4.4	Annual Report	-	$4,500
		4.5	Excavation	-	$245,000 - $702,036**
		4.6	Soil Stockpiling/Management	-	$7000 - $20,058**
		4.7	Soil Transportation and Disposal	-	$43000- $123,215
		4.8	Remedial Completion Report	-	$20,500
			Task Contingency (25%)	$0	$106,321 -$243,898**
			Remediation Subtotal	***$0***	***$531,606 -$1,219,492****
	Clay Cap Construction				
			TOTAL	***$1,128,750***	***$1,691,606 - $2,379,492****

** Soil Volumes used in upper end soil excavation, managemnet and disposal costs were pprepered by Haley and Aldrich, Inc.
Notes:
1) Probable costs are in 2022 USD.

Appendix C – Qualifications



John C. Murphy, CCM, CHMM

Chief Operating Officer/ Senior Principal

Summary of Experience

Mr. Murphy is a Certified Construction Manager, currently serves as GZA's Chief Operating Officer and leads GZA's Construction Management and Demolition practice. Mr. Murphy's expertise includes pre-design, design, procurement, construction, and post-construction activities on a variety of environmental, energy, building, heavy construction, demolition, and facility closures projects throughout the United States. Mr. Murphy has specialized experience with work sequencing, scheduling, waste minimization, logistics and the management of hazardous materials, asbestos, lead, mold, polychlorinated biphenyls (PCBs) in buildings and site structures. He also has significant experience with site development, remediation and design as well as installation of specialty groundwater and soil treatment systems, containment structures and caps.

Relevant Project Experience

Principal in-Charge, Reclamation Cost Estimate, Milford I & II Windfarm and 345KVA gen tie, SunEdison, Beaver, Utah. GZA was retained to prepare a Reclamation Cost Estimate to meet the requirements of federal Bureau of Land Management (BLM) policy IM-2015-138 regarding financial assurance. The entire Milford I & II Wind Farm development is comprised of 165 WTGs, 4 permanent MET towers, electrical collector lines, electrical transmission lines, a substation, and an Operations and Maintenance building. The development encompasses an area of approximately 40 square miles of public, Utah Schools and Institutional Lands Administration lands, and BLM-managed lands. .

The Wind Farm components that are on BLM-managed lands include: 62 WTGs, 4 permanent MET towers, 88 miles of 346kva electrical collector lines, electrical transmission lines, a substation, and certain access roads. GZA prepared a detailed reclamation cost estimate which included analysis of salvage and long-term monitoring costs.

Principal in-Charge, Decommissioning Plan and Opinion of Probable Costs, Northern Pass Transmission, Confidential Client, New Hampshire. GZA was retained to prepare a Decommissioning Plan and Opinion of Probable Costs for the Northern Pass project which includes a 192-mile transmission line network and over 50 miles of underground conductor installation. Work was performed to support requirements of the New Hampshire Siting and Evaluation Committee and included a detailed cost estimate and an analysis of salvage values for the entire project.

Principal in-Charge, Demolition and Clean-Up of Fire Damaged Battery Storage Building at 30 Mega-watt Windfarm, Confidential Client, Kahuku, Hawaii. Responsible for overall coordination, planning and management of a fixed price demolition and clean-up of a battery storage building that served a 30 Mega-Watt windfarm damaged in a catastrophic fire. The structure consisted of a steel-framed high-bay building with concrete slab which housed approximately 12,000 lead acid batteries in use at the facility. Lead debris was present in the form of hazardous ash, molten lead, and burnt lead batteries plates still remaining in the racks. Prior to on-site demolition and clean-up activities, GZA conducted a pre-demolition asbestos survey,

developed a Demolition and Clean-Up Work Plan and obtained approval from the regulatory agency, obtained a demolition permit, coordinated subcontractors, characterized waste streams, coordinated recycling and disposal facilities, and established work areas and site controls. Work included segregation, removal, and containerization of hazardous materials and non-hazardous materials remaining in the building as well as complete decontamination and removal of the building structure. The clean-up design was focused on waste minimization and maximizing the percentage of materials suitable for recycling through labor intensive waste segregation. Segregated materials were containerized in accordance with applicable shipping regulations and transported off-site for disposal. Following demolition of the structure, the surface of the slab and surrounding soils were remediated to meet regulatory requirements.

Principal in-Charge, Former Manufactured Gas Plant, Liberty Utilities, Manchester, New Hampshire. Responsible for completion of a supplemental site investigation (SSI), data gap investigations, Initial Response Action (IRA), and historic structure remediation for this former manufactured gas plant (MGP) site. MGP byproducts including light and dense non-aqueous phase liquids (LNAPLs and DNAPLs) are present at the site, and a dissolved-phase volatile organic compound (VOC) plume extends off site. Work also included upgrades and repairs to facility stormwater systems.

Technical Principal, Public Service of New Hampshire, Natural Resources and Construction Support for Transmission Line Projects in New Hampshire. Responsible for providing constructability review to support ongoing natural resources data collection, wetlands and shoreland permitting, environmental compliance monitoring, agency negotiations and resolution, and wetland mitigation and restoration design and implementation oversight.

