The Queensboro Ironworks

Boston Affiliates, Inc. prepared this booklet, based on archaeological surveys conducted by Rutgers University Center for Public Archaeology.

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Figure 1: View of the former Queensboro Ironworks furnace stack, as it appeared in 1884.
Source: Ransom, 1966: 161

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When the United States Military Academy at West Point acquired the land that now forms the southwestern tip of the Military Reservation in 1942, it became the steward of one of the most interesting historical industrial ruins in the region: the Queensboro Ironworks. During the last years of the 18th century and the early part of the 19th, at the end of the period when iron was produced by charcoal-fueled furnaces in the United States, the Queensboro Ironworks was an important part of the Hudson Highlands region iron industry.

Why Was the Ironworks Here?

Several geographical factors combined to make this an ideal location for an ironworks during the latter part of the 18th century. The low hard rock ridges of the Hudson Highlands contain seams of rich magnetic iron ore that were initially mined in the early 1700s, and streams in the deeply worn valleys of softer sedimentary stone between the ridges provided power to run the ironworks. These streams also formed the only continuous, regular grades suitable for overland transportation of raw materials and finished products. Early ironmakers shipped their products to market along the smaller streams and rivers to the great highway that was the Hudson.

At Queensboro (sometimes called "Queensbury" in colonial documents) the presence of the Forest of Dean Mine about two-and-a-half miles to the northwest assured a steady source of iron ore. The Hudson Highlands provided extensive deposits of limestone, which was required as a fluxing agent in the processing of iron. (See "How Did the Furnace Work?" below.) The region was also covered by vast stands of timber for production of the charcoal necessary to fuel the ironworks. Popolopen Brook, which flowed rapidly in a steeply descending channel, provided the water power potential that could be harnessed to run the machinery of the ironworks. Finally, good landings close by on the Hudson River assured convenient transportation connections for the products of the ironworks to reach their markets.

