National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in National Register Bulletin, *How to Complete the National Register of Historic Places Registration Form.* If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions.

1. Name of Property
Historic name: Concord Gas Light Company Gasholder House
Other names/site number: Concord Gasholder House, Liberty Utilities Gasholder
Name of related multiple property listing**:** N/A
(Enter "N/A" if property is not part of a multiple property listing

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2. Location
Street & number: Gas Street
City or town: Concord State: New Hampshire County: Merrimack
Not For Publication: ☐ Vicinity: ☐

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3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended,

I hereby certify that this _X_ nomination ___ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60.

In my opinion, the property _X_ meets ___ does not meet the National Register Criteria. I recommend that this property be considered significant at the following level(s) of significance:

_X_ national **___statewide** **___local**
Applicable National Register Criteria:

___A **___B** **_X_C** **___D**

____

Signature of certifying official/Title: **Date**

____

State or Federal agency/bureau or Tribal Government

In my opinion, the property ___ meets ___ does not meet the National Register criteria.

____

Signature of commenting official: **Date**

____

Title : **State or Federal agency/bureau or Tribal Government**

4. National Park Service Certification

I hereby certify that this property is:

___ entered in the National Register

___ determined eligible for the National Register

___ determined not eligible for the National Register

___ removed from the National Register

___ other (explain:) ______________________

Signature of the Keeper Date of Action

5. Classification

Ownership of Property

(Check as many boxes as apply.)

Private:	X
Public – Local	
Public – State	
Public – Federal	

Category of Property

(Check only **one** box.)

Building(s)	
District	
Site	
Structure	X
Object	

Number of Resources within Property
(Do not include previously listed resources in the count)

Contributing	Noncontributing	
0		buildings
0		sites
3		structures
0		objects
3	0	Total

Number of contributing resources previously listed in the National Register 0

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6. Function or Use
Historic Functions
(Enter categories from instructions.)
INDUSTRY: energy facility

Current Functions
(Enter categories from instructions.)
NOT IN USE

7. Description

Architectural Classification
(Enter categories from instructions.)
LATE VICTORIAN: Italianate

Materials: (enter categories from instructions.)
Principal exterior materials of the property: BRICK; STONE: Slate

Narrative Description
(Describe the historic and current physical appearance and condition of the property. Describe contributing and noncontributing resources if applicable. Begin with **a summary paragraph** that briefly describes the general characteristics of the property, such as its location, type, style, method of construction, setting, size, and significant features. Indicate whether the property has historic integrity.)

Summary Paragraph

The Concord Gas Light Company Gasholder House (Gasholder House) is located 0.06 miles south of the intersection of South Main Street and US Route 3/Water Street in the southeast part of Concord, Merrimack County, New Hampshire. The 2.12-acre property along the west side of the Boston & Maine Railroad right-of-way contains the cylindrical brick Gasholder House with interior wrought-iron gasholder, constructed in 1888 by the Concord Gas Light Company as a storage tank for purified manufactured coal gas. Extant landscape features on the property include two granite retaining walls and foundation ruins from other buildings in the gasworks complex. The Gasholder House is currently not in use. The structure retains integrity to convey its significance as the last intact gasholder and gasholder house in the United States.

Narrative Description

The Gasholder House is situated at the north end of a truncated triangle-shaped parcel of land between South Main Street and the Boston & Maine Railroad right-of-way, within an historically industrial area of southeastern Concord just south of the city's historical central business district. The parcel is bounded by South Main Street on the west, an elevated portion of US Route 3/Water Street and the railroad right-of-way on the east, and Gas Street on the south. A one-story commercial building with a surface parking lot and a one-and-one-half-story end-gable residence now in commercial use occupy the two adjacent parcels to the north, at the intersection of South Main and Water streets. Commercial, light industrial, and small residential buildings constructed in the late nineteenth and early twentieth centuries surround the Gasholder House parcel, which is enclosed by an early to mid-twentieth-century chain-link fence with stylized metal finials. A pedestrian gate is near the north end of the South Main Street fence, and a double vehicular gate is near the center of the Gas Street fence.

The grass-covered site is terraced, rising in two gradual slopes from the southeast to the northwest. The Gasholder House occupies the upper terrace at the northwest corner of the lot. A mortared split-faced granite retaining wall measuring 5 feet (ft), 6 inches high forms the base of the fence along the northeast edge of the site and curves around the eastern portion of the upper terrace to retain the earth fill around the foundation of the Gasholder House. A similar granite retaining wall with heavy capstones runs along South Main Street at the southwestern edge of the site, inside the fence. Deciduous trees line the corner edges of the site, and larger overgrown deciduous trees and shrubs are clustered at the north edge and along the curved retaining wall. A single large spruce tree stands on the slope in front of the Gasholder House's south valve house, and some low evergreen shrubs are planted near the Gasholder House foundation. Small-scale landscape features on the site consist primarily of remnant circulation elements and visible remains of former gasworks infrastructure. A grass-covered brick walkway edged with dimensional lumber leads from the South Main Street gate to the south valve house entry, and the ruins of wood and brick steps are visible leading down the terrace slope from the south valve house entrance. Slender cast iron light posts inside the fence on either side of the South Main Street gate feature fluted bases, curved tops with applied scrollwork, and white globe fixtures. Concrete slab foundation ruins and metal footings associated with former gasworks buildings and structures are visible at grade on the level southeast portion of the site.

Exterior

The Concord Gas Light Company Gasholder House (Gasholder House) is a typical late nineteenth-century gasholder house, being a cylindrical brick masonry structure with Italianate-style details. The structure is topped with a large conical roof and cupola and rests on brick foundation (the tank of the gasholder). Valve houses in the form of attached entry vestibules project from the south and west sides of the structure. The overall structure measures 88 ft in diameter to the outside of the walls and approximately 72 ft from grade to the top of the cupola; an additional 24 ft of the gasholder structure is set below grade.[1]

The Gasholder's conical roof is covered in slate shingles, with its bottom lip terminating at a tin ogee-profile flashing along the eave. An octagonal wood cupola projects from the top of the roof and is surrounded by a painted sheet metal skirt that provides the geometric transition and weatherproofing between the faceted cupola walls and curving roof surface. The cupola's octagonal roof is covered in slate shingles and terminates at a shallow overhanging eave that is ornamented with sawn brackets and an ogee-profile wood cornice. A prominent copper weathervane atop the cupola incorporates a compass prism and a movable wind vane with an abstract arc-shaped design. Plank weatherboard sheathing and corner boards clad the cupola. A single round-headed, double-hung, four-over-four wood sash is set within each wall of the cupola and surrounded by a wood plank frame. Four heavy copper cables—the vestiges of a lightning protection system—run down the Gasholder House roof and brick walls.

[1] Measurements throughout the description are taken from drawings prepared by Brian C. Lombard for the Historic American Engineering Record (HAER) (Lombard 1982).

Brick pilasters with shallow buttresses evenly divide the curving Gasholder House walls into 16 regular bays, 14 containing windows and 2 containing valve houses. The over 1-ft-thick, load-bearing masonry walls are assembled from common red brick laid in a running bond with occasional header courses. A continuous corbelled brick cornice runs along the top of the walls, and the top of each bay is also corbelled. A single opening centered in each window bay holds a round-headed, double-hung, four-over-four wood sash. The windows are framed by heavy curved brick molds and sheltered under projecting semi-circular brick hoods. All the window openings are covered with heavy wire screens. The window sash in the three northerly window openings have been removed temporarily to facilitate the support of temporary scaffolding for a roof repair (discussed below). Bush-hammered bluestone trim is employed for the window sills, buttress caps, and a beveled water table set close to grade.

The window sash in one opening on the east wall of the structure was removed (date unknown) and replaced with an improvised gas gauge. The gauge consists of a white-painted wood board with black index marks (no units of measurement provided). The gauge's needle assembly uses a pointed strap iron needle attached to a counterweight, which is in turn fixed to a metal cable pulley system. The gauge's window opening is planked over on the inside. A simple iron light fixture—now missing its shade—hangs over the gauge. Two small gas pipes project from the south and east sides of the Gasholder House near grade.

The two valve houses are of similar, but not identical, design. The west valve house adjoins the South Main Street sidewalk. It has a steeply pitched slate roof with copper ridge flashing and tin ogee-profile molding on the rakes and eaves. The walls and end gable feature prominent corbelled cornices and gable rakes, and a marble date stone engraved with the year 1888 is set in the gable end. A personnel entry in the south wall contains a late twentieth-century replacement four-panel wood door with narrow plank trim and a bluestone lintel and threshold (integrated into the water table). The valve house doorstep is a semicircular slab of poured concrete set on a foundation of mortared brick. The west and north walls each contain a single window opening and sash identical in design to, but smaller in scale than, those in the main Gasholder House walls. Subtle differences in the brick of the west wall and a stone lintel in the water table indicate an entrance formerly at this location that was removed at an unknown date.

The south valve house is slightly shallower (as measured from its front wall to the Gasholder House wall) than the west entrance, and its gable roof is missing. The valve house's brick walls, the masonry of which is crumbling at the top, rest atop a bluestone water table. A double-leaf, late-twentieth-century replacement wood door with a semicircular wood transom window is centered in the south wall and sheltered under a projecting semicircular brick hood. Welded gates have been added to the exterior of the door opening, and a plain sheet metal light fixture is mounted above the door. The east and west walls of the valve house each contain a single window opening and sash identical to those in the west valve house. These openings are covered with plywood for security but retain their sash, which is visible from the interior. An etched sheet metal plaque mounted on the wall adjacent to the door commemorates the centennial (1988) of the Gasholder House construction.

Interior

The interior of the Gasholder House is a single high-bay, clear-span, cylindrical space that runs from the foundation floor to the ceiling to house the gasholder and provide for its expansion and ventilation of any escaped gas via the cupola. Temporary steel I-beams run across the bottom of the structure (i.e., the top of the gasholder tank) and support a temporary scaffolding that reaches the base of the cupola. The scaffolding is part of an effort (temporarily halted) to stabilize the Gasholder House roof.

The ceiling of the Gasholder House is the exposed underside of the wood-frame roof structure. Long 3 by 14-inch primary rafters run from the cupola base to the top of the brick Gasholder House walls. The tops of the rafters are tied together at the cupola by a 10-by-10-inch section compression ring[2] constructed of curving wood boards that are bolted together. The rafter bottoms rest on a 13⅛-by-7 5/8-inch section rafter plate, or thrust ring,[3] that runs across the top of the brick wall. This ring is also constructed of wood boards bolted together. Purlins spaced at regular intervals between the primary rafters support secondary "jack" rafters, which in turn support the plank roof sheathing.

The interior walls of the Gasholder House are exposed, unpainted brick. The window and door openings are framed with plain wood plank surrounds. The door opening to the west valve house is infilled with brick. A simple dog-leg staircase assembled from wood stringers and steps runs up the north wall and ceiling slope. Triangular metal brackets affixed to the wall support the staircase.

The Gasholder House still houses its gasholder, comprised of the sheet iron gasholder bell and the masonry tank. Currently, the gasholder bell is empty and in its collapsed state, thus filling the below-grade (approximate lower third) portion of the Gasholder House and forming a "floor". A continuous, approximately 8-inch-wide gap runs the circumference of the structure between the gasholder bell and the brick foundation walls that create the water seal tank of the gasholder. The foundation/tank walls are thicker than the upper walls and divided into bays by pilasters that conform in plan to the locations of those on the exterior of the Gasholder House.

The gasholder utilizes a cylindrical, riveted sheet iron bell of the single-lift type with a capacity of 120,000 cubic ft. It is guided by a system of eight rolled iron rails fastened at regular intervals to the walls of the Gasholder House via triangular cast-iron brackets. Double-flanged iron wheels, or "sheaves," roll on the rails and are mounted on curved "gooseneck" brackets bolted to the top of the corner of the gasholder bell. Additional pairs of mounting bolts are set into the brick walls between the existing rails, indicating that there originally may have been a total of 16 guides or that accommodations for 16 guides were made but not utilized. Two squat cylindrical sheet iron inspection hatches project from the top of the tank. Several rectangular holes have been cut into the top of the tank for remediation access. The floor of the foundation is a concrete slab, and a brick pier rises from the center of this floor to support the gasholder bell when it is in its collapsed position (James Wieck, GZA GeoEnvironmental, Inc.; personal communication with John Daly, PAL, April 18, 2016).

The interior of the west valve house is no longer accessible. It consists of a single small room clad in painted vertical bead board and having a plank floor. Gas lines from the former generator house and purifier house (both demolished), the gasholder, and the street meet in this room, where valves (no longer operational) controlled the junctions. The door opening into the main space of the Gasholder House is infilled with brick.

The interior of the south valve house has unpainted brick walls and a wood plank floor. A chase below the floor contains remnants of the former gas line from the purifying house (demolished) and a tar sump. A gas valve and a hand-operated cast-iron pump for the tar sump are mounted on the wood floor. Double wood panel doors lead into the main space of the Gasholder House through an arched opening identical to the exterior doorway of the south valve house. The window openings have plain wood plank surrounds and iron security gratings installed on the interior.

[2] Terminology established by HAER; current engineering reports refer to this feature as a tension ring.
[3] Terminology established by HAER; current engineering reports refer to this feature as a compression ring.