Principal in-Charge, Demolition Planning and Procurement, North Campus Academic Center Project, Dartmouth College, Dartmouth, New Hampshire. Responsible for overall coordination and management of pre-design, assessment, final design and procurement for the demolition of the Gilman building and Dana building including the Gilman/Dana Connector and portions of the Gilman/Remsen Connector located on College Street at the North Campus of Dartmouth College. The project includes a 62,740 square-foot Gilman building, 27,100-square-foot Dana building, a 700-square-foot Dana-Gilman connector, a 1,110-square-foot Dana-Remsen connector, concrete and gravel sidewalks, paved parking, and landscaped areas. Work included full facility assessment, project sequencing demolition plan and specification development and management of procurement process on behalf of Dartmouth College.

Principal in-Charge, Former Manufactured Gas Plant, Liberty Utilities, Concord, New Hampshire. Responsible for completion of a supplemental site investigation (SSI), data gap investigations, Initial Response Action (IRA), and historic structure maintenance activities for this former manufactured gas plant (MGP) site. MGP byproducts including light and dense non-aqueous phase liquids (LNAPLs and DNAPLs) are present at the site, and a dissolved-phase volatile organic compound (VOC) plume extends off site.

Work included the completion of subsurface investigations to delineate dissolved-phase and DNAPL contamination, as well as the evaluation and summary of work performed by others that included storm water sampling, subsurface explorations, groundwater sampling, and an evaluation of subsurface MGP structures. GZA developed work plans for an IRA to remove liquid and sludge contained within the subsurface structures, and completed a soil vapor migration study. GZA also developed a 3-dimensional numerical model of site vicinity stratigraphy and DNAPL. The model provided insight into the distribution and historic movement of DNAPL within the subsurface.

Principal in-Charge, Siding and Roofing Removal and Confidential Client, Avanel, New Jersey. Responsible for overall coordination and management of pre-design, assessment, final design, and procurement for the removal and replacement of asbestos siding and roofing coated with PCB paint at an operating industrial facility that produces food grade sodium silicate based products. Paint containing PCBs at varying concentrations had previously been identified on approximately 250,000 square feet of asbestos (transite) siding and roofing throughout the facility. As Construction Manager as Agent, GZA designed and implemented a remedial strategy to comply with a state mandated source removal of PCBs from the paint on the siding.

Principal in-Charge, Demolition Planning and Procurement, PQ Corporation, Plant 1 Demolition. Responsible for providing comprehensive engineering and construction management services to PQ Corporation at one of its active manufacturing Sites in

New Jersey as the company complies with Industrial Site Recovery Act (ISRA) and New Jersey Department of Environmental Protection (NJDEP) requirements. As part of the ISRA process, PQ Corporation decided to demolish the portion of the plant no longer in use. GZA provided pre-demolition asbestos-containing material (ACM), PCB, lead paint, and hazardous material surveys of the Plant 1 buildings. GZA developed technical specifications to address the abatement of ACM, PCBs, and hazardous materials, the planned approach for demolition of site structures, utilities, and site work required to meet the needs of PQ. GZA prepared a Soil Erosion and Sediment Control Plan and prepared a PCB Work Plan. GZA was retained as Construction Management as Agent to manage the demolition and Site restoration Project.

Principal in Charge, Building Demolition and Renovation, Former Dorr Woolen Mill Complex, Newport, New Hampshire. Mr. Murphy was responsible for environmental permitting, design, local plan approval and demolition activities associated with the complete demolition and removal of 250,000 square feet of the 300,000-square-foot Former Dorr Woolen Mill Complex located in Newport, New Hampshire. Approximately 50,000 square feet of the facility were separated from the demolished portion of the facility and renovated for re-occupancy by the current owner. The work was performed on a firm fixed price basis with an accelerated schedule. Work included performing a demolition level asbestos and hazardous materials survey and development of a demolition design plan to address utility capping and rerouting, abatement and demolition phasing, and renovation coordination activities to facilitate relocation of existing on-site personnel from the buildings being demolished to the newly renovated space. GZA presented its demolition and renovation plans to the Town of Newport Planning board and secured all Town approvals for the project. In addition, GZA secured wetland, shoreland protection, alteration of terrain, and construction stormwater permits for the project.

Work included removal and characterization of hazardous materials remaining in the buildings, removal of asbestos-containing materials, and demolition and processing of all building materials. GZA performed inventory and management of salvageable materials within all buildings. Following demolition, the former basement and foundation areas were backfilled with recycled crushed brick and concrete from the buildings as well as imported fill, graded, and compacted. All disturbed areas were final graded, loamed, and seeded. Work also included closure of an existing raceway below the facility which was formerly used to convey water from the adjacent Sugar River through the facility for process operations.

Technical Principal, Former MGP, Pawtucket, Rhode Island. Responsible providing constructability review and support to complete design and construction management services for the decommissioning and demolition (D&D) of Gas Holders Nos. 7 and 8 at the former Tidewater MGP facility located in Pawtucket, Rhode Island. The location of the gas holders was adjacent to sensitive receptors including an apartment complex, charter school, and private residences. Gas Holders Nos. 7 and 8 measured approximately 130 and 175 feet in diameter, respectively and were both 30 feet in height. The approximate gas storage capacity of Holder Nos. 7 and 8 was 1,000,000 and 3,000,000 cubic feet, respectively.