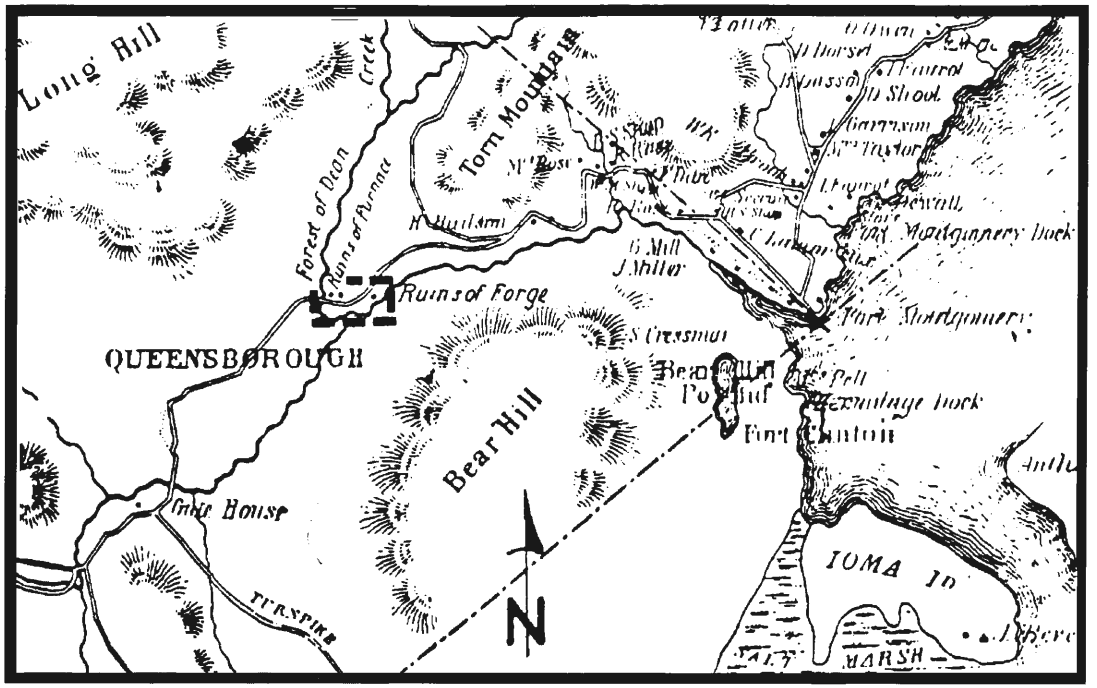


Figure 2: Sidney, J.C., **Map of Orange County,** *1851. Former Queensboro Ironworks indicated.*

History of the Ironworks

The Queensboro Ironworks was not the first iron furnace in the neighborhood. Slightly to the north of the Queensboro Tract was the Forest of Dean Mine, one of the most productive iron mines in the history of New York State, where the Forest of Dean Furnace appears to have been in operation by 1756. The mine and the furnace were located on Popolopen Brook about three-and-a-half miles to the northwest of its mouth. During the first years of the Revolution, the Forest of Dean Furnace was involved in military production in support of the American war effort, but with the taking of nearby Forts Clinton and Montgomery by British forces during the fall of 1777, the furnace was shut down. It never reopened, although the mine later resumed production of ore.

Developed about 1788, the Queensboro facility replaced the earlier Forest of Dean Furnace, and expanded beyond the production capacity previously provided by that furnace. It included a charcoal iron furnace and a finery forge for the processing of pig iron produced by the furnace. During the last decade of the 18th century, the Queensboro Ironworks used iron ore mined both from the old Forest of Dean Mine, an extremely rich source of ore that remained active into the present century, and from the newly opened Queensboro Mine nearby to produce both cast and wrought iron products.

Like many new business enterprises in the volatile days of political, economic and technological change that followed the Revolution, the Queensboro Ironworks was built by a partnership whose membership continually shifted as fortunes rose and fell and hopes waxed and waned. Throughout its history, the group consisted mostly of individuals associated with mercantile pursuits in New York City, but also included Samuel Leonard and Josiah Dean, members of families who had been prominent in ironworking in southeastern Massachusetts since the 1640s. It seems likely that it was Leonard and Dean who designed and built the Queensboro Ironworks.

In 1799, the Ironworks was described as "consisting of a furnace and forge, with two fires, both in compleat repairs, and provided with all the buildings necessary for carrying on the said Manufactory, viz. coal houses, carpenter and blacksmith shops, a convenient two story house for a manager, built last summer, and a number of other frame and log houses, with gardens, for the accommodation of the workmen—there is besides, a saw mill erected near the furnace, which supplies the establishment, and the market, with a considerable quantity of lumber; and a farm improved on the Queensboro' tract...." It was claimed that "the quality of the metal is perfect—the agents for government, the states of New-York and Connecticut have drawn considerable supplies of ammunition from the Queensboro' furnace to their avowed satisfaction" and that the works was conveniently served by the landing on the river only two-and-a-half miles distant.

The furnace, which was plagued by financial problems for most of its existence, was taken out of blast during the first decade of the 19th century, while the forge appears to have continued in operation into the 1840s. By mid-century, however, all iron production activities had ceased at Queensboro. The "Ruins" of both the furnace and the forge at Queensboro were depicted on the map of Orange County published in 1851 (see Figure 2). Since that time, little has happened to the central core of this former ironworking facility, and the former furnace stack and the piles of slag at the forge site remain as signposts to the property's industrial past.