The Gasholder House is in fair to poor condition. The roof has lost some slate shingles, and a tree felled during a 2013 storm pierced the north roof slope and adjacent wall cornice. The storm-damaged portions of the roof were stabilized but not repaired. Temporary scaffolding erected along the north wall to address this damage required the removal of three sets of window sash. The cupola is tilting, apparently because of structural displacement in the rafters.[4] Many window panes in the cupola are broken. The bluestone wall trim is spalling in several places. In the winter of 2015–2016, the roof of the south valve house collapsed and the resultant debris was removed, along with a small part (about the top 6 inches) of the valve house walls. The floor of this valve house is now heavily rotted.

Statement of Integrity

The Concord Gas Light Company Gasholder House retains the high degree of integrity necessary to justify its engineering significance at the national level as the last remaining example of the gasholder house property type in the United States that retains its gasholder. The Gasholder House employs and retains typical aspects late nineteenth-century gasholder house design, workmanship, and materials—a conical slate-clad roof with cupola, cylindrical structural envelope of robust brick masonry and wood frame construction, valve houses, water seal tank, and late nineteenth-century architectural detailing—that characterize this type of structure. It retains its location adjacent to railroad tracks (the means for importing fuel coal to the gas plant) on the edge of the City of Concord's downtown (the distribution territory for gas within the gasholder) and setting within a light industrial and residential neighborhood of late nineteenth- and early-twentieth century origins. The gasholder itself remains in the Gasholder House (albeit with small portions of its bell removed for remediation), and the important rail and roller guide system that allowed the holder to expand in volume in relation to the gas produced is intact. Together, the Gasholder House and its gasholder convey the feeling and association that demonstrate the property's essential character as a structure designed to house and distribute the gas of a coal gas plant, and to link the structure to engineering and architectural trends in late nineteenth-century gasholder house and gasholder design.

The structure's immediate setting has been impacted through the demolition of the other buildings and structures associated with the gas production works. Structural remains of several of these gasworks buildings are extant and visible within the former Concord Gas Light Company parcel. The large granite retaining walls that allowed the gasworks site to be terraced and retain the fill around the foundation of the Gasholder House are also extant. None of the identified condition problems of the Gasholder House impinge on its integrity.

Previous owners of the Gasholder House have made several alterations to the structure during the historic period in support of continued operation of the facility. These alterations should not be considered as impinging on the integrity of the structure. They consist of: changes to the entry configuration of the west valve house, the replacement of a window with a gas gauge, and the possible removal (not confirmed) of additional guide rails or a pulley system for the gasholder.

[4] This tilting occurred during the historic period in the locally famous Hurricane of 1938, and the local community now recognizes it as an idiosyncratic visual characteristic of the structure.

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

[ ] A. Property is associated with events that have made a significant contribution to the broad patterns of our history.

[ ] B. Property is associated with the lives of persons significant in our past.

[X] C. Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

[ ] D. Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply.)

[ ] A. Owned by a religious institution or used for religious purposes

[ ] B. Removed from its original location

[ ] C. A birthplace or grave

[ ] D. A cemetery

[ ] E. A reconstructed building, object, or structure

[ ] F. A commemorative property

[ ] G. Less than 50 years old or achieving significance within the past 50 years

Areas of Significance
(Enter categories from instructions.)
ENGINEERING

Period of Significance
1888

Significant Dates
1888–Gasholder House completed and enters operation

Significant Person
(Complete only if Criterion B is marked above.)
N/A

Cultural Affiliation
N/A

Architect/Builder
Deily & Fowler of Laurel Iron Works (architects/engineers)
W.C. Whyte (builder)

Statement of Significance Summary Paragraph (Provide a summary paragraph that includes level of significance, applicable criteria, justification for the period of significance, and any applicable criteria considerations.)

The Concord Gas Light Company Gasholder House is significant at the national level under Criterion C in the area of Engineering as the last remaining example of a gasholder house in the United States that retains its gasholder. Concord Gas Light Company (chartered 1850), suppliers of illuminating gas to the City of Concord, New Hampshire, installed the Gasholder House in 1887–1888 during one of several late-nineteenth-century improvements to its facility on South Main Street. The structure was designed and erected by Deily & Fowler of Laurel Iron Works, Philadelphia—a nationally recognized firm in the field of gasholder design and fabrication. During the second half of the nineteenth century, coal gas was an important fuel for municipal and industrial illumination, as well as domestic purposes, and therefore played a significant role in the growth of American cities and industry. In this period, gasholder houses were emblematic of urban progress generally and the coal gas industry in particular, and, as one of the larger buildings or structures on a city's skyline, often came to have landmark status in a community. In Concord, the introduction of coal gas coincided with a dramatic period of physical and economic expansion, as well as the community's incorporation as a city. The Gasholder House is located in South Concord, a residential and industrial area with strong associations to the late nineteenth century development of the City as a manufacturing and transportation hub. In the period 1900–1950, coal gas manufacturing and distribution facilities became obsolete as electricity and natural gas emerged as viable competitors. Concord Gas Light Co. discontinued use of the Gasholder House in 1952 when it switched to the sale of natural gas. Wholesale demolition of disused coal gas plants and their iconic gasholders has occurred across the country, and currently only a handful of gasholder buildings or gasholders survive. The Gasholder House is now the only known gasholder house in the country that retains its metal gasholder. It is demonstrative of typical late nineteenth-century gasholder house and gasholder design and retains all the essential physical features required to convey its engineering significance. The period of significance for the Concord Gas Light Company Gasholder House begins and ends in 1888, when the structure was completed and entered active use as a gasholder.

The Gasholder House was documented for the Historic American Engineering Record (HAER) program in 1984. In 1993, the structure was determined eligible for listing in the National Register as a component of the Concord Gas Company/Holt Brothers Industrial Historic District. Since 1993, all other buildings and structures of the Concord Gas Light Company complex have been removed, leaving the Gasholder House as the only tangible record of coal gas manufacturing in the city. In 2012, the New Hampshire Division of Historical Resources (NH DHR) determined that the property was individually eligible for listing in the National Register of Historic Places because of its engineering significance (Mausolf 2012a, NH DHR 2012).

Narrative Statement of Significance (Provide at least **one** paragraph for each area of significance.)

CRITERION C – ENGINEERING

The Concord Gas Light Company Gasholder House (the Gasholder House) is significance at the national level in the area of Engineering as the sole remaining example of the gasholder house property type that retains a gasholder. Gasholder houses and gasholders were once ubiquitous across the United States because of the essential role they played in the coal gas manufacturing process. Coal gas, which was discovered in England and first used in the United States for illumination in the first decade of the nineteenth century, was a highly useful fuel source for domestic illumination, cooking, and heating, as well as industrial illumination and power. It consequently played an important role in the country's energy portfolio and urban and industrial development throughout the nineteenth and early twentieth centuries, until replaced by natural gas and electricity. Since the phasing out of coal gas, gasholder houses and gasholders have been demolished across the country, leaving only the Gasholder House in Concord as an example of this important property type.

Concord Gas Light Company and the Construction of the Gasholder House

The Concord Gas Light Company was chartered in 1850 to provide street lighting for the downtown area of Concord, the capital of New Hampshire. On the verge of becoming a city, Concord recorded a population of 8,576 in 1850, a sufficient density to justify the investment in a gas lighting system.[5] The company held its first meeting in August 1852 and purchased land from the Concord Railroad Company (later the Boston & Maine Railroad, or B&M RR) on the south side of Concord and periphery of downtown between South Main Street (a primary road in the original town plan) and the railroad tracks (laid out in 1842) (Lyford 1903:427–428, 456–457; HAER 1984:3). It hired the Somersworth Machine Company to construct the gasworks facilities on the site (Figure 1). A few small commercial buildings, including two blacksmith shops and a shoe shop, and Abbot's Carriage Works were scattered nearby (Mausolf 2012b). The area's proximity to the railroad was essential to the Concord Gas Light Company's manufacturing process, providing efficient access to the railroad cars that transported coal to the complex where it was heated with oil and steam to produce gas (see discussion of the gas making process and the role of gasholders therein, below). By 1857, 21 locations in the downtown business and residential area just north of the Concord Gas Light Company had gas street lamps (Hengen 1994:128).

Demand for gas to supply the city's lighting and heating needs increased rapidly in the 1860s and 1870s due to the rapid growth of Concord. In the year ending June 1, 1870, the Concord Gas Light Company manufactured 9,161,000 cubic feet of gas in 18 retorts using 1,200 tons of coal. Its capitalization grew from an initial value of $35,000 in 1852 to $80,000 by 1870 and $100,000 by 1880. Its four gasholders (aka gasometers) had a total storage capacity of 80,000 cubic feet: two adjacent to the gashouse each held 16,000 cubic feet (Figure 2), another on the property of St. Paul's School at the end of the distribution line held 8,000 cubic feet, and a fourth on the edge of the business district held 40,000 cubic feet (HAER

[5] Concord became a city in 1853 when the residents voted to accept a charter granted in 1849 (Lyford 1903:427–428).

1984:3–4). By 1881, Concord had 133 gas street lights, and demand continued to outpace production (Lyford 1903:556). By the late 1880s, the company's average daily output was 95,000 cubic feet and its highest was 112,000 cubic feet, which meant that during high demand the facilities could not store enough reserve gas and on days of heavy usage the system almost ran out of gas (HAER 1984:4). A newspaper article in April 1888 noted that by 10:00pm, the city's holders were on "several occasions … entirely empty" (*Concord Evening Monitor* quoted in HAER 1984:5).

Recognizing the need to expand, the Gas Light Company acquired the lot adjacent to the northern boundary of the gasworks complex in the summer of 1887 and began construction of a new and larger gasholder—the Gasholder House—on April 9, 1888. Deily & Fowler of Laurel Iron Works, a gasworks manufactory in Philadelphia, designed the gasholder tank and its brick enclosure. John M. Hill, treasurer of the Gas Light Company from 1856 to 1888, made some alterations to the Deily & Fowler plans to suit the company's needs. For example, Hill suggested the addition of wrought-iron bands consisting of 16 sections locked together with wedges around the walls of the masonry water tank at 2 feet and 7 ft below ground level "to secure the greatest possible strength" (*Concord Evening Monitor* quoted in HAER 1984:7). In general, however, the new structure was typical of enclosed gasholders built around the same time in the Northeast. The Italianate detailing on the brick Gasholder House reflected the aesthetic that the Gas Light Company wanted to convey as a prominent business within the community. The below-ground masonry tank could hold 800,000 gallons of water, and the wrought-iron single-lift gasholder had a capacity of 120,000 cubic feet. The purified gas from the retort entered the holder through the south valve house and exited through the west valve house into the city's distribution mains. The cupola provided ventilation for any gas leakage. The New York construction firm of W. C. Whyte built the Gasholder House, and Laurel Iron Works assembled the gasholder. Local contractors E. B. Hutchinson supplied some carpentry work, W. M. Darrah installed the slate roof shingles, and Samuel Holt produced the 550,000 bricks used to construct the enclosure. Two granite retaining walls were also constructed on the site to retain the terraced slope around the Gasholder House foundation (Figures 3–6). The final inspection of the completed Gasholder House occurred in December 1888 (HAER 1984:5–8, 18).

At about the same time as the Gas Light Company expanded its gasworks, it also attempted to capture the market for electric lighting in Concord. The company altered its charter in 1887 to enable it to furnish light and power by electricity and in 1889 negotiated a purchase of the recently organized Concord Electric Light Company and its electric generating plant (Hengen 1996; HAER 1984:9–10). In 1892, however, Concord Gas Light sold the electricity plant to the Concord Land and Water Power Company, which then contracted with the city to supply its electric lights (Lyford 1903:556–557). The same year, Concord Gas Light leased its gasworks to the United Gas Improvement Company (UGIC), a large holding company headquartered in Philadelphia. UGIC took over maintenance and operation of the Concord facility, renamed Concord Light & Power Company, and almost immediately converted its gas production from the traditional coal-burning process to carbureted water gas (HAER 1984:10; Republican Press Association 1893). The conversion involved the construction of several new buildings and structures on the site, but the Gasholder House remained in use as a storage tank for the purified gas (Figure 7).

Continued growth of the city during the early twentieth century increased the number of gas customers, who primarily used it for cooking and space and water heating as electric lighting superseded gas. In 1921, the Concord Light & Power Company built a new steel telescoping gasholder immediately south of the Gasholder House that had a capacity of 500,000 cubic feet (Figures 8 and 9). The Gasholder House became a relief holder for the raw gas coming directly from the gashouse, before it was sent to the purifier house and then pumped into the new gasholder for distribution into the gas mains (HAER 1984:13). It remained in use and unaltered for the next 30 years, excepting some structural displacement of the cupola that resulted from the 1938 hurricane (New Hampshire Historical Society 1982:2). During the late 1940s and early 1950s, demand for gas increased and technological improvements in the manufacturing process (e.g., the use of better coal and high-grade oil) enabled the company's production to exceed the design capacity of its generator (500,000 cubic feet per day). By 1951–1952, the Concord facility produced a record 1,359,000 cubic feet during a 24-hour-period. Its distribution system totaled 45 miles, serving approximately 100 gas heat customers (HAER 1984:14–15).

