EVALUATING MILL SITES: HOW MUCH DO WE DIG?

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INTRODUCTION: STATEMENT OF THE PROBLEM

How much excavation is necessary to obtain the data needed to evaluate a site's significance is a perpetual problem in archaeology. On the one hand, in writing research designs for data recovery archaeologists sometimes find themselves wishing they had more information: after all you can always dig more. The trouble of course is that evaluation efforts inevitably have to work within tight budgets and schedules, and more is not necessarily better. The question, then, is how to achieve an effective strategy that achieves the needs of the research design, and neither digs too much, nor too little.

This paper will examine this question with respect to mills as a particular class of historic archaeological site, and discuss the planned evaluation of the Middleford Mills site in Sussex County Delaware on behalf of the Delaware Department of Transportation by Parsons Engineering Science as a case study. Mills are common elements of the American landscape and are often associated with bridges. As DOTs face a growing number of bridge replacement projects across the country, the fact that many of these bridges may cross mill races, or are located along mill dams, the issues surrounding the evaluation of these resources will become more prevalent.

Mills are sometimes difficult to scope for evaluation testing. On the one hand, this may be because mills are seldom small discrete sites, but are rather part of a complex industrial landscape development that may be more properly considered an archaeological district than a single site. A further problem is that the nature of the information potential in mill sites is not always clear. Review of some of the literature on mill sites, and discussion with those who have excavated mills, has sometimes shown a certain disappointment in what was actually learned about the site through excavation as compared with historical research. For example, upon completion of data recovery excavation at the East Creek Mill site in New Jersey, project archaeologists felt that excavation had not been as successful in addressing the research design focusing on milling technology as had documentary research (Morin 1991).

There are several reasons for the limits on the ability of mill sites to address questions concerning milling technology. The use of water power was a fairly conservative technology, and apart from the introduction of turbines in the 19th-century, the technology of mill dams, races, and wheels may not have changed very much over time. Changes in the internal workings of mills are very difficult to get at through archaeology because the machinery from abandoned mills tends to be salvaged rather than left in place. This suggests that either mills as resources don't have as much potential as perhaps was thought, or we may wish to reconsider the kinds of questions we bring to mills.

ARCHAEOLOGY AND MILLS

In order to understand the potential significance of mills, a short review of mill anatomy is helpful. Although the term mill can be used to describe a wide variety of water powered industries (grist mills, saw mills, furnaces and forges all used water power, among others) they all had certain elements in common. A water mill worked by channeling water from a stream or river to turn a wheel which in turn moved the internal workings of the mill, whether a grinding stone or roller for a grist mill, or bellows for a furnace, or trip hammer for a forge. The structures that conveyed the water, and the structure of the wheel itself varied according to the energy needs of the industry, and the possibilities and constraints of the local landscape. In some locations, water was diverted from a river through a head race that led to a flume (usually of wood) that conveyed the water to the wheel. Water was carried away from the wheel as quickly as possible in a tail race. Sluice gates were used to control the flow of water in the head race. In tidal areas like Sussex County, sluice gates would also have been necessary in the tail race to prevent water from reversing direction in the wheel well at high tide. In many locations dams were built to create a mill pond in order to help regulate the supply of water. In Sussex County, Delaware, it was common for mills actually to be placed in the dam itself. There were also locations that used tides to power wheels. High tide would flow into a pond or holding pen through a sluice gate that would be closed when the tide had reached its highest point. The head of water in the holding pond would then be drained through a wheel at low tide.

There were several varieties of wheel used in 18th and 19th-century America. The main types consisted of overshot, pitchback, breastshot, and undershot wheels. In an overshot wheel, the flume carries water to a point forward of the wheel's highest point. These were common in places where there was at least 10 feet of head, and depended more on the weight of water than the current. A pitchback wheel received the water just before the wheel's highest point, and revolved in the opposite direction from an overshot wheel. An apron on the inside of the wheel helped keep the water in the wheel buckets. Advantages of this were that the flow of water in the tail race was in the same direction as the movement of the wheel, and the apron helped keep water from splashing out of the buckets before the lowest point on the wheel, taking more energy out of the water. Breastshot wheels were often used for heads of between 6 and 10 feet. This wheel was designed in a way similar to a pitchpack wheel, except that the water current provided more impulse to the wheel than in a pitchback design. Undershot wheels were used for low falls of water, and were powered entirely by the water current, and not the weight (Howell and Keller 1977). The type of wheel employed at a mill is obviously of interest; however, if the wheel and and flume do not survive, and all that is left is the wheel pit and races, it may not be possible to tell what design was used; although the amount of available head may provide a clue.