Recent History of the Site

The "Ruins" of the former Queensboro Ironworks appear to have remained largely undisturbed until the early part of the present century when the Federal Government developed the water supply capacity of the Popolopen Brook for the United States Military Academy. This major development effort, involving the construction of large dams and reservoirs, aqueducts, pipelines, and smaller secondary flow control dams on Popolopen Brook and its tributaries, changed the geography around the Ironworks somewhat. Two small dams were built very close to the former ironworks, one just to the south of the furnace stack and the other a short distance to the east of the forge site. The dam near the furnace site was built on or very near the place where the Queensboro Road crossed the brook during the 18th and 19th century. This appears to have resulted in the relocation of the Queensboro Road to the north side of the furnace stack, with the new crossing of the brook on a concrete arch bridge completed in 1908. Dam construction also impacted the Queensboro Forge Site by raising the water level of the brook, submerging some features adjacent to the creek. At the same time, some stabilization of the furnace stack was undertaken and a historical plaque placed on it.

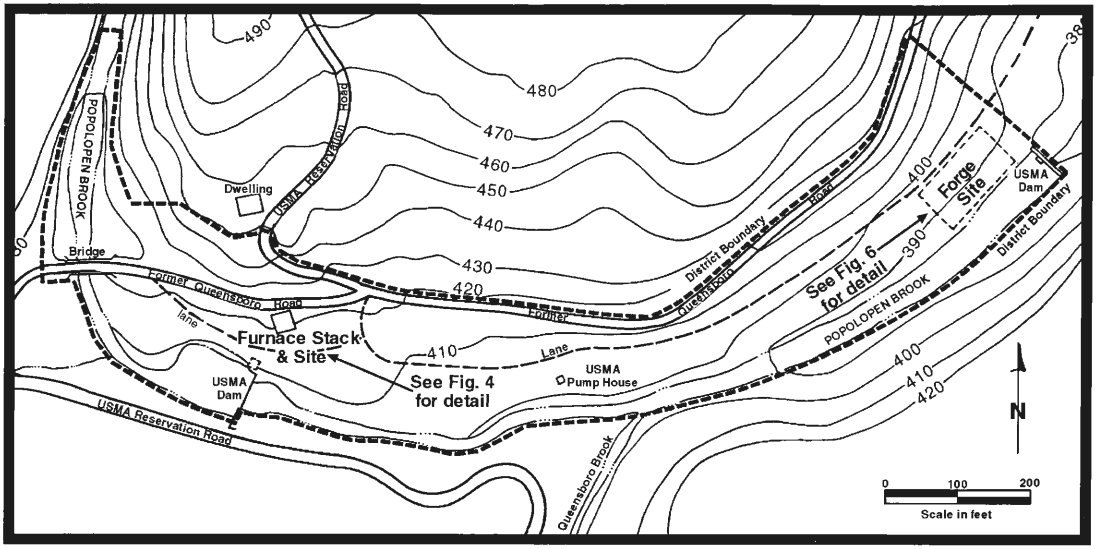


Figure 3: The Queensboro Ironworks Historic District

The Queensboro Ironworks Today

The Queensboro Ironworks consisted of two main elements: the furnace and the forge (See Figure 3). Parts of both of these are visible today, the most notable being the tall stone furnace stack. The Historic American Engineering Record identified the site in the 1980s as one of the most interesting in the area and recorded it. An archaeological study has revealed much about the original appearance and function of these intriguing ruins through the use of old maps and documents as well as some subsurface testing, (Boston Affiliates, Inc./Rutgers University Center for Public Archaeology, 1993). The Queensboro Ironworks Historic District is under consideration for listing on the National Register of Historic Places.

Queensboro Furnace Site

The Queensboro Furnace Site is located along the north bank of Popolopen Brook. It contains the ruins of the furnace stack and remains of several features associated with it, including the area of the furnace building, the charging area, and the hydropower system.

How Did the Furnace Work?