The introduction of a natural gas pipeline to Concord in 1952 prompted another overhaul of the company's facilities. The business changed its name to the Concord Natural Gas Corporation and began converting its distribution system to natural gas on August 13, 1952. Its production of gas and amount of stored gas decreased over the next year as each section of the city switched over to natural gas. By August 13, 1953, the last day gas was produced on the site, all the holders were empty. The Gasholder House has remained unused since that day (HAER 1984:16–17). Energy North acquired the Concord Natural Gas Corporation in 1985 and dismantled the 1921 steel gasholder in 1989 (Mausolf 2012b). The two earlier gasholders on the site were removed by 1932, and the other buildings and structures in the gasworks complex (the regulator houses, boiler house, retort house, purifying house, and oil tanks) were removed during the 1980s (Mausolf 2012a). The current owner of the Gasholder House, Liberty Utilities, acquired the property from Energy North (a subsidiary of National Grid) in 2012 (Brooks 2015). A 2013 storm caused a tree to fall on a section of the Gasholder House roof, damaging the wood thrust ring at the base and the supporting masonry wall. Liberty Utilities repaired the roof with a temporary patch in September 2014, removing three sets of window sash from the north wall in the process to facilitate the erection of scaffolding (Garvin 2015). The roof of the south valve house collapsed during the winter of 2015–2016 and has not been repaired.

Role of Gasholders in the Manufactured Illuminating Gas Industry

Historical Development of the Manufactured Illuminating Gas Industry

Before the development of the process to manufacture gas from coal, illuminants were obtained from organic sources such as animal tallow, bees' wax, whale oil, vegetable oils, and tree rosin (Clark 1916:492-494). The Industrial Revolution and increasing urbanization of American cities during the first half of the nineteenth century created increased need for nighttime illumination and a consequent demand for illuminants in much larger quantities and greater quality than ever before. Coal gas provided a seemingly inexhaustible, cheap, and flexible source of fuel that had the initial advantage over petroleum-derived illuminants like kerosene of transportability through direct piping from its source of production. As a result, the commercial manufacture of coal gas grew into a major industry in the United States between 1850 and 1900 and was a highly important trend in the development of the country's energy supply in the late nineteenth century.

Historically, two processes were used to manufacture illuminating gas in the United States. The first to be perfected was the decomposition of coal or other materials containing hydrocarbons through the application of heat to coal in the oxygen-deficient retort (an industrial oven). This process, known as destructive distillation, was most commonly used to produce coal gas, as in the case at Concord. In the late nineteenth century, the second process and product, carbureted water gas, was perfected. Manufacturers of carbureted water gas relied on a chemical reaction between heated coal and steam to produce the gas, which was then enriched with oil or similar liquid hydrocarbon to increase its illuminating power (American Gas Journal 1951:27).

Experimentation with coal gas as an illuminant began in Europe in the seventeenth and early eighteenth centuries in England, France, and Belgium. Following on early experiments in these countries, in 1792-1798 English engineer William Murdock, working for steam engine manufacturers Boulton & Watt, made the first successful practical demonstration of coal gas illumination on a commercial scale when he constructed an experimental distillation plant and sold gas to a factory and several shops in Birmingham, England. New distribution and lighting systems utilizing the fuel were soon installed in public buildings and streets in London and Paris. Both systems were the result of efforts by German-born Frederick A. Winsor (or Winzer, sometimes called the father of gaslighting), in 1810 and 1815, respectively. By the mid nineteenth century, gas works and distribution networks were widespread across major European cities (Myers 1978; Pratt and Nolte 1998; Tomory 2011:79-81).

In the United States, entrepreneurs in several northeastern cities made tentative steps to experiment with coal gas lighting in the first and second decades of the nineteenth century. Philadelphia's new Masonic Hall was designed with gas lighting in 1809 and parts of Independence Hall received gas light in 1816. Rembrandt Peal introduced gas light to his Baltimore museum in 1816 and obtained permission to lay a street network and sell gas in the city that same year. This was the first manufactured gas plant constructed for commercial gas light distribution in the United States. New York City, after some studies and experiments, issued its first franchise to supply gas in 1823, after which it became a wide success. In New England, coal gas was reportedly used in mills in Boston and Providence in 1812 and Boston adopted gas for street lighting in 1822 (Clark 1916:494; Myers 1978; Pratt and Nolte 1998).

During the two decades before the Civil War there was a significant increase in the pace of gas plant development. At the beginning of the period in 1840, there were only 11 chartered gaslight companies in the United States. That number increased to 51 by 1850 and 362 by 1862. The heavily industrialized and densely populated northeastern and mid-Atlantic states were the leading producers of gas. States with the largest number of plants were New York (84 plants), Massachusetts (58 plants), and Pennsylvania (53 plants) (Myers 1978). Of these, 386 were producing coal gas, 1 was producing wood gas, 30 were making rosin gas, and 3 were making carbureted water gas (Myers 1978).

The profitability of coal gas plants increased between 1820 and 1850 with the development of laboratory and commercial chemical industries that identified marketable applications for the byproducts of gas plants. By the 1820s, coal tar was recognized as an effective means to treat rope and create and air- or water-tight seals in piping. After distillation of coal tar began about 1830, its constituent elements were also used for wood preservatives (creosote), roofing, and road paving. Later in the nineteenth century, the availability of "lighter" gas byproducts such as benzene and toluene were of interest to laboratory chemists developing models of organic chemistry. Coal tars also found application in the creation of artificial dyes. The chloride and ammonia byproducts also became valuable constituents in chemical fertilizers (Benjamin 1889:900; Pratt and Nolte 1998).

Throughout the antebellum period, the market for gas was largely driven by municipal and industrial clients. Domestic consumption during this period was relatively low and primarily in homes owned by the wealthy. After the Civil War, however, as the cost of the product declined and distribution networks expanded, gas became more available to middle and lower income earners. The major reason for this market growth was the development of more efficient gas production through the refinement of the carbureted water gas process. Experiments with carbureted water gas had begun as early as 1780, but the first practical gas plants utilizing this process were not constructed until 1870s. These were quickly supplanted with the generator-retort system (described below) perfected by Dr. Thaddeus Sobieski Constantine Lowe (T.C.S. Lowe) in the 1860s, and patented and made commercially available in the early 1870s. Lowe's process simplified the production process and reduced the space required for the gas plant.

It also allowed for near-continuous operation, as opposed to distillation, which was a batch process wherein the retorts had to be reloaded manually. As a result, gas production became cheaper and more efficient. By the 1876 Centennial most of the nation's population centers of 10,000 or more were served by gas plants and by 1900, even small towns with populations of only a few thousand residents had gas service. While municipal governments owned some plants, most were privately organized companies that were formed by local entrepreneurs to produce gas on a commercial basis. These early commercial plants were often built from prefabricated kits produced primarily in New York and shipped via boat or rail to their communities (*American Gas Journal* 1951:29-30; Hatheway 2009; Stephenson 1916:9-13; Taylor 1984).

Electricity emerged as a direct competitor with gas for the illumination market in the late nineteenth century and precipitated a steady decline in manufactured gas market share, which was increasing relegated to residential or industrial heating, or manufacturing (Hatheway 2012:100). The new technology was embraced relatively quickly by municipalities and manufacturers on the East Coast as a safer and more cost-effective way to light streets and factories. Gas companies strove to ward off the threat of the electric utilities through advertising campaigns and improved gas light technology. They touted the reliability of their service and they decried the onerous work required to install electrical wiring in one's home. Improved gas lighting fixtures had an appearance and operation that compared favorably with the new electric light bulbs. Chief amongst these was the inverted burner and the Welsbach burner, or gas mantle. Inverted burners cast their light downwards to provide more direct light and avoid shadowing. Austrian chemist Dr. Carl Auer von Welsbach introduced his burner in about 1890. This long-lived, conical mantle glowed with a bright, warm flame (Myers 1978).

The gas industry's decline accelerated after World War I. In addition to competition from electricity, the consolidation of small plants into utility holding companies led to the discontinuance of local plants in favor of larger, more efficient central stations. The final blow to the industry was the widespread adoption of natural gas. During World War II, the Federal government financed the construction of pipelines from the fields of Texas to the industrial northeast. When the war was over the pipelines were sold to natural gas suppliers, which forced most of the manufactured gas plants in the northeast, including Concord's, into the natural gas supply business, or out of business altogether (Hatheway 2009).

Gas Manufacturing Processes and Infrastructure

William Murdoch and his employer, Boulton & Watt, developed the fundamental apparatus and process model for coal gas manufacture between 1802 and 1806. The basic steps in this production technique included distillation, condensation, and purification.[6] On completion of purifications, gas was stored in a gasholder and then distributed in mains and lines to consumers. Contrary to the general nineteenth-century trend in industrial architecture that tended towards a consolidation of plant activities into larger buildings, gasworks companies typically housed the component steps of gas making in individual buildings because of the specialized infrastructure required and to minimize damage that might result from explosions. Gasworks at first favored standard (for the period) fireproof brick industrial architecture, then later steel and concrete buildings. Ideally, gasworks were sited close to, but on the periphery of their intended market where inexpensive land was available and there were few neighbors to complain about gas company operations. Sites adjacent to railroad lines were invaluable in providing a reliable and

[6] This section provides a generic overview of coal gas manufacturer and the role of the gasholder therein and is not intended to be specific infrastructure or processes that were employed in the Concord Gas Light Company plant at any given time.

inexpensive supply of the coal that was needed in large amounts for gas production (Hatheway 2012:17–18).

Distillation occurred in a retort house, which enclosed long, narrow, cast-iron or clay chambers called retorts. Coal was loaded in 200-250 pound charges into ranks (called benches) of retorts set in a fire brick oven. The mixture of coals used was chosen to provide marketable coke, as well as to produce enough illuminating gases for the desired candlepower. Cannel coal, which contains a large amount of hydrogen, was particularly desirable as a so-called "enricher" in the gas plant. The coals were then heated in an oxygen-deprived atmosphere to temperatures exceeding up 700 degrees Fahrenheit. The heat drove off the lighter constituent elements of the coal including methane, hydrogen, and other gases, oils, and tars. These elements were drawn off from the retorts via metal conduits. The coal remaining in the retorts at the end of the process was converted to coke, a hard porous combination of carbon and ash that was a valuable fuel source in metallurgical and other applications (Benjamin 1889:901-903; 930-931; National Gas Museum Trust 2010; Ness 1982; Pratt and Nolte 1998; Tomory 2011:79).

The raw coal gas driven off from the retorts had to be further treated before sent to consumers. From the conduits, the gases, mainly consisting of hydrogen and carbon monoxide, were passed into the condenser, a series of iron tubes passing through cold water or exposed to air. Lighter gasses and heavier constituents (collectively referred to as tars) were divided at the condenser. From the condenser, the gas passed into a washer and thence to a scrubber. In the washer, gas was bubbled through water to remove the last traces of tars and ammonia, and to remove much of the sulfur. Tars and heavier materials, including ammonia, were disposed of or sold to other chemical plants for further distillation. A gas scrubber further purified the gas by removing the last of the hydrogen sulfide and carbon dioxide. Scrubber technology evolved over time from relying on the "wet lime" (lime water, or milk of lime – calcium hydroxide in water) and "dry lime" processes, to the Lauring or iron ore processes. The first two were highly effective but produced highly offensive odors and unusable waste products. The second two, introduced after 1850, relied on iron in various forms to react with and draw the sulfur from the gas and resulted in less waste and/or saleable waste products (Benjamin 1889:901-903; 930-931; Ness 1982; National Gas Museum Trust 2010; Pratt and Nolte 1998).

The carbureted water gas process dispensed with coal distillation in retorts and instead relied upon a chemical interaction between superheated coal or coke and water in the form of steam. In this reaction, water molecules broke down into their constituent hydrogen and oxygen components and then the oxygen combined with carbon in the fuel to create carbon monoxide. The resulting gaseous mixture of carbon monoxide and hydrogen, called blue gas or water gas in the industry, was flammable but had a relatively low illuminant and BTU value. To bring the gas up to standards for consumer use, it was enriched by means of the injection of a petroleum-based gas, thus converting it to carbureted water gas (*American Gas Journal* 1951:29-30; Pratt and Nolte 1998; Stephenson 1916:9-13).[7]

Carbureted water gas plants typically utilized a refined version of Dr. Lowe's process. Steps in the process, termed the generator-retort system, included generation, enriching, and fixing. The gas was produced in the generator—a vertically-oriented, cylindrical sheet iron oven lined with firebrick. The generator had a grate and ash pit at the bottom, inlet ports for steam and air, and outlet ports for gas. A generator would be run in two stages—the blow and the run. During the blow, coal or coke in the fuel bed

[7] Industrial plants such as mills and factories, glassworks, and ceramics kilns also manufactured gas using the water gas process, but without the enrichment necessary for illumination. Referred to as producer gas, this fuel was used as a heat source in kilns or other types of furnaces, or in producer gas engines that could power pumps, assembly lines, and other equipment (Hatheway 2012).

of the generator was ignited and raised to a white heat with a continuous air blast. When the appropriate temperature was reached, the air blast would be cut off and the run was commenced. In this stage, steam would be injected both up and down through the generator, resulting in the production of carbon monoxide and hydrogen gas. The gas was then forced out of the generator into the carburetor. This was a second sheet iron apparatus, with a matrix of firebrick occupying the whole of the interior. The carburetor was heated during the blow through secondary combustion of carbon monoxide resulting from the fire. During the run, oil such as naphtha was injected into the superheated gas stream and then vaporized in the carburetor. From the carburetor, the gas passed into the fixing chamber, a third sheet iron and firebrick cylinder. Here, the gas was reheated to ensure that all the oil was broken down into its gaseous elements. Upon exit from the generator set, the raw gas was processed through a series of apparatus to clean and purify it before storage and transmission to the consumer. These steps were similar to those used in coal gas production and included a wash box scrubber, and condenser to remove sulfur compounds and tars (*American Gas Journal* 1951:29-30; Benjamin 1889:941; Stephenson 1916:9-15, 21-35).

Regardless of whether the distillation or the carbureted water gas method was used, gas passed from the washers and scrubbers, through a station meter, which measured the gas production of the plant, and thence to the prominent cylindrical gasholder for storage.