The question then arises, just what can one learn in excavating a mill. Some evidence for the anatomy of a given mill often survives in the archaeological record, but not necessarily all of it. Mill dams and ponds often survive long after the mill itself is

gone. In other locations, parts of the dam itself may be missing, so the pond has drained and is no longer recognizable. Although salvage, or acts of nature often conspire against the survival of mill machinery (such as the hurricane Agnes floods that scoured out the wheel pit at Lanes Mill, in Fairfax County VA, depositing the wheel miles downstream), there are exceptions. Excavation at Philipsburg Manor Upper Mills uncovered the watermill shaft. Even if machinery is absent, evidence for the races, and the wheel and cog pits of the mill itself are likely to survive. At Lanes Mill, excavations across the head race showed that it had been made wider and deeper at least once during the mill's history, possibly to increase the power supply to the mills (Knepper 1992). Excavations at Philipsburg Manor also found extensive evidence of the mill foundations, as well as the heavy wood cribbing that formed the foundation of the mill dam (Howell and Keller 1977). Other examples where extensive wood structural remains have been found preserved include Cubbage Mill in Delaware, and the East Creek Mill in New Jersey. At Cubbage Mill, dendrochronology was used successfully to tightly date preserved timbers, aiding in an understanding of construction chronology.

EXAMPLE: BRIDGE 238 OVER GRAVELLY BRANCH

Ongoing efforts by Parsons Engineering Science to evaluate mill-related remains encountered during an archaeological inventory survey for replacement of Bridge 238 in Sussex County Delaware for the Delaware Department of Transportation can be used as a case study in how to answer the question of how much to dig. Bridge 238 carries Route 46 over the Gravelly Branch of the Nanticoke River near Seaford, Delaware. Initial study found that this branch of the river is an 18th- or 19th-century mill race, and that Route 46 runs along the top of a mill dam constructed between 1805 and 1807. Although shovel tests placed along the shoulder of the road recovered very little in the way of artifacts, a line of wooden posts that cross the southern end of the race was visible above the surface of the water at low tide. Further examination of the floor of the race under the bridge, and along the embankment identified further wood features**.** Interview with a local resident and archaeologist familiar with archaeological features in the area showed that numerous mill and furnace related features were known, including mill machinery, slag piles, borrow pits, and deposits of iron ore. Work then proceeded to use documentary sources to flesh out the history and cultural context of the mill complex, information necessary to deciding on an appropriate field strategy for evaluating the National Register eligibility of the mill site.

HISTORY OF MIDDLEFORD MILLS

Archival research concentrating on Sussex County deeds, warrants and surveys, and court records (available at the Delaware State Archives in Dover) produced a series of maps and documents illustrating development of the Middleford Mills area and the Bridge 238 location. The first documented development to the area occurred in the 1760s, when Joseph Vaughan and Company constructed the "Nanticoke Forge" "on the west side of Northwest Fork of the Nanticoke, at the head of the tide water." The same

company owned the "Deep Creek Furnace," approximately four miles to the east on Deep Creek. Although the precise location of the original "Nanticoke Forge" is not known, it likely was situated on or near an 18th-century dam constructed across the Nanticoke River, upstream from Bridge 238. An 1807 survey map shows the location of the old dam (Kent County Warrants and Surveys B9#177).

The forge operated at least until the Revolutionary War, and possibly as late as the 1790s. The Vaughn company land was paritioned in 1802, and the tract of land including the Bridge 238 property was sold to William Huffington, Jr. and Thomas Townsend in 1805. Huffington constructed a new dam approximately 300 yards below the first dam (Scharf 1888). This dam, which is also shown on the 1807 map, now carries Route 46. William Huffington and his brother James constructed a new forge after 1805, as well as "2 sets of waste gates," a saw mill and a grist mill. The 1807 map shows the location of the saw mill and the grist mill on the west side of the dam, and a waste gate or mill race on the east side of the dam, where Bridge 238 now stands. The location of the forge is not shown. It is unclear whether the actual race was reused from the original 18th-century dam, or was constructed in 1805 as part of the new dam.

By at least 1826, Huffington's ca. 1805 forge was no longer standing. The "Nanticoke Forge" had been torn down some time previously, and in a court case from that year none of the people who testified could remember where the old forge was located, although all agreed the ruins were still visible (Sussex County Chancery Court Case Files H81). In 1825, the Middleford Mills complex was rebuilt, but a fire in 1846 caused extensive damage. In 1857, a grist mill and saw mill were built on the east side of the dam. A survey made in 1860 illustrates the two mills, the town of Middleford, the mill pond, and the waste gates for the pond (Sussex County Orphans Court Vol. AA-28). By this time, four mill races were operating. The Bridge 238 location is over a race with a feature labeled as "waste gates". Another map of the Middleford Mills area was made in 1900, when William W. Rawlins sold the property to Robert C. Purvis (Sussex County Deeds 135:85). On this plot, the Bridge 238 location is shown over a race called "Forge Run" and "Forge Race." This suggests the possibility that the post 1805 forge may have been located in the vicinity of Bridge 238. The current USGS map shows that the mill pond is now completely gone, and evidence for the races exist as parallel channels of the Nanticoke River.