D&D activities included evaluation of treatment and discharge options for accumulated stormwater in the gas holders; preparation of D&D design plans and specifications; contractor procurement; permitting; storm water removal, treatment, and discharge; implementation of perimeter air monitoring system; and construction management of abatement and demolition of the gas holders.

The Tidewater gas holder D&D project was completed within an aggressive schedule and on budget with no change orders.

Principal in- Charge, Construction of GE Aviation Welcome Center and Site Entrance, Hooksett, New Hampshire. Responsible for design-build construction of the new Site entrance and construction of a new GE Hooksett Welcome Center. The new Site entrance and Welcome Center was constructed at the location of an existing secondary access drive to the main facility. The location of the secondary access drive was redesigned to accommodate the Welcome Center and is the new main entrance into the facility and the check-in/out of employees and visitors upon arrival and departure. The new Site entrance includes a 3-lane entrance with a 90-foot automated slide gate and a 2-lane exit with a 45-foot automated slide gate. The ADA compliant Welcome Center building includes a guard station, waiting area, bathroom, telecommunication closet, and a utility room. Sidewalks around the Welcome Center are equipped with an automated snowmelt system. GZA performed as Construction Manager at Risk for all phases of the project including permitting, civil design, building design, earthwork, utilities, footings and foundation, building

structure, interior and exterior finishes, building and Site electrical, mechanical, fire alarm, sprinkler system, fencing and slide gates, and demolition of the former guard shack.

Principal-in -Charge, Facility Upgrades, G&K Services, Manchester, New Hampshire. Responsible for overall management of a design-build contract to install two Ellis VOC stripper/washer-extractors at G&K's Manchester, New Hampshire towel wash plant. To support the new VOC stripper/washer-extractor installation, numerous infrastructure upgrades were required not only to support the new washers, but also to increase the efficiency and productivity of the entire washing process. Infrastructure upgrades included retrofitting the existing drain system including existing wastewater trenches; construction of a floor sump in the concrete slab; installation of shaker screen, 75 BHP steam generating boiler, heat exchanger, stack economizer, soap system, and chemical totes with automated level controls; building structure renovations; earthwork, foundation, and installation of a new hazardous materials storage building; and installation and/or relocation of electrical, network, compressed air, hot and cold water, natural gas, high pressure steam, wastewater, and condensate return lines. As part of our design work, GZA provided G&K with building renovation, mechanical, and electrical engineered plans for all systems supporting the towel wash plant upgrades and obtained permits, authorizations, and approvals for completion of the work. A requirement of our contract for construction services was an aggressive schedule and detailed work sequencing that included no impact to facility operations. Completion of all building structural renovations, mechanical piping and connections, electrical conduit, wiring and connections, and new equipment rigging and installation were performed with essentially no interruption to the facility with required shut-down connections performed outside of the facilities normal working hours (nights and weekends).

Principal in Charge, Demolition and Soil & Groundwater Remediation, Former Sanmina Facility, Derry, New Hampshire. Responsible for the relocation of an existing groundwater treatment system consisting of 3 bedrock and 12 overburden extraction wells including installation of new underground piping and conduit and construction of a new treatment building. Completed demolition activities associated with complete demolition of an existing approximately 126,000-square-foot, 2-story former plating facility. Work included removal and characterization of hazardous materials remaining in the buildings, removal of asbestos-containing materials, and demolition and processing of all building materials including removal of foundations and footings. Following demolition, the former basement and foundation areas were backfilled with imported fill, graded, and compacted. Work also included the excavation and disposal of approximately 1,300 tons of contaminated concrete and 3,500 tons of contaminated soil.

Principal in Charge, Building Demolition, The Salvation Army, Dorchester, Massachusetts. Responsible for design and demolition activities associated with the complete demolition and removal of an existing 21,000-square-foot, 1-story industrial building; 9,500-square-foot, 1-story industrial building; and six multi-family, apartment buildings located in an urban setting. Work included removal and characterization of hazardous materials remaining in the buildings, removal of asbestos-containing materials, and demolition and processing of all buildings including removal of foundations and footings. Following demolition, former basement and foundation areas were backfilled with imported fill, graded, and compacted. Work also included excavation, removal and disposal of three underground solvent and gasoline tanks and one No. 6 oil tank located in a below grade vault. Contaminated soil associated with releases from the tanks was excavated and disposed of off-site. Approximately 180 tons of lead-impacted soil were also excavated and disposed of offsite.

Project Manager/Estimator, Facility Closures, Defense Fuel Supply Center (DFSP-Newington, DFSP-Casco Bay, and DFSP-Searsport). Responsible for the development of fixed price costs for competitively bid facility closure programs for three military bulk fuel storage and transportation facilities managed by the Department of Defense and located in the Northeastern United States. GZA was awarded the contract as best value to the government. DFSP-Newington includes a marine fuel pier, a multi-acre bulk fuel storage terminal consisting of six underground storage tanks with a total capacity of approximately 15.4 million gallons, and a 3-mile-long pipeline system to Pease Air Force Base. DFSP-Casco Bay includes a marine fuel pier, a 67-acre bulk fuel storage terminal consisting of 14 aboveground fixed-roof storage tanks with a total capacity of approximately 39.5 million gallons, and a 12-mile-long pipeline system to Brunswick Naval Air Station. DFSP-Searsport includes a marine fuel pier, a 52-acre bulk fuel storage

terminal consisting of nine aboveground fixed-roof storage tanks with a total capacity of approximately 37.8 million gallons, and a 200-mile-long pipeline system to Bangor Air National Guard Facility and Loring Air Force Base.