A charcoal iron furnace built in the Hudson Highlands region during the second half of the 18th century could be expected to have certain classic features. The core of the furnace was the stack, a truncated pyramid of stone sited at the foot of a hill and adjacent to a potential source of water power. The furnace

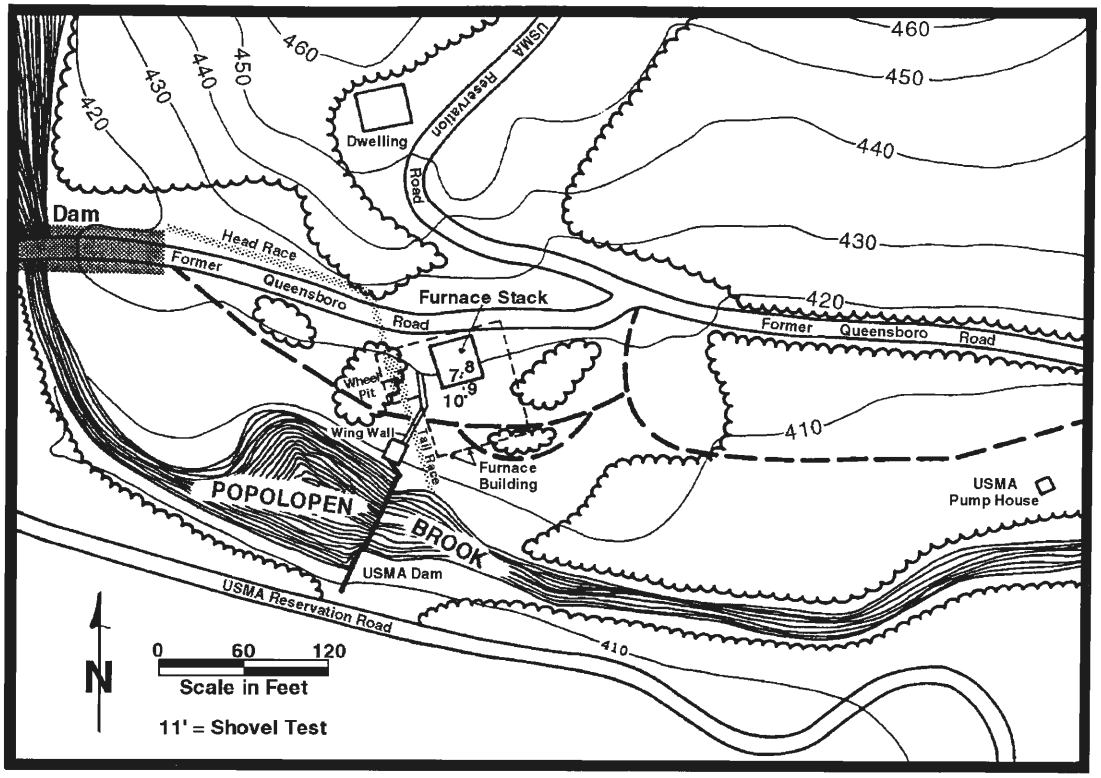


Figure 4: Queensboro Ironworks Historic District—Furnace Site Area
The locations of the dam, head race, wheel pit, tail race, and furnace building are conjectural.

stack was generally about 25 feet square at the base and from 20 to 30 feet in height. The interior of the stack was lined with heat-resistant stone to withstand the great temperatures created during the blast or melting of the iron ore. The stack wall contained two large arches, the casting and bellows arches, which were generally about 12 feet wide at the base and about 15 feet high. The casting arch was the primary focus of activity within the furnace as it was here that the molten iron produced during the blast was extracted to the casting floor. The bellows in the bellows arch forced air into the stack through the tuyere, the connection between the bellows arch and the interior of the stack, to intensify the fire within the stack. A hydropower system, usually consisting of a dam (to divert water from the stream), a battery pond (to hold the water for a steady supply), a head race (to channel the water to the wheel), a wheel pit (which held the wheel to be turned to generate power), and a tail race (to channel the water back to the stream), was installed to power the bellows. A bridge or causeway was built from the adjacent hill to the top of the stack to allow the furnace to be "charged" or filled from above with ore and fuel (see description below). The furnace building, which could be either stone or frame, was basically a large shed constructed around the stack to cover the casting floor and the bellows and its associated waterwheel. (See Figure 4 for a conjectural drawing of these elements at Queensboro.)

