Configuration of Mill Complex (Panel)

Thomas Wheeler, Jr.'s mills were operational in 1732. His mill complex comprised a grist- and a sawmill. Portions of the mills' original masonry have either tumbled down or been repurposed. But enough intact walls, as well as fallen building blocks, remain to enable an understanding of how the water delivery system was configured (see Figure A). Designs for New England's 18th and 19th century water-driven mills also provide insight about the cleverly engineered hydraulic system developed for this mill site.

Choice of Site

A felicitous choice of location for the mill complex—originally selected by Native Americans for a fish weir—ensured the necessary resources. Building stones and boulders came from the stream bed. The forest provided wood for levers, posts, and structural timber. Oxen from Wheeler's contiguous farmstead did the lifting and hauling, while an undocumented but probable resource was Indian labor. The topography of the stream bed and flood plain provided the essential microenvironment. The challenge in constructing any water-driven mill is to develop enough power from the flowing water to run machinery. A fall of flowing water of at least 10 vertical feet is required to turn a water wheel. An axle attached to the water wheel transfers the generated energy to the milling machinery. Water wheels varied: either an overshot or undershot wheel was common; tub wheels were also used (see Figure B-1 and B-2).

Canal

Between the dam and the downstream bridge crossing, the stream bed drops naturally more than 10 feet. What was needed to power machinery, however, was 10 vertical feet of water falling onto a wheel. To achieve this drop, a canal was built along the northerly side of the flood plain using trench and berm construction. Both the trench's inner walls and the berm's outer wall were reinforced against high water stages by a well laid-up stone wall.

Because the canal's gradient was less than that of the natural stream bed, it was possible to extend the canal downstream to where the flowing water was 10 feet above the natural stream bed. Here, a stone barrier was fitted with a gate that controlled the amount of water flowing into the millraces. Just below this gate, a large triangular boulder separated the stream into two sub-streams, each flowing into a separate millrace that channeled water to one of two water wheels.

Mill Types

A typical gristmill was a large, three-story wooden structure which enclosed a large hopper positioned high above two horizontal grinding stones, one above the other. Raw grain, stored on the third story, was introduced into the hopper, which funneled the grain to drop slowly into a hole in the upper grinding stone. The stone was turned by machinery powered by energy developed from the rotating water wheel. Milled flour trickled out of runnels cut into the inner surface of the grinding stone.

A sawmill (see Figure C), on the other hand, often was not fully housed but comprised of a long, narrow, horizontal platform (C-1) erected over the stream on supporting posts or walls set into the stream bed. It might have a roof to protect workers and machinery from weather but usually had no side walls. A vertically mounted saw blade (C-2) was positioned within the platform. The water wheel (C-3), turned by water flowing along the millrace (C-4) under the platform, created energy which was transferred by the wheel's axle to machinery (C-5) that moved the saw blade up and down.

At our mill, a cut log (C-6), felled in wintertime, was floated along the canal from the millpond to the mill gate, where it was introduced directly onto a sliding log carriage (C-7) that moved the log into the teeth of the saw blade. Sawn lumber would come to rest on the downstream end of the platform.

Gates

The height and rate of flow of water supplying these two milling operations was controlled by two, or possibly three, gates: a main gate; a mill gate; and likely a canal gate.

The main gate (see Figure A), built into the southeasterly end of the wide stone and earthen dam, controlled the water level in the mill pond behind the dam. Much of the stonework that formed this gate has tumbled down. It was repaired with concrete in the earlier part of the last century, and again in the 1990s by prisoners from the Concord Reformatory. Later floods have breached this side of the dam again.

The dam's northeasterly end, where the canal begins, contains a second portal. At this writing, a beaver lodge obstructs this portal making it impossible to determine whether a second gate existed there. One function of this portal, however, was to allow a log to pass into the canal, where it would float to the sawing platform.

The mill gate (see Figure A), located at the end of the canal, regulated the height of water in the canal to facilitate passage of a log from the canal onto the milling platform. As water that had propelled the log along the canal flowed over the gate, it was separated into two sub-streams as discussed above.

Races

The southerly sub-stream flowed over a smooth outcrop of bedrock towards the gristmill. Two low extant masonry walls directed the stream to a drop-off where the water fell vertically onto a horizontally-positioned tub wheel (see Figure B) located within the grist-millrace. This wheel developed the power to run the gristmill machinery. The tub wheel's masonry enclosure remains intact, as does the gristmill's square masonry foundation with large chimney base at its back, set just above the millrace embankment.

Nothing but rubble remains in the channel where the sawmill was likely located. The wheel was either an over- or undershot wheel (see Figure B), and the water drop likely exceeded the necessary 10 feet. The wooden log carriage received a log as it passed onto the platform and carried it into the blade that milled it into lumber. Two extant tailraces show where water from the two sub-streams flowed back into the brook's main stream bed.
The sawmill's location has been inferred from a combination of remaining structures: the canal, the mill gate, the triangular stone that divided the stream, the northerly millrace flowing from that stone, and a stone socket cut into a level stone bed within the sawmill's tailrace. This socket was likely the pivot hole for a crane. Such a crane would have lifted sawn lumber off the milling platform and swung it to the higher ground above the partially collapsed foundation wall beside the tail race. The socket's position indicates where the water wheel, milling machinery, and saw blade were located.