Principal in Charge, Building Demolition, The Salvation Army, Utica, New York. Due to a structural failure of the roof on a 100,000-square-foot warehouse, GZA was retained to perform overall Demolition of the warehouse and adjacent 3-story former residence building. Work included performing a demolition level asbestos and hazardous materials survey and subsequent abatement of identified materials. Given the extended period of time that had elapsed since the roof collapse, abatement of significant amounts of pigeon guano was required to protect worker health & safety during site activities. Upon completion of abatement activities, a complex building separation was performed where the building tied into an occupied adjacent structure and the entire building was demolished. Site work included removal of all utilities. The site was graded and left in a "parking lot" ready condition.

Principal in Charge, Environmental Services, The Salvation Army, Various Locations. Mr. Murphy is responsible for overall coordination of investigation and remedial work at all client-owned facilities in the Northeast. Facilities range from single-family residences to multi-story commercial buildings to 100-acre summer camps. GZA performed environmental inspections at over 2,300 facilities and ranked environmental risk based on our observations of lead, asbestos, tanks and water intrusion issues. An Internet based application was developed by GZA that catalogued our visits, findings and rankings. At the completion of the studies, GZA Identified 125 "priority" sites that required immediate action. As follow-on to our initial study, GZA was tasked with remediation at these priority sites. This work involves generation of work plans, bid administration and construction management at these sites. To date work has involved asbestos, lead, mold, aboveground and underground storage tank removal, water intrusion, and contaminated soils. In addition to abatement and remediation, GZA is responsible for restoration of disturbed building or Site surfaces.

Principal in Charge, Beede Waste Oil Superfund Site, Plaistow, New Hampshire. Responsible for cost estimating and management of this fixed price competitively bid remedial action. Work included installation of two separate vacuum enhanced dual phase extraction systems capable of removal groundwater and light non-aqueous phase liquid (LNAPL) from 143 extraction well locations. Approximately 1 mile of heat fused aboveground polypropylene piping was installed to transport LNAPL and groundwater from three-separate on-site plume locations to the treatment systems. In addition, an existing interceptor trench was extended to capture LNAPL migrating into Kelly Brook at the down gradient edge of the Site. This remedial action is considered a Non Time Critical Removal Action (NTCRA) by EPA and is designed to contain the existing on-site plumes and stop off-site migration to adjacent surface water.

Professional Development

US Army Corps of Engineers, Construction Quality Management for Contractors

Remediation of Hazardous Waste Sites, Center for Professional Advancement

Construction Dewatering, Northeastern University

OSHA 29 CFR 1910.120 (e)(3) HAZWOPER Initial Training (40 Hours)

OSHA 29 CFR 1910.120 (e)(8) HAZWOPER Refresher Training (8 Hours/Annual)

OSHA 29 CFR 1910.120 (e)(4) HAZWOPER Management and Supervisor Training (8 Hours)

Factory-Certified, Level B Safety Equipment, North

James M. Wieck, P.G.

Associate Principal, Hydrogeologist

Summary of Experience

Mr. Wieck has completed numerous environmental hydrogeologic projects including investigation and remediation at facilities with complex historical usage and hydrogeologic settings, as well as water supply investigations and permitting. He has experience in evaluating site hydrogeologic and contaminant conditions, numerical and analytical simulation of hydrogeology, aquifer testing/analyses, and water supply development and protection. Mr. Wieck has over 28 years of experience with the New Hampshire groundwater and surface water protection rules and has prepared numerous milestone documents including site investigation (SI) reports, remedial action plans (RAPs), and applications for groundwater management and discharge permits. Mr. Wieck has experience working with industry, municipalities, institutions, and utilities including the nuclear power industry to assist in meeting their regulatory requirements. Recent work includes investigation and remediation of emerging contaminants including 1,4-dioxane and per- and poly-fluoroalkyl substances (PFAS).

Relevant Project Experience

Project Manager, Former Manufactured Gas Plant, Concord, New Hampshire. Responsible for completion of a supplemental SI, data gap investigations, Initial Response Action (IRA), RAP preparation and implementation, and historic structure maintenance activities for this former manufactured gas plant (MGP) site. MGP byproducts including light and dense non-aqueous phase liquids (LNAPLs and DNAPLs) are present at the site, and a dissolved-phase volatile organic compound (VOC) plume extends off site. Mr. Wieck has overseen the groundwater monitoring for the site since 2009.

Work included the completion of subsurface investigations to delineate dissolved-phase and DNAPL contamination, as well as the evaluation and summary of work performed by others that included storm water sampling, subsurface explorations, groundwater sampling, and an evaluation of subsurface MGP structures. Mr. Wieck developed work plans to remove liquid and sludge contained within the subsurface structures and completed a soil vapor migration study. Mr. Wieck also developed a 3-dimensional numerical model of site vicinity stratigraphy and DNAPL. The model provided insight into the distribution and historic movement of DNAPL within the subsurface.