The actual process of cast iron production began with the charging of the stack with alternating layers of iron ore, charcoal (fuel), and limestone (a fluxing agent that facilitated iron separation) through the charge hole at the top of the stack. The furnace was then fired and the bellows was put into operation. The use of the bellows and the enclosed nature of the system eventually created temperatures high enough to melt the iron in the ore. The heavy molten iron would then flow downward through the crucible to the hearth at the base of the stack. Slag, the by-product of iron production, was lighter than the molten metal and floated on top, allowing it to be drawn off through an opening called the cinder notch. With the opening of the tapping hole at the base of the stack, the molten iron flowed out of the hearth and into a trough in the sand bed within the casting arch. This trough extended out into the furnace's casting floor and fed the flowing molten iron into dead-end branch channels or into molds. The iron was then allowed to cool and harden, yielding pig iron from the branch channels and firebacks, pans, stoves, and other cast iron products from the molds .

What Remains Today?

The **furnace stack** was the central core of the furnace operation, and is the most dramatic element that remains today. The interior has been substantially filled, and there is evidence that portions of the lower section of the interior may have been altered or removed during the early part of the present century, perhaps as part of the 1908 stabilization work. Archaeological testing has uncovered what is probably the front edge of the **hearth**, or base of the furnace stack, lined up directly with the interior opening of the **casting arch**. The stones of the hearth show evidence of extreme heat and burning, with slag still adhering to exposed surfaces.

There are no surface indications of the **furnace building** that would have been associated with the furnace stack. This building was probably a frame structure that sheltered the **casting floor** to the south of the stack and the **wheel pit** that held the waterwheel which powered the **bellows** to the west of the stack (see Figure 4 for a conjectural location of the furnace building). Despite the impacts of later construction, it seems probable that some remnants of this building survive intact below the current ground surface.

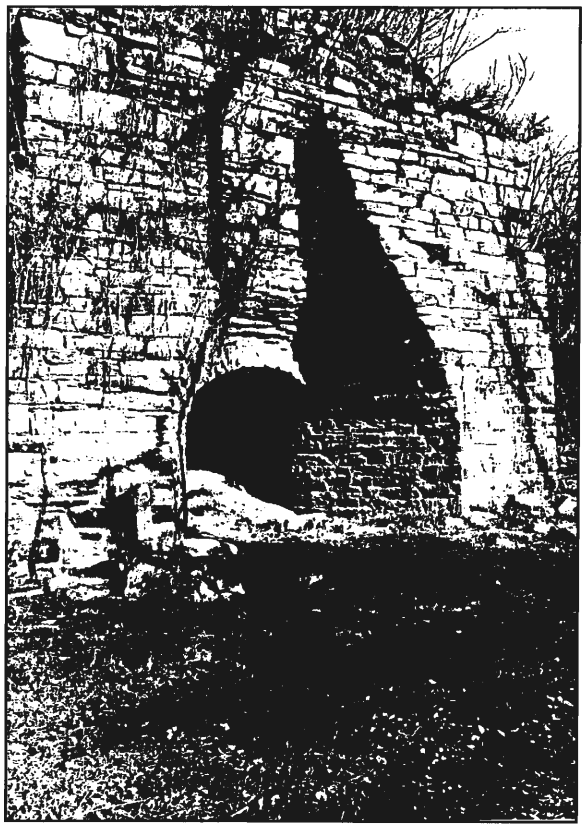


Figure 5:Recent photograph of the furnace stack.
Photograph by John Nanian, November 1993.

The **charging area** was on the hill north of the furnace stack, but it is this portion of the furnace site that has been most severely altered during the present century. The relocation of the former Queensboro Road to the north side of the furnace stack required that the southern end of this hill be quarried out to provide the necessary roadway width. These quarrying activities removed the portion of the former charging area that would have included the direct connection to the furnace, which probably took the form of a charging bridge extending from the edge of the hill to the stack.