The Gasholder

Gasholders, known initially within the manufactured gas industry as gasometers[8], have played a prominent and consistent role in the operation and physical plant of manufactured gas facilities:

> A 'gasholder; as the term in understood, is something more than a mere receptacle for the storage of gas. It furnishes the pressure required for distribution, and it acts as a regulator between the uniform rate of production during the 24 hours, and the extremely fluctuating rate of consumption. Not only on these grounds, but also on account of so large a proportion of capital being absorbed in their construction, and that fact, that *from an engineering point of view, they are the most important portion of gasworks plant, gasholders claim the earnest attention of engineers* [emphasis added] (Sir George T. Livesey, on the Principles of Gasholder Construction, as cited in Hatheway 2012:410).
>
> Gasholders constituted the focal point of any gasworks, always the first aspect of the gasworks to catch the travelers eye (Hatheway 2012:410).

For the gas production and supply infrastructure of a gasworks to function successfully as an integrated system, a continuous supply of gas was essential from both a safety and customer satisfaction standpoint. From the earliest days of gas manufacture, it was an essential, but unwritten rule that gasworks should have a day's supply in storage in case of any plant malfunction that interrupted manufacture. As well, from the earliest (1805) gasworks, the gasholder was the buffer between the manufacture and distribution of manufactured gas. The gasholder captured and stored the output of the gas plant, and the weight of the gasholder bell (the gas-entrapment vessel, shaped like a giant upside-down cup) provided the necessary distribution pressure. An added benefit to the gasholder was that in passing through the water that

[8] The term *gasometer* referred to gasholder's early use as a means to gauge the amount of gas that had been produced in a gasworks plant. As measurement tools for gas production became more sophisticated, the term became antiquated and was largely replaced with *gasholder*, which is used throughout this document for consistency (Hatheway 2012:412).

provided the water seal, the gas was cooled and subject to a final cleaning in which remnant particles of tar might be captured (Hatheway 2012:410–412).[9]

Consumer demand drove gas company production and, as communities grew, required new and larger gasholders. As these were installed, the original older gasholders were typically retained as they could still provide useful service within the gas plant. In instances where carbureted water gas generating systems were installed, the original holder was retained as a "relief' holder, which provided regulating backpressure for the cyclical recurrence (nominally every few minutes) of blow and run of the generator equipment and acted as a cooler for the fresh hot gas from the generator. Additionally, if both carbureted water gas and distillation were simultaneously employed, the gasholder provided a vessel in which the output of the two processes could mix so that the final product was consistent (Hatheway 2012: 423–424).

The principal of the gasholder—a bell of metal sitting in a tank of water—was invented by famous French chemist Antoine-Laurent de Lavoisier (1743–1794) in 1782 during his experiments with gases. Murdock employed this principle in the construction of the world's first manufactured gas distribution plant, then many mechanical design elements of cylindrical gasholders, including movement-guidance systems, were developed by British gas engineer John Malam about 1820. The earliest gasholders held about 5,000 cft. As manufactured gas increased in popularity, patents and proposals for a wide variety of bell and water seal systems, guide systems, and bell or gasholder house designs proliferated. The capacity of gasholders increased as well, reaching 25 million cft at the end of the manufactured gas era in the 1940s. However, typical gasholders such as that in the Gasholder House operated on the same general principles. A typical gasholder consisted of its large inverted hollow cylindrical sheet metal vessel—the bell—floating with its open end down in a slightly larger diameter, watertight masonry or concrete pit—the tank. This arrangement created a sealed, interior void under the bell, allowed the bell to move vertically within the tank, and provided a contained pool of pit water to form the seal between the interior and exterior. Fresh clean manufactured gas was pumped through an inlet pipe and backflow-resistant valves that penetrated the tank and rose vertically under the bell. The piped gas filled the bell and caused it to rise within the gasholder house, while the bottom ring of the bell remained submerged in the tank to form a seal to prevent the gas from escaping. The weight of the bell, which was typically fabricated from riveted sheet iron, created the pressure to force the gas out of the bell through a second outflow pipe to distribute the gas through mains to consumers. This counterbalancing effect also regulated pressure differences between production and consumption (Benjamin-Ma et al 2015; Hatheway 2012:410–413).

Like the gasholder in the Gasholder House, most nineteenth-century gasholders employed a subsurface round masonry tank to provide the water seal. Nineteenth-century tanks were typically just a few feet wider than the diameter of the bell and extended to a depth that approximated the height of the bell. The tanks were typically built of multiple thickness of brick masonry, sometimes reinforced with cut stone on the outer side.[10] Masonry thickness increased from top to bottom to contain the hydrostatic pressure of the sealing water. Design of the tank floor varied based on local ground conditions and builders' experience, but most often employed tamped earth or puddled clay to prevent water leakage. Mass (unreinforced) concrete came into use in some tank floors by the 1870s. Some tanks were deeper at the edges, with a shallow, truncated conical dome, or "dumpling" at the center, which allowed residual coal tar to collect at the bottom outer edges for removal. In general, early (pre-1850) tanks were brick with conical earth floors and were up to 16 ft deep. After 1850, tank materials remained consistent, but increased in depth to up to 48 ft. After 1880, tapered concrete walls became commonplace in tank design. After circa 1890, a

[9] One negative aspect was that the tank water was cool and tiny tar particles that remained in the gas, precipitated, sunk, and over decades filled a portion of the water-seal tank (Benjamin-Ma et al 2015).
[10] Iron was used for gasholder tanks in rare instances (Hatheway 202:422).

masonry pier would often be erected on the center of the tank floor to support the gasholder bell when fully collapsed. As gasholders became larger, tanks became deeper. About 1900, tank construction shifted to aboveground tanks with sheet steel or reinforced concrete walls and reinforced concrete slab bases (Benjamin-Ma et al 2015; Hatheway 2012:413, 417, 420-429).

Gasholders were constructed in single-lift and multiple-lift (telescopic) variants. Early gasholders were of the single lift variety, and consisted of the bell slowly riding up and down within a subsurface water seal tank and supported in vertical alignment by structural guide columns. Telescoping gasholders allowed two or more cylinders to collapse within one another, thus providing more storage capacity within a given footprint (Benjamin 1889:920-925; Ness 1982; National Gas Museum Trust 2010; Pratt and Nolte 1998). The vertical travel of a cylindrical gas bell had to be carefully controlled in order to keep it physically concentric with the water seal tank it rode and fell within. Vertical travel was controlled by a variety of mechanisms that evolved over time. Some of the very earliest, small systems had square tanks and bells, but the cylindrical model was quickly adopted for its greater stability, with installation at the first larger urban gasworks after 1810. The earliest bells used a central guide system, employing a vertical tube at the center of the bell, which itself rode up and down a fixed central column. This system was only practical for small installations. About 1850, the capacity of gas bells was increased through development of the double-lift bell, which incorporated a second, inner ring (lift) that telescoped up and down from the inside of the first and included a positive seal between the sections. Triple-lift holders emerged about 1870, and gasholders eventually reached a working maximum of five lifts. As gasholders became larger, center columns faded from use and were replaced by systems where vertical travel was guided by a system of cables and rollers. Many, but most of these gasholders also employed iron counterbalance weights to aid the bell's rise and fall. About 1860, cable systems were replaced by multiple external columns, with vertical bell travel guided by rollers mounted on goosenecks attached around the upper exterior edge of the bell. That system was common through the 1880s, when columns were replaced by a cage-like cylindrical frame and roller guide systems surrounding the outside of the bell, which remained common well into the twentieth century. Alternative systems emerged that were guided by internal spiral guides, and by the 1920s, very large, waterless, non-telescoping models dominated the skyline at large urban gasworks (Benjamin-Ma et al 2015; Hatheway 2012:410, 413-416, 423; Thomas 2014:6-9).

Early gasholders were often enclosed in masonry or wood shelters—the gasholder house—to protect the apparatus from weather. In these instances, the robust masonry tank provided a natural foundation for the gasholder. The primary rationale for the gasholder house was to avoid winter freezing of the water seal, as well as to contain escaping gas to prevent fires, however, explosions of trapped gas proved a greater problem, and enclosed bells fell out of favor earlier in England and Europe. They remained in favor and use longer in North America for the basic climatic reasons. Masonry shelters protected the riveted sheet iron or steel gas bells from snow and wind loads, protected the water seal in the tank from freezing, and kept the vertical movement guide mechanisms from jamming in very cold or hot weather. Steam heat and mechanical ventilation made the American gasholder houses safer and more reliable and inhibited moisture condensation (Benjamin-Ma et al 2015; Lawry 1977b: 13,15; Pollak 1969:2; Thomas 2014:2).

As was often the case with visible, urban public utility structures in the nineteenth century, gasholder houses might be provided with ornamental details the reflected stylistic trends of the day. The structures were almost always executed in brick (consistent with the use of brick for the tank below) with a conical slate roof crowned by a cupola for the venting of gas leaks. In some instances, such as at Roxbury Massachusetts, and Troy, New York, a domed roof evocative of the Pantheon in Rome was employed. Many gasholders demonstrate a light Neoclassical touch in the use of segmental arched window openings, pilasters, and cornice friezes. The Attleboro Falls gasholder house in North Attleboro, Massachusetts, employed Romanesque Revival or Shingle Style ganged window openings and robust brownstone window and door trim. The Italianate influence evident in Concord's Gasholder House is also demonstrated at other surviving structures (Pyne 1989; Taylor 1984).

Like other metal structures such as bridges, Gasholders were modular and could be purchased from specialty fabricators and shipped in pieces wherever sufficient transportation networks were available. Consequently, by 1875, a number of specialty holder manufacturing companies had come into being, and the total number of such firms nationwide at the late nineteenth-century peak of the manufactured gas era may have numbered a dozen. These firms provided comprehensive design, fabrication, and installation services. This was the case with Concord's Gasholder House and gasholder, designed by well known (within the manufactured gas trade) Deily & Fowler of the Laurel Iron Works, Philadelphia (Hatheway 2012:423).

Deily & Fowler and the Laurel Iron Works

Philip P. Deily (1809–1889) established the Philadelphia manufacturing company Laurel Iron Works in 1842 and entered into partnership with his nephew John Fowler (1846–1911) in 1868 as the design firm of Deily & Fowler. Deily learned the general iron and boiler-making trades working near his birthplace in Plainfield, Pennsylvania, and after moving to Philadelphia in 1834 worked in local machine shops. Fowler began working with his uncle after obtaining a degree in mechanical engineering from Polytechnic College of Pennsylvania in 1865. Laurel Iron Works initially manufactured boilers and general iron products. The company's first gasholder project was for Northern Liberties, a manufactured gas supplier incorporated in Philadelphia in 1844. Like other nineteenth-century gas works designers and purveyors, much of Deily & Fowler's working knowledge of gasholders may have been acquired through self-education and on the job experience. Subsequently, the firm specialized in the design and construction of gasholders and became a prominent supplier of these structures. Projects by Deily & Fowler included the 1872 gasworks at Hazleton, Pennsylvania (Hatheway 2012:461). Writing about the construction of the Concord Gas Light Company Gasholder House in 1888, the *Concord Evening Monitor* reported that the firm had built hundreds of gasholders throughout the country (HAER 1984:6). One of the firm's largest gasholders was the Washington, DC, Gas Light Company holder completed in November 1888, the last project with involvement by Deily (Light, Heat and Power 1889:43). Fowler continued to manage the business after Deily's death, serving as president when it was incorporated as Deily & Fowler Manufacturing Company in 1908. His son J. Scott Fowler (1881–1951), a 1903 graduate in engineering from Cornell University, was vice president and treasurer when John Fowler died in 1911. John Fowler's obituary notice printed in the *American Gas Light Journal* described the company as "a corporation that in due time became known the world over where the manufacture and distribution of gas were accomplished facts. While it is true that the firm's connection with the industry was best known through participation in the construction section of the business, and mainly in the designing and erection of gasholders, it is also true that to both principals the organization and subsequent successful operation of many gas plants can be traced" (American Gas Light Journal 1911:938). Deily & Fowler Manufacturing Company was listed in industry publications through at least 1922 (BSI 1922:1138; Robbins Publishing Company, Inc. 1922:923).

Extant Gasholders and Houses

There is no published master list of manufactured gas plants in the United States (Hatheway 2012:20). Hundreds, if not thousands of such plants for municipal or captive industrial use were constructed across the country, and each by necessity employed at least one gasholder. As natural gas made inroads on the manufactured gas market, gasholders and their houses have been demolished, with the largest number of demolitions occurring in the period 1960–1975. Environmental remediation of coal tars associated with manufactured gas facilities creates another impetus for the demolition of gasholders. One expert in the field of manufactured gas history and remediation (Allen W. Hatheway) estimates that perhaps 1 percent of all gasholders survives (Hatheway 2012:473). Surviving gasholder houses that retain their gasholders are even more scarce. There are currently 14 gasholder houses in the United States; of these, only the Concord Gasholder House retains its gasholder inside.[11] The other gasholder houses are either empty or have been converted to other uses (see Table of Extant Gasholder Houses below).

Table of Known Extant Gasholder Houses in the United States.