Project Manager, Former Manufactured Gas Plant, Manchester, New Hampshire. Responsible for completion of a remedial feasibility study and remedial action plan (RAP) for this former MGP. The project included review of existing site information including the results of DNAPL and LNAPL mobility and recoverability studies. The information was used to evaluate the feasibility of selected remedial alternatives with the objective of controlling the movement of DNAPL and recovering LNAPL and DNAPL. Mr. Wieck developed a three-dimensional numerical model of site and site vicinity stratigraphy and DNAPL. The model provided insight into the potential sources distribution and historic movement of DNAPL within the subsurface.

Remedial alternatives evaluated include excavation, in-situ treatment and stabilization, product removal, and barrier methods. The RAP includes a combination of source

remediation and product recovery. Other work includes Groundwater Management Permit- (GMP-) related sampling and implementation of the RAP.

Senior Project Manager, Hydrogeologic Site Investigation and Remediation, Hanover, New Hampshire. This on-going remedial project included evaluation of 1,4-dioxane transport in overburden and fractured bedrock groundwater systems from a former medical research waste disposal facility. Waste included scintillation fluids used in radiological research that contained 1,4-dioxane. 1,4-dioxane was detected following remediation and closure of the facility relative to radiological waste. The investigation phase of the project included multiple phases of groundwater monitoring well installation and testing to evaluate the transport of 1,4-dioxane, including evaluation of potential transport to private water supply wells downgradient of the former facility.

Bedrock mapping and surficial and borehole geophysical methods were used in the evaluation of the bedrock fracture fabric to identify potential preferential directions of groundwater flow and 1,4-dioxane transport. Water supply sampling has included sampling of over 140 private water supply wells, surface water, and community and public water supplies. Delineation of the source and extent of dissolved phase transport supported the design of a groundwater remedial system and issuance of a groundwater management permit. Radionuclide sampling and analysis was also performed in consideration of the historical waste disposal at the site.

The groundwater remedial system was constructed in a remote location and includes extraction of groundwater from overburden and fractured bedrock, and treatment using an ion exchange resin. Steam regeneration of the resin is performed on site, with condensate treated using granular activated carbon. Excavation of laboratory waste including evaluation of 1,4-dioxane and radionuclides was performed.

Mr. Wieck was GZA's project manager and is the lead hydrogeologist, responsible for work plan preparation and implementation, data evaluation, and remedial design and construction. An important portion of Mr. Wieck's work was communication of technical information to residents regarding the properties of 1,4-dioxane and the investigation and remediation activities.

Project Manager, Industrial Facility, Derry, New Hampshire. Comprehensive environmental services including SI, remedial design and construction, building abatement, and operation of a remedial system of for a hydrogeologically and environmentally complex site. Responsibilities include: investigation and evaluation of chlorinated solvents, metals, 1,4-dioxane and inorganic parameters in overburden and fractured bedrock; and oversight of source remediation and building demolition activities. Recent sampling indicates the presence of PFAS. Delineation PFAS is ongoing along with the integration of its remediation with the existing remedial system.

The project included removal of approximately 200 buried containers and associated contaminated soil; design, construction and operation of a groundwater extraction well field consisting of bedrock and overburden groundwater wells; design and construction of a groundwater treatment system; industrial discharge permit-related effluent monitoring and reporting; demolition of the site manufacturing facility; remediation of overburden source areas; and GMP-related sampling and reporting.

Senior Project Manager, Hydrogeologic Site Investigation and Remediation, Confidential Client. This on-going project includes the remedial investigation of a former tannery for contaminants including PFAS used in the finishing of leather. The investigation focused on identification of tannery wastes and delineation of PFAS in overburden groundwater, surface water, and sediment. On-going remedial activities related to PFAS are focused on controlling PFAS transport in a multi-unit overburden groundwater system including prevention of transport to an adjacent river. The hydrogeologic setting is complicated by the presence of a dam on the adjacent river. The remedial system incudes groundwater extraction and treatment using granular activated carbon (GAC). Mr. Wieck's responsibilities include development of investigation work plans; technical support during work plan implementation; data evaluation; and design of the groundwater extraction components of the remedial system.

Senior Project Manager, Hydrogeologic Site Investigation and Remediation, Brentwood, New Hampshire This on-going project includes a phased site SI of a fire training drill yard. The SI is focused on evaluating the extent of PFAS contamination in soil, groundwater, and surface water. The SI also includes the sampling of private and community water supply wells, and the sampling

of groundwater monitoring wells related to a wastewater spray irrigation field associated with a groundwater discharge permit on an adjacent property. A supplemental SI work plan has been prepared and is being implemented including installation of multilevel well couplets to evaluate vertical transport of PFAS, and the evaluation of leaching of PFAS to groundwater. Mr. Wieck's responsibilities include development of SI and supplemental SI work plans, technical support and review; and management of the spray irrigation and supplemental SI projects.

Project Manager, Radial Collector Well, Hooksett, New Hampshire. Providing permitting and hydrogeologic evaluation services including the preparation of a Large Groundwater Withdrawal permit for this first of its kind municipal water supply project in New Hampshire. The Radial Collector Well (RCW) includes an approximately 70-foot-deep, 16-foot-diameter vertical caisson constructed on shore, and six horizontal laterals constructed in a fan-like pattern beneath the bed of the Merrimack River. The laterals have an average length of approximately 207 feet.