The **hydropower system** associated with the furnace would have consisted of the dam, battery pond, head race, wheel pit, and tail race (see Figure 4 for conjectural locations of these elements). The **dam** appears to have been located on the site of present Queensboro Road/Popolopen Brook Bridge. The earth and stone embankments of the present bridge, notably the embankment to the east of the brook, may, in fact, be reused sections of this former dam. This dam would have impounded a small **battery pond** extending approximately 350 feet upstream on the Popolopen. The **head race** would have extended eastward from the eastern end of the dam toward the stack, and the slight depression visible along the north side of the former Queensboro Road might be a remnant of this feature. The water conveyed from the pond via the head race was then carried to the waterwheel (possibly by a wooden flume) within the **wheel pit**. The action of the wheel powered the furnace's bellows, which were set just to the east of the wheel pit and immediately adjacent to the **bellows arch** of the furnace. Finally, water was carried away from the wheel pit via the **tail race** and returned to the Popolopen just to the south of the furnace. This system would have provided just over 15 feet of fall.

Queensboro Forge Site

The Queensboro Forge Site contains remains associated with the forge building and its water power system (consisting of the dam, head race or flume, and wheel pits).

How Did the Forge Work?

A forge such as the one built at Queensboro during the latter part of the 18th century would have been designed to function as an adjunct to a furnace. Forges of this type, referred to as finery forges, contained two primary processing areas—the hearth and the hammer. The forge hearth was essentially an enclosed firebox outfitted with a water-powered bellows to provide the air blast necessary to bring the fire within the hearth to the temperatures required to soften iron. The water-powered hammer was used to pound the softened mass of iron to remove impurities from the metal. The forge building was generally a rectangular structure sited close to its source of water power—often located on or near the bank of the stream just downstream of the dam, with short headraces running to the waterwheels that powered the bellows and the hammer.

The process of wrought iron production within a finery forge began with the reheating in the hearth of pig iron from the furnace. The fuels used in the hearth were charcoal and, in later years, coal. The mass of softened pig iron was then removed from the hearth and subjected to pounding by the forge hammer.