Name	Location	Date	Material	Architect/ Engineer	Gasholder Extant?	Current Use
Attleboro Falls Gasholder House	380 Elm Street, Attleboro Falls, MA	1882	Brick	Unknown	No	Storage
North Attleboro East Street Gasholder House	75 East Street, North Attleboro, MA	1865	Brick	Unknown	No	Office/light industrial storage
Roxbury Gasholder Building/ South Boston Gasholder House	Boston, MA	1868–1873	Brick	Unknown	No	Hotel
Northampton, MA Gasholder House	244 Main Street, Northampton, MA	1856	Brick	Unknown	No	Office/commercial space
Gasholder House at Lockwood Mill	Intersection of Water St and Kennebec St, Waterville, ME	Unknown	Brick	Unknown	No	Office/commercial space
Concord Gasholder House	209–213 South Main Street, Concord, NH	1888	Brick	Deily & Fowler	Yes	Houses disused holder
Concord Gasholder House	Library Road, Concord, NH	1880	Brick	Unknown	No	Preparatory school post office
Batavia, NY Gasholder House	11 Evans Street, Batavia, NY	c. 1855	Brick	Unknown	No	Utility Company Storage
Saratoga Gas, Electric Light & Power Company Complex	Intersection of East Ave and U.S. 9, Saratoga Springs, NY	Unknown	Brick	Unknown	No	Utility company storage
Troy Gas Light Company	William and Jefferson Streets, Troy, NY	1873	Brick	Unknown	No	Office/light industrial storage

[11] Surviving extant gasholder houses were identified using lists of these structures compiled in the Journal for Industrial Archaeology (Pyne 1989; Taylor 1984), as well as internet searches for gasholders and gasworks conducted in the National Register of Historic Places Digital Archive maintained by the National Park Service and the Historic American Buildings Survey/Historic American Engineering Record archives in the Library of Congress. This targeted research was supplemented with a broader internet search to identify other was conducted to determine whether any other gasholders or gasholders exist that were not listed in other resources that were consulted. The survival and the current use of identified gasholders in a "desktop" analysis using Google Maps and Street View.

Name	Location	Date	Material	Architect/ Engineer	Gasholder Extant?	Current Use
Oberlin Gas Lighting Company Gasholder House	South Main Street near Edison Street, Oberlin, OH	1889	Brick	Unknown	No	Vacant
Atlantic Mills	Intersection of Aleppo Street and Manton Ave, Providence, RI	Unknown	Brick	Unknown	No	Office
Woonsocket, RI Gasholder House	113 Pond Street, Woonsocket, RI	c. 1865	Brick	Unknown	Yes	Office
Baltic Mill Gasholder House	Bushnell Hollow Road, Sprague, CT	c. 1874	Concrete	Unknown	No	Vacant

9. Major Bibliographical References

Bibliography (Cite the books, articles, and other sources used in preparing this form.)

American Gas Light Journal
1911 American Gas Light Journal, Vol. 94. Obituary for John Fowler. A.M. Callender & Co., New York, NY.

American Gas Journal
1951 Processes for Manufacturing Gas. *American Gas Journal*, February 1951:27-30.

Anon.
2001 National Register of Historic Places, Saratoga Gas, Electric Light, and Power Company Complex. Electronic document, https://npgallery.nps.gov/NRHP/AssetDetail?assetID=c8082369-d45d-4e2a-9297-32a1935fc617, accessed March 10, 2017.

Anon.
1971 National Register of Historic Places, Troy Gas Light Company, Electronic document, https://npgallery.nps.gov/NRHP/AssetDetail?assetID=8b4b6d24-075f-4f49-9a2e-b29f03836fba, accessed March 10, 2017.

Anon.
1998 National Register of Historic Places, Oberlin Gas Lighting Company Gasholder House, Electronic document, https://npgallery.nps.gov/NRHP/AssetDetail?assetID=c49944be-207c-4759-aca1-011968b5b61b, accessed March 10, 2017.

Badger, S.C.
1855 *Map of the City of Concord, New Hampshire.* S.W. Chandler & Brothers, Boston, MA.

Benjamin, Park; ed.
1889 *Appleton's Cyclopaedia of Applied Mechanics: A Dictionary of Mechanical Engineering and the Mechanical Arts*. D. Appleton and Company, New York, NY.

Benjamin-Ma, Nicole, Rita Walsh, and Matt Kierstead
2015 New Hampshire Historic Property Documentation. Claremont Gas Works Complex. Lower Cul De Sac Place, Claremont, New Hampshire, NH State No. 724. On File at NHDHR, Concord, NH.

Brooks, David
2015 Concord Gasholder Building is Elegant, Unique and Expensive to Fix. *Concord Monitor*, October 7, 2015. On file, New Hampshire Division of Historical Resources, Concord, NH.

Bureau of Statistics and Information, Pennsylvania Department of Internal Affairs (BSI)
1922 *Fourth Industrial Directory of the Commonwealth of Pennsylvania*. J. L. L. Kuhn, Harrisburg, PA.

Clark, Victor S.

1916 *History of Manufactures in the United States.* Carnegie Institution of Washington, Washington, D.C. Electronic Document, https://archive.org/details/historymanufact00clargoog, accessed March 10, 2017.

Driemeyer, Laura B. and Lynne Emerson Monroe

2011 *Nashua Gas Light Company*. NHDHR Individual Inventory Form. On file, NHDHR, Concord, NH.

Garvin, James L.

2015 Concord, New Hampshire Gasholder Faces Uncertain Future. Society for Industrial Archaeology, New England Chapters. Chestertown, NY. On file, New Hampshire Division of Historical Resources, Concord, NH.

Hatheway, Dr. Allen

2009 "History and Chronology of Manufactured Gas." Electronic Document, http://www.hatheway.net/01_history.htm.

2012 *Remediation of Former Manufactured Gas Plants and Other Coal Tar Sites.* CRC Press, Boca Raton, FL.

Hengen, Elizabeth Durfee

1996 *An Historic and Architectural Overview & Historic Preservation Assessment of Concord, NH: An Appendix to the Concord Master Plan.* DRAFT. Concord Heritage Commission, Concord, NH.

1994 *Capital Views, A Photographic History of Concord, New Hampshire, 1850–1930.* New Hampshire Historical Society, Concord, NH.

Historic American Engineering Record (HAER)

c. 1968 Roxbury Gas Light Company, Gasholder, 8 Gerard Street at Massachusetts Avenue, Boston, Suffolk County, MA. Historic American Engineering Record. Electronic document, http://www.loc.gov/pictures/item/ma1235/, accessed March 10, 2017.

1984 Concord Gas Company: Gasholder House, South Main Street, Concord, Merrimack County, New Hampshire. Historic American Engineering Record. Electronic document, http://www.loc.gov/pictures/item/nh0131/, accessed April 4, 2017.

Lawry, Nelson

1977a *Dover Times*, "Past Perspective." A Look at Dover's Vital, Yet Little Known Gasworks. July 31.

1977b *Dover Times*, "Past Perspective." Classical Gas: It's Just a Burning Matter in Dover. August 7.

Light, Heat and Power
1889 Light, Heat and Power, Vol. VI. Philadelphia, PA.

Lombard, Brian C.
1982 *Concord Gaslight Company: Gasholder House, 1888.* HAER No. NH-7. Measured drawings. Historic American Engineering Record, Washington, DC.

Lyford, James O., ed.
1903 *History of Concord, New Hampshire.* Rumford Press, Concord, NH.

Mausolf, Lisa
2012a Concord Gaslight Co. Gasholder House. Individual Inventory Form. On file, New Hampshire Division of Historical Resources, Concord, NH.

2012b South Main Manufacturing District. Historic District Area Form. On file, New Hampshire Division of Historical Resources, Concord, NH.

Myers, Denys Peters
1978 *Gaslighting in America: A Guide for Historic Preservation.* U.S. Department of the Interior, Washington, D.C. Electronic Document, https://hdl.handle.net/2027/mdp.39015006746641 accessed March 10, 2017.

National Gas Museum Trust
2010 "History of Gas: Making Gas from Coal." Electronic Document, http://www.nationalgasmuseum.org.uk/index.asp?page=history-02.

Ness, Leah
1982 "Beverly Gas and Electric Company," Massachusetts Historical Commission Inventory of the Historic and Archaeological Assets of the Commonwealth Form B – Building. Filed as Area BEV.D. On file, Massachusetts Historical Commission, Boston, MA.

New Hampshire Division of Historical Resources (NH DHR)
2012 Determination of Eligibility: Concord Gas Light Co. Gasholder House. Inventory # CON0288. May 2. On file, New Hampshire Division of Historical Resources, Concord, NH.

New Hampshire Historical Society
1982 Gasholder's Vital Statistics to be part of Federal Record. New Hampshire Historical Society Newsletter, Volume 20, No. 5 September 1982. On file, New Hampshire Division of Historical Resources, Concord, NH.

North Attleborough Historical Commission
n.d. *Attleborough Falls Gasholder Building*, Electronic Document, http://www.nattleboro.com/historical-commission/pages/attleboro-falls-gasholder-building, accessed March 10, 2017.

Parsons, Bonnie
2010 *Northampton Gaslight Company*. NTH.795. On file, Massachusetts Historical Commission, Boston, MA.

Pollak, Richard J.
1969 Historical Report for Troy Gas Light Company, Gasholder House. Historic American Engineering Record, HAER No. NY-2.

Pratt, Daniel R. and Kelly Nolte
1998 *Saratoga Gas Light Company, Gasholder No. 2. HAER No. NY-313*. Historic American Engineering Record, National Park Service, Philadelphia, PA.

Pyne, Mary E.
1989 New England's Gasholder Houses. The Journal of the Society for Industrial Archaeology, Volume 15, Number 1 1989. Society for Industrial Archaeology, Washington, D.C.

Reed, Roger R.
2007 National Register of Historic Places, Lockwood Mill Historic District, Waterville, Kennebec County, Maine. Electronic document, https://npgallery.nps.gov/pdfhost/docs/NRHP/Text/07000412.pdf, accessed March 10, 2017.

Republican Press Association
1893 Contract between the Concord Gas Light Co. and the United Gas Improvement Co., October 27, 1892. Republican Press Association, Concord, NH. On file, New Hampshire Historical Society, Concord, NH.

Robbins Publishing Company, Inc.
1922 *Brown's Directory of American Gas Companies and Gas Engineering and Appliance Catalogue*. Robbins Publishing Company, New York, NY.

Sanborn Map & Publishing Co.
1879 *Concord Fire Insurance Map.* Sheet 5. Sanborn Map & Publishing Co., New York, NY.

1889 *Concord Fire Insurance Map.* Sheet 8. Sanborn Map & Publishing Co., New York, NY.

Sanborn-Perris Map Co. Ltd.
1899 *Concord Fire Insurance Map.* Sheet 24. Sanborn-Perris Map Co. Ltd., New York, NY.

Sanborn Map Co.
1928 *Concord Fire Insurance Map.* Sheet 22. Sanborn Map Co., New York, NY.

Taylor, William W.
1984 The Concord (New Hampshire) Gasholder: Last Intact Survivor from the Gas-Making Era. The Journal of the Society for Industrial Archaeology, Volume 10, Number 1 1984. Society for Industrial Archaeology, Washington, D.C.

Thomas, Russell.
2014 Gasholders and Their Tanks: A profile of the construction of different types of gasholders, their associated tanks and their occurrence on former gasworks and gasholder station sites." Parsons Brinckerhoff, Redland, Bristol, England.

Tomory, Leslie
2011 Building the First Gas Network, 1812-1820. *Technology and Culture* 52(1):75-102.

Previous documentation on file (NPS):

____ preliminary determination of individual listing (36 CFR 67) has been requested
____ previously listed in the National Register
_X__ previously determined eligible by the National Register
____ designated a National Historic Landmark
____ recorded by Historic American Buildings Survey #____________
_X__ recorded by Historic American Engineering Record # NH-7_____
____ recorded by Historic American Landscape Survey # ___________

Primary location of additional data:

_X__ State Historic Preservation Office
____ Other State agency
____ Federal agency
____ Local government
____ University
____ Other
Name of repository: _____________________________________

Historic Resources Survey Number (if assigned): CON0288_______________

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10. Geographical Data

Acreage of Property 2.12 acres

Use either the UTM system or latitude/longitude coordinates

Latitude/Longitude Coordinates
Datum if other than WGS84:__________
(enter coordinates to 6 decimal places)

A. Latitude: 43.196394 Longitude: -71.530850

B. Latitude: 43.196465 Longitude: -71.530437

C. Latitude: 43.196599 Longitude: -71.530058

D. Latitude: 43.196243 Longitude: -71.529695

E. Latitude: 43.195739 Longitude: -71.529645

F. Latitude: 43.195684 Longitude: -71.529666

G. Latitude: 43.195723 Longitude: -71.531018

Verbal Boundary Description (Describe the boundaries of the property.)

The Concord Gas Light Company Gasholder House property is a truncated triangle-shaped lot bounded by Water Street/US Route 3 and the Boston & Maine Railroad right-of-way on the east, Gas Street on the south, South Main Street on the west, and the adjacent parcel line on the north. The boundary is shown on the attached sketch map.

Boundary Justification (Explain why the boundaries were selected.)

The Concord Gas Light Company Gasholder House boundary encompasses the Gasholder House building and adjacent landscape features, the only extant resources associated with the former Concord Gas Light Company complex. It excludes additional vacant land at the southeast corner along the railroad right-of-way that is part of the current tax parcel because no significant activities or resources associated with the Concord Gas Light Company were located on that land.

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11. Form Prepared By

name/title: John Daly/Senior Industrial Historian; Laura Kline/Architectural Historian; Michelle Johnstone/Assistant Architectural Historian
organization: The Public Archaeology Laboratory, Inc. (PAL)
street & number: 26 Main Street
city or town: Pawtucket state: Rhode Island zip code: 02860
e-mail: jdaly@palinc.com
telephone: (401) 728-8780
date: May 2017

Additional Documentation

Submit the following items with the completed form:

- **Maps:** A **USGS map** or equivalent (7.5 or 15 minute series) indicating the property's location.