Groundwater and induced infiltration from the Merrimack River are drawn into the laterals and pumped out of the caisson. The RCW was constructed to supply the City of Manchester, New Hampshire with up to 7.2 million gallons of water per day (MGD). As part of the large groundwater withdrawal permitting, Mr. Wieck was responsible for the design and implementation of the withdrawal testing program, and evaluation of the potential influence of the withdrawal on groundwater flow necessary to ensure that there are no unplanned adverse impacts due to the withdrawal. Withdrawal test data were used to prepare a Final Report which was approved by the New Hampshire Department of Environmental Services including approval of the requested 7.2 MGD withdrawal. Mr. Wieck is currently managing a project to develop a surface water source protection plan for the RCW.

Senior Project Manager, Hydrogeologic Site Investigation and Remediation, Amhurst, New Hampshire This project included completion of the initial phase of a SI at an industrial site related to the release of PFAS compounds. Potential air dispersion and groundwater discharge sources were preliminarily evaluated. Soil samples were collected within the vicinity of the site from soils accessible to sensitive receptors and agricultural properties to evaluate PFAS concentrations at these locations. Site hydrogeology and PFAS concentrations within groundwater were preliminarily evaluated. A work plan for completion of the SI is currently being prepared. Mr. Wieck was responsible for development of the preliminary investigation work plan and provided technical support and review of the work. Mr. Weick is currently responsible for the preparation of the work plan for the final phase of the SI.

Project Manager, Brownfields Site Investigation, Durham, New Hampshire. Performed a multi-phased hydrogeologic site investigation and prepared a Remedial Action Plan (RAP) for an abandoned former dry-cleaning supply facility located on a lot surrounded by the University of New Hampshire Durham campus. The objective of the investigation was delineation of tetrachloroethene soil and groundwater contamination and evaluation of potential sources of soil and groundwater contamination. Investigations included bedrock fracture fabric evaluations; installation of multilevel bedrock and overburden monitoring wells; very low frequency (VLF) and borehole geophysical surveys; water supply well, groundwater, and surface water sampling; review of land usage; bedrock borehole zone sampling; bench and field scale testing of enhanced reductive dehalogenation; and the evaluation of hydrogeologic data.

Work also included the preparation of Quality Assurance Project Plans (QAPPs) and addenda for United State Environmental Protection Agency (EPA) review and approval. The majority of work on this project was conducted for the State of New Hampshire Office of State Planning under an EPA Brownfields grant. A RAP was developed focused on facilitating redevelopment. Other projects have included: evaluation of potential migration of VOCs to a municipal swimming pool; site building demolition and capping; water quality and soil vapor intrusion monitoring; environmental and geotechnical services related to rehabilitation of a box culvert that transects the site; and Groundwater Management Permit (GMP)-related monitoring.

Project Manager, Brownfields Site Investigation, Tilton, New Hampshire. Planned and conducted a hydrogeologic site investigation at a town owned former mill complex located adjacent to the Winnipesaukee River. Work on this project was conducted for the NHDES under an EPA Brownfields grant. The work was focused on identifying sources of soil and groundwater contamination based on site usage information. Areas of historic solvent and petroleum usage were identified and investigated. Soil quality was evaluated for selected metals to address tanning activities and ash from lead paint released when the former mill was burnt. Soils containing lead and barium at concentrations exceeding applicable standards were identified and remedial

approaches to manage the soil contamination developed to facilitate redevelopment of the site as a public park. Work on this project also included the preparation of a Master QAPP and a site-specific addendum for EPA review and approval.

Senior Project Manager, Former Wastewater Treatment Facility, Salem, New Hampshire. Provided hydrogeologic data evaluation support for investigation and remediation of a TCE source at a former wastewater treatment facility. Support included interpretation of geologic data and development of a 3-dimensional numerical models of groundwater flow and TCE transport and transformation within multiple glacial geologic deposits. The model included steady state and transient boundary conditions and was used to evaluate remedial alternatives for the site, as well as the effects of potential site redevelopment scenarios on TCE transport. More recent work included preparation of a RAP, implementation of a zero valent iron and biotic enhanced reductive dehalogenation pilot study, and completion of a high resolution characterization of the source area.

Senior Project Manager, Industrial Facility, Jubail Industrial Complex, Saudi Arabia. Project management and hydrogeologic data evaluation support for remediation of a chlorinated volatile organic compound source at a major chemical manufacturing industrial facility. A simplified model of groundwater flow and transport was developed to evaluate potential remedial alternatives and design an in-situ reductive dehalogenation treatment cell. The treatment cell included injection, circulation, and a subsequent downgradient transport of a remedial additive selected to enhance reductive dehalogenation of chlorinated solvents. The project included the construction and pilot testing of the treatment cell. DNAPL was encountered during the pilot testing. Recent work has included the design of a DNAPL recovery system and evaluation of recovery data.

Project Manager, Industrial Facility, Newmarket, New Hampshire. Project included design/construction of a remedial system for a former mill facility with fuel oil within a tidally influenced multi-layered groundwater system. Project involved evaluation of previous hydrogeologic studies and collection of additional information leading to the selection of a remedial technology aimed at product recovery and soil remediation, the preparation of a RAP and application for GMP, and oversight of remedial system construction. The proposed remedial system included the use of passive free product recovery and natural attenuation of site contaminants based on a low estimated risk to human health and the environment. Subsequent phases of work included investigations to facilitate the development of the site under the NHDES Brownfields program, and subsurface investigations that confirmed the presence of Manufactured Gas Plant (MGP)-related contamination at the site. Portions of the work on this project were conducted for the State of New Hampshire Office of State Planning under an EPA Brownfields grant.