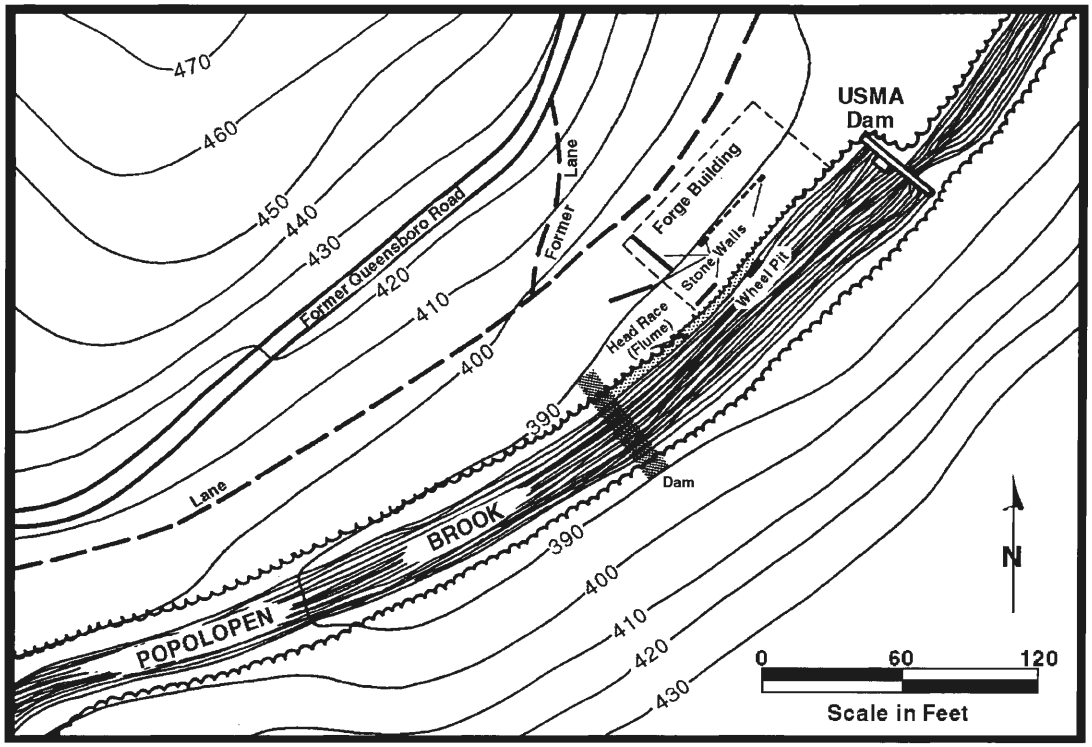


Figure 6: Queensboro Ironworks Historic District—Forge Site Area
The location of the dam, head race (flume) and forge building are conjectural.

Additional alternating sequences of heating and hammering were done as necessary, depending on the desired quality of the end product. This process yielded wrought, or bar, iron, which could then be worked into various forms to produce tools, weapons, and other objects. This final stage could be handled either in the forge or in a blacksmith shop, and it involved reheating the bar iron to again make it malleable and shaping it into the desired forms by hammering, cutting, and filing.

A slightly different production process was utilized in a bloomery forge, which produced bar iron directly from iron ore. Here ore, charcoal, and limestone were heated in the forge hearth to eventually yield a mass of iron that was then hammered, and, if necessary, reheated and hammered again, to produce wrought iron. It was not uncommon for a finery forge associated with a furnace to function as bloomery forge after the abandonment of the furnace, and this seems to have happened at Queensboro.

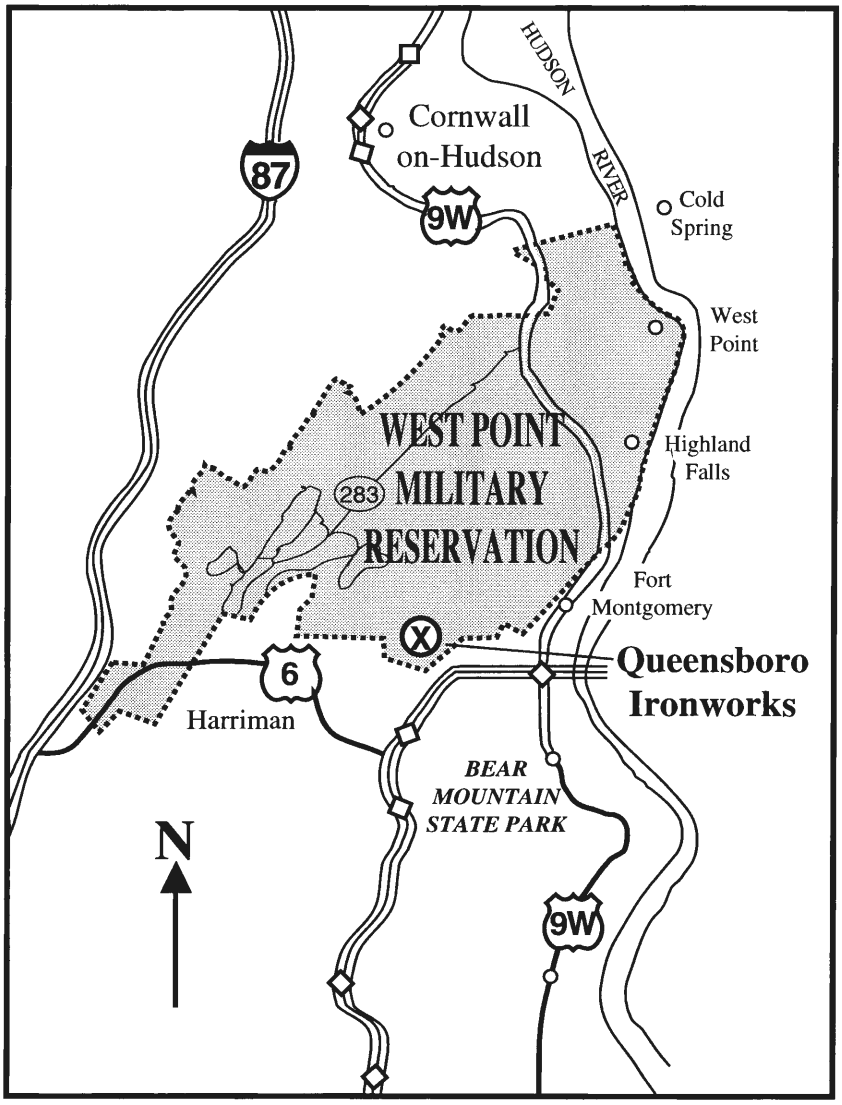
What Remains Today?