- **Sketch map** for historic districts and properties having large acreage or numerous resources. Key all photographs to this map.

- **Additional items:** (Check with the SHPO, TPO, or FPO for any additional items.)

Photographs

Submit clear and descriptive photographs. The size of each image must be 1600x1200 pixels (minimum), 3000x2000 preferred, at 300 ppi (pixels per inch) or larger. Key all photographs to the sketch map. Each photograph must be numbered and that number must correspond to the photograph number on the photo log. For simplicity, the name of the photographer, photo date, etc. may be listed once on the photograph log and doesn't need to be labeled on every photograph.

Photo Log

Name of Property: Concord Gas Light Co. Gasholder House

City or Vicinity: Concord

County: Merrimack State: New Hampshire

Photographer: John Daly, PAL

Date Photographed: April 18, 2017

Description of Photograph(s) and number, include description of view indicating direction of camera:

1 of 14. Concord Gas Light Co. Gasholder House (Gasholder House), looking northeast.

2 of 14. Gasholder House and its setting in the South Main Street manufacturing district, looking southeast from South Main Street.

3 of 14. View of Gasholder House within Concord Gas Light Co. parcel, looking north.

4 of 14. View of Gasholder House within former Concord Gas Light Co. parcel with foundation remains of gas plant and Water Street Bridge over former B&M RR tracks, looking northwest.

5 of 14. West side of Gasholder House and west valve house, looking east from South Main Street.

6 of 14. Gasholder House and its retaining wall, looking west from rear of Concord Gas Light Co. lot.

7 of 14. Detail of Gasholder House cupola, looking east.

8 of 14. Detail of Gasholder House window and south valve house, looking northwest.

9 of 14. Detail of Gasholder House gauge in window opening, looking west.

10 of 14. General view of Gasholder House interior showing top of gasholder's metal bell (the "floor"), looking north.

11 of 14. Ceiling framing of Gasholder House with cupola opening (obscured by scaffolding) at top right.

12 of 14. Detail of top of gasholder bell and gasholder guide, looking east.

13 of 14. Interior of Gasholder House south valve house with tar pump and gas line valve, looking east.

14 of 14. South Main Street retaining wall on the Concord Gas Light Co. parcel, looking west.

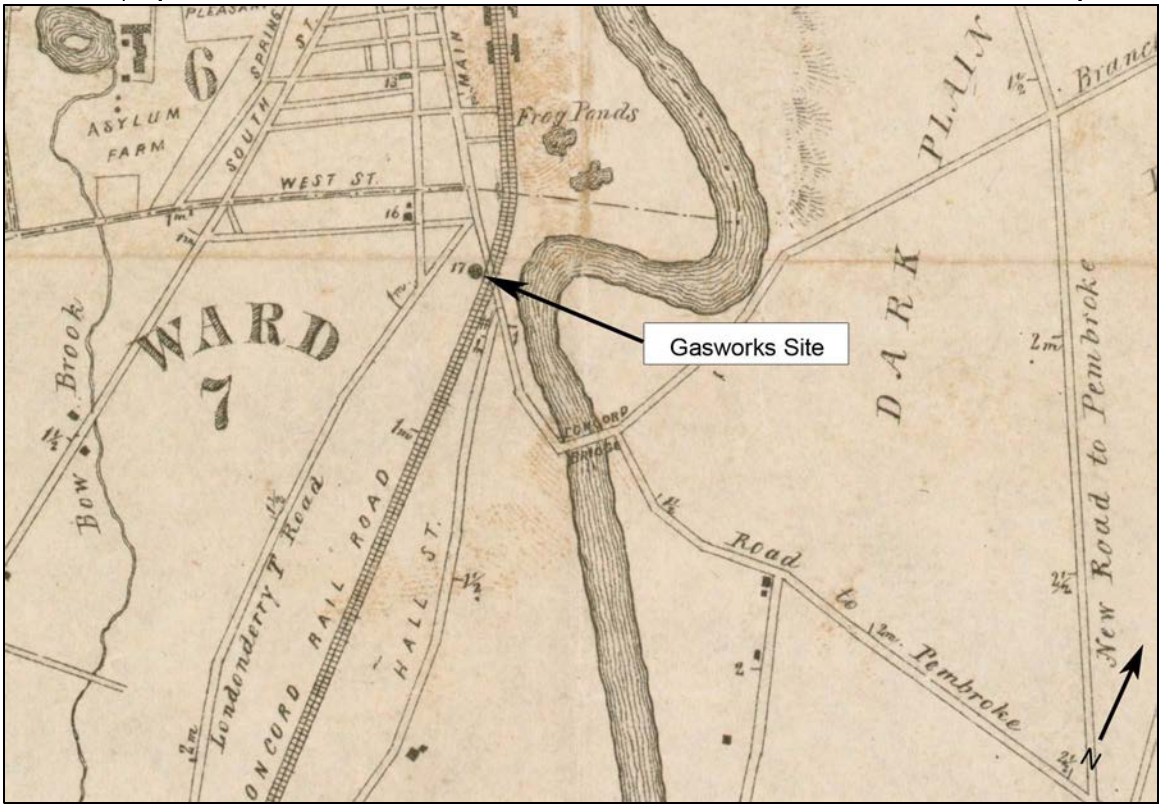


Figure 1. Detail from 1855 Badger map of Concord showing location of Concord Gas Light Company facilities (Badger 1855).

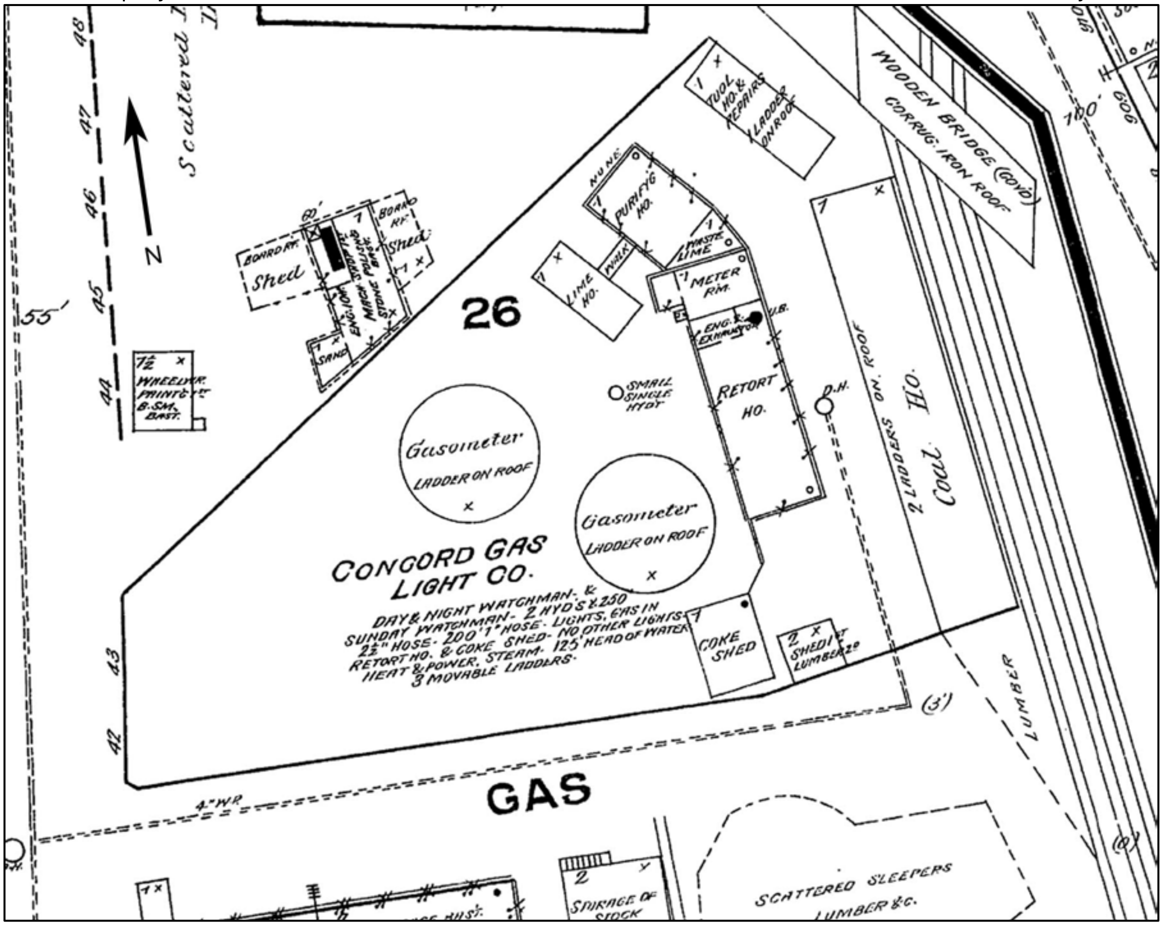


Figure 2. 1879 Sanborn map of Concord Gas Light Company site, 9 years prior to construction of the Gasholder House (Sanborn Map & Publishing Co. 1889).

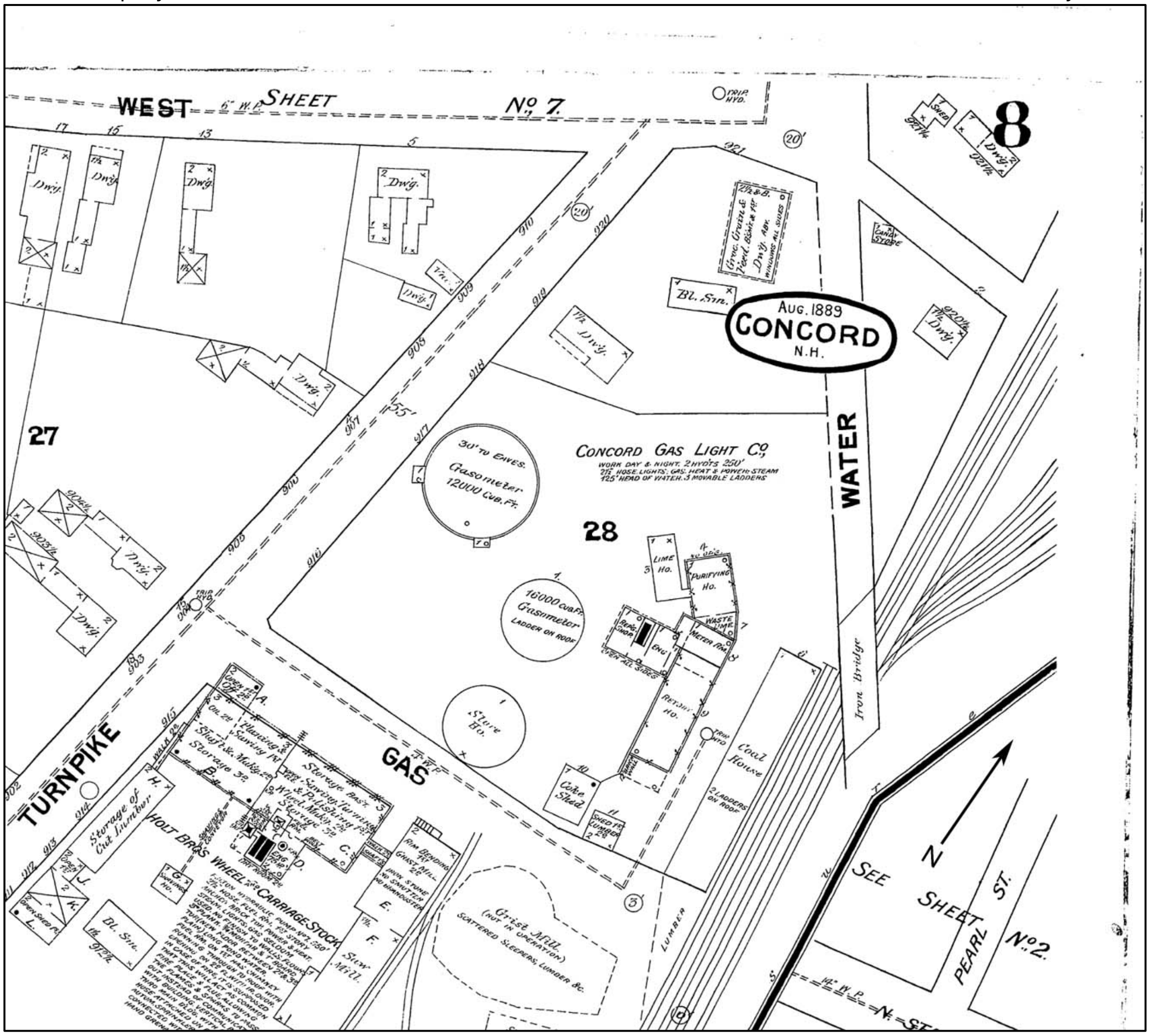


Figure 3. 1889 Sanborn map of Concord Gas Light Company site, with the Gasholder House labeled as "Gasometer 12,0000 Cu. Ft.". (Sanborn Map & Publishing Co. 1889).