Project Manager, Brownfields Site Investigation, New Boston, New Hampshire. Performed a hydrogeologic site investigation at an abandoned property formerly occupied by a propane and oil sales and service operation and a garage that serviced heavy equipment. Work on this project was conducted for the NHDES under an EPA Brownfields grant and focused on identifying sources of soil and groundwater contamination based on site usage information. Groundwater quality was used as an indicator of unidentified areas of soil contamination. Solid waste disposal areas were delineated and characterized. Recommendations for management of the limited soil contamination identified by the work and solid waste were developed to facilitate redevelopment of the site by potential developers. GZA's work also included the preparation of a Master QAPP and a site-specific addendum for EPA review and approval.

Project Manager, Brownfields Site Investigation, Claremont, New Hampshire. Performed a hydrogeologic site investigation at two of the former Monadnock Mills buildings and the site of a demolished mill building located adjacent to the Sugar River. Work on this project was conducted for the NHDES under an EPA Brownfields grant. The work focused on identifying sources of soil and groundwater contamination based on site usage information. Areas of historic solvent and petroleum usage were identified and investigated. Soil and groundwater quality was evaluated for solvents, petroleum products, and metals to address historic site use. A RAP was prepared based on the investigation that includes the use of administrative controls to limit exposure to future site occupants. Work also included the preparation of a site-specific QAPP addendum to our Master QAPP. Subsequent work included development of an activity and use restriction and construction oversight.

Senior Project Manager, Spring Water Source Investigation and Development, Alton, New Hampshire. Performed a hydrogeologic evaluation in support of the development of a bedrock spring water source. Site geology included a thin layer of glacial till deposits overlying fractured metamorphic bedrock. The evaluation included several phases of subsurface exploration and testing, including bedrock mapping and geophysical surveys, installation of bedrock groundwater extraction and monitoring wells, installation of overburden monitoring wells and surface water gauging stations, pumping tests, construction and monitoring of weirs, and a metrological station. Pumping tests included the monitoring of numerous residential water supply wells within the area for potential adverse impacts. The investigation was performed to support the development of the spring water source including meeting the requirements of the State of New Hampshire permitting process for Large Withdrawals of groundwater. GZA successfully obtained a Large Withdrawal Permit and spring water certification for this project.

Project Manager, Residential Drinking Water Evaluation, Derry, New Hampshire. Performed a hydrogeologic investigation to identify the source of a volatile organic compound contaminating numerous private bedrock water supply wells. Investigations included: a bedrock fracture fabric evaluation; installation of groundwater monitoring wells and bedrock sentry wells; water supply well, monitoring well, and surface water sampling and analyses; review of land usage; and geophysical surveys. The project was conducted in several phases and included extensive communications with municipal, State, and federal officials and property owners, and presentation of results at a locally televised Town Council meeting.

Senior Project Manager, Hydrogeologic Assessments, Pilgrim Station, Plymouth, Massachusetts, and Arkansas Nuclear One, Russellville, Arkansas. Managed hydrogeologic assessments of two active nuclear power facilities in support of the client's Groundwater Protection Initiative. The objectives of these projects focused on assessing potential radionuclide pathways to the ground from impacted, and potentially impacted, plant systems. For each facility, the project included a site field reconnaissance, engineering systems review; review of as-built plant drawings, review and analysis of regional and local hydrogeological information and development of a Site Conceptual Model. Based on our assessment, options for future permanent monitoring well locations were developed for each facility.

Senior Project Manager, Hydrogeologic Assessment, Vermont Yankee Nuclear Power Station, Vernon, Vermont and Palisades Nuclear Plant, Covert, Michigan. Provided site review and technical review and support in the completion of hydrogeologic assessments of active nuclear power facility in support of the client's Groundwater Protection Initiative. The objectives of the projects focused on assessing potential radionuclide pathways to the ground from impacted, and potentially impacted, plant systems. The projects included a site field reconnaissance, engineering systems review; review of as-built plant drawings, review and analysis of regional and local hydrogeological information and development of a Site Conceptual Model. Based on our assessment, options for future permanent monitoring well locations were developed for each facility.

For the Vermont Yankee Power Station Mr. Wieck also provided technical guidance and oversight of the development of a 3-dimensional numerical groundwater flow model using Groundwater Modeling Systems software to simulate groundwater flow on local watershed and site scales. The project included modeling of a complex subsurface geology, numerous anthropogenic features, and complex hydraulic boundary conditions.

Project Manager, Site Investigation, Community and Residential Water Supply Well Evaluation, Windham, New Hampshire. Conducted on-site and off-site investigations at an active gasoline station. The project involved evaluation of potential sources of M*t*BE groundwater contamination within fractured bedrock. The project included evaluation of fracture connectivity and contaminant transport from the site to off-site community and residential water supply wells. Typical gasoline-related compounds were not detected and the source of the M*t*BE was eventually attributed to a vapor phase release from the UST system. Off-site well installation, bedrock fracture fabric analysis, bedrock pump testing, bedrock packer zone sampling, and monitoring for natural attenuation indicator parameters were performed. Bedrock pump testing included monitoring and evaluating water level response in community and residential water supply wells. Monitored natural attenuation combined with operation of three point-of-entry groundwater treatment systems at affected off-site locations was selected as the remedial approach.