The former site of the **forge building** is readily apparent on the present ground surface (see Figure 6 for a conjectural location of the limits of the forge building). The northwestern part of the site is marked by a large embankment of forge waste consisting of slag, coal, and coal ash—large quantities of slag are also found on the ground surface throughout the vicinity of the forge site. Archaeological testing has revealed a variety of features related to the former forge. A large **working floor**, approximately 30 feet by 100 feet between the large embankment of forge waste and the north bank of the creek, is defined along its northwestern side by a partially intact stone wall that retained the embankment. The forge building was probably a frame structure covering the working floor.

The embankment or slag heap also extends toward the brook at either end of the working floor. A **ramp** formed by a substantial dry-laid stone retaining wall lead down to the working floor from the lane along the northwest side of the embankment. The remains of an abandoned roadway ramp with a stone embankment wall can be seen just to the northwest of the forge site, and it is possible that this marks the point of separation between the original and present courses of **the Queensboro Road,** which connected the furnace and the forge and provided the primary transport route to and from the Ironworks.

The forge's hydropower system appears to have been entirely sited along the side of the building adjacent to the creek (see below). The building would have been served by either two or three waterwheels that lined its southeastern wall, with one of these power sets serving the **hammer**. In 1799 and again in 1810 this forge was described as consisting of two fires. If the forge had a single, centrally-sited bellows serving both fires there would have been only one additional wheel; if each hearth was served by its own bellows there would have been two additional wheels.

The **hydropower system** associated with the forge appears to have consisted of the dam, head race, and wheel pits (see Figure 6 for conjectural locations of the dam and head race). The **dam** was probably sited at the top of a natural fall of water located just upstream from the forge building. No indications of this dam are apparent on the ground surface—the flow of the brook is quite heavy in this location, and any remains of this dam may have been destroyed by floods. A short **head race**, probably in the form of a wooden flume, would have extended along the bank of the creek to the waterwheels in their wheel pits along the southeast wall of the forge. These wheels powered either one or two bellows and the hammer within the forge. Water would have exited directly from the wheel pits into the Popolopen. The remains of one of the forge's **wheel pits** are visible within the brook against its northern bank, with a wall of dry-laid stone about 10 feet in length forming its northwest wall and a number of timbers associated with it remaining in the creek.



Visiting the Queensboro Furnace

Access to the Queensboro Ironworks District is limited. Individuals wishing to visit the site can contact U.S. Military Academy, West Point, Cultural Affairs Office at (914) 938-6388 to schedule an appointment to see the furnace. Please remember it is illegal to excavate or collect artifacts or otherwise disturb historic or archaeological sites on West Point Property without prior specific authorization. Violators will be subject to citation and prosecution under the Antiquities Act of 1906, the Archaeological Resources Protection Act of 1979 or Title 36 of the Code of Federal Regulations.