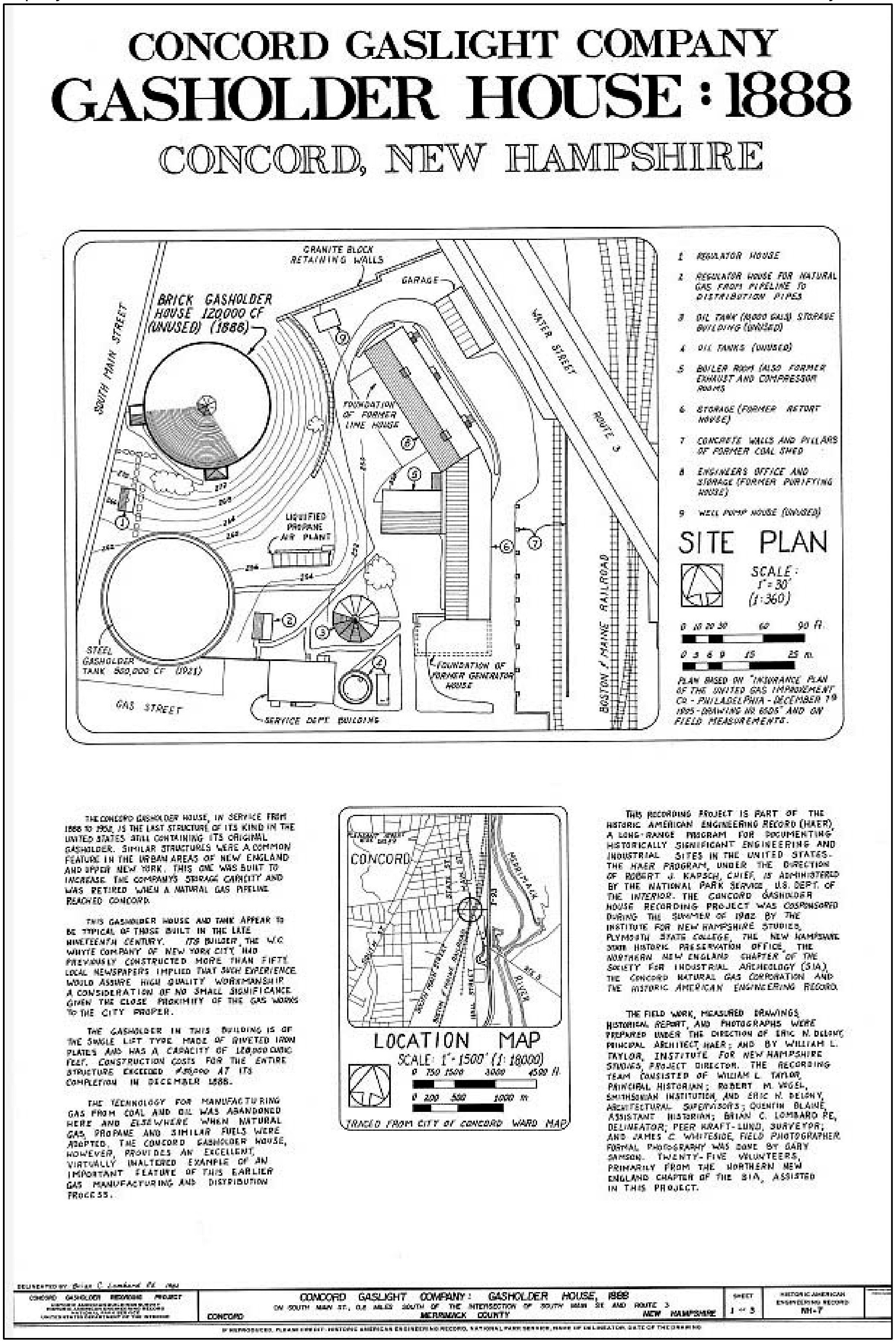


Figure 4. HAER drawings of Gasholder House, Sheet 1 of 3 (HAER, National Park Service, Brian C. Lombard, 1982).

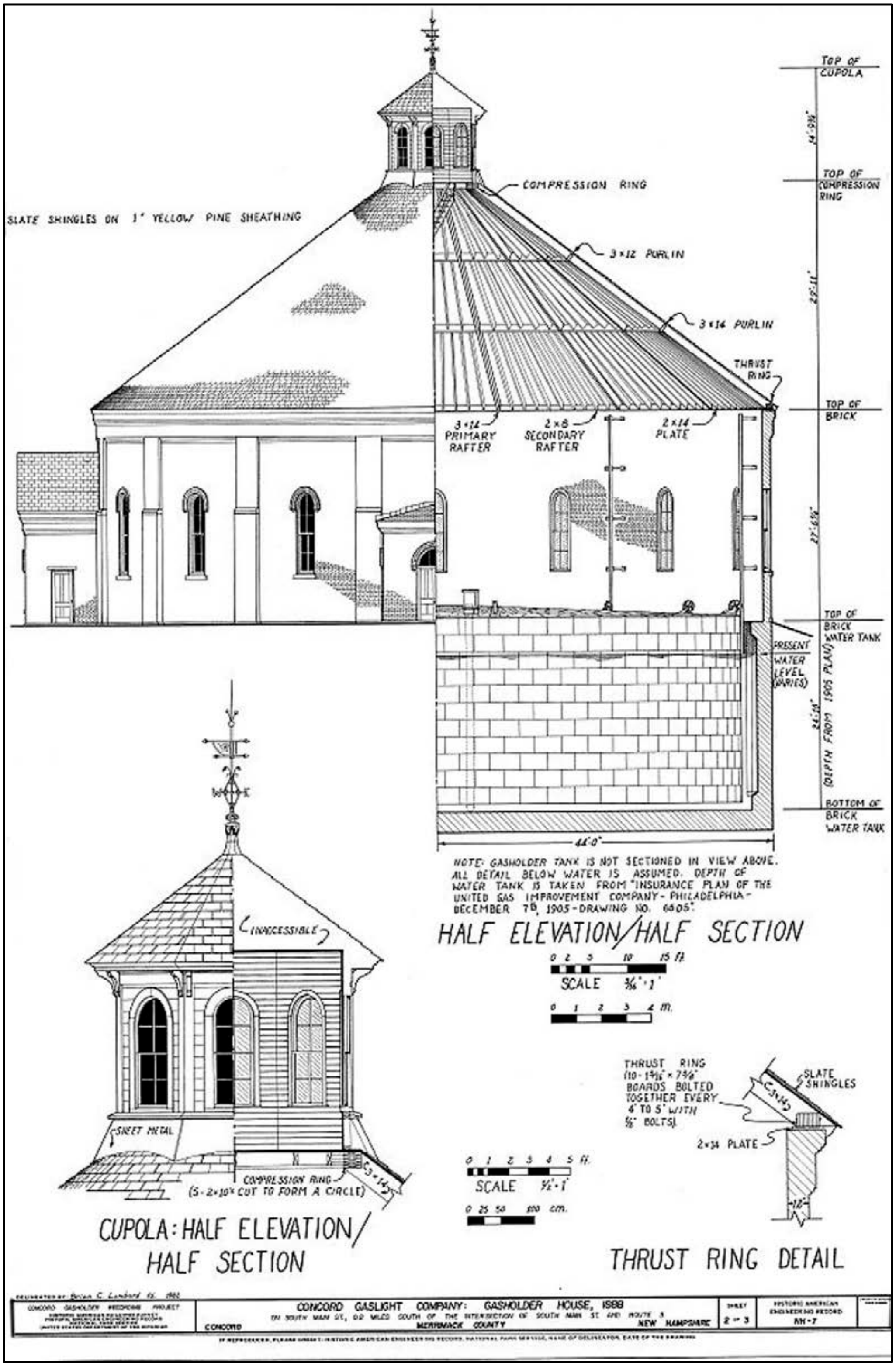


Figure 5. HAER drawings of Gasholder House, Sheet 2 of 3 (HAER, National Park Service, Brian C. Lombard, 1982).

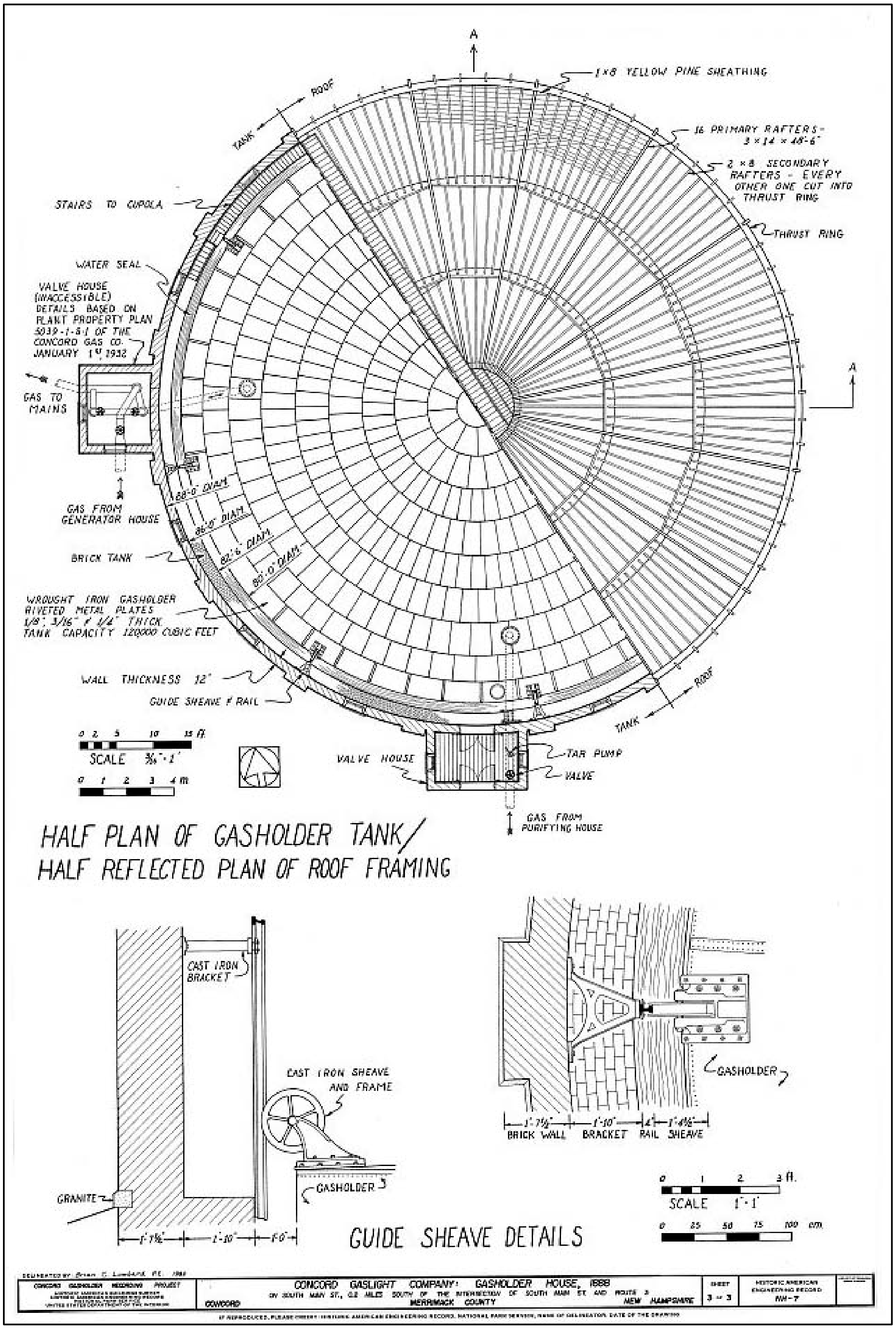


Figure 6. HAER drawings of Gasholder House, Sheet 3 of 3 (HAER, National Park Service, Brian C. Lombard, 1982).

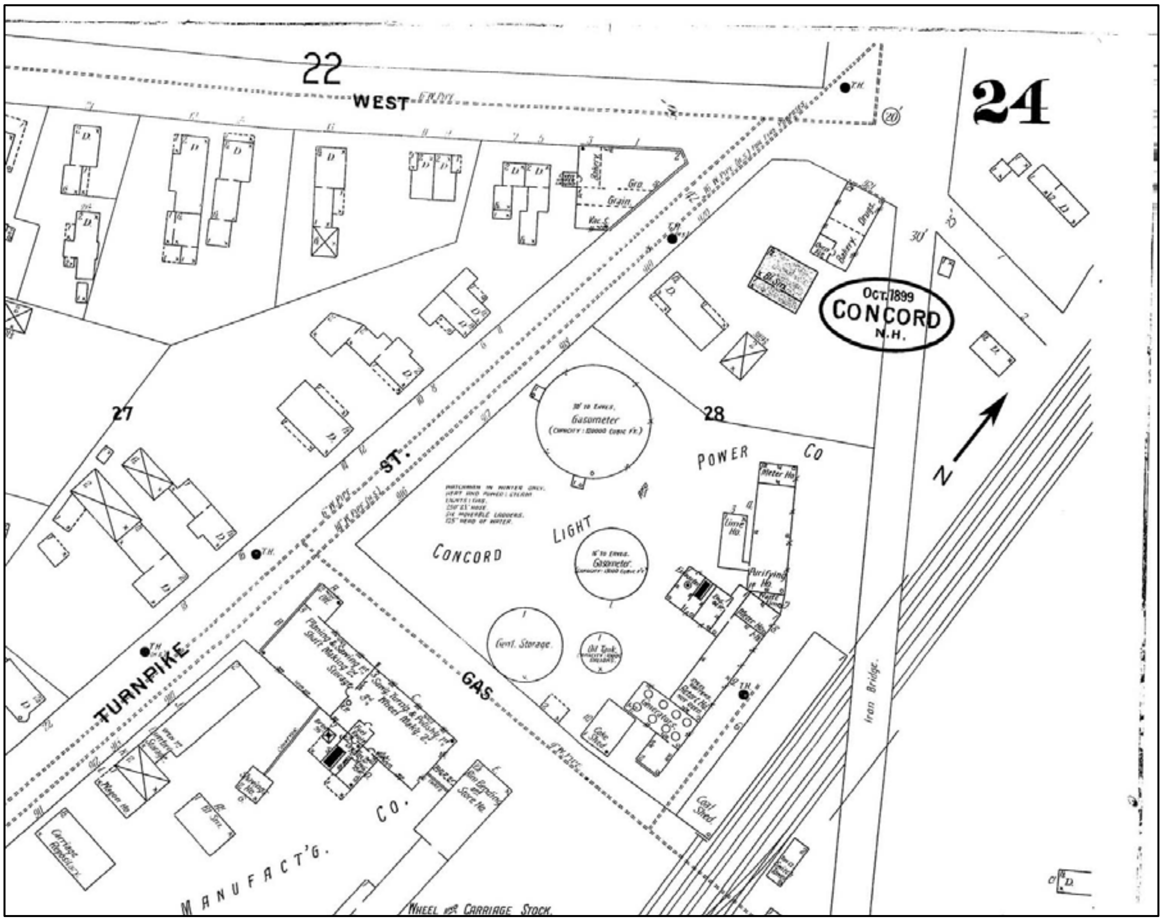


Figure 7. 1899 Sanborn map of Concord Light and Power Company site (Sanborn-Perris Map Co. Ltd 1899).