Other Structures
An additional stone foundation—likely for the wood turning shop—as well as rusted circular remains of the tub wheel's housing and other bits of mill machinery exist at the site. Masonry portions of the canal, millraces, gates, and building foundations were restored in 2008 and 2009 with a grant from the Community Preservation Committee. Remaining restorations were halted due to increased hazard of frequent, unusually high floods. Until the dam is reconstructed with modern gates, the remaining masonry reconstruction will not be undertaken.

Information Panel for the Wheeler Mills (McElroy NEARA)

Thomas Wheeler, Jr., of Concord, believed to have been a relative of Capt. Thomas Wheeler, also of Concord, had the mill complex fully operational by 1732. The location is most suitable for mills. Here, the natural topography of the streambed, with its gently sloping wooded banks, favored the construction of a canal along the northerly stream bank configured to supply water to the downstream sluices and gates, with a height of fall sufficient to power two mills.

The dam that is now called the Robbins Mill Dam, owing to changes in ownership over the years, was originally the Blood family's dam. There is no recorded deed of ownership. They may have been squatters who converted an earlier Indian fish weir into a stone and earthen dam, thereby creating the mill pond behind it. In any case, Thomas Wheeler's Blood grandmother left the land on which the dam sits to him on her death. It is likely she had the land as dowry when she married Thomas' grandfather. Thomas acquired the abutting land through a Concord lottery and by trading lots until he had acquired several hundred abutting acres that included the entire mill complex plus additional land along the southerly side of the brook, some of which includes the Indian sites.

The mill complex is itself a marvel of hydrological engineering. The ten-foot drop needed for sufficient head to turn a mill wheel existed along the natural gradient of the streambed between the dam and the present footbridge. But to get a vertical ten-foot drop, a canal was built along the north bank of the brook such that the gradient was enough for water to flow, and the length below the dam was enough to achieve the necessary vertical drop.

The dam was fitted with two mill pond outlets. The main gate controlled the height of water in the millpond and drained off excess water during flood stages. The other gateway, at the entrance to the canal (whether with or without a gate is not clear), controlled the amount of water flowing through the canal so as to maintain sufficient height to float logs from the mill pond, along the canal, to the edge of the milling platform.

At the downstream end of the canal, a lower gate controlled the rate and height of water flow. After passing through this lower gate, the water was divided into two smaller streams, each of which powered one mill wheel. The southerly stream was directed to a tub wheel which powered the grist mill machinery; the northerly stream turned either an undershot or overshot wheel that provided power to the sawing machinery. (See figure 4, a schematic of the Mills complex)

Much of this operation has been deduced from the stone remains that were found within the mill complex. The stonework of the original gates, though damaged, is clearly identifiable. A huge boulder in midstream below the lower gate, together with a low retaining wall, was used to divide the water into two streams, and the stone masonry housing for the tub wheel was located in the southerly sluiceway. This housing in turn was located next to a fairly large building foundation containing a huge chimney base, indicating that the building was heated, and sturdily enough built to house the grist milling machinery and hoppers. A tail race below the tub wheel enclosure led water back to the main brook stream. Rusted curved metal housing parts have been found near the mill foundation.

The configuration of the saw mill machinery is less obvious, but photos of such mills from the period indicate that saw mills usually only contained a platform, level with the water floating the un-milled logs, posts in the sluiceway below to support the platform, and a rough roof to keep the operation dry. At the location where the platform would have been, there is the necessary ten-foot vertical drop.

A wheel located just below this drop would have powered the machinery necessary for the sawing operation; a large stone socket was found in the correct location for supporting a crane that lifted milled lumber from the platform and swung it into some kind of warehouse, remains of which have also been found. In line with this socket is the beginning of the tail race that led the saw mill’s used water back to the brook streambed.

It may become feasible, if/when the Town can be induced to restore the dam, to reconstruct the damaged stonework so that it can once again allow water to flow through the system as it once did. This site then would become the jewel in the crown of the TTT. Many hours and not a little research into period mills have been spent sorting out how this water delivery system was configured so as to power two mills with the same water. The whole is an ingenious piece of hydrological engineering, beginning with the conversion of a pre-existing Indian fish weir, then adapting the topography of the natural stream bed, using manual labor and oxen to move tons of stone around in a roughly two-acre area. This accomplishment is worthy of anyone's admiration at any period and place.

Sadly, work was halted in 2012 when our stonemasons realized that the restorations downstream of the dam would be compromised by lack of water control during flood stages resulting from the deteriorated condition of the dam. The Robbins Mill Dam is listed among Massachusetts dams needing repair, but because no downstream structures are threatened by the dam's possible failure, the Town will defer making a decision to carry out this mandate for as long as possible.