Project Manager, Industrial Facility, Hooksett, New Hampshire. Investigation of a hydrogeologically complex site with cVOC and metals groundwater contamination. Responsibilities included work plan development, oversight of field activities including soil gas surveys; microwell, overburden and bedrock boring and monitoring well installation programs; and a groundwater sampling program including compliance with the requirements of an existing groundwater management permit. Potential impacts to off-site groundwater supply wells were also evaluated. Planned and oversaw an off-site hydrogeologic investigation to delineate the extent of site-related groundwater and surface water contamination and evaluate the potential for natural attenuation of contaminants. A RAP and application for GMP utilizing natural attenuation as the remedial alternative for the site were prepared. Activities included the preparation and presentation of numerous presentations for municipal and state officials and affected individuals.

Project Manager, Industrial Facility, Bristol, New Hampshire. Hydrogeologic investigation to evaluate performance of an existing groundwater remedial system to improve capture and reduce time to closure associated with chlorinated aliphatic and petroleum hydrocarbons. Project objectives also include remediation of vadose zone soil contamination and remediation of soils contained within concrete and polyethylene soil enclosures. Design, construction, and operation of supplemental and replacement groundwater extraction wells, and soil vapor extraction systems have been performed. Remedial technologies include groundwater extraction and treatment using air stripping and carbon, and soil vapor extraction for vadose zone, and soil enclosure for VOC-contaminated soils. Use of bioremediation via reductive dehalogenation was evaluated for the site. Other activities include permit-related water quality monitoring and reporting, permit application preparation, and technical assistance associated with the operation and maintenance of the groundwater remedial system by the site owner.

Senior Project Manager, Hydrogeologic Data Review, Dover, New Hampshire. Performed a review and evaluation of existing hydrogeologic data to evaluate MtBE transport to a public water supply well. The source of the MtBE and other VOCs was an automobile recycling facility. Site geology included a sand and gravel aquifer, silt and clay deposits, and glacial till. Data evaluation included development of a 3-dimensional numerical model of site conditions using the ModFlow and ModPath computer codes. Model development and post-processing of data were performed using Groundwater Modeling System (GMS) software. Results of the model were used to evaluate the potential future impacts to the well. Remedial alternatives were developed based on the results of the evaluation to limit potential impacts to the water supply well.

GMS software was used to prepare 3-dimensional models of major bedrock fracture zones for presentation to local and State officials during public hearings.

Project Manager, Spring Water Source Investigation and Development, Peterborough, New Hampshire. Performed a hydrogeologic evaluation of a sand and gravel aquifer to develop a spring water source. Hydrogeologic investigations included groundwater monitoring well and pumping well installation, aquifer testing/analysis, hydrogeologic mapping, groundwater quality analyses, and water supply pumping well design. The purpose of the project was to develop a spring water source with a flow rate of up to 200 gallons per minute. Aquifer analysis included the use of numerical simulation of groundwater flow to evaluate the capture zone of the proposed withdrawal. Aquifer modeling and numerical simulation was performed using the 3-dimensional finite difference computer code known as ModFlow, and GMS pre- and post-processing software. The project was complicated by a Superfund groundwater contamination site within the site vicinity. Capture zone analyses were conducted to evaluate the potential for contamination of the spring water source.

Recent work has included long-term technical support and oversight of system modifications related to ozonation and chlorination disinfection systems.

Project Manager, Industrial Facility, Nashua, New Hampshire. Prepared a RAP and GMP Application for multiple fuel oil-contaminated areas and a chromium-contaminated area. Responsibilities have included the design and oversight of water quality monitoring programs and milestone regulatory documents including RAPs for the petroleum and chromium areas and a Groundwater Management Permit application for the petroleum areas. Work has included conducting remedial options evaluations that included the evaluation of biochemical fixation of chromium using indigenous soil bacteria. Recent work also

included implementation of the RAP for the chromium area which included excavation of shallow and "hot spot" contaminated soils from beneath an existing building and construction of an engineered cap as part of an activity and use restriction.

Project Manager, Former Dry Cleaners, Keene, New Hampshire. Responsibilities included oversight of remedial system operation and groundwater quality monitoring/reporting at a chlorinated solvent contaminated site. Work includes the evaluation of a previously installed soil vapor extraction and air sparging groundwater remedial system, supplemental delineation of an off-site chlorinated solvent plume, and monitoring of indoor air quality within an on-site retail mall located adjacent to the groundwater remedial system. Work included evaluation of off-site transport. The evaluation of the remedial soil vapor extraction/air sparging remedial system supported termination of operation of the system and transition of the site to remediation by monitored natural attenuation.

Project Manager, Industrial Facility, Keene, New Hampshire. Responsibilities included evaluation of an existing 3-dimensional finite difference groundwater flow model relative to new hydrogeologic and aquifer test data and the evaluation of historical water quality data. The objective of the project was to refine the existing model into a predictive tool used during the long-term implementation of a groundwater recovery and treatment system. Site contaminants include chlorinated aliphatic and petroleum hydrocarbon compounds. The results of this study were used to support termination of active remediation at the site with remediation by natural attenuation being used to remediate limited residual groundwater contamination.

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