EXCAVATION STRATEGY FOR MIDDLEFORD MILLS

The known history of Middleford mills shows that the remains encountered at Bridge 238 were part of a much larger industrial complex that went through periodic redevelopment over the course of nearly a century and a half of operation. The maps show that the dam was relocated at least once, and that there were three and sometimes four races in operation at different times. Reconnaissance survey of the complex has discovered a possible fifth unmapped race that may have run perpendicular to the other races, as well as numerous borrow pits, probably from the mining of iron ore. Preliminary exploration of wood elements found in the water underneath the bridge

suggested that extensive articulated structural remains may survive under the bridge fill. Of interest was evidence that at least one of the timbers partially visible under the bridge pilings showed evidence of having been reused. The reuse of large timbers has been noted at the East Creek Mill in New Jersey, and at the Cubbage Mill in Delaware, and may relate to issues of material supply and craftsmanship traditions.

From this preliminary data, it appears that the archaeology of the Middleford Mills complex has the potential to show how the owners of the mills initially designed, and then periodically redesigned and rebuilt the complex possibly in response to changes in local and regional market conditions, periodic fires, and possibly silting of the Nanticoke River resulting from the deforestation brought about in part by the enormous demand for wood of Nanticoke Forge, and the furnaces that supplied it. Study of the surviving structural elements may illuminate some of the engineering and design decisions made by the owners, such as how much power may have been harnessed, and how the power needs of the mill may have changed over time. Examination of construction material may also say something about the craftsmanship traditions of those who constructed and reconstructed the mill. Such information is of interest because relatively little is known about the 18th- and 19th-century development of Susssex County, Delaware compared to the other two counties in the state, and because the industries represented by the mill complex, iron working, lumber, and grist milling, were three of the most important industries of the early period of the region's development.

The potential significance of this particular mill complex within the context of Sussex County Delaware appears to be in the presence of multiple mills operating multiple industries, and how that complex evolved over time, together with what information structural elements may have about design and construction decisions and craftsmanship. The question of "how much to dig" is answered by considering what data needs to be collected in order to evaluate the integrity of the resource. Integrity is the ability of a resource to convey its significance. In order to learn whether sufficient data remains to address the site's significance, a combination of detailed mapping, and excavation are planned. Intensive pedestrian survey of the mill complex as a whole, and mapping using GPS tools, and GIS software will allow for a reconstruction of the mill layout thus showing the potential of data to show how the mill owners adapted the complex to changes in market and landscape conditions. It is important to note that survey of the complex as a whole is necessary because it is only in overall context that the function of individual elements within the complex can be identified and understood. Excavation underneath the fill for Bridge 238 will be carried out in order to expose surviving timbers that may have been part of a sluice gate system for one of the races, or possibly the remains of a nineteenth-century forge. Emphasis will be placed on identifying the function of the remains found, describing construction techniques employed, and looking for evidence of repair or reconstruction. This will show the potential of site data to address questions concerning craftmanship traditions.

CONCLUSIONS

Lessons for evaluating mills sites as a class of historical resource suggest that excavation strategies for evaluating mill complexes should start by focusing on the layout of the mill as a landscape, and, if significant structural remains survive but not internal machinery, questions should be raised about how the mill was constructed rather than about the internal workings of the mill. Specific research issues might include: what kinds of materials were used? Was there evidence of timber re-use? What was the quality of construction? Were mill elements continually being replaced or repaired? Can dendrochronology be used to reconstruct construction and repair sequences? The answer to the question "how much to dig" will of course depend on the nature of the resource. In locations where important mill features are buried under road or bridge fill, significant earth moving may be necessary. On the other hand, if mill features are readily visible on the surface, extensive excavation may be unnecessary. Unless the complex includes a domestic site, artifacts found around the mill remains may say little about the milling operation, and limited excavation may suffice to record the building materials and design used, and the construction techniques employed. In such cases detailed survey of the mill complex as a whole, and identification of its disparate elements in order to discover how the mill landscape was built, and later modified, may be more important to an evaluation than really intensive excavation of isolated individual elements.

One implication of this for DOT projects is that important information needed to fully evaluate the significance of mill elements may be located well outside the project right of way. If the layout of a mill complex is what is interesting and important, it may not be possible to evaluate a given mill-related resource within the confines of a narrow corridor. It is also worth noting that in certain regions (such as the Atlantic coastal plain) where the landscape may not have enough relief to provide sufficient head for a mill, the mill apparatus may have been placed in the mill dam itself. The practical implication of this is that once abandoned, the remains of these mills may then be incorporated into the fill for modern bridges over the old mill race. As DOTs approach state-wide historic bridge surveys, they may wish to consider identifying which bridges may be associated with defunct mill operations in order to avoid costly surprises during bridge replacement construction work. It happened that an unrelated, past architectural survey of bridges along Route 46 in Delaware, including Bridge 238, did not note that the road carried by those bridges ran along an old mill dam.

The larger lesson of this exercise is that as with any historic resource, the question of how much to dig depends on the research questions, which in turn depends on the historic context. While mills as a class of resources have much in common, each resource will need to be considered on its own merits, within the context of local, regional, and national history. This last point is obvious, but can not be overstated. Furthermore, DOTs must be prepared in evaluating resources to develop new historic contexts for types of resources and for locations for which such contexts have not already been developed.

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