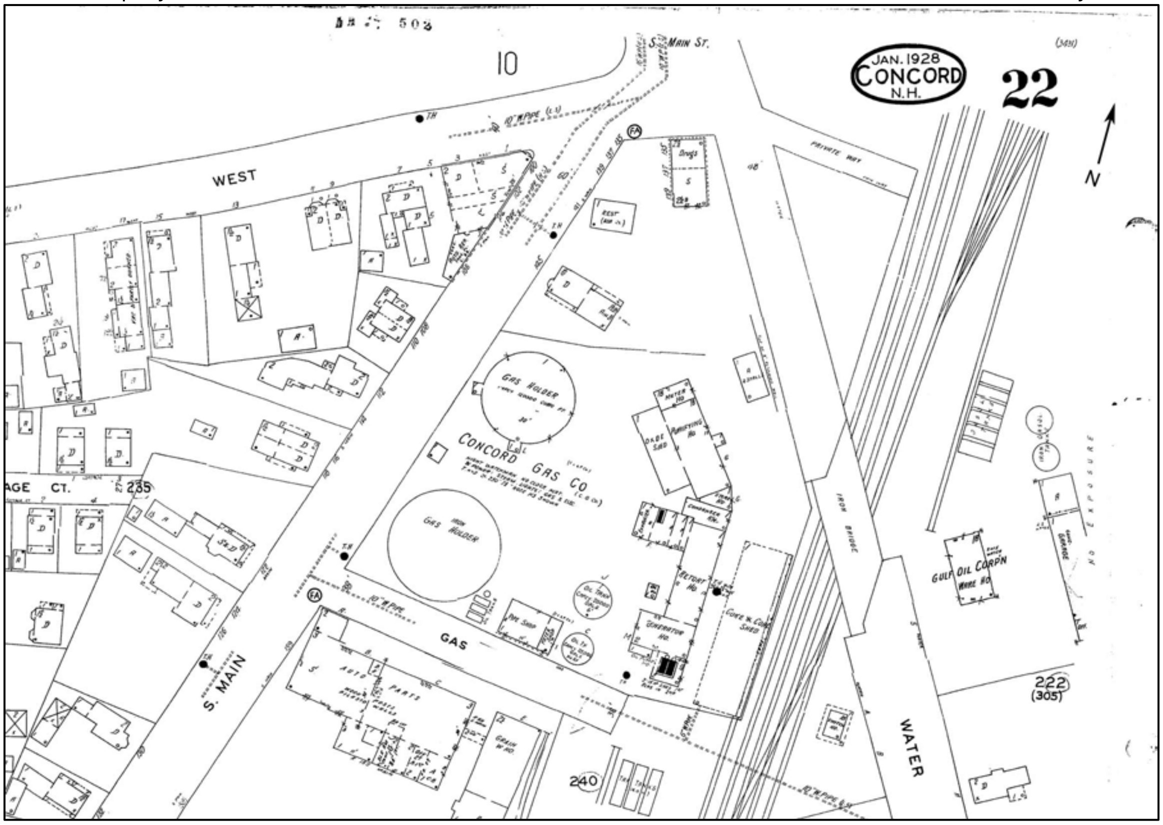
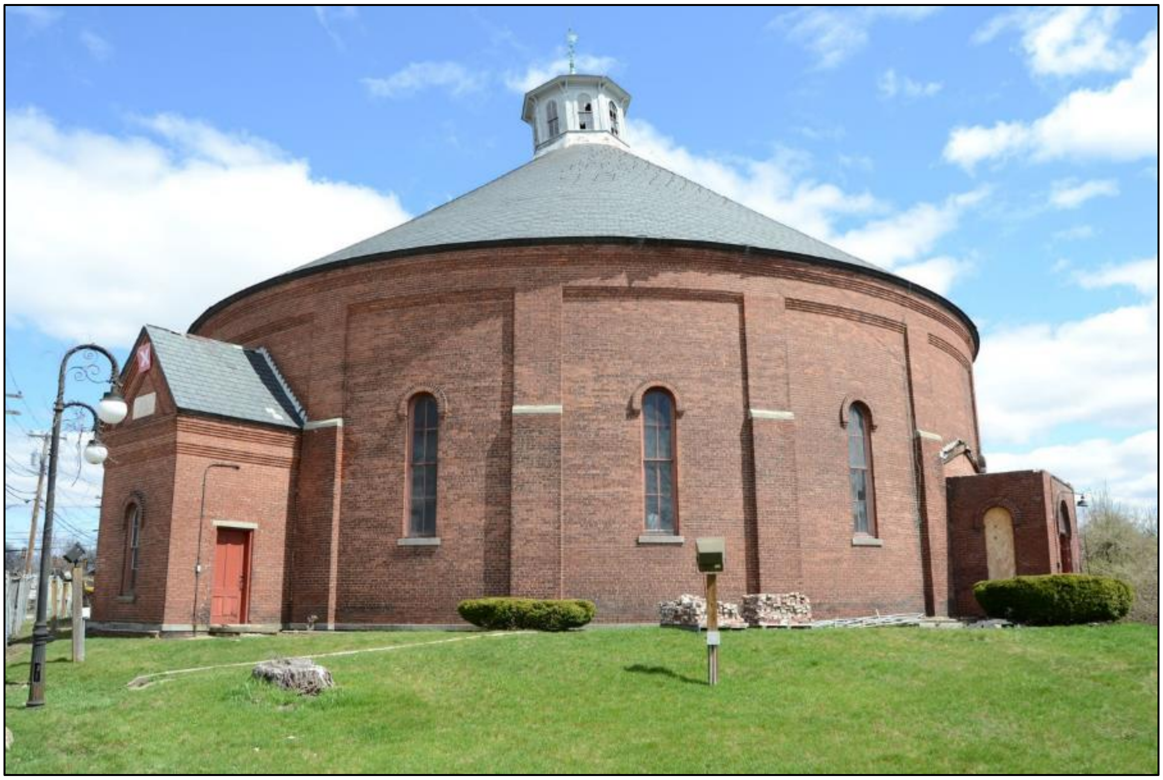


Figure 8. 1928 Sanborn map of Concord Light and Power Company site (Sanborn Map Co. 1928).

Figure 9. Undated, post-1921 photo of Concord Light and Power Company complex, looking northwest from Gas Street (Concord Gas Light Co. Photo Collection, New Hampshire Historical Society, Concord, NH).



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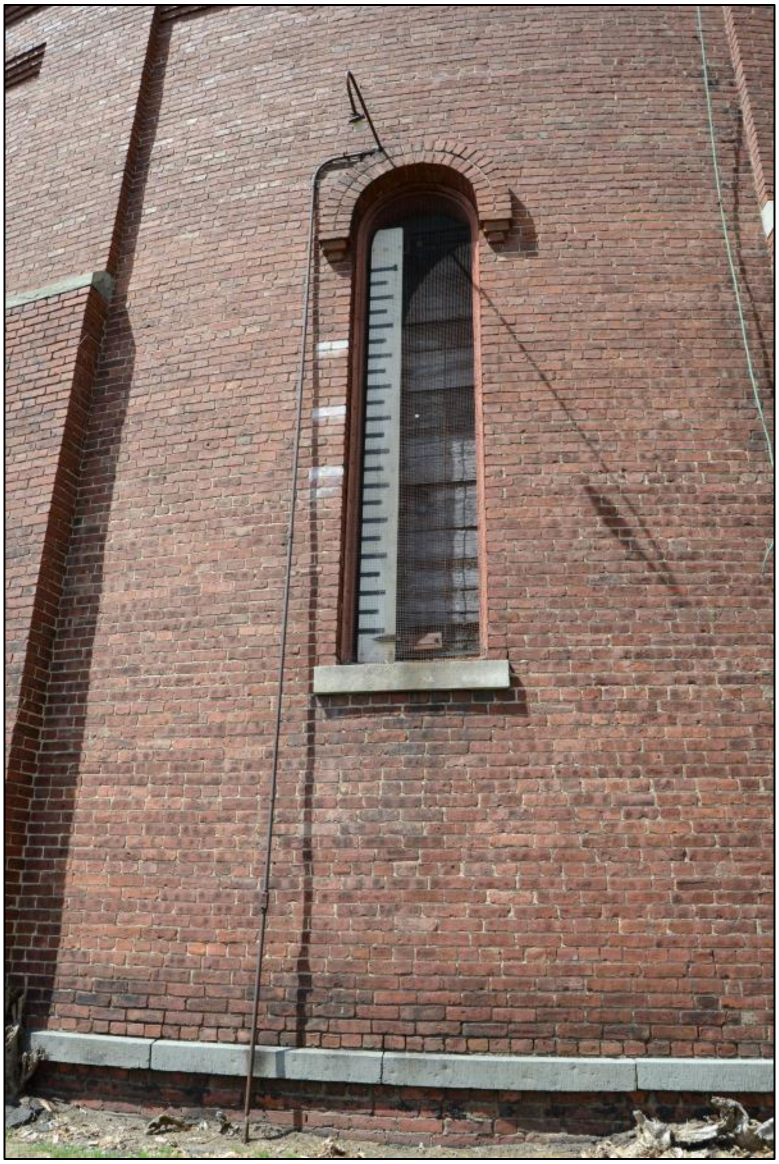

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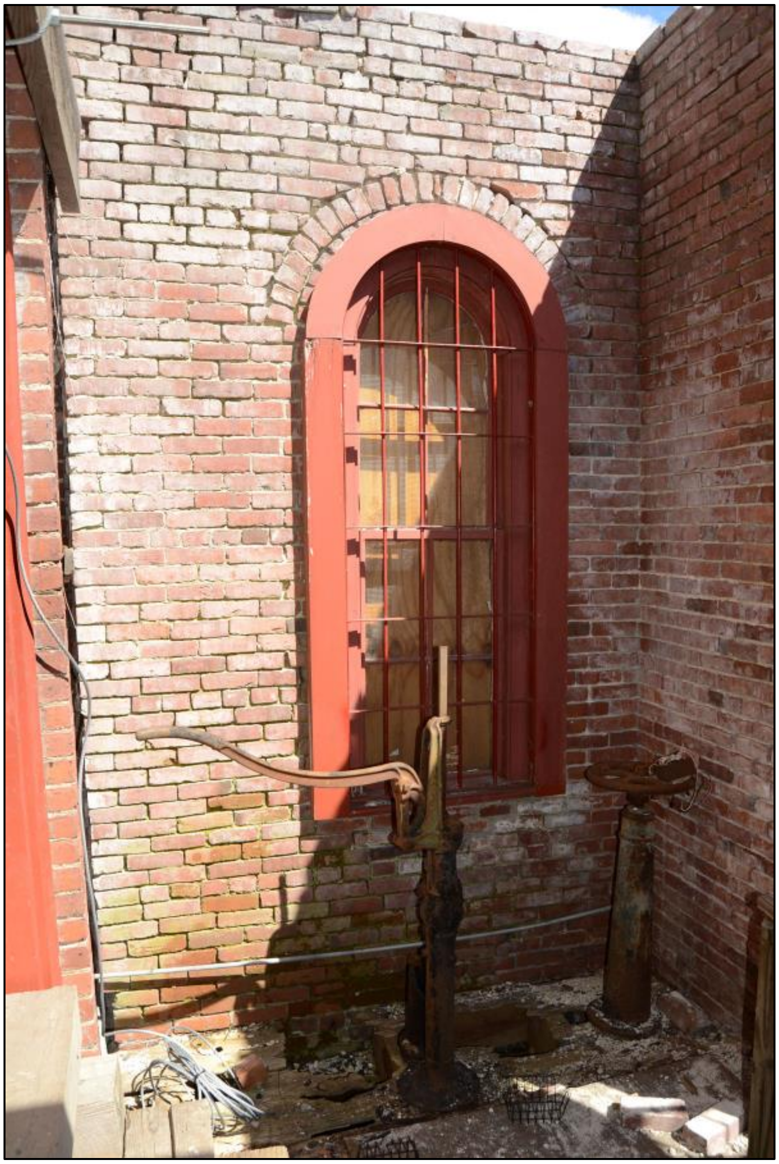

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